CONCERTED ACTION
ENERGY PERFORMANCE
OF BUILDINGS

Co-funded by
the European Union

ELECTRONIC VERSION
OCTOBER 2013

Implementing the Energy Performance of Buildings Directive (EPBD)

FEATURING COUNTRY REPORTS 2012

www.epbd-ca.eu

Porto, October 2013
ISBN 978-972-8646-28-8

This is the electronic version of the Concerted Action EPBD book “Implementing the Energy Performance of Buildings Directive - Featuring Country Reports 2012”, with active hyperlinks and some additional updates/corrections to the hyperlinks, as well as minor improvements in format/layout. It replaces the provisional version (ISBN 978-972-8646-27-1) issued in June 2013, concurrently with the printed version.

Porto, October 2013
ISBN 978-972-8646-28-8

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*This book is '**Co-funded under the Intelligent Energy - Europe Programme of the European Union'***
under the contract IEE/CA/10/002 SI2.588732

Co-funded by
the European Union

More details on the IEE Programme can be found at
ec.europa.eu/intelligentenergy

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FOREWORD

by
Mr. Phil Hogan, Minister for the Environment, Community & Local Government
Irish Presidency of the EU, May 2013

The decisions we make in the planning, design, construction, renovation and operation of our built environment have a profound bearing on our societal energy use, greenhouse gas emissions and indeed our overall quality of life. For this reason, meeting our EU 2020 energy and climate policy targets places the burden of action on buildings more than any other sector.

The Energy Performance of Buildings Directive, reinforced in its Recast in 2010, is a powerful instrument to give practical effect to key energy efficiency, renewable energy and climate policies, which also improve our energy security and provide sustainable job opportunities. Reflecting the complex and diverse nature of the built environment, it presents a major challenge to all Member States to fully implement all its elements in a manner that is most effective in delivering those positive impacts to the benefit of all EU citizens.

To help Member State authorities in tackling that challenge, this Concerted Action is a highly useful forum for pooling, sharing and assessing different perspectives and experiences and for identifying best practice examples. From our perspective in Ireland, it has been an invaluable initiative that has facilitated the process of evaluating and developing practical approaches to several elements of the task of implementing the EPBD.

Within the framework of the Directive, and informed by this work, Ireland has undertaken two reviews of its energy performance regulations for dwellings, resulting in a performance improvement of 60% in the past five years. Another key action has been the introduction and administration of an energy performance certification system for buildings which is well recognised in the construction and property market and has already covered over 370,000 buildings, or one fifth of the national building stock. These are unprecedented changes within a short timescale and it is pleasing to see commitments – and actions - of this kind being made in concert across the wide diversity of Member States' climates and building traditions.

The Concerted Action continues to be a cost-efficient mechanism for research and insight into the approaches taken, proposed or contemplated in implementation. It provides an excellent opportunity to examine in depth the key issues, share information and learn from experiences across Member States in a spirit of open and mutual cooperation.

I therefore welcome this report, which highlights the considerable progress being made to date across the EU, reflected in a compendium of national progress reports and significant learnings from the specialist working activities of the Concerted Action. These activities cover the fields of performance standards, certification, training, enforcement, economic assessment, and financial and information measures. I am pleased that access to such knowledge also continues to be available to the wide community of stakeholders through a number of online channels.

Looking ahead, and building on these achievements, this work will be increasingly useful as Member States strive to meet the challenges ahead, particularly in making the necessary but formidable journey to near zero energy and carbon buildings. In this endeavour, it will also be important for the EU Commission, through programmes such as Intelligent Energy Europe, to monitor and support Member States and a network of stakeholders in their pursuit of practical, cost efficient solutions to the array of detailed technical, economic, financial and logistical challenges to be faced in this marketplace.

I look forward to the next report in two years' time, and wish all parties concerned every success in meeting the extensive challenges of this decade in order to deliver on our vital energy and climate policy objectives for year 2020.

Editor's message

The Concerted Action EPBD (CA) is a forum where EU Member States' (MS) experts in charge of transposition of the Energy Performance of Buildings Directive (EPBD), its implementation and the practical day-to-day running can gather, meet one another, and discuss common problems from a variety of points of view. Building certification, training of experts, inspections, information campaigns, preparing building regulations and calculation tools, national approaches to Nearly Zero-Energy Buildings (NZEB), cost-optimal studies and many other tasks related to energy efficiency in buildings and planning/financing the rehabilitation of the existing building stock towards NZEB status are all tackled.

These discussions take place in full confidence about confidentiality, with no obligations attached, knowing that their deliberations and ideas for the future are not going to become public knowledge the next day. In the process, a quite productive dialogue with European Commission officials and CEN experts has been established, and a mutual understanding on various issues has contributed to clarifying and improving procedures and legal texts before their final adoption by the Member States, the European Commission and/or CEN.

This is the third book in what has by now become a regular tradition. Every two years, starting with the 2008 report, these national representatives report on the status and on the progress achieved in their respective countries or regions. They do so with full openness, clearly stating what is working well or needing to be improved and on occasion even indicating issues where the EPBD has not yet been fully implemented, as it should by now.

This book contains national reports with a snapshot of the status of implementation at the end of 2012 ("end of 2012", as stated in the title of the reports, should be broadly interpreted as a time period including the last few months of 2012 and the first few months of 2013, to incorporate the latest developments that took place just before this book was published) for all EU MS, Croatia (soon to become also an EU MS) and Norway. They all follow a common structure, in so far as possible, describing, namely:

> the history of the legal status of the transposition of the EPBD (Directive 2002/91/EC) and the EPBD recast (Directive 2010/31/EC);
> the evolution of minimum energy efficiency requirements over time, starting before the EPBD, showing the impacts of both the EPBD and its recast, and expectations, if available, till the 2020 NZEB target, for new and existing, residential and non-residential buildings;
> the detailed energy performance requirements for all building categories at the end of 2012;
> the functioning of the certification market, including the Energy Performance Certificate (EPC) formats and their main contents, building classes, how EPCs are issued, their use in advertisements, sales and rental contracts, required qualifications and training for Qualified Experts (QE), information about the numbers of QEs and issued EPCs, as well as provisions for quality control;
> the status of certification of public buildings;
> the status of inspections of boilers, heating and air-conditioning (AC) systems, required qualifications and training for inspectors, information about the numbers of inspectors and inspections, as well as provisions for quality control and compliance, or what has been done in terms of alternative measures that, according to the EPBD, may replace mandatory inspections;
> and an overview of the next steps for transformation of the building stock to improved energy performance levels.

These national reports are quite transparent, clearly stating what is working well or needing improvement. They also indicate expectations for the future that still depend on political decisions and, therefore, any references to future developments should always be taken with the required care. They are valid now, but many aspects, major or minor, can change in the future as those in charge of the process change.

Preceding the national reports, the book contains a collection of topical summaries describing the main accomplishments and the remaining problems for each of the major issues covered by the EPBD across Europe, according to the views expressed by the CA EPBD participants:

> certification;
> inspections of boilers;
> heating and AC systems;
> training of experts and inspectors;
> cost-optimal studies and regulations;
> NZEBs;
> compliance with regulations, as well as
> quality control on EPCs and inspection reports; and
> financial instruments, namely for rehabilitation.

Combined, these reports allow readers to become fully familiar with the situation in each country or region, as well as the overall situation in Europe. After reading them, it should become apparent how the EPBD (and its recast), despite all the difficulties and misgivings that were often made public by some MS and various stakeholders, has a major positive impact on the energy performance of buildings throughout Europe, not only in terms of energy efficiency, but also in relation to the use of renewable energy to meet the needs of Europe's buildings.

I hope that you will find this book interesting, informative, inspiring and contributing towards the advancement of EU implementation of the EPBD, and towards the grand objective - and still a major challenge remaining- of having by the end of 2020 all new buildings as NZEB, as well as having a significant movement towards transformation of the existing building stock towards the same objective during the next few years.

Eduardo Maldonado

CA EPBD Coordinator

19 June 2013

Acknowledgements

This book is the result of the collective work of many individuals and organisations, duly listed as authors of the various chapters or individual reports. In addition to them, we are pleased to acknowledge the following contributions in particular:

> the staff of the European Commission in charge of the Energy Performance of Buildings Directive (EPBD), Robert Nuij, Laurent Deleersnyder and Clemens Haury, for their open-minded and active participation in the Concerted Action (CA) EPBD meetings and discussions, always highly motivating and with a positive influence, providing support whenever necessary and taking into consideration the conclusions and consensus of the participants in the formulation of the policies and measures and in the drafting of the legal documents;
> the Working Groups of national CA EPBD participants that contributed in a very important way to the success of the technical discussions in the CA EPBD meetings; they are too many to be listed here, a sign of the enthusiastic participation that is at the very root of the success of the CA EPBD, but this general reference is meant as a sincere thank you for their volunteer effort;
> the CEN TC 371 team, coordinated by Jaap Hogeling, who attended every CA EPBD meeting and actively promoted and engaged in fruitful dialogue between the Member States (MS) representatives and the European Standardisation Committee (CEN), as well as entering into a novel and most useful dialogue and cooperation with the MS Liaison Committee;
> the coordinators and various guest contributors from the Concerted Actions for the Energy Services Directive (ESD, superseded by the Energy Efficiency Directive - EED) and the Renewable Energy Sources Directive (RESD), whose co-operation in sharing relevant elements of their work and findings has helped to strengthen the robustness of the CA EPBD work and achieve new efficiencies and synergies;
> all the expert guests who accepted invitations to attend the CA EPBD meetings, presenting the results of their work (coordinators of projects -IDEAL-EPBD, iSERV, REQUEST, TABULA- financed by the Intelligent Energy – Europe (IEE) Programme or their representatives –, as well as EC service providers – ECOFys), or the views of their institutions, e.g., the European Investment Bank, the Joint Research Centre, etc..

A very special acknowledgment is due to our colleagues who welcomed CA EPBD participants in the cities of Luxembourg, Vienna, Athens and Madrid, and provided pleasant and productive environments that were essential for achieving an excellent collaboration between all those who attended the meetings. Thanks to Tom Eischen, Christina Spitzbart, George Markogiannakis and Aitor Domínguez, and of course their colleagues, for all their efforts in the organisation of our meetings.

The same recognition is warmly extended to the organisers of our 'Study Tours', technical sessions dedicated to Nearly Zero-Energy Buildings (NZEB) in Germany (public buildings), in the UK (housing) and in southern France (warm-climate NZEB), where participants discussed the issues at length and in depth for two full days with local experts and were able to visit outstanding examples of already existing NZEB. Thanks to Horst Schettler-Köhler, Roger Hitchin and Marie Christine Roger, and their colleagues.

Our communications unit, expertly managed by Peter Wouters, has also played a crucial role in the smooth running of the CA EPBD. They provide all the internal communication but also our links to the stakeholders: the CA EPBD website and all our publications. A sincere word of recognition to the dedication and effort of Marianna Papaglastra and Alexander Deliyannis, at Sympraxis Team, who, together with their collaborators, put this book together in record time while providing a very appealing graphic quality that makes the book easy to read.

Finally, last but certainly not the least, a very special acknowledgment to our Programme Officer at the European Commissions' Executive Agency for Competitiveness and Innovation (EACI), Gordon Sutherland, who has been a vital force for keeping the CA EPBD concept alive, and who, through his incessant enthusiasm, attention to detail, innovative ideas and successive challenges for improvements, plays a decisive role in the CA EPBD. His deep involvement in the review of every report in this book, most often to the sacrifice of his personal time, is beyond any words of praise that could be written in this paragraph. Gordon, please do not even consider leaving us before we are done!

FURTHER DOCUMENTATION

The CA EPBD started in 2005 and has since then released many other public reports, namely:

> the Book of Country Reports 2008;
> the Executive summary report of the CA EPBD (2005-2007), released in 2008;
> detailed technical reports from the Core Themes – Certification, Inspections, Training and Procedures - of the CA EPBD (2005-2007), released in 2008;
> the Book of Country Reports 2010;
> the Executive summary report of the CA EPBD (2007-2010), released 2011;
> several reports on specific technical issues, e.g., costs of certificates, high-performance buildings, inspection methodologies, effective ways to reach consumers, summer requirements in EU regulations, the practical application of the cost-optimal concept, etc..

These reports are available on the website of the CA EPBD (*www.epbd-ca.eu*) and the European Commission's portal BUILD UP, energy solutions for better buildings (*www.buildup.eu*).

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Core Theme Reports

Certification

OVERVIEW AND OUTCOMES

NOVEMBER 2012

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1. General information

The main objective of the Concerted Action EPBD (CA EPBD) is to assist the EU Member States (MS) transpose and implement the recast Directive (Directive 2010/31/EU) on the Energy Performance of Buildings (EPBD), published on the 19th of May 2010. One of the topics dealt within this context is the topic of 'Certification'. Certification refers mainly to the following articles of the recast EPBD that should have been transposed by MS by the 9th of July 2012:

> article 11 'Energy Performance Certificates';
> article 12 'Issue of Energy Performance Certificates';
> article 13 'Display of Energy Performance Certificates'.

According to the EPBD, EU MS shall ensure that an Energy Performance Certificate (EPC) is issued for buildings or building units which are constructed, sold or rented out to a new tenant, along with periodic certification of buildings which are owned by public authorities and frequently visited by the public.

The following areas are addressed under the topic 'Certification':

> the content of the certificate (layout and information included, acceptance of the certificate in the real estate sector, use of the certificate data for monitoring processes, etc.);
> the process of certification itself (e.g., software programmes, qualification requirements for auditors and quality assurance of certificates, modalities of transferring and storing EPCs, publishing of certificates, adaptation of the certificates to accommodate new minimum Energy Performance (EP) requirements, especially concerning the Nearly Zero-Energy Buildings (NZEB) and the application of the cost-optimal methodology);
> use of the certificate in publicity of buildings offered for sale or rent.

This report about 'Certification' activities, results and lessons learned, covers the period 2011-2012.

2. Objectives

The EPBD aims at transforming the building sector towards ambitious energy efficiency standards and increase in renewable energy use. In this respect, the EPC has an important role because it informs potential buyers and tenants about the energy performance of a building unit (for example, a flat or an office) or an entire building, and allows for comparing building units and buildings. The EPC should influence the decision of potential clients whether or not to rent or buy a building or building unit, and to provide the owner or tenant with recommendations for its cost-effective improvement to a better energy efficiency class.

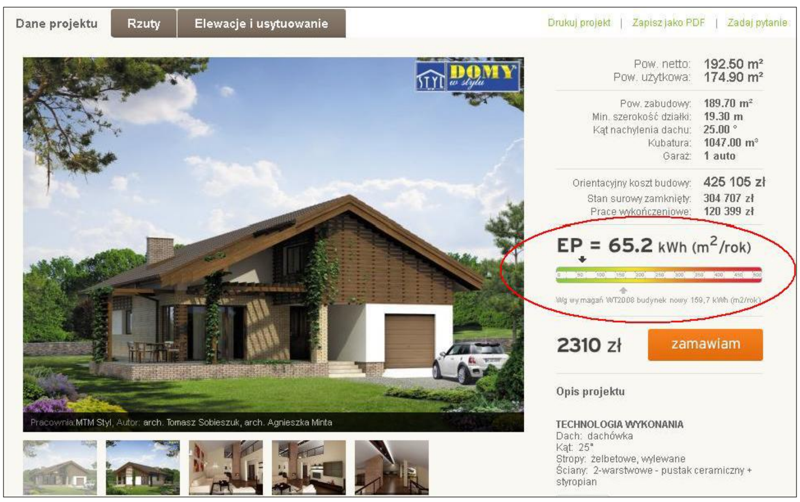
During the past few years, extensive experience has been gained regarding the use of the EPC, and strengths and weaknesses of different approaches to certification have been identified.

The objective in the CA EPBD is to share lessons learned, in order to benefit from other good examples and to work together on improving the weaknesses identified. Over the years, many aspects of certification have been dealt with. In the period 2011-2012, the content of the certificate, as well as the process of certification have been the focus, always with regard to the main objective of influencing the demand for buildings with excellent, energy efficient performance and a high share of renewable energy use on the one hand, and to influence building owners to energetically refurbish their buildings or building units on the other.

During this period, specific requirements of the EPBD recast were especially important, such as e.g., the requirements of advertising and the timing of handing it over, or the mandatory recommendations for improving energy performance as part of the EPC.

Figure 1: EPC information in advertisements in Luxembourg.

Figure 2: EPC information in an advertisement in Poland.



3. Activities under 'Certification'

3.1 Demand side actions

The EPC should create awareness regarding the energy performance of a building or building unit and finally lead to increasing the demand for buildings with an excellent energy performance. In this regard, the following aspects are very important: the use of EPC labels in advertising, the role of real estate agents (who are the first users of building certificates on the real estate market), the use of building certificates as a tool to support finance (e.g., labelling/rating related to incentive schemes) and the requirements of the new voluntary EU certification scheme for non-residential buildings (including its layout).

3.1.1 Use of EPC labels in advertising

In reviewing the use of EPCs in advertising across the EU MS, aspects of interest were:

> innovators and their early experiences;
> the type of published energy indicators;
> challenges during implementation;
> reaction of consumers;
> and differences between residential and non-residential buildings.

The examples of EPC labels in advertising provided by several MS showed that the type of indicators and layout of scales and energy classes influence what information can be provided within an advertisement. In addition to revealing the pros and cons of energy classes and scales (more space and colour print is needed, which increases the costs of advertisements in printed media but provides better information for consumers) and distinct numbers (cheap in advertisements but hard to understand for customers), the work resulted in the following findings:

> Rules for publication in different media are useful because the additional information on EPC indicators requires more space which might increase the costs of advertisements.
> It is better to provide more information on the EPC together with the advertisement. On websites, this is possible by clicking on the EPC information.
> Introduce sanctions and prevent falsification of information: falsification might become an issue when the information on the EPC influences the price of a building or the time to sale.

3.1.2 Real estate agents and the use of EPC databases

It was explained in 3.1.1 that the type of indicators and the layout of scales and energy classes influence what information can be provided within an advertisement. Additional cost for advertising will arise from additional space needed for information on energy efficiency, and this explains one of the advantages of an EPC database, which can be used to disseminate more information. Regardless of whether there is a need for additional information or not, the EPC database in any case might be an appropriate source of information for real estate agents.

In May 2012, 18 MS had implemented central databases on national or regional level. Access rights and data protection issues are important topics when options to make use of the stored data are under discussion. Who can have access to databases and to what extent differs across MS, e.g., due to data protection laws, but the topic is of interest to many of them.

In connection with the use of information and images on the energy efficiency class (or similar information) in advertisements, the prevention of fraud, and thus control mechanisms, become an important issue.

If control mechanisms are missing, real estate agents could easily manipulate the information they provide on the energy efficiency of a building. Therefore, in three countries (Belgium - Flemish Region, Portugal and Ireland) successful mechanisms to prevent fraud are in place. There are regular controls comparing data from the original EPC with the information provided in advertisements. The real estate agent and the owner of the property are both responsible for the accuracy of the information provided.

National or regional central databases of Energy Performance Certificates enable the implementation of control mechanisms which are necessary to prevent fraud and strengthen the trust in the certificate.

3.1.3 EPC as supporting tool for financing

A broad range of financial instruments is in place and experience concerning advantages of stipulating the need for an EPC to access financing is available. In some countries, financial mechanisms are not linked with the EPC at all, although in these countries the existence of an EPC is generally considered positively. Success factors highly depend on the implemented schemes and are often based on the

Table 1: Examples of various situations regarding access of EPC databases in the Member States.

Austria, Greece	No access for real estate agents	Administrative staff (public organisations and the facilitator of the database) are the only ones to have permanent access to the database. The experts only have access to the EPCs they upload themselves. Researchers are sometimes granted access to the data for certain purposes, and policy makers could get access but rather rely on analysis done by administrative staff and researchers. So far, real estate agents do not have access.
Belgium (Flemish Region)	No access for real estate agents	Notaries have access to see the Energy Indicator, so they can check before the selling is definitely done, that there is an EPC. There is no access for real estate agents. Policy makers rely on analysis done by the Flemish Energy Agency. Researchers cannot be granted access due to the applicable law.
England & Wales	Limited access	Single EPCs are freely accessible by anyone with either the EPC unique reference number, or the building address. The latter route is subject to the owner/occupier of the building having not opted out. Bulk access to the EPC database is restricted (e.g. for anonymity/ data protection) and subject to a fee.
Malta	Limited access	Real estate agents can access the database with the EPC registration number and can check the validity of the EPC.
Portugal	Limited access	Types of access to EPC-database: • expert: to keep record of the developed work; • administrative staff: management and quality assurance of EPCs; • owner and real estate agent: limited access to visualise the EPC energy rating; • researchers: limited access, sometimes expanded access to specific data for research purposes; • policy makers: full access for statistics and supervision of the system.
Norway	Full access	The owner has direct and full access to his EPC data. Depending on the way of registration, a large part of any individual EPC is open to anyone. The EPC is considered a public document which anyone can demand insight to.

specific experiences in the MS. For instance, Austria has a long-term history in requiring a better energy performance than the building code prescribes as the condition to receive financial support, for building construction or renovation, that is higher than that of an average applicant. The EPC has to be submitted as a proof, in order to be eligible for receiving the increased amount of funding.

In general, grants are the most popular scheme in the MS, especially for households, although different kinds of loans and tax relief measures become more important. The report on 'Effectiveness of Support Initiatives' provides more details on these instruments and financing in general.

The effective use of an Energy Performance Certificate in advertisements and as a supporting tool for financing is very important to increase the demand for energy efficient buildings on the market.

3.1.4 EU voluntary certification scheme for non-residential buildings

According to the recast EPBD, article 11.9, the European Commission shall adopt a 'voluntary common EU certification scheme for the energy performance of non-residential buildings'. There are national voluntary building certification systems in place in some EU MS, which display the environmental quality of a building, or even have extended the scope towards assessing the sustainability of a building (residential and non-residential). Although these systems are tailored to the national construction and real estate industries, consideration of the practical experience gained with these systems was thought to be useful in the context of the new voluntary EU scheme. Therefore, lessons learned were taken into account when discussing potential features of the new voluntary EU scheme, among others the type of criteria, the level of detail, the appropriate certification fees, and the expectations of real estate companies representing the users of such a certificate. During discussion, it turned out that there was a broad range of opinions. However, there was some agreement among CA participants that the EU voluntary certification scheme should be based on technical building details, while certification costs should be modest.

3.2 Recommendations for improving the energy performance of buildings and building units

The EPC is, most of all, a communication tool that informs owners or tenants how their buildings perform, or can be expected to perform. The recommendations, which demonstrate the building improvement potential, represent a very important element of the EPC, especially when it comes to energy efficiency improvements, or to tapping the full potential of energy savings in the building stock. Under the recast EPBD, recommendations must be an integral part of the certificate.

There is a trade-off between standard recommendations and tailor-made recommendations: tailor-made recommendations may be more effective, but will also increase the cost of issuing the EPC and increase the cost of monitoring the implementation of recommendations, while standard recommendations may help to keep the required effort low.

This trade-off was previously discussed in 2008-2009, resulting in the conclusion that recommendations should be tailored to the specific building.

In 2010-2011, the CA participants dealt once again with the topic recommendations, but this time from the perspective of monitoring their uptake. The Intelligent Energy Europe project REQUEST[1] has demonstrated how building certificates can increase the uptake of renovation measures, and its outcomes were instrumental in highlighting the challenges and options presented below.

3.2.1 Monitoring the implementation of EPC recommendations

The monitoring of the implementation of recommendations and their impact assessment is crucial in order to obtain insight into the success of implemented certification schemes and measures, and to quantify the savings achieved. Monitoring can also be used as a tool for reshaping the recommendations, or to support financial instruments.

The lack of proper monitoring procedures is definitely a constraint on the evaluation of energy and financial savings and the potential impact on reshaping policy instruments, if there is little or no feedback on the implementation of measures.

1 Renovation through Quality supply chains and Energy Performance Certification Standards (IEE/09/870), *www.building-request.eu*

At present, all MS are still at an early stage of dealing with monitoring the implementation of recommendations for improving the building energy performance. According to a 2012 survey, only 3 countries monitor implementation of recommendations on a regular basis.

MS widely agree that a central database on implemented recommendations is the essential foundation of a useful procedure for monitoring the implementation of recommendations. The entities that manage the central registries of EPCs are seen as the most appropriate to manage the database of recommendations.

The few countries that monitor the recommendations rely on feedback from external sources. There is no link established with a central database yet. This finding correlates well with the fact that electronic standard lists of recommendations are not common practice, either. However, standard lists of recommendations will be important if the monitoring system for the implementation of EPC recommendations is database-centred.

Monitoring of the implementation of recommendations is crucial to keep track on the actual improvements in building energy performance, especially in the building stock.

3.2.2 Standard lists of recommendations and the appropriate level of detail

Although electronic standard lists of recommendations are not yet common practice, MS widely agreed that standard lists of recommendations are important to support the procedure for monitoring and controlling the implementation of recommendations at low cost. In this regard, the level of detail of the standard lists is crucial to ensure monitoring at low cost, but also to ensure that recommendations address the actual needs of a specific building.

Regarding the level of detail, it is important to distinguish between EPC recommendations, which are provided on a rather general level, and the detailed energy audit. Standard recommendation lists support the energy experts in giving advice, but do not substitute a detailed energy audit.

A database-centred approach with standard lists of recommendations is considered useful, but most Member States are still at the beginning and little experience is available.

3.3 Quality Assurance of EPCs and certification mechanisms

Quality Assurance (QA) of EPCs is one of the most important topics. It is broadly accepted that a low quality of the certificates will destroy the credibility of the whole certification system. Also insufficient quality will prevent the certificates from being used as a basis for funding, monitoring, etc.

There is a great variation in experience with Quality Assurance mechanisms among the Member States. There are a number of countries with effective operational examples.

3.3.1 Quality Assurance of individual EPCs

A central database can be seen as the fundamental precondition to assure the quality of specific EPCs. However, in some countries there are problems with data privacy issues preventing full advantage to be taken of electronic data storage for monitoring and quality checks.

Databases allow for automatic control procedures to check each EPC during upload into the database. Two questions were discussed:

> how to define a sufficient level of detail that allows detection of mistakes in a specific EPC;
> which characteristics of the existing database are considered as satisfactory.

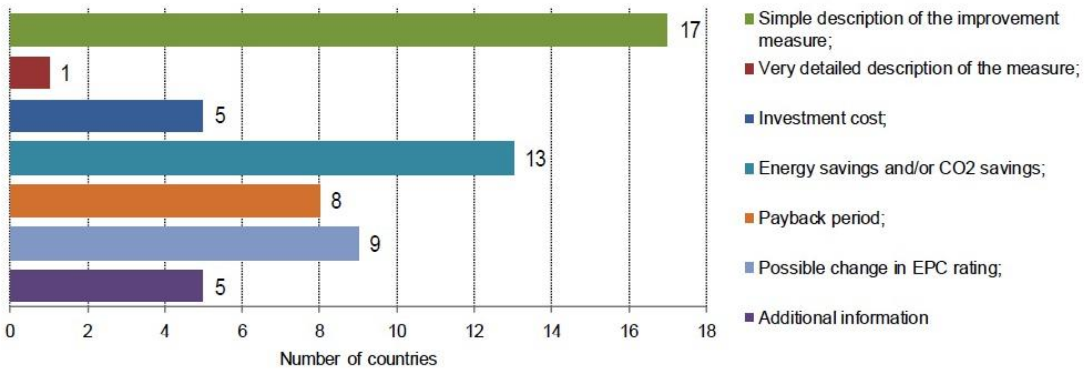
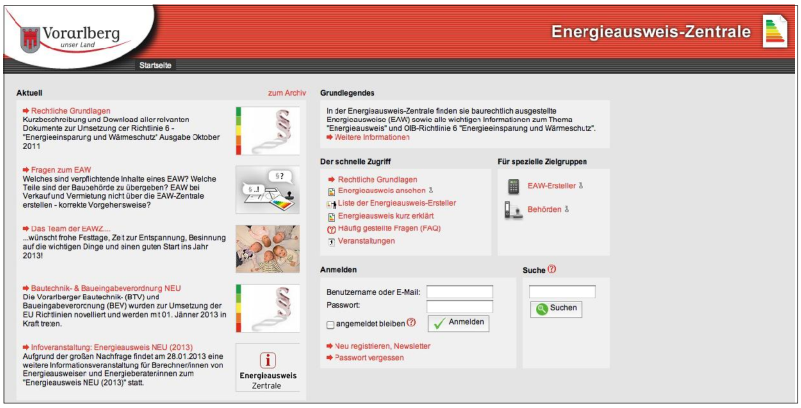


Figure 3: Type of information provided in the EPC recommendations or in the additional report.

Figure 4: Example of a central database. Regional database of Vorarlberg, Austria (www.eawz.at).



In addition to the automatic control procedure, on-site checks are important. However, most MS have problems with the on-site checks of existing buildings due to the related personnel costs and because building owners/tenants are not obliged to grant access to their building.

An obvious challenge for almost all MS is financing. In fact, the EPBD implementing authority has to define who pays for the initial investment, as well as the running costs of the QA of EPCs, the latter not to be underestimated. Nevertheless, there are good examples of countries overcoming this challenge.

Countries in the process of building up their Quality Assurance (QA) schemes can adapt effective operational examples to national circumstances.

3.3.2 Quality Assurance scheme for EPCs in general

The recast EPBD introduced the mandatory independent control system (art. 18) with the aim of getting a better quality of the certificates and a more effective implementation of the Directive. A quality control system in which the quality of a particular certificate is checked, is only part of all possible QA mechanisms that would lead to a high quality and trustworthy certification system. If there is a lack of quality in the system, possible QA actions can address and improve (1) training, (2) accreditation, (3) development of method/procedure,(4) on-site inspection, (5) software use, (6) delivery/content of the certificate, (7) quality control, and (8) market response.

While some MS have several years of experience with a comprehensive scheme, others still struggle with defining certain basic aspects.

3.4 Certification of blocks and flats of blocks

In the period 2007-2010, it became evident that there are two leading factors that influence MS decision on whether there is a certification of individual flats or certification of the whole multi-unit residential buildings: the use of asset or operational rating, and the distribution of individual and common heating systems. The main finding was that there is a trade-off between providing useful information about the building and individual flats and the costs of the EPC. There are advantages and disadvantages connected with both options, such that an optimum solution might be to have both approaches implemented and have one certificate for the whole building and another one for each individual flat.[1]

Lessons after 3 years

In the present day way-of-thinking, it can be concluded that this situation has barely changed since then. Advantages and disadvantages of both types of certification systems for multi-unit residential buildings are still valid, but there is little evidence that MS will make both options mandatory, as this means additional costs. However, when comparing to the situation in 2007, it seems that a significant number of MS now allows both options of certificates. Depending on the ownership structure (one common owner or many individual owners), technical systems, energy billing method and type of rating system, the more appropriate solution can be chosen. A pattern which can be observed is that a common EPC is provided for new buildings. There is the tendency that existing buildings that undergo major renovation also receive a common EPC, while an individual EPC is provided at sale or rent of individual flats. If both options are possible, new challenges arise. One example is which EPC should be used for sale or rent if both a common and an individual EPC exist and they have different labels.

Advantages and disadvantages of two types (individual or common) of certification systems for multi-unit residential buildings are clearly established, and several Member States allow both types.

1 For a complete discussion on this topic, please read the corresponding section in the CA EPBD Book of 2010 national reports.

4. Main outcomes of 'Certification'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Voluntary common EU certification scheme for non-residential buildings.	International real estate companies prefer comparability across borders and less expenditure for different calculation procedures and thus a common EU scheme.	When designing the new voluntary EU common certification scheme, a balance between national applicability and international comparability has to be found.	Existing national voluntary environmental and sustainability building certification schemes should be considered when designing the new voluntary EU common certification scheme on energy performance.
2. Use of Energy Performance Certificate (EPC) labels in advertising.	The type of indicators, layout of scales and energy classes used by a MS influence the information that can be provided within an advertisement. Information on EPC indicators requires more space, which increases cost of advertisement.	There is a need for publication rules in different media. More information on the EPC should be given together with the advertisement. On the internet, this works easily by clicking on the EPC information.	Consumers' reaction and market uptake: Only little is known yet but Member States (MS) are aware of this topic and are either carrying out market research or plan to do so in the near future.
3. Real estate agents and the use of EPC databases.	In connection with the use of EPC information in adverts, the prevention of fraud and thus control is important. In some countries, control to prevent fraud is already in place. Controls compare data from the original EPC with the information in the advertisements.	Positive effects of allowing real estate agents to access EPC databases: The information they need is available to them and control to prevent fraud can be easily implemented. The protection of personal data is a critical issue for many countries.	Most MS have now implemented central databases on national or regional level. Access rights and data protection issues are important legal topics to be solved on the national level when options to make use of the stored data are discussed.
4. EPC as supporting tool for financing.	In some countries, an EPC is a requirement prior to obtaining financing, in others, financial mechanisms are not linked with the EPC at all, although in this case the EPC is generally positively considered.	A broad range of financial instruments is in place and experience concerning advantages of linking financing to the EPC is available.	Financial instruments in the building sector should always be linked to EPCs.
5. Monitoring the implementation of EPC recommendations.	Most countries do not yet have any experience with monitoring the implementation of recommendations.	A central database on recommendations is essential for a useful monitoring procedure.	The entities that manage the central EPC registries are seen as the most appropriate to manage the database on recommendations.
6. Standard lists of recommendations and monitoring the implementation of recommendations.	MS widely agreed that standard lists of recommendations are helpful for monitoring and controlling the implementation of recommendations. Electronic standard lists of recommendations however are not common practice.	Standard recommendation lists support the energy experts in giving advice, but do not substitute a detailed energy audit. Building typologies provide a starting point for the development of standard lists and a system for monitoring of recommendations.	The development of standard lists of recommendations must take into account compatibility with detailed building-specific energy audits.

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
7. Quality Assurance (QA) of EPCs.	While some MS have several years of experience with a comprehensive scheme, others still struggle with defining certain basic aspects.	A central database is the fundamental precondition for a QA scheme. Related IT tools, such as automatic checks, are also important.	To check the quality of a particular certificate is only part of the overall QA mechanism. If there is a lack of quality in the system, actions should also tackle weaknesses in training, accreditation, etc..
8. Certification of flats and blocks of flats - lessons after 3 years.	A significant number of MS allow both whole-building and apartment specific certificates. Depending on ownership structure, technical systems, energy billing method and type of rating system, the more appropriate solution can be chosen. This can include a combination of both approaches.	There are buildings which receive a common EPC after a major building renovation, while at sale or rent of a flat, an individual EPC is normally issued. New challenges arise if a common and an individual EPC exist and they have different labels and recommendations.	The advantages and disadvantages of both types of certification systems for multi-unit residential buildings remain valid.

5. Lessons learned and recommendations

Database-centred systems are the precondition for managing energy performance certification schemes effectively in terms of effort and cost.

They allow for data transparency and fraud prevention, while supporting Quality Assurance (QA) mechanisms and constant improvement processes, which are essential to strengthen consumers' trust in the Energy Performance Certificate (EPC).

Database-centred systems are also important for monitoring the implementation of recommendations. Standard lists of recommendations can support the monitoring process effectively. However, it must be considered that systems should be compatible with building-specific energy audits, taking into account that EPC recommendations cannot substitute detailed building specific energy audits.

Among other stakeholders, real estate agents play an important role in strengthening the role of the EPC on the market. However, only few countries have so far extended the access of databases of certificates to other stakeholders than administrative staff and qualified experts. Therefore, there is still a vast potential to make use of information provided in the certificates.

The impact on market transformation is still hard to assess due to lack of information. Nevertheless, it will be necessary to address this issue in the coming years.

Inspections

OVERVIEW AND OUTCOMES

NOVEMBER 2012

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Bruce Young
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1. General information

The Concerted Action EPBD (CA EPBD) is a joint initiative of the European Commission and EU Member States and its main objective is to assist EU Member States (MS) transpose and implement the recast Directive (Directive 2010/31/EU) on the Energy Performance of Buildings (EPBD), published on the 19th of May 2010. It is a sequel to initial Concerted Actions that dealt with Directive 2002/91/EC, published on the 16th of December 2002.

The recast EPBD sets down requirements for inspection of heating and air-conditioning systems and allows for a number of options and alternatives. The CA EPBD has been concerned with understanding the changes in scope of the recast Directive; how they would require adaptation of existing inspection and advice schemes; the evaluation and reporting of alternative measures where chosen; and extension of the inspection concept to include remote monitoring and control.

This report summarises the main outcomes of the discussions devoted to inspections in 2011-2012, including conclusions and statistics about national plans on specific issues. During this period, three large meetings were organised, each gathering more than 120 MS representatives, with the focus being on the transposition of the recast Directive into national law.

2. Objectives

The three principal objectives under the topic of inspections are:

i. to develop a wider understanding of the detailed requirements of the EPBD in regard to inspection of heating and air-conditioning systems;
ii. to assist MS in the formation of their national regulations for both inspection schemes and alternative measures; and
iii. to help develop the methodology whereby it can be shown that alternative measures have an equivalent impact to inspection.

Awareness is maintained of technical and legislative developments and standards concerning the energy performance of Heating, Ventilation and Air-Conditioning (HVAC) systems, including monitoring and control. In addition, a number of surveys are carried out to discover what developments are taking place in the MS implementing the recast EPBD.

3. Activities under 'Inspections'

The activities organised under the topic of Inspections are mainly technical meetings, supported by preparatory papers circulated in advance. The papers set the meeting agenda, summarise the current position, and supply some of the material to be presented and debated. Final versions of the papers are produced after the meeting to record points raised during discussion, conclusions reached, and any recommendations for future work.

Often, surveys are carried out, in the form of questionnaires to CA members, to ascertain the current status in MS and provide material for discussion. Questions have been asked about the implementation options that have been chosen, the working practices adopted, future plans and developments, assessment of costs and benefits, use of standards, and perceived needs and difficulties.

These activities are described below under four subject areas comprising:

a) the changed scope of the recast EPBD;
b) review of inspection schemes and their impact;
c) alternatives to inspection; and
d) automatic monitoring and control.

One additional short paper, available at the CA EPBD website, was produced on building monitoring as a cost-saving alternative to more frequent inspection, the purpose being to present the case for legislators to include monitoring as a future option within newly drafted national regulations.

3.1 Understanding and implementing the recast EPBD

The recast Directive contains significant changes relating to the inspection of heating and cooling systems. They alter scope, reporting requirements and treatment of alternatives to inspection. The recast EPBD also allows advice as an alternative to inspection of air-conditioning – an option not previously permitted. Also, the inclusion of 'technical building systems' (TBS) under article 8 of the Directive introduces a wider range of building services equipment to which attention must be given after installation.

3.1.1 New requirements of the recast EPBD

In April 2011, a report from the CA concluded that most MS had not yet decided how to alter their inspection schemes and other measures to incorporate all the changes brought in by the recast Directive. Some MS, however, were considering provision of advice on air-conditioning instead of inspection. The new options to adjust inspection periods by reference to age, size and type of equipment, and allow automatic monitoring and control as a partial substitute, had not yet been explored.

Table 1: Summary of replies to the questionnaire of October 2011, from a total of 16 Member States who responded.

		Yes	No	(blank)	Yes and No
Q1	Do you intend to provide advice instead of mandatory inspection?	10	6		
Q2	Do you have plans to change the inspection scheme to match the new scope?	4	3	8	1
Q3	If so, will amended regulations include other accessible components such as the controls and circulator?	4	2	10	
Q4	Do you intend to modify the inspection scheme to allow lighter or less frequent inspections?	2	6	8	
Q5	Is the inspection scheme being amended to meet the new reporting requirements?	3	4	8	1
Q6	Would you be likely to adopt a modified CEN standard (replacing EN 15378:2007) covering these alterations in requirements?	6	2	8	
Q7	Are you introducing an independent control system?	4	4	8	
Q8	If so, will it be linked to the control system for energy performance certificates? (It does not have to be.)	2	6	8	
Q9	Did you send a report to the EC on the equivalence of advice to inspection by 30 June 2011?	7	3	6	
Q10	Do you intend to provide advice instead of mandatory inspection?	7	9		
Q11	Do you have plans to change the inspection scheme to match the new scope?	6	5	5	
Q12	Do you intend to modify the inspection scheme to allow lighter or less frequent inspections?	3	8	5	
Q13	Is the inspection scheme being amended to meet the new reporting requirements?	7	3	5	1
Q14	Would you be likely to adopt a modified CEN standard (replacing EN 15240:2007) covering these alterations in requirements?	9	2	5	
Q15	Are you introducing an independent control system?	7	4	5	
Q16	If so, will it be linked to the control system for energy performance certificates? (It does not have to be.)	3	6	7	
Q17	Does this mean you will be withdrawing an existing scheme for inspection of air-conditioning set up for the original Directive?	4	5	7	
Q18	Did you send a report to the EC on the equivalence of advice to inspection by 30 June 2011?	3	5	8	
Q19	Do you have plans to introduce regulations for TBSs?	8	8		
Q20	Do you have any plans (whether by regulations or otherwise) to introduce intelligent metering systems or install active control systems?	9	6	1	
Q21	Do you foresee a need for any CEN standards (in addition to EN 15378 and EN 15240) to assist in carrying out the obligations and recommendations of the recast Directive in regard to inspections and technical building systems?	6	10		
Q22	Would you make use of other, less formal, guides or procedures that could be developed and altered more quickly than European standards?	8	7	1	

3.1.2 Plans for implementation

A survey was carried out in October 2011 to re-examine the position when the plans of MS were further advanced. A summary of survey results for the direct answers (‘Yes’, ‘No’, etc.) regarding inspection of heating systems is given in Table 1. Many additional comments were received in free text, and were discussed in December 2011.

Plans by MS for adaptation to the new requirements have to be completed in time for the application dates of January 2013 (public buildings) and July 2013 (other buildings), as defined in article 28 of the recast EPBD. About half of the respondents to the survey had not yet embraced the new definitions affecting the scope of inspection (articles 14 and 15) and the new reporting arrangements that would fully cover the points set out explicitly in article 16 of the EPBD recast.

Seven MS planned to offer advice instead of inspection for air-conditioning systems, and would then cancel the mandatory status of inspection schemes for air-conditioning where these were already in operation. The choice of inspection or advice for both heating and cooling systems (updated to February 2013) is shown in Figure 1.

In general, the actions on technical building systems had not been brought together as a coherent response to article 8, and the necessity for further regulation remained to be decided.

The scope of inspection has been changed, with new options and alternatives and additional reporting requirements. Alternative measures in the form of advice can now replace inspection of air-conditioning systems as well as heating.

3.2 Inspection schemes and their impact

Inspection schemes were brought into operation under the EPBD in January 2009. By May 2012, over three years of working experience had been acquired, and it was timely to review the schemes, see how well they were working, what impact they had, and whether they offered good value for money.

3.2.1 Review of air-conditioning inspection schemes

The operation of air-conditioning inspection schemes was investigated in May 2012 and a discussion was held on what modifications were thought necessary. A review had already taken place in the UK.

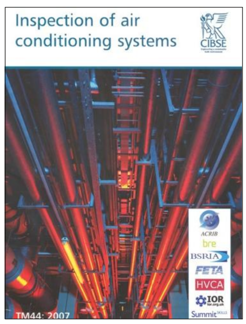
Figure 1: Implementation of inspection or alternative measures.

A survey had been sent to CA participants to ask if they had reviewed their schemes, assessed their cost-effectiveness, and held opinions about the CEN standard 15240. Replies revealed that 5 of the 15 MS who responded had reviewed their schemes, but none had assessed their cost-effectiveness.

Earlier CA EPBD work had indicated that many MS do not make full use of the CEN standard[1] for inspection of air-conditioning, and it was intended to explore the reasons before the standard is re-written. Replies to the survey indicated that no MS used the standard as a whole, some (59%) used parts of it, and a large minority (41%) do not use it at all.

Guidance in the UK had been extensively revised. The quality assurance and operating rules had also been reviewed, and a more detailed specification was issued by the UK government in March 2012. The guidance is contained in a CIBSE Technical Memorandum,[2] the original edition of which preceded EN 15240 and had influenced its development.

Figure 2: CIBSE Technical Memorandum TM44: Inspection of air-conditioning systems, used in the UK.



1 EN15240: Ventilation for Buildings – Energy Performance of Buildings – Guidance for inspection of air-conditioning systems
2 CIBSE Technical Memorandum TM44: Inspection of air conditioning systems

Table 2: Part of a CA EPBD survey on air-conditioning inspection review, from a total of 17 MS who responded.

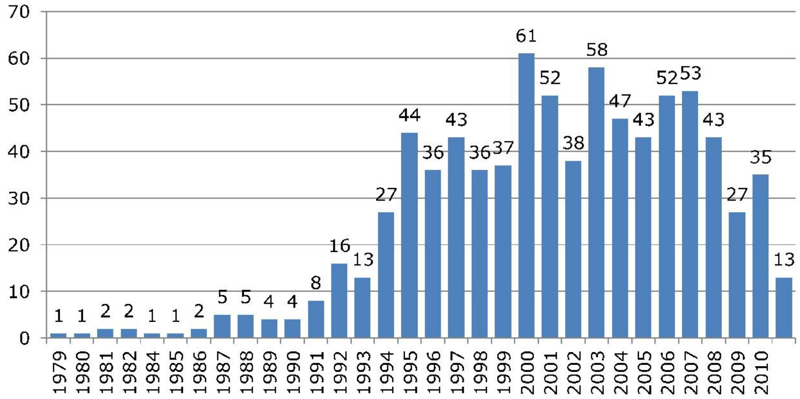
Question	Yes	No	Partly
Q1: Do you use the standard EN15420?		7 (41%)	10 (59%)
Q2: Have you interpreted it for local use?	6 (40%)	9 (60%)	
Q3: Have you reviewed the scheme?	5 (33%)	10 (67%)	
Q4: Can you share the review with the CA EPBD?	4 (36%)	7 (64%)	
Q5: Have you assessed cost-effectiveness?	0	15 (100%)	

Problems to be solved included collection of data, how to deal with incomplete inspections, rules for distinguishing between ‘simple’ and ‘complex’ systems, and how reports could be made more suitable for non-expert building owners. The lack of data about installed equipment and the amount of time required to collect it was a widespread difficulty, in particular for complex systems. There is scope for data collection by less-skilled staff to reduce costs. Inspections were often incomplete, through difficulty of access, but data sampling for incomplete inspections was considered acceptable when no serious omissions were identified.

No uniformity was found in the way simple and complex systems are distinguished. In some MS no distinction is drawn; elsewhere there are specific rules. For example, one straightforward rule is that a simple system is a unitary package in conjunction with natural ventilation, and anything else is to be regarded as complex.

There was little experience of making reports more suitable for non-expert building owners, although the recast Directive is now more explicit about reporting requirements. In some national schemes, the reports were poorly adapted to the needs of non-expert building owners, and therefore risked being ignored. To avoid this, and comply with the Directive, reports should be written in less technical language and could be accompanied by a standard leaflet to explain general principles and common defects.

Figure 3: Distribution of boiler age in the Emilia Romagna region of Italy.



3.2.2 The impact of recommendations given at inspections

The EPBD allows for alternatives to inspection, and offers a number of options for adapting or reducing inspection requirements to save costs. The energy saving impact of inspection schemes can be assessed, and if found to be relatively ineffective or expensive, a scheme can be adapted or replaced using the available options or alternative measures.

Impact depends on the extent to which individual recommendations in the inspection reports are taken up, but little is known about the quality of inspection reports and their influence on building owners. In May 2012, the CA considered what had been done to examine inspection schemes, how the information in reports could be used for various purposes, and if there were barriers (other than cost) to doing more to evaluate impact and cost-effectiveness.

A questionnaire was sent to CA participants to ask how the information in inspection reports is used. Possible additional uses identified were: to add detail to energy performance certificates, to steer incentive schemes, to support regulatory intervention for the replacement of old equipment, and to inform the updating of inspection methods, standards, and benchmarks.

One example is to use inspection reports to collect information on the age of installed boilers for national statistics and modelling. The IEE project ‘MOVIDA’ had used data from the Emilia Romagna region of Italy to show the age distribution of 810 heating systems.

A national boiler stock model can be built using age of installation in conjunction with other factors, such as efficiency (which can be estimated approximately from boiler age), fuel, power, and building type.

There were no known studies evaluating the impact of advice given as a result of inspection, but four were found that evaluate energy efficiency advice campaigns. These are expected to have some similarity and relevance to advice following inspection. One of them was the work done by the French national environment and energy management agency (ADEME) to assess the impact of local energy advice centres. This used phone interviews to discover the percentage of users who engaged in investments after the received advice, and the extent to which the advice had influenced the decision. It had provided sufficient information to produce quantified estimates of energy savings.

Another approach to impact assessment was to develop a national model for boiler stock, the number of inspections, the recommended actions and take-up level, and the energy savings that could reasonably be expected from each of the actions. A presentation described how this could be done, in outline. Where alternative measures were adopted instead of inspection schemes, it could be seen that a similar assessment methodology was needed.

Although ideas on data collection, stock models, and impact assessment have been explored, it was concluded that relatively little had been done so far to assess the impact of inspection schemes. Of those who responded to the survey:

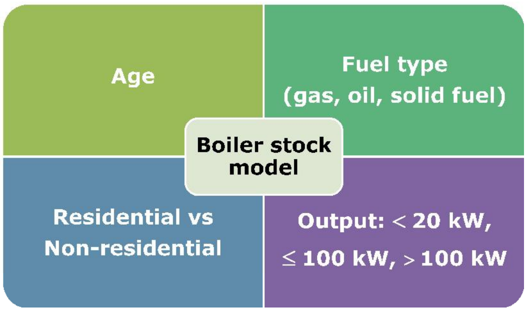


Figure 4: Features of a boiler stock model.

- 7 out of 8 MS who have inspection schemes had not analysed a sample of the reports to assess their usefulness, accuracy, or likely impact;
- 6 out of 7 had not carried out follow-up surveys or similar work to find what action was taken by building owners after receiving the inspection reports;
- 7 out of 8 had not analysed the energy saving impact of the inspection regime, and were therefore unable to assess cost-effectiveness or value for money;
- 2 out of 6 had used the information collected during inspection to update national models of the number and types of boiler installed;
- none had used it for any other purposes.

Other than cost and unfamiliarity, there were no specific barriers to carrying out an assessment of inspection schemes.

Inspection schemes have been running for 3 years and, in some cases, reviewed. Little has been done so far to evaluate their wider impact and cost-effectiveness.

Impact of the EIE = Number of deep contacts × Rate of move to action × Rate of influence of the EIE × Unit energy impact of the action.

Figure 5: Impact of the EIE ('Espaces Info Energie', or energy advice centres) calculation according to ADEME.

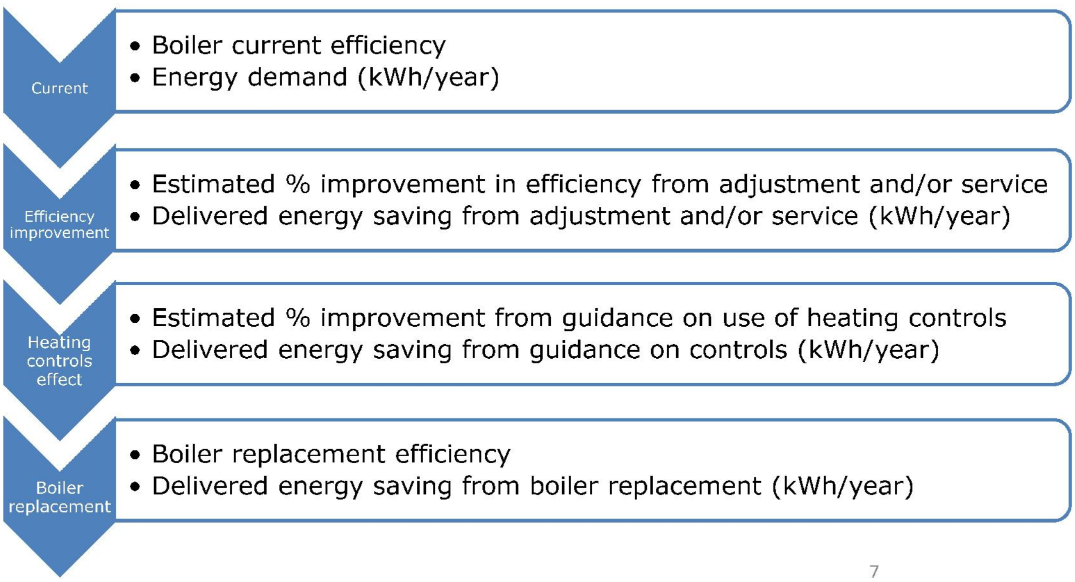


Figure 6: Development of energy figures from inspection records.

3.3 Alternative measures

The EPBD allows for advice as a substitute for inspection, which may still include inspection in more limited circumstances. For heating, the relevant wording of the Directive is "*... measures to ensure the provision of advice to users concerning the replacement of boilers, other modifications to the heating system and alternative solutions to assess the efficiency and appropriate size of the boiler.*" For cooling it is "*... measures to ensure the provision of advice to users on the replacement of air-conditioning systems or on other modifications to the air-conditioning system which may include inspections to assess the efficiency and appropriate size of the air-conditioning system*". It is a requirement that the overall impact of this approach shall be equivalent to that arising from inspection.

If MS have chosen to provide advice instead of inspection, they are required to submit to the Commission a report on the equivalence of those measures.

3.3.1 The requirement for equivalent impact

There is no uniformity in approach to either advice or inspection as the EPBD does not require it, nor to the preparation of what have come to be called 'equivalence reports'. In April 2011 the CA EPBD explored basic questions such as what is relevant and necessary in an equivalence report for heating systems, and how should data for it be gathered and analysed. The new option of alternatives to inspection of air-conditioning will also require equivalence reports.

If advice is to be offered as an alternative to inspection it must include options for system modification or replacement - which might first need an inspection to assess system efficiency and optimal plant size. This raises a number of questions for the CA EPBD to consider, such as:

> What type of advice can be considered to fulfil obligations under the EPBD?
> How is the impact of advice to be measured, and over what time frame?
> What data is required to do so?
> What would have been the impact of inspection if that had been carried out instead?

The approach to demonstrate equivalence remained undecided, and there was no consensus. Comparison with the impact of an inspection regime in the same MS can only be speculative as no such scheme exists. Comparison with other countries that do operate an inspection regime may have some limited validity, but factors that impede comparisons include the scope of inspection (relative to the exact requirements of the EPBD) and variations in climate, building stock, range of HVAC systems, fuels used, and customary installation practices. The EPBD does not require MS with inspection schemes to analyse and report on their energy saving impact, and consequently there is no body of data with which comparison can be drawn.

There is no established methodology for assessing the impact of alternative measures and comparing it with inspection, and no uniformity of approach. This area remains under active development.

3.4 Automatic monitoring and control

The recast EPBD refers to automatic monitoring and control as an option to reduce inspection frequency, and encourages its use for benchmarking and technical building systems. In articles 14 and 15 of the Directive the relevant words are "*Member States may reduce the frequency of such inspections or lighten them as appropriate, where an electronic monitoring and control system is in place*" and in article 8 "*Member States may furthermore encourage, where appropriate, the installation of active control systems such as automation, control and monitoring systems that aim to save energy*".

Monitoring can also provide useful data for performance comparison envisaged by the EPBD (article 16 includes the wording "*The recommendations [in an inspection report] may be based on a comparison of the energy performance of the system inspected with that of the best available feasible system and a system of similar type for which all relevant components achieve the level of energy performance required by the applicable legislation*"). Large-scale monitoring schemes allow comparisons to be made between installations, and offer a systematic approach to performance measurement and benchmarks.

3.4.1 Monitoring to facilitate or replace inspection

In April 2011 the CA EPBD explored, in outline, the capabilities and potential for automatic building monitoring, and in particular how allowance might be made for it in the regulations being prepared by MS for the recast EPBD. The European HARMONAC[1] project (now completed) had already indicated that monitoring is more likely to be cost-effective than universal inspection.

3.4.2 Inspection of HVAC through continuous monitoring and benchmarking

In December 2011 the leader of the European iSERV[2] project, Dr Ian Knight, talked about the prospects for large-scale monitoring of buildings. The HARMONAC project, which measured and monitored ventilating and cooling systems in office buildings in different countries of the EU, had found that delivered energy consumption covered a very wide range (10 to 320 kWh/m^2.year). It showed that some office buildings in relatively cold countries (e.g., the UK and Belgium) consumed more energy for cooling and ventilation than others in warm countries (e.g., Greece and Portugal).

There is little information on what makes a specific HVAC installation energy efficient in practice. Automatic monitoring allows continuous feedback on performance, thereby showing how savings can be achieved and maintained. Monitoring systems show real energy consumption, and with actual data it is possible to establish which systems consume the least and which approaches work best in practice and with people.

Centrally placed remote monitoring systems require ongoing management and a system to identify and report installations with good and bad performance. Climate data, building size and function, and other inputs as 'structural' data all need to be taken into account. Without experience to build on initially, analysis might be unreliable, but can be expected to evolve and improve with time. The scale of data collection is important and analysis can be carried out at all levels, including national, regional, district, city, estate, building and individual systems, the aim being to develop comparators (or 'benchmarks') from large data sets.

A way of handling cases of apparently bad performance would need to be developed and legally supported. Regulations would have to be framed so that inspections will still be required of those installations provisionally identified as inefficient: their selection would be subject to specified criteria and may require expert engineering judgment.

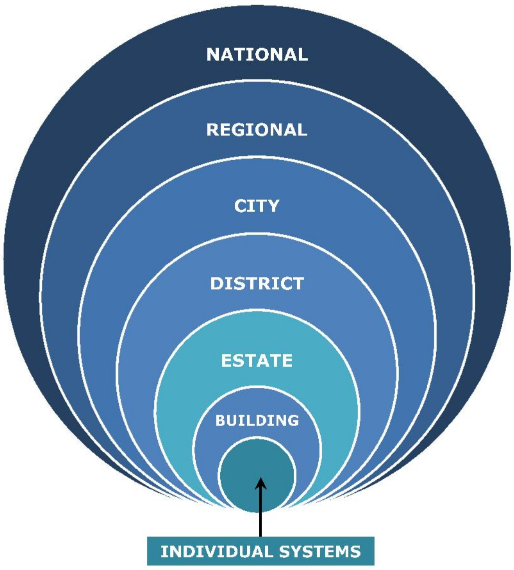
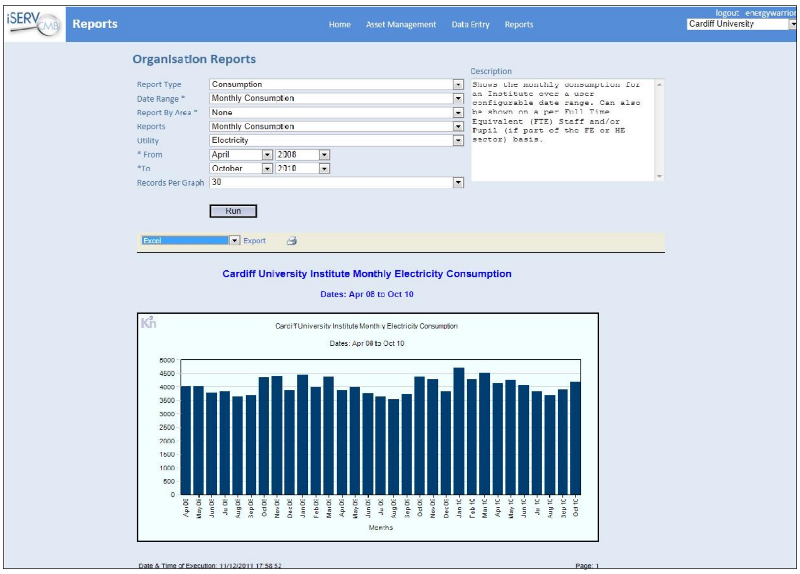


Figure 7: System levels for separate analysis.

Presentation of the case for building monitoring in national legislation for the recast EPBD requires further thought and convincing evidence. Following the discussions within the CA EPBD, a paper was prepared suggesting how to approach the case for legislation. It was important that new legislation should not inadvertently close off the opportunity for automatic monitoring of buildings in future.

Automatic building monitoring and control is recognised by the recast EPBD and can be used to develop benchmarks and reduce inspection frequency.

Figure 8: Monitoring reports.



1 HARMONAC – Energy Consumption in European Air Conditioning Systems and the Air Conditioning System Inspection Process *www.harmonac.info*

2 iSERV – Inspection of HVAC Systems through continuous monitoring and benchmarking *www.iservcmb.info*

4. Main outcomes of 'Inspections'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Member States' (MS) plans for implementation of the recast Energy Performance of Buildings Directive (EPBD) regarding inspection and technical building systems.	Changes to scope of inspection. New options to adjust frequency of inspection. Additional requirements for reporting to building owners.	About half of the MS have chosen alternative measures for heating systems. Some are considering it for air-conditioning systems. Detailed plans for implementation not yet ready.	A better understanding of the trade-off between inspection frequency and the costs/benefits for different system types. Central collection and analysis of data on impact of inspection.
2. Introduction of the term 'Technical Building Systems' (TBS) with additional post-installation requirements.	An area that had already been developed separately from the EPBD in a different regulatory structure.	TBS are more likely to be covered in separate regulations (e.g., building codes) and minimum standards.	Synergy with product regulations under Ecodesign, which now look more widely at system performance. Revision of standards should follow.
3. New requirements and options for the inspection process and reporting of results.	Alterations introduced by the recast EPBD allow different approaches, with implications for the implementation plans.	Alterations understood but not yet incorporated in re-designed inspection schemes. Additional skills and expertise required. Reporting procedures need further development.	Ways to improve inspection (e.g., the simple 'check list' approach) and inspectors, promoting better advice and understanding. Link recommendations in reports to future inspection. New standards should be simplified and more strongly focused on procedures.
4. Energy saving impact of inspection and the recommendations following it.	Little is known about quality and influence of inspection reports. Information gathered has value at national level. Data from inspections can be used to develop national stock models for plant type, age and energy performance.	In general the impact has not been assessed. Reports are not analysed for usefulness, accuracy, or impact. Follow-up surveys are not carried out. Value for money (to inform prospective changes) has not been tested.	A standard data structure for reports to permit central storage and analysis and facilitate quality control. Energy saving value of recommendations to be quantified. Reporting addressed to non-technical building owners. Links to recommendations in Energy Performance Certificates (EPCs).
5. Equivalence reports: advice instead of inspection for heating and cooling systems.	The type of advice that is relevant and its impact. Data required for assessment of the impact if inspection had been carried out instead. The scope and frequency of inspection for comparison.	The need for an assessment methodology. Definition of a hypothetical inspection scheme for comparison, and metrics to be used. Initial reports to EC are due.	Further understanding of requirements for quantified results. Development of a more uniform and coherent approach to equivalence reporting.
6. Review of air-conditioning inspection methods.	Schemes have been in operation since January 2009, and are due for review to see if they are working well and what needs to be changed. The UK has concluded a review and introduced significant changes.	Main problems are collecting data, classifying systems, completing inspection where access is difficult, understanding the level of accuracy required, and making reports intelligible to non-technical building owners. Load reduction measures should be treated with greater importance.	Data collection as a less skilled procedure. How to classify system types, decide when ventilation should be included, deal with incomplete inspections. Linkage with EPCs. Examination of cost-effectiveness. Improvements to training and qualifications.

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
7. Automatic monitoring and control systems as a means of reducing inspection frequency.	Monitoring as an option recognised by the EPBD (art. 8, 14, 15). Understanding its capabilities, potential for energy saving, and cost effectiveness.	Monitoring not yet implemented as part of the EPBD. Low recognition of its potential for widespread data acquisition and analysis. Concerns about privacy, security, safety and cost-effectiveness.	Costs and benefits of automatic monitoring. Justification for it as a substitute for more frequent inspection. How to apply in a regulatory context.
8. iSERV - an Intelligent Energy Europe (IEE) project to collect energy data from Heating, Ventilation and Air-Conditioning (HVAC) systems in many buildings across Europe.	An example of automatic monitoring that can be recognised as an aid to inspection. Production of benchmarks for performance comparison (art. 16).	Monitoring more useful for larger buildings, usually with air-conditioning but also other TBS. iSERV could provide evidence of value. Regulations should allow for future monitoring, even if not ready and proven at present.	The case for recognition, and the qualities required of an 'approved' scheme. Authority to impose inspection when poor performance is found. Active control as the step beyond monitoring. Linkage with Building Energy Management systems (BEMs).

5. Lessons learned and recommendations

The Concerted Action on the Energy Performance of Buildings Directive (CA EBPD) identified a number of actions and topics in need of further investigation, either by the CA EPBD, Member States (MS), or other agencies. These would assist all MS in developing a more effective and coherent approach to inspection, advice, monitoring, and similar activities in relation to technical building systems.

5.1 Understanding and implementing the recast EPBD

> Improve the procedures for inspections and the quality of inspectors, using a simplification of the methodology currently given in standards.
> Develop the check-list concept of inspection, taking a progressive approach that starts at a simple level and moves to more complex matters later.
> Create a data structure for inspection reports that is suitable for central storage and analysis, rather than free text.
> Establish the cost-effectiveness of inspection; identify ways in which it might be improved, how it compares with alternative measures, and the reasons MS choose alternatives.
> Link recommendations in reports to future system inspections, so that future inspections take into account what was recommended previously and the level of take-up can be assessed.
> Encourage building owners/operators to take action on recommendations given in reports, possibly by national campaigns and advertisements.
> Use data collected during inspection for wider benefits; eg, to update standards or benchmarks, provide feedback on energy performance certificates, and trigger 'early replacement' regulations.
> Determine suitable rules for the installation, dimensioning, adjustment, and control of all types of Technical Building Systems (TBS) (article 8).
> Consider the relevance and compatibility of forthcoming Ecodesign regulations on heating and cooling products, which now evaluate whole system performance in the absence of specific building data.

5.2 Inspection schemes and their impact

> Classify types of heating and air-conditioning systems to allow a structured approach to procedures, data collection and recommendations; in particular define the distinction between 'simple' and 'complex' systems.
> Formulate rules about when ventilation systems should be inspected.
> Develop procedures to collect data as a preliminary activity by persons with lower qualifications.
> Decide how to deal with incomplete inspections in which it was not possible to inspect the whole installation,

usually because of access difficulties.

> Revise the inspection standards for heating and cooling systems, with an emphasis on straightforward step-by-step actions.
> Consider the role of Quality Assurance (QA) during inspection and the following reports.
> Investigate methods to understand and measure the benefits of inspection, so that impact and value for money can be quantified and compared.
> Make reports intelligible to non-expert building owners, to increase take-up of recommendations.
> Survey building owners/operators to find out how many respond positively to recommendations and what action they take.
> Analyse the range and frequency of particular recommendations following inspection and estimate their energy saving values.

5.3 Alternative measures

> Develop a coherent approach to impact assessment methodology, preferably as a joint action with other MS.
> Define a hypothetical inspection scheme, compliant with the EPBD, as a comparator and estimate its impact.
> Examine feedback from the European Commission on their analysis of equivalence reports.

5.4 Automatic monitoring and control

> Investigate the costs and benefits of monitoring versus inspection schemes, to justify a particular level of reduced inspection frequency when combined with monitoring.
> Ensure that national regulations allow for future use of automatic monitoring in conjunction with reduced inspection frequency.
> Decide the qualities required of an ‘approved’ monitoring scheme for regulatory purposes.
> Investigate the potential for active control, as a step beyond automatic monitoring.
> Consider the role of Building Energy Management systems (BEMs) in automatic monitoring schemes.
> Follow the progress and underlying methodology of the iSERV project.

Training Experts

OVERVIEW AND OUTCOMES

NOVEMBER 2012

Authors

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1. General information

To support EU Member States (MS) in the task of implementing the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD), the Concerted Action (CA) EPBD was launched by the European Commission to promote dialogue and exchange of best practices. The Concerted Action EPBD brings together the national authorities implementing this legislation, and other bodies appointed and entrusted by them to do so. It fosters exchange of information and experiences amongst representatives designated by all 27 Member States (MS), plus Norway and Croatia.

During 2011-2012, the CA EPBD organised three large meetings that gathered more than 120 MS representatives, including thematic sessions on 'Training Experts'. The sessions on this topic were all closely related with art. 17 of the recast EPBD. The sessions were focused on three main aspects affecting both training of the experts and, in this way, the quality of the Energy Performance Certificates (EPCs). They explored training tools suitable for use by several MS, addressed the training of the building workforce regarding the Nearly Zero-Energy Buildings (NZEBs), discussed the need for continuous professional development of each expert, analysed the conditions, tools and processes for data collection at the building sites and, finally, they also considered the influence and the role of building owners in the process of issuing EPCs. This report summarises the main outcomes of the sessions devoted to Training Experts in 2011-2012, highlighting the main conclusions.

2. Objectives

In the period 2011-2012, discussions in the CA EPBD about training of experts had the following objectives:

> to analyse the training schemes for Qualified Experts (QEs) for issuing EPCs;
> to share and learn from experiences in MS about how QEs collect data on site;
> to gain insight into building owners´ understanding of the EPC and how the owners' communication with the experts affects the quality of energy certificates and the final rating of the building.

To understand the duties and approaches of the experts while rating the energy efficiency of the building when issuing the EPCs, an additional objective was also identified:

> the definition of tools and processes for on-site data collection, focused on providing the QE with the necessary knowledge —through appropriate training— to professionally collect data commensurate with the requirements on energy certification of buildings.

Since the requirements and the scope of the rating scheme differ from MS to MS, the matter of interest was limited to the energy certification of residential buildings, and to the data collection for energy use for heating and Domestic Hot Water (DHW) production.

3. Activities under 'Training Experts'

3.1. Training in the MS
CA EPBD participants discussed the positive elements and weaknesses in the training of QEs for issuing EPCs and inspection reports in the MS, in light of the requirements set forth in the recast EPBD. The resulting conclusions are based on a sample of 15 MS that provided information about the situation in their countries. From the responses it is possible to conclude that in all those 15 MS, i.e., more than half of the EU MS, the training is prepared by professional organisations, the participants had a university degree and the training program included calculation methods, software manuals and guides on how to fill out the EPC (Figure 1). The training also covers packages of available improvement measures (e.g., how to prepare recommendations to include in the EPC or in the inspection report). Fourteen of the fifteen MS providing information prescribe written exams, or a combination of written and oral exams. Periodic re-qualification is not required in general, and –at the time of the study, in early 2011- most MS (13), amongst those providing information, were not planning a required training on the changes stemming from the new requirements imposed by the recast EPBD.

3.2. Training the building workforce for NZEBs
The CA EPBD discussed which sectors of the building workforce should be trained towards correctly constructing NZEBs and when it would be necessary to prepare the workforce.

> Attention should be paid to all professions in the construction sector. Each specialist must do their own work, on structures, technical systems and installation of RES, correctly; only then can a whole construction be energy-efficient. The approach to training should take into account the specificities of each profession, tailored to meet their needs.

> An overall understanding of the roles of different professionals in the sector is needed. A continuous flow of information must be established so that the groups of professions are aware of the process, technologies and efficiency of systems as a whole.

> There is a lack of professionals for new technologies in most MS, such that it is not possible to ensure effective construction of energy-efficient buildings and the potential decrease in energy consumption. In some countries there is lack of RES installers, as well as knowledge about requirements and conditions for energy effective construction.

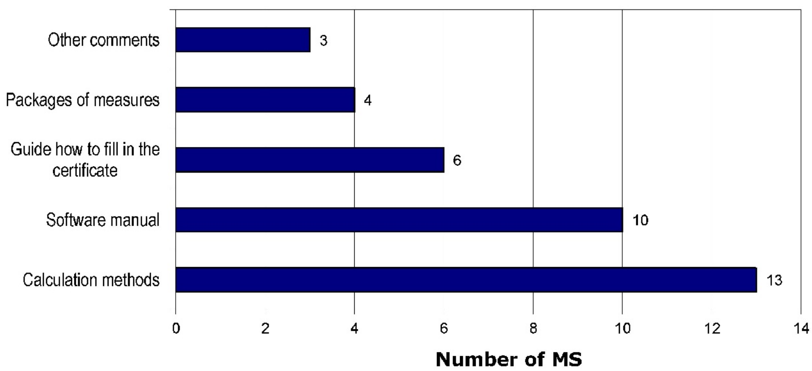
Training the workforce along the building supply chain is urgently needed. This workforce needs to know how to work with other professionals in the sector.

3.3 Continuous professional development (CPD) of qualified experts and inspectors
CPD is generally recognised as a good practice to keep professionals technically up to date. The personal development includes activities that improve awareness and identity, develop talents and potential, build human capital and facilitate employability, enhance quality of life and contribute to the realisation of dreams and aspirations.

The CA discussed the needs for CPD in connection with EPBD requirements (Qualified Experts and Inspectors). CPD of experts should be focused on improving knowledge on existing and new technical standards and legal documents, process for energy performance certification and best practices, construction and technical systems, as well as data collection and software tools. In MS, CPD is strongly influenced by the price of EPCs, as well as by the competition and interest of owners. In Ireland, for example, the experts have to undertake a web-based exam every two years. In the majority of countries there is no mandatory CPD system for the experts: at the end of 2011, only 4 MS notified establishment of a formal system of CPD.

The prices of the Energy Performance Certificate and the competition on the market are the drivers for Continuous Professional Development (CPD) because, in most Member States, CPD for Qualified Experts and inspectors is not established.

Figure 1: What kind of studying materials are available?



3.4 Conditions, tools and processes for data collection on-site

In 11 MS (of the 15 providing information), the QE must make an on-site visit to collect the data needed to produce an EPC based on a calculated (asset) energy rating, or to confirm the data specified in the design, since the real conditions of the building after construction (new buildings and major renovations) are not necessarily the same as specified in the design project. For existing buildings, EPCs for sale or for rent require a site visit by the QE in 6 out of the 15 MS, i.e., in less than half.

To obtain good quality data on the building to be certified, it is necessary to have a good documentation of the design available.

The CA EPBD participants discussed the necessary knowledge and training conditions of the QE to correctly collect the data necessary to fulfill the requirements on energy certification of buildings. The discussion was limited to the scope of residential buildings, and to data collection for energy use for heating and hot water production. Data collection is a topic of training in a small minority of the MS (only in 4 of the 15 MS providing information). In 7 of the MS a checklist form is used for the on-site collection of data. In other countries, any kind of record taken during an on-site visit is satisfactory. The majority of the CA experts agreed that a digital camera, a compass, a pair of binoculars, as well as a distance and angle meter (analog or digital and a flashlight (see Figures 2 & 3) were sufficient.

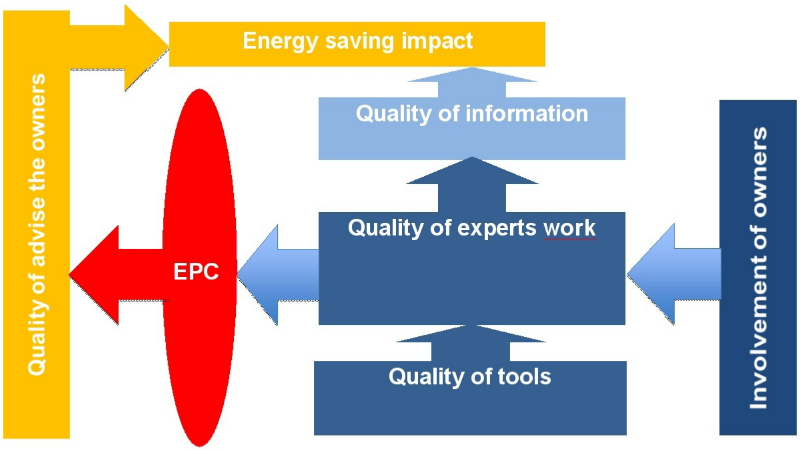
The recast EPBD does not further specify conditions and requirements on the independency of experts, other than the provisions under art. 17, e.g., that energy performance certification and inspections of heating and air-conditioning systems "*are carried out in an independant manner by qualified and/or accredited experts*" or that "*the experts shall be accredited taking into account their competence*".

Collecting data at the building site for the Energy Performance rating is a necessity, but the on-site visit has a high impact on the price of the EPC. The use of a 'Checklist' can simplify on-site work.

Figure 2: Equipment for on-site visit.

Figure 3: Checking the sizes of the building.

Figure 4: Expert-owner relation.



3.5 Influence of the owners on EPC quality

Article 20 of the recast EPBD specifies that "*MS shall ensure that guidance and training is made available for those responsible for implementing this Directive. Such guidance and training shall address the importance of improving energy performance, and shall enable consideration of the optimal combination of improvements in energy efficiency,...*". Building owners may have an important impact on the quality of the information given to the expert who is to prepare the EPC (Figure 4). The EPBD, however, does not place any duties on building owners. The CA EPBD participants discussed the importance of the role of the building owner in relation to the selection of the expert, the interaction and communication between expert and owner, provision of wrong or misleading data, and different approaches based on the owners´ age and their views on EPCs and energy saving. It was concluded that the knowledge of the owners about the consequences of the building energy rating is poor (see Figure 5).

From the questionnaire and discussion, it can be concluded that experts are being selected by the owners or administrators mainly according to cost, recommendation from a friend, previous personal experience and reputation of the expert (see Figure 6).

In most MS, clients select experts based mainly on the cost of the Energy Perfromance Certificate and the reputation of the issuing expert.

There is no doubt that the EPC may (and with rising prices of energy, it definitely will) be a useful instrument contributing to competition in the real estate market. According to the CA EPBD representatives from 20 countries, less than 50% of owners are familiar with the EPC as a competitive instrument.
It can be concluded that when selling or renting an apartment, owners are unaware of the importance of the EPC, and do not take advantage of it.
To overcome this important issue, several measures can be taken, such as:

> campaigns targeting the building owners, explaining them the importance of the EPCs and the consequences of providing incorrect data to the expert, and advising them on how to communicate with the expert;
> actions to increase the reputation of the expert (this also entails more demands on their training (CPD) and on provision of feedback on their work, e.g., on evaluation by clients and track-record of mistakes in issuing EPCs).

Figure 5: How the MS describe knowledge of the owners about the consequences of providing incorrect data for the final building energy rating.

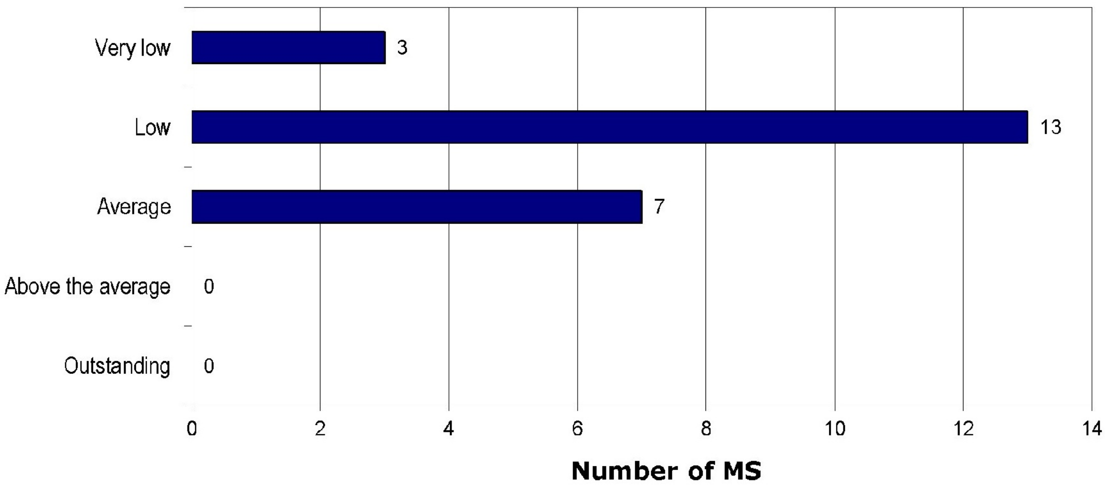
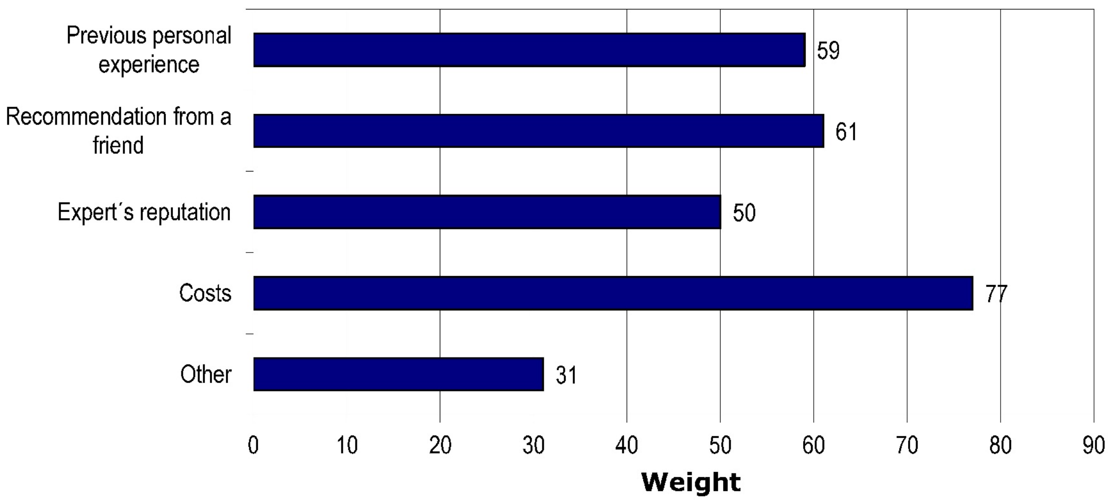
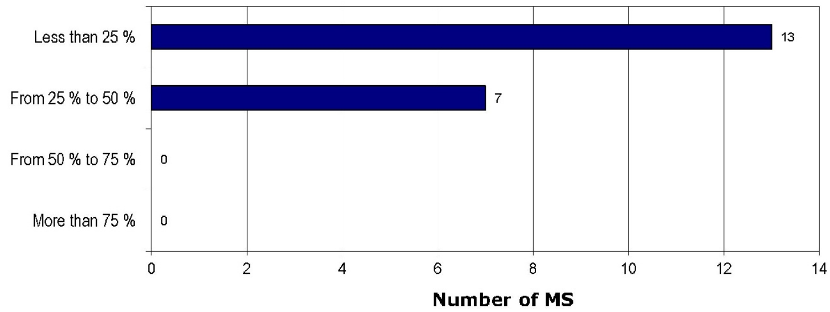


Figure 6: Criteria used by the owners or administrators to select Qualified Experts.



When selling or renting an apartment, less than 50% of owners are aware of the role of the Energy Performance Certificate as a competitive instrument in the decision-making process of prospective purchasers or tenants.

Figure 7: Percentage of owners in MS who attribute some importance to the EPC when selecting a house for purchase or rent.



4. Main outcomes of 'Training Experts'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Training of Qualified Experts (QEs) in the Member States (MS).	Strengths and weaknesses of the training systems in MS.	In several countries, there is a problem that after finishing the university studies, students do not pass the exam to become an expert.	MS must carefully establish requirements for the QE (level of education and professional experience), the contents of QE training and Continual Professional Development (CPD) schemes.
2. Training the building workforce for Nearly Zero-Energy Buildings (NZEB).	New issues are becoming important: airtightness (blow door test), thermal bridges (thermographic measurements), optimalisation of solar gains, etc..	QEs must be familiar with requirements and systems for low energy houses. There may be a need to increase the amount of training hours.	MS must carefully evaluate gaps and needs for training QEs and design appropriate courses.
3. Continuous professional development (CPD) of the experts.	CPD is mainly based on self-motivation. CPD is a requirement in only a few MS.	CPD is mainly based on self-motivation and a pro-active approach is missing.	CPD should be a duty of the MS.
4. Conditions, tools and processes for on-site data collection.	A visit on site should always be made, but it still is not compulsory in many MS. Some MS already have checklists for on-site surveys and/or lists of required tools.	The inspector has to be a person experienced in construction. The on site visit increases the price of an Energy Performance Certificate (EPC) and it is therefore a major obstacle.	Establish affordable procedures that require on-site visits and train QEs adequately for efficient work on site.
5. Influence of the owners on the EPC quality.	Selection of the experts, communication between the expert and the owner in terms of collecting data and using the EPC as a competitive instrument on the real estate market.	In most cases, experts are selected almost exclusively on the basis of the lowest cost of the EPC, neglecting their professional background.	Owners must be convinced about the value of a good EPC. They should have easy access to data of experts to be able to assess their quality.

5. Lessons learned and recommendations

There is significant room for improving the training of Qualified Experts (QEs) in all areas of the experts work. Their knowledge, skills and ability to communicate with owners also need to be improved.

The familiarity of owners with the Energy Performance Certificate and its real importance, meaning and advantages need to be much improved. As most people do not place any value on the EPC, QEs are usually selected on the basis of lowest cost available, without taking QE qualifications into account. This further degrades the image of the whole certification system.

It is clear that there are substantial differences between Member State (MS) approaches to training and recognition of QEs.

Energy performance requirements using the

Cost-optimal methodology

OVERVIEW AND OUTCOMES

NOVEMBER 2012

Authors

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1. General information

The Concerted Action EPBD (CA EPBD) has the main objective of assisting the EU Member States (MS) transpose and implement the recast Directive 2010/31/EU on the Energy Performance of Buildings (EPBD), published on 19 May 2010, as well as the continued implementation of the actions initiated with the initial EPBD, Directive 2002/91/EC, published on 16 December 2002. The CA EPBD brings together the national authorities implementing this legislation, and other bodies appointed and entrusted by them to do so. It fosters exchange of information and experiences amongst representatives designated by all 27 MS, plus Norway and Croatia.

The CA EPBD is organised around 7 main sets of topics, including one focussing on the Energy Performance (EP) requirements using the cost-optimal methodology and its implementation, as mentioned in the recats EPBD: "*MS shall calculate cost-optimal levels of minimum energy performance requirements using the new comparative methodology framework and compare the results of this calculation with the minimum energy performance requirements in force.*"

The CA EPBD has supported and will continue to support the MS by exchanging experiences in the path of implementing a cost-optimal methodology. Regulations, Guideline documents and experiences by the MS have been all analysed and discussed. Through such information exchange, the MS supported one another, as well as the EU Commission, in the development and implementation of the regulations and their future revisions.

This report summarises the main outcomes of the discussions on cost-optimality in the period 2011-2012, including conclusions and statistics about national plans on specific issues.

2. Objectives

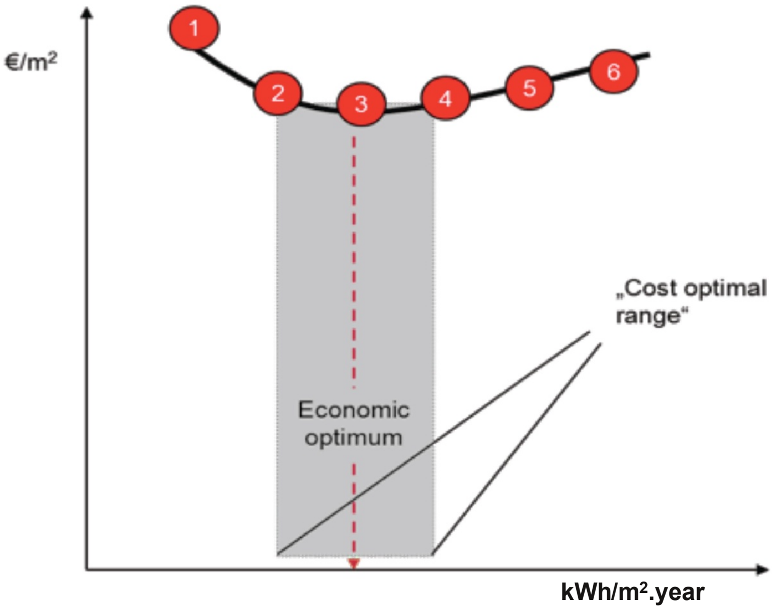
The recast EPBD obliges the MS to ensure that minimum EP requirements are set with a view to achieving cost-optimal levels (art. 4). The MS must also take the necessary measures to ensure that new buildings, buildings undergoing a major renovation, and replaced or retrofitted building components that form part of the building envelope, meet the requirements set with a view to achieving cost-optimal levels (art. 6 & 7).

The cost-optimal level is "*the energy performance level which leads to the lowest cost during the estimated economic lifecycle*" (art. 2.14).

The MS must report on the comparison between the minimum energy performance requirements and the calculated cost-optimal levels, using the Comparative Methodology Framework (art. 5.2, 5.3, 5.4 and Annex III) provided by the EC.

The cost-optimal framework is not intended for comparisons between MS,

Figure 1: Definition of Cost-optimal range derived from the costs of several variants. Source: Boermans, Bettgenhäuser et al., 2011, Cost-optimal building performance requirements - Calculation methodology for reporting on national energy performance requirements on the basis of cost optimality within the framework of the EPBD, ECEEE.



but rather as a tool by which the MS can determine if their regulations are too lax compared to the economic optimum, and by which the Commission can analyse whether the building energy requirements in a particular country deviate too much (more than 15%) from the cost-optimal levels calculated for that same country.

The CA discussed questions relating to articles 3-8 of the recast EPBD, as well as to Annexes I and III. In the period 2010-2012, the work concentrated primarily on the cost-optimal procedure.

3. Activities under 'Energy performance requirements using the cost-optimal methodology'

The following topics are presented in this report:

> Cost-optimal procedures:
  · legal framework;
  · early experience on cost-optimality calculations.
> Compliance checks for energy requirements in new buildings.
> Requirements for existing buildings.

Some topics were also discussed within a wider context in the CA EPBD. They are, therefore, also described in their relevant chapters from their perspective.

3.1 Cost-optimal procedures

The relevant legal document providing the framework is the Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 (hereafter, 'the Regulation'). To help the MS, the Regulation is accompanied by Guidelines (2012/C 115/01) (hereafter, 'the Guidelines') outlining how to apply the framework for calculating the cost-optimal performance level. The Regulation is based on a CEN package of standards. Moreover, the Commission provides information on the estimated long-term energy price developments to be used in the calculations.

A proposal for the framework was adopted by the European Commission on 16 January 2012, and the Council approved it on 1 March 2012. The framework was announced, and thus became legally binding, on 21 March 2012; the Guidelines were published on 19 April 2012.

According to the Regulation, the MS must submit to the Commission reports with comparisons to their current national requirements, at regular intervals of maximum five years, with the first report due by 21 March 2013, one year after the adoption of the Regulation.

The comparative methodology framework requires MS to:

> Define reference buildings that are characteristic and representative of their functionality and climate conditions. The reference buildings must cover residential and non-residential buildings, both new and existing ones.
> Define the energy efficiency measures that are assessed for the reference buildings. These may be measures for buildings as a whole, for building elements, or for a combination of building elements.
> Assess the final and primary energy need of the reference buildings, as well as that of the reference buildings with their defined energy efficiency measures applied.
> Calculate the costs (i.e., the net present value) of the energy efficiency measures during the expected economic life cycle applied to the reference buildings, taking into account investment costs, maintenance and operating costs, as well as earnings from the energy produced.

The MS may decide whether the national benchmark used as the final outcome of the cost-optimal calculations is the one calculated with a macroeconomic perspective (looking at the costs and benefits of energy efficiency investments for the society as a whole), or from a strictly financial viewpoint (looking only at the investment seen from an investor's perspective). The MS must make the calculations under both these perspectives, and choose the perspective on which they shall base their energy performance requirements.

3.1.1. Recommendations from the CA EPBD on the development of the legal framework

As early as in December 2010, CA EPBD started to discuss the possibilities and challenges for the implementation of the cost-optimal procedure as outlined in the recast EPBD. The CA EPBD agreed that the comparative framework could be a powerful instrument to guide the MS to improve their energy requirements, and produced a first list of recommendations sent to the EC about issues that needed to be addressed in the process of finalising the Regulation and the Guidelines. These recommendations included the following:

> A too rigid comparison methodology can have a negative effect on setting national requirements, e.g. exposing that a MS prescribed requirements that are stricter than those calculated using the cost-optimal methodology, even though there may be well substantiated reasons why a MS should impose stricter requirements.
> Reference buildings must be as representative as possible for the national building typologies and historic changes in building tradition. From the experience of several countries, it seems a satisfactory approach to have experts define, in consultation with the market, a number of not too complicated reference buildings for different user typologies. Based on these buildings, sensitivity studies can lead the way to cost-optimal levels.
> There is much statistical data for the existing residential buildings, but the amount of information available about non-residential buildings is often very scarce. The use of synthetic data could be a solution for the definition of reference buildings to these building types.
> One of the major challenges will probably be setting up reliable and up-to-date cost databases, as well as providing software tools, which can produce a large number of variant calculations that can form the lower edge of the cost curve.
> Generally, results show that switching to a societal perspective calls for more efficient buildings, though without showing huge differences compared with the private investor perspective.

3.1.2. Early experience on cost-optimality calculations

The CA EPBD discussed the common framework for a cost-optimal methodology after its formal publication. In December 2011, a team of researchers from the Joint Research Centre (JRC) presented to the CA EPBD the results from their first test calculations using this methodology.

The JRC test calculations included an analysis to investigate the sensitivity regarding cost-related functions (interest rate, investment cost, running costs, energy price development, VAT, cost of environmental damage). Furthermore, the analysis covered the calculation period, energy conversion factors, incentives for Renewable Energy Sources (RES) (only photovoltaics -PV), and the discount rate. Figure 2 shows the results of calculations for 7 cases (bottom) using different calculation periods, as well as the variation in calculated primary energy consumption for each case (top).

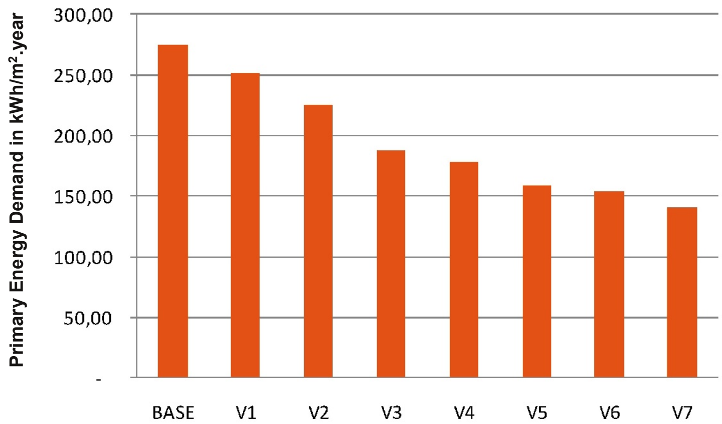
In the sensitivity analysis, shifting from the financial to the societal perspective had almost no impact on the point of cost-optimality, while a large increase in the energy prices resulted in a shift towards the most energy-efficient set of energy saving measures. However, the curve shifted towards a straight line, and the optimum was clearly not within the selected range of energy saving measures. In the case of extreme increase in energy prices, the shape of the curve is completely dominated by this one factor.

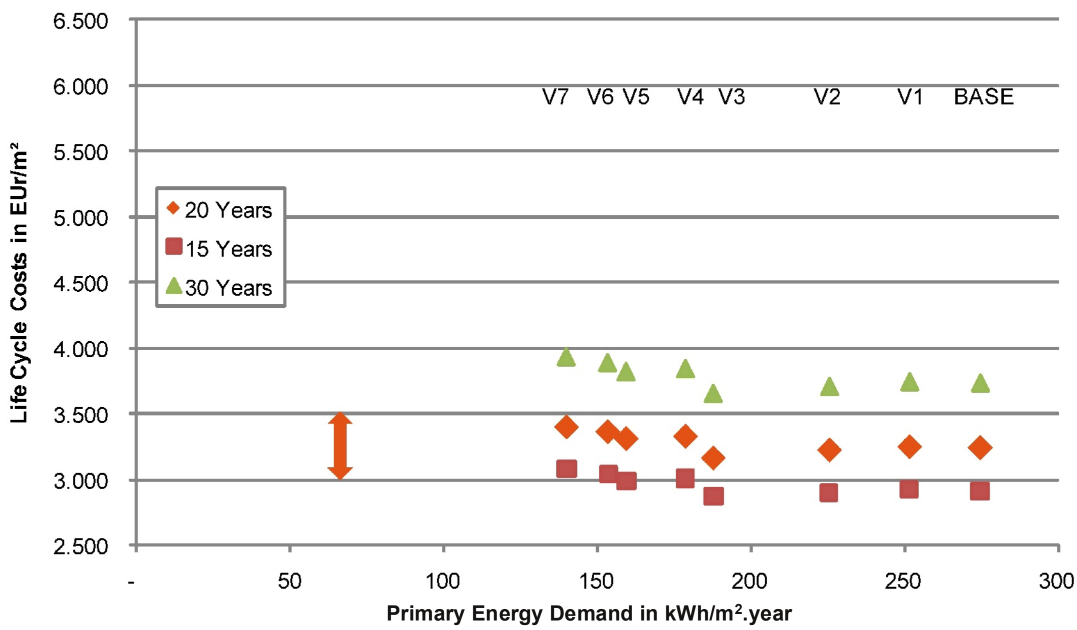
The main results of the first test runs can be summarised as follows:

> Because of the complexity and nature of the data, it is suggested to involve, in the data preparation and the calculations, only experts skilled in the field of energy performance of buildings.
> In order to be sure that the optimal point/zone has been identified as a minimum requirement, at least 10 variants per reference building should be used. However, to obtain a clear curve, more variants (20-30) are needed.

***Figure 2:* Test calculations (financial perspective) on a new reference building. At the top are the variations of the calculated primary energy consumption for 7 cases. The plot on the bottom shows the results from different calculation periods for each case, with a linear rather than a curved shape that fails to clearly define the optimum.**

ENERGY PERFORMANCE IN kWh/r	BASE	V1	V2	V3	V4	V5	V6	V7
NET ENERGY DEMAND								
NET HEAT DEMAND	75,64	53,10	40,52	37,86	38,03	38,03	38,03	38,03
NET COOLING DEMAND	46,31	51,76	45,53	30,96	24,26	20,08	20,08	20,08
PRIMARY ENERGY DEMAND								
HEATING	128,67	95,52	77,70	67,49	67,89	66,73	70,15	70,15
HOT WATER	11,31	11,00	10,81	10,63	10,63	10,63	1,22	1,22
COOLING	65,24	75,76	67,61	40,23	31,07	6,47	6,47	6,47
VENTILATION	35,98	35,98	35,98	35,98	35,98	42,45	42,45	42,45
LIGHTING	33,25	33,25	33,36	33,36	33,11	33,11	33,11	33,11
PV	-	-	-	-	-	-	-	- 13,43
SUM	**274,45**	**251,50**	**225,46**	**187,69**	**178,68**	**159,39**	**153,40**	**139,97**





- > The cost-optimal appears to be not only a point, but an interval (a range of values).
- > The results for the financial and societal perspectives do not show significant differences in the cost-optimal range but, in general, as expected, they show that switching to a societal perspective calls for more energy-efficient buildings.
- > Changes in some input factors, namely, the discount rate and the growth rate of energy prices, have significant impact on results.
- > Changes in the primary energy factors have a direct effect on the horizontal position of the curve, thus directly changing the recommended or mandated primary energy level.

Early experiences show that the results of applying the methodology depend strongly on the selected reference buildings and economic criteria, but sensitivity analysis and early experience provide a good insight into cost dynamics.

CA EPBD has discussed early experiences from MS who had already applied a cost-optimal calculation. Some MS that had carried out a cost-optimality study on their national energy regulations based on an early draft of the Regulation, have presented their early experiences and results. The highlights and the main conclusions from such studies are described next.

In the case of Spain, the example in Figure 3 shows results from cost-optimal calculations representing the Madrid region (climatic Zone D3) for the winter situation. In this case, where the reference building is far away from the cost-optimal level, the curve shows a nice shape with a clear optimum. The estimated additional cost for obtaining a 30% increase in the energy performance for new buildings is about 10%. Furthermore, the calculation exercise showed that there is a different cost-optimal level for each building typology located in each individual climatic zone. The situation will differ in the case of cooling calculations, which are more complicated to carry out. In Spain, and in regions with similar climates, a compromise must be sought between heating and cooling savings in the search for the optimum energy performance.

When analysing the existing building stock in The Netherlands, there is a number of challenges that need to be dealt with, but the prime challenge is the diversity of the existing building stock. This is one of the reasons for establishing a large number (184) of reference buildings in The Netherlands. In an attempt to determine the requirement levels for components in existing Dutch buildings, the following procedure was investigated:

> establish energy savings opportunities for components and systems, based on characteristics derived from reference building models;
> determine possible case-scenarios for building components and technical building systems for rehabilitation;
> analyse the cases (cost, benefit, feasibility);
> check the consistency of the sets of measures in buildings;
> formulate requirement levels for the existing buildings.

Reference building models were used to verify the assumptions made on the building component level. For components in the building's thermal envelope and with a specific user pattern, the energy need per m² is proportional to the U-value. The energy savings are proportional to the change in the U-value. Reference buildings are being used to determine the energy use and savings for the buildings technical installations, as well as the costs (capacity related default values were used for costs). Furthermore, a number of reference buildings were used to check the validity for packages (combinations of thermal envelope and technical systems improvements) of energy saving measures (Figure 4).

In Germany, a sensitivity analysis was carried out, and the results were plotted in a radar chart (Figure 5) in order to investigate which parameter influenced the life cycle cost the most. Looking at the averages, most parameters have equal impact on the life cycle cost, but some parameters, like the energy price and the general price development, result in the most significant variations in the cost calculation results, in line with the conclusions of the JRC study.

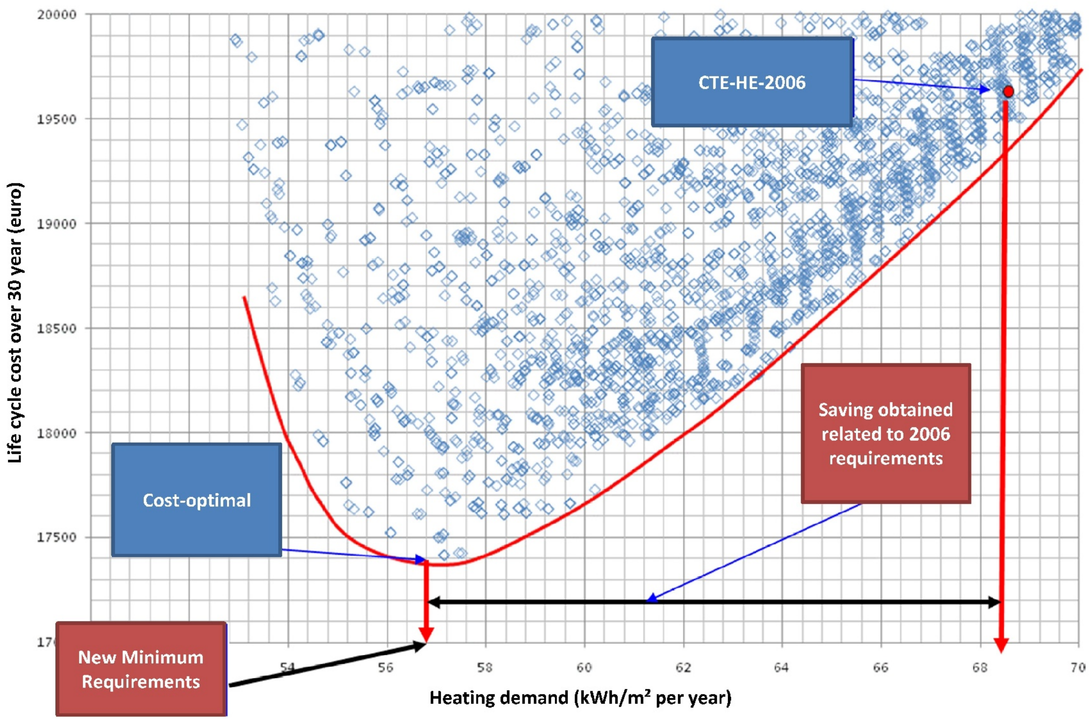


Figure 3: Early experiences (January 2012) on cost-optimality calculations for Madrid, Spain region. Different building model configurations will show different optimums (see blue dots following the same shape as the red line, but above the red line representing the cost-optimal).

Figure 4: Number of reference-building models defined in MS/regions to represent existing buildings in the analysis of cost-optimal levels for energy performance requirements (Spring 2012).

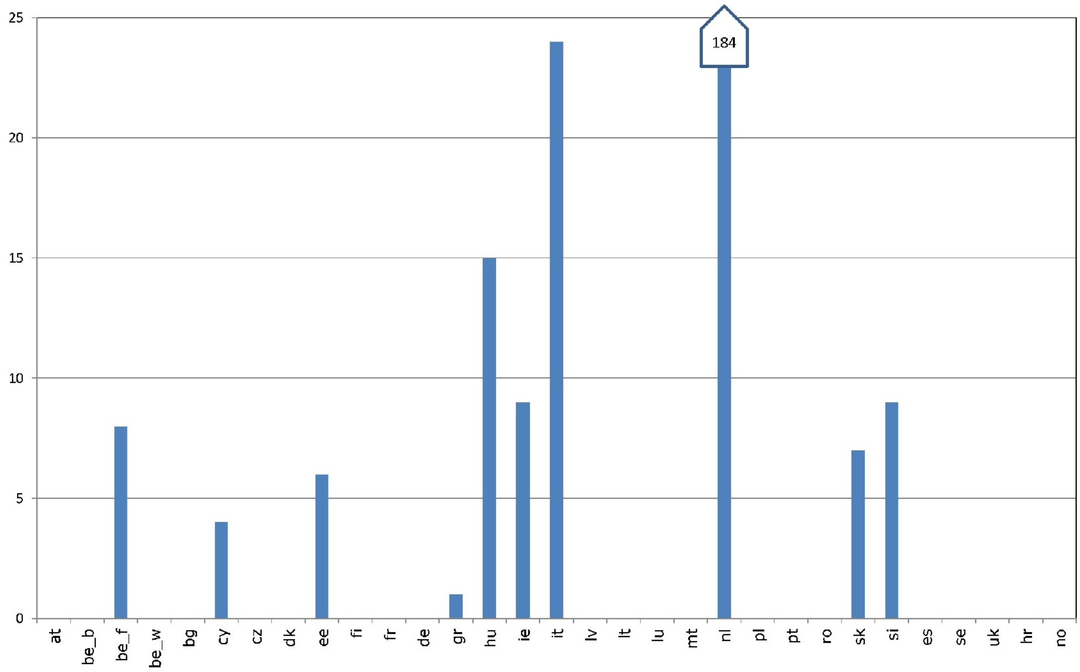
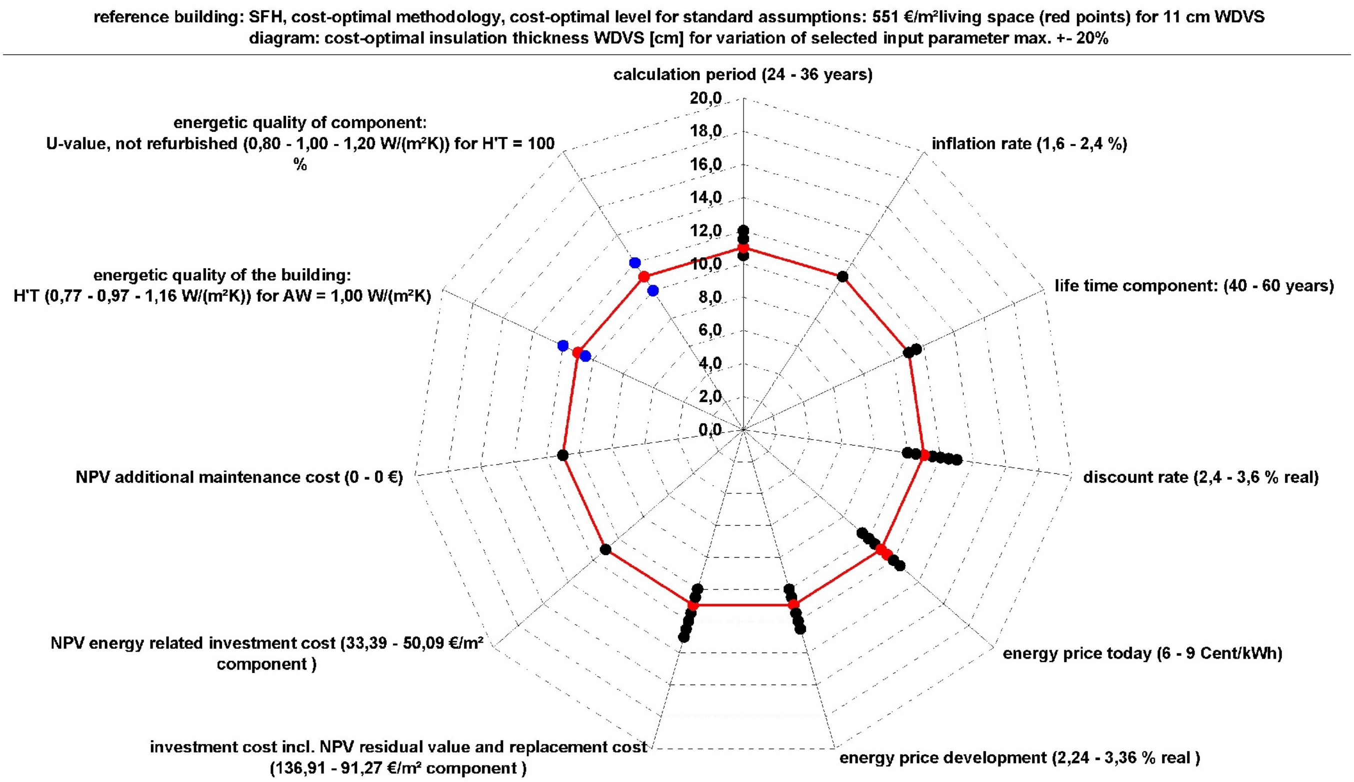
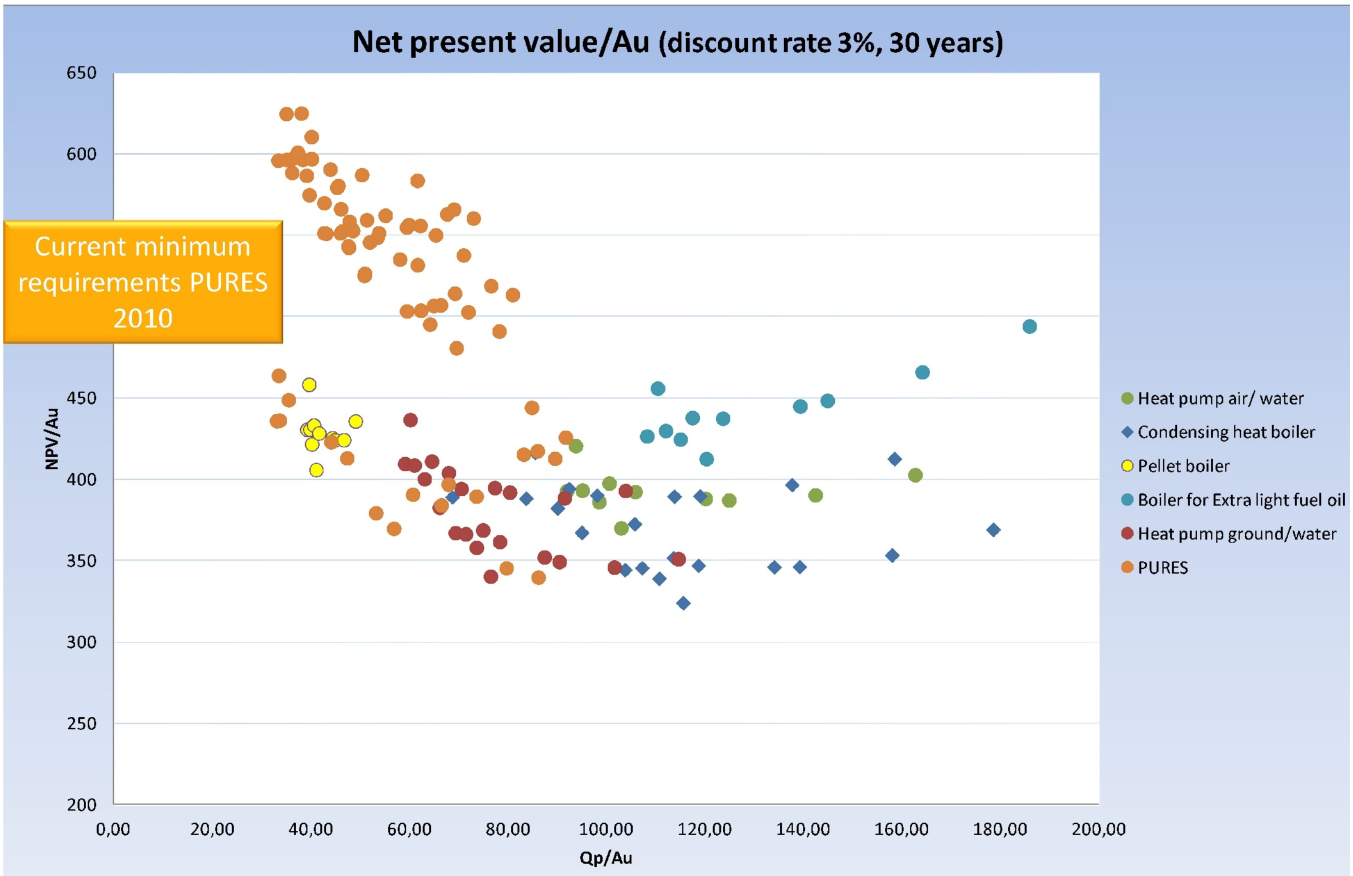


Figure 5: Radar chart showing which parameters have the largest impact on the life cycle cost in the German calculations.



In Slovenia more than 150 scenarios were constructed based on combinations of thermal envelope improvements (external walls, roofs, floors and windows) and different combinations of heating and ventilation installations (Figure 6). Comparing the cost-optimal calculations with the current Slovenian EP requirements for new buildings, it seemed that the then existing current requirements were beyond (i.e., more demanding than) the cost-optimal point. Calculations of the cost-optimal levels were also conducted for 2 of the 4 building types identified in the TABULA project; namely, single-family houses and blocks of flats. The introduction of subsidies has changed the prioritised/optimal technologies from condensing gas boiler to ground/water heat pump. From the analysis, it is evident that subsidies are efficient and have a great impact on the selection of the cost-optimal solutions. In general, the lowest net present values are found for good insulation levels (> 200 mm), low-e double glazing, natural

Figure 6: Current requirements in Slovenia are more demanding than the cost-optimal point for the test calculations.



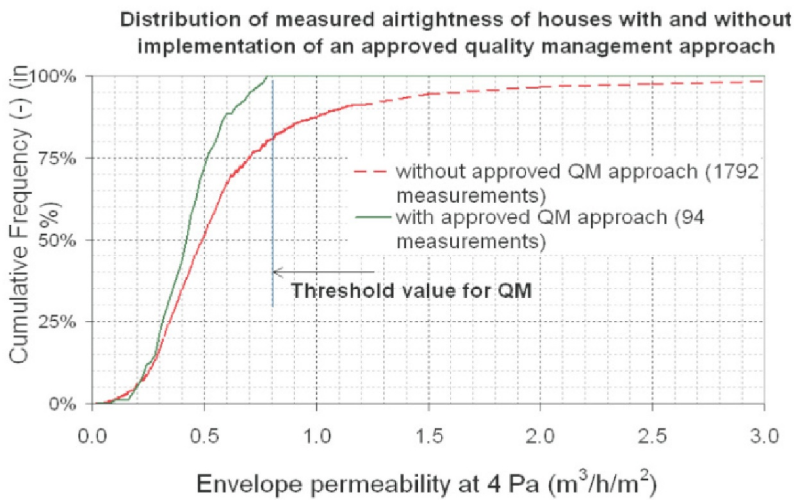
ventilation and condensing gas boilers/heat pumps (with solar collectors being close competitors). Currently, a PV net feed-in tariff is not allowed in Slovenia, but if this changes, it will clearly change the conditions and thus the results of the cost-optimal calculations.

It will be challenging to identify the appropriate reference buildings in many Member States, but a number of solutions exists e.g., building typologies, stock analysis, etc..

3.2 Compliance checks for energy requirements in new buildings

With the increased EP requirements for Nearly Zero-Energy Buildings (NZEB) included in future national building regulations, the compliance checking of the performance of new buildings becomes increasingly important. If buildings do not meet the requirements, it will be impossible to obtain cost-optimality both for buildings and for building components. One particular issue that needs special attention is the airtightness of the building envelope. Without sufficient airtightness, the building will not be able to meet the strict requirements for NZEB buildings.

Figure 7: French investigations show that airtightness complies fully with the requirements in buildings where the quality management is in place, while only for 80% in buildings without quality management.



Moreover, leaky buildings will cause an obstacle for cost-optimal solutions; e.g., for mechanical ventilation systems, the overall efficiency will be influenced by parallel air-flows through holes and cracks. Figure 7 shows the importance of quality management. All buildings with quality management in place comply with the requirements, while only 80% of the buildings without quality management comply with the requirements.

In most MS, the check of energy requirements is conducted by calculation. However, in Sweden, the compliance check philosophy in place is based on measured energy use. During the design phase, compliance is checked using the asset-rating approach. After the building is taken into use (after 2 years, in order to let concrete dry and other functions to get stabilised), compliance is checked using the operational rating approach, together with the Energy Performance Certificate (EPC). The holistic approach underlying the operational rating does thus include an evaluation of the airtightness of the building. The cost-optimal requirements in Sweden must match both the calculated and the measured energy use. It will be interesting to follow the Swedish experience on this holistic approach in the years to come.

Compliance checks for energy performance requirements in new buildings are crucial for achieving cost-optimal solutions towards Nearly Zero-Energy Buildings.

3.3 Requirements for existing buildings

There are different practical ways used by MS to set EP requirements for existing buildings and, among all MS, the whole range can be found: building requirements, component requirements and a combination of the two. According to the recast EPBD, both kinds of requirements need to be set. There are advantages and disadvantages attached to each of the approaches. The approach used in each MS depends on many factors, including building tradition, national building regulations and the capability of checking compliance with the requirements.

In the spring of 2012, a small survey revealed that 2 MS/regions have solely whole-building requirements, while 7 MS/regions rely solely on component requirements. In 17 MS/regions, there is a combination of component and whole-building requirements.

A combination of whole-building and component requirements can lead to more energy savings.

The setting of requirements for retrofitted and replaced building components that form part of the building envelope and have a significant impact on the energy performance of the building is mandatory. The primary advantages of component requirements are that they are easy to explain, confirm and enforce, and they therefore offer the possibility for increased user acceptance. On the other hand, they are difficult to regulate (indoor works are especially difficult or even impossible to check), and they do not lead to improvements of adjacent areas or components. Moreover, without a holistic approach, it is not easy to decide which measure to implement first. However, energy performance improvements that are implemented in combination with ordinary, planned renovation works will require only a marginal investment cost for the energy savings, and thereby ensure better cost-effectiveness.

The setting of requirements for existing buildings that undergo a major renovation is also an obligation of the recast EPBD. Applying whole-building requirements, on the other hand, makes it easy to set ambitious EP requirements for major renovations, change of use and extensions, as well as to avoid costly energy measures that only have a small effect on the energy demand of the building. However, there are no requirements ensuring the use of energy-efficient components for normal maintenance or minor refurbishments, and there is the risk that additional costs due to requirements for the whole building may be a hindrance in implementing energy saving measures at all.

In many cases, especially in the case of minor refurbishments, it is a matter of the owner and craftsmen to secure compliance with the requirements.

4. Main outcomes of 'Energy performance requirements using the cost-optimal methodology'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Design of the comparative cost-optimal framework.	A tightly defined procedure defining all the parameters needed for the calculation at EU level vs. a framework allowing adjustment for national conditions.	The comparison procedure must easily match the national calculation procedure.	The procedure could be to allow modifications from the prescribed approach under the condition that they can be justified properly.
2. Reference buildings and energy saving measures.	From the experience of several countries, experts, in consultation with the market, should define a number of not too complicated reference buildings for different use typologies.	Based on these buildings, and a sufficient number of variations on the base case, sensitivity studies can produce cost-optimal levels.	For existing buildings, it is of great importance to allow a more comprehensive set of references and to provide flexibility in the framework.
3. Legal framework.	Analysing the cost-efficiency of energy saving measures in the existing building stock is common practice among consultants for specific buildings.	For the purpose of setting or comparing energy performance requirements, measures have to be judged in a more general and transparent way in order to be valid for enforcing requirements.	The framework should take into account the fact that adjustments and refinement will be needed in the near future; further exchange of experience will be necessary.
4. Implementation of the cost-optimal regulation.	The balance between the effort of carrying out the calculations and the information that can be drawn from the results is crucial for gaining broad acceptance for the methodology among Member States.	One of the major challenges will probably be setting up reliable and up-to-date cost databases, as well as providing software tools.	Production of a large number of variant calculations that can form the lower edge of the cost curve and produce the optimal range.
5. Compliance checks for Energy Performance (EP) requirements for new buildings.	The methodologies for EP requirements compliance checks differ depending on the assessment method.	If buildings do not meet the requirements, it will be impossible to obtain cost-optimality for the buildings and the building components.	With the increased EP requirements for Nearly Zero-Energy Buildings (NZEB) included in future national building regulations, the compliance checking of the performance of new buildings becomes increasingly important.
6. Compliance checks for airtightness in new buildings.	There are different possibilities for checking compliance with airtightness requirements.	Compliance can be ensured either by post-construction measurements and/or by implementing a quality management system. Leaky buildings will cause an obstacle for cost-optimal solutions.	With the increased EP requirements for NZEB included in future national building regulations, the compliance checking of the airtightness of new buildings becomes increasingly important.
7. Setting EP requirements for existing buildings.	Pros and cons for setting mandatory EP requirements in existing building renovation with both whole-building and component requirements.	A combination of component and whole-building requirements may prove to be the system that best ensures the implementation of the most energy saving measures.	There is a need to identify ways to set requirements that ensure maximum energy savings, with a view on reducing investment costs and not hinder refurbishments due to too rigid or complicated requirements.

5. Lessons learned and recommendations

Cost-optimal procedures

The Comparative Methodology Framework is a powerful instrument to guide the Member States (MS) in the process of checking the level of their minimum Energy Performance (EP) requirements, and to greatly improve the energy performance of the building stock. However, it is important to understand that a too rigid comparison methodology can have a negative effect, by reducing the freedom of the MS to set more demanding requirements.

Early experiences of cost-optimal calculations and analyses in various MS show that the use of the cost-optimal procedure provided awareness about the importance of the economic criteria. It seems that it is possible to obtain different cost-optimal levels, depending on the assumptions used in the calculations. The initial results show that, in some MS, the present requirements are below cost-optimal levels, but others have minimum requirements that are already more demanding than the cost-optimal level calculated by the EPBD regulation.

Results from calculations show that switching to a societal perspective asks for more efficient buildings, though with only small differences when compared with a private investor perspective.

Some MS (e.g., Estonia, the Flemish region of Belgium, and Lithuania) found that their current energy requirements are too lax compared with their calculated cost-optimal level. In Estonia, the new cost-optimal minimum requirements were tightened by 20-40% and in some cases even up to 200% compared with the current requirements. Information from the individual MS about the influence of the cost-optimal calculations on the current requirements is available in some of the country reports in this book.

According to the Regulations, the MS should define a minimum of 9 reference buildings – one for new and two for existing buildings, for respectively single-family, multi-family, and office buildings. Ideally, the reference buildings are defined based on the characteristics of the existing building stock. Among MS and regions that have a reference model for their existing building stock, the number of reference building models differs significantly.

The experience within the Concerted Action (CA) on the Energy Performance of Buildings Directive (EPBD) was instrumental in informing the final content of the Regulations, the cost-optimal framework methodology and the Guidelines before they were adopted. The topic has been discussed in depth since December 2010, and the practical application of the Regulation was discussed in detail during 2011-2012.

Compliance checks for energy requirements in new buildings

With the increased EP requirements for Nearly Zero-Energy Buildings (NZEB) included in future national building regulations, the compliance checking of the performance of new buildings becomes increasingly important. The methodologies on compliance checks of EP requirements used in MS differ depending on the assessment method, i.e., use of calculated or measured energy consumption.

In addition to the whole building energy performance, it is also relevant to talk about the compliance check of the performance of different components such as ductwork airtightness and building airtightness. Without sufficient airtightness, the building will not be able to meet the strict requirements for NZEB. Moreover, leaky buildings will create obstacles for cost-optimal solutions, namely by disturbing the performance of mechanical ventilation systems.

Requirements for existing buildings

There are advantages and disadvantages associated with both the component and the whole-building approach for setting EP requirements for the existing building stock. The approach used in the MS depends on many factors, including the building tradition, national building regulations and the capability of checking compliance with the requirements. A combination of component and whole-building requirements is required by the recast EPBD. This combination can ensure the implementation of measures that can save more energy.

Towards 2020 Nearly Zero-Energy Buildings

OVERVIEW AND OUTCOMES

NOVEMBER 2012

Authors

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1. General information

To support EU Member States (MS) in the task of implementing Directive 2002/91/EC on the Energy Performance of Buildings (EPBD), the Concerted Action (CA) EPBD was launched by the European Commission to promote dialogue and exchange of best practices. The Concerted Action EPBD brings together the national authorities implementing this legislation, and other bodies appointed and entrusted by them to do so. It fosters exchange of information and experiences amongst representatives designated by all 27 Member States, plus Norway and Croatia.

With the adoption of the recast EPBD in 2010 (Directive 2010/31/EU), MS faced new tough challenges. The most prominent among them is the progress towards new and retrofitted Nearly Zero-Energy Buildings (NZEB) by 2021 (2019 in the case of public buildings). Thus, from 2010 onwards, the range of topics of the CA EPBD has been extended to cover activities focusing on moving 'Towards 2020 - Nearly Zero-Energy Buildings'.

This report summarises the main outcomes of the discussions on this topic from March 2011 to early 2013. The successful contribution regarding the MS progress towards 2020 is based on the active participation of the national delegates, including information gained from questionnaires, national studies, poster presentations, and study tours.

The work focused on the transposition of the recast EPBD into national law, namely on the national application of the definition of NZEB, and on the national plans for increasing the number of NZEB.

2. Objectives

Article 9 of the recast EPBD requires that "*Member States shall ensure that (a) by 31 December 2020 all new buildings are nearly zero-energy buildings; and (b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings*". Member States shall furthermore "*draw up national plans for increasing the number of nearly zero-energy buildings*" and "*following the leading example of the public sector, develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings*".

A NZEB is defined in article 2 of the recast EPBD as "*a building that has a very high energy performance... . The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby*".

The specific CA EPBD activities on the topic 'Towards 2020 – Nearly Zero-Energy Buildings' support the MS through the exchange of experience regarding already existing high performance buildings

Figure 1: Two examples of high performance buildings: on the top, a net zero heating energy house in Durbach (Germany); on the bottom, a net zero energy office building in Lisbon (Portugal).

(ranging from low energy buildings to passive houses, zero-energy and zero-emission buildings, and even to energy surplus houses).

The discussion topics include the different national applications of the NZEB definition, national plans for increasing the number of NZEB, the most common building and service system solutions, calculation methods, awareness-raising activities, subsidies and other available incentives, supporting documents (e.g., guidelines), etc..

Furthermore, there is close interaction with the CEN activities for the development of the 2nd generation standards on the Energy Performance (EP) of buildings.

The timeline for actions by the MS and the EC related to NZEB (article 9 of the recast EPBD) is presented in Figure 2.

3. Activities under 'Towards 2020 – Nearly Zero-Energy Buildings'

So far, the focus of work has been on five major topics:

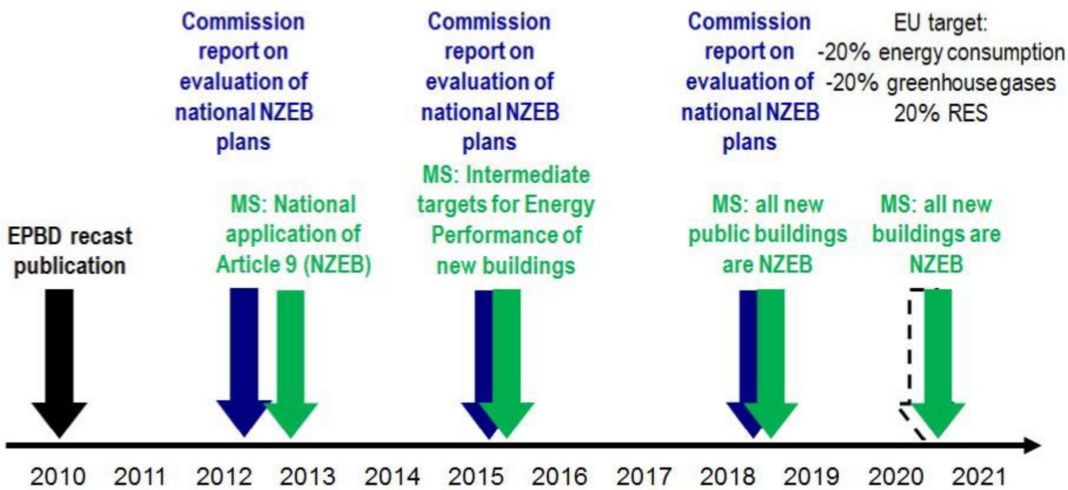
> mapping of national applications of the NZEB definition;
> national plans to increase the number of NZEB;
> boundary conditions for the assessment of renewable energy in national calculation methods (including calculation methods for NZEB);
> convergence between the concepts of NZEB and cost-optimal EP requirements;
> practical experience with NZEB.

There is a very close link between the NZEB discussion and the CA activities on EP requirements using cost-optimal levels, because the cost-optimal minimum EP requirements will have to meet the NZEB level by the end of 2018 for public buildings, and by the end of 2020 for all other new buildings. Additionally, both topics involve work on calculation procedures.

3.1 Mapping of national applications of the NZEB definition

The status of the MS national applications of the NZEB definition has been gathered and compared. From a total of 19 countries that provided detailed information in March 2013, six have their NZEB application fixed in a legal document, and another six have the application ready but not yet legally fixed. The other seven countries are at various stages of developing the application of the NZEB definition, with national studies already performed and currently being evaluated, or with studies still being underway.

Figure 2: Timeline of NZEB-related actions according to the recast EPBD.



In March 2013, six Member States had their national application of the Nearly Zero-Energy Buildings definition legally fixed, while another six Member States had them ready but not yet published in a legal document.

Annex I of the recast EPBD gives a common general framework for the calculation of the EP of buildings, including NZEB, as follows: "*The energy performance of a building shall be determined on the basis of the calculated or actual energy that is consumed in order to meet the different needs associated with its typical use, and shall reflect the heating energy needs and cooling energy needs (energy needed to avoid overheating) to maintain the envisaged temperature conditions of the building, and domestic hot water needs.*" Furthermore, the Annex lists aspects that shall be taken into consideration for the methodology. These aspects include natural and mechanical ventilation, and built-in lighting installation (mainly in the non-residential sector).

The energy aspects that are, or will be included in the national calculations[1] on the demand side are:

> Heating and (domestic) hot water in all 19 MS for both building types.
> Cooling in 18 MS for non-residential buildings, and in 17 MS for residential buildings. One MS has not yet decided how to include cooling energy needs.
> Ventilation in all 19 MS for non-residential buildings, while in 17 MS for residential buildings. The other 2 MS use a simplified calculation procedure that does not distinguish between natural and mechanical ventilation, with or without heat recovery.
> Lighting in all 19 MS for non-residential buildings, and in 8 MS for residential buildings (the latter not being a requirement in the EPBD Annex I).
> Auxiliary energy in 18 MS for non-residential buildings, and in 17 MS for residential buildings.
> Energy used for household equipment in 5 MS for residential buildings, and for example office equipment in 7 MS for non-residential buildings. Equipment is not mentioned in the EPBD Annex I.
> Energy for lifts and external lighting is additionally calculated in 1 MS for non-residential buildings.

The analysis of national NZEB applications and their calculation procedures also focused on the integration of renewable energy. The following renewable energy generation systems are or will be included by the MS that answered this question:

> Solar thermal: 18 of 18 MS.
> Photovoltaic: 17 MS.
> Passive solar, daylighting, biomass: 16 MS.
> Heat recovery, passive cooling and geothermal: 15 MS.
> Biogas: 14 MS.
> Micro wind generator, micro Combined Heat Power (CHP), ambient air (e.g., in air-to-air heat pumps) and biofuel: 13 MS.
> Waste heat (from industries, computer server rooms, etc.) and solar cooling: 9 MS.
> Waste heat from hot water (bath/shower, washing machines, etc.): 6 MS.

The balancing time steps in the NZEB calculation also differ among the 18 countries that reported on this issue. On the demand side, 6 MS use a yearly time step, 10 MS a monthly time step, and 6 MS an hourly time step, with 3 countries allowing for both monthly and hourly calculation (partly depending on the building type) and 1 country allowing a yearly and hourly calculation (depending on the building type). On the generation side, there are

Figure 3: Interview of the national delegates concerning the country application of the NZEB definition.

1 From the 19 MS that provided information.

9 MS with yearly balancing time steps, 8 MS with a monthly approach, and 6 MS with an hourly approach. Again, some countries allow for more than one type of time steps.

14 MS allow taking into account the self-used energy generated by renewable energy systems, of which 5 also allow taking into account extended self-use of energy (by battery or other storage systems). 6 MS additionally allow taking into account the feed-in of energy generated by renewable energy systems.

The boundary of renewable energy integration is one of the main points still under discussion in many countries. This boundary also depends on the type of the renewable energy system. For example, renewable integration into district heating systems is often at neighbourhood or infrastructural level, while photovoltaic is mostly taken into account only at building or building complex level. However, the answers from 18 countries show that there is a tendency to use a wider boundary than the building level only. 10 MS plan to use at least the building complex level for the accounting of the renewable energy (Figure 4).

The specific national NZEB requirements have been compared for the 19 MS that answered the questionnaire. All but 2 MS use or will use primary energy as the main indicator. These 2 countries will use either CO_2 emissions as the sole indicator, or base their energy requirements on measured energy that will not be multiplied by a primary energy factor (but 'energy-weighted' according to different energy sources). Additional indicators used or planned by the MS are:

> mean U-values, thermal transmittance coefficient or transmission losses;
> heating, cooling, hot water and lighting energy needs;
> efficiency of building service systems;
> summer comfort, bioclimatic index.

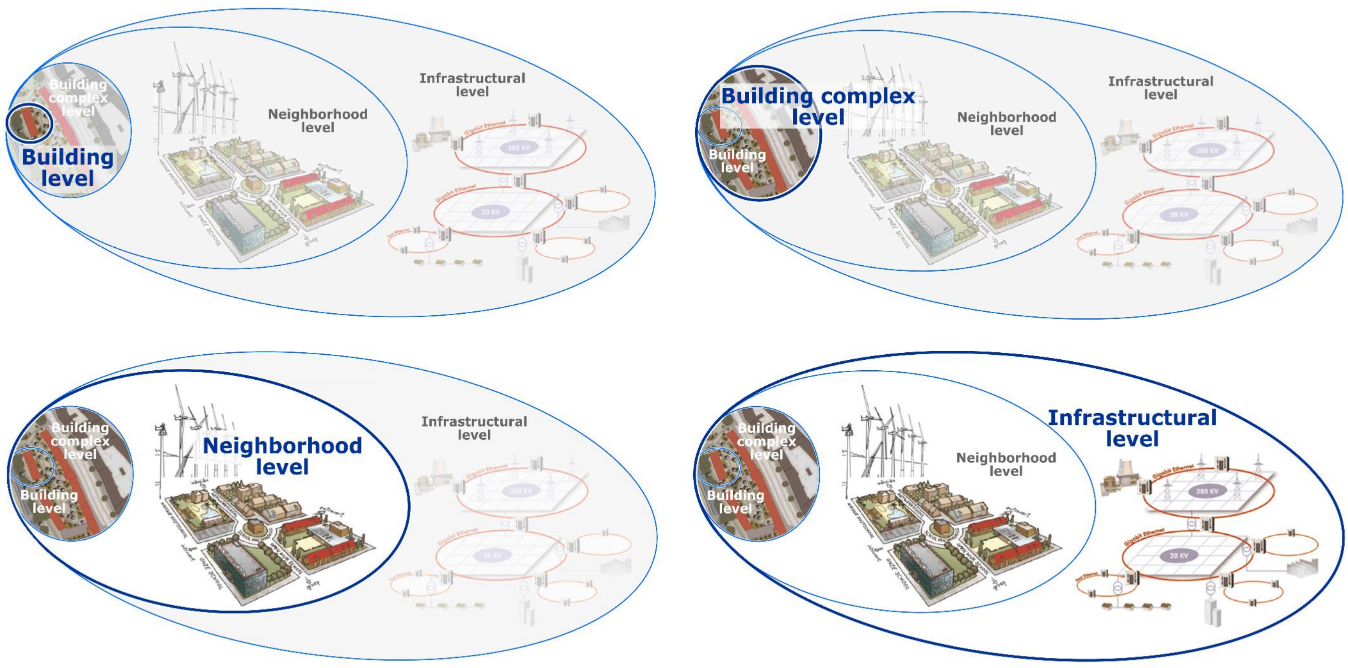
Concerning the type of EP requirements (regarding primary energy or other), the following will be realised, or is at least planned by the 18 countries that provided information:

> 10 MS will use fixed values;
> 6 MS will use fixed values with allowances (for certain building usages or, e.g., for the integration of cooling systems in buildings);
> 5 MS will use mirror baseline buildings with a fixed set of reference technologies to compare with. Here, the minimum requirement is fixed by calculating the EP of a building with the same geometry, orientation and user profile(s) as in the original building, but applying a defined set of technologies representing the current state of good practice.

3 MS will use a combination of two types of requirements:

> One MS plans to use the fixed value for the residential buildings and the mirror baseline building approach for the non-residential buildings.
> In another MS, the fixed value plus

Figure 4: Possible boundaries for integrating renewable energy into NZEB calculations.



allowances is used for residential buildings while the mirror baseline building approach is used for non-residential buildings.

> The third country uses a fixed value plus allowances for the primary energy requirement and a mirror baseline building approach for a summer comfort requirement.

16 MS also reported on whether they will ask for a specific share of Renewable Energy Sources (RES) as part of their NZEB requirements. 9 MS will use a fixed ratio. 2 MS will use a minimum absolute renewable energy contribution. 1 MS will use either fixed ratio or minimum absolute contribution, depending on the building type. 6 MS plan to have no specific renewable energy requirement. Not all the renewable energy systems that can be calculated in the MS procedures can be taken into account in the required share of RES (Figure 5).

Member States have adopted a wide range of definitions of Nearly Zero-Energy Buildings.

9 MS made an estimation of the planned tightening of the NZEB requirements compared to the current EP requirements for new buildings. The values range between 20% and 60%, with an indicative average of 40% tightening.

The planned average tightening of the Nearly Zero-Energy Buildings requirements compared to the current Energy Performance requirements for new buildings is about 40%.

3.2 National plans to increase the number of NZEB

In article 9, paragraph 1 of the recast EPBD, it is written that "*Member States shall draw up national plans for increasing the number of nearly zero-energy buildings*". Further definitions of what has to be included in the national plans are described in the other paragraphs of article 9.

The drafts of the national NZEB plans have been discussed, and a possible structure for the plans has been developed. In general, there seem to be two ways to structure the national NZEB plans: either with the focus on the content topics, as defined in the EPBD article 9 (i.e., a report topic by topic), or by concentrating on the building type (new/existing/public/residential/non-residential). A summary matrix as presented in Table 1 can give an overview of how the relevant topics are transposed per building type.

An expert study ordered by the EC gave insights into the planned evaluation of the national NZEB plans.[1] In 2012, the CA EPBD forum provided the opportunity for dialogue between the MS representatives and the EC service provider carrying out the study. By early 2013, 12 MS had provided their national plans for increasing the number of NZEBs.

By March 2013, twelve Member States had provided the EC with their national plans for increasing the number of Nearly Zero-Energy Buildings.

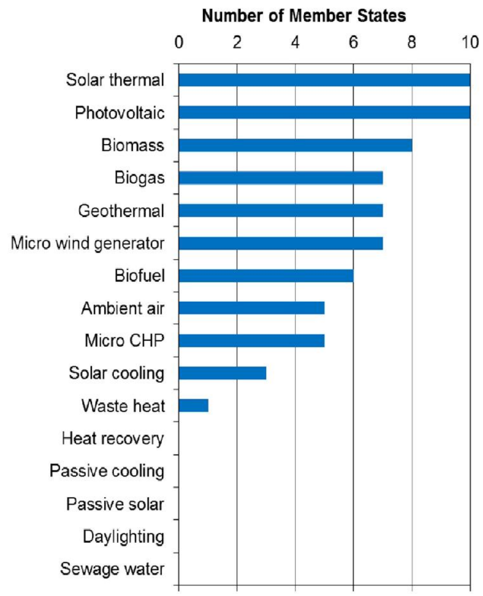


***Figure 5:* Renewable energy systems foreseen for accounting in the share of RES in 10 analysed MS.**

		Building type					
		New residential buildings	New non-residential buildings	New public buildings	Existing residential buildings	Existing non-residential buildings	Existing public buildings
Topic	Detailed application in practice of the NZEB definition.						
	Intermediate target for improving the energy efficiency of new buildings in 2015.						
	Measures (such as the setting of targets) in order to stimulate the transformation of buildings that are refurbished into NZEB.						
	Policies for the promotion of NZEB.						
	Financial measures for the promotion of NZEB.						
	Other measures for the promotion of NZEB.						

***Table 1:* Overview matrix for a structured reporting on the different topics and building types in the national plans for increasing the number of NZEB.**

1 Towards nearly zero-energy buildings. Definition of common principles under the EPBD. March 2013. *ec.europa.eu/energy/efficiency/buildings/buildings_en.htm*

Additionally, the national promotion programmes for NZEB have been analysed in 17 countries. 11 MS have or plan to have financial support programmes to stimulate the market towards NZEB. 9 MS (including 6 of the 11 MS with financial support programmes) will launch other types of NZEB promotion schemes, including guidance to industry, pilot projects, communication, etc.. Three of the 17 MS do not plan any specific promotion programme for NZEB.

The Concerted Action EPBD activities and an EC expert study supported the Member States in developing their national plans towards Nearly Zero-Energy Buildings.

3.3 Boundary conditions for the assessment of RES in national calculation methods (including calculation methods for NZEB)

The major questions regarding the integration of RES in NZEB are:

1. What is meant with on-site and nearby RES?
2. What is a 'very significant extent'?
3. How are RES taken into account in the calculation methods of the MS? Should the benefit of renewable energy be limited to the energy consumption during the same month, the same hour, or other options?
4. What kind of RES are currently mostly used in high performance buildings in the MS?

The discussions and the country status reports summarised in 3.1 show that, in the MS, there are various approaches on how to take into account the renewable energy in the EP calculations. The issue of how to consider renewable energy that is either not produced on-site, or is produced on-site but is fed into the general electricity grid or district heating network, seems to be a discussion topic in most MS. Various RES are already used for covering the building energy needs in EU countries, with heat pumps, solar thermal, photovoltaic and biomass being the most frequent. Questions remain on how to express renewable energy contributions such as daylight, heat recovery, heat pumps and passive solar energy in the Energy Performance Certificates (EPCs).

In most of the countries, the use of RES seems to be influenced by the availability of subsidies.

Other important issues are 'how to assess and express renewable energy generation in the EPCs' and 'how to ensure that renewable energy production is not counted twice'. Four different methods of connecting RES with buildings are possible (on building level, on building complex level, on neighbourhood level, and on infrastructural level). As described in 3.1, the used methods depend on the RES. Also, there is a tendency to use a wider boundary than the building level only.

MS concluded that when the energy from renewable sources is channeled into a public grid, there are difficulties in the identification of the actual proportion of renewable energy supplied to one specific building.

The used boundaries for accounting renewables in the NZEB calculation are depending on the renewable energy generation source and differ widely. There is a tendency to use a wider boundary than the building level only.

There is a close cooperation with CEN in which the European calculation standard (EN) approaches to calculate renewable energy contributions are reviewed and mirrored with national procedures. However, further information exchange among the countries, and harmonisation with the relevant approaches within the EN calculation standards are needed.

3.4 Convergence between the concepts of NZEB and cost-optimal EP requirements

Based on EPBD articles 5 'Calculation of cost-optimal levels of minimum Energy Performance requirements' and 9 'Nearly Zero-Energy Buildings', the beginning of the years 2019 (for new public buildings) and 2021 (for all new buildings) will be the meeting point between the cost-optimal calculations and the definition of NZEB: by 2019/2021, NZEB shall have a cost-optimal combination of building envelope and building service systems.

Thus, the cost-optimal calculations for 2012 have to be reviewed for 2019/2021, as there are certain factors that will change between now and 2020. Though future prices and innovations cannot easily be predicted, MS have to take into account at least the following factors:

> primary energy conversion factors, especially regarding district heating and electricity;
> energy prices;
> investment costs;
> technology efficiency developments and innovations.

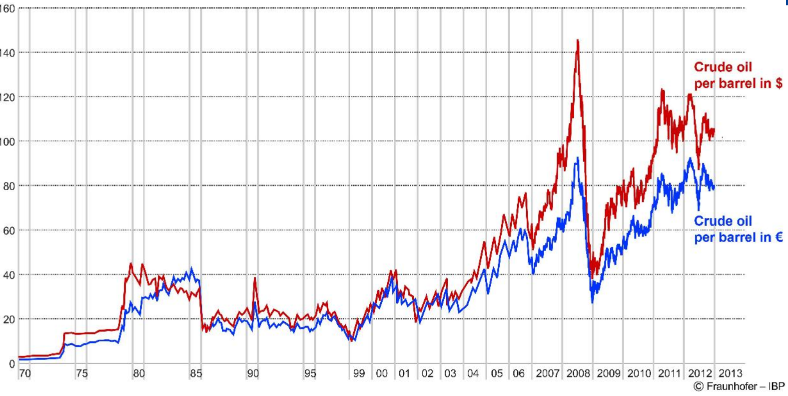


Figure 6: Strong fluctuation of the crude oil price complicates the prediction of the 2019/2021 NZEB boundaries.

10 MS reported that they have already performed a study that takes into account the changes in at least some of the mentioned parameters:

> Primary energy conversion factors: 8 MS.
> Energy prices: 9 MS.
> Investment costs: 5 MS.
> Technology efficiency developments and innovations: 3 MS.

3 countries have studied all the factors listed above. Other factors that were examined (but only one factor per MS) were CO_2 reduction costs and discount factors.

MS reported that, using the present costs, technologies, and primary energy conversion factors, the currently available national applications of the NZEB definition are not fully in compliance with the cost-optimal requirement. Only 1 country reported that it has used the study on the evolving factors to fix its national application of the NZEB definition. Other countries might follow.

Therefore, the topic is certainly worth revisiting after all MS have concluded their cost-optimal calculations. Future developments of existing and new technologies, as well as the cost of these technologies, may well change the picture, and hence initiate new calculation results and new discussions.

Ten Member States performed a cost-optimal study for 2019/2021 (e.g., for Nearly Zero-Energy Buildings), taking into account evolving parameters such as primary energy conversion factors, energy prices, investment costs, and technology efficiency developments and innovations.

3.5 Practical experience with NZEB
In article 9, the recast EPBD sets earlier implementation dates for NZEB for new buildings occupied and owned by public authorities. The idea is that public buildings shall be used as leading examples for the progress towards NZEB. The CA EPBD has therefore specifically focused on public buildings, and has analysed examples of high performance public buildings in Germany, the political role these buildings can play, the offered incentives and promotion initiatives, the currently used requirements, as well as examples of specific guidelines.

> There is a variety of high performance public buildings in Germany, such as prominent buildings like the Federal Parliament building ‘Reichstag’, several ministry buildings, and community buildings such as schools and kindergartens.
> These buildings are used as lighthouses for the general development in the building sector. This is especially true for school buildings, which can be used as communication means towards pupils and their families, and can thus reach many different society groups. This approach is applied in several MS.
> In Germany and Latvia, there are specific research and funding programmes for new and retrofitted community buildings towards the NZEB level.
> There are several German communities that have implemented their own energy decree, with EP requirements that are further tightened compared to the national ones. These requirements apply to community buildings and buildings built on community ground. This approach is applied also in other MS, such as Belgium (Flemish region) and Denmark. The German Federal Government has committed to realise the NZEB level for its own new buildings already in 2012.
> An interesting measure is the installation of an energy commissioner responsible for the energy efficiency of all federal buildings of Germany.

A list of instruments to support the use of public buildings as leading examples was compiled, and is presented in Figure 7.

The use of public buildings as leading examples is already in place in several Member States. Various instruments, e.g., financial support for communities, specific research programmes, further tightened Energy Performance requirements, etc., are in use.

In the EU, single-family houses are the most common building type, and thus the interest of the MS peaks on this type. The experience in the UK shows that:

> It is difficult to introduce NZEB in countries in which the average time

Figure 7: Compiled list for the use of public buildings as leading examples towards nearly zero-energy buildings.

Instruments for the use of public buildings as leading examples towards NZEB

- Tighter requirements for public buildings.
- Guidelines for new/for the retrofit of public buildings.
- Energy commissioner responsible for all government buildings.
- Database of energy consumption of all public buildings (identify poor performers).
- Publish the database of energy consumption of public buildings (name and shame).
- Annually published energy report of all public buildings.
- Accelerated implementation of NZEB. E.g., Germany: from 2012 onwards, all new government buildings have to be NZEB.
- Already fixed roadmap towards NZEB.
- Pilot projects of NZEB in public buildings.
- Subsidy programme for new NZEB public buildings.
- Subsidy programme for the energy retrofit of public buildings into NZEB.
- Information campaign to present good examples of public buildings.
- Only buildings with a good EPC can be let to government/public bodies.
- Promotion of the next building generation: Plus energy houses (subsidy programme).
- Specific requirements in architectural competitions for government buildings.
- Using schools as shining examples with influence on pupils, parents, etc..
- RES requirements for new public buildings or for all new buildings.
- Money from white certificates used for the retrofit of public buildings.
- Adjustment of public procurement to facilitate innovative tenders.
- Commitment of local authorities in their energy action plans to develop NZEB.

people stay in a purchased home is about 7 years before a new home is bought and the old one is sold. This makes investment in energy efficient technologies rather hard, as they rarely pay back within that short timespan.

> There is often a difference between the predicted (calculated) EP and the measured results. While the absolute amount of deviation of the energy use is often smaller in high performance buildings, the deviation percentage increases with the reduction of the energy need. The following reasons have been determined, based on experience with high performance buildings:
  - Deviations between the planning and the construction site.
  - Significant lower seasonal efficiency of boilers and heat pumps than that predicted and expected.
  - Problems with mechanical ventilation systems, including draught, noise, faults and poor performance. This experience was backed-up by at least another MS (The Netherlands).
  - Poor workmanship at the installation of solar thermal systems.
  - Different user behaviour in reality than in the calculations.
  - Use of control systems that are too complicated for the users.

Some countries, like Austria and Germany, have good practical experience with high performance dwellings. In those countries, fewer failures on the construction site are found, and houses with a higher energy efficiency than that required by the national regulation have a dominant share in the market of new residential buildings.

There is often a significant difference between the predicted (calculated) Energy Performance of buildings and the measured results. In countries that already have good practical experience with high performance houses, these houses have a dominant share in the market of new residential buildings.

A survey among CA EPBD representatives showed that the ratio of high performance buildings is lower in southern MS than in middle and northern Europe. In order to study effective measures for countries with warm climate, the following topics were discussed, based on the experience in Southern France:

> the setting of minimum EP requirements, and the national application of the NZEB definition in warm climates;
> strategies and technologies that help to achieve NZEB in warm climates;
> practical experience with high performance buildings in warm climates.

The experience in France led to NZEB requirements being a combination of EP and comfort: primary energy use, bioclimatic indicator (relating heating, cooling and artificial lighting demand) and indoor temperature accounting for the intensity of discomfort. The technologies most used in order to reduce the cooling energy demand are:

> night ventilation;
> ground coupled heat exchanger for ventilation;
> mobile or fixed shading devices and structures (including verandas);
> ventilation systems with summer mode (bypass of heat exchanger);
> reversible heat pumps.

According to practical experience, the following conclusions can be drawn:

> The use of night ventilation and shading are the most important passive cooling strategies.
> Thermal mass can only be used effectively in climates with significant differences between day and night outdoor air temperatures.

Additional experience by other warm climate countries is:

> Ground coupled heat exchanger for ventilation (earth cooling tubes) work well in, e.g., Portugal and Greece.
> Insulation is effective in warm climates, as it can reduce both the heating and cooling energy need.

In countries with a warm climate, a combination of Nearly Zero-Energy Building requirements for the Energy Performance and comfort criteria might be advisable. The essential issue is to create indoor conditions that allow occupants to feel comfortable without air-conditioning during the warm periods.

4. Main outcomes of 'Towards 2020 – Nearly Zero-Energy Buildings'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. National applications of the Nearly Zero-Energy Buildings (NZEB) definition.	In March 2013, six Member States (MS) had their national application of the NZEB definition legally fixed. Another six MS had their applications ready but not yet published in a legal document.	The already fixed national applications differ significantly in the included energy aspects, the balancing time steps, the accounted Renewable Energy Sources (RES) and the number of used indicators.	The national plans for increasing the number of NZEBs should contain detailed information on the national applications of the definition of NZEBs.
2. Boundary conditions for the assessment of RES in national calculation methods.	There are different approaches for taking into account renewable energy contributions.	Renewable energy contributions from daylight, heat recovery, heat pumps and passive solar energy should be included in the required share of RES.	There is a need for further national work and CEN work on how to account renewable energy and how to express passive contributions.
3. Convergence between the concepts of NZEB and cost-optimal Energy Performance (EP) requirements.	There are uncertainties in predicting factors like energy prices, component costs and technical innovations.	One country reported that it has used the study on the evolving factors to fix its national application of the NZEB definition. Other countries might follow.	The topic needs to be revisited in the future, when all MS have experience from the calculation of the cost-optimal application.
4. Public buildings as leading examples towards NZEB.	Several countries use public buildings as lighthouses for the general development of high performance buildings.	A list of instruments to support the use of public buildings as leading examples towards NZEBs was compiled.	Financial support programmes for community buildings are important in the future (e.g., for NZEB retrofit).
5. Practical experiences with nearly zero-energy dwellings.	In some MS, there is a significant difference between the predicted and the measured EP.	In MS with a dominant share of high performance buildings in the market of new residential buildings, fewer failures are reported.	The workforce needs to be trained for installing certain more advanced technologies (BUILD UP Skills).
6. NZEB strategies in warm climate countries.	Successful technologies for reducing the cooling energy use include night ventilation, ground heat exchangers, good shading and heat pumps.	In countries with warm climate, a combination of NZEB requirements for the Energy Performance and comfort criteria might be advisable.	Further information exchange on successful technologies and their costs is needed.

5. Lessons learned and recommendations

With many details in the national applications of the Nearly Zero-Energy Buildings (NZEB) definition still under development, the information exchange in the Concerted Action (CA) on the Energy Performance of Buildings Directive (EPBD) platform is very helpful for the Member States' (MS) delegates.

A major problem is the meeting point between the NZEB definition and the cost-optimal Energy Performance (EP) requirements. Several major parameters cannot be easily predicted for the coming 6-8 years, such as future performances of new and further developed technologies, future primary energy factors (mainly for electricity, as well as for district heating and cooling), due to changes in the infrastructure, cost developments of technologies, energy carriers, labour and planning, as well as boundaries like changing climate and lifestyle.

Thus, the national applications of the NZEB definition need to show a clear direction, but the exact values might have to be adjusted by the MS at a later stage, when costs and the other mentioned influencing factors become more predictable. However, a clear indication of the tightening range (e.g., 30-50% better EP compared to the current requirements) is necessary for the building industry, investors and planners, in order to stimulate technology innovations and developments.

Pilot and demonstration projects of NZEB have been realised in the MS, and promotion and subsidy programmes support their market implementation. Despite the current financial crisis in Europe, these kinds of projects and programmes should be continued and extended to all European countries. Experience in some MS shows that the state investment in financial incentive programmes is a win-win situation, because of the payback by the increased number of jobs and taxes.

Compliance and Control

OVERVIEW AND OUTCOMES

NOVEMBER 2012

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1. General Information

The Concerted Action EPBD (CA EPBD) is a joint initiative of the European Commission and EU Member States (MS) to assist national implementation of the EU legislation on the energy performance of buildings. It involves national authorities or their appointed representatives, and helps to identify shared solutions to common challenges.

The Directive 2010/31/EU on the Energy Performance of Buildings, hereafter called the 'recast EPBD', lays an emphasis on compliance and control as vital elements for its successful implementation. This report contains information, statistics, outcomes and conclusions from the dialogue on national approaches to compliance and control, gathered in the years 2011-2012. During this period, three large meetings were organised, each gathering more than 120 Member States representatives, with the focus being on the transposition of the recast Directive into national law.

The exchange on the topic of compliance and control encompassed, on the one hand, compliance and control regarding the energy performance requirements and the certificates and, on the other hand, compliance and control regarding inspections. The topic was addressed in 12 dedicated sessions to the discussion and analysis of the findings from questionnaires, national studies and European projects, as prepared by working groups in the period between meetings.

2. Objectives

The EPBD introduced two new obligations to improve the quality of its implementation:

> MS shall lay down the rules on penalties applicable to infringements of the national provisions adopted pursuant to the Directive (art. 27).

> MS shall implement an independent control system for the certificates and for the reports on the inspections (art. 18). The requirements for the control system are specified in the Annex II of the recast EPBD.

Experience during the last years showed that regulation without enforcement leads to lack of compliance, while the existence of penalties increases compliance with the regulations. The examination of compliance and control during 2007-2010 revealed that many of the MS did not have a clear view on compliance rates, and that only a few of them had considerable experience of a running quality control system. Still, there are very few MS that have statistics on compliance, but, from the available information, the level of implementation (number of issued certificates, quality of certificates, changes in the energy performance of the building stock) seems to be correlated with the enforcement strategy, although there is not yet enough data for conclusive proof.

Not only the check of compliance, but also the control on the quality of the issued certificates and inspections is essential to exploit the opportunities arising from the EPBD in the best way, to have high credibility in the market and to capitalise the potential benefits.

Addressing compliance and control, the aim is:

> To detect the best enforcement strategies and control systems among the MS that have both a high compliance rate, as well as an effective Quality Assurance (QA) system in place, with the aim of providing guidance to MS that are implementing or re-evaluating their compliance and control system.
> To share success factors for high compliance and high quality, as well as smart enforcement strategies.
> To discuss the management of quality control and sanctioning systems.
> To share practical experience.
> To discuss how the results of quality controls and sanctions can be fed into the global certification, requirement or inspection system.
> To monitor the outcomes and results of the implementation among the MS of either option a) or b) of article 8 of the Directive 2002/91/EC.

3. Activities under 'Compliance and Control'

3.1 The status of compliance checking & quality control for energy performance requirements, the certificate, and inspection reports

A status overview regarding compliance and control was carried out in April 2011. At that time, most countries still had to adapt their regulations in order to implement the recast EPBD, as the deadline for the transposition was the 9th of July 2012. Twenty two MS participated in the survey. The status in the other countries is unknown.

3.1.1 Compliance with the energy performance requirements

Each of the 22 MS had in its regulations a provision for checking the compliance of new and renovated buildings with the energy performance requirements. Compliance with the requirements was actually checked in almost every country. Sanctions were applied in more than half of the countries. In the majority of the countries, on-site controls were foreseen.

Cultural differences among the Member States regarding compliance were revealed: some apply strict sanctions, while another group emphasises on support rather than on penalties.

3.1.2 Compliance checks for the certificate

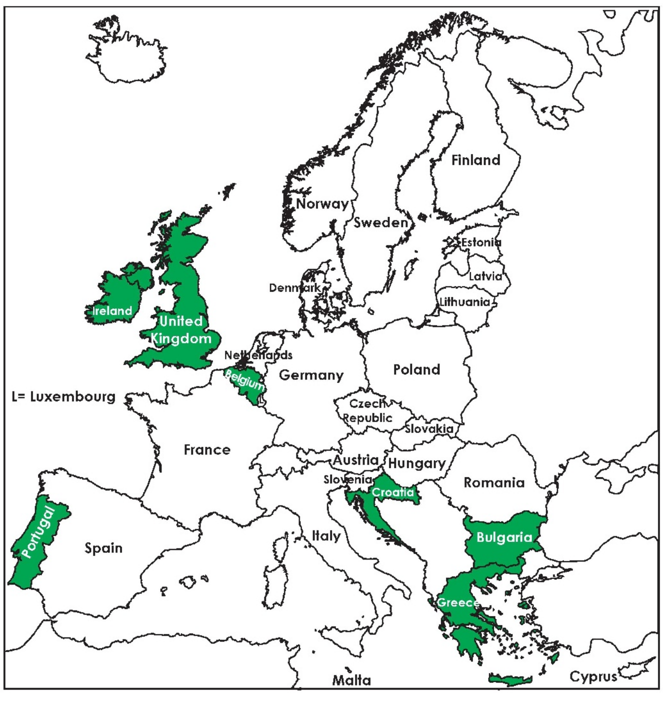
Sixty percent of the MS had in their regulations a provision for checking the compliance in regard to the existence of the certificate at the moment of a selling/renting out transaction (see Figure 1). However, in practice, the existence of the certificate was checked in only 1/3 of the countries (see Figure 2). Sanctions for not having a certificate were only applied in 5 of the 22 countries.

3.1.3 Independent control system

Sixty percent of the countries foresee in their regulations a quality check of the calculation (for new and existing

Figure 1: Countries with provisions for control of presence of the certificate at the moment of the sale/renting transaction in their 2011 regulations.

Figure 2: Countries actually checking the presence of certificates at the moment of the sale/renting transaction in 2011.



buildings). In these countries, this check is almost always implemented in practice, both for new and for existing building certificates. All these countries can perform on-site controls as part of the quality check, but there is only evidence from 12 countries that they actually have carried out such checks.

Even if compliance and control are part of the regulation in many Member States, it is too often a theoretical option that is not applied in practice.

3.1.4 Control systems for inspection

There are three approaches concerning independent control systems for inspections: i) one managed by the public bodies (e.g., by regions in Italy, or by the State in smaller countries); ii) one managed by authorised local service providers (e.g., chimney sweepers in Germany); and iii) one provided by private certification companies (e.g., UK and France for air-conditioning (AC) inspections). Several MS are slowly moving towards the latter option, in order to reduce costs for the public budget and use skilled staff for compliance controls. In most cases, the experience regarding the practical implementation of control systems is still limited, and there is no quantitative information about the degree of compliance. Even in a country like Italy, with 20 years of experience in boiler inspections, the control system evidence is limited to the exclusion of a couple of inspecting companies, subcontracted by some provinces, for misconduct. In the chimney sweepers system, compliance is based on the control exerted by the master, who owns the exclusive rights in a certain area, on his assistants.

3.2. Sanctions for non-compliance or low quality certificates and inspection reports

The art. 27 of the recast EPBD states that penalties or sanctions should be effective, proportionate and dissuasive. All MS agree that penalties are definitely needed in serious cases, because there is the risk of fraud regarding the Energy Performance Certificates (EPCs), as they have an impact on the market value of the building. Sanctions can be foreseen both for building owners and for experts. The fines are the most common sanctions, followed by loss of licence or accreditation. Figure 3 presents the sanctions included in the regulations of 14 countries.

Fines and loss of accreditation are the most common sanctions.

3.2.1 Sanctioning system

Penalties should be used as a reaction to severe neglect by the building owner, or to untruthful reporting of the real energy performance, or any other severe lack of compliance by the expert. The penalties should be severe enough, in order to avoid this behaviour. The penalties process should be clear and simple, both for the administration handling the system and for building owners and experts.

The integration of preventive mechanisms into the system is seen as best practice for the limitation of possible errors (e.g., automatic control integrated into the software).

3.2.2 Effectiveness of sanctions

In case of absence of certificates, two types of penalties are seen as effective to be imposed on the owners. The first type concerns financial penalties or fines. The

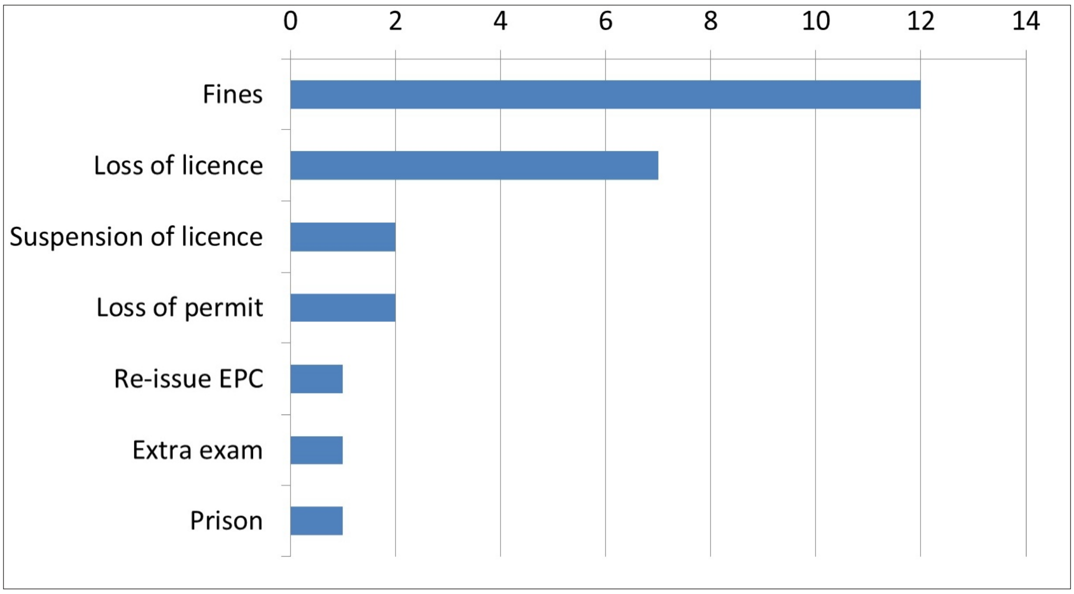


Figure 3: Type of sanctions foreseen for qualified experts in 14 MS regulation.

second type concerns the prohibition to build or use a building, or to sell or rent it.

Two types of penalties are seen as effective to be imposed on the expert in case of bad quality certificates. The first type concerns financial penalties, e.g., a fine or the obligation to reissue the EPC. The second type affects the accreditation of the expert, e.g., loss of licence, warnings or remarks, repeated training or examination. Extra audits and negative publicity are the other options.

For inspections, the most common type of sanction is the cancellation of an inspector's accreditation in the event of malpractice.

3.2.3 Proportionate sanctions

For a sanctioning system to be proportionate, flexibility is important. For building owners, the sanction can be proportionate with the size or the value of the building. For experts, the sanction can be proportionate with the effects of the mistakes on the result (severe neglect or limited error), with the cost of the EPC or with the energy efficiency class of the building. Increasing the severity of penalties is also used in order to have proportionate sanctions for the expert. This can be done, e.g., by a penalty point system or by ‘unlocking’ certain sanctions (loss of licence) only after several fines or warnings. A small group discussion on what the right sanction is for what type of mistakes resulted in the following guidance:

- > to guide the experts whose mistakes are not made on purpose;
- > to warn in case of minor mistakes (<5% deviation);
- > to sanction in case of major mistakes;
- > to check other certificates of experts that make mistakes;
- > to suspend only in severe and repeated cases: the impact of suspension is large.

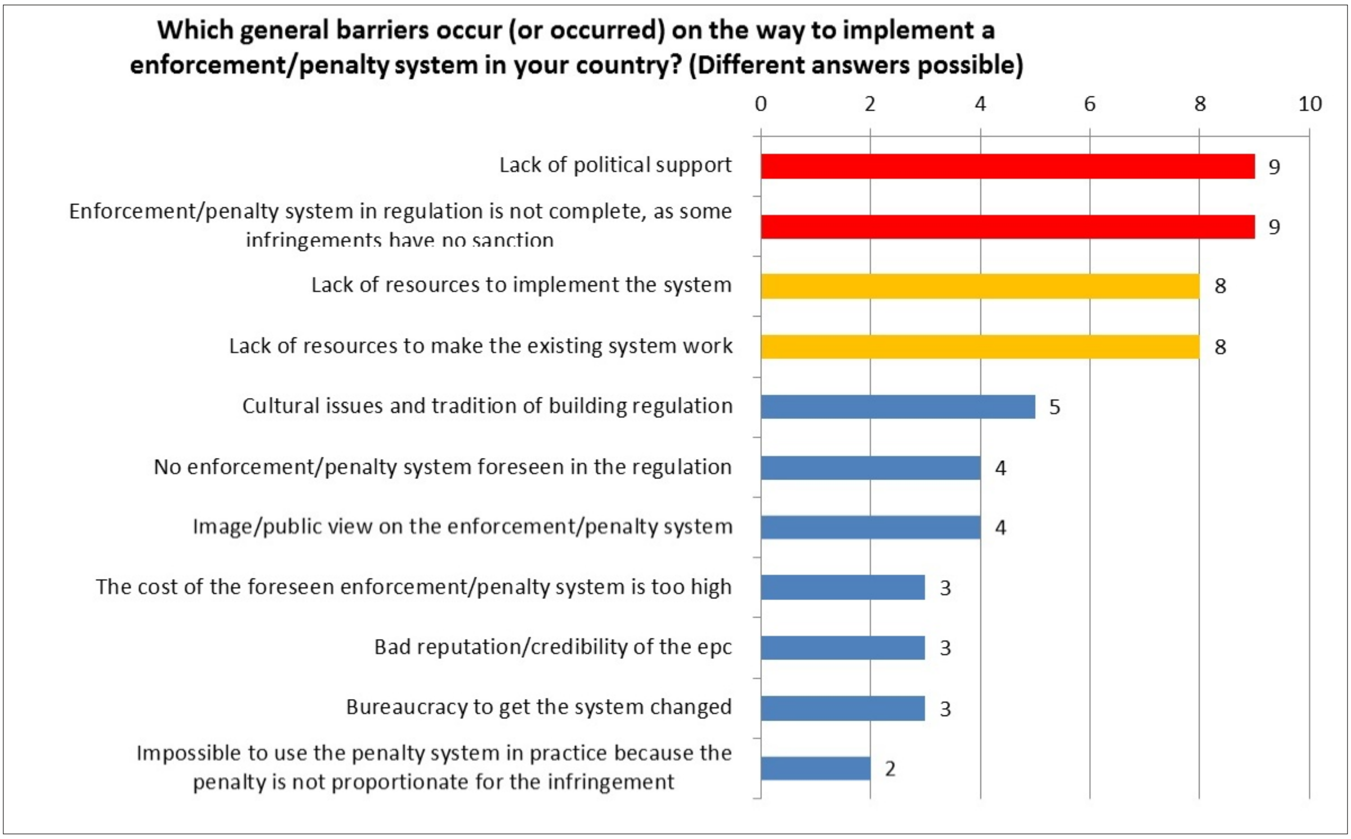
3.3. Barriers to implement enforcement in practice

In many countries, enforcement strategies and quality control are difficult to implement in practice. There are barriers both on governmental and on market level. There are quite a few large barriers, but also a combination of smaller barriers can challenge an effective compliance system in practice. The main barriers for applying enforcement strategies to inspection is the cost for the public administration, the lack of clear enforcement powers within the administrations, and the still low number of inspections carried out so far.

3.3.1 Inventory of barriers

An overview of possible barriers can be found in Figure 4. Only 3 countries reported that there had been no major barriers. The

Figure 4: General barriers that occur(ed) on the way to implement an enforcement system in the MS.



current economical situation makes it difficult to allocate resources to enforcement and quality control, even in countries where a compliance and quality control scheme is running.

Many countries face similar barriers in the implementation of a compliance and quality control scheme. Political support, good management and smart financing of the scheme are the keys to success.

3.3.2 Overcoming barriers

Some MS have successfully overcome barriers to implement enforcement and quality control. Political support is one of the first keys to success. Smart and continuous financing (e.g., expert licence fee or fee for each certificate) and good management of the schemes are also necessary. Other key elements may be:

> consumer awareness about the value of the EPC and their rights;
> linking financial support mechanisms to the requirement to have an EPC: the enforcement is then a control mechanism on efficient expenditure of public money;
> setting up procedures for citizens complaint as an initiator for control/for stimulating control.

A good quality of the Energy Performance Certificate is needed to gain public trust.

3.4. Independent control systems

Quality control is the process with which the quality of an individual EPC (for a new or for an existing building) or an inspection report is checked by an assessor. Article 18 and Annex II of the EPBD recast set the requirements regarding the mandatory quality control scheme.

The MS presented 20 different quality control schemes used in their countries in June 2012 (see Table 1). The discussions that followed gave to the MS the opportunity to exchange experiences and best practices, and to identify conclusions and recommendations on these issues.

The issues that should be considered when setting up a control system are described next.

A central database with a large set of information is fundamental for a quality control scheme. It provides to the quality assessor quick access to all certificates, and makes cross-checks possible.

3.4.1 Independency of the control system

The control body has to be independent from the person issuing the EPC or carrying out the inspection. The government, or a third party controlled by the government, can run the control system. Control organisms should not issue EPCs or inspection reports.

Guidelines on how to perform a quality control should be available, in order to get a uniform approach of the control conducted by different assessors.

3.4.2 How to deploy a quality control system

Commitment of the national body, as well as funding, are necessary conditions in order to set up an effective quality control system. The responsibilities of the quality assessors should be described. It is consensual that a good practice requires establishing in advance clear procedures for control and sanctions, approved by lawyers. Standard templates for checking reports and letters will help assessors to make a quick start. MS can use cross-checks between different input values of the EPC to detect strange or out-of range values. Comparisons with other databases can also give valuable information.

3.4.3 Organisation of the quality control

In most cases, the running quality control systems distinguish more than one type of audit (Figure 5).

On-site checks are the least used, as they are the most difficult to perform. Different types of audit are often used in a particular sequence: more detailed audits are

Table 1: Overview of the posters on quality control processes that were presented in Athens, June 2012.

	QC system refers to			
Member state	**EPC new & ren**	**EPC existing**	**boiler inspection**	**AC inspection**
Austria	x			
Belgium	x	x		
Cyprus	x			
France	x	x		x
Germany	x	x		
Greece	x	x		
Ireland		x		
Italy			x	
Latvia		x		
Lithuania	x			
Luxembourg	x			
Portugal	x	x		
Slovenia	x	x		
The Netherlands		x		
UK				

performed if the first check reveals problems. According to the experience of various MS, a central database is a powerful tool to facilitate the quality control, but the cost for its setup and maintenance is non-negligible.

3.4.4 Which EPC or inspection report to check?

The control process should be transparent, allowing experts to comprehend the type, level and procedure of the controls. There are two views on the organisation of the control system. The first assumes that every EPC or inspection report should have the same possibility to be checked. The focus is on controlling the documents only, and not the experts. The second focuses on the control of the experts: every expert has the same possibility to be checked. As some experts are very active, it makes sense to have a strategy of controlling them. Figure 6 gives an overview of different ways to select an EPC for control.

3.4.5. What to check in inspection reports?

A survey for the assessment of the relevance of controlling different items in the inspection report revealed that the control system should evaluate not only the heating/AC system information, the accuracy and the relevance of the recommendations, but also the completeness of the report and the independent nature of the recommendations.

Figure 5: The use of different types of quality control audit.

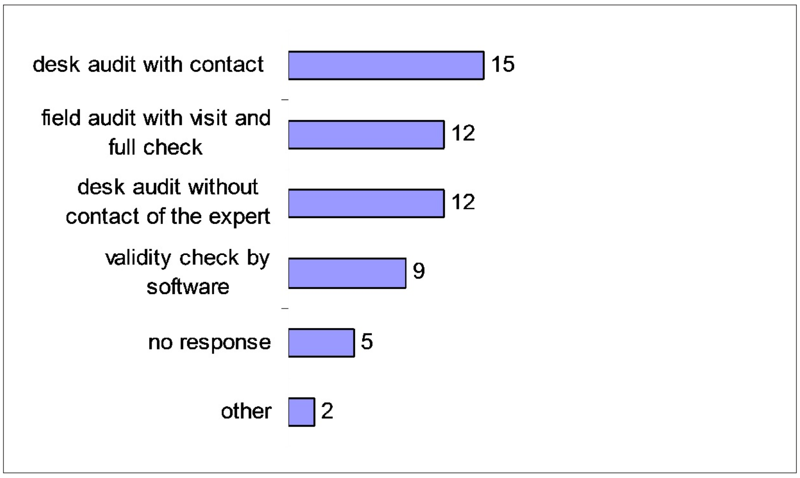


Figure 6: The selection of an EPC for quality control.

3.4.6. What to inspect on-site with the aim of quality control?

The on-site control by the quality assessor with the aim to check the quality of an EPC or an isnpection report is an effective way to identify false declarations. A discussion among the MS representatives produced the following recommendations:

- On-site controls during the building phase should focus on elements that cannot be controlled or changed easily afterwards (e.g., insulation).
- Visiting the new building when completed is often more effective, as more elements can be checked.
- On-site control should focus on those points which have large impact, such as insulation, and heating or cooling installation, rather than on the type or size of the bricks.

3.4.7. Automatic validation of EPCs and inspection reports

Input data validation is the first step for an efficient quality control system. It helps to improve the quality of an individual EPC or inspection report, and to produce unbiased recommendations. Professionals already working on a specific building (e.g., Operations & Maintenance personnel) could be involved in the EPC and boiler/AC inspection procedures by providing reliable input data in a cost-effective way.

Automatic validation reduces the workload of the assessors and prevents sanctions for mistakes that can be easily avoided. It is a first and easy level of check, right at the calculation or reporting stage.

3.4.8. Outcomes of the quality control

The results of a quality control are used to evaluate and sanction the expert, if necessary. Documentation of all the control steps is needed in order to do so. The communication of the results to the expert should be accomplished as quickly as possible, and should contain clear and precise information on the reasons and sanctions. The possibility for an oral hearing can be useful in the sanctioning process. The control body should communicate the control procedures, or any changes to it, to all assessors, in a transparent and clear manner.

It is also important to use the outcome of the quality checks to improve the certification and inspection schemes. In that way, the reputation of the EPC/inspections and the repeatability are improved and the number of compliant reports can increase.

3.5. Quality assurance

Quality Assurance (QA) is the set of actions implemented in the EPC or inspection scheme (training – methodology - software – inspection protocol – delivery – checking the assessor, etc.) to get high quality results and to guarantee or improve the reputation of the scheme.

The role of the building owners should not be underestimated: if they demand quality, there is a strong motivation for better EPC quality. Member States that implemented a QA strategy report that it facilitates effectively the improvement of the whole certification system.

3.5.1 Plan-Do-Check-Act

Plan – Do – Check – Act (PDCA) is a four-step management method used to control and continuously improve processes and products (see Figure 7). It is often used in quality management. This methodology is an example of how to add the quality assurance aspect in a process.

Quality Assurance (QA) is a key element for the high quality and good reputation of the scheme. Plan-Do-Check-Act is an example of how to integrate QA into the certification or inspection scheme.

3.5.2 How to improve the EPC scheme?

A list of possible QA mechanisms was compiled in June 2012. The following topics are seen as the most promising when an improvement of the EPC scheme is needed in the field of compliance checking or control:

> dialogue with key market actors;
> automatisation of statistical sample checks, out of range (or outlier) EPC value detection, and cross-checking among detailed information;
> standardised process to perform quality control checks;
> involve and inform owners about price setting and levels of quality;
> campaign to encourage the EPC market control.

3.5.3 How to improve an inspection scheme

Some good examples come from the privately driven schemes of QA for inspections. One AC inspection scheme (UK) includes training and qualification of inspectors, their accreditation, production of handbooks for inspection and standard reporting formats, management of complaints, check of a random sample of inspection reports—where the size of the sample varies for new or experienced inspectors—together with an additional number of checks when some failure appears.

In another example (France), at least 2 reports/year and one on-site control is provided during the time span of the accreditation of each inspector. There are many companies providing accreditation.

For publicly-managed QA systems, the focus is found to be on the qualification and selection of proper and independent inspectors, while limited attention is given to the verification of their performance. Moreover, in these cases, the final responsibility for forcing end users to apply energy efficiency or safety measures, when they fail to meet legal requirements (e.g., if the boiler is not at the efficiency level required by minimum requirements at the time it was purchased), rests with the local administration. Conversely, where chimney sweepers operate as inspectors, the 'master' chimney sweeper has the responsibility for performance verification; the recent introduction of competition in the periodical assignment of an area to a master chimney sweeper could introduce some form of public control.

In one case of voluntary inspection system (in The Netherlands), a compulsory check-up list, with automatic generation of advice, was developed as a useful enforcement tool to guarantee independence.

It is a good practice to use the results of individual quality control assessments not only to give feedback to the assessor, but also to feed the quality assurance strategy.

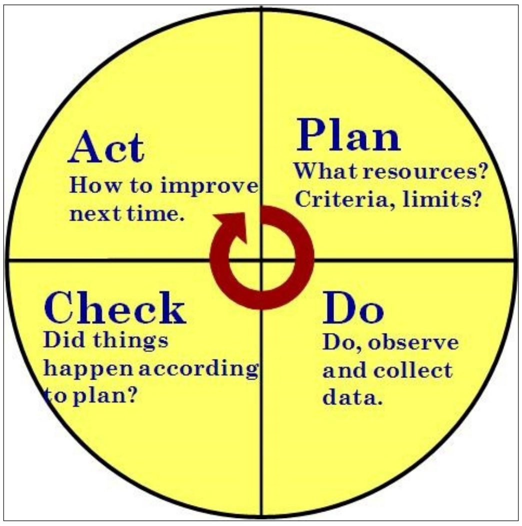


Figure 7: PDCA wheel. [1]

1 Source: *www.bizmanualz.com/information/2011/06/07/how-are-pdca-cycles-used-inside-iso-9001.html*

4. Main outcomes of 'Compliance and Control'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Status of checking compliance of constructed buildings with the regulations in Member States (MS)	In 2011, many MS had still to adapt their regulations to require that buildings actually complied with the regulations in line with the EPBD recast.	All MS realise the importance of compliance checking. Cultural differences explained the observed differences between MS regulations.	Analyse ways to overcome barriers to enforcement (see hereunder).
2. Overcoming barriers to run an enforcement system	Different types of barriers to run an enforcement system and impose penalties were identified by the MS. Similar problems exist in most countries.	Ideas and examples of countries having solved difficult barriers (e.g., lack of resources) exist.	Barriers are very different among the MS. MS that are faced with barriers can use the experience of other MS that overcame a similar barrier.
3. Control system: Effective, proportionate and dissuasive sanctions	MS agree about the way sanctions should be included in control systems. Effective experience is available. The way sanctions are integrated into the legal framework depends on the national context.	The control system should limit possible errors, via automatic control in software. Penalties should be used as a reaction to severe neglect/non-compliance or bad quality. The penalty system should be clear and simple.	Monitoring of the sanctions is needed to evaluate if they are indeed effective and dissuasive.
4. Setting-up an independent control system	The MS established a list of criteria for an independent control system. The way the control system is organised can be very different. Twenty examples of control system processes are available.	Generic principles and different options for a control system were defined. The implementation of control systems in the MS is well advanced. Criteria to guarantee the independency have been identified.	The MS can adopt their control system from among the available best practices in place in other MS.
5. Control on inspection reports	Control criteria on inspection reports were identified and discussed.	Control operations should provide information about report compliance, independency of inspectors, completeness of report, and independent nature of recommendations.	Studying examples of automatic checks of report filling.
6. Automatic validation	Automatic validation can help to improve compliance and to provide independent recommendations.	There are tools that automatically generate advice on the basis of the filled-in checklists. Some mistakes can be prevented.	Future developments of the illustrated validation systems.
7. Output of quality control	Evaluation and sanctioning of the expert are based on the control. All steps should be documented. Use the outcomes not only for single experts, but also to improve the quality of the EPC scheme.	Quick and clear communication to the expert about control results and possible sanctions is desirable.	Exchange experience in how to ameliorate communication with experts.
8. Quality Assurance (QA) mechanisms for Energy Performance Certificates (EPC)	The different steps to be considered in QA mechanisms aiming to guarantee qualitative EPCs have been identified.	QA mechanisms are tools that guarantee the quality of EPCs. Based on the Plan-Do-Act-Check methodology, MS can identify weak elements in the chain and improve them.	By integrating the different steps of the chain into this mechanism, the MS are able to improve the quality of their running systems.

5. Lessons learned and recommendations

Effective compliance and control systems are the key elements making Member States (MS) regulations effective in practice or not.

Most MS needed to integrate or implement compliance, as well as a control system, at national level in 2011. By 2012, fourteen were setting up a control system or had already one running for at least one of the three aspects: certification, minimum requirements, or inspections. This practical experience in some MS can serve as inspiration for others.

There is a common understanding among MS of the principles of effective, dissuasive and proportionate sanctions. Financial penalties and others affecting the accreditation of the expert are seen as the most effective sanctions. Flexibility in the sanctioning system is important for proportionate sanctions. The sanction can e.g., be proportionate with the size or the value of the building. Penalties should be used as a reaction to severe neglect, non-compliance, or bad quality. Monitoring is needed to evaluate if sanctions are indeed effective and dissuasive in practice. Such monitoring results are not yet available.

Experience with running quality control systems showed that a central database, an automatic validation and a well defined sequence between different types of audit are keys to success. The outcome of the quality control should not only be used to improve an individual Energy Performance Certificate (EPC) or inspection, but also to improve the whole certification or inspection scheme.

There are very few experiences on inspection quality assurance and control systems. The available information is limited to four countries implementing the chimney sweepers system for boiler inspections, two countries having introduced privately driven certifying systems for air-conditioning (AC) inspections, and two countries having established a control of the local or State authority on the selection and verification of compliance of inspectors (AC or boilers). Other countries have introduced voluntary inspections as a complement to the ‘option B’ offered to the MS, as an alternative to a compulsory inspection system. In this case, the control is generally lighter but, in one case, a compulsory check-up list with generation of advice was developed as a useful enforcement tool to guarantee independence.

Effectiveness of Support Initiatives

OVERVIEW AND OUTCOMES

NOVEMBER 2012

Authors

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1. General information

This report summarises the main outcomes of the Concerted Action (CA) on the Energy Performance of Buildings Directive (EPBD) sessions devoted to the topic of 'Effectiveness of Support Initiatives' for EPBD implementation during 2011-2012, including conclusions and indications about future directions. It excludes a number of topics relating to certification and training, which are addressed in other chapters.

Discussions on this topic have been approached at a strategic level, aimed at developing and assessing information and options pertinent to the obligations of Member States' (MS) authorities under the EPBD. The majority of CA EPBD participants had a prior general knowledge of financial incentives and the provision of information about improving energy efficiency. The overall progression of this work has been towards ensuring the impact of the EPBD and EPBD recast as an effective instrument of change in the building construction marketplace.

2. Objectives

With the adoption of the EPBD recast in 2010, EU MS faced tough new challenges. There are many barriers to be addressed in tackling the transformation of the building stock - technology, skills, economic, informational, financial, organisational, marketing. Within this arena, the focus of 'Effectiveness of Support Initiatives' is on tackling the financial and informational barriers to energy efficiency action by informing building owners, investors and users. Its specific remit is to assist the implementation of articles 10 and 20 of the EPBD recast.

Article 10 is concerned with financial incentives and market barriers, and includes a first reporting requirement by MS to the European Commission by the 30th of June 2011, with updating every three years thereafter. Articles 10(4) and 10(5) relate to the Commission's complementary obligation to assist MS in setting up financial support programmes, and to analyse the effectiveness of the national supports listed in National Energy Efficiency Action Plans (NEEAP).[1]

Article 20 relates to the provision of information. Owners and tenants of buildings shall be provided with information on the different methods and practices for improving energy performance. MS shall make guidance and training available to those responsible for implementation. Obligations are also placed upon the Commission in relation to improved information services, including promotion of available financial instruments.

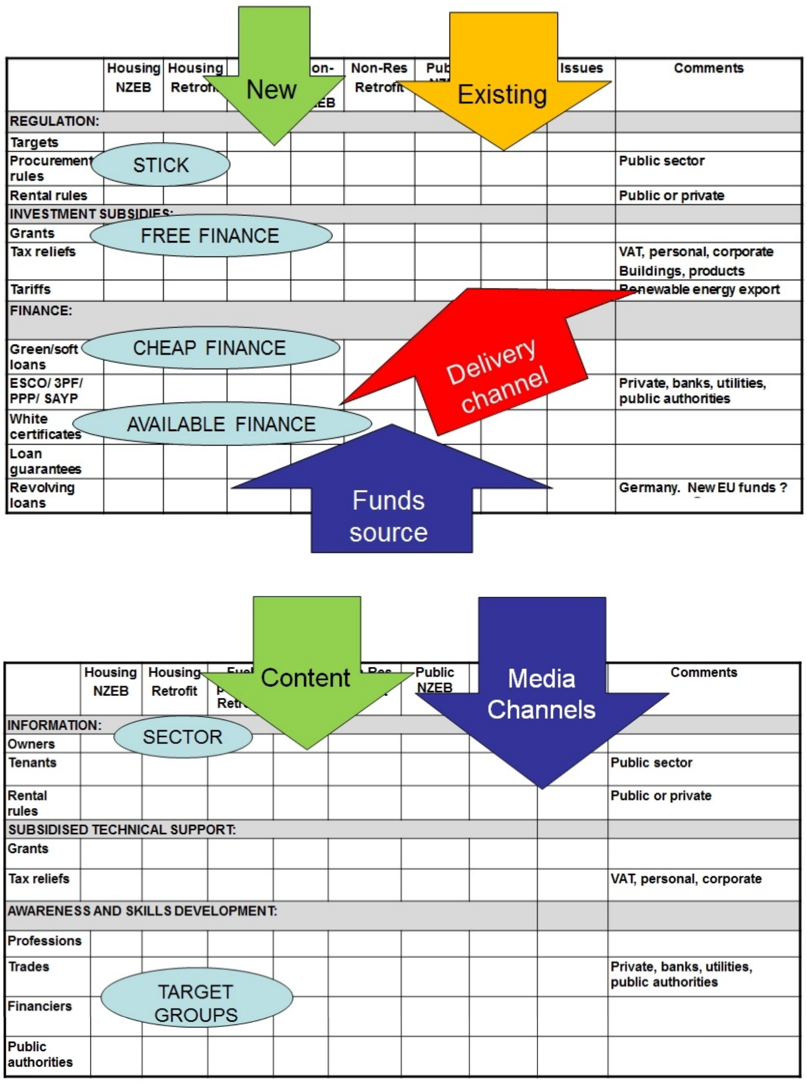
1 An EU Commission report on financial supports, published in April 2013, can be viewed on *ec.europa.eu/energy/efficiency/buildings/buildings_en.htm*

Dialogue amongst CA members on the aforementioned articles aims to identify and explore the array of financial and informational instruments available within the EU and assess their effectiveness, thus helping to inform national authorities in considering policy options within their jurisdictions. It also aims to raise awareness among CA participants of areas of potential synergy in transposition and implementation between EPBD/EPBD recast and the Energy Efficiency Directive (EED) and the Renewable Energy Sources Directive (RESD).

3. Activities under 'Effectiveness of Support Initiatives'

Reflecting the primary requirements in articles 10 and 20 of the EPBD recast, in the period 2011-2012 activities were planned around two groupings –financial instruments and information actions. Financial topics and issues include:

Figure 1: Overview matrices of financial and informational initiatives.



> public private partnerships;
> EU-level and MS/regional scale funding –including revenue raising mechanisms and targets;
> grant assistance for specific or advanced levels of energy performance in retrofit or new buildings;
> subsidised loan schemes, loan guarantee schemes, green mortgages;
> Energy Service COmpanies (ESCOs) as funding mechanisms for improving the energy efficiency of the public sector.

All MS have experience in delivering information campaigns. Topics that were explored here include:

> leveraging follow-through information support and investment action in retrofit linked to building energy certification;
> success stories from MS in effective information transmission and lessons learned;
> establishing and promoting registers of product and service providers.

A summary is now given of the outcomes from each of the following topics addressed during the period 2011-2012:

1. Mapping of available support initiatives.
2. MS position on implementing articles 10 and 20 of the EPBD recast.
3. Baselines and monitoring for financial and policy instruments.
4. Energy Service COmpanies (ESCOs) in public and commercial sectors.
5. Leveraging energy performance with financial instruments.
6. Interactions and synergies with the EED and the RESD.
7. Mobilising complementary EU financial instruments.

3.1 Mapping of available support initiatives

A strategic overview of both financial and informational support initiatives was a first step towards categorising and prioritising the work on the topic of effectiveness of support initiatives and is summarised in Figure 1.

Support initiatives can be divided into 5 categories, with strong opportunities (and need) for combined actions across multiple actors:

> initiatives from financial institutions;
> initiatives from suppliers of energy efficient goods;
> initiatives from real estate agents,

social housing companies or building companies;
> information initiatives that improve the knowledge on the Energy Performance Certificate (EPC);
> governmental initiatives.

The effectiveness of incentives depends on: having a clear target group, design and adminstration of the instrument, accompanying actions (e.g., information), and particularly on having available matching capital for building owners to invest.

Questionnaire responses from MS are summarised in Figures 2 to 5, indicating that subsidies/grants, EU funding and soft loans are perceived to be the most significant current and future types of financial instruments.

However, due to the economic climate in Europe, with governments having little capital for financial incentives, it is important to seek alternatives.

A key practical issue is whether effectiveness is measured in the speed of take-up in renovation activity or in actual evidenced lower energy consumption.

3.2 Member States' position on implementing articles 10 & 20 of the EPBD recast

Intelligence was sought on the state of progress among MS regarding the promotional, reporting and activation obligations of implementing article 10 (concerned with the financial incentives and market barriers) and 20 (relating to the provision of information) of the EPBD recast. As shown in Figure 6, grants and soft loans are the leading financial instruments for residential and commercial buildings, whereas for public buildings ESCOs/third party finance initiatives are leading, closely followed by grants/subsidies.

Regarding information for the general public and building professionals, the leading new initiatives planned by MS are to improve the promotion and quality of existing certification schemes, and the promotion of Nearly Zero-Energy Buildings (NZEB). As suggested in Figure 7, the main area of new guidance and training planned by MS is in the optimal combination of improvements in energy efficiency.

Figure 2: Relationship of financial instruments to the EPBD.

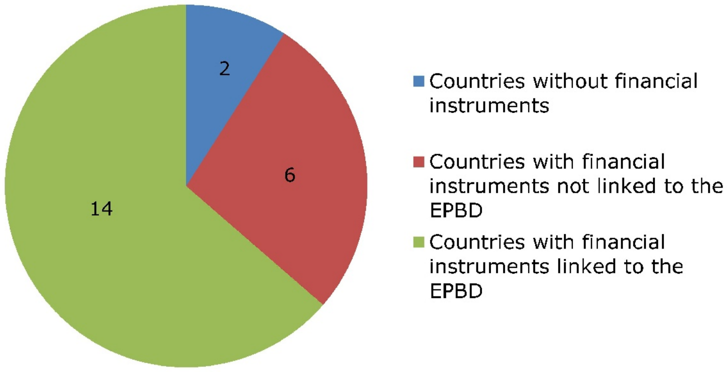


Figure 3: Distribution of categories of financial instruments across MS.

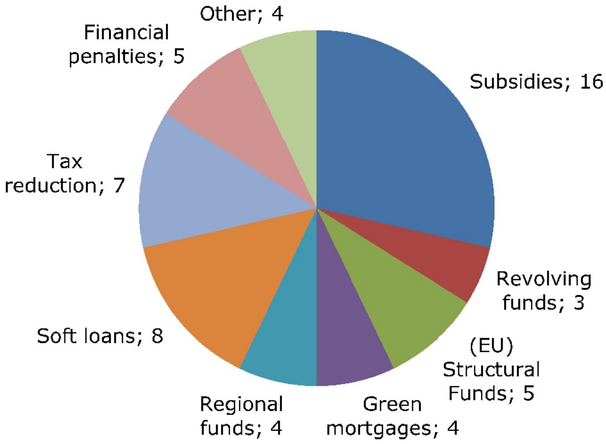


Figure 4: Ranking of perceived effectiveness of financial instruments.

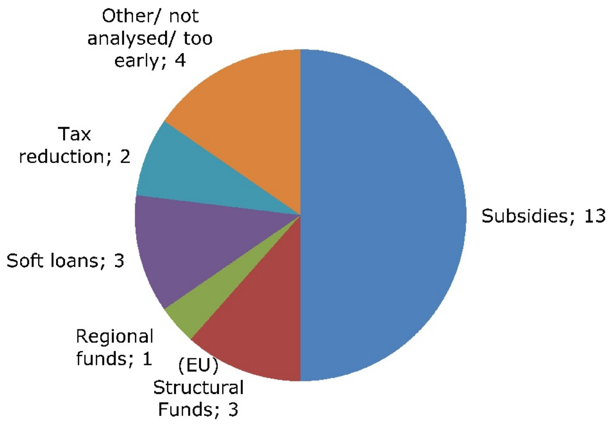


Figure 5: Perceived future relative importance of financial instruments.

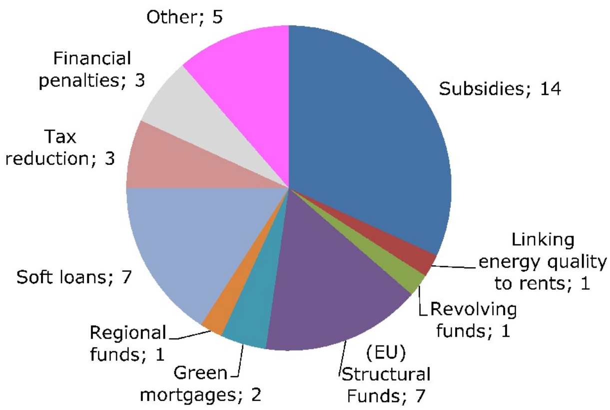


Figure 6: MS views on the most important financial instruments by building type.

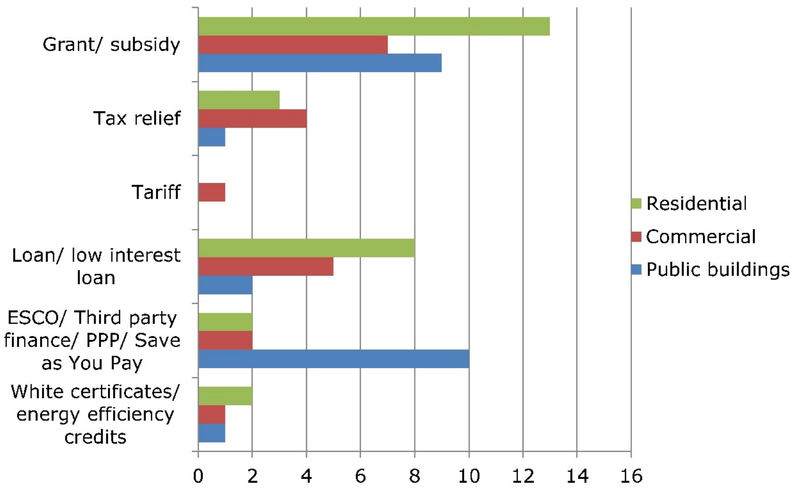
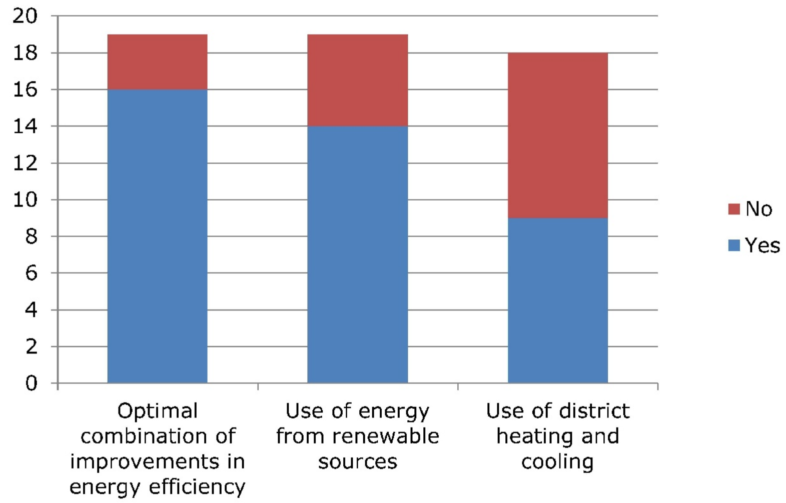


Figure 7: Member States preferences on areas of new guidance and training initiatives.



The consensus was that authorities in MS need to focus on three related challenges:

> National authorities and the professional community of building energy experts need to engage positively in partnership with the financial community, using the frameworks and language of that community.
> In tandem, the financial community needs to be educated and persuaded on the benefits of investing in energy efficiency, and the energy expert community needs to be educated to adapt to the risk assessment and decision making frameworks of the financial community.
> Coordination between government ministries and agencies will have the advantage of improving public policy coherence and communication, and of improving the efficiency and synergy of delivery of different measures under the three directives. A 'one stop shop' type service integrating and offering a full suite of information and guidance on energy efficiency improvements for buildings may be a useful mechanism.

Energy experts need to engage, educate and persuade the financial community on the case for investing in energy efficiency in buildings. They must learn and apply the finance community's frameworks of risk, language and decision making.

3.3 Baselines and monitoring for financial and policy instruments

The importance of strong reporting has grown because of reporting requirements on emissions abatement commitments, EU energy directives and national energy policies. Table 1 (source International Energy Agency (IEA)) suggests three possible levels of evaluation that can be applied.

However, analysis by the IEA suggests that the practice of efficiency evaluation internationally (including many EU MS) is weak or superficial, merely scratching the surface of interactions among policy and programme impacts, process and market variables, and costs. Sometimes evaluation is regarded as an extra expense that detracts from other programme tasks such as performing audits or providing subsidies. Some countries undertake evaluation only to the minimum level prescribed by bilateral or multilateral fund donors. Very few have a protocol for energy efficiency evaluation followed consistently by all agencies. Moreover, evaluation and data collection capacity is critically low. However, evaluation of a project, policy or programme provides a critical feedback loop in determining the effectiveness of a scheme.

The certification and inspection programmes developed in the process of implementing the EPBD have the potential to yield a comprehensive data source on the energy performance quality of buildings. To maximise the potential of this data source, central registers of certificates and inspection reports should be equipped with querying functions to determine the effectiveness of policy interventions.

Example of EPBD data evidencing policy action: Denmark has the longest history of energy certification and profiling of the building stock. From this

Elements included	Level A Comprehensive evaluation	Level B Targeted evaluation	Level C Programme review evaluation
Quality control of programme tracking data	Review of all key data	Review selection (about half) of key data	Verify level of inputs
Analysis of programme tracking data	Ex-ante estimates	Focussed on main target(s) of the programme	
Estimate of programme costs	Different types of costs	Restricted to programme costs	Verify programme costs
	Broad range of topics	Focussed on information for baseline indicators	Indicators for targeted population

Table 1: Three ambition levels of evaluation (Source: IEA).

information, scenarios for potential energy savings in different building types and ages, plus the necessary investments, have been calculated. This has informed the government's energy saving strategy, which was implemented in 2012.

Example of EPBD data informing an incentive scheme: Ireland in 2008 launched a pilot grant scheme for home energy efficiency upgrades. Ex-post evaluation was based on 'before and after' EPC data, calibrated with EPC data modelling and assessment of energy bills from a sample of participants, to inform the final design and evaluation system of the full grant scheme.

To establish effective evaluation regimes, there is a need to build an evaluation culture so that impact, process, market and cost are built into the design and implementation of the policy instrument, matching the evaluation approach to the policy objectives and programme design, and with adequate funding for evaluation. This will allow key statistics to be accurately collected. Within this process, there is a need to establish clear methods and build the capacity to deliver the evaluation.

Incorporating effective monitoring and evaluation into a scheme or programme from concept stage (e.g., through Energy Performance Certificate registries) is vital to determine its effectiveness and value for money.

3.4 Energy Service COmpanies (ESCOs) in public and commercial sectors

ESCO markets in Europe are at diverse stages of development, so MS have much to learn from each other in supporting these markets. Some countries have many ESCOs (e.g., over 100 each in Germany, Italy and France) but most have few (less than 20) ESCOs established, complemented by engineering consultancies and technology providers offering solutions with some ESCO elements such as equipment leasing and performance guarantees. A strong market growth took place from 2007 to 2010 in Denmark, Sweden and Romania and to a lesser extent, in Spain, Italy and France. However, the most common trend across all countries has been a slow market growth.[1]

Public bodies are expected to take a lead in using the ESCO model. Prior work carried out by the Concerted Action for the Energy Services Directive indicated that in 68% of MS the ESCO market is perceived to be well developed in public administration buildings and in nearly half of MS it is also developed in hospitals and schools. In the private sector, the ESCO market is well developed in industry (57% of MS), followed by hotels and others, including large retail premises.

Financial support for ESCOs comes mostly from central government, with 44% of MS offering tax reduction and/or some form of funding to support the energy services market. Most also have legislation to

1 Energy Service Companies Market in Europe - Status Report 2010 JRC Scientific and Technical Reports *publications.jrc.ec.europa.eu/repository/handle/111111111/15108*

Figure 8: Indicative distribution of categories of financial incentives active across MS.

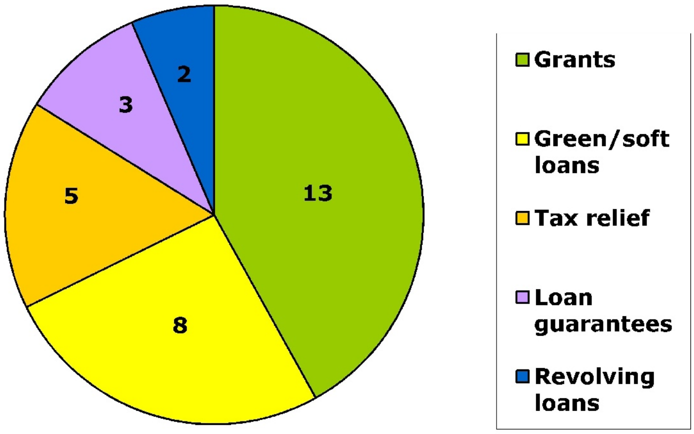


Figure 9: Indicative sectoral application of financial incentives across MS.

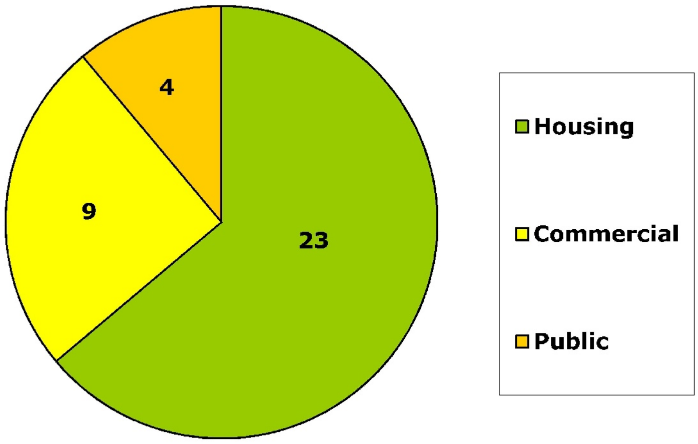
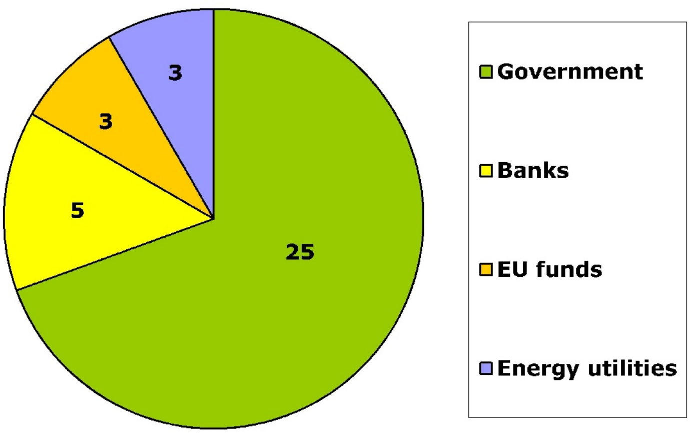


Figure 10. Indicative sources of funding across MS.



promote the market, but one third of MS have no financial support. Following central government, local government is an important source in 40% of MS, but the European Investment Bank (EIB), World Bank and UN are only important for 5% of MS.

Common barriers to ESCOs include:

> ambiguity in the legislative framework, including public procurement rules;
> low and fluctuating energy prices reducing the potential for energy savings;
> the financial crisis, making access to finance difficult;
> real and perceived business and technical risks ;
> mistrust and low awareness of the ESCO model by both customers and financing institutions.

Many Member States are still developing model contracts, opening credit lines, working with public banks and preparing calls for tender to enable competitive private investment in Energy Service COmpany services to be applied in the public sector.

3.5 Leveraging energy performance with financial instruments

This topic was restricted to financial instruments directly linked to the Energy Performance Certificate (EPC) and accompanying recommendations. The context was the need to develop and apply new financial instruments to mobilise investment by building owners in improvement actions identified through the EPC process.

Responses to a short questionnaire indicated (Figure 8) that the 37 individual financial instruments identified in MS were led by grants, followed by green/soft loans, tax reliefs, loan guarantees and revolving loans. Figure 9 indicates that these were targeted mainly at housing, followed by commercial and public sectors. Figure 10 shows that funding sources were predominantly central or regional government, followed by banks, EU funds and energy utilities.

Many schemes do not leverage from the EPC in a formal or specific way. When used, its most common role is to verify energy savings on a ‘before vs. after’ basis. Some interesting applications include a mortgage scheme and provincial subsidy scheme from The Netherlands, a Danish scheme of financing through higher rents, the French PT2+ loan scheme, the Italian tax credit scheme and the UK Green Deal programme.

The most common role of the Energy Performance Certificate (EPC) is to verify the energy savings from implementing specific measures. The EPC is not always linked to the EPC improvement class.

A wide range of financial schemes is in place, with grants being the most popular, especially for households. But different kinds of loans and tax reliefs appear to be becoming more important. There are indications that policies are favouring the emergence of new, more market-related instruments rather than grants, e.g., leveraging finance from banks in partnership with ESCOs, but the volume of experience to date seems limited.

Given the broad range of financial instruments in place, there should be extensive experience concerning relative advantages and disadvantages. To enable exchange of experience, it is recommended to carry out a systematic mapping of financial instruments according to type, target groups, country etc., and accompanying experiences and learnings.

Grants are the most popular scheme, but different kinds of loans and tax reliefs appear to be becoming more important. Detailed exchange of experiences with different schemes would be valuable.

3.6 Interactions and synergies with the Energy Efficiency Directive and the Renewable Energy Sources Directive

As shown in Table 2, identified areas of potential synergy between the EPBD recast, the Energy Efficiency Directive (EED) (incorporating provisions from the former Energy Services Directive (ESD)) and the Renewable Energy Sources Directive (RESD) relate to reporting, energy certification/auditing, training and accreditation schemes, the exemplary role of the public sector, smart metering/building monitoring, information campaigns, and financial instruments.

A common opportunity exists to deliver information campaigns via energy supply utilities, especially where the utility is wholly or partly owned or managed by a local municipality/authority.

Targeted financial actions could include tax incentives/reliefs for purchasers of energy-efficient products and grant schemes that facilitate renewable technology deployment.

Training and accreditation schemes are an area of significant public/private sector cooperation as most MS have delivered schemes through a combination of government/national agency defined rules, commercial training providers and/or construction professional bodies.

Regarding requirements for training/qualification/accreditation of experts across the three directives, Europe is lacking appropriate training for architects, engineers, auditors, craftsmen, technicians and installers, notably for those involved in refurbishment. Although the need for qualified workers in 2015 is estimated to be around 2.5 million, today only about 1.1 million are available. This need is in part being addressed by the BUILD UP Skills initiative.

The BUILD UP Skills initiative is addressing the training lacking in various areas and is seen as a powerful resource towards implementing the directives and delivering synergy benefits.

	EPBD recast	**ESD (now EED)**	**RESD**	**Comment**
Target	No	Indicative	Binding	
Scope	Heat, power	Heat, power, transport	Heat, power, transport	
Actions	Yes	Yes	Yes	
Action Plan required	No	Article 14	Article 4	
Reporting	Yes	Article 14	Article 22	**June 2011**
Public / visited buildings	Article 7	Article 5	No	
Information & training	**Article 20**	**Article 7**	**Article 14**	Synergy?
Energy certificates / audits	Articles 11, 12	Article 12		Synergy?
Competent persons	Article 17	Article 8	Article 14	Synergy?
Financial instruments	**Article 10**	**Articles 9, 11**	**Some**	Synergy?
Energy suppliers	No	Articles 6, 10, 11, 13	Yes	Synergy?
Metering & billing info	Article 20	Article 8	Some	
Smart metering / building monitoring	Articles 8, 14, 15	Articles 12, 13	Some	Data capture

Table 2: Areas of interaction between the three EU directives – EPBD, EED and RESD.

While most MS recognise the opportunities available, the majority of them have not yet implemented approaches to benefit from these synergies.

Examples of synergistic policies in MS include the following:

> In Finland, different ministries are responsible for the directives and are collaborating (e.g., NEEAP, EPC monitoring). Resource constraints provide a strong incentive to seek and realise the benefits associated with synergies.
> The Carbon Emissions Reduction Target (CERT), UK, requires energy supply companies to reach a savings target set in proportion to market share, mainly by improving existing dwellings.
> In Poland, Slovakia and Finland, energy auditor schemes link the energy audit and certification of a building. The scheme in Finland has also undergone successful evaluation, highlighting the benefits of including training, monitoring, quality control, tools and models as central elements from the start.
> Romania has had a more compartmentalised approach between the three directives. A national qualification platform has been set up to address this gap and, wherever possible, deliver the benefits associated with synergies. A potentially significant barrier to skills improvement is the 'informal economy' in the building industry.
> Slovenia has a unique legislation for all three directives with a common training/certification article. The country is implementing a modular training approach to deliver the synergies across the directives.

The potential for synergy depends on national transposition and how responsibility for implementation is assigned and co-ordinated. Where implementation of the three directives is led by different agencies, synergy to date seems limited.

3.7 Mobilising complementary EU financial instruments

Nine sets of EU financial instruments, cited in recital 18 of the EPBD recast, have considerable potential to amplify the impact of national instruments in improving building energy performance. The status of these instruments was reviewed in terms of scale of funds, terms of support, sectors and regions of application and experience and impact of applying these funds on the basis of evidence and case examples.

Another conclusion is that the business case of national authorities and financial institutions should not be restricted to looking at the energy savings achieved, but should include benefits from improving the quality of the housing stock as a capital asset, and related quality of living. But it is not an easy task to make decisions or to monitor and evaluate the effects.

There is a strong appetite for EU funding in many MS but there appears to be a lack of awareness among participants as to what funds are available. Moreover, EU funding needs matching MS funding. Grants act as a catalyst, but ultimately there needs to be a sustainable market dynamic for energy efficiency, e.g., revolving loans and ESCOs, and there is a gradual move in that direction. The Estonian KredEx model highlights how funds can be successfully leveraged.

More information on the motives and decision-making process of building owners is needed. Usually energy efficiency is not the main argument and there are different perspectives from different stakeholders. For building owners, it may be an overall upgrading of building quality and value, and for governments it may be employment content. Thus, there is a need for information to be configured in a versatile way for different decision makers.

Member States have a strong appetite for EU level funding, for example for building energy renovation, but appear to lack awareness on the required conditions of appropriate schemes or projects.

4. Main outcomes of 'Effectiveness of Support Initiatives'

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
1. Mapping of available support initiatives.	Support initiatives can come from: financial institutions, government, suppliers of energy efficiency goods, real estate agents, including information initiatives to improve understading of the Energy Performance Certificate (EPC), with strong opportunities for combined initiatives.	Effectiveness of subsidies for new buildings and renovation depends on many factors, but particularly on the availability and provision of sufficient matching capital.	Structured engagement with financial institutions. Promotion of the Energy Services COmpanies (ESCO) market in the non-domestic sector and the public sector.
2. Member States (MS) position on implementing the recast Energy Performance of Buildings Directive (EPBD) articles 10 & 20.	For residential and commercial buildings, grants and soft loans are the leading instruments. For public buildings, ESCO/third party finance initiatives are leading, closely followed by grants/subsidies.	National authorities and the professional community of building energy experts need to engage positively in partnership with the financial community, using the frameworks and language of that community.	Energy experts need to engage, educate and persuade the financial community on the case for investing in energy efficiency in buildings. They must learn and apply the finance community's frameworks of risk, language and decision making.
3. Baselines and monitoring for financial and policy instruments.	The practice of evaluation across MS is relatively weak. It is sometimes regarded as an extra expense that detracts from other programme tasks. Few countries globally follow a consistent protocol for energy efficiency impact evaluation.	It is crucial to build an evaluation culture and incorporate effective monitoring and evaluation tools into a scheme or programme from initial concept stage, in order to determine its effectiveness and value for money.	Match the pre- and post-evaluation to the policy objectives and programme design. Look for smart systems of low cost monitoring, data collection and evaluation. Central EPC registries can play a useful role in this.
4. Energy Service COmpanies (ESCOs) in public and commercial sectors.	ESCOs in MS are at varying stages of development. The most common trend has been a slow market growth, due to several barriers.	Many MS are still developing model contracts, opening credit lines, working with public banks and preparing calls for tender to enable competitive private investment in services to be applied in the public sector.	The public sector needs to continue taking an exemplary role by encouraging the use of ESCOs and accelerating its use of this business model.
5. Leveraging Energy Performance (EP) with financial instruments.	37 individual financial instruments were identified in MS. Government grants in housing are the most widely used financial incentive. Not all financial instruments link to the EPC.	Financial instruments should be linked to the EPC class improvement.	A systematic mapping of financial instruments according to type, target groups, country, etc., and accompanying experiences and learnings would be valuable.
6. Interactions and synergies with the Energy Efficiency Directive (EED) and the Renewables Energy Sources Directive (RESD).	Areas of potential synergy include: reporting, certification/auditing, training, accreditation, information, building monitoring, public sector role, and financial instruments. But where implementation of the three directives is led by different agencies, synergy to date seems limited.	The potential for synergy depends on national transposition and how responsibility for implementation is assigned and co-ordinated. BUILD UP Skills could be a powerful resource to assist implemention and deliver common benefits.	More coordinated approaches are needed at national level to exploit synergies. Investigate opportunities for a framework allowing transnational recognition of specialists as mandated by RESD. Encourage ministries/agencies to facilitate synergies.
7. Mobilising complementary EU financial instruments.	Recital 18 of the EPBD cites nine sets of EU financial instruments, with potential to amplify the impact of national instruments. But MS can lack awareness on the required conditions for such funding.	Additional to energy savings, national and financial bodies should value the benefits to building stock quality and quality of living. The potential of the European Investment Bank and Structural Funds should be more strongly applied.	Further insight into the decision-making process and motives for building owners and consumers undertaking energy efficiency work is needed. Often energy efficiency is not the main driver and there are different stakeholder perspectives.

5. Lessons learned and recommendations

Two key objectives continue to inform the work on the topic of 'Effectiveness of Ssupport Initiatives'. Firstly, to ensure the effectiveness of the recast Energy Performance of Buildings Directive (EPBD) implementation regarding provision of financial incentives and information services in the construction and property marketplace, it is vital that Member States (MS) adopt robust arrangements to catalyse the necessary transformation of both new buildings and the existing building stock, mobilising a range of institutional and professional actors. Secondly, to assist that effectiveness, it is desirable that all possible opportunities are identified and pursued in exploiting the potential synergies between the EPBD, the Energy Services Directive (ESD) - now Energy Effifiency Directive (EED) - and the Renewable Energy Sources Directive (RESD).

To date, comprehensive knowledge of the national building stock is limited in many MS. However, the certification and inspection programmes developed in the process of implementing the EPBD have the potential to yield a comprehensive data source on the energy performance quality of buildings. To maximise the potential of this data source, central registries of certificates and inspection reports should be equipped with querying functions to determine the effectiveness of policy interventions.

Monitoring the results and the effectiveness of policy interventions is underdeveloped at present among most MS. Incorporating the need for both evidence base and evaluation into policy and programme planning will help identify data needs and collection approaches.

The public sector is required to take an exemplary role in leading the transition to low-energy buildings but to date has received relatively less attention in certification schemes in MS. In a climate of limited public sector capital, it needs to employ the third party financing available through the energy performance contracting/Energy Services COmpany (ESCO) model and to highlight the benefits of its investment in improved energy performance in order to stimulate similar action in commercial buildings.

There is a key need to convey to the financial community and the general public that a building cannot be 'high quality' unless it is an energy efficient building.

Recommendations to improve the effectiveness of support initiatives:

> Structured engagement with financial institutions (including the European Investment Bank) as vital players in the investment arena, to understand and inform their perspective especially on energy efficiency renovation of buildings.
> A unified/standardised approach to methodologies for evaluating effectiveness of policies (guidelines/ principles/ strategies) to be developed together with Concerted Action (CA) EED.
> Promotion of the ESCO frameworks and market in the non-domestic and public sectors.
> Alignment of financial instruments according to type, target group and institutional framework with the diferent needs of different sectors would be beneficial.
> Awareness and leverage of EU level funding can be increased at MS level for the improvement of the new and existing building stock. A critical mass of good examples would inform MS of successful applications of EU funding.
> A more coordinated approach to information sharing with CA RES and CA ESD to exploit the potential synergies identified in this report.
> Active sharing with BUILD UP Skills as a significant resource in implementing the three directives.
> Investigate opportunities and proceed to develop a framework allowing transnational recognition of building energy assessors.

Country Reports

EPBD implementation in Austria

STATUS AT THE END OF 2012

Authors

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1. Introduction

In Austria, Energy Performance Certificates (EPCs) had been issued since 1998 in some of the *'Länder'* of the Federal Republic, using the space heating demand ('HWB', referring only to the building envelope) as a central element for the definition of requirements. A (simple) regular inspection of heating systems was also already in use. Both regulations were differing widely among the 9 *'Länder'*. So, the implementation of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) offered the opportunity to start a harmonisation process within Austria, to develop a common calculation methodology, to implement further elements like Heating Ventilation and Air-Conditioning (HVAC) systems, and to enhance regular inspections.

The implementation of the EPBD recast (2010/31/EU) led to a complex calculation methodology, including an 'energy efficiency factor'. It has to be mentioned that the requirements for subsidised buildings had always been very ambitious, nearly fulfilling the 2020 requirements of the building code already in 2012.

2. Energy performance requirements

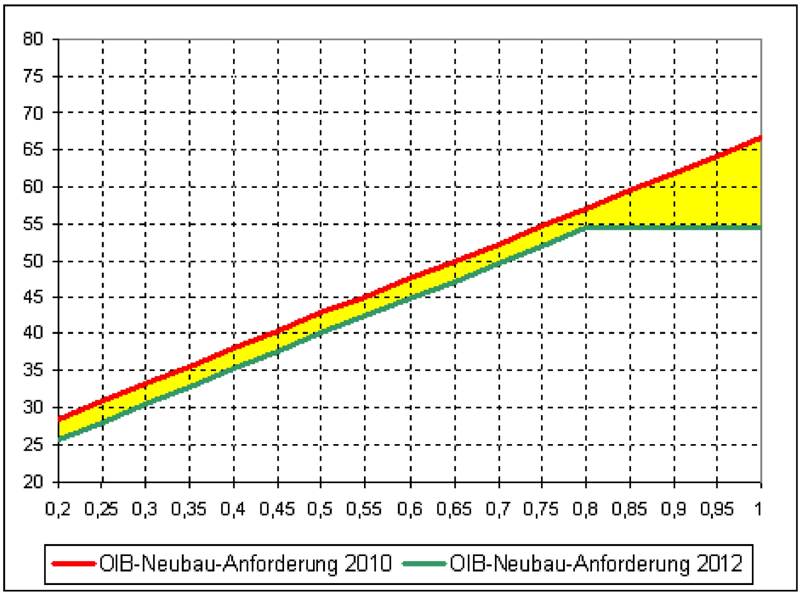
2.1 Progress and current status

The building regulations in Austria fall under the responsibility of the nine Austrian regional states, the *'Länder'*. Starting from different energy requirements in the respective building codes, the *'Länder'* and the federal state agreed on the development of a harmonised implementation of the EPBD in 2006. This process is managed by the Austrian Institute of Construction Engineering (OIB) and by a working group of representatives of the nine *'Länder'*, who agreed on common methods and requirements, fixed in OIB guidelines which had to be implemented in the respective *'Länder'*. In this way, the OIB guidelines serve as the basis for the harmonisation of building regulations and may be used by the *'Länder'* for this purpose. The declaration of a legal obligation of the OIB guidelines is subject to the *'Länder'*. The first guidelines were finalised in 2007, and the regulations in the *'Länder'* came into force between January and May 2008.

The regulations, based on the OIB guideline 6, 2007 issue, included all types of buildings, both residential and non-residential, both new and major renovations. The requirements mainly covered the heating and cooling demand (useful energy), as well as the final energy demand related to space heating and domestic hot water. For the space heating demand, the guidelines enclosed a tightening by January 2010. In addition, requirements on building elements, as maximum U-values, were stated. The requirements were revised after just a few years, and the 2011 issue of the OIB guidelines was adopted (see next subchapter). While the requirements for major renovations remained unchanged, the maximum accepted space heating demand in new buildings was tightened.

National Websites *www.oib.or.at*

Figure 1: Required maximum space heating demand for new residential buildings [kWh/m².year, vertical axis], depending on form factor A/V [horizontal axis]. Source: Erläuternde Bemerkungen zur OIB-Richtline 6, Ausgabe Oktober 2011 (www.oib.or.at).



Red: requirements since 2010; green: requirements since 2012.
Energy demand is related to conditioned gross floor area, including outer walls.

A survey of the requirements for residential buildings from 2007 to 2012 is given in Table 1. The results of the current tightening are shown in Figure 1. A picture over all tightening steps up to future Nearly Zero-Energy Buildings (NZEB) is given in Figure 4.

The recast of the guidelines also contains some smaller adjustments and additional indicators, without implicating any further tightening, but establishing a basis for redesigned Energy Performance Certificates (EPC) and future plans, as described later in this report.

2.2 Format of national transposition and implementation of existing regulations

With the adoption of the EPBD recast in 2010, Austria proceeded on its way towards new and retrofitted NZEBs by tightening the OIB guideline 6 'Energy economy and heat retention' (covering the minimum requirements of the Austrian energy performance indicators), as well as the OIB guideline 'Energy performance of buildings' (covering the calculation methodology framework). Both documents were amended in October 2011. For calculation details, the latter refers to a new set of Austrian standards (ÖNORM B 8110-6, ÖNORM H 5056- 5059) which has been revised before March 2011. By having issued the OIB documents at the end of 2011, the technical transposition of the recast EPBD was finished, and the legal implementation started. Carinthia has already fully implemented the new OIB documents since October 2012 in its construction law. Vienna, Vorarlberg and Styria did the same by January 2013. The other Austrian *'Länder'* will follow.

For the implementation of the EPBD recast article 12, 'Issue of energy performance certificates', the Austrian Energy Certificate law was renewed in April 2012. This federal law regulates the duty of the seller or renter to submit an EPC to the buyer or tenant when selling or renting buildings and building units, according to the new provisions of the recast EPBD.

Regarding the implementation of the EPBD recast article 17, 'Independent experts', regularly updated lists of qualified and/or accredited experts/companies will be published by the Ministry of Economy, Family and Youth on the basis of the federal trade and civil engineering law by January 2013.

For the implementation of the EPBD recast article 18, 'Independent control system', the nine *'Länder'*, being responsible for the building codes, had already installed control systems when

Table 1: Required maximum space heating demand and maximum U-values for new residential buildings and for existing buildings in case of major renovation. Source: OIB-Richtline 6, Ausgabe April 2007 and Oktober 2011 (www.oib.or.at).

		Space heating demand (HWB) [kWh/m².year] Maximum value	But not exceeding	Extract: Building elements (all buildings and periods)	Maximum U-values [W/m².K]
2007	**New buildings**	26 * (1 + 2.0/ℓ_c)	78.0	Outer walls	0.35
2010		19 * (1 + 2.5/ℓ_c)	66.5	Windows and glass doors	1.40
2012		16 * (1 + 3.0/ℓ_c)	54.4	Doors without glass	1.70
2007	**Major renovation**	34 * (1 + 2.0/ℓ_c)	102.0	Roofs	0.20
2010		25 * (1 + 2.5/ℓ_c)	87.5	Floors over outdoor air	0.20
2012		25 * (1 + 2.5/ℓ_c)	87.5	Ground floor or cellar ceiling	0.40

ℓ_c is defined as the characteristic length of a building, which is the reciprocal value of the form factor A/V.
Energy demand is related to conditioned gross floor area, including outer walls.

implementing the first EPBD. Some *'Länder'* started controlling the subsidised residential buildings (like Styria in 2008), thus gaining experience and giving advice to the issuers in order to enhance the quality of EPCs. Some installed a central database (like Carinthia and Vorarlberg), providing mandatory upload of EPC data in their building codes. A (different) control system exists in each of the *'Länder'*, but now efforts are being made to harmonise them. A central national database is in preparation (*'Gebäude- und Wohnungsregister'* (GWR)), where all EPC data will be registered, finally offering the possibility to install a common quality management system for all *'Länder'*.

2.3 Cost-optimal procedure for setting EP requirements

Several institutions initiated studies to establish the cost-optimal levels of minimum Energy Performance (EP) requirements for buildings and building elements. So far, results are available only from the Austrian Energy Agency. The analysis focuses mainly on single-family houses and multi-storey residential buildings. The investigation relates to both new and existing buildings. For the calculations, reference objects were defined. These reference objects are representative of typical Austrian buildings. Different construction methods (solid brick construction, lightweight wood construction and solid wood construction) and heating systems (wood pellet, condensing gas and heat pump technology) have been considered. Also, renewable technologies have been integrated in the examinations (solar thermal systems). On the basis of the reference building for a new single-family house, the preliminary results are illustrated in Figure 3 (examples given for solid brick construction and lightweight wood construction).

For single-family homes, different thermal building standards (space heating demand 15, 35 and 52 kWh/m².year useful energy) and different energy technologies concerning heating and ventilation have been considered. These design variants were observed with and without thermal solar systems, and with and without supply and exhaust air ventilation systems with heat recovery (in the Figure marked as MV = 'Mechanical Ventilation'). The calculations show that the cost-optimal design variant is a specific space heating demand of 52 kWh/m².year (gross floor area) in combination with a gas condensing system (yellow spots). However, the cost difference (global costs) to the design variant with a space heating demand of 15 kWh/m².year in combination with the air heating system (air to air heat pump with supply and exhaust air ventilation system) is very small (red spots) and, compared to the gas systems, this design variant has much less primary energy consumption.

Compared to the basic systems, the global costs of the variants with a solar thermal system are only slightly higher, but have much less primary energy consumption. The combined systems (heating system and supply and exhaust air ventilation system) show the highest global costs. Nevertheless, the global costs can be reduced considerably through high thermal quality of the building envelope (space heating demand 15 kWh/m².year; red spots) and use of an air heating system, according to the 'Passive House' concept.

Regarding the different construction methods, it can be said that there is no difference concerning the cost-optimised variants. The cost relations among the different design variants are the same for all construction methods. The current calculations of the Austrian Energy Agency show that, for new buildings, the cost-optimised variants correspond to the magnitude of the numbers in the national plan (see next subchapter).

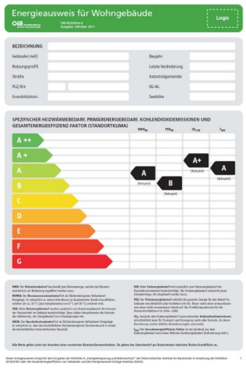
2.4 Action plan for progression to NZEB

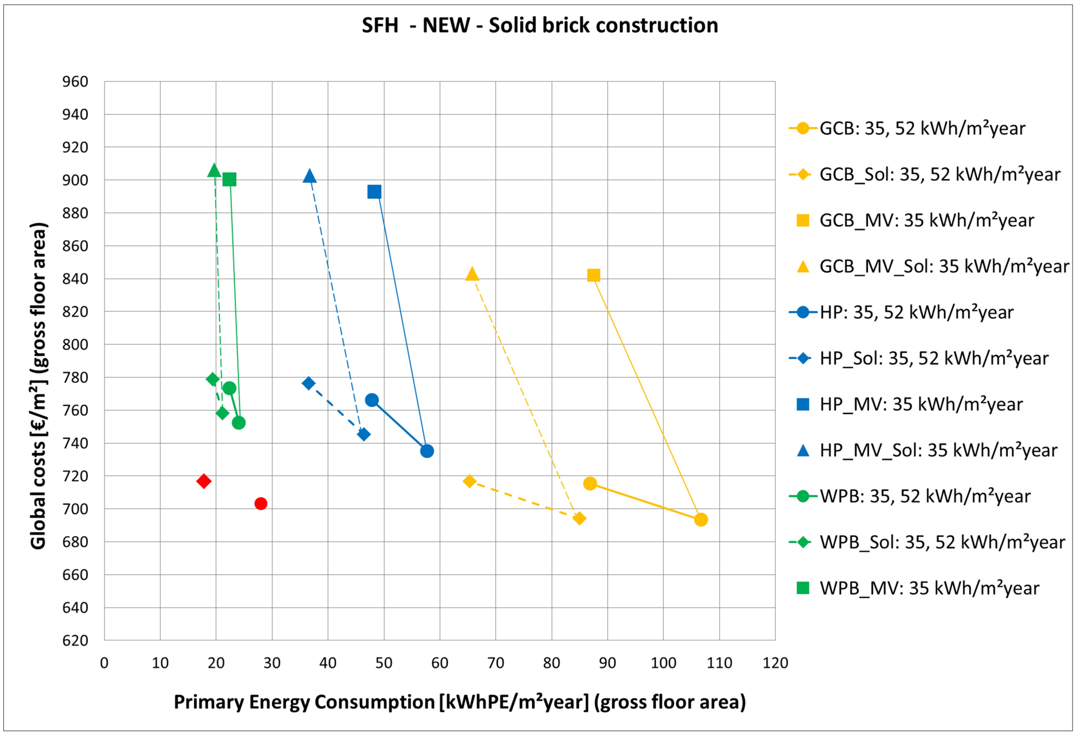
In November 2012, the national action plan was still under preparation. An OIB draft of the 29th of October 2012 describes the present results. The *'Länder'* agreed on using the four following indicators to describe the overall EP of a building:

> Space heating demand (*'Heizwärmebedarf'* (HWB)).
> Energy performance factor (*'Gesamtenergieeffizienz-faktor'* (fGEE), an indicator related to the overall final energy demand). An fGEE value of 1 corresponds to a reference building fulfilling the OIB 2007 requirements.
> Primary energy demand (*'Primärenergiebedarf'* (PEB)).
> CO_2 emissions (*'Kohlendioxidemissionen'* (CO_2)).

Four indicators have to be met: HWB, PEB, CO_2 and energy performance (not the

Figure 2: Cover page of the redesigned EPC Source: OIB guideline 6, 2011 issue.





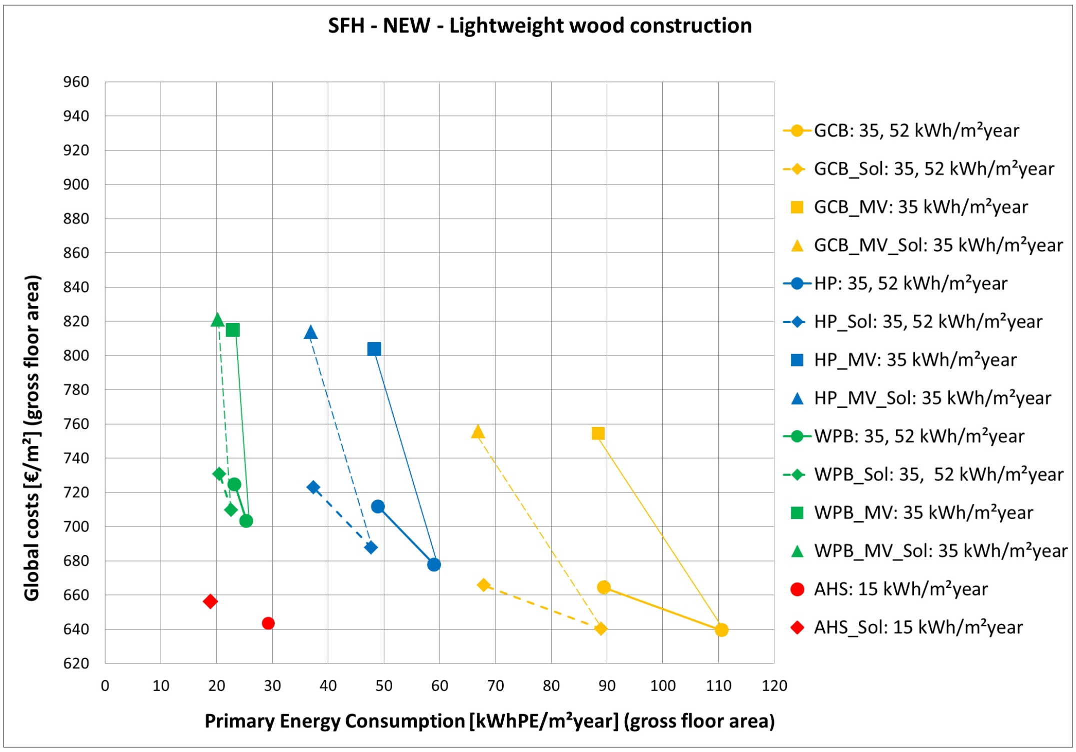


***Figure 3:* Global costs (vertical axis) and primary energy demand (horizontal axis) for different energy standards (space heating demand) and various technical solutions (list on the right). Examples related to new single-family homes with solid brick construction (top) and with lightweight wood construction (bottom).**

GCB = gas condensing boiler
HP = heat pump
WPB = wood pellet boiler
AHS = air heating system
Sol = solar thermal system
MV = mechanical ventilation system.

same as fGEE). However, the agreement includes that the EP criterion, expressed as overall final energy demand (‘*Endenergiebedarf*’ (EEB)), could be fulfilled in two different ways:

> The first way is to meet the dynamically tightened requirements on space heating demand (HWB) by using a predefined default technical building system.
> The second way is to meet the dynamically tightened energy performance factor (fGEE). In this case, the space heating requirements are not tightened, but the technical building system has to be more efficient in order to meet the final energy requirements. Gains from renewable energy production on-site or nearby can be taken into account.

It is important to be aware that all mentioned indicators (apart from the HWB) also cover the energy demand related to household electricity or electricity needed for the regular operation of a building, respectively, including all lighting and technical equipment, but not production devices.

In the calculation methodology, the corresponding values are fixed.

Minimum EP requirements on these four indicators are related to the Austrian reference climate, but the *'Länder'* can adapt the requirements to climate on-site. Conversion factors for primary energy and CO_2 are defined in the OIB guideline 6, 2011 issue. The primary energy factor is the total of the factors for the renewable and the non-renewable share. The agreed numbers for stepwise tightening of the minimum requirements for residential buildings are shown in Tables 2 and 3. Table 2 applies to new buildings, while Table 3 is valid for major renovations. The results, expressed in gradually decreased space heating demand, depending on the building's compactness, are illustrated in Figure 4.

Minimum EP requirements and milestones for non-residential buildings will be designed along the same lines, but the negotiations on that were not yet completed by November 2012.

Summing up, the Austrian way to define NZEBs is to design a combination of four different main requirements, which, all in all, result in very energy efficient buildings, taking into account a robust building envelope (HWB), the overall energy efficiency (fGEE), resource conservation (PEB) and climate protection (CO_2). From 2020, for new buildings, this will normally mean a space heating demand on the 'Passive House' level –or even lower, in case of more compact

Table 2: Minimum energy performance requirements for new residential buildings. Source: OIB-Dokument, Entwurf 22. Oktober 2012.

	HWB_{max} [kWh/m².year]	EEB_{max} [kWh/m².year]	$f_{GEE,max}$ [-]	PEB_{max} [kWh/m².year]	CO_{2max} [kg/m².year]
2014	16 × (1 + 3.0 / ℓ_c)	using default $HTEB_{Ref}$	0.90	190	30
2016	14 × (1 + 3.0 / ℓ_c)	using default $HTEB_{Ref}$		180	28
		or			
	16 × (1 + 3.0 / ℓ_c)		0.85		
2018	12 × (1 + 3.0 / ℓ_c)	using default $HTEB_{Ref}$		170	26
		or			
	16 × (1 + 3.0 / ℓ_c)		0.80		
2020	10 × (1 + 3.0 / ℓ_c)	using default $HTEB_{Ref}$		160	24
		or			
	16 × (1 + 3.0 / ℓ_c)		0.75		

Table 3: Minimum energy performance requirements for existing residential buildings in case of major renovation. Source: OIB-Dokument, Entwurf 22. Oktober 2012.

	HWB_{max} [kWh/m².year]	EEB_{max} [kWh/m².year]	$f_{GEE,max}$ [-]	PEB_{max} [kWh/m².year]	CO_{2max} [kg/m².year]
2014	23 × (1 + 2.5 / ℓ_c)	using default $HTEB_{Ref}$		230	38
		or			
	25 × (1 + 2.5 / ℓ_c)		1.10		
2016	21 × (1 + 2.5 / ℓ_c)	using default $HTEB_{Ref}$		220	36
		or			
	25 × (1 + 2.5 / ℓ_c)		1.05		
2018	19 × (1 + 2.5 / ℓ_c)	using default $HTEB_{Ref}$		210	34
		or			
	25 × (1 + 2.5 / ℓ_c)		1.00		
2020	17 × (1 + 2.5 / ℓ_c)	using default $HTEB_{Ref}$		200	32
		or			
	25 × (1 + 2.5 / ℓ_c)		0.95		

Note for both tables

ℓ_c is defined as the characteristic length of a building, which is the reciprocal value of the form factor A/V. Other abbreviations are described in the text.
Four indicators have to be fulfilled, see the text.

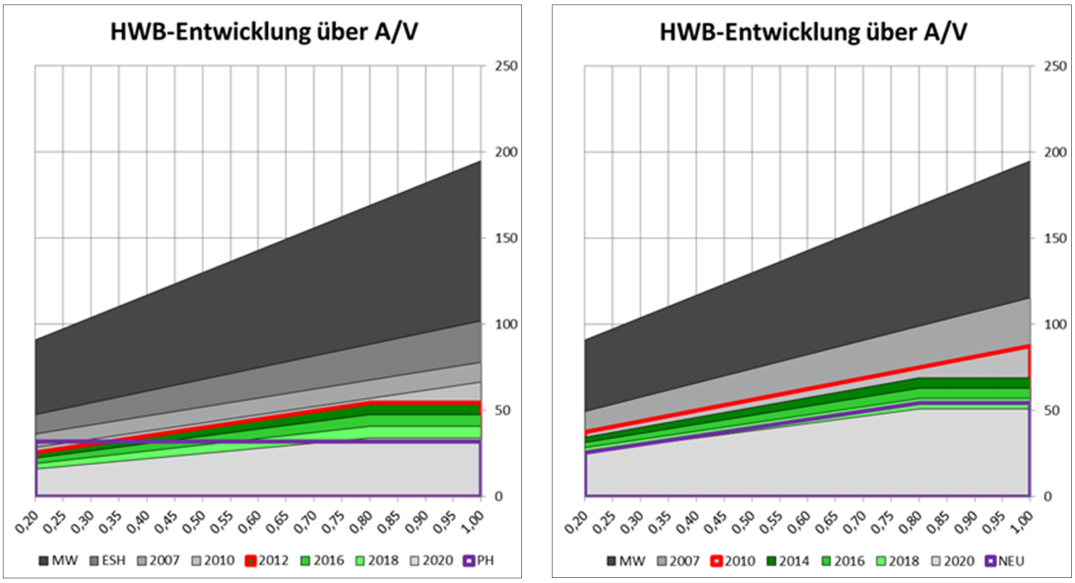


Figure 4: Decreased space heating demand [kWh/m².year gross floor area, vertical axis], depending on form factor A/V [horizontal axis], as a result of tightening minimum EP requirements for residential buildings according to the national action plan. Left: new buildings. Right: major renovations.

MW = average of all existing Austrian homes, based on measured values;
ESH = Existing Energy saving homes according to Austrian standard;
PH = Passive houses, without taking into account heat recovery;
NEU = New buildings 2012

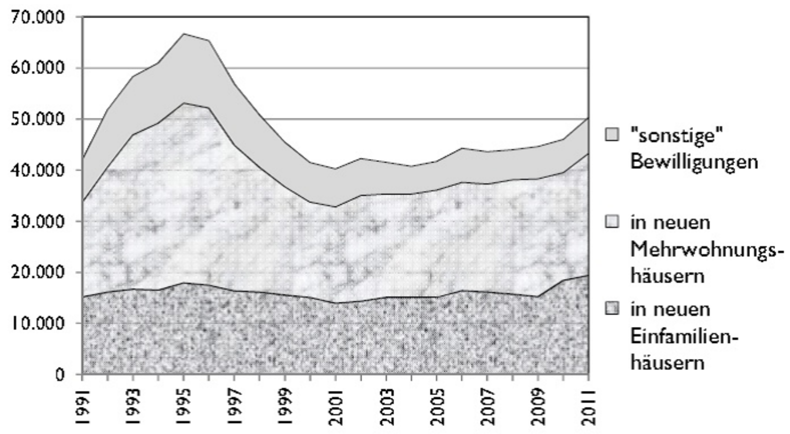
buildings. Nevertheless, it will not be required to build a 'Passive House'. Implementing other very efficient energy measures, it will be possible to have a building envelope which does not meet perfectly all the 'Passive House' requirements. The Austrian NZEB definition is not related to a specific concept like the 'Passive House'. This will allow the application of different approaches, as long as these ensure at least the same overall energy efficiency. On the other hand, building according to the 'Passive House' concept will not be enough to meet all indicators in every case. Other energy efficiency measures —like solar collectors or bioenergy— will be necessary.

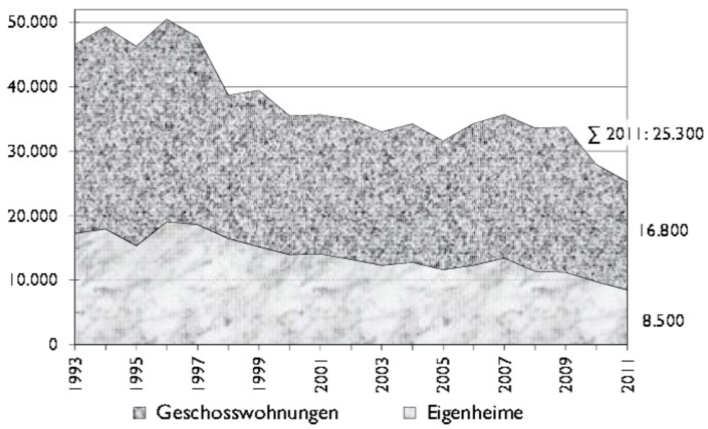
2.5 Other relevant information
A large share of new buildings and major renovations in the Austrian residential sector get a support for housing (*'Wohnbauförderung'*). All nine *'Länder'* provide support programmes. The conditions to get such subsidies have always been stronger than the requirements in the building codes, related both to energy and other building qualities. Therefore, many —in particular newer— buildings in Austria provide a better energy performance than that required in the building codes. This system with special subsidies for even higher energy efficiency of residential buildings will continue in the future, as agreed by the *'Länder'* and the federal state.

As shown in the following graphs, until recently, the subsidised homes had a marked share, up to 90%, for new houses. The last years, however, this percentage is reduced to below 50%, while the share of privately financed housing units has increased, especially for single-family homes.

Until 2010, the total expenditures of the *'Wohnbauförderung'* for new and renovated homes in the nine Austrian *'Länder'* rose to about 2,500 M€, but fell by approximately 10% in 2011.

Figure 5: Building permits (above) and support commitments (below) for residential units in Austria's nine regional 'Länder'. Source: IIBW (2012): Wohnbauförderung in Österreich 2011.





3. Energy performance certificates

In Austria, the Energy Performance Certificate (EPC) has to be issued by a person authorised according to the relevant rules and regulations of the trade, by an accredited inspection authority or by a person who has been certified on the basis of cooperation in the building trade. They can be chartered engineering consultants with relevant authorisation, engineering agencies within their trading license, master builders and master carpenters, general legally accredited experts of relevant expertise, as well as technical departments of public enterprise bodies. In addition, the certification bodies in the *'Länder'* may certify people for the purpose of issuing EPCs.

In 2010, there were about 4,000 recognised qualified experts in Austria, ranging from chimney sweepers to licensed consulting engineers or architects (*'Ziviltechniker'*). So far, there is no federal register of experts for Austria. In connection with the independent control system, some of the *'Länder'* will implement their own database.

3.1 Progress and current status on sale or rental of buildings
In some Austrian *'Länder'*, EPCs existed for many years before implementing the EPBD. Therefore, such certificates are well known in Austria, but mostly relating to new buildings. Since the 1st of January 2009, it has become mandatory to submit a certificate when

buildings or building units are sold or rented out. The certificate is based on the different but harmonised regulations in the nine *'Länder'*, while the obligation to submit the certificate is provided for in a federal law, the *'Energieausweis-Vorlage-Gesetz'* (EAVG). The background for the latter is the fact that such obligations are regulated by civil law and not by building regulations. Civil law is a federal issue in Austria, and the *'Länder'* are not in charge of that.

According to the EAVG issued in 2009, a copy of the certificate had to be physically delivered, and not only shown to the buyer or renter. Submission also applies to protected buildings; in general, the submission cannot be waived. The new EAVG, which came into force on the 1st of December 2012, clarifies more precisely that the contracting parties are not allowed to agree on something different. In addition, the new law introduces penalties in case of infringement. The fine can be up to 1,450 €. The first EAVG did not include sanctions. Therefore, only about 20% of the existing buildings upon sale or rent had a certificate before 2012 under the former law. Up to date, experience with the new EAVG is not yet available.

3.2 Progress and current status on public and large buildings visited by the public

In Austria, according to regional regulations, every public building with a gross floor area larger than 1,000 m^2 was required to display en energy certificate at the main entrance since 2008. The term 'public building' means frequently visited by the public, irrespective of whether owned by private or government bodies. By the end of 2010, only several hundred public buildings were certified, but the number increased considerably since then. Some of the *'Länder'* developed ambitious programmes to certify their building stock faster than planned in the official time schedule for Austria.

In accordance with the 2011 issue of the OIB guidelines, the new regional regulations in the nine *'Länder'* implement now the stricter rules of the EPBD 2010. This means that the threshold will now be lowered to 500 m^2 gross floor area and to 250 m^2 by the 9th of July 2015 if the building is occupied by public authorities.

3.3 Implementation of mandatory advertising requirement – status

Under the first law regarding the issue of EPCs, the EAVG, it was not required to advertise the energy performance indicator. The new EAVG, which came into force on the 1st of December 2012, states this obligation and introduces penalties in case of infringement. The fine can be up to 1,450 €. Up to now, there are only few examples of advertising and, due to the date of implementation of the new law, the corresponding statistics are not yet available.

3.4 Information campaigns

As already mentioned, EPCs existed in some Austrian *'Länder'* for many years before implementing the EPBD. Therefore, such certificates are well known in Austria. Nevertheless, in the run-up to the introduction of the EPBD EPCs, comprehensive measures to inform the public and professionals were taken in all the Austrian *'Länder'*. In the period 2008 – 2010, representatives and experts of all the *'Länder'* governments, regional energy agencies, as well as of the chambers of commerce and the chambers of engineers have been present in more than 3,000 events, fairs, seminars and workshops, disseminating information on the certification process and the EPCs.

Information and training activities, like calculation courses, were addressed to different target groups; these activities are continuing. All the *'Länder'* provide corresponding websites, brochures and so on. The same applies for the chamber of commerce and for trade associations. In particular, advisory activities in connection with the *'Wohnbauförderung'* contribute to good information of the stakeholders.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems

In Austria, inspection obligations for boilers exist for more than 15 years. The frequency of inspections depends on the energy source and the size (power output) of the heating system. At present, the requirements of boiler inspections differ among the nine Austrian *'Länder'*. The present regulation will be replaced by a new agreement between the *'Länder'* and the federal government of Austria. The new agreement has been presented to the *'Länder'* on the 31st of January 2011.

According to the new agreement, heating systems have to be inspected, in order to guarantee that they meet the emission and efficiency standards according to the power output and the used energy source. These inspections have to be carried out after the start-up of the heating system and further on in defined time periods. Moreover, the emissions of heating systems with a power output over 10 MW have to be monitored continuously.

The new agreement differentiates between basic and full inspections of heating systems. In case of heating systems with a power output up to 400 kW, only basic inspections have to be carried out. The mandatory periods for basic inspections are shown in Table 4.

In case of heating systems with a power output above 400 kW, the first full inspection has to be carried out during four weeks after start-up. Further periodic inspections depend on the power output of the heating system. Mandatory periods for full inspections are shown in Table 5.

Heating systems with a power output above 400 kW also need to undergo a basic inspection at least once a year. This basic inspection is only waived in the year when a full inspection is carried out.

After each inspection, a report has to be prepared by the auditor. Basic inspections have to be carried out by an official expert, or an organisation or expert who can show detailed expertise in this field. A basic inspection can be carried out by authorised craftsmen, licensed consulting engineers or architects (‘*Ziviltechniker*’), and accredited inspection authorities. Full inspections can be implemented only by official experts or organisations fulfilling the requirements of §14 of the ‘anti-pollution law’. At present, the detailed training requirements for experts who will be authorised to carry out basic and full inspections are under discussion within local and regional authorities.

Up to now, a quality control system for heating inspections is not implemented. The mandatory inspection report includes only little information, but local and regional authorities have to be informed if basic requirements (emission, performance or safety requirements) are not entirely fulfilled.

4.2 Progress and current status on AC systems

Obligations for the inspection of air-conditioning (AC) systems commenced as of the 1st of January 2009. Requirements in regard to inspection reports for AC systems were introduced together with the obligation of the inspection itself. Austria consists of nine regional *‘Länder’*, and legislation concerning inspection of AC systems is within their competence. Subsequently, the Austrian regional governments introduced nine regulatory frameworks which are slightly different in each of the nine *‘Länder’*. Common inspection intervals are three, five, ten or twelve years, or a combination depending on the scope of the inspection. In some regions, a short inspection every three years is combined with a more comprehensive one every 12 years. In all nine *‘Länder’*, AC systems from a 12 kW total rated output in a single building (refrigerating capacity) are to be inspected. If there are several systems in one building, their rated outputs are added up to establish if the 12 kW limit is exceeded.

Table 4: Inspection periods (basic inspections) according to power output and used energy source.

Used energy source	**Power output**	**Inspection period**
Natural gas	Up to 26 kW	Minimum, once every fourth year
Standardised biomass and fossil fuel	Up to 50 kW	Minimum, once every second year
All energy sources	Above 50 kW	Minimum, once a year

Table 5: Inspection periods (full inspections) according to power output.

Power output	**Inspection period**
Above 400 kW up to 1 MW	Only one full inspection after start-up
Above 1 MW up to 2 MW	Every fifth year
Above 2 MW	Every third year

Table 6: Regulatory frameworks in regard to AC system inspections in Austria's nine regional 'Länder'.

Province	Law/regulation	§	Time intervals
Burgenland (Burgenland)	Burgenländisches Luftreinhalte-, Heizungsanlagen- und Klimaanlagengesetz 2008	§ 19b	**3-year interval:** > 12 kW
Kärnten (Carinthia)	Kärntner Bauvorschriften	§ 50	**3-year interval:** > 12 kW **5-year interval:** > 12 kW
Niederösterreich (Lower Austria)	NÖ Bauordnung 1996	§ 34b	**10-year interval:** > 12 kW
Oberösterreich (Upper Austria)	Oö. Luftreinhalte- und Energietechnikgesetz 2002	§ 31a	**1-year interval:** > 50 kW **3-year interval:** > 12 kW but < 50 kW
Salzburg (Salzburg)	Baupolizeigesetz 1997	§ 19c	**5-year interval:** > 12 kW
Steiermark (Styria)	Steiermärkisches Baugesetz	§ 93	**1-year interval:** > 12 kW **3-year interval:** > 12 kW **12-year interval:** > 12 kW
Tirol (Tyrol)	Tiroler Heizungs- und Klimaanlagengesetz 2009	§ 11b	**5-year interval:** > 12 kW
Vorarlberg (Vorarlberg)	Bautechnikverordnung	§ 46	**3-year interval:** > 12 kW
Wien (Vienna)	Wiener Feuerpolizei-, Luftreinhalte- und Klimaanlagengesetz	§ 14a	**3-year interval:** > 12 kW **12-year interval:** > 12 kW

There are annual inspections only in Upper Austria (rated output of more than 50 kW) and in Styria (all AC systems from a 12 kW rated output). Lower Austria introduced only one kind of inspections for all systems above 12 kW, where all inspections need to be conducted only once every 10 years.

The inspection is to be carried out according to ÖNORM EN 15240 (AC systems) and ÖNORM EN 15239 (Ventilation). Currently, ÖNORM H 6041, a supplement to these two standards focusing on the assessment of the energy efficiency of an AC system, is under development and due to be published in 2013. Inspections for all AC systems have to be paid by the end user or by the owner of the building.

Regional governments are in charge of compliance and control of AC inspections. In most provinces, the qualification of the experts responsible for carrying out the inspections is based on the Austrian trade law. According to this law, experts are allowed to carry out AC inspections provided that they possess a trade license for planning, installing, modifying, maintaining and auditing AC systems. Inspectors can also be accredited by auditing bodies, public authorities or engineering firms with relevant competencies. Training for inspectors is currently offered by private and public training institutes, as well as by the chamber of commerce.

5. Conclusions and future plans

Most of the articles (art. 2 to 13, except art. 5) of the recast Directive on the Energy Performance of Buildings (EPBD) are covered by the aforementioned Austrian Institute of Construction Engineering (OIB) guideline which has been already implemented in the building code of Carinthia, Vienna, Vorarlberg and Styria, and will soon be implemented in the building codes of the other 5 Austrian *'Länder'*, since they have already agreed to do so. The Nearly Zero-Energy Building (according to the OIB guideline 6) has been already introduced for subsidised residential buildings, and will become the standard in the building code requirements in 2020. The Austrian NZEB is normally a building with space heating demand at or below 'Passive House' level, but the requirements are not related to a specific concept — which will allow different approaches to be applied. Nevertheless, more than 11,800 'Passive Houses' were already in use in Austria in 2010, and it seems as if this concept will become the widely-used new voluntary standard, at least as far as new residential buildings are concerned. As early as in 2008, 12.9% of all newly built residential units were 'Passive House'.

Also, the regulations for the inspection of Heating Ventilation and Air-Conditioning (HVAC) systems are implemented in different laws. A common format of reports (art. 16) is still under development, as well as the independent control system, which already exists in each of the *'Länder'*, but is not yet fixed by law.

As for the cost-optimal way of building, several methodologies have been developed, and they will be integrated into a single one, also including the available information offered by the Commission, until March 2013. The studies have shown that the mentioned requirements meet cost-optimality well, so there should be no problem to make the NZEB affordable – provided that long term calculations are made and accepted by the building industry, as well as by the owners and users. Because of the current lack of comprehensive information, the regulations for non-residential buildings will still have to be developed and may introduce new elements in the future, e.g. the role of smart meters and more differentiated requirements according to different use.

Finally, there is a new federal law to ensure the issuing of Energy Performance Certificates (EPC), including sanctions, since the 1st of December 2012. A central database is planned (some of the *'Länder'* already have one), where all EPC data should be stored, thus offering to the users the possibility to profit from the existing experience. A quality management for EPCs is used in most *'Länder'* as a basis for the independent control system.

EPBD implementation in Belgium Brussels Capital Region

STATUS AT THE END OF 2012

1. Introduction

The implementation of the Energy Performance of Buildings Directive (EPBD) in Belgium is a regional responsibility. In the Brussels Capital Region, the EPBD is under the combined responsibility of the regional Ministry of Energy and the regional Ministry of Environment. At the end of 2012, they both have the same administration and the same Minister.

On the 7th of June 2007, the Government of the Brussels Capital Region adopted an ordinance transposing the EPBD into regional law. Some minor changes were introduced on the 14th of May 2009 and on the 3rd of February 2011.

This ordinance has been implemented through several executive orders adopted by the Government of the Brussels Capital Region or by the Minister of Energy.

A new set of energy demand requirements has been voted in May 2011 by the regional government, regarding individual dwellings, offices and educational buildings. These requirements shall come into force in January 2015.

The Brussels Capital Region has yet to transpose the recast EPBD. A new ordinance in progress, the Brussels Air, Climate and Energy Code, will be adopted in June 2013. This law reorganises and integrates the Brussels legislations in the air, climate and energy area, and will fully transpose the recast EPBD.

2. Energy performance requirements

2.1 Progress and current status

According to the Ordinance of the 7th of June 2007, the Energy Performance (EP) requirements are mandatory for buildings for which a building permit has been requested since July 2008. The applicable EP requirements are on primary energy consumption, insulation level, ventilation rate, overheating, technical installation, etc., and depend on the building type.

Since July 2008, the requirement concerning the K-level was tightened, and other requirements were added (E-level, insulation performance of walls and roof, minimum ventilation ratio, requirement on technical installations). These requirements are different for new buildings, major or simple retrofits, or existing buildings.

E-level is an EP level expressed as the fraction of primary energy consumption (for heating, hot water production, auxiliary equipment and cooling, plus lighting in the case of offices, from which the production from the cogeneration and solar panels, if any, is subtracted), by an expression including the area of the building envelope with thermal losses, the volume, the ventilation rate and, in the case of offices, the usable floor area and a variable for lighting.

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Table 1: K-level and E-level required for new buildings.

	K-level		E-level		
	Before the EPBD (July 2008)	EBD: From July 2008 until January 2015	Before the EPBD (July 2008)	EBD: Before July 2011	EBD: From July 2011 until January 2015
Individual dwellings	55	40	-	90	70
Offices	55	45	-	90	75
Schools	55	45	-	90	75

The E-level for residential units is calculated as follows:

$$E = 100 \times E_{char\,ann\,prim\,en\,cons} \,/\, E_{char\,ann\,prim\,en\,cons,ref}$$

$$E_{char\,ann\,prim\,en\,cons} = \sum_{m=1}^{12}\left(E_{p,heat,m} + E_{p,water,m} + E_{p,auxiliar,m} + E_{p,cool,m} - E_{p,photovoltaic,m} - E_{p,cogen,m}\right) \text{ (MJ)}$$

$$E_{char\,ann\,prim\,en\,cons,ref} = 115 \times A_T + 70 \times V_{PER} + 105 \times \dot{V}_{dedic,ref} \quad \text{(MJ)}$$

with:

- A_T: Area with losses (m^2)
- V_{PER} : volume (m^3)
- $\dot{V}_{dedic,\,ref}$: ventilation flow rate (m^3/h)

K-level is a function of the average U-value of the building envelope weighted by areas and correlated with compacity (see requirements in Table 1):

$$K = 100\frac{U_m}{U_{m,ref}}$$

With:

- $U_m = \frac{H_T}{A_T}$ [$W/m^2.K$]
- H_T: thermal transfer coefficient [W/K]
- A_T: Area with losses (m^2)
- Compacity = (building's volume)/(thermal loss surface)
- $U_{m,ref}$ = 1 if Compacity ≤ 1 m:
- $U_{m,ref}$ = (C + 2)/3 if 1m ≤ Compacity ≤ 4 m
- $U_{m,ref}$ = 2 if 4 m ≤ Compacity :

These requirements have been revised and tightened in May 2011 and will enter into force in January 2015.

Table 2: Requirements for new buildings as from January 2015.

	Heating needs [$kWh/m^2.year$]	Cooling needs [$kWh/m^2.year$]	Primary energy consumption [$kWh/m^2.year$]	Overheating (%)
Individual dwellings	15		45	(time > 25 °C) < 5%
Offices and schools	15	15	90 - 2.5 x compacity*	(time > 25 °C) < 5%

**Compacity is the ratio: building volume / thermal loss surface*

2.2 Format of national transposition and implementation of existing regulations

The calculation procedure is defined in an executive order published on the 5th of May 2011. The method is similar to those established in the Flemish and the Walloon Regions. A study to revise and extend the calculation procedure for cooling and overheating has been completed. The results of this study are being incorporated into the calculation procedure (2012-2013).

The calculation method for primary energy already includes the input of Renewable Energy Sources (RES), such as solar energy (thermal and photovoltaic), biomass heating, geothermal heating and heat pump systems, as well as passive cooling techniques.

An integrated calculation tool with 3D construction graphical views, product databases and administrative forms has been developed in collaboration with the Walloon Region, and has replaced the previous software tool in July 2011. This last version integrates the new calculation procedure (on the 5th of May 2011) and takes into account the constructive nodes (including thermal bridges).

The Qualified Experts (QEs) designated to follow up new buildings and major renovations are called EPB-advisors. This accreditation is accessible only to architects and engineers, who have to attend a specific training programme, to obtain a certificate of competency, and to request an accreditation by the IBGE-BIM. The training is organised by independent training centres. At the end of 2012, 4 centres and about 702 EPB-advisors are accredited. In 2011, EPB-advisors were able to follow an additional training, in order to learn how to take thermal bridges into account, and how to use the new software.

The enforcement of small renovations (not falling under the definition of major renovations) is directly handled by the municipalities. Major renovations and new buildings are handled by the IBGE-BIM.

Quality Assurance (QA) system

The independent quality control of EPB-advisors started in March 2012. Thirty EPB-advisors have been checked so far. This first control did not have aim at imposing penalties; it was designed to get feedback on the work of the EPB-advisors in the market. The results are positive. Currently, the control of the EPB-advisors' work is performed entirely by the IBGE-BIM.

2.3 Cost-optimal procedure for setting EP requirements

The cost-optimal study is in progress. The final report is expected in June 2013. The study will check both the current and the 2015 EP requirements.

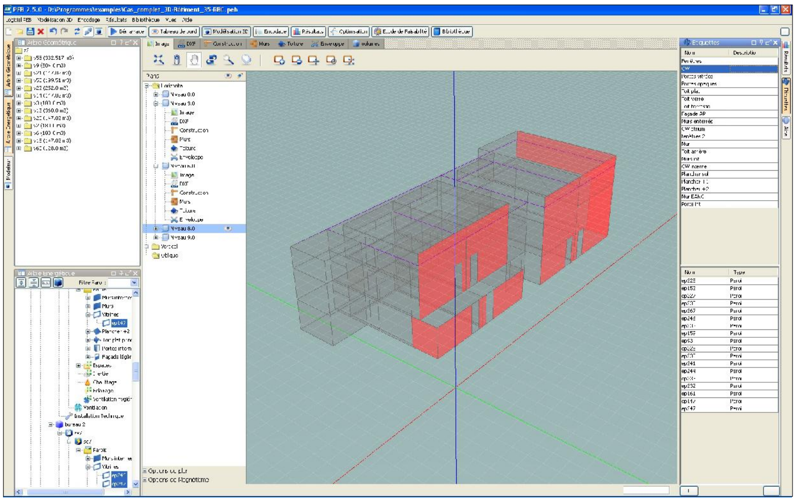
2.4 Action plan for progression to NZEB

The new requirements coming into force in January 2015 specify that, in case of a renovation of more than 75% of the building envelope with heat losses and a respective change of technical installations, the maximum energy needs for the building after the renovation cannot exceed 120% of the requirements for a new building.

A new requirement of airtightness of 0.6 air changes per hour at 50 Pa will be voted in 2013 by the Regional Government for individual dwellings, offices and educational buildings, and will come into force in January 2018.

The severe tightening of the new requirements is a first step towards Nearly Zero-Energy Buildings (NZEB), which will be compulsory in 2021 (2019 for public buildings).

Figure 1: 3D construction graphical view in the new software tool.



The definition of NZEB included in the Brussels Air, Climate and Energy Code uses the definition given by the recast EPBD (2010/31/EU), i.e., “*nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby*”. The results of the cost-optimal study will be used to make this definition more specific.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

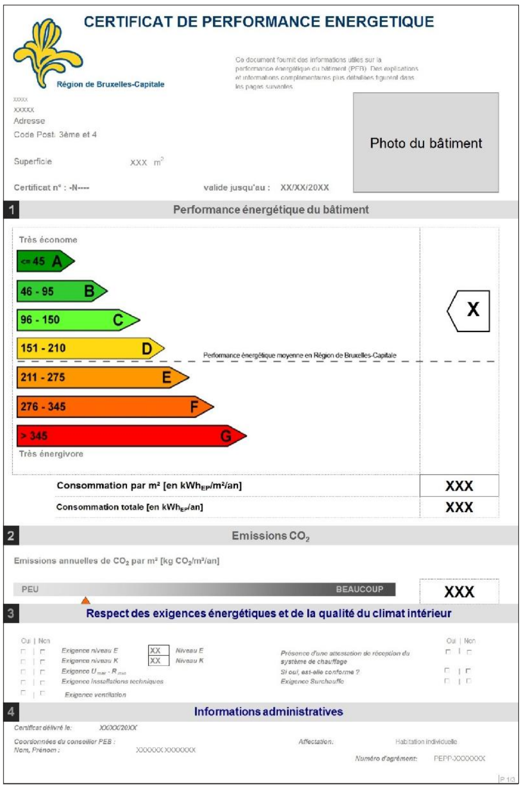
New buildings

For new dwellings, offices and education buildings, an Energy Performance Certificate (EPC) is issued by the IBGE-BIM at the end of the EP certification process, based on the final EP declaration. Other types of buildings do not have to obtain an EPC when built. EPB-advisors are in charge of this EP declaration. This EPC has to be used for real estate transactions, in the same way as the EPCs issued for older existing buildings. Therefore, the layouts are very similar.

This EPC contains:

> the address of the building and possibly the ‘name’ of the building;
> a picture of the building;
> the expiry date of the certificate;
> the floors (or parts of the building) certified if the EPC does not cover the whole building;
> the identifying number of the certificate;
> the label (A^+ to G) granted to the building (ranking based on consumption [kWh/m².year], in accordance with the

Figure 2: First page of the EPC for a new individual dwelling.



CEN (EPBD)-standard: EN 15217);

- the consumption values per m² and the total annual consumption of primary energy in kWh/year, calculated using the EP software;
- the amount of CO_2 emitted annually per m², calculated using the EP software;
- E and K levels, calculated using the EP software;
- a statement of compliance with the energy and climate quality inside the building, checked for each requirement;
- the date of issuance;
- assignment (individual dwelling, office, school);
- the data of the EPB-advisor (name, address, phone, e-mail, number of registration).

The EPC for new buildings includes explanations, as well as a list of typical measures for improving the energy performance of the buildings. These standard recommendations relate to heating, Domestic Hot Water (DHW), ventilation, summer comfort, lighting and domestic appliances. These recommendations are not specifically identified for any particular building.

Certificates for new buildings are issued since the beginning of 2011. By the end of 2012, the IBGE-BIM had issued about 430 certificates.

Existing buildings

Executive orders determining the certification rules, the asset calculation procedure, the accreditation of QEs, and the accreditation of training courses, have been adopted in the beginning of 2011. They came into force on the 1st of May 2011 for dwellings and office buildings for sale, and on the 1st of November 2011 for dwellings and office buildings for renting. Buildings undergoing renovation are considered as existing buildings.

The EPC includes recommendations obtained from a list of typical measures for improving the energy performance of the building, but imposes no obligation for carrying out works in order to meet specific energy requirements. The reference values determining the energy label are the same as those for new buildings. For dwellings, the recommendations are automatically triggered by poor quality for each element of the dwelling.

The mandatory software to be used for issuing EPCs operates in combination with a central registry. This software has various Graphical User Interfaces, and allows the expert to input specific elements, such as special windows or complex skylights, with ease.

Table 3: Reference values determining the EP for individual dwellings and office buildings in kWh/m².year (primary energy - ep)

	Office buildings				Dwellings			
Energy class	Consumption range [kWh_{EP}/m^2.year]				Consumption range [kWh_{EP}/m^2.year]			
A+			to	0			to	15
A	from	1	to	31	from	16	to	30
A-	from	32	to	61	from	31	to	45
B+	from	62	to	93	from	46	to	62
B	from	94	to	124	from	63	to	78
B-	from	125	to	155	from	79	to	95
C+	from	156	to	186	from	96	to	113
C	from	187	to	217	from	114	to	132
C-	from	218	to	248	from	133	to	150
D+	from	249	to	279	from	151	to	170
D	from	280	to	310	from	171	to	190
D-	from	311	to	341	from	191	to	210
E+	from	342	to	372	from	211	to	232
E	from	373	to	403	from	233	to	253
E-	from	404	to	434	from	254	to	275
F	from	435	to	527	from	276	to	345
G	over	527			over	345		

The software also includes automatic controls on a comprehensive list of possible discrepancies, thus avoiding many possible mistakes.

As of November 2012, about 60,000 EPCs have been issued for houses and apartments. Also, about 3,000,000 m² of office buildings are covered by an EPC.

In order to avoid creating barriers regarding the entry into the certification market, there are no minimum requirements (diploma or experience) for participating to the training in order to become a QE. This allowed the development of tailor-made (short and long) training courses for all kinds of participants. Typically, the courses take 3 to 6 days. However, candidates must pass a mandatory exam before requesting their accreditation as QE. The ministry ensures that there is a similar level of difficulty for the exams in all training centres.

There are 2 types of QEs for existing buildings, depending on the certificate type:

> existing residential buildings for real estate transaction;
> existing non-residential buildings for real estate transaction.

All QEs have to follow a specific training programme, to obtain a certificate of competency, and to request an accreditation by the IBGE-BIM. The training is conducted by private training centers, according to the regulation rules. At the end of November 2012, 7 centres have been accredited, and there are about 1,200 registered QEs for residential and non-residential buildings, whose data can be found on the IBGE website.

The cost of an EPC ranges from about 200 € for a studio flat, to 500 € for a big house (VAT included).

Quality Assurance system

QEs have the obligation to maintain for at least 5 years all the data on calculations and all the evidence for the EPCs they issue, and to make these details available to the ministry upon demand.

The IBGE-BIM set up a Quality Assurance (QA) scheme. A private body was hired for a 6 months period in order to control QEs issuing EPCs for dwellings, and for improving the scheme. On a yearly basis, the overall amount of controls performed should correspond to a sample of 1% of the issued certificates.

Figure 3: Mandatory software to be used for issuing EPCs.

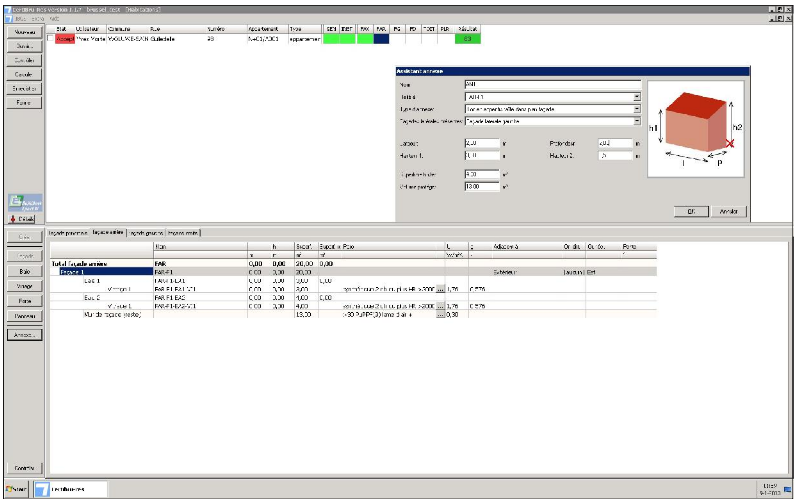
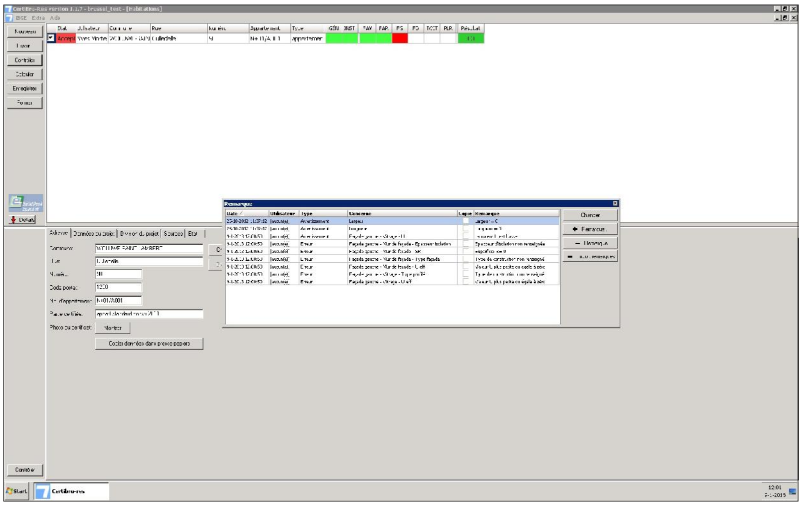


Figure 4: Mandatory software to be used for issuing EPCs.



The objective of the scheme includes control of administrative obligations, compliance of technical procedures, and possession of the required documentation (drawings, bills, photographs, etc.). The controllers execute desk audits, detailed interviews with the QEs and on-site controls. The final report of this QA exercise is due at the end of May 2013. Further similar objectives will be set every year.

Due to the lower number of issued EPCs for office buildings, the QA for these EPCs has been managed by the IBGE-BIM itself, often with the support of the issuing QE, before or during the issuance of the EPC. However, this could change soon.

Penalties may be imposed if relevant errors are discovered and confirmed. The first time, the license of the QE may be suspended for 45 days. After two suspensions, the IBGE-BIM can request the withdrawal of the accreditation. Fines for the QEs are not applicable.

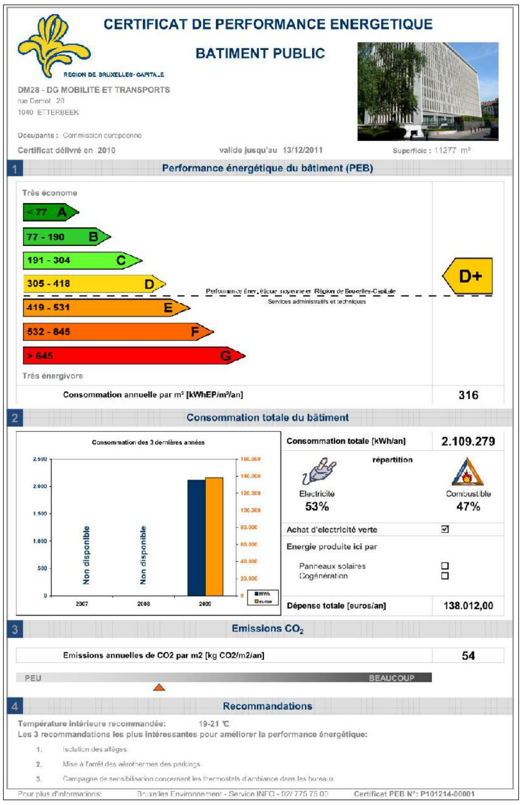
3.2 Progress and current status on public and large buildings visited by the public

Since the 30th of June 2012, public bodies that occupy more than 1,000 m² in a building must display an EPC on the front door or in the main lobby of the building. The rules related to this certificate are defined in an executive order adopted by the Government of the Brussels Capital Region on the 27th of May 2010.

The executive order came into force in two phases, according to the category of the building being certified: phase 1 (a list of the buildings to be certified since the 1st of January 2011, and a list of those with an issued certificate since the 1st of July 2011), and phase 2 (a list of the buildings to be certified since the 1st of January 2012, and a list of those with an issued certificate since the 1st of July 2012). The building categories and the respective phases are the following:

> Offices: administrative and technical services, town halls and communal houses (phase 1).
> Buildings of Parliament, judicial courts and administrative courts (phase 2).
> Sport facilities: swimming pools and sports centres (phase 1).
> Schools: nurseries, schools, colleges, universities, etc. (phase 2).
> Culture and entertainment facilities: museums, theatres, cultural centres, libraries, media centres and similar services (phase 2).
> Health and other facilities: hospitals, health centres, nursing homes, rehabilitation and care centres for the elderly, and similar services (phase 2).

Figure 5: First page of the EPC for a public building (offices).



The certificate is based on consumption data for electricity and fossil fuels used for all purposes, based on meters or invoices and, where appropriate, on data on the on-site production of electricity. The data cannot be metered earlier than 24 months before the date of the certificate issuance, and has to cover a continuous period of 11 to 13 months. The EP indicator is calculated on the basis of the occupied floor area.

The certificate reflects the EP level of the public building, and places it on a scale of labels according to its category. The mean EP level for the building categories in the Brussels Capital Region is illustrated as a dotted line in the scale. In addition, the certificate displays the index of CO_2 emission, as well as other information, such as financial data, information on on-site production systems, recommendations selected from a list of typical cost-effective measures, and a histogram of the consumption over the last three years (fully completed after three years).

If the occupant is the owner of the public building, they have to install a meter for each energy source and for each building individually, within 24 months from the date on which the executive order came into force.

Table 4: Mean CO_2 emisisons and energy consumption per building type.

	Category of building	Mean CO_2 emissions [kgCO_2/m².year]	Mean consumption [kWh/m².year]
1	Administrative and technical services	60	418
2	Town halls and communal houses	60	440
3	Buildings of parliament, judicial courts and administrative courts	60	323
4	Nurseries	60	390
5	Schools, colleges	40	230
6	Technical and evening schools	40	250
7	Universities, high schools	40	270
8	Museums, theatres, cultural centres	60	310
9	Libraries, media centres and similar services	60	310
10	Hospitals, health centres	80	527
11	Nursing homes, rehabilitation and care centres for the elderly	80	450
12	Swimming pools	1,200	7,376
13	Sports centres	80	468
14	Other	40	286

The certificate is to be issued by a QE using the relevant software, and applying the protocol provided by the IBGE-BIM. The executive order determining the rules for the accreditation of QEs and the accreditation of training courses was adopted on the 17th of February 2011. The training is conducted by private training centres, according to the regulation rules. At the end of November 2012, 3 centres are accredited, and there are about 80 registered QEs for public buildings, whose data can be found on the IBGE-BIM website.

3.3 Implementation of mandatory advertising requirement – status
As the EPC aims at informing the potential buyer or tenant of the EP level of the building, it has to be issued before the real estate transaction takes place, and before any advertising, and must be available to the potential buyer or tenant. Therefore, the original 2007 Ordinance already states that the reference values shall appear clearly on all advertisements. These reference values are currently the energy class, the EP [kWh/m².year] and the CO_2 emissions.

A lot of contacts with major and minor real estate agencies, as well as with owner unions, made the compliance with the requirements possible in most cases of advertising. After some years of performing campaigns, fines are foreseen to start being levied in 2013 for those who will not comply with these rules.

Beyond advertising, there is also an obligation to obtain a valid EPC at the time that the building (residential or non-residential) is sold or rented. To ensure law enforcement, the administration agreed with the notary association on the obligation to report every real estate transaction for which a valid EPC is not available.

3.4 Information campaigns
Advertising campaigns on the radio, in the press, with banners on the administration website, etc. are foreseen for 2013, in order to encourage certification and boiler inspection. In addition, professionals will be informed through newsletters and specific seminars, in collaboration with professional associations. A lot of information is available on the IBGE-BIM website.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems
Since the 1st of January 2011, heating systems must meet a series of requirements that aim at the minimum acceptable energy efficiency level and at the reduction of the environmental impact of these systems. To ensure compliance with these requirements, the regulations require various inspections to be carried out by QEs. These requirements and actions are determined in the Executive Order of the Government of Brussels Capital Region of the 3rd of June 2010, concerning the requirements for the heating systems of a building during installation and operation.

The executive order applies to all heating systems in the Brussels Capital Region territory, which include one or more boilers with the following characteristics:

> with a nominal power above 20 kW;
> operating on liquid or gas fuel; and
> with hot water as the heat transfer fluid.

The heating system is the set of components necessary to heat the air in a building and/or the DHW, including one or more heat generators, distribution lines and storage tanks, and the terminal units for heat exchange (radiators, convectors, etc.), as well as control systems. A heating system is of Type 1 if the heat is produced by a boiler with a nominal output equal to or lower than 100 kW, and of Type 2, if the heat is produced by a boiler with a nominal output greater than 100 kW, or by more than one boilers.

The executive order contains 16 requirements concerning the following points:

1. the holes for measuring the combustion efficiency;
2. the combustion efficiency and emissions of boilers in operation;
3. the sizing of the boilers;
4. the modulation of the power of boiler burners;
5. the chimney draft;
6. the ventilation of the boiler room;
7. the tightness of exhaust gas and combustion air supply ducts;
8. the insulation of pipes and accessories;
9. the partitioning of heating and air distribution;
10. the control of the heating system;
11. the logbook;
12. the energy metering of boilers;
13. the energy metering of electric fans;
14. the heat recovery of exhaust air;
15. the variation of the flow of fresh air

by actual occupation (for spaces with variable occupation);
16. the energy accounting (measuring, analysing and reporting the energy consumption of the heating system).

Acceptance tests of heating systems with new boiler(s)

The system owner must hire a QE to perform an inspection of the entire heating system during its commissioning, in anyone of the following cases:

> after installing the boiler;
> after replacing the boiler body;
> after replacing the burner;
> after moving the boiler.

The purpose of the approval is to verify the system compliance with the legal requirements, including all the points in the previous list. This type of inspection is named 'reception' of heating systems.

At the end of the acceptance tests, the QE completes a report. The original is given to the system owner, and a copy is sent to the IBGE-BIM; the QE keeps another copy. The minimum contents of this report are legally fixed.

Periodic inspection of boilers

The owner of the heating system has to hire a qualified technician to maintain and check the boiler every year for oil boilers, and every 3 years for gas boilers. This type of inspection is named 'periodic inspection of boilers' and follows a formal methodology, unrelated to the CEN standards. This inspection shall include the following items:

> cleaning of the boiler;
> cleaning the exhaust system of combustion gases;
> adjustment of the boiler burner;
> verification of the following requirements:
  · presence of holes for measuring the combustion efficiency;
  · combustion efficiency and emissions of the boiler in operation;
  · power modulation of boiler burners;
  · chimney draft;
  · ventilation of boiler room;
  · tightness of the exhaust gas and combustion air supply.

At the end of the 'periodic inspection', the qualified technician completes a report. The original is given to the system owner, and the inspector keeps a copy. If the boiler does not comply with the legal requirements, the inspector sends a copy of the report to the IBGE-BIM. The minimum content of this report is legally fixed.

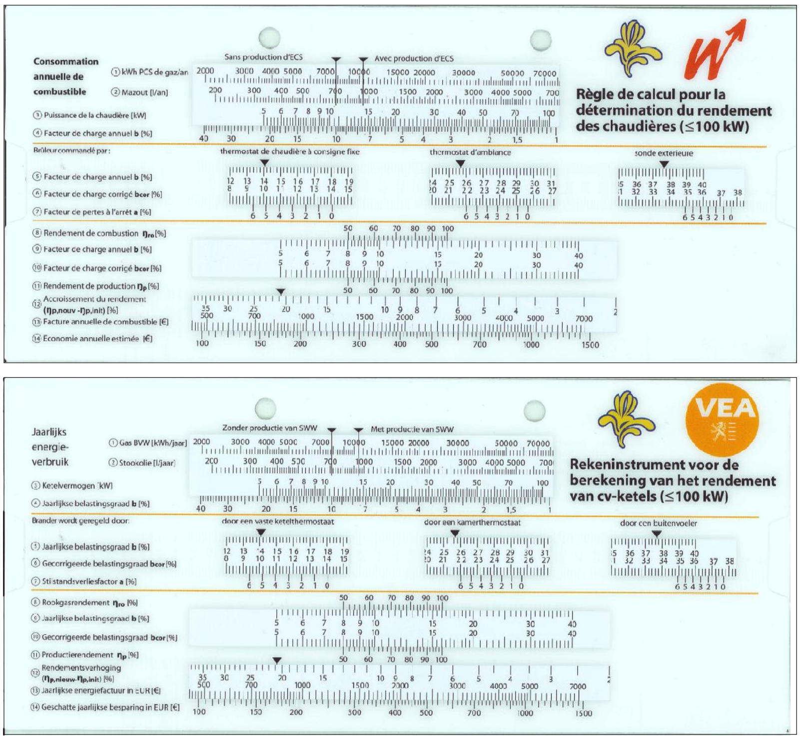


Figure 6: Calculation device for one-off inspection of heating systems (Type 1).

One-off inspections of heating systems

The one-off inspection of a heating system is an assessment of the whole system by a QE. It must be performed not earlier than one year before and not later than one year after the oldest boiler, with a power greater than 20 kW, that is connected to the heating system has reached the age of 15 years. A periodic inspection shall have to be conducted within 12 months prior to this one-off inspection. The one-off inspection includes:

> assessment of the EP of the boilers and the heating system;
> information regarding compliance with applicable requirements, depending on the type of the heating system;
> assessment of the oversizing of the boilers;
> advice on:
  · boiler replacement;
  · other possible changes to the heating system;
  · the use of the heating system;
  · alternative solutions.

The method and tools for the one-off inspection were developed in collaboration with the Flemish and Walloon Regions. Different tools are used depending on the type of the heating system (Type 1 or Type 2). For Type 1 systems, a calculation device is used. For Type 2 systems, a specific software programme was developed.

Type of inspection	Type of heating system	Type of qualified expert
Reception	Type 1	Certified heat engineer
	Type 2	EP heating advisor
Periodic inspection	Type 1 & 2	Certified boiler technician L, G1, G2
One-off inspection	Type 1	Certified heating engineer
	Type 2	EP heating advisor

Table 5: Types of Qualified Experts, depending on the type of heating system and type of inspection for which they are authorised.

Qualified Experts for carrying out boiler Inspections

There are 5 types of QEs, depending on the inspection type and the boiler type:

> the certified boiler technician L (oil boiler);
> the certified boiler technician G1 (atmospheric gas boiler or premix burner);
> the certified boiler technician G2 (gas boiler with forced air burner);
> the certified heating engineer;
> the EPB heating advisor.

The accreditation by the IBGE-BIM is subject to certain conditions, including obtaining a certificate of competency after attending a training course and passing an exam on the regulation and the techniques (depending on the type of accreditation), complying with certain obligations (e.g., keeping copies of the reports, accepting the quality control, using the methodologies and the tools supplied by the IBGE-BIM, etc.) and attending follow-up refresher training. The accreditation is valid for 5 years, and may be extended for additional periods of 5 years.

The IBGE-BIM has provided a specific syllabus with the content of the training (including the exam). They are available free of charge on the IBGE-BIM website or on demand. The trainings are organised by independent training centres since the beginning of 2011.

In November 2012 there were about:

> 360 certified boiler technicians L;
> 500 certified boiler technicians G1;
> 150 certified boiler technicians G2;
> 150 certified heating engineers;
> 50 EPB heating advisors.

Quality Assurance system

The quality control of the certified boiler technicians, the certified heating engineers and the EPB heating advisors has started, but it is still in the first phase. It is still more of a 'coaching' than a punitive control. However, if necessary, the IBGE-BIM can suspend or revoke the license of a QE (in case of repeated non-compliance with the obligations).

4.2 Progress and current status on AC systems

The regulation on the energy performance of air-conditioning (AC) systems aims at the minimum acceptable energy efficiency level, and the reduction of the environmental impact of these systems. It came into force on the 1st of September 2012. This regulation determines:

> a series of requirements (see below);
> a minimum maintenance programme;
> a periodic inspection.

According to the energy balance of the Brussels Capital Region, AC, ventilation and refrigeration represent 8% of the electricity consumption in the tertiary building sector. About 50% of the commercial buildings have AC systems; this percentage rises to 70% in private offices. The regulation on the energy performance of AC systems should allow a reduction of 5 to 10% of the energy consumption of these technical facilities.

This regulation applies to AC systems with an effective rated output greater than 12 kW. This effective rated output is the sum of the cooling capacity of refrigeration systems that make up the AC system, and are connected to a common control.

The EP requirements concern the following points:

> sizing of the refrigeration plants;
> thermal insulation of pipes and accessories;
> partitioning of cold and air distribution;
> energy metering on the refrigeration plant;
> energy metering on the electric fans;
> variation of the flow of fresh air according to the actual occupation (for spaces with variable occupation);
> energy accounting (measure, analyse and report the energy consumption of the AC system);
> keeping a logbook.

Maintenance

AC systems need to be maintained in accordance with a minimum maintenance programme to be determined in a ministerial executive order. Once this

Table 6: Maximum interval between two consecutive AC inspections.

Effective rated output of the AC system	Maximum interval
from 12 to 100 kW	15 years
≥ 100 kW	5 years

order is in force, and after a transition period, this maintenance will have to be performed under the supervision of a technician accredited by the IBGE-BIM.

Periodic inspection
AC systems must be checked periodically by an inspector accredited by the IBGE-BIM.

The first periodic inspection must be completed by the 1st of September 2013. The maximum interval between two consecutive inspections depends on the effective rated output of the AC system, as presented in Table 6.

In addition, after installing a new AC system or after a significant modification, a periodic inspection must be carried out. The periodic inspection includes:

> evaluation of the sizing of the AC system;
> verification of control parameters such as temperature setpoints and operating schedules;
> verification of system maintenance;
> verification of compliance with the EP requirements;
> recommendations for improvements and corrections to the existing AC system and, if necessary, advice on replacement and on alternative solutions.

At the end of the 'periodic inspection', the inspector completes a report using the software supplied by the IBGE-BIM. The original is given to the system owner, a copy is sent to the IBGE-BIM and the inspector keeps another copy for their archives. The minimum contents of this report are legally fixed.

Qualified Experts for carrying out AC systems inspections
There are 2 types of QEs for carrying out AC system inspections: EPB air-conditioning technician, and controller.

The EPB air-conditioning technician is responsible for the maintenance supervision, while the controller performs the periodic inspections.

The accreditation by the IBGE-BIM is subject to the same rules described for boiler inspectors.

Quality Assurance system
The regulation foresees a quality control, but it has not been implemented yet.

5. Conclusions and future plans

Before the Energy Performance of Buildings Directive (EPBD), the only energy requirement for a new building was to get a K-level (average U-value of the building envelope, weighted by compacity) of 55, and to have the liquid fuel boilers maintained by an accredited professional each year. Following the EPBD, the K-level was tightened, and additional requirements and controls were introduced, as described in this report. The Energy Performance Certificates (EPCs) have also been introduced.

Future plans
The following steps are under way:

> finalisation of the last executive or ministerial orders required for the certification of existing buildings and the inspection of AC systems;
> training and accreditation of the Qualified Experts (QE) to perform heating system inspections and certifications;
> revision of the calculation procedure for new buildings;
> upgrade of the software tool for the Energy Performance (EP) calculation for new buildings;
> new efficient software tool for the EP calculation for public buildings;
> enhancement of controlling the enforcement of the regulation for the Energy Performance Certificates (EPCs);
> transposition of the recast EPBD, including planning for Nearly Zero-Energy Buildings (NZEB).

EPBD implementation in Belgium Flemish Region

STATUS AT THE END OF 2012

Authors

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1. Introduction

In Belgium, the implementation of the Energy Performance of Buildings Directive (EPBD) is a regional responsibility. The Flemish Energy Agency (VEA) and the Ministry of Environment, Nature and Energy are responsible for the EPBD implementation in the Flemish Region. VEA is also the managing body for the requirements and certification schemes. VEA designed, developed and supports the requirements and certification system for the Flemish Region, based on a central register.

In 2011, an evaluation process of the Flemish legislation was finalised. The Energy Decree and the Energy Act were changed in order to implement the recast EPBD (Directive 2010/31/EU), to tighten the requirements, and to improve the methodologies and certification process, based on the experience gained over the years.

This report presents an overview of the current status of the implementation and of the plans for the evolution of the implementation of the EPBD in the Flemish Region. It addresses certification and inspection systems, including quality control mechanisms, training of Qualified Experts (QE), as well as information campaigns.

2. Energy performance requirements

2.1 Progress and current status

The Energy Performance (EP) requirements for new and renovated buildings came into force in January 2006. Since then, each new or renovated building has to fulfil requirements on EP (E-level), insulation (U-values and global insulation 'K-level') and indoor climate (risk of overheating, and ventilation). The most important requirement concerns the E-level, which is the annual primary energy consumption, divided by a reference consumption.

The maximum EP level was reduced by 20% (from E100 in 2006-2009 to E80 since 2010) for new residential buildings. At the same time, some maximum U-values of roofs and outer walls were tightened for all new and renovated buildings. This tightening was based on a first cost-optimal study for residential buildings, conducted in 2008. Since 2010, it is obligatory to take thermal bridges into account, which means that additional measures were needed to meet the EP requirements.

A second tightening has taken place since the 1st of January 2012. The E-level was further decreased by 10%, reaching the level E70 for new residential buildings. The maximum E-level was also set at E70 for schools and office buildings. All the U-values were tightened, and the global insulation level was decreased from

National Websites *www.energiesparen.be/epc, www.energiesparen.be/epb/prof/home, www.energiesparen.be/epb/energieprestatieregelgeving, www.lne.be/campagnes/centrale-verwarming, www.energiesparen.be/verwarmingsaudit, www.lne.be/themas/erkenningen/airco-energiedeskundige*

K45 to K40 (Figure 1). The overview of the required U-values since 2006 is shown in Table 1. A new requirement on the net energy demand for heating was introduced for residential buildings, to stimulate insulation and airtightness of the building envelope, and the use of controlled ventilation (max. 70 kWh/m².year).

Figure 1: Definition of the global insulation level K, as a function of the mean U-value and the compactness of the building.

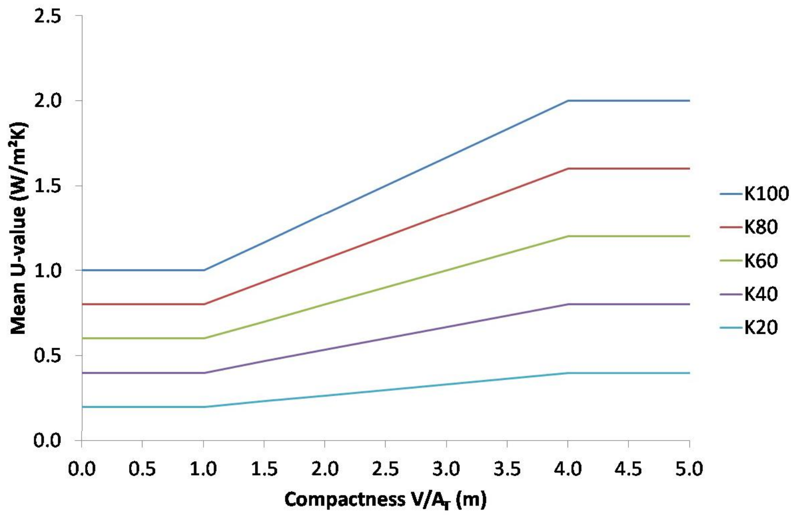


Figure 2: Percentage of final declarations for single-family houses/year (year in which the building permit is asked for).

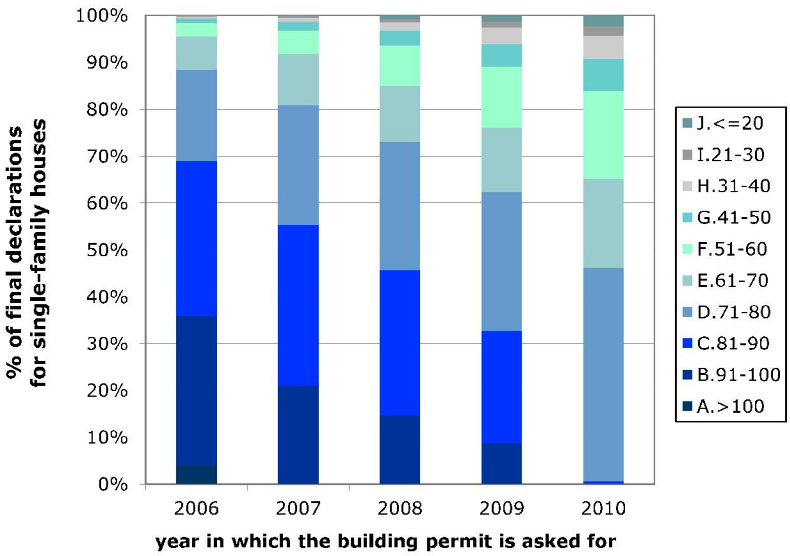
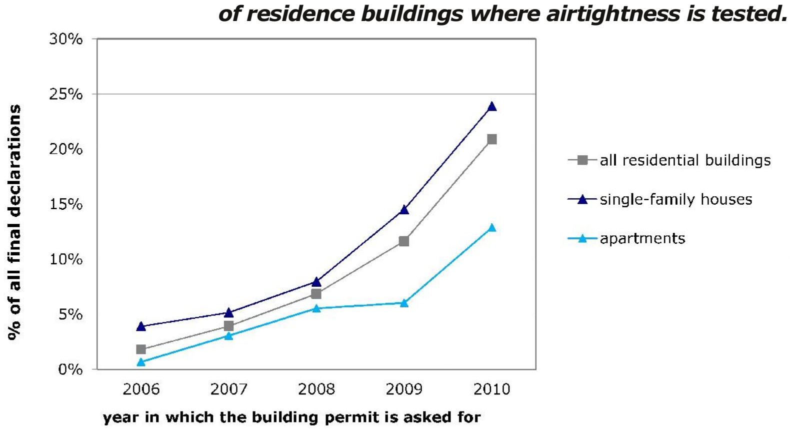


Figure 3: Percentage of all final declarations of residence buildings where airtightness is tested.



A new step for tightening the requirements in 2014 (E60 and U-values) is already introduced in the legislation.

More than 125,000 final declarations were sent to the central register. VEA analysed the results included in the final declarations[1], and concluded that the average E-level decreases every year. It was also found that the improvement is more rapid for new single-family houses. The percentage of single-family houses with an E-level higher than E80 has dropped from nearly 70% (building permits in 2006) to 47% (building permits in 2010), while the percentage of low-energy houses (≤ E60) increased from about 11% (building permits in 2006) to about 35% (building permits in 2010) (Figure 2). The average E-levels of flats, offices and schools decrease more slowly. These results are shown in Table 2.

The amount of airtightness tests also rises fast: the airtightness is measured in about 21% of new residential buildings (building permits in 2010). The evolution since 2006 is shown in Figure 3. In nearly 20% of the residential buildings (building permits in 2010), one or several renewable technologies (PV, solar hot water panels and heat pumps) are used. The trend line since 2006 is shown in Figure 4.

2.2 Format of national transposition and implementation of existing regulations

All necessary changes in the Energy Decree to transpose the recast EPBD were made in 2011.

The recast EPBD requires that infringements must be penalised. The Energy Decree describes sanctions in case of infringements or low reporting quality since 2006. Two documents are used as evidence: an initial declaration, with the desired performance, and a final declaration describing the performance of the finalised building. Both documents, together with the building permits, are stored in a central database. VEA uses this database to check compliance and quality control. The final declaration is used to prove compliance with the requirements.

The number of buildings in which one or more of the requirements (K, E, U and ventilation) are not met reduces every year: from 9% in 2006 to 3% in 2010.

1 *www2.vlaanderen.be/economie/energiesparen/epb/doc/EPBincijfers-2006-2011.pdf*

Table 1: Overview of the maximum U-values since 2006.

	Maximum U-value (in W/m².K)			
	from 2006 to 31/12/2009 incl.	from 2010 to 31/12/2011 incl.	from 2012 to 31/12/2013	from 2014
Roofs, ceilings to attics …	0.40	0.30	0.27	0.24
Outer walls	0.60	0.40	0.32	0.24
Floors on the ground or above cellars	0.40	0.40	0.35	0.30
Windows (profile + glazing)	2.50	2.50	2.20	1.80
Glazing	1.60	1.60	1.30	1.10

Table 2: Overview of the average E-levels/year (year in which the building permit is asked for).

	2006	2007	2008	2009	2010
New single-family house	85	80	76	72	64
New flats	90	83	81	80	70
New office buildings and schools	100	88	83	82	(statistically not relevant)
Maximum E-level	100	100	100	100	80 (residential) 100 (schools and office buildings)

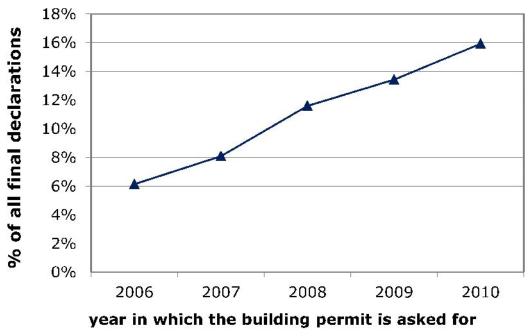


Figure 4: Percentage of all final declarations of residential buildings where one or several renewable technologies (PV, solar hot water panels and heat pumps) are used.

Most of the fines are imposed for not meeting ventilation requirements, whereas non-compliance with the required EP level is rare. More than 6,000 cases of requirements infringement were initiated during the period 2006-2012. More than 4,000 administrative fines were imposed.

VEA also checks compliance with procedures. For example, in 2012, VEA detected more than 1,700 cases where the building was in use, but the final declaration was not available.
If the builders do not respond to the reminder, a fine is imposed in these cases also.

The recast EPBD demands that the EP calculations are to be performed by qualified and independent persons, and that an independent quality control system is in place. In the Flemish Region, the final declaration is composed by a ‘reporter’. To be a reporter, a diploma of engineer or architect is necessary. Supplementary training is often organised by the market, but is not obligatory. The possibility of suspending a reporter when incompetence is identified, based on several incorrect reports, was introduced in the Energy Decree in 2011. The reporter may also be suspended when independence is not assured; e.g., if the reporter also sells ventilation installations.

The independent quality control system is running since 2006, based on two types of inspections:

- Desk audit: this inspection takes place at random, and on the final declarations in which the requirements are just met, or in which a low EP that entitles the owner to a tax refund is reached. Conducting a few checks, VEA verifies if the declarations are largely correct, and the claimed result is realistic. If not, VEA performs a more in-depth investigation. More than 2,000 final declarations have undergone a desk audit.
- On-site checks, either on the building site or on the finalised building, where the VEA controller compares the materials and installations used with those reported in the final declarations. If not in accordance, there is again further examination.

From all inspections carried out in 2011, VEA found 107 EPB-reporters with one or more incorrect final declarations; these cases have undergone further investigation and more than 120 files were treated in 2012. Fines are imposed if the expert reports performances better than the real ones.

VEA uses its website *www.energiesparen.be* as the primary channel where all the information can be found. Distinct websites were set up for builders and for reporters. VEA also spreads new information in its digital newsletter and there is a helpdesk for questions and technical support, receiving more than 10,000 questions yearly.

At the end of 2012, a new revision process of the current legislation was launched. In 2013, VEA will make suggestions on the current decree and legislation, based on the results of a study on system requirements, on the revision of the calculation method, and on the study of the cost-optimal procedure.

A new requirement on Renewable Energy Sources (RES) was recently added to the EP requirements, to transpose the Directive 2009/28/EC on the promotion of the use of energy from renewable sources (RES Directive). This is obligatory for new schools and office buildings with public services since the 1st of January 2013, and will be obligatory for residential buildings, as well as for all schools and office buildings without public services, from the 1st of January 2014. In single-family houses, at least one of the following arrangements will be necessary: thermal solar systems, photovoltaic panels, a biomass heating boiler, a heat pump, connection to a district heating, or participation in a renewable energy project. For larger residential buildings, schools and office buildings, at least 10 kWh/m².year of renewable energy will be needed.

2.3 Cost-optimal procedure for setting EP requirements

The cost-optimal approach was already used in the Flemish Region before the recast EPBD, to investigate the needs and to broaden the public support in tightening the requirements.

In July 2012, the calculation of the cost-optimal levels of minimum EP requirements for buildings and building components was launched, according to the comparative methodology framework published by the European Commission. The results of this study are expected in the spring of 2013. They will then be used to evaluate the current and planned requirements, and to develop a plan with future tightening steps until 2020.

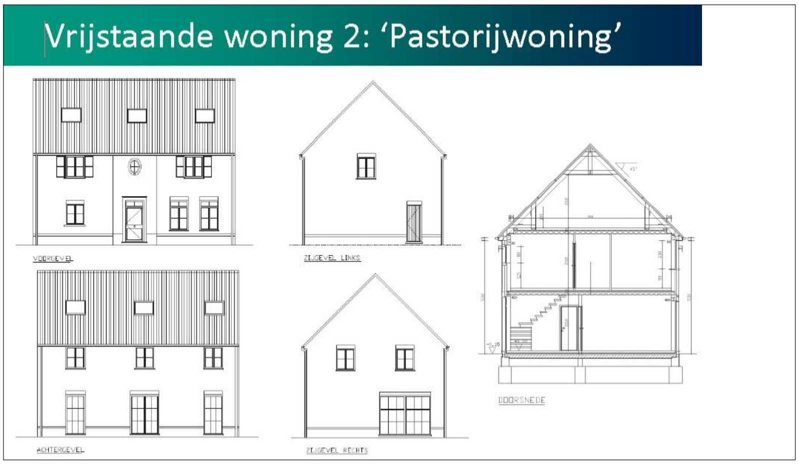
The study is divided in 4 parts, with a distinction between residential and non-residential buildings on the one hand, and between new buildings and renovated buildings on the other. A set of 4 single-family and 3 multifamily house typologies are considered for both new and renovated residential buildings, with only small typological differences (e.g., Figure 5). One school and one office building were selected for each non-residential part, resulting in 4 different reference buildings for new and renovated non-residential buildings.

A large set of measures, covering different steps of the most important input parameters of the existing EP calculation method, will then be applied on these reference buildings. Each individual measure will be combined with all other measures (excluding clearly non-optimal solutions), in order to obtain a notable cloud of data points to derive the cost-optimal level. The characteristics and prices of the different measures were presented to the stakeholders in October 2012 for feedback.

An additional sensitivity analysis of the expected energy reduction is included in the study. The impact of a real energy use that is half or two thirds of the calculated energy use will be studied, taking into account the users behaviour and the fact that in houses with poor EP, energy saving measures do not always lead to the predicted energy savings, because users choose a higher standard of comfort level.

The study will also investigate the need to change or differentiate the types of requirements, e.g., the need to apply the E-level for renovated buildings. The question arises if the current set of requirements can be simplified and/or adjusted.

Figure 5: One of the residential reference buildings for the cost-optimal evaluation.



2.4 Action plan for progression to NZEB

The Regional and Federal Governments have compiled their policy measures in one Belgian Nearly Zero-Energy Buildings (NZEB) Plan. However, each region formulates its own definition of NZEB, and is responsible for monitoring the implementation of its own policy measures. The Federal State will not formulate a definition.

The Flemish action plan was developed based on the barriers to realise NZEB. All stakeholders, like local governments, building federations, knowledge institutions and environmental organisations, were actively involved.

The main purpose is to realise a transition to a broad societal acceptance of NZEB in 2020, by stimulating the construction of NZEB on a large scale, with a specific policy focus on trend-setters. In order to achieve this objective, the 23 actions presented in the Flemish action plan are categorised into five pillars (Figure 6).

During the introductory phase, trend-setters shall receive support in the development and application of these systems, technologies and services, so that they are followed by the early adopters, ushering in a growth phase. When the ‘early majority’ has adopted the systems, technologies and services, only then can a volume market be achieved (Figure 7).

Imposing a roadmap with clear and transparent EP requirements will lead to the realisation of new NZEB. However, the challenges, as well as the opportunities for the energy retrofit of existing buildings, are large. Stimulating measures and actions for these buildings play an even more important role to achieve the desired transition.

The actions are aimed at encouraging both the market of new building construction and the renovation market to attain the NZEB requirements. The actions are developed for all types of residential and non-residential buildings.

The exemplary role of the government during the transition process is extremely important. In addition, the attainment targets which are enforced for public buildings must be implemented more rapidly. Therefore, special attention is given on measures for the public sector.

In compliance with the recast EPBD, the national plans shall include the detailed definition of NZEB. It is reasonable to assume that NZEB must at least satisfy the cost-optimal level, with a minimum level of RES as far as the EP requirements are concerned (Figure 8). The study to determine the cost-optimal levels of the minimum EP requirements is underway. The outcome of this study will be used as input for the detailed application of the Flemish definition of NZEB. The detailed definition of NZEB and the intermediate targets are foreseen for 2013.

Figure 6: The five pillars of the Flemish NZEB action plan.

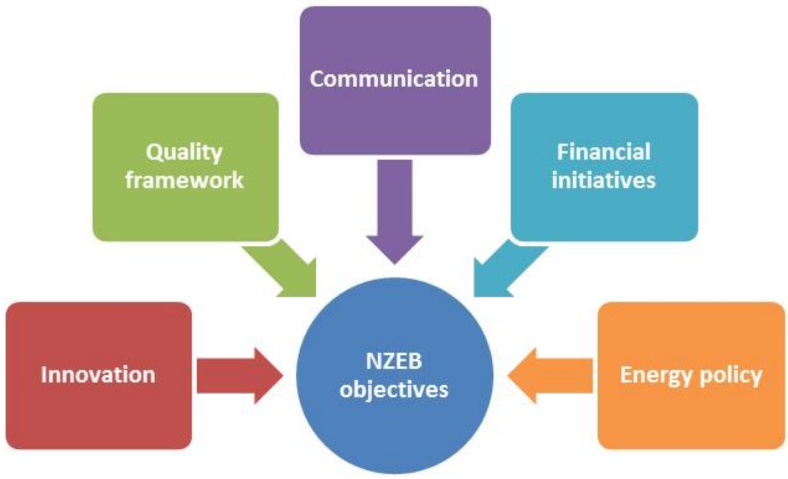
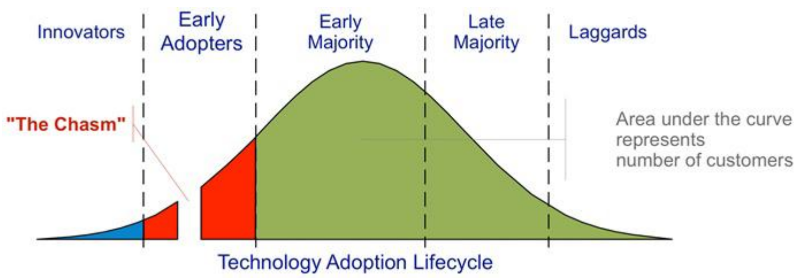


Figure 7: Technology lifecycle and the role of the front runners.



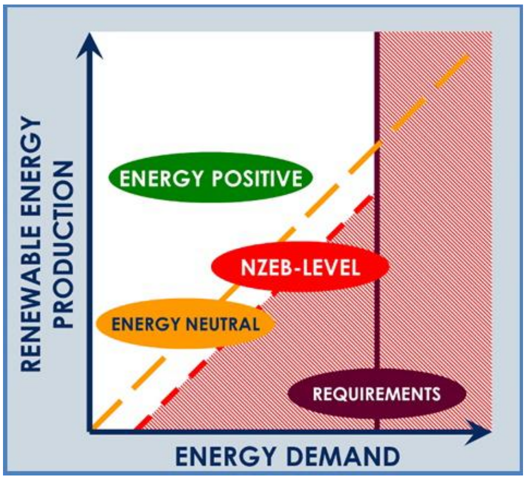


Figure 8: Ratio of renewable energy and energy demand to achieve NZEB level.

3. Energy performance certificates

The certification of new buildings started in January 2006. The Energy Performance Certificate (EPC) for new buildings is linked to the final declaration regarding the requirements. Ninety thousand certificates for new buildings were issued since 2006. For existing residential buildings, certification started in 2008; more than 500,000 certificates for existing residential buildings were issued since then. The EPC includes standardised recommendations that are automatically generated and tailored to the building, depending on the input. The introduction of a central exam for new experts in 2013 is a new milestone in the history of the EPCs in Flanders.

3.1 Progress and current status on sale or rental of buildings

There are 5,601 registered QE for residential buildings. Furthermore, 532,916 EPCs were issued for existing residential buildings (both for sale and rent) by the end of October 2012. The number of certificates issued per month and year is shown in Figure 9. Most certificates are issued when single-family houses are sold. Figure 10 shows the number of certificates issued for each type of existing residential buildings in the different provinces within Flanders. There are no statistics about costs charged for the certificates.

Figure 9: Number of EPCs for existing building by month and year.

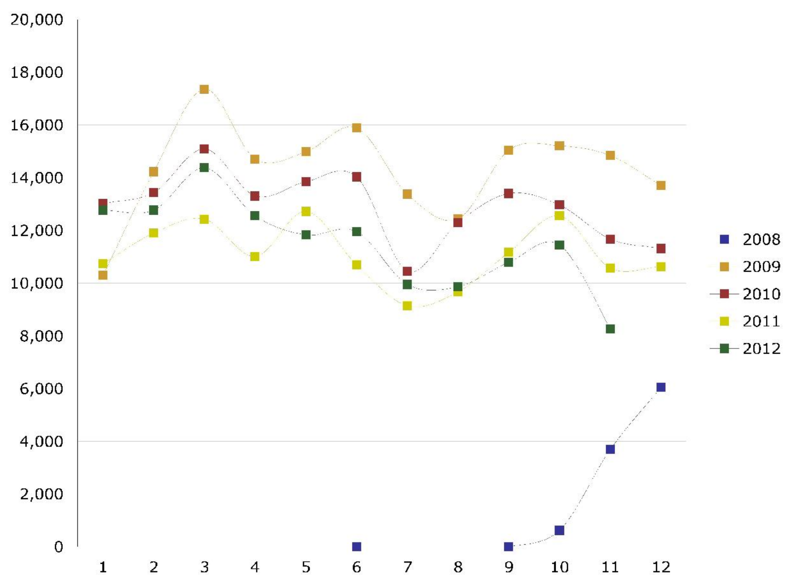
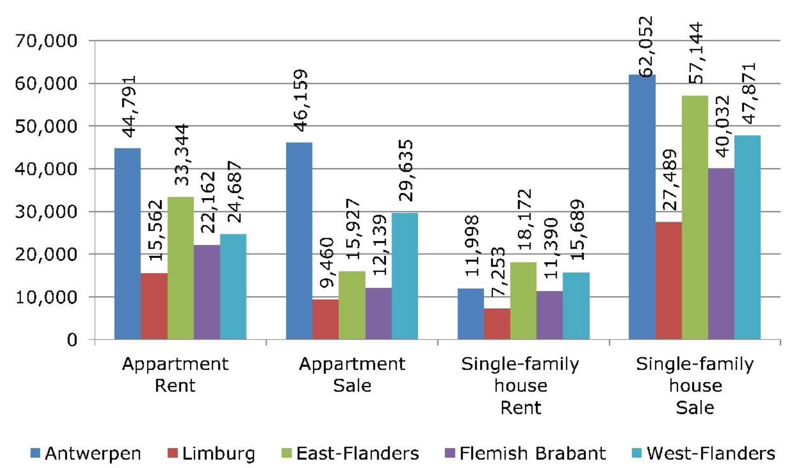


Figure 10: Number of EPCs by region and type of building (existing residential).



A calculated (asset) energy index in kWh/m².year (primary energy) is used to describe the EP of both new and existing residential buildings. This index is shown on a continuous scale on the certificate (Figure 11). Figure 12 shows the average energy score, sorted by province and type of existing residential building.
The average energy score in Flanders is 404 kWh/m².year. The average per building type and age is shown in Figure 13.

Since September 2012, candidate experts should follow a course and succeed in a central exam. The first central exam took place in February 2013.

The Energy Decree describes sanctions in case of infringements since the launch of the certification scheme. VEA checks the following:

> If an EPC is available when a building is put for sale or rent. Compliance with the availability of the certificate has significantly improved over the years. More than 95% of the buildings controlled in 2012 had a certificate. Furthermore, 3,312 advertisements were checked in 2012 on availability of the EPC. Only 142 did not include an EPC (4,29% of the total). In 2011, 81% of the controlled dwellings (4,846) had a certificate, whereas, in 2010, 68% of the controlled dwellings had a certificate. The owner (seller) risks a penalty between 500 € and 5,000 € if there is no certificate available. In 2011, 202 fines were imposed (120 in 2010).

> If the energy score and address or unique code are mentioned in the advertisements (see 3.3). The sanction for the building owner, user or their agent, in case the advertisement does not show the (correct) energy score, is between 500 € and 5,000 €.

> If the certificates are correct. VEA executes a quality check on 233 energy experts in 2012. Most of these files are still under investigation. In 2011, VEA checked 692 certificates of 258 experts.

Of those, 161 were found to have correctly issued their EPCs, while 97 had to send evidence to back up the data they had inserted in the EPCs. After checking the evidence, 76 experts had to pay a fine, and 3 were suspended. Experts risk a fine between 500 € and 5,000 € if the control shows that the certificates are not issued. Until now, only fines of 500 € were imposed for e.g., non-availability of the EPC, lack of information about the energy score in the advertisement, or poor quality of the EPC.

The implementation of certification for non-residential (and non-public) existing buildings, also on the basis of an asset rating, is only foreseen for 2015.

3.2 Progress and current status on public and large buildings visited by the public
There are 1,164 registered QEs for public buildings and 828 internal experts. An internal expert is an experienced member of the public organisation's personnel who is able to arrange the EPC for their organisation's building.

From 2009 until the end of October 2012, 6,563 certificates for public buildings were issued. These certificates are issued on the basis of an operational rating (measured energy consumption).

Since September 2012, candidate experts must follow a course and succeed in a central exam. The first central exam took place in February 2013.

VEA checks:

> If a certificate for a public building is available. Table 3 presents an overview of the controls regarding the availability of the certificates for public buildings.
> If the certificates are correctly issued.

3.3 Implementation of mandatory advertising requirement – status
Since January 2012, it is mandatory to publish the energy score and the address or the unique certificate reference number in each commercial advertisement. From January until October 2012, 1,951 controls have been executed regarding the advertising requirements. 213 advertisements were incorrect, representing 11% of the controlled advertisements. Both private persons and broker agencies can get a fine between 500 € and 5,000 € for not publishing the required data regarding the EPCs. The penalty files are still under investigation; there are no detailed data on the penalties yet available.

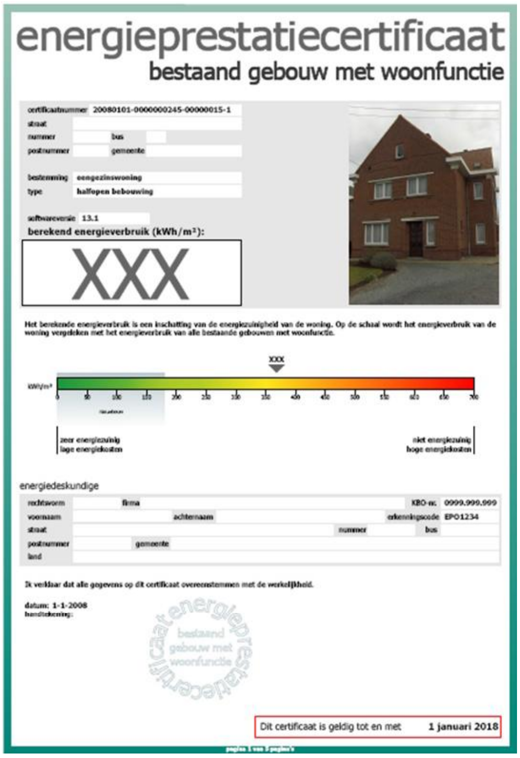


Figure 11: Front page of the EPC for an existing residential building.

Figure 12: Average energy index by region and type of existing building (residential).

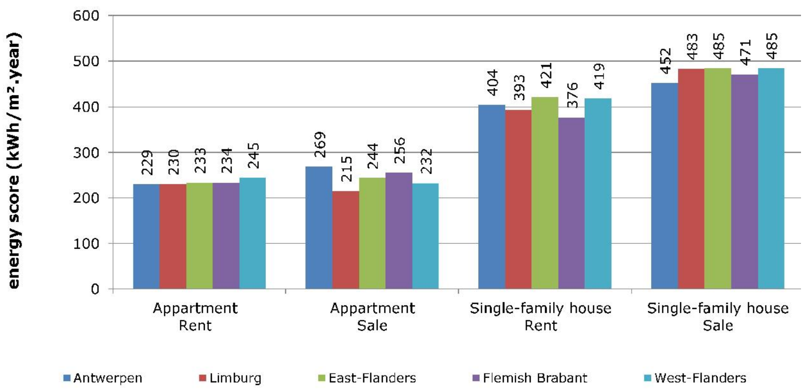


Figure 13: Average energy index by type and age of building (residential).

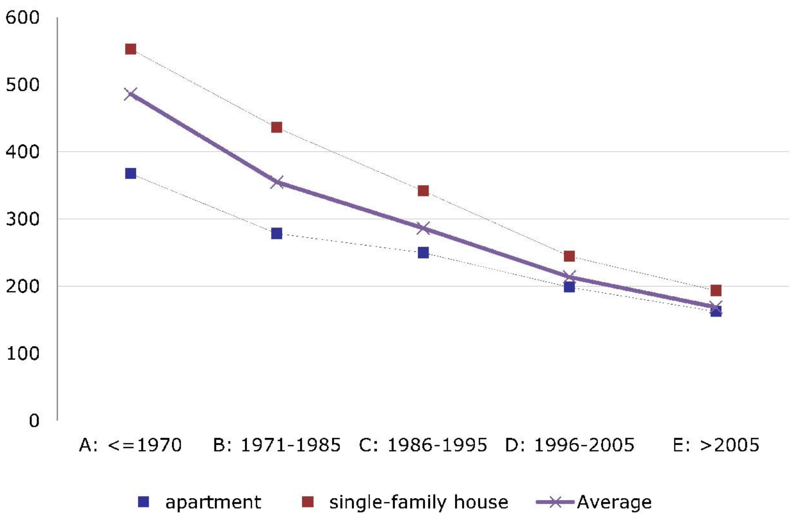


Table 3: Overview of controls regarding the availability of certificates in public buildings.

	Controls on availability of EPCs in public buildings
2009	33 municipalities
2010	33 municipalities
	5 provinces
	18 colleges of higher education
	5 universities
	50 schools (toddler, elementary and secondary)
2011	35 municipalities
	60 schools (toddler, elementary and secondary)
	39 (all) psychiatric hospitals 67 (all) general hospitals
2012	25 rest homes
	60 schools (toddler, elementary and secondary)
	35 municipalities

3.4 Information campaigns
After the initial campaign in 2008 there were no more major information campaigns and neither are there any planned for the near future. In 2011, VEA had a meeting with the real estate sector and the notaries, to inform them regarding the advertisement requirements. A brochure with the obligations regarding the EPC is available on the website, both for public and for residential buildings.[1,2] Energy experts and other stakeholders are also informed through a newsletter, the website, specific mailings, and other means.

3.5 Any other relevant information
In the near future, the certificate for existing residential buildings will be extended with some extra information, namely, additional advice and more information on the input data. In the further future, the current software (for residential buildings) will be extended, so that experts can deliver more customised advice in order to improve the EP of buildings.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems
Since 1978, liquid fuel boilers must be inspected annually, while gas boilers must be inspected every two years. These inspections include an inspection of the accessible parts of central heating systems used for heating buildings. Since the 1st of January 2009, the legislation also requires a one-off inspection of central heating systems older than 15 years, by means of a heating audit. The method and tools for the one-off inspections are developed in cooperation with the Brussels-Capital and Walloon Region. For smaller systems (between 20 kW and 100 kW), a calculation tool is used. For systems above 100 kW, specific software was developed. The inspections are carried out by certified technicians, recognised by the Flemish Government after completing a specific initial training. After that, the technicians have to attend in-service training every five years, in order to keep their recognition. A list of recognised technicians is available to the public.

Taking into consideration the recast EPBD, the Flemish Government is going to take measures to establish regular inspections. The former one-off inspection will be carried out more frequently, as follows:

> Liquid fuel boilers with an effective rated output of more than 100 kW will be inspected every two years; gas boilers every four years.
> Smaller heating systems (between 20 kW and 100 kW) will be inspected every five years.

Every year, a number of recognised technicians are selected by the Flemish Government; they have to send to the government a list of data of inspections recently carried out. The list of technicians to be controlled consists of technicians against whom complaints have been made, as well as of a random selection of other recognised technicians. Each year, a statistically significant percentage of all the inspection reports will be verified by an independent accredited inspection body, by order of the government. The Flemish Government may suspend or withdraw the recognition when the technician fails to meet the recognition requirements. The decree of the 5th of April 1995, concerning general provisions relating to environmental policy, contains the sanctions for the owner when the mandatory inspection is not carried out.

1 *www.vlaanderen.be/nl/publicaties/detail/b5-het-energieprestatiecertificaat-een-energierapport-voor-koop-en-huurwoningen*
2 *www2.vlaanderen.be/economie/energiesparen/epc/doc/brochure_epcpubliekegebouwen.pdf*

4.2 Progress and current status on AC systems

The Flemish Region incorporated the inspection requirements for air-conditioning (AC) installations in the Order of the Flemish Government, issued on the 1st of June 1995, concerning general and sectoral provisions relating to environmental safety. Individual AC systems with a nominal cooling capacity above 12 kW need regular inspection by a competent expert. If an AC system consists of a number of individual systems connected through a central control system of pipes, then the nominal cooling capacities of the different individual systems have to be added up. A competent expert for AC inspection needs a specific bachelor's degree, a diploma or certificate (e.g., a bachelor's degree in electromechanics, specialising in climate control, a diploma of secondary education in cooling and heating technology, industrial cooling technology or cooling installations), or must be a cooling technician recognised by the Flemish Government. A competent expert may also be someone who has at least three years of demonstrable experience in servicing and installing AC systems with a nominal cooling capacity above 12 kW, or who holds the qualification or accreditation required in another EU Member State (MS) for testing AC systems. The inspection consists of an assessment of the efficiency and sizing of the AC, compared to the cooling requirement of the building. The Minister can determine the content and frequency of the inspection.

In 2008 and 2009, the Flemish Government organised an informal consultation with experts from the sector, in order to determine the aspects and frequency of inspections. Following this consultation, it was concluded that an inspection tool prepared by the Flemish Government, which could be freely used by inspectors, would be necessary. This tool would promote the effective implementation of the inspection obligation, would allow for the identification of many occurring shortcomings, or items that are subject to significant improvement, and would prevent inspections from not meeting the desired minimum requirements. Also, with this tool, Inspections would be carried out in a uniform way. The development of the inspection tool was finished in February 2011. The Minister then determined that the software (i.e., a spreadsheet) had to be used during inspections from the 10th of April 2011 onwards. The software produces an inspection report that contains the result of the inspection, and includes recommendations for the cost-effective improvement of the EP of the inspected system. The Minister also determined the frequency of the inspection (Table 4).

nominal cooling capacity	frequency of inspection
> 12 kW and < 50 kW	every 5 years
≥ 50 kW and < 250 kW	every 3 years
≥ 250 kW	every 2 years

Table 4:* *Frequency of inspection of air-conditioning systems with a nominal cooling capacity above 12 kW.

The legislation in the Flemish Region was adjusted in the context of the implementation of the recast EPBD. From the 1st of January 2015, the inspection may only be conducted by a recognised expert who has attended a specific training course (including the use of the software) and has passed a specific test. Only persons with at least a minimum training or experience on refrigeration can take the training course. The recognised expert has to attend an additional training course every five years, and pass the accompanying test. The Flemish Government plans to publish on its website all the information relevant to obtaining a recognition as an AC inspector expert, as well as a list of the recognised experts. Recognised experts must keep a register with all their inspections of the previous calendar year. A number of these registers are requested at random annually by the Flemish Government, so that the quality of at least a statistically significant percentage of all inspection reports issued annually can be checked. An external independent accredited inspection body will be hired for the verification of the quality. The Flemish Government can suspend or withdraw the recognition in specific cases. The Decree of the 5th of April 1995 concerning general provisions relating to environmental policy contains the sanctions for the building operator if the mandatory inspection is not carried out.

5. Conclusions and future plans

Energy Performance (EP) requirements in the Flemish Region are in place since 2006. Many efforts and developments have taken place since then, but the objective regarding Nearly Zero-Energy Buildings (NZEB) is still very challenging. To fulfil this objective, new legislation will be needed. Furthermore, a set of strategies and actions must be carried out to ease the way. At this moment, the current requirements are examined according to the cost-optimal methodology, aiming at their evaluation and improvement in order to meet the NZEB standards in the future. A roadmap until 2020, the detailed definition for NZEB and the intermediate targets will be set up during 2013. Actions will soon be initiated with the support of the relevant stakeholders. The Flemish Energy Agency (VEA) will keep improving the system and tools; e.g., a new software tool for new and renovated buildings will be introduced in 2014. Continuous improvement and automatisation of the EP database is also planned, in order to reduce the administrative burden and to increase the efficiency of the enforcement process.

In the future, VEA shall continue to focus on the quality of the Energy Performance Certificates (EPCs) of existing buildings. Also, the introduction of the central exam can help to improve the knowledge of the experts and the quality of the EPCs. The current software for residential buildings will be extended with an extra module for advice, so that experts can deliver customised advice in order to improve the energy performance of buildings.

In 2013, the recognition of training centres and experts for air-conditioning (AC) inspections will start. After the 1st of January 2015, these inspections may be conducted only by recognised experts. An evaluation of the software used for the inspection of AC systems with a nominal cooling capacity of over 12 kW (e.g., web-based software instead of a spreadsheet) is planned for the years to come.

EPBD implementation in Belgium Walloon Region

STATUS AT THE END OF 2012

Authors

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1. Introduction

In the Walloon Region of Belgium, the overall responsibility of the implementation of the Energy Performance of Buildings Directive (EPBD) rests with the Department of Energy and Sustainable Buildings, except for the inspections of boilers and air-conditioning (AC) systems, which are under the responsibility of the Walloon Agency for Air and Climate.

The Walloon Region of Belgium implemented the EPBD on the 19th of April 2007. The Region has had a thermal regulation for new and existing dwellings, schools and offices, for many years. For existing buildings, there are requirements for the building envelope (U-values) and ventilation. These requirements are applied in the case that a building permit (‘*permis d'urbanisme*’) is required for a renovation. For new buildings, the requirements depend on the building type, and may cover the building envelope (U-values, global insulation level), the global Energy Performance (EP) rating (E_w, E_{spec}), ventilation, and an overheating rating. A certification scheme is in place for existing residential buildings since June 2010. More than 150,000 certificates are already delivered, representing more than 10% of the existing residential building stock. The regulation concerning the certification of existing non-residential buildings is in place since October 2011.

2. Energy performance requirements

In Belgium, regulations on the building energy performance are of regional competence. However, there are cooperation agreements between the 3 Regions, in order to establish an almost common methodology, leaving each Region to define its own requirements. Also, the 3 Regions will soon use a single software tool (Figure 1), developed jointly. The aim is to enable the easier application of the tool by professionals.

2.1 Progress and current status

The calculation procedures and the minimum requirements for new and existing buildings have been included in an Executive Order (*M.B. du 22/06/2012 , p. 34014*). After the first phase, which started in 2008, the Walloon EP Regulation came into force in its current form in May 2010.

The type and level of requirements for new buildings are determined by the function and type of the building (residential/schools and offices/industry/other non-residential buildings), (Table 1) and cover:

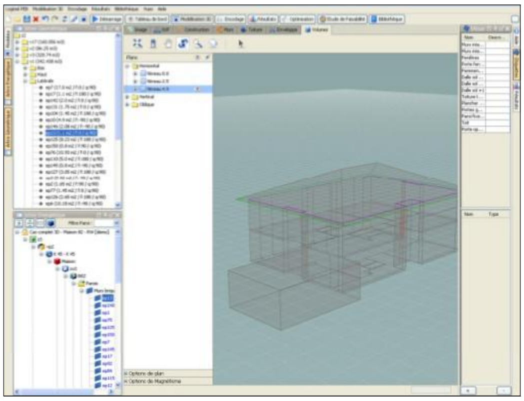


Figure 1: Software tool for the building energy performance.

National Websites *energie.wallonie.be*

> the maximum E_{spec} value, which expresses the primary energy demand per m² of heated floor area;
> the maximum E_w value, which expresses the primary energy consumption of the building compared to the primary energy demand of a reference building;
> the maximum K-value, which depends on the average U-value and the compactness of the building;
> the maximum U-values for each element of the building envelope;
> the requirements concerning ventilation (minimum ventilation rates to ensure indoor air quality);
> the maximum value for overheating rating.

For small existing buildings (<1,000 m²), the requirements of the previous regulation (in force since 1996) remain in place for ventilation, with more demanding U_{max} values. The requirements are also extended to other building typologies (including industry in some cases of extension or rebuilding). For renovated buildings larger than 1,000 m², the type and level of requirements is a function of the building type and the extent of the renovation.

Since May 2010, the requirements have been tightened twice, in terms of the demand level:

> The first tightening came into effect in September 2011, and it concerned the consumption requirements for new buildings. The maximum primary energy demand was reduced from 170 kWh/m² to 130 kWh/m², and the E_w value from 100 to 80.
> The second tightening came into effect in June 2012, and it concerned the insulation requirements for new and existing buildings. The maximum K-value was maintained at 45, but with the obligation to take into account the impact of thermal bridges. The maximum U-values for each element of the building envelope were also tightened. The calculation procedure has also been slightly modified (main changes: incorporation of the impact of constructive thermal bridges, integration of a cooling flow by opening windows, integration of ventilation on demand, modification of formulas related to cogeneration, information on photovoltaic panels, etc.).

Table 1 (continued on next page): Requirements evolution.

Requirements		Before EPBD		EPBD		
		Old requirements (2)	Requirements sept '08 - apr '10	Requirements may '10 - aug '11	Requirements sept '11 - dec '13	Requirements jan '14 - ...
A - U_{max} values - New and existing (1) houses, collective housing, hospitals, offices and schools - New and existing shops, catering buildings, sports facilities, business, industry						
1.	Walls delimiting protected volume, excluding dividing walls with an adjacent protected volume					
1.1.	Windows and others translucent walls excluding doors, garage doors, curtain walls and glass bricks	$U_{w,max}$ = 3.5	$U_{w,max}$ = 2.5 and $U_{g,max}$ = 1.6	$U_{w,max}$ = 2.5 and $U_{g,max}$ = 1.6	$U_{w,max}$ = 2.2 and $U_{g,max}$ = 1.3	$U_{w,max}$ = 1.8 and $U_{g,max}$ = 1.1
1.2.	Opaque walls					
1.2.1	Ceilings and roofs	0.4	0.3	0.3	0.27	0.24
1.2.2	Walls without any contact with the ground, with the exception of walls covered in 1.2.4	0.6	0.5	0.4	0.32	0.24
1.2.3	Walls in contact with the ground	0.9	0.9	R_{min} = 1.0	R_{min} = 1.3	R_{min} = 1.5
1.2.4	Vertical walls and sloping walls in contact: - with underfloor space - with cellar outside the protected volume	0.6 0.9	0.6 0.9	R_{min} = 1.0	R_{min} = 1.2	R_{min} = 1.4
1.2.5	Floor in contact with the outside environment or above an underfloor space	0.6	0.6	0.6	0.35	0.3
1.2.6	Others floors: - above a crawl space - above a cellar outside the protected volume - basement floors underground	0.9	0.9	U_{max} = 0.4 or R_{min} = 1.0	U_{max} = 0.35 or R_{min} = 1.3	U_{max} = 0.3 or R_{min} = 1.75
	- above the ground	1.2				
1.3.	Doors and garage doors	$U_{D,max}$ = 3.5	$U_{D,max}$ = 2.9	$U_{D,max}$ = 2.9	$U_{D,max}$ = 2.2	$U_{D,max}$ = 2.0
1.4.	Curtain walls	3.5	$U_{CW,max}$ = 2.9 and $U_{g,max}$ = 1.6	$U_{CW,max}$ = 2.9 and $U_{g,max}$ = 1.6	$U_{CW,max}$ = 2.2 and $U_{g,max}$ = 1.3	$U_{CW,max}$ = 2.0 and $U_{g,max}$ = 1.1
1.5.	Glass bricks walls	3.5	3.5	3.5	2.2	2.0
2.	Walls between 2 protected volumes located on adjacent properties	1.0	1.0	1.0	1.0	1.0
3.	Opaque walls inside a same protected volume or adjacent to an other protected volume on the same property, except for doors and garage door :					
3.1.	between distinct dwelling units	1.0	1.0	1.0	1.0	1.0
3.2.	between dwelling units and common spaces (staircase, entrance hall, passage)	-				
3.3.	between dwelling units and non-residential occupancy spaces	1.0				
3.4.	between industrial occupancy spaces and non-industrial occupancy spaces	1.0				

(1) Renovated building where a building permit is mandatory and non-heated buildings changing their occupancy
(2) These U-value requirements do not apply to shops, catering buildings, sports facilities, business, industry

Upcoming enhancements are planned for January 2014, and will involve the maximum primary energy demand, the maximum E_w value, the maximum K-value and the maximum U-values, depending on the function and type of the building (see Table 1).

The calculation procedure will also evolve, with two major changes:

> a better approach of the cooling and overheating rating calculation in residential buildings (main changes are: more accurate treatment of the effect of shading devices, consideration of new cooling systems, such as free cooling or Canadian well (ground-coupled heat exchanger), changes in the assumptions for assessing the risk of overheating, etc.);
> an extension of the methodology concerning non-residential buildings.

Figure 2 shows the impact of the changes in the regulations on the primary energy consumption of projects registered in the EPB database (for new buildings).

Requirements	Before EPBD		EPBD		
	Old requirements (2)	**Requirements sept '08 - apr '10**	**Requirements may '10 - aug '11**	**Requirements sept '11 - dec '13**	**Requirements jan '14 - ...**
B - K values (-) – Global insulation level (function of average U-value and compactness)					
New buildings:					
Houses	K55				
Offices and schools	K65	K45	K45	K45	K40
Collective housing, hospitals, shops, catering buildings, sports facilities, business	-				
Industry	-	K55	K55	K55	K55
Existing non-heated buildings changing their occupancy to:					
Houses	K65				
Offices and schools	K70	K65	K65	K65	K65
Other destinations (heated)	-				
Existing heated buildings (except industry) changing their occupancy to:					
Houses	K65				
Offices and schools	K70	-	-	-	-
Other destinations (heated)	-				
Existing industry (heated or non-heated) changing their occupancy to:					
Houses	K65				
Offices and schools	K70	K65	K65	K65	K65
Other destinations (heated)	-				
Others	-	-	-	-	-

Requirements	Before EPBD		EPBD		
	Old requirements (2)	**Requirements sept '08 - apr '10**	**Requirements may '10 - aug '11**	**Requirements sept '11 - dec '13**	**Requirements jan '14 - ...**
C - E_w (-) – Global energy performance level (calculated primary energy consumption divided by calculated primary energy consumption of a reference building) **D - E_{spec} (kWh/m².year) – Specific energy consumption (calculated primary energy consumption per square meter of heating floor area)** **E - Overheating rating (Kh)**					
New buildings:					
Houses	-	-	$E_w \leq 100$ $E_{spec} \leq 170$ $I_{overh} \leq 17{,}500$	$E_w \leq 80$ $E_{spec} \leq 130$ $I_{overh} \leq 17{,}500$	Values not yet fixed
Offices and schools	-	-	$E_w \leq 100$	$E_w \leq 80$	
Other destinations	-	-	-	-	
Existing building:	-	-	-	-	-

Requirements	Before EPBD		EPBD		
	Old requirements (2)	**Requirements sept '08 - apr '10**	**Requirements may '10 - aug '11**	**Requirements sept' 11 - dec '13**	**Requirements jan '14 - ...**
F - Ventilation					
New houses and buildings changing their occupancy to houses	Requirements are set in the annex V of the execution order of the 17^{th} of April 2008 (based on NBN D50-001)				
New offices and schools and buildings changing their occupancy to offices or schools	Requirements on air outputs are function of premises use	Requirements are set in the annex VI of the execution order of the 17^{th} of April 2008 (based on NBN EN 13779)			
New collective housing, hospitals, shops, catering buildings, sports facilities, business and buildings changing their occupancy to these destinations	-				
Renovated houses with mandatory building permit	Partial system (only for air entrance if windows are replaced)				
Renovated offices and schools with mandatory building permit	Partial system (only for air entrance if windows are replaced)				
Renovated collective housing, hospitals, shops, catering buildings, sports facilities, business with mandatory building permit	-	Partial system (only for air entrance if windows are replaced)			
New and existing industry	-	-	-	-	-

Figure 2: Average results of buildings registered in the EPB database in terms of E_w (primary energy consumption) compared to the legal requirements.

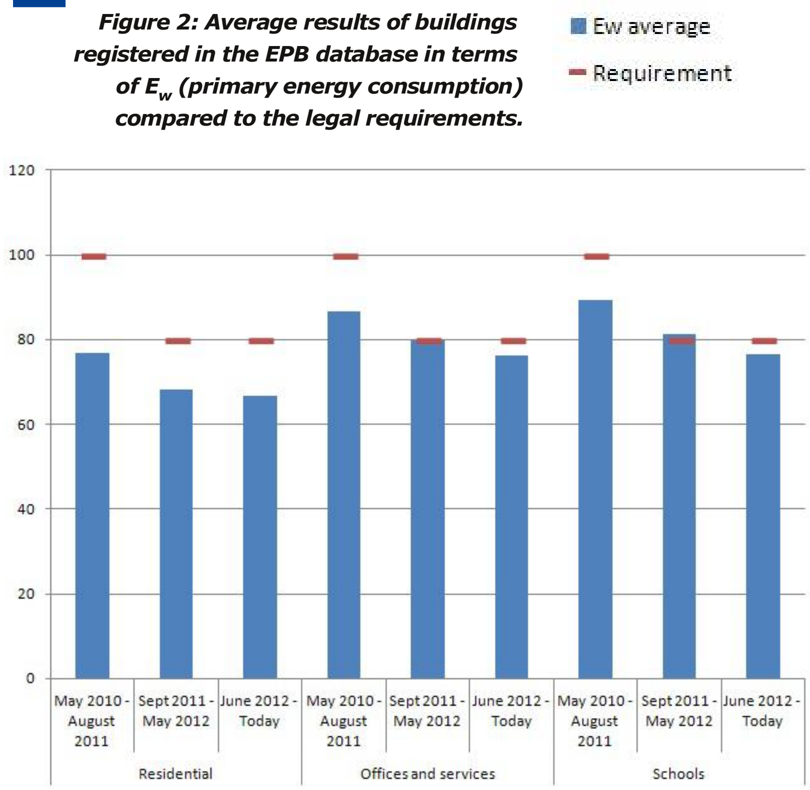


Figure 3: Central EPB web database.

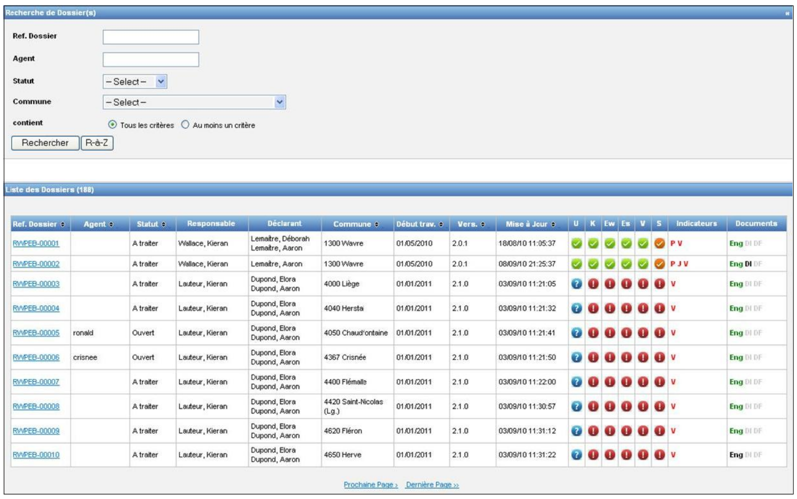
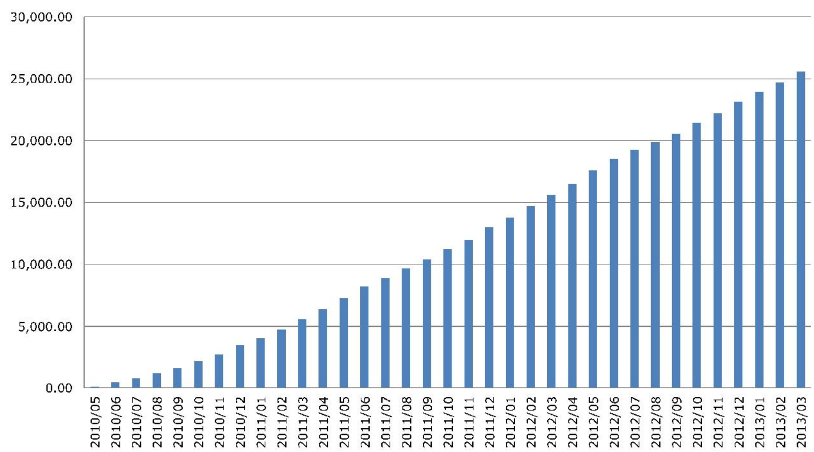


Figure 4: Central EPB web database – recorded files.



2.2 Format of national transposition and implementation of existing regulations

Qualified Expert

Professionals in charge of implementing the regulation are called '*EPB responsibles*'. The required degree is that of an architect or engineer. For the moment, 3,362 QEs are accredited. Among them, 922 are firms and 2,440 are private persons. For a person to become accredited, he/she must hold one of the required degrees, and prove that they have insurance coverage. Names and addresses of QEs are listed on the website[1] of the Department of Energy and Sustainable Buildings.

Software tool

A free software tool has been developed for QEs to be able to calculate the primary energy consumption of the building, to check compliance with regulation requirements, and to deliver proper forms to the administration. The software tool integrates a 3D Builder interface to facilitate the project coding. Since the first online version, when the regulation came into force in May 2010, four updates have been made available. In addition to the adaptations necessary for the implementation of reinforcements, the Region ensures constant improvements related to the usability of the tool, in response to the expectations of users.

QEs must save all their files on the central EPB web database (Figure 3). Local and regional administrations (866 civil servants) have access to this database in order to control compliance with the regulation. For the moment, 26,714 projects are registered in the database (new buildings and major renovations since May 2010), from which 2,369 are completed (building construction completed) (Figure 4).

Training Courses

Training courses are organised continuously. Their aim is to:

> explain the basic principles of the calculation method and the energy requirements to new QEs;
> explore in more detail the technical aspects to the accredited QEs.

The training courses are voluntary.

1 *energie.wallonie.be/fr/liste-des-responsables-peb-agrees.html?IDC=7264*

Practical guide and support
A practical guide (Figure 5) designed for professionals helps them to understand the new regulation. This guide is available on the website[1] of the Department of Energy and Sustainable Buildings.

A specific support service called '*Facilitateurs PEB*' is available. This service is accessible by mail or phone, and requires more than 3.5 full-time staff.

2.3 Cost-optimal procedure for setting EP requirements
Tenders for a public service contract were launched by the Walloon Region at the end of 2011, for the conduct of a study (named the 'Co-ZEB study') aiming at:

> determining the requirements relative to Nearly Zero-Energy Buildings (NZEB);
> determining the optimal EP level in relation to costs.

The contract was awarded to the Association of the University of Mons (Energy Centre), the University of Liège (EnergySuD), and the study bureau 3E.

At the end of 2012, only the first task of the study has been completed. Results for the second task will be available in May 2013.

2.4 Action plan for progression to NZEB
The Co-ZEB study qualifies any NZEB by a level of energy performance of the building envelope close or equivalent to the 'Passive House' standard. However, it is not necessary for a NZEB to comply with all of the criteria set by the 'Passive House' standard, given the highly constraining nature of these criteria for certain building types and/or for certain locations (in particular the criterion on the airtightness of the building envelope, which imposes a specific level of performance that is often difficult to achieve in construction terms). The quantification of the EP level is based on the development zones and the building type, as well as on whether the building is new or renovated.

NZEB will be characterised by the high thermal performance of the building envelope, together with covering a part of the residual consumption for heating/cooling and electricity using Renewable Energy Sources (RES).

This means that, at the design stage, a NZEB is characterised by an energy performance that is close or equivalent to that of the 'Passive House' standard in terms of the building envelope, and by the renewable energy coverage of part of the consumption, as illustrated in Figure 6.

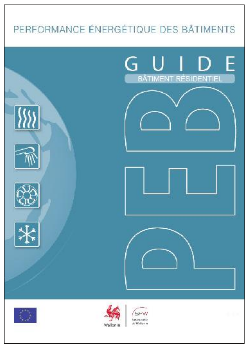
To be certified as NZEB, the building must meet a series of strict requirements or alternative criteria. A series of non-restrictive recommendations aims at facilitating compliance with the requirements set. A list of recommended solutions for the equipment encourages the occupants of NZEB to align their actual energy consumption with the projected or reference consumption estimated for items not considered in the characterisation of a NZEB at the design stage (Table 2).

The definition of NZEB and the EP level that is associated with NZEB shall evolve together with the available technologies, their cost and their ability to be implemented.

Interim targets for improving the energy performance of new buildings by 2015
The main targets set in the Regional Policy Statement (RPS) and included in the First Employment-Environment Alliance (EEA) of the '*Plan Marshall 2.Vert*' are described as follows:

"*With regard to new buildings, all construction will comply with the 'very low energy' standard from 2014 onwards. Construction will also comply with the 'passive' standard or equivalent from 2017. From 2019 onwards, all new buildings - in addition to the passive standard - will be required to comply as a minimum with the 'net zero' standard and tend towards positive-energy buildings*

Figure 5: Guide on the building energy performance for residential buildings.



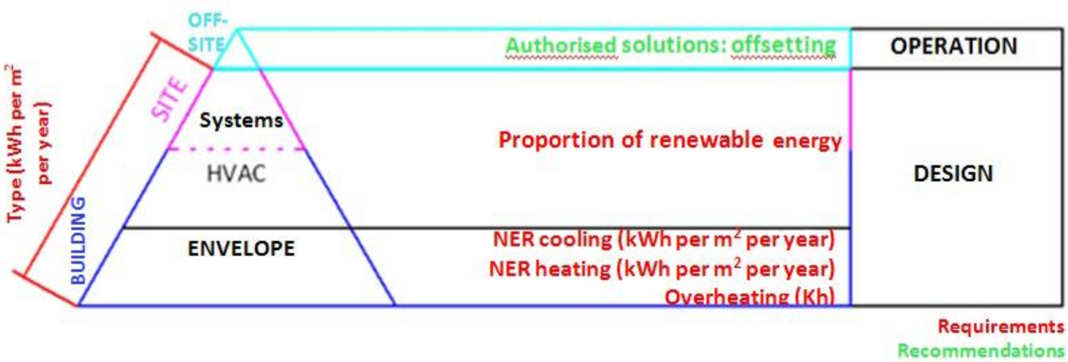


Figure 6: NZEB - Definition.

1 *energie.wallonie.be/fr/guide-de-la-performance-energetique-des-batiments-peb.html?IDD=20571&IDC=6935*

Table 2: NZEB – Requirements and recommendations.

	Residential building	Apartments	School	Offices & services
Requirements for the energy performance of NZEB				
Consumption E_{spec} (primary energy)	55 kWh/m².year		45 kWh/m².year	
Airtightness	≤ 2 m³/h.m²			
Net energy needs for heating	≤ 15 kWh/m².year		≤ 35 kWh/m².year	
Net energy needs for cooling	/	/		
Overheating (Kh)	Same as EPB regulation		Same as EPB regulation	
Minimum part of EP consumption covered by RES	50%			
Maximum CO_2 emissions allowed (alternative criteria % of renewable energy < 50%)	10 kg/m².year			
Thermal solar system	Sensors production > 500 kWh/m².year (in standardised test conditions) + Solar Keymark sensor or system. Certified installer in accordance with the Directive 2009/28/EC	Sensors production > 500 kWh/m².year (in standardised test conditions) + Solar Keymark sensor	/	
PV solar system	certified installer in accordance with the Directive 2009/28/EC	Performance ratio> 80%		
Heat pump	SPF > 2.88 Label EHPA HP certified installer in accordance with the Directive 2009/28/EC	SPF > 2.88		
Recommendations				
Level E_w	< 40		< 50	
Average U_{max} value for opaque walls	0.15 W/m².K			
Net energy needs for heating	/		≤ 20 kWh/m².year	
Net energy needs for cooling	/		≤ 15 kWh/m².year	
Ventilation	Double flow with heat recovery			
Appliances	European Energy Labeling A+		/	
Lighting and appliances	Indication of reference consumption (PE: 42.5 kWh/m².year)		Lighting as already considered in the PEB maintained	

(i.e. buildings where the production of renewable energy is equal to or greater than the consumption of non-renewable primary energy on an annual basis).
(...) *In order to set an example, from 2012 onwards the Walloon Region will apply these standards for all public buildings, as well as for granting subsidies, making donations or any other form of aid for property investments that the Region grants to other public or associated bodies."*

In the spirit of the RPS, any new building will tend towards compliance with the 'very low energy' standard from 2014 onwards, while at least complying with the requirements E_w ≤ 60 and K ≤ 35. In addition to these indicators and in accordance with the EPB regulations, the requirements regarding the insulation of walls, ventilation and overheating continue to apply.

Parallel to the requirements regarding E_w, E_{spec} and K, the requirements regarding U_{max} and R_{min} will gradually be tightened.

Interim targets for improving the energy performance of renovated buildings by 2015

The energy requirements provided in the RPS from the 1st of January 2015 for large-scale renovation works are to comply with 'very low energy' requirements. According to the Government Decree of the 17th of April 2008, large-scale renovations correspond to buildings with a total usable floor area larger than 1,000 m^2 that are the subject of major renovation works, i.e.:

> either if the renovation involves works encompassing at least 25% of the building envelope;
> or if the total cost of the renovation works relating to the building envelope or the building energy systems is greater than 25% of the value of the building (the value of the building does not include the value of the land on which the building is situated).

2.5 Any other relevant information
There are various voluntary actions concerning new and existing residential and non-residential buildings. The most significant ones are:

> The Energy Advice Procedure for existing residential buildings, in force since 2006. This audit provides an evaluation of the energy performance of the building, as well as recommendations to improve this performance. At the moment, more than 852 assessors are accredited. All audits are centralised on a database. Currently, more than 27,850 audits are registered on this database, representing almost 2% of the existing building stock in the Walloon Region. A brand new procedure, accompanied by a new report layout and providing a strong link with energy certification has been developed and will be used by the end of 2013.
> The call for the projects 'Exemplary buildings in Wallonia' is a new action for the development of construction and refurbishment of buildings with strict energy and environmental criteria. The first call ended in December 2012. 70 projects have been submitted.

3. Energy performance certificates

In relation to energy performance certification, the following regulations apply:

> Certification of new buildings: the enforcement order was approved by the government on the 25th of August 2011 (*M.B. du 05/09/2011, p. 56370*).
> Certification of existing residential buildings: the enforcement order was approved by the government on the 3rd of December 2009 (*M.B. du 22/12/2009, p. 80379*), and was modified on the 27th of May 2010 (*M.B. du 07/06/2010, p. 35958*).
> Certification of existing non-residential buildings: the enforcement order was approved by the government on the 20th of October 2011 (*M.B. du 03/11/2011, p. 65830*).
> Certification of public buildings: the enforcement order was approved by the government on the 24th of November 2011 (*M.B. du 12/12/2011, p. 72952*).

Since the 1st of May 2010, certification is mandatory for new buildings when the building permit is requested. An EPB-responsible is identified at the beginning of the construction works and is responsible for compliance with the requirements. At the end of the process, the certificate is issued by the administration on the basis of the information contained in the final EP declaration of the building. The certificate is valid for 10 years. The layout and indicators are the same as those for existing buildings, except of the recommendations that are limited to behavioral aspects.

The Executive Order of the 20th of October 2011 regulates the certification of existing non-residential buildings. It is, however, not implemented yet. The calculation method and the software tool are under preparation. Certification of existing non-residential buildings is expected to start in 2015. The certificate will be valid for 10 years. The certificates will be registered in a database. They will be based on an asset rating and will be issued by an accredited assessor. The degrees and/or the professional experience required in order to be accredited as an expert for issuing certificates for existing non-residential buildings are defined in the Order. Assessors must have at least one of the following qualifications:

> have a valid agreement as '*responsable PEB*'; or
> be authors of technical, environmental and economical feasibility studies; or
> be assessors for certification of existing residential buildings; or
> be external assessors for the certification of public buildings; or
> be assessors under the Executive Order of the 30th of May 2002 concerning subsidies granting for the improvement of the energy performance and the promotion of a more rational energy use in the private sector (AMURE); or
> be assessors under the Executive Order of the 10th of April 2003 concerning granting subsidies to legal persons of public law and to non-commercial bodies, for the realisation of studies and refurbishment aiming at the improvement of the buildings' energy performance (UREBA).

In order to obtain the accreditation to issue certificates, assessors will have to attend a training course of 5 to 7 days, and pass an exam. In order for a firm to be accredited, there must be at least one accredited private person working in the company.

3.1 Progress and current status on sale or rental of buildings

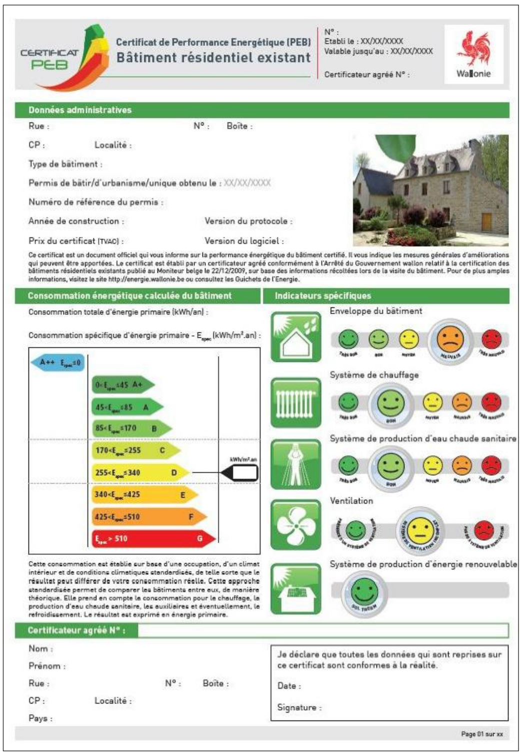
Certification of existing residential buildings (Figure 7) applies to buildings whose building permit was requested earlier than the 1st of May 2010. A certificate has to be available at the time of a preliminary sales agreement at the latest in case of selling, and at the time of contract signature at the latest in case of renting. If the certificate is missing, an administrative fine of 2 €/m² with a minimum of 250 € and a maximum of 25,000 € is legally prescribed. The administration has not applied this rule yet.

The certificate is valid for 10 years.

For existing residential buildings, the development of the calculation method (asset rating), the handbook for assessors, the content of the certificate, the software tools, and the training material are being finalised but are not completed yet. They are continuously adapted to input received from the certification support service as clarification to questions posed by assessors.

In multifamily residential buildings, the certificate is issued per flat. In case there is a collective system for heating, Domestic Hot Water (DHW), ventilation, etc., an audit of the collective system must be completed at the time of renting or selling of the first apartment. This data of the audit are saved in a database, and are used as input for the certification of the other flats of the building.

Figure 7: EPC for residential buildings.



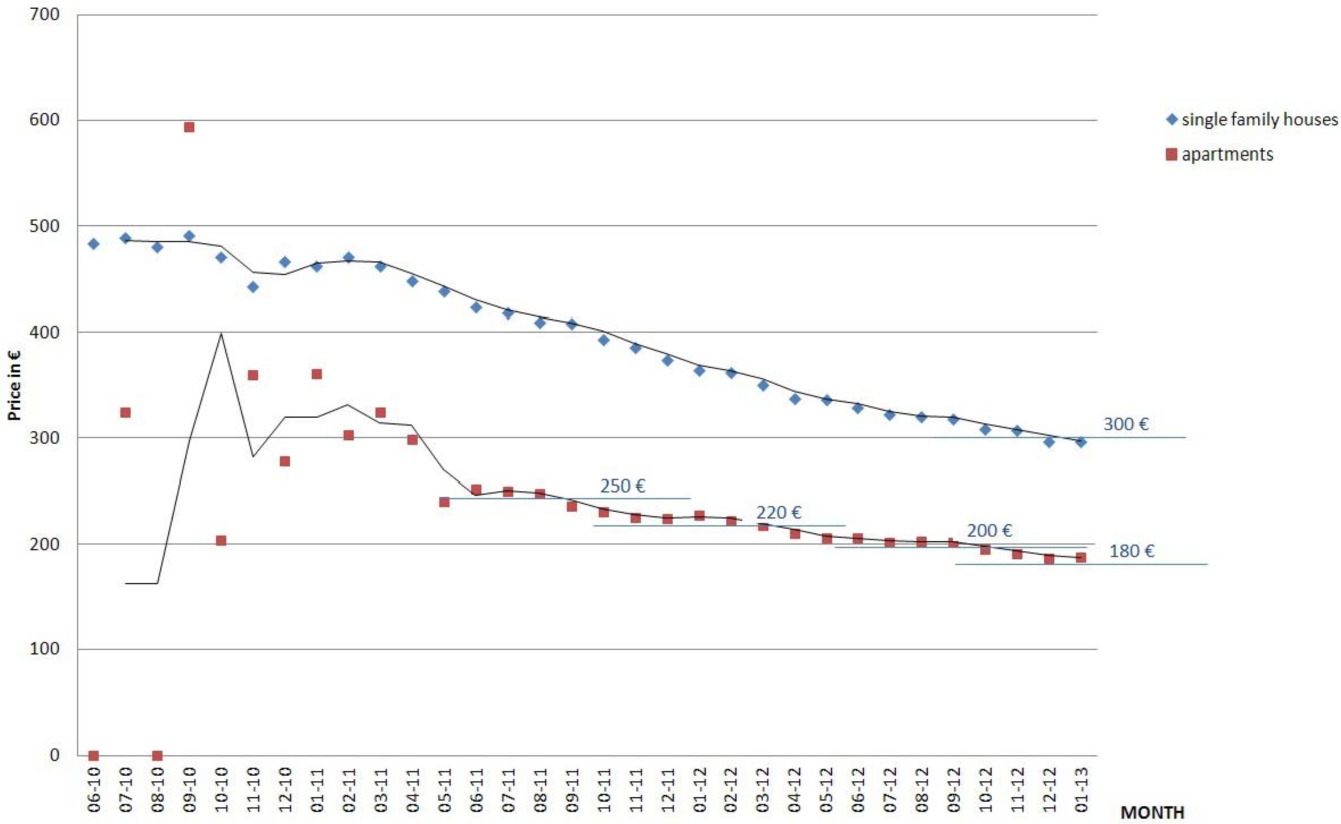
The certification process is quick (lasts for about 4 hours), in order to keep the price -which is displayed on the certificate- low. In the early stages of certification, the average price (Figure 8) was 480 € (VAT included) for single-family houses; currently, it is about 300 € (VAT included). Respectively, the average price for an apartment was 300 €; currently, it is about 190 €. The total turnover generated since the beginning of the certification of existing residential buildings in June 2010 is about 50 M€ (VAT included).

The Energy Performance Certificate (EPC) contains improvement measures without detailed facts and figures. These measures are automatically delivered by the software tool, however, they are related to the result of the calculation. For example, a recommendation concerning the improvement of wall insulation is given by the software if the U-value calculated for this wall is above 0.4 W/m².K. A revision of the recommendations, covering both content and layout, is expected in early 2014.

If a house has an incomplete or incorrect EPC, it is proposed to the landlord to conduct an audit of the building (this audit lasts for about 1.5 day). The outcome of this audit is linked to incentives to improve the energy performance of the house. These audits provide improvements with detailed facts and figures. A brand new energy audit procedure, report layout and a strong link with energy certification has been developed and will be used by the end of 2013 (Figure 9). Assessors competent to conduct audits are those who are also competent to issue certificates.

The degrees and/or the professional experience required in order to be accredited experts for issuing certificates are set in the Order (a degree of architect or engineer, or other degrees concerning the energy performance of buildings, or a professional experience of at least 2 years in the field of the building EP calculation). Assessors to issue certificates must attend a training course of 5.5 days, and pass an exam. So far, the administration has received more than 3,400 applications, of which, 3,200 fulfill all the requirements set

Figure 8: EPC – Evolution of average price.

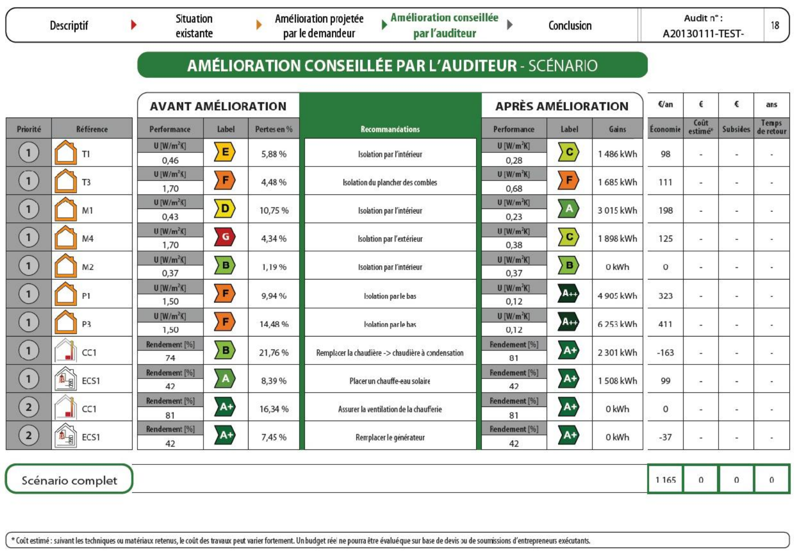


in the Order regarding degrees or professional experience. At the end of 2012, more than 1,800 assessors were accredited. Among them, more than 80% are engineers or architects. The names and addresses of the assessors are listed on the website[1].

Support for assessors is available by email and phone. This service requires more than 3 full-time staff. Another aim of this support service is to provide tools for assessors: a semestrial newsletter, a list of frequently asked questions, help on the workflow (documents in tree structure form helping accredited experts to make decisions on how to treat a residential building – e.g., number of certificates needed, certification as 'apartment building', 'single-family house' or 'collective housing',…) , workshops, improvements of the calculation procedure, handbooks, software, training material, etc..

All certificates are generated by a central database on the basis of output files coming from the software. An assessor needs a login and a password to be able to insert a file in the central database. The generated certificate is then sent to the assessor by mail. This database is managed by the administration, and it is used for communication purposes (articles, publication, radio broadcast,

Figure 9: New energy audits layout.



Descriptif ▸ Situation existante ▸ Amélioration projetée par le demandeur ▸ Amélioration conseillée par l'auditeur ▸ Conclusion | Audit n° : A20130111-TEST- | 18

AMÉLIORATION CONSEILLÉE PAR L'AUDITEUR - SCÉNARIO

		AVANT AMÉLIORATION				APRÈS AMÉLIORATION			€/an	€	€	ans
Priorité	Référence	Performance	Label	Pertes en %	Recommandations	Performance	Label	Gains	Économie	Coût estimé*	Subsides	Temps de retour
1	T1	U [W/m²K] 0,46	E	5,88 %	Isolation par l'intérieur	U [W/m²K] 0,28	C	1 486 kWh	98	-	-	-
1	T3	U [W/m²K] 1,70	F	4,48 %	Isolation du plancher des combles	U [W/m²K] 0,68	F	1 685 kWh	111	-	-	-
1	M1	U [W/m²K] 0,43	D	10,75 %	Isolation par l'intérieur	U [W/m²K] 0,23	A	3 015 kWh	198	-	-	-
1	M4	U [W/m²K] 1,70	G	4,34 %	Isolation par l'extérieur	U [W/m²K] 0,38	C	1 898 kWh	125	-	-	-
1	M2	U [W/m²K] 0,37	B	1,19 %	Isolation par l'intérieur	U [W/m²K] 0,37	B	0 kWh	0	-	-	-
1	P1	U [W/m²K] 1,50	F	9,94 %	Isolation par le bas	U [W/m²K] 0,12	A++	4 905 kWh	323	-	-	-
1	P3	U [W/m²K] 1,50	F	14,48 %	Isolation par le bas	U [W/m²K] 0,12	A++	6 253 kWh	411	-	-	-
1	CC1	Rendement [%] 74	B	21,76 %	Remplacer la chaudière -> chaudière à condensation	Rendement [%] 81	A+	2 301 kWh	-163	-	-	-
1	ECS1	Rendement [%] 42	A	8,39 %	Placer un chauffe-eau solaire	Rendement [%] 42	A+	1 508 kWh	99	-	-	-
2	CC1	Rendement [%] 81	A+	16,34 %	Assurer la ventilation de la chaufferie	Rendement [%] 81	A+	0 kWh	0	-	-	-
2	ECS1	Rendement [%] 42	A+	7,45 %	Remplacer le générateur	Rendement [%] 42	A+	0 kWh	-37	-	-	-
Scénario complet									1 165	0	0	0

* Coût estimé : suivant les techniques ou matériaux retenus, le coût des travaux peut varier fortement. Un budget réel ne pourra être évalué que sur base de devis ou de soumissions d'entrepreneurs exécutants.

etc.) and quality checks. For the moment, the database contains more than 150,000 certificates, representing more than 10% of the existing building stock. Depending on the market activity, more than 4,000 certificates for single-family houses are inserted in the database every month, and more than 2,500 certificates for apartments.

From the analysis of the data available in the central database, it is possible to extract quite interesting information. For example, the average building label is E,

1 *energie.wallonie.be/fr/liste-des-certificateurs-peb-agrees.html?IDC=7233*

Figure 10: Distribution of the number of EPCs per label regarding apartments and single-family houses.

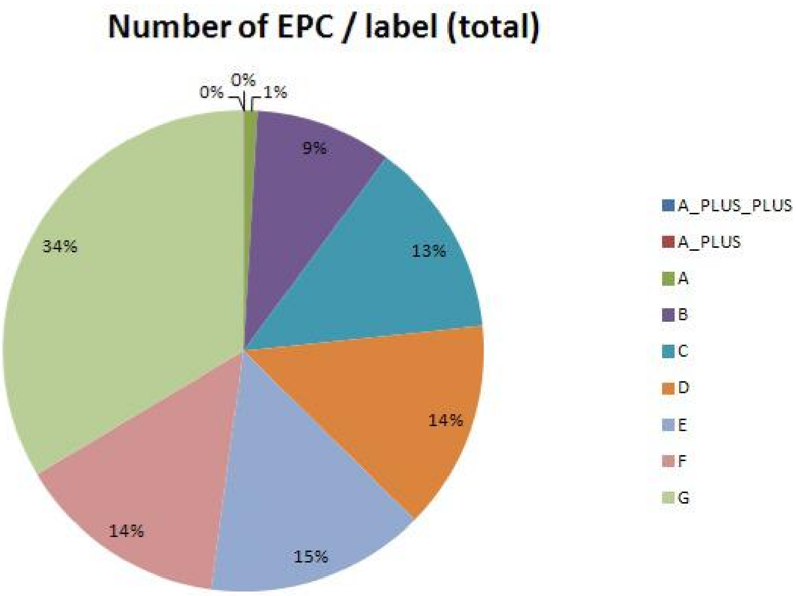
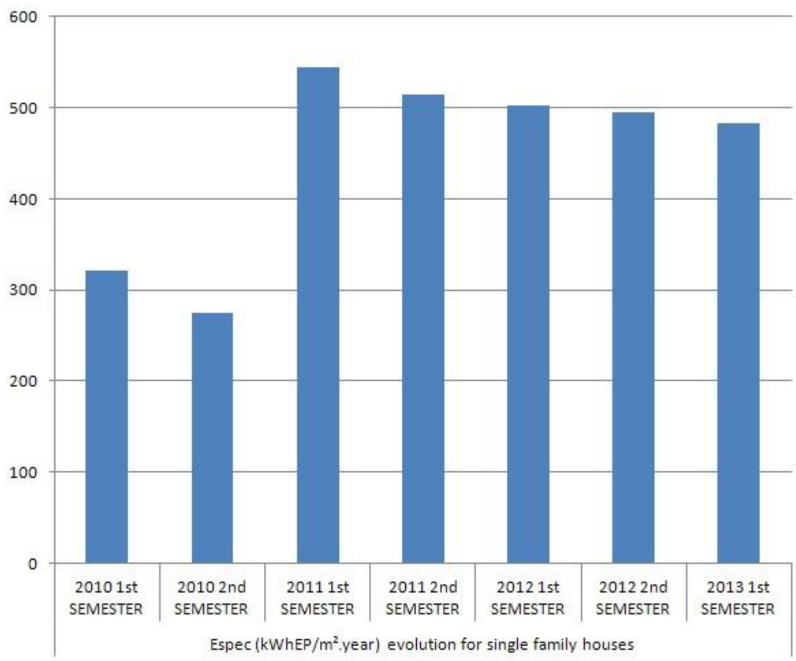


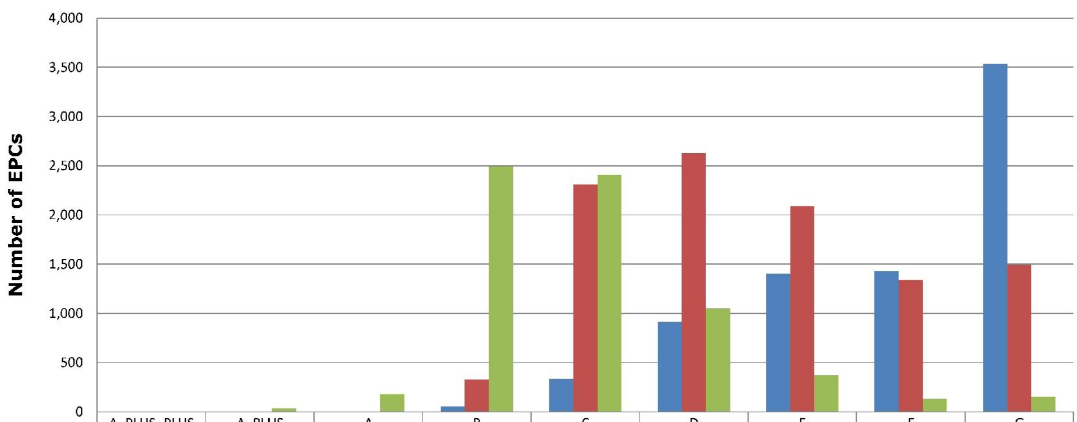
Figure 11: Evolution of the average E_{spec} in the certification of single-family houses.



but it depends on the use of the building: the average label for single-family houses is F and for apartments is D (Figure 10). The average E_{spec} (Figure 11) has evolved since certification started in 2010 in the following ways:

> Between June 2010 and January 2011, certification was only mandatory at the time of selling single-family houses with building permits requested after the 1st of December 1996. This explains why the average results were 280 kWh_{EP}/m^2.year - label D, in line with the minimum requirements which were in place then.
> In the first semester of 2011, the obligation to have a certificate was extended to all cases of selling single-family houses. The database shows a very high average primary energy consumption (more than 540 kWh_{EP}/m^2.year - label G). A first explanation is that the stock of single-family houses in the Walloon Region is very old and, therefore, the buildings often have a poor EP. A second explanation is that the obligation was not well known to the wider public and, as a consequence, few people presented additional documents (proof) to assessors in order to prove a better EP of their house.
> Since the second semester of 2011, all single-family houses and apartments on sale or rent have the obligation to have a certificate. The results coming from the database are better, since apartments have a better EP than that of the single-family houses (global average for apartments and single-family houses is currently about 420 kWh_{EP}/m^2.year corresponding to label E, whereas the average for single-family houses only is about 480 kWh_{EP}/m^2.year - label E), and, since then, people know more about how to use the information in the EPC.

Figure 12: Distribution of EPC labels in relation to the building age (only when the building age is known).



	A_PLUS_PLUS	A_PLUS	A	B	C	D	E	F	G
< 1970		1	1	52	334	912	1,400	1,428	3,531
1971-2000			2	324	2,311	2,626	2,088	1,339	1,494
>2000	1	34	179	2,493	2,408	1,050	371	130	153

However, it is important for the general public to understand that old houses do not necessarily have a poor energy performance, as much as recently built houses do not necessarily have a good energy performance; the only way to know the actual energy performance of a building is by obtaining an EPC. Figure 12 shows the distribution of EPC labels in relation to the building age (for cases where the building age is known).

Quality controls begun in 2012 through the analysis of the certificates database. As a result, the first procedures concerning infringement have been issued. In 2012, the administration initiated 15 control demands, based on those first procedures, with the following results: one assessor had to undergo a new training, and another has seen his accreditation revoked. Furthermore, a control web tool is being developed, and will be finalised in 2013. The aim is to increase efficiency and to systematise quality checks by identifying suspicious data in the database (based on improved queries during the first control), by randomly selecting certificates for each assessor, and by automating the input and saving of documents related to each assessor.

3.2 Progress and current status on public and large buildings visited by the public

The Executive Order of the 24th of November 2011 regulated the certification of public buildings. The certificate is valid for 5 years. The Walloon region adopted a simplified calculation method based on an operational rating. The energy consumption indicators must be updated every year and be registered in the database. The degrees and/or professional experience required in order to be accredited as expert for issuing certificates of public buildings are defined in the Order. For an external private person to become accredited for the certification of public buildings, these persons must meet the same conditions as described earlier for existing non-residential buildings. Candidate assessors must attend a training course and pass an exam. In order for a firm to become accredited, there must be at least one accredited external private person working in the company. The ability to become accredited experts also have private persons working for a public authority, with at least 2 years of professional experience in the field of monitoring the energy consumption. However such persons only have the competence to issue certificates for the public authority they work for.

3.3 Implementation of mandatory advertising requirement – status

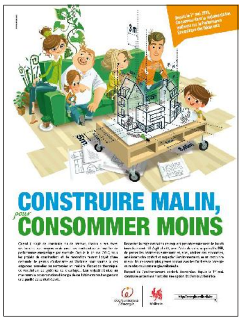
A draft decree, already approved in its first reading by the government, is launching mandatory advertisement; it requires the EP indicator(s) included in the EPC to be mentioned in advertising, starting in 2013. The proposed decree foresees an administrative fine from 250 € to a maximum of 50,000 € in case that the EP indicator(s) of the EPCs are not mentioned in the advertisement.

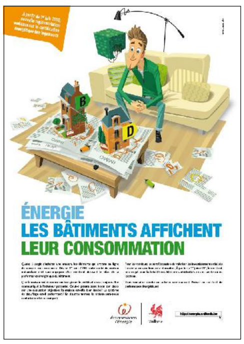
3.4 Information campaigns

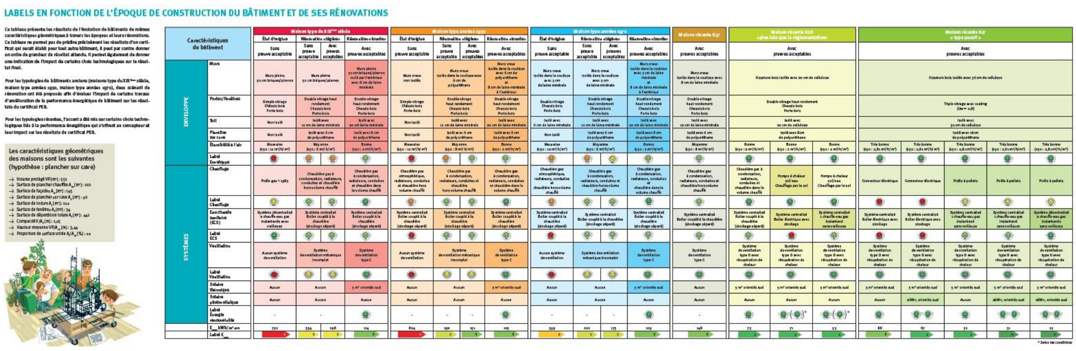
Information campaigns targeting the general public took place in 2010 and 2011. In parallel, regular discussions with the Notary Association have been led since 2009 in order to determine the role of notaries in the control of the availability of EPCs at the time of selling. As a result, notaries require an EPC to be available before any sales agreement. In case of renting, lease agreements have to be registered at the Federal Administration. It seems now that administrative practice requires the EPC to be available in order for a lease agreement to get registered. However, statistical information is not available, because information on the transaction type is not an input data of the EPC, but this obligation is now well known to the large public, and is well followed.

Detailed brochures (Figure 13), as well as official texts and tools are available on the Walloon Region website.[1]

Figure 13: Information campaigns.







1 *energie.wallonie.be/fr/vendre-acheter-louer-un-batiment.html?IDC=7234*

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems
The inspection of heating systems has been included in an Executive Order on the 29th of January 2009. The Government of the Walloon Region approved this Order to prevent the atmospheric pollution produced by central systems for heating and DHW, and to reduce their energy consumption. This Order is an extension of the Royal Order in force since 1978 for the inspection of liquid or solid fuel boilers. Inspections are mandatory at least every year for oil boilers, and every three years for gas boilers, regardless of their power.

At the end of March 2013, about 2,100 technicians are certified to inspect gas fuel boilers, and roughly the same number for liquid fuel boilers. In order to obtain the certificate, technicians must pass an examination in a centre recognised by the Walloon authorities. Currently, 11 centers are recognised for technicians inspecting liquid fuel boilers, and 8 for inspecting gas fuel boilers.

According to the '*Décret du 05 juin 2008 relatif à la recherche, la constatation, la poursuite et la répression des infractions et les mesures de réparation en matière d'environnement*', control of compliance with the Order of the 29th of January 2009 is a responsibility of the Department of Environmental Police and Controls of the Walloon Region. This decree also defines the penalties that may be imposed on persons violating these regulations.

The Order of the 29th of January 2009 also requires that a post-control of certified technicians is carried out by accredited control bodies.

4.2 Progress and current status on AC systems
The Government of the Walloon Region approved two Executive Orders, on the 12th of July 2007 and on the 18th of October 2012, respectively, to prevent pollution at the time of installation and putting into service of fixed air-conditioning (AC) systems using fluoride cooling, as well as in case of intervention on those systems.

Those Executive Orders foresee energy inspections by accredited experts to ensure energy performance of the AC systems by evaluating the EP of the AC unit, as well as its sizing regarding the cooling needs of the building.

Once the system is implemented, accredited AC experts will have to complete a specific training in an accredited training centre in order to be able to carry out energy inspections on AC systems. Controls of accredited AC experts are foreseen to be performed by an accredited control body.

5. Conclusions and future plans

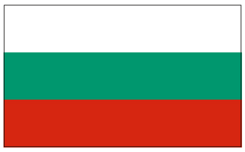
In the Walloon Region, the regulation in compliance with the Energy Performance of Buildings Directive (EPBD) is in place since 2007, and is currently well known to architects, and engineers, but also to building contractors. As an example, a few years ago, practical solutions to constructive thermal bridges were known to only a few architects and engineers, whereas today they are often used by building contractors. This is also the case for airtightness and other quality issues. Also, awareness of the general public concerning the importance of having a well-insulated building, with efficient energy systems, is raised. Energy certificates and energy audits also contribute largely to the raise of awareness, as do the voluntary actions led by the region in the field of the Energy Performance (EP) of buildings, as well as the financial incentives (energy investment tax credit, allowances, 0% interest loan for energy investments, etc.).

However, despite this gradual raise of awareness in the first phase of the enforcement of the regulation, the region has to intensify controls by finalising the software tools, and by dedicating more human resources to this end. This is also in line with the requirements of the recast EPBD.

For the moment, the Walloon Region works on finalising the results of the study on cost-optimality, and will deliver a report by the end of May 2013. Furthermore, the government adopted a new project of the EPBD Decree. This decree should be definitely adopted by the end of 2013. In parallel, the Walloon Region works on a new set of Executive Orders in order to comply with the recast EPBD.

EPBD implementation in Bulgaria

STATUS AT THE END OF 2012



Authors

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1. Introduction

The building sector has great potential for energy savings. It has long been proven that the application of certain legal, technical and financial measures results in improved energy efficiency and reduces carbon emissions. This report outlines the development of regulatory measures to ensure mechanisms for reducing the energy consumption in buildings in Bulgaria. The current status and the identified arrangements for further action to improve the energy efficiency of buildings in Bulgaria are also presented in the report.

Certain provisions of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) were introduced in the Bulgarian legislation in 2005. The development of the legal framework continued with the adoption of the new Energy Efficiency Act, promulgated in the State Gazette (SG) No. 98/14.11.2008. The next amendments after 2010 were promulgated in the SGs No. 35/3.05.2011 and No. 38/18.05.2012. The Sustainable Energy Development Agency (SEDA) has been created, replacing the Energy Efficiency Agency (AEE). The new Energy Efficiency Act was promulgated in the SG No. 24/12.03.2013, and came into force on the 12th of March 2013. The regulations for the implementation of this act (including regulations related to the building energy efficiency) shall be adopted, issued and enforced within six months after its entry into force.

In Bulgaria, the state policy to increase the energy efficiency in the final energy consumption, and the provision of energy services, shall be implemented by the Ministry of Economy, Energy and Tourism.
The state policy on building energy efficiency shall be conducted by the Ministry of Regional Development and Public Works. SEDA performs the activities on behalf of the government.

2. Energy performance requirements

According to the Bulgarian legislation, buildings are divided into two main categories: new and existing. Each of these categories has specific requirements for different types of buildings, according to their use (residential, non-residential and public).

Legislative measures that have been taken include: compulsory certification of buildings, labeling of electrical appliances, energy efficiency standards for appliances, and rules of procedures for promoting the energy incentives for homeowner associations in residential buildings.

Financial and technical measures: insulation, transition to alternative fuels (pellets, briquettes, biomass, etc.), replacement of existing appliances with more efficient units (heating and cooling equipment, ovens, refrigerators, washing machines, computers, lighting, etc.).

National Websites *www.seea.government.bg, www.mee.government.bg/bg*

2.1 Progress and current status
The main change in the legislation is the new Energy Efficiency Act, which introduces the recast EPBD (Directive 2010/31/EC). The obligated entities have to implement energy efficiency improvement measures, as well as to introduce activities associated with the implementation of these measures. The new Energy Efficiency Act introduces obligations to owners of public service buildings with a built-up area of over 500 m^2 that they must implement by March 2013. The same requirements have to be applied to all public service buildings with a built-up area of over 250 m^2 by the 9th of July 2015. The national programme concerning the Nearly Zero-Energy Buildings (NZEB) is foreseen to be implemented within the next five years.

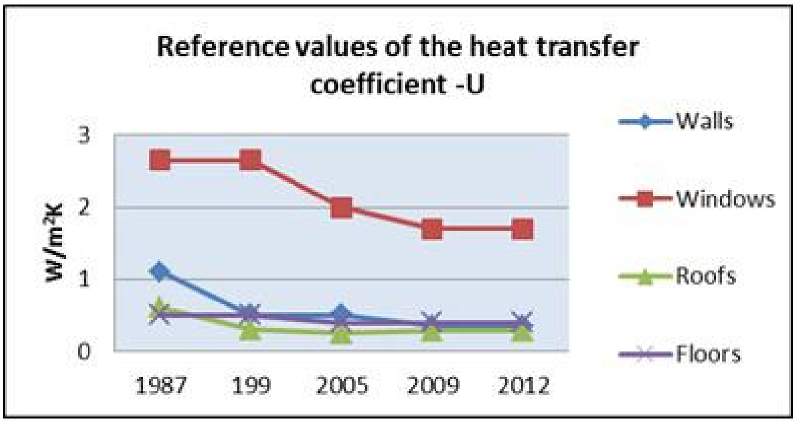
There are special regulations for the Energy Performance (EP) of buildings:

> Ordinance № RD-16-1057 of the 10th of December 2009 'On the terms and procedure for conducting energy efficiency audits and certification of buildings, the EP certifications, and the categories of certification'. A new ordinance, which will probably come into force by the end of 2013, is being developed. The new ordinance will tighten the requirements for building elements.
> Incentives: Tax exemption on real estate for certified buildings, for 3, 5, 7, or 10 years, depending on the category (A or B) of the Energy Performance Certificate (EPC) and on whether Renewable Energy Sources (RES) are used or not (article 24 - Local Taxes and Fees Act).

Table 1: Building requirements over time (U values – W/m^2.K).

Year	1987	1990	2005	2009	2012
Walls	1.11	0.5	0.5	0.35	0.35
Windows	2.65	2.65	2.0	1.7	1.7
Roofs	0.603	0.3	0.25	0.28	0.28
Floors	0.503	0.5	0.4	0.4	0.4

Figure 1: Reference values of the heat transfer coefficient - U.



The calculation methodology
The calculation procedures have been adopted via the Regulation on Energy Efficiency, Heat Conservation and Energy Retention in Buildings – in force since the 1st of March 2005 by the Ministry of Regional Development and Public Works, recast in 2009. These are:

> Requirements for buildings, and technical energy efficiency requirements: energy savings and heat conservation, minimum EP requirements for the design of new, as well as the reconstruction of existing buildings, total and major renovation of existing buildings (see Tables 1 & 3).
> Technical requirements for heat conservation and energy retention in buildings shall apply to the design and construction of residential and non-residential buildings with an average indoor air temperature above 15 °C, relative air humidity of up to 70%, and an average indoor air temperature between 12 °C and 15 °C, depending on the design of buildings heated for at least three months per year (see Tables 1 & 3).
> Technical rules and standards for the design of thermal insulation, including thermal transmittance and minimum requirement values for thermal insulation.
> Rules for water vapour penetration, water tightness, air leakage, and solar protection during the summer period.
> Minimum EP requirements for buildings.

The thermal and technical performance values of the building envelope and building elements, as well as the efficiency of the heating, cooling, ventilation and DHW systems, are determined under the legal acts in force at the moment the building came into use.

> For new buildings at the design and construction stage, the specific energy consumption shall correspond to Class B of the energy consumption scale.
> For existing buildings built in the period 1991-2009, the specific energy consumption after renovation shall correspond at least to Class C.
> For existing buildings built before 1990, the specific energy consumption after renovation shall correspond at least to Class D.

Table 2: Energy criteria and classes.

Limits [kW/m².year]	Energy consumption class	Building energy demands
EP < 0.5 EPmax,r	A	High energy efficiency
$0.5\ EP_{max,r} < EP \leq EP_{max,r}$	B	
$EP_{max,r} < EP \leq 0.5(EP_{max,r} + EP_{max,s})$	C	
$0.5\ (EPmax,r + EP_{max,s}) < EP \leq EP_{max,s}$	D	
$EP_{max,s} < EP \leq 1.25\ EP_{max,s}$	E	
$1.25\ EP_{max,s} < EP \leq 1.5\ EP_{max,s}$	F	
$1.5\ EP_{max,s} < EP$	G	High energy consumption

Where:
> EPmax,r (kW/m².year) – total specific energy consumption for heating, cooling, ventilation, Domestic Hot Water (DHW) and lighting, coresponding to the current national norms.
> EPmax,s (kW/m².year) – total specific energy consumption for heating, cooling, ventilation, DHW and lighting, coresponding to the norms in operation when the building came into use.

Table 3: Reference values of the heat transfer coefficient –U [W/m².K].

Type of envelope structures and elements	U [W/m².K]	
	Int. T ≥ 15 °C	Int. T < 15 °C
External walls in contact with the external air	0.35	0.44
Walls adjacent to unheated spaces	0.50	0.63
Floor slab over an unheated basement	0.50	0.63
Floor of a heated basement	0.45	0.56
Floor of a heated space in contact with the external air	0.28	0.35
Wall, ceiling or floor in contact with the external air or the ground with inbuilt area	0.40	0.50
Flat or sloped roof with a heated under-roof space designed for habitation	0.28	0.35
Ceiling slab of an unheated flat roof with an air layer with thickness δ > 0.30 m	0.30	0.38
External door, solid, adjacent to the external air	2.2	2.75
External door, solid, adjacent to an unheated space	3.5	4.38

The calculation method is based on the BDS EN ISO 13790 and on efficient European practices in the calculation of the annual energy consumption for heating, ventilation, cooling and DHW. This method provides a quantitative evaluation of the impact of:

> heat losses and heat gains through the building envelope;
> ventilation heat losses and gains as a result of the air exchange;
> heat gains from solar radiation as a result of both direct radiation through transparent elements and the absorption of radiation from non-transparent elements;
> heat losses from skyward radiation;
> heat gains from internal sources, lighting and people.

2.2 Format of national transposition and implementation of existing regulations

The energy consumption for each building is calculated taking into account the characteristics and power of the appliances and equipment.

Energy efficiency requirements and basic indicators are as follows:

> For new buildings with a district heating system serving all the apartments: the total annual energy consumption for heating, cooling, ventilation, DHW, lighting and appliances per m² of the total heated area of the building (A_f), defined in terms of final energy demand and primary energy.
> For new buildings with local heating, or where the constructions do not permit district heating: the total annual energy consumption for heating, cooling, ventilation, DHW, lighting and appliances per m² of the total heated area of the building (A_f), defined as final energy.
> For existing buildings: the total annual energy consumption for heating, cooling, ventilation, DHW, lighting and appliances per m² of the total heated area of the building (A_f), or per m³ of gross heated volume (V_s), defined in terms of primary energy.
> The reference values of the heat transfer coefficient U of building envelope constructions and elements used both in the design of new buildings and after reconstruction, total and major renovation, capital repair, or conversion of the existing buildings (see Table 3).

2.3 Cost-optimal procedure for setting EP requirements

The new Energy Efficiency Act introduced the definition of the cost-optimal level, as the energy performance which results in the lowest cost during the estimated economic lifecycle. Regarding controls on heating and air-conditioning (AC) systems, the reports from assessment bodies contain only partial assessments of a cost-benefit analysis.

The cost-optimal methodology for setting minimum requirements for both the envelope and the technical systems is not yet applied, as the factors and measures needed in order to work out the cost-optimal thresholds need to be defined. For this purpose, an internal working group is set up, with the following objectives: to define the national targets depending on the building categories, to determinate the baseline year for the targets, set national parameters (numerical indicator [kWh/m²] primary energy) for NZEBs, etc.. The task is to set minimum requirements for both the envelope and the technical systems. There is a list of approximately 20 standards deriving from the Regulation RD-16-1057 'Main methods for expressing EP and calculating energy demand' to be taken into account.

2.4 Action plan for progression to NZEB

The action plan for progression to NZEB is in development. According to the Energy Efficiency Act, art. 4a, the 'National Plan to increase the number of NZEB' will be developed and adopted. The National Plan will include the national definition and the technical indicators for buildings with nearly-zero energy consumption. In the aforementioned period, a special regulation for the indicators for energy consumption and EP, as well as the scale of the building energy classes will be adopted. The eligible measures to improve energy efficiency, and the methodologies for assessing the energy savings shall be determined in an ordinance, approved by the Minister of Economy, Energy and Tourism on the proposal of the Executive Director of the Sustainable Energy Development Agency. Until now, two documents have been approved, containing 12 methods for assessing the energy savings.

A working group of the Ministry of Regional Development and Public Works has to develop a definition of NZEB, and to create a set of energy consumption values for different types of buildings. The conclusions of the working group are expected at the end of 2013.

2.5 Any other relevant information

For the implementation of the EPBD, SEDA made an estimate for state and municipal buildings with an area from 250 m² to 500 m². There are 3,965 such buildings, with a total area of 1,702,000 m². If forecasts are fulfilled, 100 buildings with an area from 250 m² to 500 m² will be inspected (the energy audit companies are not interested in buildings with a small floor area, due to possible small profitability).

The expected annual energy savings after implementing energy-saving measures in 100 buildings with a floor area from 500 m² to 1000 m² are up to 7 GWh.

The expected annual energy savings after implementing energy-saving measures in 100 buildings with a floor area from 250 m² to 500 m² are up to 3 GWh.

It should be taken into account that the usual energy consumption of these buildings is below the current minimum requirements.

Since it is not possible to predict how many buildings will be audited, and considering the eligibility period of 3 years for the implementation of the prescribed measure, it is reasonable in the present moment to provide annual funding for energy audits and for the implementation of the measures.

3. Energy performance certificates

The Energy Efficiency Act requires that the seller of a building provides the buyer with the original EPC of the building, and/or the Energy Passport. In the case of renting, the landlord should provide the tenant with a copy of the building's EPC and/or the Energy Passport. Unfortunately, in the majority of renting cases, this requirement is not met. There is no supervision and administration system requiring the energy efficiency certification on sale and rental of housing. There is no provision for sanctions or fines for failing to deliver an EPC on sale or rental of houses, apartments or any other residential buildings.

3.1 Progress and current status on sale or rental of buildings

New and existing buildings have their own specific requirements for different types of use (residential, non-residential and public).

An energy consumption scale consisting of classes from A to G is established following the BDS EN 15217 (Figure 2). The energy consumption class scale is composed on the basis of two values of the integrated EP characteristic:

1. $EP_{max,r}$ - total specific energy consumption for heating, cooling, ventilation, DHW and lighting, corresponding to the current national norms.
2. $EP_{max,s}$ – total specific energy consumption for heating, cooling, ventilation, DHW and lighting, corresponding to the norms in force when the building came into use.

The values of the thermal and technical performance of the building envelope and elements, as well as the efficiency of the heating, cooling, ventilation and DHW systems, are determined under the legal acts in force when the building came into use. Buildings in operation before 1990 can only have an A rating if the energy criteria have been proven by an energy audit (Table 1), and if the energy characteristics of the elements correspond to the values of Table 3.

A so-called 'Energy Passport' (Figure 3) is required for a new building after the completion of its construction. It is issued by qualified construction consultants. The passport contains the EP parameters, corresponding to the normative and project requirements for the energy efficiency of the completed construction.

The Energy Performance Certificate (EPC) is required for existing buildings. The EPC of the building (Figure 4) shall be updated after major renovation leading to the improvement of the overall EP. The EPC for an existing building is issued by physical or legal entities registered in the SEDA, after a detailed audit of the construction. The energy certification can only be conducted in no less than 3 years and in maximum 6 years after obtaining the building permit. All public buildings in operation with a floor area above 500 m^2 are subject to obligatory certification.

The validity of the EPC for property tax reductions can be up to 10 years. This depends on the energy efficiency class of the building, and on whether RES are used for the reduction of the energy demands for purchased energy. The buildings that came into use before the 1st of January 2005, with Class B certificates, and the buildings that came into use before the 1st of January 1990 with Class C certificates, issued under the Energy Efficiency Act and the Ordinance under art. 25 of the Law on Energy Efficiency, are exempted from property tax, as follows:

a) for a period of 7 years from the year following that of the certificate issue;
b) for a period of 10 years from the year following that of the certificate issue, if measures to use RES were applied in order to meet part of the building needs.

The buildings that came into use after the 1st of January 1990 and before the 1st of January 2005, with Class C certificates, and the buildings that came into use before the 1st of January 1990, with Class D certificates, are exempted from property tax, as follows:

a) for a period of 3 years from the year following that of the certificate issue;
b) for a period of 5 years from the year following that of the certificate issue, if measures to use RES were applied in order to meet part of the building needs.

The price of the EPC, including an energy audit, is determined by the market and the complexity of the building, and ranges from 1 €/m^2 to 2 €/m^2.

Figure 2: Scale of Energy Classes of buildings. Model graphical representation.

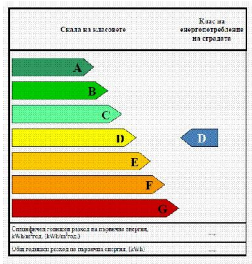
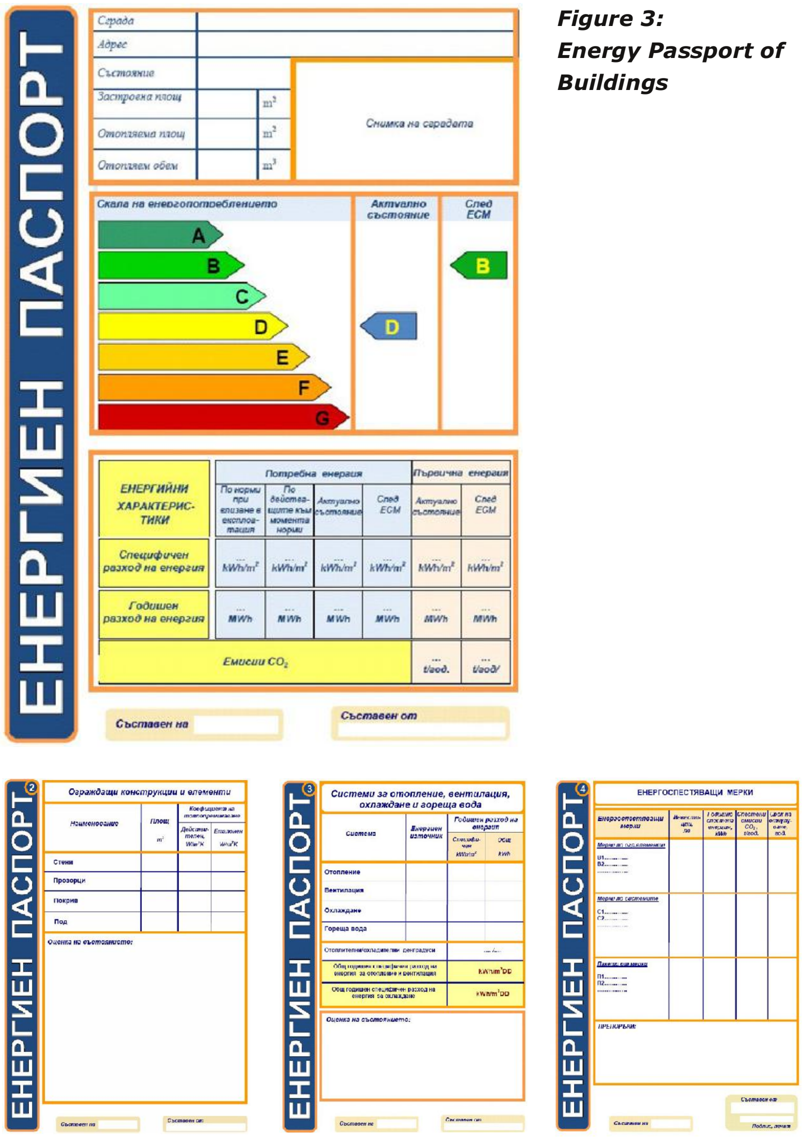
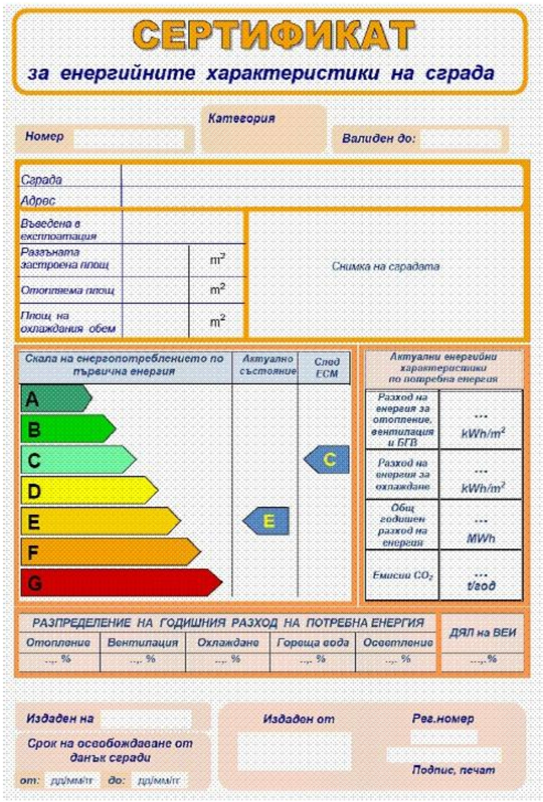


Figure 3: Energy Passport of Buildings



The EPC contains the following information:

> The type of the building, its address, the year in which it was put into use, total floor area, heated area, cooled area, and pictures of the building.
> The values of the building's integrated EP according to the required energy: total annual energy consumption in MWh, annual generated CO_2 emissions in t/year, rating and class of the energy consumption according to the primary energy and category of certificate.
> The distribution of the annual energy consumption for heating, ventilation, cooling, DHW and lighting, expressed as a share of the total consumption.
> The name of the person who carried out the certification, and the number of their public registration certificate.
> Number, date of issue, period of validity and period of exemption from property tax, according to the Local Taxes and Fees Act.
> Recommended groups of energy efficiency measures leading to the achievement of minimum requirements. The measures, leading to the energy efficiency increase, are calculated and prescribed in the energy audit.



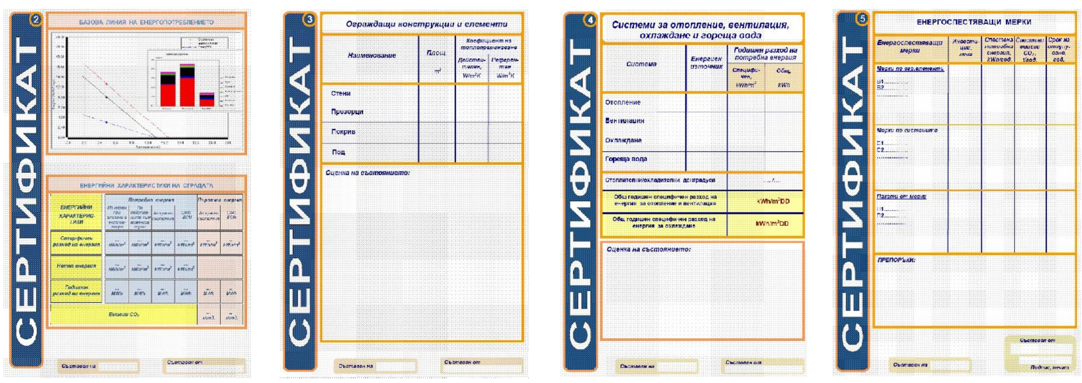


***Figure 4:* Energy Performance Certificate.**

Categories of certificate - A and B

The Bulgarian legislation has introduced two categories of certification - 'A' and 'B' - for existing buildings constructed before 2005. This should not be confused with the building energy class. The certificate defining a category is issued to assist the building owner to get an exemption from property tax for the period of validity. This is done to promote the process of certification of existing buildings, and to improve the building EP.

Category A certificate - with validity from 7 to 10 years- is issued for:

1. Buildings constructed between 1990-2005, with Energy Class B.
2. Buildings constructed before 1990, with Energy Class C.

Category B certificate - with validity from 3 to 5 years- is issued for:

1. Buildings constructed between 1990-2005, with Energy Class C.
2. Buildings constructed before 1990, with Energy Class D.

A certificate that defines the building category is issued after the building has been in use for one year from the date of the implementation of the energy saving measures.

Independent experts and training procedure

SEDA maintains a public register for the companies carrying out audits for the energy efficiency and the certification of buildings. The number of currently registered companies is 328, and the Qualified Experts (QE) are about 990. SEDA issues a certificate for the entities included in the register, against a 50 € fee. Eligible entities must meet the following minimum requirements:

> Minimum set of technical means for measuring.
> Available qualified staff, with at least three specialists with labour contracts:
  • one specialist on architecture and civil engineering;
  • one specialist on thermotechnics;
  • one electrical engineer.

In compliance with the rules regulating the requirements and procedures for the registration of individual persons dealing with the energy efficiency auditing and the certification of buildings at the SEDA register, the specialists must meet the following requirements:

> Technical high-school education.
> Bachelor or masters degree, depending on the qualification.
> Success at the exam on audits and certification of buildings.
> Service experience in the field for 2 years for those with a masters degree, and not less than 3 years of experience in the field for those with a bachelor degree.

These requirements apply to all three types of specialists listed above.

Training procedure

The scope of the examination material, as well as the evaluation procedure, are standard throughout the country. These are prepared by technical high-schools, are accredited and coordinated by the Executive Director of the SEDA, and approved by the Minister of Economy, Energy and Tourism.

At the end of the training course, the QE/inspectors have to pass a two-part final exam: an individual test and a presentation of a team project.
The final exam is conducted by an examination board. The experts who pass the exam are registered in the database of the SEDA Information System for a period of 3 years. After this period, the experts must undertake and pass a new exam, in order to maintain the status of QE.

There are no penalties upon QEs for issuing incorrect certificates.

Figure 5: Refurbished buildings.

3.2 Progress and current status on public and large buildings visited by the public

By the 31st of August 2012, 4,198 buildings with an area over 1,000 m^2 have been audited, of which 2,973 are state and municipal buildings. There are still 3,878 state and municipal buildings with an area over 1,000 m^2 (total area 11,300,000 m^2) left to be inspected. It is estimated that the number of state and municipal buildings with an area from 500 m^2 to 1,000 m^2 is 3,142 (total area 2,660,000 m^2). If the annual forecast for the number of audited buildings is fulfilled, possibly 300 buildings with an area from 500 m^2 to 1000 m^2 will be inspected.

The expected annual energy savings after implementing energy-saving measures for 100 buildings with a floor area over 1,000 m^2 are up to 30 GWh.

Under the law, the EPC and/or the Energy Passport of a building should be displayed at a clearly visible place within the said building. Unfortunately, this requirement is not always met, and no fines or penalties are imposed for non-compliance.

3.3 Implementation of mandatory advertising requirement – status

A mandatory advertisement requirement is imposed when a building with EPC or one of its individual units is advertised for sale or rent. The indicator for specific annual consumption of primary energy (kWh/m^2.year), has to be noted in every advertisement.

3.4 Information campaigns

Advertising campaigns on financial mechanisms and grants to encourage the implementation of energy-saving measures in buildings are launched continuously. The media regularly carry out advertising campaigns. SEDA publishes informational material in its webpage,

Figure 6: Seminars – in Blagoevgrad (left) and Varna (right).

and distributes brochures to promote the implementation of energy efficiency measures and the use of renewable energy.

The 'Management of energy efficiency and renewable energy' seminars are a part of the SEDA's information campaign, organised in 2012 for economic planning in six regions.

3.5 Any other relevant information
Bulgaria developed and introduced measures for the transparency and reputation improvement of the work of SEDA. The project was financed by the European Social Fund and the Bulgarian state budget, through the Operational Programme Administrative Capacity. The main aim of the project was to guarantee transparency and honesty in the SEDA activities. Some of its specific aims are:

> establishing publicity and access to information for citizens and business representatives on the administrative activities and services provided by SEDA;
> improving protection against possible opportunities for corruption;
> increasing the public confidence in SEDA, and encouraging the active participation of the public in the decision processes and the control on issues connected with the energy efficiency.

The National information system for energy efficiency maintains registers and databases, providing information on the energy efficiency status in the country. The databases contain information on all certificates issued for buildings. This is available through the SEDA webpage.

4. Inspection requirements - heating systems, air-conditioning

Bulgaria adopted option A of the article 8 of the EPBD, establishing a regular inspection of boilers. Inspection of boilers and air-conditioning (AC) systems (article 9) was introduced as an obligatory procedure in Section III of the Law on Energy Efficiency, in force since the 14th of November 2008. The new Energy Efficiency Act stipulates a regular inspection of these systems. The energy efficiency control of water-heating boilers and AC installations in buildings aims at establishing the level of their efficiency, and identifying the measures for promoting their improvement. The inspection under this act covers heating installations in public service buildings with boilers of an effective rated output for space heating higher than 20 kW, and AC systems with nominal power above 12 kW.

The heating boilers and the AC systems are subject to obligatory inspections once every:

> 4 years - for boilers using liquid or solid fuel, with nominal power from 20 to 50 kW;
> 3 years - for boilers using liquid or solid fuel, with nominal power from 50 to 100 kW;
> 2 years - for boilers using liquid or solid fuel, with nominal power above 100 kW;
> 4 years - for boilers using natural gas, with nominal power of above 100 kW;
> 4 years - for AC systems with nominal power above 12 kW.

For boilers being over 15 years in use, the energy efficiency inspection shall also include assessment of the heating installation, and shall be accompanied by recommendations to the owner regarding the replacement of the boiler, modifications of the heating installation and/or other alternative decisions. The inspection procedure is subject to a separate regulation under the law, which sets the following basic mechanisms:

> methodology for the inspection of the energy efficiency of boilers;
> methodology for the inspection of the energy efficiency of AC systems;
> deadlines for inspections;
> QE responsible for the inspection;
> registration of the QEs;
> establishment and maintenance of a database containing the boilers and AC systems subject to inspections.

Within 6 months after the date of commissioning new equipment subject to inspection, the owner of the boiler or AC system shall submit the respective declaration to SEDA. Fines or penalties are imposed to owners who do not meet this requirement. Inspections of boilers and AC systems are based on the assessment of efficiency under normal working conditions. A formal template was established for the inspection report. The reports are submitted to the SEDA information system, and hard copies are kept in SEDA. There is no quality control system for the registered reports. There are no sanctions for incorrect reporting.

The data in Table 6 are taken from the database established and maintained by SEDA for boilers and AC systems.

The mechanism for the improvement of the energy efficiency of heating boilers/systems and AC systems is based on the measures identified in the inspection reports. The application of these measures is mandatory for the equipment owner, and must have taken place until the next inspection.

Table 4: Assessing the effect of introducing periodic inspections of boilers with nominal power higher than 20 kW.

№	Type of fuel	Number	Nominal power	Average unit capacity	Energy consumption	Energy savings		Saved financial resources
			kW	kW /nom.	GWh/ year	MWh/ year	toe/ year*	Thousand BGN/year
1	Solid fuels	231	38,544	167	48	2,409	207	192
2	Liquid fuels	955	442,310	463	553	27,644	2,377	4,230
3	Natural gas	621	344,366	555	430	21,523	1,851	1,851
4	Liquid fuels & Natural gas	130	69,109	532	86	4,319	371	516
5	Liquid & solid fuels	3	710	237	1	44	4	5
6	Electrical energy	4	480	120	1	30	3	5
	Total:	**1,944**	**895,519**	**461**	**1,119**	**55,970**	**4,813**	**6,798**

* Toe: tons of oil equivalents

Registered AC systems with capacity exceeding 12 kW		384
Installed capacity (total)	MW	30
Average unit capacity	kW/no.	79
Electricity consumption in cooling mode (2500 h; 50%)	GWh/year	38
Expected energy savings as a result of the inspections (5% annually)	MWh/year	1,875
Saved financial resources for non-stop operation mode	k BGN/year	312
Expected savings in electric capacity	MW	1

Table 5: Assessing the effect of introducing a periodic AC inspection with a nominal power of 12 kW.

		Heating boilers	AC systems
Number of systems in the database		4,600	860
Installed power	MW	2,185.60	66.8
Number of inspected systems		954	173
Decommissioned/replaced units		34	0
Number of inspectors		106	28

Table 6: Data from inspection activity (by the 10th of January 2013).

Notes:
- > Energy consumption is determined at 2,500 work hours and 50% average load of the installed capacity (nominal power).
- > Energy savings are determined with a 5% improvement in the efficiency of the boilers as a result of the inspection.

Training and evaluation of qualified experts

The scope of the examination material, as well as the evaluation of the QE are standard throughout the country. These are prepared by accredited technical high-schools, are coordinated by the Executive Director of SEDA, and approved by the Minister of Economy, Energy and Tourism. The educational plan contains mandatory topics concerning the national legislation, physics fundamentals, methodology, construction and operating conditions for boilers and AC systems.

The training plan consists of 45 hours of lectures, 15 hours of practical exercises and 30 hours of an individual project of energy analysis and certification. At the end of the training course, QEs have a two-part final exam – an individual test and a presentation of the individual project. The final exam is conducted by an examination commission, whose board members are professors from technical universities, as well as representatives of the Ministry of Regional Development and Public Works, and the Ministry of Economy, Energy and Tourism.

5. Conclusions and future plans

A new Law on Energy Efficiency transposed the recast Energy Performance of Buildings Directive (EPBD) into the national legislation. The implementation of the recast EPBD reduces the built-up area of public service buildings. Of these buildings, those with an area from 1,000 m^2 to 500 m^2 are subject to mandatory certification by March 2013; those with an area from 500 m^2 to 250 m^2 are subject to certification on the 9th of July 2015. In public service buildings the new Energy Efficiency Act stipulates regular inspections for heating installations with boilers of an effective rated output higher than 20 kW, and AC systems with nominal power above 12 kW. The obligations concern only the owners of public service buildings.

A new ordinance is in the process of elaboration, in which the currently in force Energy Performance Certificate (EPC) and Energy Passport of Buildings will be revoked. The new rating documents will be the Certificate of Design Energy Performance Requirements, and the EPC. The first will be issued for buildings under construction, while the EPC will be issued for buildings after coming into use, and depending on the results of the energy audit. The form and content of these documents will be determined in the new ordinance.

EPBD implementation in Croatia

STATUS AT THE END OF 2012

Author

Nada Marđetko Škoro
Ministry of Construction and Physical Planning

1. Introduction

The implementation of the Energy Performance of Buildings Directive (EPBD) in Croatia started in 2005. Since the recent amendments of the Energy Efficiency Act in May 2012, the implementation of the EPBD has come in its entirety into the responsibility of the Ministry of Construction and Physical Planning.

The EPBD has been transposed into the national legislation. The Physical Planning and Building Act, published in the Official Gazette No. 76/2007, laid the legal basis for the adoption of the implementation regulations regarding the application of the minimum Energy Performance (EP) requirements for new buildings and building components, as well as for existing buildings and building components that are subject to renovation. The Energy Efficiency Act, published in the Official Gazette No 152/2008, laid the legal basis for the adoption of the implementation ordinances regarding the application of other requirements of the Directive: the obligations for issuing Energy Performance Certificates (EPC), and for the inspection of heating and air-conditioning systems, as well as the obligations for establishing an independent control system. All regulations and ordinances are under the responsibility of the Ministry of Construction and Physical Planning.

For the full implementation of the recast EPBD, the EP of a building (which includes a numeric indicator of primary energy) has to be set in order to achieve cost-optimal levels. This is planned to be completed by the end of 2013. An energy certificate of a building includes the determination of its energy class, taking into account its energy performance identified on the basis of a calculated specific annual energy need for heating for the reference climatic data.

The first requirements relating to energy economy and heat retention for buildings were set by a regulation in 1970, which defined the requirements for the building envelope. Requirements were put regarding the specific thermal losses and the maximum permitted thermal transmittance values for building elements. The last improvement of these requirements was in 1987. In 2005, in order to comply with the EPBD, new requirements on buildings were set, which included a maximum permitted annual energy use for heating, as well as new higher restrictions on thermal transmittance values for building elements.

Any improvement of the legislation in the field of construction will allow the reduction of the energy consumption for home heating. Building on principles of implementing energy efficiency measures introduced by the EPBD, brings major changes. In fact, building in compliance with the new rules brings significant reduction in the energy consumption (at least 30%) for space heating in the housing sector, and an average of about 50%, compared to the period before the implementation of the Directive. New savings that are planned for the future are expected to bring an additional reduction of 20% in the final energy consumption for space heating in the housing sector. Real projections will be more accurate after the completion of the cost-optimal analysis.

National Website *www.mgipu.hr*

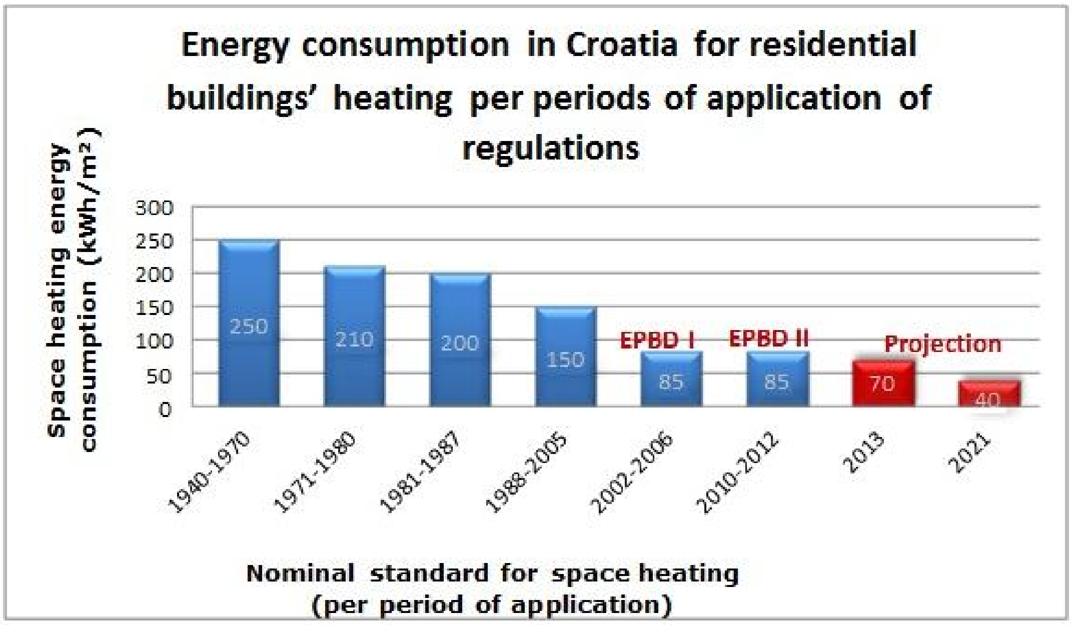


Figure 1: Energy consumption in Croatia for residential buildings' heating per periods of application of regulations.

The energy standard for Nearly Zero-Energy Buildings (NZEB) includes further reductions of the energy consumption, and establishes the minimum requirements of renewables. It is assumed that the final energy demand for heating in the housing sector until 2021 could be decreased by an additional 40%.

2. Energy performance requirements

The Energy Performance (EP) requirements for new buildings differ with regard to the temperature at which the buildings are heated, their purpose (residential and non-residential) and their size.

2.1 Progress and current status
The regulation imposes limits on the following items:

1. Maximum permitted annual energy use for heating per m^2 of usable floor area of a building, or per m^3 of a heated part of a building.
2. Maximum permitted transmission heat transfer coefficient per m^2 of a heated part of the building.
3. Prevention of overheating due to solar radiation during summer.
4. Limitation of the air-tightness of the building envelope.
5. Maximum allowed heat transmission coefficients U of building components of new buildings, small buildings and after renovation works performed on existing buildings (Table 1).
6. Minimisation of the impact of thermal bridges.
7. Maximum permitted water vapor condensation inside a building component.
8. Prevention of surface condensation of water vapour.

Specific requirements are set for residential and for non-residential buildings. A residential building planned to be heated at a temperature of 18 °C or higher shall be designed and constructed in such a way that the annual energy need for heating per m^2 of usable floor area $Q''_{H,nd}$ (kWh/m^2.year), depending on the building shape factor f_0, does not exceed the following values:

$Q''_{H,nd} = 51.31$ for $f_0 \leq 0.20$
$Q''_{H,nd} = (41.03+51.41\, f_0)$ for $0.20 < f_0 > 1.05$
$Q''_{H,nd} = 95.01$ for $f_0 \geq 1.05$

When designing a renovation of an existing building, technical requirements relating to energy economy and heat retention shall be required when:

1. An existing building is extended and/or new floors are added, if the floor area of the building heated at a temperature above 12 °C increases by more than 50 m^2.
2. Building elements forming a part of the envelope of a heated part of the building are renovated, or are partly or completely replaced, so that the works cover at least 25% of the area of each building component, or at least 75% of the envelope of a heated part of the building.
3. Only certain building elements of the envelope of a heated part of the building covering an area over 25% of that building component or element related to each individual geographic orientation are renovated.
4. In case of a conversion of a non-heated building or a part of the surface area of a usable floor area thereof exceeding 50 m^2 into a space heated at a temperature above 12 °C.

The application for a building permit for a new building and for the improvement of the energy performance of an existing building with a useable floor area over 1,000 m², in case of a major renovation, shall be accompanied by a study of technical, environmental and economic feasibility of alternative systems for electricity supply, especially decentralised energy supply systems based on Renewable Energy Sources, cogeneration systems, long distance or block heating systems containing heat pumps.

2.2 Format of national transposition and implementation of existing regulations

The EPBD requirements relating to the setting of minimum energy efficiency requirements for new buildings and for existing buildings undergoing renovation have been transposed in the national law through several technical regulations.

The technical regulation on energy economy and heat retention in buildings is a basic technical regulation directly transposing the EPBD requirements, as well as setting a requirement with regard to the maximum annual specific heat consumption for heating.

The use of alternative energy supply systems is promoted through the obligation to develop technical, economical and ecological feasibility studies for alternative energy supply systems. This study must be a part of the main design when submitting the application for obtaining the building permit.

Regulations indirectly transposing the EPBD requirements are:

> the technical regulation for windows and doors (OG 69/06);
> the technical regulation for chimneys in construction works (OG 03/07);
> the technical regulation on heating and cooling systems in buildings (OG 110/08);
> the technical regulation on ventilation systems, partial air-conditioning and air-conditioning of buildings (OG 03/07).

The technical performance of a construction material must be such that, along with the required integration in line with the purpose of the building works, as well as with the maintenance prescribed and foreseen in the design, it shall endure the impact of regular use and environmental conditions, so that the building works into which the material is integrated meet the essential requirements for such building works throughout the designed life cycle of the building. These requirements also include the essential requirement for energy economy and heat retention. The fulfilment of essential requirements is proven by the design. The programme of quality control and provision, depending on the design, also includes, among others, the required material performance, the conditions of execution, the requirements of inspection frequency during maintenance, the control procedures, as well as the procedures of efficiency testing of the designed and installed systems (with regard to heating and cooling systems). During the construction work, the approved architect

No.	Structural part	U [W/m².K]			
		$\Theta_i \geq 18$ °C		12 °C < Θ_i < 18 °C	
		Θ_e,month, min > 3 °C	Θ_e,month, min ≤ 3 °C	Θ_e,month, min > 3 °C	Θ_e,month, min ≤ 3 °C
1.	External walls, walls to the garage, attic	0.60	0.45	0.75	0.75
2.	Windows, balcony doors, roof windows, transparent facade elements	1.80	1.80	3.00	3.00
3.	Flat and pitched roofs above heated rooms, ceilings to the attic	0.40	0.30	0.50	0.40
4.	Ceilings above external air, ceilings above garages	0.40	0.30	0.50	0.40
5.	Walls and ceilings to non-heated rooms and non-heated stairways at a temperature higher than 0°C	0.65	0.50	2.00	2.00
6.	Walls to the soil, floors on the soil	0.50	0.50	0.80	0.65
7.	External doors, doors to non-heated stairways, with non-transparent door wings	2.90	2.90	2.90	2.90
8.	Walls of the roller shutter box	0.80	0.80	0.80	0.80
9.	Ceilings between apartments, ceilings between heated working premises of various users	1.40	1.40	1.40	1.40

Table 1: Maximum allowed heat transmission coefficients U [W/m².K] of building components of new buildings, small buildings (Ak < 50 m²) and after renovation works performed on existing buildings.

Note: $\Theta_{e,mon,min}$ is the mean monthly temperature of the outdoor air in the coldest month at the building location or the approved engineer is responsible for conducting an independent building surveillance. Inspectional supervision is also carried out by the building inspection division of the Ministry. After the construction, inspections should be carried out by authorised persons, depending on the requirements prescribed in the main design of the building.

2.3 Cost-optimal procedure for setting EP requirements
The EP requirements for buildings are set in such a way as to achieve a higher energy efficiency level, a reduction in the energy demand of buildings, as well as a reduction of the environmental impact. Such requirements prescribed in the technical regulation of 2006 have enabled a reduction by at least 30% of the building's energy demand for heating, as well as a decrease in CO_2 emissions at the same percentage. The setting of requirements for buildings along with the cost-optimal criteria is planned to be developed by the end of 2013 for various designated functions of buildings.

2.4 Action plan for progression to NZEB
The national definition of NZEB shall be developed upon the establishment of the minimum EP requirements for buildings in accordance with the results of the cost-optimal analysis. NZEB shall refer to high energy efficiency buildings, and the share of renewables shall be defined in line with the national energy strategy. The envisaged definition shall enable clear and simple implementation, and shall be adapted to buildings in accordance with their designated function. The action plan for progression to NZEB is expected to be developed by the end of 2013.

3. Energy performance certificates

The energy certification of buildings started in 2010, when also the authorisation to issue EPCs was granted to the first natural and legal persons.

For purposes of monitoring the energy consumption in public sector buildings, and in order to promote the implementation of measures for energy efficiency improvement, the Energy Management Information System (EMIS) has been developed. This is a web-based application for the control and analysis of the energy and water consumption. The database includes data on 8,000 buildings (construction and energy data), as well as data on the energy and water consumption, which are entered on a monthly basis. In the current test phase, 40 buildings are connected to the system by means of a remote energy consumption meter.

The obligation of the energy certification of buildings is laid down for new buildings prior to their use, existing buildings being sold, rented or leased, and buildings used for public functions. The display of energy certificates of buildings with public functions, with usable floor area above 1,000 m^2, is required since the 31st of December 2012. For buildings with usable floor area above 500 m^2, the display obligation starts from the 31st of December 2013. For buildings with usable floor area over 250 m^2, it starts from the 31st of December 2015.

The energy certification of buildings started in 2010. Since then, and up to January 2013, more than 5,000 energy certificates have been issued, of which 60% for residential buildings (single-family and multifamily houses) and about 40% for non-residential buildings.

3.1 Progress and current status on sale or rental of buildings
The energy certificates are issued for residential buildings, non-residential buildings and non-residential buildings in which energy is used to achieve certain conditioning environments, but without heating them above 18 °C.

The buildings are classified into eight energy classes, from A+ to G, and energy classes are indicated using reference climate data.

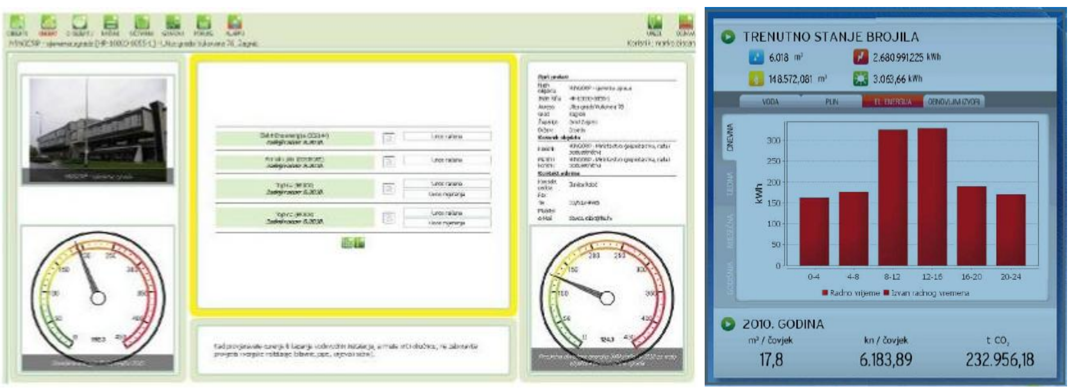


Figure 2: Energy Management Information System.

Submission of energy certificates of existing buildings or their separately used units for the information of the buyer, tenant or lessee, is obligatory when these buildings are sold, rented out or leased, prior to stipulating the sale, rent or lease contract. If advertising is done in the media, the advertisements shall contain also the energy class of the building or its separately used unit. Although this obligation will come into force only on the date of the accession of the Republic of Croatia to the European Union, on the 1st of July 2013, certain advertisements for the sale of apartments in new residential buildings already include the energy class of the building.

The energy certificates contain recommendations of economically justified measures specifically tailored to the specific building for the improvement of the energy performance. The recommendations are not mandatory. The maximum prices for the development of energy certificates of buildings are established by a Ministerial Decision, and include the price for conducting an energy audit of an energy certificate.

The conditions and criteria for persons performing energy audits and energy certification of buildings are prescribed by the Ordinance OG 81/12. The authorisation requires education (university studies of engineering in the field of architecture, civil engineering, mechanical engineering or electrical engineering), at least five years of professional working experience, successful completion of the Training Programme (pass an examination), as well as professional liability insurance against any potential damage. The validity of the authorisation is 3 years. After this period, accreditation shall be granted if the authorised person continues to comply with the requirements for granting the accreditation, and duly fulfills their obligation of attending the Professional Improvement Programme once a year. Until the end of 2012, about 980 engineers attended the Training Programme Module 1 for energy audits of buildings with simple technical systems, and about 440 attended the Training Programme Module 2 for energy audits of buildings with complex technical systems. 530 persons are authorised by the Ministry for performing energy audits and energy certification of buildings.

The training is carried out by ten regionally distributed institutions that have obtained the relevant approval from the Ministry of Construction and Physical Planning. For

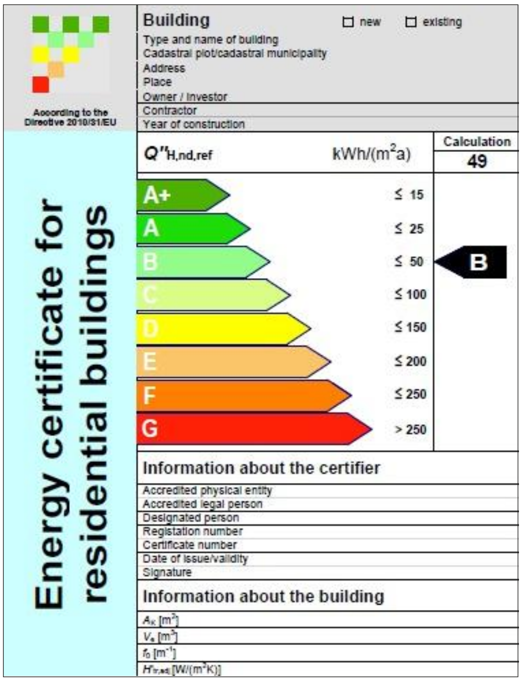


Figure 3: Energy Performance Certificate for residential buildings.

Table 2: Energy Classes in EPCs.

	Residential buildings	Non-residential buildings
Energy class	$Q_{H,nd,ref}$-specific annual energy need for heating in kWh/(m².year)	$Q_{H,nd,rel}$-relative value of annual energy needs for heating in %
A+	≤ 15	≤ 15
A	≤ 25	≤ 25
B	≤ 50	≤ 50
C	≤ 100	≤ 100
D	≤ 150	≤ 150
E	≤ 200	≤ 200
F	≤ 250	≤ 250
G	> 250	> 250

purposes of education of professionals, manuals on energy certification of buildings have also been published.

For purposes of monitoring and ensuring the quality of the developed energy certificates for buildings, a programme has been developed, which is used by authorised persons issuing energy certificates which are also registered in the database maintained by the Ministry of Construction and Physical Planning. The trial operation of this application ended in mid-December 2012, and full implementation is expected from the 1st of July 2013.

For purposes of Quality Assurance (QA), the control of energy certificates of buildings is prescribed in terms of regularity and accuracy, calculation and proposed measures. These controls shall be carried out by persons to whom authorisation will be granted by the Ministry. The selection of energy certificates shall be carried out in one of the proposed ways in the EPBD: at random, from the total number of issued energy

Table 3: Maximum prices for carrying out energy audits and issuing energy certificates of buildings.

THE HIGHEST PRICES OF ENERGY AUDITS OF BUILDINGS AND ENERGY PERFORMANCE CERTIFICATES

TYPE OF BUILDING		RESIDENTIAL BUILDINGS INDIVIDUAL FLATS AND BUILDINGS AS A WHOLE) AND NON-RESIDENTIAL BUILDINGS (OFFICES, NURSERIES, SCHOOLS, HOMES, HOTELS)										NON-RESIDENTIAL BUILDINGS (HIGHLY COMPLEX CONSTRUCTIONS WITH COMPLEX INSTALATION SYSTEMS AND MORE TEMPERATURE ZONES)						
		> 50 m²	≤ 250 m²	FOR A FLAT IN BUILDING	≤ 400 m² and agric. ≤ 600 m²	1,000 m²	5,000 m²	10,000 m²	20,000 m²	50,000 m²	> 50,000 m²	1,000 m²	5,000 m²	10,000 m²	15,000 m²	20,000 m²	50,000 m²	> 50,000 m²
NEW BUILDINGS	DOCUMENT REVIEW AND (IF NECESSARY) ENERGY AUDIT OF BUILDING AND ISSUE OF ENERGY PERFORMANCE CERTIFICATE	FLAT RATE: 1,400 kn			FLAT RATE: 1,750 kn	2.300 kn	6.200 kn	9.400 kn	14.300 kn	26.400 kn	FLAT RATE: 31,700 kn	3.100 kn	8.100 kn	12.200 kn	15.600 kn	18.500 kn	33.500 kn	FLAT RATE: 40,200 kn
EXISTING BUILDINGS	ENERGY AUDITS	0[1,3] to 3,300 kn		0[1,3] to 1,500 kn	0[1,3] to 5,000 kn	price for new buildings multiplied by the coefficient 0[1,2,3] to 3.8												
	EVALUATION OF ENERGY AUDITS' ACTIONS AND ISSUE OF ENERGY PERFORMANCE CERTIFICATES	FLAT RATE: 1,450 kn		FLAT RATE: 1,200 kn	FLAT RATE: 2,400 kn	price for new buildings multiplied by the coefficient 1[1,2] to 1.2												

Figure 4: Manual on energy certification of buildings, and Manual on energy audits of buildings.

certificates for buildings of a given energy class, type and designation of the building. During the three-year period of the validity of authorisation, each authorised person shall undergo such a control at least once.

The penalties for authorised persons carrying out energy audits and issuing energy certificates of buildings are prescribed in the Energy Efficiency Act. The penalties are defined to be up to 20,000 € for legal persons, and up to 1,500 € for natural persons in cases prescribed by the Act.

3.2 Progress and current status on public and large buildings visited by the public

Public purpose buildings for which the obligation for energy certification and for public display of EPCs is prescribed, include the following wide range of buildings:

1. Commercial buildings, buildings for the performance of administrative affairs of legal and natural persons.
2. Buildings of state administrative and other bodies, bodies of local and regional self-government.
3. Buildings used by legal persons with public authority.
4. Buildings used as courts, prisons, barracks.
5. Buildings of international institutions, chambers, economic associations.
6. Banks, savings banks and other financial institutions.
7. Shops, restaurants, hotels, travel agencies, marinas, other service and tourism activities.
8. Railway, road, air and water traffic buildings, post offices, telecommunication centres, etc..
9. Buildings for pre-school, primary and secondary education, nursery schools, etc., buildings for higher education, research laboratories, etc..
10. Residential buildings for communities: homes for elderly persons, children, students, employees, as well as homes for temporary or permanent residence.
11. Buildings used by sports associations and organisations, buildings for sports facilities.
12. Buildings for cultural functions: cinemas, theatres, museums, etc..
13. Hospitals and buildings of other institutions with medical, social and rehabilitation functions.

The validity of the energy certificate is 10 years. The first page of the energy certificate, enlarged to A3 format, is publicly displayed, containing the energy class. The page with recommendations of economically justified measures for improving the energy performance of the building, with a simple payback period, is also displayed.

Penalties are prescribed in case of failure to comply with the energy certification obligations with regard to buildings used for public functions. These penalties amount to 13,000 € for legal persons who are owners of buildings with public functions if they fail to publicly display the energy certificate of the building. Natural persons who are owners of buildings with public functions may be fined for such offence with a penalty up to 1,300 €.

3.3 Information campaigns

Information campaigns regarding the promotion of energy certification of buildings primarily refer to educating stakeholders at targeted conferences. Since 2005, the Energy Efficiency Promotion Project has been implemented in Croatia. Currently, this project is being implemented by the UNDP in Croatia, by the Ministry of Economy, and the Ministry of Construction and Physical Planning, under the financial support of the Environmental Protection and Energy Efficiency Fund and of the Global Environmental Facility (GEF). The primary objective of the project is to promote the application of economically viable, energy efficient technologies, materials and services, both in the public sector and in households, all in order to reduce unnecessary energy consumption and greenhouse gas emissions.

A number of educative workshops were held to inform the public of the obligation of energy management in the buildings used by them, as well as of the mandatory energy certification of buildings and the role of energy certificates of buildings, especially promoting the implementation of energy efficiency measures in buildings.

Since November 2012, these activities have been complemented by the establishment of the Energy Efficiency Green Library (ZeeK), where specialised publications and brochures will be available on increasing energy efficiency through the application of energy efficient measures and RES.

Promotion of activities improving the quality of operation in the field of the energy efficiency of buildings, and increasing the energy efficiency and use of RES are basic tasks of the Croatian Association of Energy Certifiers. The Association was established in late 2009 and it now has 140 members. Within the scope of its activities, the Association has issued a brochure promoting the obligation of carrying out energy audits and energy certification of buildings.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating and air-conditioning systems

Regular inspections of heating and Air-Conditioning (AC) systems in buildings are obligatory once every five years. Such inspections shall be carried out by authorised legal or natural persons. The conditions for obtaining the authorisation refer to professional qualification and profession (master of mechanical engineering), work experience (min. 5 years), and completion of the Training Programme prescribed by the Ordinance. Further education following the prescribed education programme is underway. By the end of 2012, the first authorisations were issued to approved inspectors. The inspection is followed by an inspection report which contains

Figure 5: Computer application for the development of energy certificates of buildings and databases.

Figure 6: Green Library.

Figure 7: Brochure on energy certification.

measures for the improvement of energy efficiency. Quality controls for inspection reports are established and will be carried out by independent authorised legal entities. The selection of the reports to be controlled is prescribed by the Ordinance. A database of heating and AC systems will be established.

The impact of carrying out inspections of heating and AC systems shall be assessed after having collected experience in this field. By the end of 2012, the first two persons to perform regular inspections of these systems were authorised.

Various activities in the scope of system maintenance shall be carried out in accordance with the provisions of the Technical Regulation on heating and cooling systems for buildings, and the Technical Regulation on ventilation systems, partial AC and AC of buildings. Testing during maintenance activities is mandatory for all heating/cooling systems and ventilation systems, partial AC and AC of buildings, regardless of their power. Regulatory inspections aimed at the systems maintenance shall be carried out at intervals, in accordance with the requirements of the building design, but not less frequently than once a year. The method of carrying out regular inspections includes at least: visual inspection, repair, replacement and cleaning of the system components, as well as check measurements of the design parameters, of the temperature and of the noise level. The inspection of a system shall always be carried out prior to its first use and prior to its resumed use if the system was out of operation for more than 6 months, unless otherwise specified by a special regulation.

5. Conclusions and future plans

In September 2012, activities began in relation with the definition of reference buildings, for the purpose of cost-optimal calculations in order to set the minimum Energy Performance (EP) requirements. On this task, relevant institutions will be engaged; conclusions are expected by late spring of 2013. In the first stage, four types of buildings will be defined (single-family buildings, apartment block buildings, office buildings and buildings with educational functions). It is envisaged to determine the reference buildings according to their purpose and age of construction (buildings built before 1987 and buildings built in the period from 1987 until today), and according to climatic zones (for two characteristic climates: continental and littoral). In compliance with the defined reference buildings and the carried out cost-optimal analysis, the new minimum requirements on the EP of buildings will be determined. Also, the heat transmission coefficients of building parts which constitute the envelope will be made more stringent, as well as the requirements for technical systems regarding energy efficiency. These new values shall be established within cost-optimality limits. For purposes of defining Nearly Zero-Energy Buildings (NZEBs), the following will be determined: a more stringent criterion of maximum primary energy consumption, more stringent requirements with regard to heat transfer coefficients of parts of buildings, and the share of Renewable Energy Sources (RES) in the total consumption, as well as limit values of annual carbon emissions.

In order to promote the application of alternative systems, and to meet the obligation of establishing the share of RES for new buildings, a programme will be developed for the education of plumbers/fitters of biomass boilers, heat pumps, solar photovoltaic, or solar thermal devices. Authorisation will be granted to plumbers/fitters on the basis of this training programme. The activities for the education of all those involved in planning, designing, building and maintenance of high EP buildings will be continued in a systematic manner. The education will also include public service employees and other authorities in charge of running public buildings.

The continuation of implementation of the Retrofitting Programme for Public Sector Buildings is planned, as well as the Retrofitting Programme for Residential and Commercial Buildings. The implementation of a number of measures for improving the energy efficiency and the construction of new buildings or reconstruction of existing buildings up to achieving a high energy efficiency level will be promoted.

Continuous controls will be carried out in order to achieve a higher quality of the energy audits of buildings, as well as of the energy certificates of buildings issued by authorised persons. Also, the national computer programme to be developed until the end of 2013, through which all authorised persons will calculate the EP of buildings, both in final and primary energy, will contribute to an increase in quality of the whole certification system.

EPBD implementation in Cyprus

STATUS AT THE END OF 2012

Author

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1. Introduction

The Law for the Regulation of the Energy Performance of Buildings 2006 (L.142(I)/2006), is the legal document upon which the transposition of the Energy Performance of Buildings Directive (EPBD) in Cyprus is based on. The implementation of the EPBD started in 2007 with setting minimum requirements for the building envelope, and has been fully implemented in 2009 with the launching of the Energy Performance Certificate (EPC) and the inspection of air-conditioning systems and heating systems with boilers. In 2012, the House of Representatives passed an amendment of the Law for the Regulation of the Energy Performance of Buildings 2006, for the transposition of the recast EPBD in Cyprus.

This report presents an overview of the current status of implementation of the EPBD in Cyprus.

2. Energy performance requirements

The first attempt to introduce energy conservation in buildings was the preparation of a voluntary CYS98:1999 Standard for the Insulation and Rational Use of Energy in Dwellings. However, the implementation of the EPBD in Cyprus was the first attempt ever made to regulate the energy consumption in buildings. The Ministerial Order for the Minimum Energy Performance Requirements of 2007 made only the thermal insulation of the elements of the building envelope mandatory. The second Ministerial Order of 2009 keeps the same maximum U-values for the elements of the building envelope, but makes the requirements more stringent as it regulates the building as one whole entity. The calculation of the cost-optimal levels of the minimum Energy Performance (EP) requirements is expected to indicate the untapped energy saving, and a new Ministerial Order for the Minimum Energy Performance Requirements is expected to be issued, after the cost-optimal calculation will be finished in March 2013.

2.1 Progress and current status

The Ministerial Order for the Minimum Energy Performance Requirements of 2007 included only maximum U-values for roof, external wall, doors, windows and floors above unheated spaces and floors in contact with the external environment. The requirements of the Ministerial Order of 2007 are shown in Table 1.

In 2009, a new Ministerial Order for the Minimum Energy Performance Requirements was issued. It keeps the same maximum U-values for the building envelope, but introduces the following new requirements:

> The calculation of the average U-value (or U-mean) takes into account the U-value of each element of the building element and its corresponding surface

Table 1: Minimum EP requirements for new buildings and all buildings above 1,000 m² that undergo a major renovation (Ministerial Order of 2007).

Description	U-value (W/m².K)	Comments
Horizontal structural elements of the building envelope	≤0.75	
Wall and structural elements of the building envelope	≤0.85	Not applied to passive systems
Windows and doors of the building envelope	≤3.8	Not applied to shop windows
Floor in contact with unheated spaces	≤2.0	

National Websites *www.mcit.gov.cy*

Figure 1: Minimum EP requirements for new buildings and all buildings above 1,000 m² that undergo a major renovation (Ministerial Order of 2007).

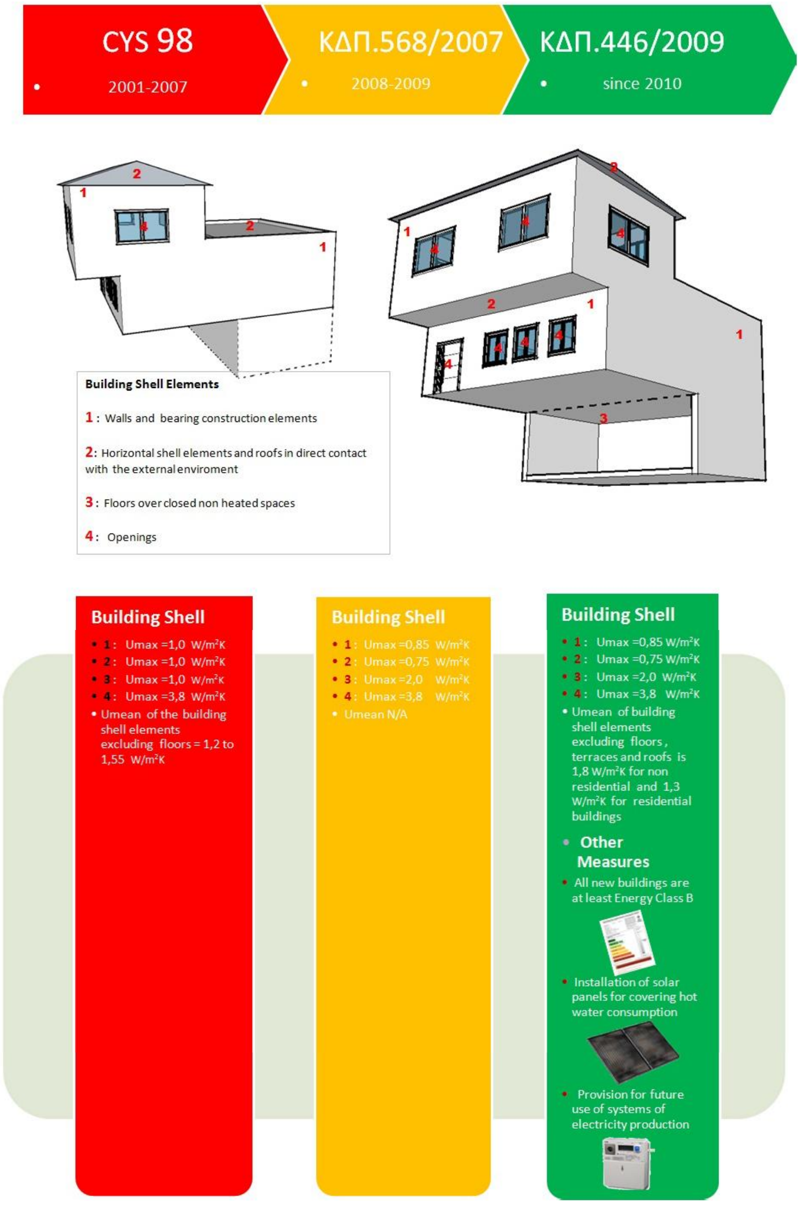


Table 2: Predetermined U-values for the reference building.

Exposed element	**U-value (W/m².K)** (residential)	**U-value (W/m².K)** (non-residential)
Roofs[1] (irrespective of pitch)	0.6375	0.6375
Walls	0.7225	0.7225
Floors	0.6375	0.6375
Ground floors	1.6	1.6
Windows, roof windows, roof lights, and pedestrian doors	3.23	3.23
Vehicle access and similar large doors	Same as real building	Same as real building

[1] *Any part of a roof having a pitch greater or equal to 70° is considered as a wall*

area and averaged over the whole area of the building envelope. The roof and the floor are not included in this calculation.

> The B energy category, as a minimum requirement, is achieved only if the building needs the same or less primary energy than the reference building. The reference building has predetermined energy performance characteristics like U-values, thermal mass and technical systems, as described in Table 2.

The Ministerial Order for the Minimum Energy Performance Requirements of 2009 also introduced requirements for integrating Renewable Energy Sources (RES) in the building. The Ministerial Order requires that a solar thermal system for the production of hot water is installed, according to the 'Technical Guide for the Installation of Solar Thermal Systems', in all new residential buildings. The installation of solar thermal systems for the production of hot water in residential buildings was already a common practice in Cyprus. However, the Ministerial Order not only made it mandatory for all new residential buildings, but it also regulated some technical parameters of the solar thermal system, including the size of the system according to the needs for hot water in the building. Additionally, all new buildings must have the necessary infrastructure pre-installed in case the future owner decides to install photovoltaic (PV) panels to produce electricity. Table 3 shows the additional minimum requirements set by the Ministerial Order of 2009 and Figure 1 shows the gradual advancement of the minimum EP requirements.

2.2 Format of national transposition and implementation of existing regulations

The methodology for calculating the energy performance is defined by the Ministerial Order of 2009 and it is described in the following documents:

> Guide of Thermal Insulation of Buildings (2nd Edition).
> Methodology for Calculating the Energy Performance of Buildings.

The 'Guide of Thermal Insulation of Buildings' was first issued in 2007 in order to guide engineers and architects to calculate U-values and inform them on different insulation techniques. The 2nd Edition (Figure 2), published in 2010, included more detailed calculation methods for U-values and parameters related to thermal mass.

Description	U-value ($W/m^2.K$)	Comments
Average U-value not including floors and roofs	≤1.3 residential ≤1.8 non-residential	
Energy class on the EPC B or better		
Installation of solar thermal systems in all new residential buildings according to the 'Technical Guide for the Instalment of Solar Thermal Systems'		It is subject to restrictions and requirements set by the Department of Spatial Planning and Housing
Installation of the needed infrastructure for the future installation of RES electricity production systems		

Table 3: Minimum EP requirements for new buildings and all buildings above 1,000 m^2 that undergo a major renovation (Ministerial Order of 2009).

The 'Methodology for Calculating the Energy Performance of Buildings' (Figure 3) describes all the algorithms and assumptions used to calculate the energy consumption. It includes heating, cooling, domestic hot water (DHW) and lighting needs, expressed in terms of primary energy. Both documents are based on CEN standards, and they are both mandatory, to be used to calculate the energy performance of all buildings, existing and new. The calculation methodology is implemented with the software 'SBEMcy' (Figure 4), developed by the Energy Service of the Ministry of Commerce, Industry and Tourism. In 2012, the software named 'Eco-engine' was developed by the private sector, and was approved for calculating the energy performance of buildings and issuing Energy Performance Certificates (EPCs).

The implementation of minimum EP requirements is randomly checked by inspectors appointed by the Minister of Commerce, Industry and Tourism. According to the Law, these inspectors have the right to enter any building and construction site and inspect if the building complies with the minimum EP requirements. The inspectors report on a monthly basis to the Director of Energy Service and, in case of non-compliance, legal measures are taken against the building owners. The inspectors are also in close corporation with the building permit authorities which are kept informed for cases of non-compliance. So far, legal measures have been taken for seventeen cases (Figure 5).

2.3 Cost-optimal procedure for setting EP requirements

The calculation of the cost-optimal levels of minimum EP requirements is started with the definition of the reference buildings for new and existing single family houses, apartment buildings and office buildings. The reference buildings are either virtual or real, in an attempt to represent the average and typical building stock. Since there is no comprehensive database of the building stock, the relevant statistics by the Statistical Service of the Ministry of Economics were used instead. These statistics gave a good indication of the average size, shape, thermal insulation and technical systems used in existing and new buildings. Furthermore, the input of various stakeholders was used to develop the reference buildings. Energy efficiency measures were applied on the reference buildings. The energy savings resulting from each measure were calculated using the software for calculating the energy performance of buildings. The results derived were compared with the consumption of similar real buildings and adjustment factors were introduced where it was considered necessary. For the calculation, a cost database was developed with the collaboration of various stakeholders and data derived from government construction projects. So far, calculations have been performed for single family houses and governmental office buildings. The Energy Service has circulated among the various stakeholders a draft document for them to comment on the results and on the calculation process.

Figure 2: Guide of Thermal Insulation of Buildings (2nd Edition).

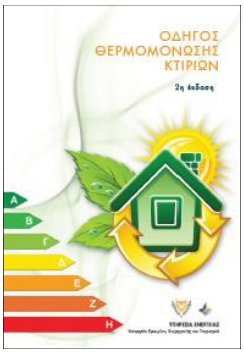


Figure 3: Methodology for calculating the energy performance of buildings.

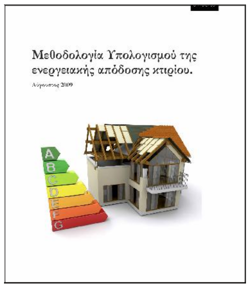


Figure 4: Software SBEMcy.

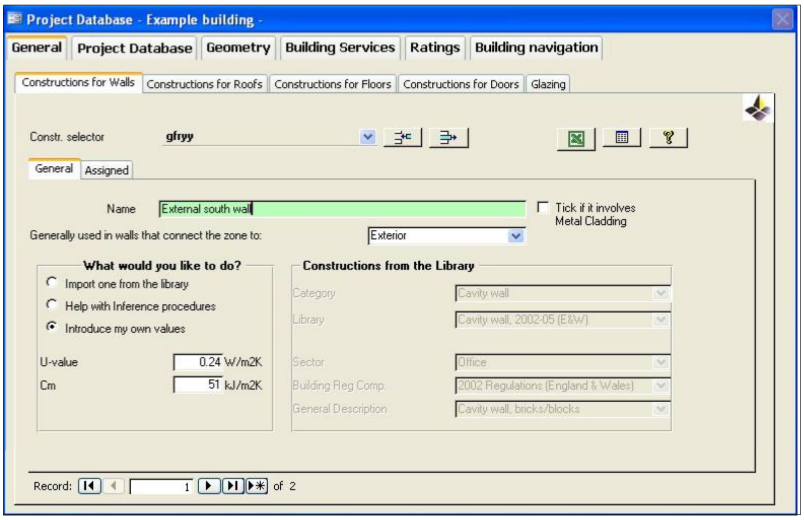


Figure 5: Inspections of buildings for compliance with the minimum EP requirements, performed by appointed inspectors between 2010 and 2012.

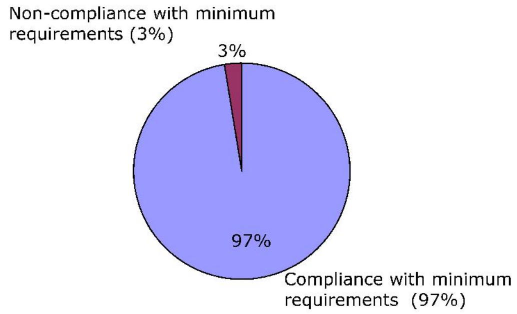
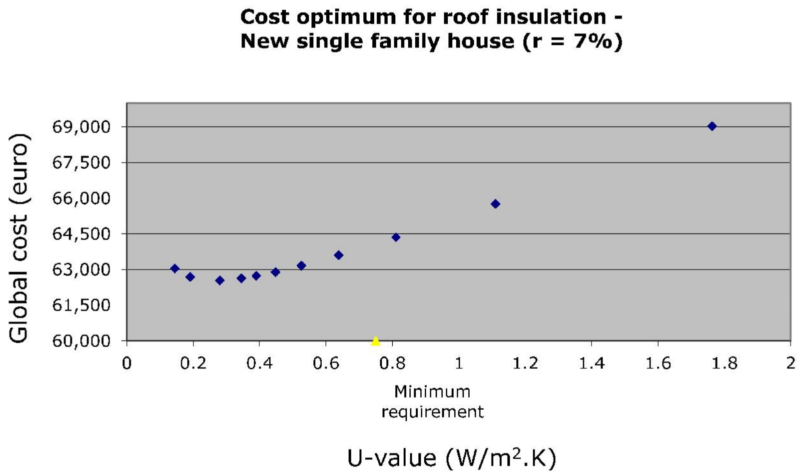


Figure 6: Graphical result from calculating the cost-optimal level for the minimum requirement of roof insulation in new single family houses.



The goal is to have inputs from as many professionals engaged in the construction industry as possible. The first draft document indicates the untapped energy saving in building elements such as roofs and walls. The preliminary calculations for houses and office buildings show that the current minimum U-value for walls shall be lowered by 15% to reach cost-optimal levels, and by more than 30% in the case of roofs (Figure 6).

2.4 Action plan for progression to NZEB
In September 2012, the Ministry of Commerce, Industry and Tourism submitted the Nearly Zero-Energy Buildings (NZEB) Action Plan to the European Commission. For the purpose of setting the definition of the NZEB in Cyprus, the Energy Service ordered an in depth study of the potential of energy saving in the three most commonly used categories of residential buildings:

> detached two storey houses;
> terraced houses;
> apartments on building blocks.

This study covered all the four climatic zones of the country, as defined in the Methodology for Calculating the Energy Performance of Buildings. The study indicated the following requirements and technical parameters for a building to be considered a NZEB:

> for residential buildings, the primary energy consumption must not exceed 180 kWh/m^2.year, and at least 25% must be covered from RES (Table 4);
> for non-residential buildings the primary energy consumption must not exceed 210 kWh/m^2.year, and at least 25% must be covered from RES.

The National Action Plan identifies the following actions to be taken until 2015 in order to increase the number of NZEBs in Cyprus:

> Preparation of a technical guide based on the results of the study on the energy saving potentials in NZEBs. The Technical Guide shall include the minimum requirements for NZEBs in Cyprus, as well as technical and construction guidance in order to facilitate the design and construction of the building. The application of the Technical Guide will be on a voluntary basis and will be upgraded continuously. It will remain in use even after the enforcement of the application of NZEBs by law.
> Residential and non-residential pilot applications of NZEBs are planned to be constructed. The Energy Service, since

Table 4: Technical requirements and specification for residential NZEBs.

1	Maximum primary energy consumption before the contribution of RES (kWh/m^2.year)	180
2	Minimum contribution of RES	25%
3	Maximum U-value of roof (W/m^2.K)	0.41
4	Maximum U-value of wall (W/m^2.K)	0.49
5	Maximum U-value of window (W/m^2.K)	2.8
	Maximum U-value of floor in contact with the external environment (W/m^2.K)	0.41
6	Solar Protection of Openings	External shading with movable shutters with G-value for the system (shutter and glass) at least 0.3 for the summer months Shutters with thermal insulation (U value =1.1W/m^2.K)
7	Natural ventilation/cooling	Natural ventilation with fresh air rate as defined in the national methodology for the certification of the energy performance of buildings. Provision for fresh air for night cooling at least 1,330 m^3/h in living spaces, and 730 m^3/h in bedrooms.

2011, has been collaborating with the Cypriot Land Development Cooperation (CLDC) in designing and constructing new developments of semi-detached and terraced buildings, as well as apartments in order to be NZEBs. CLDC is a state owned cooperation and its mission is to assist low and medium income families to acquire a house. This action is subject to land development construction demand. Also, the Energy Service is working closely with the Technical Services of the Ministry of Education and Culture in order to design and construct the first NZE schools.

> Support research programs for the development, improvement or advancement of construction techniques.
> Compare the existing national methodology for the certification of the Energy Performance of Buildings with the certification of NZEBs. Further parameters are to be accounted for the latter, thus the existing methodology should be further developed in order to include the NZEB category. Once this is done, the software now in use for the certification of buildings will have to be improved or replaced in order to reflect the new methodology for the certification of NZEBs.
> Inform the Qualified Experts (QE) and the engineers of the building industry.
> Raise the awareness of the public.
> Design and announcement of a linear tightening of the minimum EP requirements leading to the 2020 NZEB.

3. Energy performance certificates

The implementation of the Energy Performance Certificate (EPC) in Cyprus took place in two phases. The first phase applied to the certification of residential buildings, new and existing, which started on the 1st of October 2009 as optional and became mandatory by the 1st of January 2010 by issuing the Ministerial Order for the Minimum Energy Performance Requirements of 2009. The second phase applied to the certification of commercial buildings, education buildings, office buildings and all other buildings that are not considered residential, new and existing, which became mandatory on the 1st of September 2010 by the same Ministerial Order.

3.1 Progress and current status on sale or rental of buildings

The main purpose of the EPC (Figure 7) is to give useful information considering the global energy performance of the building. The buildings are rated based on calculated consumption (asset rating) of primary energy per year (kWh/m^2.year) for a typical use of the building and according to the building type.

A central registry has been established since 2009 where all EPCs are registered before being issued. The QE sends the EPC, the calculations and the recommendations report via email. The Energy Service is responsible for maintaining the registry and performs sample checks on the quality of calculations submitted. There are several criteria to flag a certificate for a quality check, of which the most important ones are: issuing a certificate for the first time, recorded previous failure of the QE to perform calculations, and use of RES other than solar thermal.

Another form of controlling the quality of EPCs is focusing on improving QEs. The Energy Service calls randomly each QE for an audit. The audit usually takes place at the QE's workplace and it has the objective of checking if all the necessary documentation exists, but also of solving any questions and misunderstandings that the QE might have. There are cases where the audits have shown that the QE is not documenting all data necessary. In these cases, the QE gets a warning for compliance. If this is repeated, then the QE is taken out of the registry. Also, QEs that have been audited and found to be using false data on purpose are immediately taken out of the registry (Figures 8, 9 and 10).

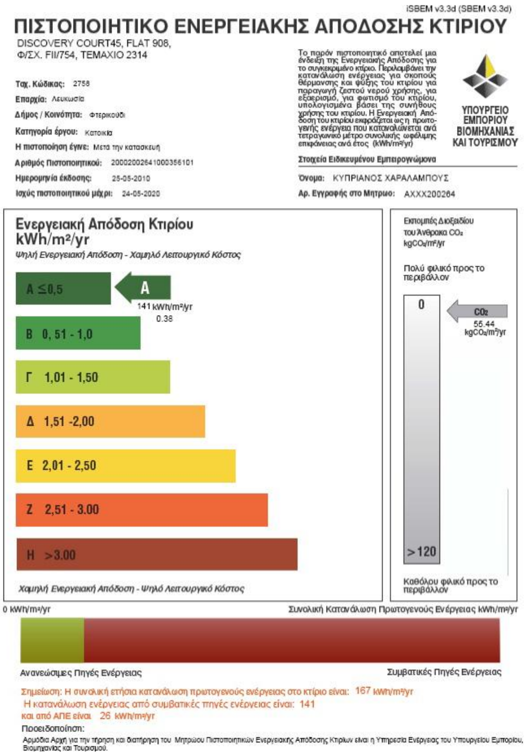


Figure 7: Energy Performance Certificate.

Figure 8:* *EPC calculations that have been checked for residential buildings.

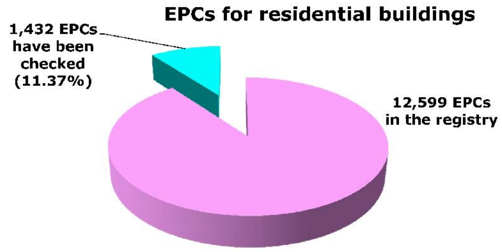


Figure 9:* *EPC calculations that have been checked for non-residential buildings.

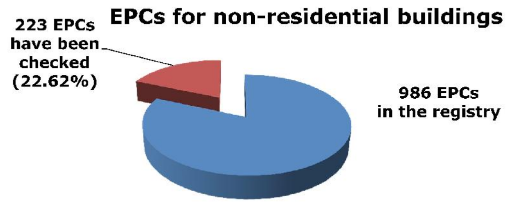


Figure 10:* *Qualified Expert audit.

The responsibilities and the qualifications of the QEs are regulated by The Energy Performance of Buildings (Energy Certification for Buildings) Regulations of 2009, decree 164/2009. According to the Regulations, there are two levels of QEs: the residential buildings QEs and the non-residential buildings QEs. By the end of 2012, there are 337 QEs, from which 230 can issue EPCs only for residential buildings, and 107 for residential and non-residential buildings.

For the residential buildings, QEs must have the following qualifications:

> a degree in architecture, mechanical engineering, civil engineering or electrical engineering;
> three years of experience;
> pass an exam.

For the non-residential buildings, QEs must have the following qualifications:

> a degree in architecture, mechanical engineering, civil engineering or electrical engineering;
> six years of experience;
> pass an exam.

QEs qualified to issue certificates for non-residential buildings are also qualified to issue certificates for residential buildings. All QEs have to be registered in a central registry maintained by the Energy Service and they have to pay a 200 € registration fee, and then 100 € every year to renew their registration.

Figure 11:* *Guide for Certifying Existing Dwellings.

All existing, residential and non-residential buildings need to be certified when they are sold or rented. The building owner has to present an EPC to everyone who is interested in renting or buying. In all cases, the EPC must be accompanied by a recommendations report. Until August 2012, 13,617 EPCs were issued. 92% of them were issued for residential buildings, and only 5% were issued for existing buildings. The implementation of article 12 of the recast EPBD (Directive 2010/31/EU) – 'Mandatory inclusion of the energy label in advertisements' – is expected to strengthen the presence of an EPC when selling or renting a building.

For the certification of existing residential buildings, the Energy Service has issued the 'Guide for Certifying Existing Dwellings' (Figure 11) where the process of collecting data is described in detail. This technical guidance was considered necessary in order to assist QEs in certifying very old buildings where no documentation exists. Also, the Energy Service has developed a tool for calculating the cost-optimality of various energy efficiency measures applied in specific buildings. The tool is directed mainly to the QEs for use while producing recommendations. The calculation is based on the global cost as it is defined in (EU) Regulation No 244/2012, and the goal is to help the QEs better understand the impact of their recommendations, not only from the perspective of the payback period, but also in respect to the lifecycle of the building.

According to a survey made by the Energy Service among QEs, the majority of them charge between 2 € and 3 € per m^2 of the building's useful area for their work.

3.2 Progress and current status on public and large buildings visited by the public

As from the 1st of September 2010, all public buildings in Cyprus with more than 1,000 m^2 of floor area that are frequently visited by the public are required to display an energy certificate at the main entrance. The definition of public building includes every building that is used by a government body or by an organisation or company that is funded or controlled by the government. Buildings are defined as frequently visited when a service is provided to the public. This definition covers a large number of buildings in Cyprus and a lot of them have already been certified.

As from 2008, for every public building there is one public employee appointed as responsible for saving energy in the workplace. These so called 'energy saving officers', are in close cooperation with the Energy Service that provides information and directions in order to assist them in promoting an energy saving culture for the building they work in. The 'energy saving officers' must every year submit to the Energy Service a report that includes measured energy consumption and measures taken to improve energy efficiency. So far, there are more than 400 'energy saving officers' from all kinds of public buildings, like office buildings, public schools and police stations.
The 'energy saving officer' also has the possibility to request the Energy Service to perform a brief energy audit of the public building that he/she is responsible for. In that case, an employee of the Energy Service is visiting the building. The visit includes collecting data related to the energy consumption, interviewing employees and inspecting the building facilities. A report with recommendations is then submitted by the Energy Service to the public authority using the building. So far, twenty six public buildings have gone through a brief audit.

The certification of public buildings with more than 500 m^2 that are frequently visited by the public, will be implemented by January 2013.
The amendment of the Law for the Regulation of the Energy Performance of Buildings 2006, L.142(I)/2006, introduces the option of issuing a certificate based on the operational rating for public buildings. Regulations regarding the methodology and rating of the operational certificate are expected to be issued during 2013.

3.3 Implementation of mandatory advertising requirement – status

Indicating the energy category of the EPC became mandatory in all commercial advertisements on the 28th of December 2012. Before the implementation, the Ministry of Commerce, Industry and Tourism has informed all relevant interest groups. In 2013, the Ministry is planning to make sample checks on the implementation of this requirement.
The Law allows the competent authority to impose a fine up to 30,000 € in case of non-compliance.

3.4 Information campaigns

The Energy Service has recognised the importance of informing both professionals of the building industry, as well as the general public in order to effectively implement the EPBD and its recast.

During the first phase, the focus was on training the building permit authorities, the majority of which are the municipalities. Training took place through several training sessions. Furthermore, a guide was issued, in order to assist the building authorities to effectively check if the buildings are complying with the EP requirements when their building permit is examined.

In the second phase, information campaigns were addressed to all parties involved in the building industry. The Energy Service organised or participated in seminars and presentations especially directed to professionals in the building industry. Some of these presentations were part of major events for the national building industry, like the 4th Conference of Land Development Companies in 2008, and the 5th Energy Saving Exhibition 'Save Energy 2009'. Presentations especially organised for professional organisations, so far have targeted the Cyprus Association Property Owners, the Cyprus Association of Property Estimators and the Property Consultants, the Cyprus Hotel Association and the Federation of Associations of Building Contractors of Cyprus.

Leaflets and advertising flyers informing the public about the EPC, as well as about the inspection of central heating systems with a boiler and air-conditioning systems, have been issued and made available in places where frequent services are offered to the public.
In 2011, an advertisement campaign addressing the EPC was also launched in the print media. The campaign covered the three largest newspapers in the country and lasted for two months (Figures 12 and 13).

4. Inspection requirements - heating systems, air-conditioning

Cyprus has chosen the option of inspections. Inspections of air-conditioning (AC) and heating systems began in 2010. The inspections of AC systems are combined with the requirements of the f-gas regulation, in order to make them more effective and to reduce the cost for the building owner. The inspections of heating systems are carried out by the Energy Service. In both cases, the inspector has to submit a report to the owner.

Figure 12: Advertisement of the EPC.

4.1 Progress and current status on heating systems

By the beginning of 2010, a total of 179 inspections were conducted for heating systems with a boiler of rated output above 20 kW. These inspections mainly covered households and public schools. They were carried out free of charge by qualified boiler inspectors on behalf of the Energy Service. A written report is filled out and submitted to the owner of the building after each inspection. Suggestions and recommendations for improving the efficiency of the boiler are included in the report.The methodology for the inspection of boilers is described in the ‘Guide for the Inspection of Central Heating Systems with Boilers’. It is based on EN 15378 and covers all accessible parts of the heating system.

In 2012, an examination program in the form of an oral and a written exam was set by the Energy Service. Only those who pass the exam are authorised to conduct inspections and eligible to enter a registry. Institutes that are interested in becoming qualified organisations for organising the exams must apply to the Energy Service and meet the criteria set. The goal is that in 2013 the registered boiler inspectors will replace the inspectors so far performing inspections on behalf of the Energy Service.

Figure 13: Three page leaflet informing the public about the EPC.

4.2 Progress and current status on AC systems

Inspections of AC systems in Cyprus started on the 1st of October 2010. The Ministerial Order for the Inspection of Air-Conditioning systems makes the inspection of individual AC systems larger than 12 kW, and the inspection of AC systems that, adding together their nominal power in the same building, exceeds 50 kW, mandatory.

The inspections can only be performed by inspectors of building services, who have to be registered in the corresponding registry of the Energy Service. Until the 1st of August 2011, the requirements for inspectors to become qualified were: a degree in mechanical engineering, membership to the Scientific and Technical Chamber of Cyprus (ETEK), and three years of related experience in designing and installing AC systems. After that date, two more requirements were added:

> certified for the installation, recovery, maintenance and repair regarding fluorinated gases according to regulation (EC) 842/2006;
> training in matters of health and safety related to AC installations.

The methodology for inspecting AC systems is described in the ‘Guide for the Inspection of Air-Conditioning Systems’ (Figure 14), and is based on EN 15240:2007. The document describes which data must be gathered, how checks should be performed and gives guidance on the recommendations.

The Energy Service implements a control system on the inspections of AC systems. According to The Energy Performance of Buildings (Inspection of Air-conditioning Systems) Regulations of 2009, decree 163/2009, the inspectors must inform the Energy Service which inspections they will perform, at least one week ahead of the schedule. This enables the Energy Service to check on them during the inspection on a random basis. Also, the Energy Service frequently asks the inspectors to submit their inspection reports in order to check their quality.

Until the end of 2012, there were fifty-eight AC registered inspectors and thirty-one inspections performed.

5. Conclusions and future plans

The biggest challenge for Cyprus in 2013 is the full implementation of the recast Energy Performance of Buildings Directive (EPBD). The amendment of the Law for the Regulation of the Energy Performance of Buildings 2006, L.142(I)/2006, that was voted by the House of Representatives, was the product of a two year consultation process. The process for implementing the recast EPBD in Cyprus already started at the Committee for Consulting the Minister; where all relevant interest groups related to buildings, e.g., professional associations, governmental departments, and consumers participated. Then, a public consultation followed. The result is that the amendment law not only transposes the recast EPBD in Cyprus, but also completes gaps and weaknesses that were found from implementing the original EPBD. The most important fields of improvement are the following:

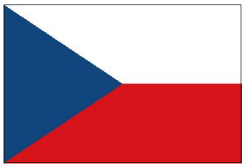
> The proper installation and maintenance of technical systems was not addressed in the previous legislation. Addressing this issue was judged essential by almost all stakeholders as a complement to inspections, and for effective implementation of articles 8 and 9 of the EPBD. The amendment law provides the legal basis for regulating the qualifications of installers of technical systems. These qualified installers will also be responsible for carrying out the adjustment and control of existing systems. A consultation between the Energy Service and the stakeholders, which started in 2012, is currently discussing the regulation of the qualifications of the installers and the processes for the installation and maintenance of heating systems with boilers. The air-conditioning (AC) systems will follow.
> The installation of high energy efficiency systems in new buildings and buildings that undergo major renovation is considered to have a lot of untapped potential. The technical, environmental and economic feasibility of those systems is now required for all new buildings and all buildings that undergo major renovation. The Energy Service is planning to develop tools for calculating the feasibility of installing such systems. The goal is to make it easy in terms of time and money spent, for the engineers and the building owners to have a clear picture of the benefits of installing an alternative system. The new legislation strengthens the availability of the feasibility study before construction starts, and also provides the legal basis for regulating the context of this study.
> The Law so far provided the authority for the Director of the Energy Service to assess fines only for not having an Energy Performance Certificate (EPC) issued. The amendment law regulates fines for every aspect of the EPBD, including, e.g., not conforming to the minimum Energy Performance (EP) requirements or to the inspections of heating and AC systems, and not stating the EP indicator in a commercial advertisement. The administrative fine can be as high as 30,000 €, instead of 8,000 € in the previous law, and guidelines for the implementation of the fines are planned to be developed in 2013.

During 2011, the building sector in Cyprus was responsible for 30% of the final energy consumption in the country, with a cost estimated to be around 600 M€. The implementation of the EPBD so far showed that new buildings that fulfil the minimum requirements use at least 50% less of the energy consumed by similar buildings of the existing building stock. The implementation of the recast EPBD is expected to gradually tighten the minimum EP requirements towards Nearly Zero-Energy Buildings (NZEB) and improve the energy efficiency of existing buildings, as well as the energy performance of technical systems.

Figure 14: Guide for the inspection of air-conditioning systems.

EPBD implementation in the Czech Republic

STATUS AT THE END OF 2012



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1. Introduction

In the Czech Republic, the overall responsibility for the implementation of the Energy Performance of Buildings Directive (EPBD) rests with the Ministry of Industry and Trade (MIT).

In the last few years, the Czech Republic has made a significant progress in the implementation of energy efficiency policies connected with the building sector (e.g., efficiency standards on household appliances and lighting). The country transposed the EPBD (2002/91/EC), including the aspects of mandatory Energy Performance (EP) certification of buildings, and inspection of boilers and air-conditioning (AC) systems in 2007. New measures arising from the EPBD and the related EU legislation were introduced into the amended Energy Management Act and the implementing secondary legislation. The legislation framework provides the methodology for the EP evaluation, and specifies the content of the Energy Performance Certificates (EPCs).

During 2012, the ministry, together with advisory groups established at the Technical University and the Chamber of Commerce, worked on the implementation of the recast EPBD requirements, as well as on the improvement of the calculation methodology. Recently (autumn 2012), the Energy Management Act was amended and harmonised with the EPBD requirements. The amendment is in force since January 2013.

2. Energy performance requirements

2.1 Progress and current status
The energy assessment of buildings is not new in the Czech Republic. A methodology for energy audits and certificates for the building envelope is in place since 2001. The energy audit is mandatory for all types of buildings with total energy consumption higher than 1,500 GJ per year. Part of the energy audit was also the energy certificate with a graphical scale (Figure 1), representing the thermal characteristics of the building envelope (external walls, roof, windows and doors, ground floor).

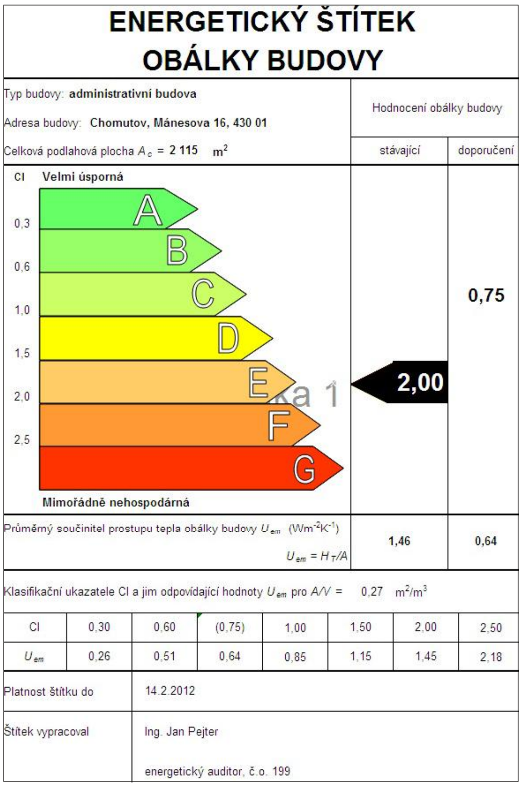


Figure 1: Certificate representing the thermal characteristics of the building envelope.

National Websites *www.tzb-info.cz, www.mpo.cz*

Table 1: The required and recommended values of thermal transmittance U_N for buildings with the prevailing design interior temperature 20 °C.

Description of the building component	Required values U_N [W/m².K]	Recommended values U_N [W/m².K]
Flat and pitched roof with the roof pitch up to 45° inclusive Floor above external space Ceiling below the unheated attic with the roof without thermal insulation Floor and wall with heating	0.24	0.16
External wall Steep roof with the roof pitch exceeding 45°	0.30	0.20
Floor and wall in contact with the soil* Ceiling and internal wall from a heated to an unheated space	0.60	0.40
Ceiling and internal wall from a heated to a partially heated space	0.75	0.50
Windows and other 'opening fillers' in the envelope of the heated space, including the respective frame**	1.70	1.20

* ČSN 730540: These values apply to walls in contact with the soil below a depth of 1 m from the surface, as well as to floors in contact with the soil. The insulation is to be placed on the outer surface of the structure. Above that level, the required U-value for walls in contact with the soil is the same that applies to the wall above the soil.

** ČSN 730540: Windows, skylights, doors, roof hatches and other glazed elements, as well as lightweight claddings, are collectively referred to as 'filling holes' in this standard. Their frames are collectively referred to as the 'frames', and its maximum allowed U-value is 2.0 W/m².K.

Table 2: Development of the U-value of the key structure elements of the buildings – required values (included in the Czech Technical Standard ČSN 73 0540).

U-value W/m².K	ČSN 73 0540 January 1979	ČSN 73 0540-2 May 1994	ČSN 73 0540-2 November 2002	ČSN 73 0540-2 January 2006	ČSN 73 0540-2 October 2011
Windows	3.7	2.9	1.8	1.7	1.5
Wall	0.894	0.461	0.38	0.38	0.3
Floor	1.091	1.034	0.6	0.45	0.45
Roof	0.508	0.316	0.3	0.24	0.24

2.2 Format of national transposition and implementation of existing regulations

The Regulation 148/2007 implementing the EP certification of buildings sets the minimum requirements for the energy performance of new buildings and of existing buildings undergoing major renovation. The requirements for new and existing buildings are the same. This means that, from the aspect of energy performance, there is no difference between newly constructed and refurbished buildings.

The main regulations are:

> the details of the energy performance of buildings set by the Regulation No. 148/2007 of the Ministry of Industry and Trade;
> the level of heat energy demand (tightening of U-values), according to the Czech Standard ČSN 73 0540-2/Z1: 2011 (see details in Table 1).

Both regulations specify the details of the energy efficiency in buildings. The required values are obligatory for almost all new buildings (except for buildings used as places of worship or religious activities, temporary buildings with a planned time of use of two years or less, industrial sites, residential buildings intended to be used for less than four months a year, and stand-alone buildings with a total useful floor area of less than 50 m²). In case of existing buildings, the required values are obligatory for larger refurbishments (e.g., if more than 25% of the building surface is going to be insulated, then the insulated areas must comply with the aforementioned standard).

The standard sets two levels of insulation: required and recommended. The required level is the obligatory minimum. The recommended level reflects the expected development in the future.

Following the development of the required U-values (Czech Standard ČSN 73 0540-2/Z1: 2011) in the Czech Republic, the impact of the EPBD regarding the tightening of the thermal characteristics of the building envelope is not very evident (the more recent update of the U-values was prepared and published in 2011).

The EP calculation remained unchanged from 2007 until 2012. It is expressed by the total annual delivered energy consumption, including heating, cooling, Domestic Hot Water (DHW) preparation, mechanical ventilation, lighting, and auxiliary energy needed for the standardised building operation. The methodology is the same within the whole Czech territory and for all building types.

The procedure is based on the published CEN standards and the applicable Czech technical standards. The Regulation No. 148/2007 has adopted the majority of the valid national standards (mostly in the form of EN ISO standards), as well as other requirements (regulations and government decrees, e.g., on the thermal insulation of hot water pipes, boiler efficiency, indoor climate), by reference to these standards and regulations.

Profiles for the occupation, lighting, indoor environment requirements and auxiliary energy use are standardised for typical zones such as offices, schools, dwellings, etc..

2.3 Cost-optimal procedure for setting EP requirements

According to the recast EPBD, the regulation for the calculation of a cost-optimal methodology has to be reflected in the prepared secondary legislation to the amendment of the EPBD law. Cost-optimal level requirements are calculated by studying the energy performance of reference buildings, i.e., of buildings of the same type, the same geometric shape and size, (which include glass surfaces and shielding from the surrounding buildings and natural obstacles), as well as the same internal structure with the same type of typical use and climatic data as the assessed building, but with the reference values of the building, its construction and technical building systems. Reference parameters were determined in accordance with the methodology of the EC, and are obligatory according to the Decree 78/2013.

2.4 Action plan for progression to NZEB

A Nearly Zero-Energy Building (NZEB) is defined by the Act 318/2012 and the Decree 78/2013 as a building where the average heat transfer coefficient of the building envelope is at 70% of the currently required reference value. The use of Renewable Energy Sources (RES) in order to meet the energy requirement is specified as a reduction of the reference value of non-renewable primary energy in a range from 10% to 25%, depending on the building type.

The NZEB requirements must be met for new buildings as follows:

1. Buildings with a conditioned area larger than 1,500 m^2, after the 1st of January 2016 (public authority buildings), or after the 1st of January 2018 (other buildings).
2. Buildings with a conditioned area larger than 350 m^2, after the 1st of January 2017 (public authority buildings), or after the 1st of January 2019 (other buildings).
3. Buildings with a conditioned area less than 350 m^2, after the 1st of January 2018 (public authority buildings), or after the 1st of January 2020 (other buildings).

The Czech Republic shall define a gradual target for new buildings, from the 1st of January 2015 onwards, incorporating RES that will contribute by 8% to 10% to the building primary energy needs. The corresponding percentage for the RES share in case of renovations shall be 3%.

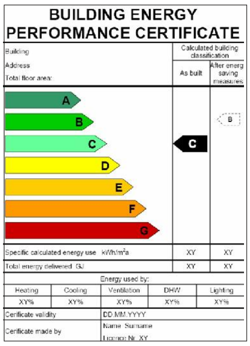
2.5 Any other relevant information

The State Energy Inspectorate (SEI) is responsible for energy audits and inspections according to the Energy Management Act. At the end of the construction works, SEI checks whether the constructor or the owner of the building has ensured that the construction complies with the requirements of the Energy Management Act. The constructor or the owner shall submit to the SEI the construction documents (project), which must be in accordance with the Regulation on documentation of buildings (499/2006) implementing the Building Act. The control method takes the form of an opinion on the building permit under the Energy Management Act, paragraph 13, and other related regulations (namely, the Regulation 195/2007 Coll.). SEI has the right to impose penalties for non-

Region	Energy consumption under 700 GJ	Energy consumption above 700 GJ
Prague and Central Bohemian Region	158	304
South Bohemian Region	39	0
Plzeň Region	8	34
Karlovy Vary Region	11	2
Ústí nad Labem Region	9	81
Liberec Region	3	173
Hrádec Králové Region and Pardubice Region	255	93
South Moravian Region and Vysočina Region	38	267
Olomouc Region	28	41
Zlín Region	7	15
Moravian-Silesian Region	43	238
Total number of controls	**599**	**1,248**

Table 3: Number of controls carried out by the State Energy Inspectorate in 2011.

Figure 2: Graphical display of the label (EPC).



compliance with the Energy Management Act. The number of controls undertaken by SEI in 2011 is illustrated in Table 3.

The controls concern the assessment of the building documentation. In 2011, SEI performed controls in approximately 1,850 building documentations. SEI is also involved in the monitoring of government buildings in terms of energy consumption.

3. Energy performance certificates

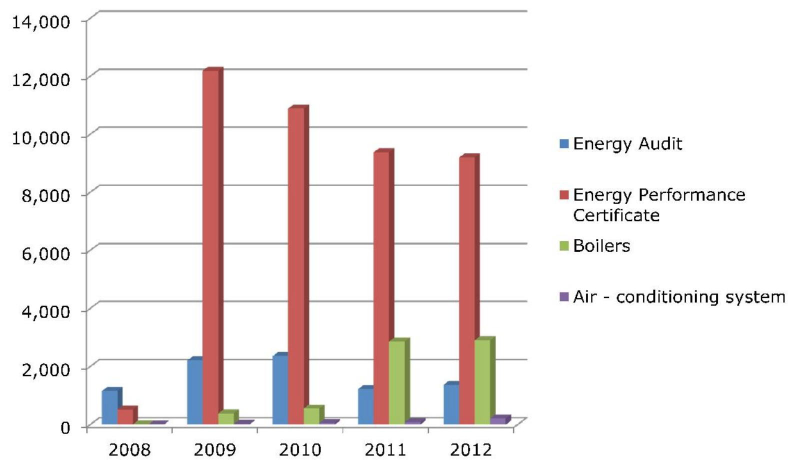
The EPC is the document demonstrating compliance with the national requirements for the energy performance of buildings. It is an integral part of the prerequisite documentation for obtaining the planning permission for the construction of a new building or for the major renovation of an existing building. The EPC includes information on the energy performance of a building, as well as recommendations for cost improvements calculated specifically for the assessed building. Figure 2 illustrates the actual EPC layout.

The Ministry of Industry and Trade grants to energy experts the authorisation for conducting certification, maintains the list of authorised energy experts, and annually collects in a database the expert records (number of EPCs issued, energy saving potential, and other monitoring indicators). The Qualified Expert (QE - the energy specialist in general) may be any person with a technical science education (on energy or on constructions – e.g., architect), having an experience according to Table 4). The applicant may attend a training course that is preparatory for the exam that takes place at MIT; this course is not obligatory. MIT requests an obligatory training after the exam, within a period of 3 years. The expert qualification covers all building types. At the end of 2102, there are 1,091 QEs authorised to issue EPCs.

Table 4: Required expert's experience according to achieved education in technical sciences.

Type of education	Work experience
University degree	3 years
Post-secondary education	5 years
Secondary school (high school) certificate	6 years

Figure 3: Number of energy audits, EPCs and inspections of boilers and AC systems in 2008-2012.



The price for issuing the EPC is not regulated, and is defined by the QE, depending on the type and documentation of the building, the delivery time, etc.. For example, the price of the EPC can start at 120 € - 150 € for a flat in an apartment building or for a single-family house, and may go up to 2,000 € - 3,000 € for hospitals or large apartment buildings.

SEI conducts a quality control analysis of the EPCs based on a random sample. A fine up to 4,000 € may be imposed to a QE for issuing a faulty EPC, violating their duties, not undergoing the obligatory training and/or if they continue conducting certifications after their authorisation has been revoked. No fines have been applied by the SEI yet.

Figure 3 includes the approximate numbers of energy audits, EPCs and inspections of boilers and AC systems made in the Czech Republic from 2008 until 2011. It is obvious that the most dynamic increase took place in the field of issuing EPCs.

Energy performance is expressed by the total calculated (asset rating) annual delivered energy consumption, including heating, cooling, DHW preparation, mechanical ventilation, lighting, and auxiliary energy needed for the standardised building operation. The energy label classifies the buildings on an efficiency scale ranging from A (high energy efficiency) to G (poor energy efficiency). In Table 5, the energy classes (in kWh/m^2.year) for different building types are displayed. Class C is the minimum EP requirement level for new buildings and for existing buildings undergoing major renovation.

3.1 Progress and current status on sale or rental of buildings

When buildings or building units are constructed, sold or rented, the EPC is to be shown and handed over to the new tenant or prospective buyer. The obligation to provide the EPC during the selling or renting process starts from the 1st of January 2013. If the seller or renter fails to provide the EPC, penalties are imposed: for natural persons, the fine goes up to 2,000 €, and for legal entities, up to 8,000 €.

Building type	A	B	C	D	E	F	G
Single - Family Houses	< 51	51-97	**98-142**	143-191	192-240	241-286	> 286
Apartment Blocks	< 43	43-82	**83-120**	121-162	163-205	206-245	> 245
Hotels and Restaurants	< 102	102-200	**201-294**	295-389	390-488	489-590	> 590
Administrative buildings	< 62	62-123	**124-179**	180-236	237-293	294-345	> 345
Hospitals	< 109	109-210	**211-310**	311-415	416-520	521-625	> 625
Educational Buildings	< 47	47-89	**90-130**	131-174	175-220	221-265	> 265
Sport Facilities	< 53	53-102	**103-145**	146-194	195-245	246-297	> 297
Wholesale & Retail Trade Services buildings	< 67	67-121	**122-183**	184-241	242-300	301-362	> 362

Table 5: Energy classes (in kWh/m².year – total annual delivered energy) for different building types.

3.2 Progress and current status on public and large buildings visited by the public
For buildings where a total floor area greater than 500 m² is occupied by a public authority, and for buildings with a total floor area greater than 500 m², which are frequently visited by the public, the EPC must be displayed in a prominent place and be clearly visible to the public (this threshold shall be lowered to 250 m² on the 9th of July 2015).

The monitoring of public buildings is already in place. Currently, the energy consumption is measured in 61 government buildings (ministries and the Office of the Government). These buildings are of different age and type of use; although they are mainly office buildings, there are also some representative and accommodation buildings. Fourteen of the monitored buildings are listed and protected, and a further 24 are situated in protected zones. All buildings were subject to an energy audit before 2004. From the monitoring of the buildings, it was found that their total annual energy cost is around 12 M€. In 2010, the savings achieved due to the monitoring reached the amount of 0.4 M€. As the monitoring of energy consumption in government buildings proved its worth, this tool was incorporated into the Energy Management Act; by 2015, all government buildings with a floor area over 1,500 m² shall be subject to energy consumption monitoring.

3.3 Implementation of mandatory advertising requirement – status
When a building or building unit is offered for sale or rent, the EP indicator of the EPC shall be included in advertisements in commercial media. The obligation to present the EP indicator in advertisements starts from the 1st of January 2013. There are penalties for failing to comply with this regulation: for natural persons, the fine goes up to 2,000 €, and for legal entities, up to 8,000 €.

3.4 Information campaigns
In the Czech Republic, there has been no official state campaign supporting the EPBD implementation. Some energy consultancy companies, technical equipment manufacturers (of pumps, space heating and cooling control systems) and professional associations are running information campaigns, mostly in collaboration with the local municipalities.

Local campaigns in the framework of the IMPLEMENT project
In the Czech Republic, the IMPLEMENT project (*www.enviros.cz/projects/iee/implement*) was launched in January 2007 in the framework of the Intelligent Energy Europe (IEE) Programme. The aim of the campaign was to set up, lead and evaluate an awareness campaign, which should communicate direct information to building owners (private persons, municipal and government authorities), building users, installing companies, designers and developers (Figure 4).

The focus of the campaign was to raise the interest of all target groups regarding the EPBD, energy savings, and the use of urban RES with respect to the minimum EP requirements set in the EPBD for new buildings and major renovations.

The campaign was not intended as a 'universal cure' solving all energy-related problems in buildings. Its success lies in making people understand how they consume energy, and in offering technical and financial solutions (Figure 5).

Furthermore, the high-quality preparation of the campaign and its power to attract the attention of the right target groups are the core of the campaign's success. Nevertheless, experience has shown that although a lot of work has been done, much more has still to be done in order to convince building owners to implement energy saving measures.

Figure 4: National EPBD information leaflet (IEE Project IMPLEMENT).

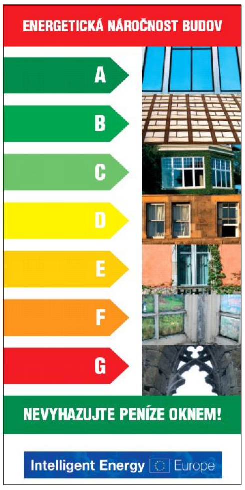


Figure 5: IMPLEMENT brochure.

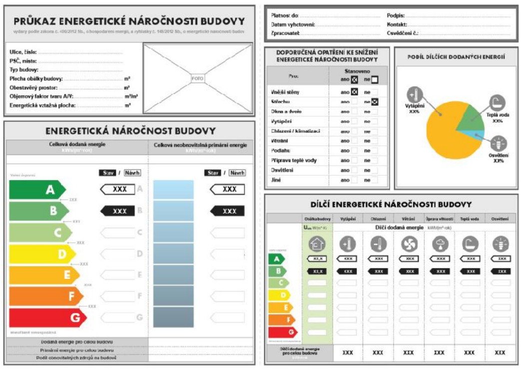


Figure 6: New EPC layout proposal.

3.5 Any other relevant information

In the framework of transposition of the recast EPBD into the Czech legislation, the graphical form of the EPC will also be harmonised with the recast EPBD requirements. Figure 6 illustrates one of the proposed EPC layouts.

The legislative requirements for the acceleration of the use of potential energy savings in buildings are being created, and the secondary legislation to the amended Energy Management Act is under preparation. In the forthcoming period, the task is to seek the most effective pathways leading to greater use of the energy saving potential in the final energy consumption, especially of heat saving in buildings.

4. Inspection requirements - heating systems, air-conditioning

Within the amendment of the Energy Management Act in 2012, the Czech Republic has transposed articles 14 and 15 of the recast EPBD, with the implementation of regular inspections of heating systems (previously 'boilers') and of AC systems, except for residential buildings where advice has been implemented instead. Regular inspections have been already adopted in 2007, but some new requirements (e.g., presenting the inspection report to the ministry within 30 days, or advice in the case of residential sector) were added in 2012.

4.1 Progress and current status on heating systems

Any boiler running on natural gas, liquid or solid fuels with a rated output power above 20 kW must be subject to regular efficiency inspections, according to the EPBD and the Czech Regulation No. 276/2007. The technical efficiency requirements for new hot-water boilers fired with liquid or gas fuels are defined by the Regulation No. 25/2003 (Table 6).

Paragraph 6a of the amended Energy Management Act (in 2006) and the Regulation No. 276/2007 require that the heating installations including heating appliances (boilers) with an effective rated heat output above 20 kW must undergo a regular inspection, thus implementing the corresponding EPBD obligation. According to this same regulation (paragraph 6a) the owner or the operator of the boiler must notify the ministry that an inspection was performed, and report the identity of the inspector.

According to the Regulation No. 277/2007, the written report must be elaborated and be ready for submission to the ministry or the SEI on demand. The energy specialists must report to the ministry their activities related to the inspections of heating systems. There are sanctions for the poor performance of inspectors - the fine can be up to 8,000 €. Heating system inspectors and building certification experts have to pass different examinations, but the same expert can be simultaneously authorised to perform more than one of these activities. Inspection experts need to be registered with an energy expert registration number, and be authorised by the MIT. The qualification of inspectors requires the same education and experience as those of building experts. Inspectors authorised in another EU Member State (MS) are also authorised to perform inspections in the Czech Republic.

Dimensioning and function of space heating systems are checked once; the repetition of the inspection is not necessary in the following years if no technical modification is performed in the meantime.

The inspection period depends on the fuel used: every 2 years for solid and liquid

	Minimum (operating) efficiency in %									
Output (kW)	20	30	40	50	80	100	130	150	180	200
Solid fuels	70.0	70.5	71.0	71.5	72.0	72.5	73.0	73.2	73.5	73.8
Liquid fuels	82.0	82.5	83.0	83.5	83.5	84.0	84.2	84.5	84.7	84.9
Gas fuels	83.8	84.6	85.1	85.4	86.3	86.7	8701	87.1	87.2	87.3

Table 6: Minimum boiler efficiency sorted by fuel and heat output according to the Czech Standard ČSN 07 0240.

fuel boilers, every 4 years for gas boilers with a heat output above 100 kW, and every year for boilers with a heat output above 200 kW. The frequency of the inspections can be reduced when the electronic monitoring and control system has been installed. In case of failure to present the inspection report, fines up to 4,000 € are imposed to natural persons and legal entities.

This obligation does not apply to boilers and internal heat distribution systems in residential buildings (single-family houses, multifamily houses and apartments) that do not include any business premises. The owners of these residential units are provided with free of charge consultation and advice by the network of Energy Consultancy and Information Centres (EKIS), which, in 2011, were funded by the MIT through the EFEKT Programme with an amount of 186,000 €. The amount foreseen for 2012 for this funding was about 260,000 €. Currently, there are 51 EKIS centres in the Czech Republic, which have provided about 5,300 consultations free of charge in 2011, and about 6,400 consultations in 2012.

4.2 Progress and current status on AC systems

In the Czech Republic, the methodology used in AC inspections is based on the CEN standard 15240 for all sizes and types of AC systems. The procedure includes reviewing the documentation of the AC system, initially to determine the extent and location of the system components, as well as to review the quality and likely effectiveness of maintenance.

It is considered that some aspects of physical inspection can be omitted from the 'standard' inspection procedure when it is clear that the systems have been well maintained. When this is not clear, the system components are inspected, largely to identify and report cases of neglect or damage that could have reduced the system efficiency.

According to the EPBD, as it was implemented in paragraph 6a of the amended Energy Management Act and in the Regulation No. 277/2007, AC systems with an effective rated output above 12 kW must be inspected regularly. An inspection report must be elaborated after each inspection, and must be available on demand. Energy specialists must report to the ministry their activities related to AC inspections. There are sanctions for the poor performance of inspectors – the fine can be up to 8,000 €. The ministry must be informed about the conducted inspection. In case of authorised persons from other EU MS, a document proving their certification is also needed. Inspectors of AC systems have to pass an examination. Experts recognised for AC inspections need to be registered with an energy expert registration number, and authorised by the Ministry of Industry and Trade. The qualification of inspectors requires the same education and experience as those of building or heating system experts.

Dimensioning and operation of the AC systems are checked once; the repetition of the inspection is not necessary in the following years if no technical modification is performed in the meantime. The inspection period is 4 years, but the frequency can be reduced if the electronic monitoring and control system has been installed.

The AC inspection includes:

> refrigeration equipment;
> outdoor heat rejection;
> cooled air and independent ventilation air, delivery systems;
> heat exchange to the refrigeration system;
> building system controls and control parameters.

4.3 Any other relevant information

The application to become a QE or an inspector of boilers, heating and AC systems in the Czech Republic may be submitted only by a person who:

> has got an energy expert registration number, or
> is registered as an authorised architect or engineer and technician by the Czech Chamber of Certified Engineers and Technicians.

The qualifications for QEs are a university degree and 3 years of technical experience, or a post-high school degree and 5 years of experience. Authorised engineers or architects undertaking a specific training course and passing an examination are recognised by the ministry as QEs. A person with just a high school degree must have 6 years of work experience.

Experts should have a liability insurance, because it is usually demanded by clients (but is not required by the law), and must play an independent role in the certification process.

The EP certificate/inspection may not be performed by a person who:

- holds a share in the company or the cooperative that ordered the EPC;
- is a stakeholder in or a member of the cooperative that ordered the EPC, or is a statutory body of or a member of the statutory body of the entity that ordered the EPC, or is employed by or has a similar relationship to the corporation that ordered the EPC;
- is someone close to people who might be, due to their position, natural or legal persons influencing the energy auditor.

If there are complaints on an expert's work, or if an expert does not perform any EPC audit for 5 years, they are deleted from the list of experts.
SEI is authorised to check the energy specialist, examine the matter and make a decision on whether the specialist acted according to the rules defined in the legal regulations. Furthermore, SEI has the authority to propose to the MIT the revocation of the specialist´s license.

Currently, in the Czech Republic, the number of certified experts is:

- for building certification - 1,091 energy specialists;
- for the inspection of heating systems - 234 energy specialists;
- for the inspection of AC systems - 168 energy specialists.

At present, the QEs must have an authorisation; this is obtained by passing the relevant exams. MIT is currently introducing an education system, according to which the energy specialists have to attend an obligatory training course every 3 years. In this course, specialists also get the necessary information on updated legislation and technologies.

5. Conclusions and future plans

In the Czech Republic, the requirements for the energy efficiency and thermal protection for new and renovated buildings are being gradually tightened. Practical experience on the implementation of the Energy Performance of Buildings Directive (EPBD) has so far revealed some minor insufficiencies in the legislation, because the current implementing regulation on the Energy Performance (EP) of buildings (148/2007) does not differentiate the source of energy supply in buildings by primary energy coefficients. These particular insufficiencies are rectified in the new amendment of the Energy Management Act, and shall be further corrected in related implementing regulations in the near future. The amendment of the Energy Management Act, implementing the recast EPBD, came into force on the 1st of January 2013.

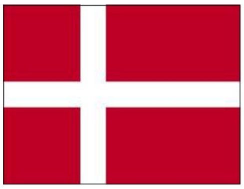
The transposition of the recast EPBD into the Czech legislation will represent the fundamental changes in the EPB law. It will have an impact on all buildings (not only on residential buildings) by bringing changes and new demands when repairing and reconstructing existing buildings, or constructing new buildings. Some of these changes are the following:

- extension of the building stock that will comply with the EPBD;
- tightening of thermal insulation characteristics of the building envelope;
- introduction of primary energy calculation;
- addition of features missing in the previous transposition of the EPBD (namely, certificates in cases of sale and rental of existing buildings, display of certificates in public service buildings frequently visited by the public).

During the next decade, with a final date by the 31st of December 2020, it will be necessary to prepare and implement a major change in the design and implementation of buildings. The basic criterion that must be met will be that of low energy consumption in buildings. This criterion includes not only the energy consumption for heating and hot water preparation, but also other forms of energy use in buildings, such as lighting, ventilation, air-conditioning (AC), operation of building equipment, etc.. In the future, it will be possible and especially appropriate to use solar energy as a small power source on the roofs of buildings.

EPBD implementation in Denmark

STATUS AT THE END OF 2012



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1. Introduction

This report presents an overview of the current status of the implementation of the Directive on the Energy Performance of Buildings (EPBD) in Denmark, as well as plans for its evolution. It addresses the energy requirements, as well as the certification and inspection systems, including quality control mechanisms and information campaigns.

The Danish building Energy Performance (EP) certification scheme has undergone a major revision in 2010 and a revised scheme has been published in the spring of 2011. In the Danish Building Regulations (BR10), the targets for the next tightening (an additional 25%) in 2015 are specified. Furthermore, a new Building Class 2020 is introduced, i.e., the Danish Nearly Zero-Energy Buildings (NZEB) definition.

This revision process introduces the requirements of the recast EPBD published in 2010, but it also aims at improving the methodology and certification processes, based on the experience gained during the last years.

In Denmark, the implementation of the EPBD is the responsibility of the Danish Energy Agency (DEA).

2. Energy performance requirements

This chapter presents an outline for the transposition and implementation of the EPBD Energy Performance (EP) requirements in Denmark. It also describes the future transition to the cost-optimal EP requirements, as well as the action plan for progression to NZEB.

2.1 Progress and current status
The EP requirements for new buildings were implemented in their current form, i.e., the EP calculation method, in 2006, after the implementation of the first EPBD. These requirements included forecasts for the tightening of the EP requirements in 2010 and 2015 – approximately 25% compared with the 2006 requirements in each step. In 2009, the requirements were revised, and the EP requirements for new buildings were tightened by 25% in the Danish Building Regulations 2010 (BR10). In the 2010 revision, no forecast for the 2020 EP requirements was included, but the building industry requested this forecast. This led to a process of cost analysis for establishing the different levels of EP requirements. The outcome was the forecast for the EP requirements for new buildings in 2020 – i.e., the Danish NZEB definition.

For existing buildings, the requirements were initially implemented according to the definition of the 25% rule in the EPBD (though no area threshold was implemented), in combination with component requirements. According to the earlier Danish Building Regulation, all cost-effective measures had to be

Table 1: Development of EP requirements (kWh primary energy per m² of heated gross floor area per year) for typically sized residential and non-residential buildings.

	2006	2010	2015	2020
Residential, 150 m^2 of heated gross floor area	84.7	63.0	36.7	20.0
Non-residential, 1,000 m^2 of heated gross floor area	97.2	73.0	42.0	25.0

National Websites *www.ens.dk, www.sbi.dk, www.seeb.dk, www.bygningsreglement.dk, www.ois.dk*

Figure 1: Danish Building Regulations 2010.

implemented if more than 25% of the building envelope or the value of the building were affected. However, studies regarding the impact of this rule on the implementation of energy saving measures showed that the rule was a hindrance to energy savings. It was thus decided to increase the uptake of energy saving measures in the existing building stock, by implementing more strict requirements for the replacement or renovation of the individual components. The BR10 contains a list of the minimum requirements; most of these are considered economically profitable under normal conditions. However, the requirements for the replacement of windows must be fulfilled without consideration of the economic aspects.

2.2 Format of national transposition and implementation of existing regulations

New buildings

The existing BR10 sets the minimum energy requirements for all types of new buildings. These requirements relate to the energy frame and the envelope of the building. In addition to the minimum requirements, BR10 also sets the requirements for two voluntary low-energy classes: Low-energy Class 2015 and Building Class 2020. These two classes are expected to be introduced as the minimum requirements by 2015 and 2020, respectively.

The energy frame is the maximum allowed primary energy demand for a building, including e.g., thermal bridges, solar gains, ventilation, heat recovery, cooling, lighting (non-residential buildings only), boiler and heat pump efficiency, electricity for operating the building, and sanctions for overheating. The overheating sanction is calculated on a fictive energy use, equal to the energy needed in an imaginary mechanical cooling system in order to keep the indoor temperature at 26 °C. This additional energy use is included in the calculated overall energy consumption of the building.

The energy frame for the primary energy demand in new buildings has been tightened by 25% compared with the 2006 baseline. Low-energy Class 2015 introduces a 50% tightening compared with the 2006 baseline, and Building Class 2020 further tightens the energy frame by 25%, thereby reducing the allowed energy frame by 75% compared with the 2006 baseline.

The building code also sets requirements for calculating the design transmission heat loss for the opaque part of the building envelope for new buildings (it fixes the temperature differential indoors-outdoors at 32°C), as well as the minimum requirements for components and installations. The minimum component requirements are primarily intended to eliminate the risk of mould growth due to cold surfaces. It is not possible to construct a building, meeting the energy frame solely by fulfilling the minimum component requirements. Both sets of requirements work in parallel with the requirements for the energy frame, and are set in order to avoid having new dwellings and/or building components and installations with a high level of renewable energy but poor insulation.
A Building Class 2020 building must be constructed so that the designed transmission loss does not exceed 3.7 W/m² of the building envelope in the case of single-storey buildings, 4.7 W/m² for two-storey buildings and 5.7 W/m² for buildings with three storeys or more. Table 2 shows the maximum allowed dimensioning transmission heat loss through the opaque building envelope. This requirement was introduced with the implementation of the EPBD in Denmark.

Calculation procedure

The calculation procedure in the BR10 has been updated according to the new requirements, and is described in the SBi Direction 213: Energy demand in buildings (In Danish at: *www.anvisninger.dk* - requires license for download). The procedure follows the relevant CEN standards to great extent. This publication also includes the updated PC calculation program Be10. The calculation core of this program is to be used by all other programs for compliance checks and energy certification, to ensure the

REFERENCE

The BR10 minimum energy frame requirement is:
> 52.5 + 1,650 / A [kWh/m^2.year] for residential buildings, and
> 71.3 + 1,650 / A [kWh/m^2.year] for non-residential buildings,
where A is the heated gross floor area.

The energy frame for the voluntary Low-energy Class 2015 is:
> 30 + 1,000 / A [kWh/m^2.year] for residential buildings, and
> 41 + 1,000 / A [kWh/m^2.year] for non-residential buildings.

Finally, the energy frame for the voluntary Building Class 2020 is:
20 / A [kWh/m^2.year] for residential buildings, and
25 / A [kWh/m^2.year] for non-residential buildings.

identical calculation of the EP of buildings. Compared with the previous calculation procedure, Be06, the new procedure has been updated with respect to:

> new energy frames and energy requirements given in BR10;
> Low-energy Class 2015 and Building Class 2020, including new district heating factors (conversion to primary energy);
> new energy frame for buildings heated to 5-15 °C;
> multiple tanks for Domestic Hot Water (DHW);
> improved calculation of cooling demand;
> multiple heat pumps in the same building/zone;
> multiple solar cell (photovoltaic) systems;
> calculation of the electricity production by on-site wind turbines.

Existing buildings

The BR10 tightened the EP requirements for individual building components for all building types. This rule applies to the replacement or major renovation of the component. However, the measures must be economically feasible. This means that the annual savings multiplied by the expected lifetime of the measure divided by the investment should be higher than 1.33 or, put in another way, the measure must have a simple payback time of less than 75% of the expected lifetime of the measure. In case of full replacement of a component (e.g., a new roof, new window, new outer wall), the new component must meet the requirements set in the BR10, regardless of profitability.

2.3 Cost-optimal procedure for setting EP requirements

The cost-optimality of the current energy requirements in the BR10 has been calculated in 2012-2013 according to the procedure and rules laid down in the Directive 2010/31/EU and in the Delegated Regulation supplementing the Directive, by establishing a comparative methodology framework for calculating the cost-optimal levels of minimum EP requirements for buildings and building components. The calculations will reflect the tight energy requirements in the Danish Building Regulations on both the component and building level for new buildings, as well as on the component level for existing buildings. They will also address the wide use of Combined Heat and Power (CHP), as well as wind power in the Danish energy supply system. Initial calculations indicate that the requirements are in cost-optimal balance.

2.4 Action plan for progression to NZEB

The Building Class 2020, which was introduced in 2011, meets the obligation laid down in the EPBD regarding NZEB. The Danish Action Plan explains the background for this building class, and lists the initiatives and policies that will increase the number of NZEB. Examples of strategies and policies are:

Figure 2: SBi-Direction 213.

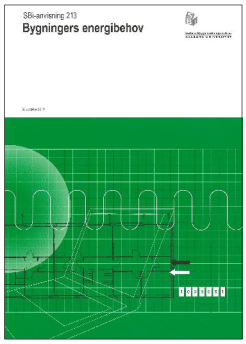


Table 2: Maximum allowed design transmission heat loss through the opaque part of the building envelope (W/m²).

Floors	2006	BR10	Low-energy 2015	Building Class 2020
1	6	5	4	3.7
2	7	6	5	4.7
3	8	7	6	5.7

Table 3: Primary energy conversion factors are being used in the calculation (primary /useful energy).

	2006	BR10	Low-energy 2015	Building Class 2020
District heating	1	1	0.8	0.6
Fossil fuels	1	1	1	1
Bio fuels	1	1	1	1
Electricity	2.5	2.5	2.5	1.8

Table 4: U-values and cold bridges requirements – examples.

All existing buildings	Changed use and extensions	Pavilions	Single component requirements	Secondary homes	Maximum requirements, new buildings
U-value requirements [W/m².K]					
External walls and basement walls towards ground	0.15	0.20	0.20	0.25	0.30
Slab on ground etc.	0.10	0.12	0.12	0.15	0.20
Loft and roof constructions	0.10	0.15	0.15	0.15	0.20
Windows	1.40	1.50	1.65 (doors)	1.80	-
Roof windows	1.70	1.80	1.65	1.80	1.80
Cold bridges [W/m.K]					
Foundations	0.12	0.20	0.12	0.15	0.20
Joints between windows and walls	0.03	0.03	0.03	0.03	0.06
Minimum energy gain [kWh/m².year]					
Facade windows	-	-	-33	-	-33

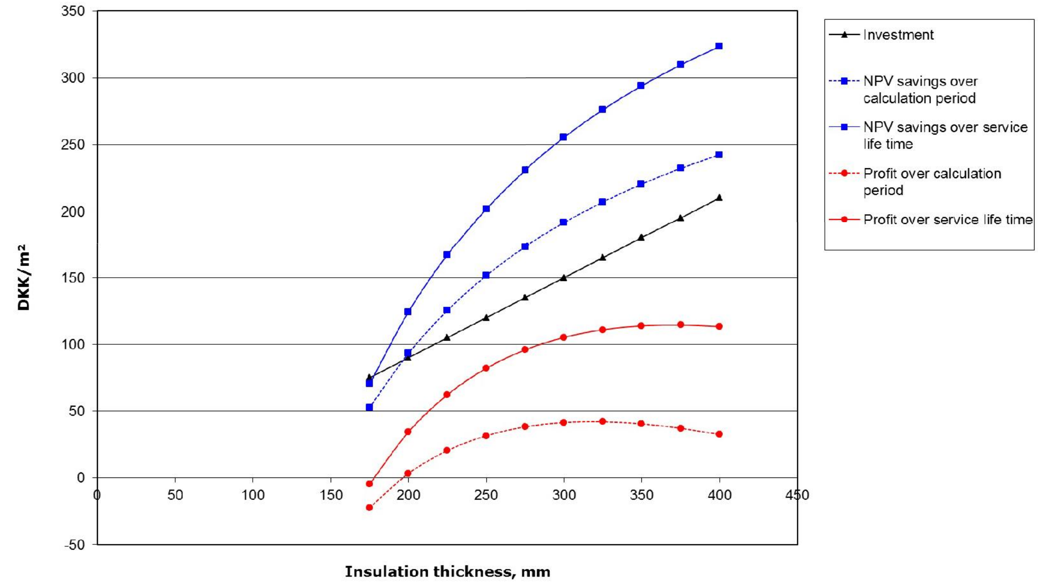


Figure 3: Net present value calculation of cost-optimal insulation levels.

- > Energy savings initiative for the energy supply companies: The Danish supply companies are obliged to provide energy savings corresponding to 2.6% of the national energy consumption (excl. transport) in 2013-2014, and 3.0% in 2015-2020. The obligation increases by 75% in 2013 and 2014 compared with 2010-2012, and by 100% in 2015-2020.
- > Strategy for the energy renovation of the existing building stock: The government is obliged to develop a comprehensive strategy for the energy renovation of the existing building stock. This strategy will be based on an analysis of the existing building stock, including potential energy savings.
- > Transition to renewable energy: As a general rule, oil and natural gas boilers will not be allowed in new buildings from 2013. From 2016, oil burners must not be installed in existing buildings in areas with district heating or natural gas supply. There are grants to promote initiatives for energy efficient alternatives to fossil fuel supply.
- > Public action: Public buildings must take the lead in implementing energy saving measures, by carrying out energy upgrading in a minimum 3% of the publicly owned and occupied building area every year.

Figure 4: Strategy for energy renovation.

2.5 Any other relevant information

On the 22nd of March 2012, a wide majority of the parties of the Danish Parliament agreed on an Energy Agreement, which lays down a number of initiatives to be implemented in the period 2012-2020.

One of the initiatives in the Energy Agreement is a Strategy for Energy Renovations of the Existing Building Stock, which is expected to be completed by the end of 2013. This strategy will contain a number of actions to increase the number of energy renovations in the most cost-efficient way. A large network consisting of representatives from the construction sector, as well as from other related sectors has been asked to contribute with knowledge and ideas for the initiatives.

3. Energy performance certificates

The Danish energy performance certification scheme has undergone a major revision in 2011. Among the major changes are the following: a) the validity of the Energy Performance Certificate (EPC) was extended from 5 years to 7 or 10 years, depending on the potential energy savings, b) the energy certification of single-family houses constructed less than 25 years prior to the certification, can take place without an onsite visit to the building, and c) the energy certification of selected buildings can be based on the calculated or measured energy consumption. Buildings that can be certified by measured energy use include multifamily buildings with a detailed and updated operational log. Buildings classified as transport facilities, wholesale, retail trade, bank/insurance, office/liberal profession, public administration, hotels, cinemas, libraries, museums, educational buildings, hospitals, day-care institutions, secondary homes, holiday camps and sport facilities can also have certificates based on the measured energy use.

In July 2012, a new act and a new order implementing the recast EPBD 2010 came into force. The main rules of this act apply as from the 1st of January 2013, and concern mandatory advertising requirements and sanctions.

The EPC assigns an energy rating to nearly all types of buildings, and lists cost-effective measures for improving the building's EP. The requirements of the EPC are stated in the Act number 636 of the 19th of June 2012, in the Ministerial Order number 673 of the 25th of June 2012, and in the DEA's Handbook for Energy Advisers.

In Denmark, the responsibility of implementing the EPC lies with the DEA. A secretariat running the daily operations of the EP certification scheme was started in May 2010. Furthermore, the secretariat also handles Quality Assurance (QA), and contributes to the future development and the marketing of the scheme.

The EPC rates the buildings on an energy efficiency scale ranging from A (high energy efficiency) to G (poor energy efficiency). Class A is divided into two sub-categories, A1 and A2.

The main benefit from the EPC is the recommendations given to the building owner. The suggested improvements include a brief description, an estimation of cost, savings, and paybacks, as well as the impact on the energy rating if all the measures were implemented. The recommendations made must refer to the specific building.

There are several reasons that can lead to energy saving suggestions In the EPC, including upgrading and replacement of:

> old roofs and attics;
> old windows, glass doors, and overhead lighting;
> oil boilers;
> old gas boilers;
> electric heating systems.

The calculation methodology is the same as the one used for proof of compliance in the BR10 for a new building. The methodology is defined in a calculation engine. Any company can create its own energy certification tool, but it must use the same calculation engine as in the SBi-Direction 213.

The cost of an EPC is regulated by the Order number 60 of the 27th of January 2011. The maximum price of an EPC for small buildings varies from 5,778 to 6,933 DKK, incl. VAT (approx. 775 – 929 €), depending on the size of the building (up to 299 m^2). The price of an EPC for buildings larger than 299 m^2 is not regulated. However, prices usually vary between 1.3 and 3 € per m^2 per certificate. The operation of the scheme is financed by fees paid by the EPC experts. Each expert pays an annual fee, as well as a fee per issued EPC. Experts in accredited companies pay a reduced fee per issued EPC, due to the mandatory internal QA of the company.

The validity of the EPC is 10 years. However, if the EPC identifies major energy savings with a simple payback time less than 10 years and with a total saving larger than 5% of the energy consumption, the validity will be reduced to 7 years.

If the rules regarding the EPC are not obeyed, the building owner, real estate agent etc. may face fines and further liability. The amount of a fine for not having an EPC, or for violating the EPC rules, depends on the size of the building and ranges from 2,000 DKK (268 €) to 45,000 DKK (6,036 €). E.g., the owner of a building of 200 m^2 may face a fine of 5,000 DKK (670 €) for not having an EPC. If an EPC is not on display in a public building, the owner may face a fine of 2,000 DKK (268 €).

Along with the fine, the owner may also face an injunction from the DEA to display the EPC or to have an EPC issued.

According to newly-made changes to the EPC regulation scheme implementing the EPBD 2010, it is possible to impose fines in more situations when the rules are violated.

Figure 5: First page of the Danish energy performance certificate for residential buildings.

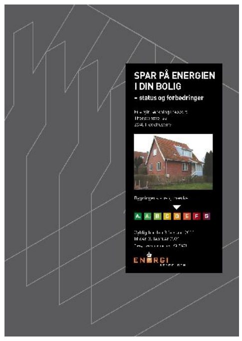
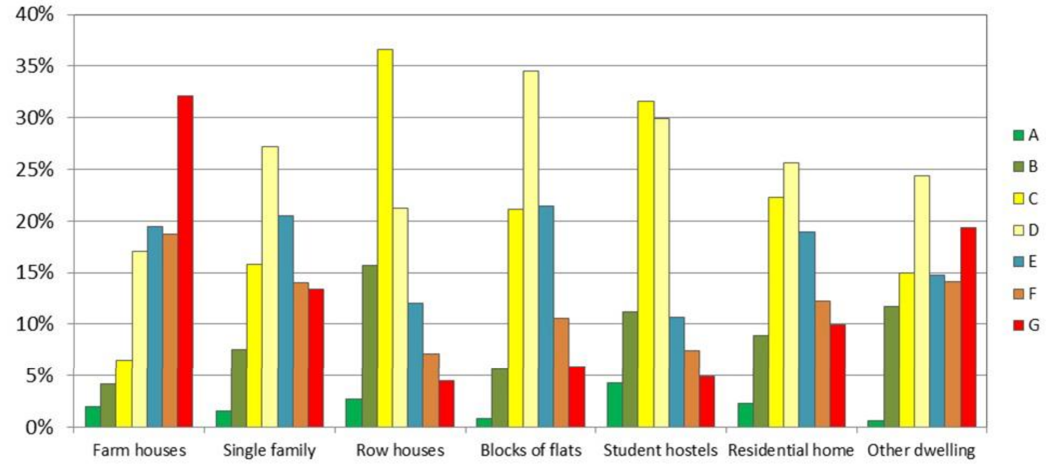


Figure 6: Energy label, A-G.

Table 5: Number of issued EPCs in the current certification scheme.

Year \ Type	2010	2011	2012 (Oct.)
Single-family houses	50,744	52,069	35,491
Multifamily houses	8,892	7,532	4,491
Large commercial/ public buildings	6,567	5,028	2,398
Second homes	4,418	630	563
Others	-	4,399	3,724

Figure 7: Distribution of certification classes for Danish dwellings since 2006.



Qualified Experts
Since May 2011, an EPC can be issued only by certified companies. The certification of a company to issue EPCs in Denmark can be conducted by a Danish accreditation agency (DANAK) or by a corresponding European accreditation agency under the European Accreditation Organisation EA (European Co-operation for Accreditation).

A certified company must implement an ISO 9001 QA scheme for its building energy certification system. There are approx. 40 certified companies employing approx. 800 energy advisers/experts. The list of certified companies is found at the EPC secretariats website (*www.seeb.dk*).

Two kinds of energy advisers/experts are available:

1. Energy experts covering single and two-family houses of less than 500 m^2.
2. Energy experts covering multifamily houses, public buildings, as well as the trade and service sectors.

The energy adviser/expert for small houses must be an architect, engineer, construction designer or the like, or may pass a special test approved by the DEA (and must have at least 2 years of documented, relevant experience of building technology and energy consultancy during the last 6 years). The energy advisers/experts for multifamily houses, public buildings, the trade/service sectors etc. must be qualified engineers or have a similar profession, or may pass a special test approved by the DEA. The advisers/experts shall participate in short courses and seminars on a regular basis.

Quality Assurance
Certified companies must carry out their own quality checks according to the DS/EN ISO 9001. The DEA carries out a market surveillance of the companies. These quality checks occur on a regular basis, but may be carried out on the basis of a complaint as well.

The DEA has set up a mandatory QA scheme. Every EPC is registered in a central database. EPCs are randomly selected for a check performed by the secretariat for quality control. A technical revision, including a re-certification by a specially appointed expert, must be carried out for 0.25% of all issued EPCs. Furthermore, an electronic analysis of all EPCs in the database is carried out to identify outliers etc..

If errors are detected, certified companies have to correct the EPC; the company may get a DEA opinion or face a DEA prosecution/warning. The DEA opinion or warning will be sent to the accreditation agency that certified the company. In the worst cases, the certified company may have its certification suspended.

Each individual certified company defines its own internal penalties for its experts.

3.1 Progress and current status on sale or rental of buildings
Figure 7 shows the distribution of the certification classes of Danish dwellings, as registered in the current EPC scheme since 2006.

In the current EPC scheme, from September 2006 until mid 2012, the number of certificates issued is about 345,000. The total number of issued EPCs in Denmark since the initiation of the certification in 1997 is more than 1.1 million.

Comparing the number of EPCs issued for single-family houses with the existing building stock, around 19% of the Danish houses already have a certificate. This figure increases to 22% for row houses.

3.2 Progress and current status on public and large buildings visited by the public

As of February 2011, all public buildings with more than 250 m^2 of useful floor area are required to have a valid EPC, even if the owner/tenant has not changed. Since July 2012, this affects all buildings owned or used by the public. In Denmark, the definition of public buildings includes 1) buildings used for public administration, 2) institutions, companies, associations, etc., if more than 50% of their expenses are covered by public funds, and 3) publicly owned companies or companies where the public has the final influence on decisions.

The EPC of public buildings must be on physical display in the building itself. Furthermore, all key information of the certificate is available on a central web-based information server (*www.ois.dk*). Through this server, it is possible to view the registered consumption of, e.g., heat, electricity and water, as well as the name and ID number of the energy expert who issued the certificate.

Large buildings (larger than or equal to 1,000 m^2, which are not public buildings) must always have a valid EPC, even if the owner/tenant has not changed. As of the 1st of January 2013, in buildings in which an area over 600 m^2 is frequently visited by the public, the EPC has to be displayed in a place visible to the public. This requirement only applies for buildings already having an EPC.

Denmark is currently working on increasing the compliance level, by enhancing the effort to impose fines by pooling different sets of data. Based on questionnaire surveys on public buildings, the DEA deems that the compliance level is very high.

3.3 Implementation of mandatory advertising requirement – status

When a building is sold, rented or in other ways handed over to a new party, the EPC must be given to the new party before a contract is signed. For sales, this means that the seller must give the buyer an EPC before the contract is made. If a building (of any type) for sale or rent is advertised in a commercial media, the advertisement must display the label of the EPC. If a real estate agent is involved in the sale, the seller must provide the agent with the EPC before advertising the building. The agent must be in possession of the EPC because, according to the requirements, it forms part of the advertisement.

The DEA estimates that the compliance level is very high, due to the owner's/real estate agent's obligation to display the EPC along with the advertisement for the building.

3.4 Information campaigns

Information initiatives to reduce the energy consumption in the existing building stock are one of the key elements in the Danish Energy Agreement of the 22nd of March 2012. Previous and current activities aim at producing cost-efficient information material in cooperation with relevant actors that deal with energy savings. The importance of local perspective and private ownership is a significant part of the activities.

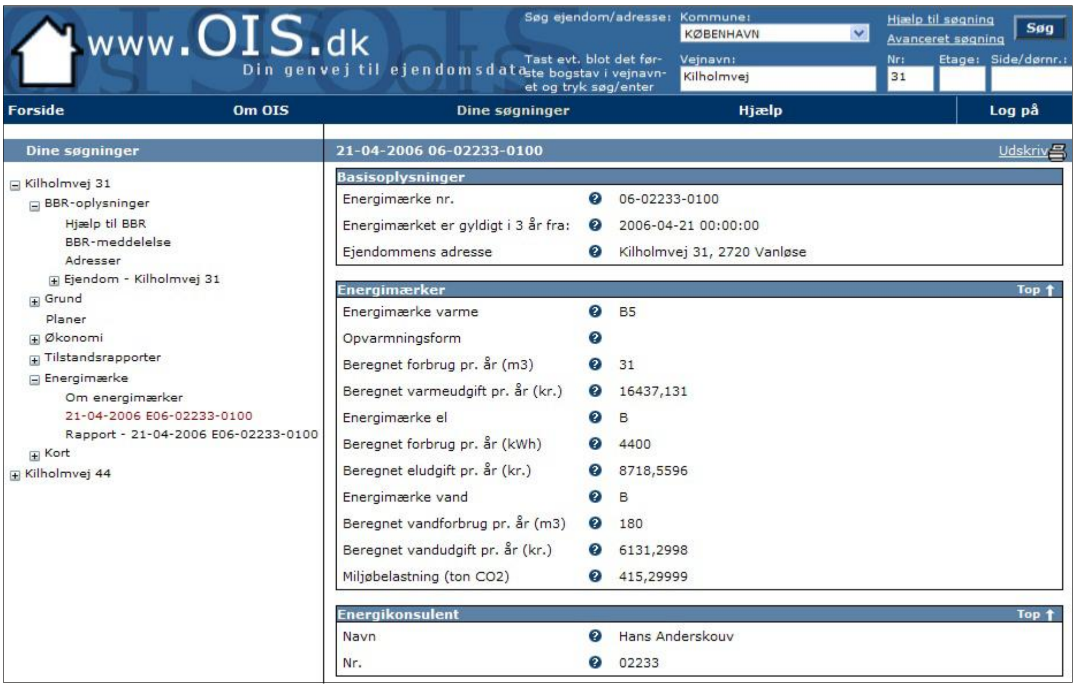


Figure 8: EP labels on public display in the OIS database.

Figure 9: Short films showing different energy saving solutions.

The DEA and the secretariat host websites containing both general and specific information on energy savings, as well as on the EPC. The DEA is currently in the process of launching a campaign in order to raise the public awareness on the importance of the EPC and its use. For the moment, the intention is to produce three leaflets with information about the EPC, one addressed to sellers of buildings, one addressed to buyers, and finally one explaining in more detail how to use the EPC.

A short sample of activities:

Short films showing different energy solutions
A number of short films have been produced, showing relevant energy solutions in households. The films make energy solutions visible and attractive to ordinary homeowners; some are targeted towards helping in the training of craftsmen. These films can also be used as marketing material by craftsmen with expertise in energy solutions.

List of craftsmen specialised in energy solutions
A list of relevant craftsmen is published in order to make it easy for homeowners to contact craftsmen specialised in energy solutions. Basically, all craftsmen can get on the list. The better trained the craftsmen are, the higher their rank of appearance in the list.

Guides to energy renovation
A number of guides have been published describing the process that homeowners must go through in connection with the renovation of their homes. The guides include an overview of market actors, a mapping of the saving potential, and a description of case-studies where energy renovations will pay off.

4. Inspection requirements - heating systems, air-conditioning

For the implementation of the article 14 of the EPBD on inspections of heating systems, Denmark adopted a combination of inspections and campaigns. For the implementation of the article 15 on air-conditioning inspections, regular inspections were adopted.

4.1 Progress and current status on heating systems
In Denmark, the effort to improve energy efficiency is primarily focused on oil and natural gas boilers, because they constitute a large proportion of all boilers (approximately 85%).

Figure 10 (left): Ranked list of craftsmen.

Figure 11 (right): Guide to energy upgrading.

Denmark adopted a combination of regular and voluntary inspections of oil boilers, together with economic incentives, rather than mandatory inspections. The Danish implementation of the article 14 should be seen as part of a political agreement on the termination of oil as a heating source by 2035; thus, the initiatives for oil boilers are mainly focused on replacing the oil boilers with other heating sources, such as heat pumps, district heating, or solar energy. However, some initiatives also focus on improving the efficiency of the existing oil boilers.

Although option B in the article 14 (alternative measures with equivalent effect) is chosen, Denmark has adopted an inspection scheme for oil boilers. The inspection scheme for boilers is stated in the Decree number 62 of the 27th of December 2011, Inspection of Boilers and Heating Systems in Buildings, issued by the DEA, and under revision at the end of 2012. The scheme is based on annual mandatory so called ‘energy measurements’, which include the measurement of soot and temperature loss in flue gas, as well as the registration of the boiler type and age. Based on these annual energy measurements, an oil boiler may be subject to a more thorough inspection, if the boiler has been manufactured before 1977 or if the two energy measurements exceed the limit values. Experts to perform the energy measurement and inspection are approved by the secretariat appointed to handle daily operations. The secretariat also publishes a list of approved experts in Denmark. It is the responsibility of the boiler owner to have an annual energy measurement, as well as an inspection in order to confirm if the conditions are met. If the mandatory energy measurement or inspection is not carried out, the boiler owner may face criminal liability. The scope of the inspection scheme includes all oil boilers, regardless of their use. The maximum fee for the inspections has been regulated.

In addition to the above, Denmark has implemented a prohibition on the installation of oil boilers in new buildings from 2013, and in existing buildings from 2016, in areas that are covered by district heating or natural gas.

Furthermore, a series of economic incentives have been introduced, such as granting a subsidy when replacing oil boilers with an alternative heating system (this led to the replacement of approximately 16,000 oil boilers). Energy companies also have energy efficiency commitments that include support for improving heating systems to produce energy savings. Amongst the energy companies’ initiatives is the replacement of oil boilers.

Finally, the DEA planned and implemented several information campaigns to promote heating sources other than oil boilers in areas not covered by district heating, as well as the improvement of the existing oil boilers.

The DEA expects that all these measures combined shall decrease the number of oil boilers in the near future.

Besides the legal initiatives, a large number of the oil and natural gas boilers are covered by various voluntary inspections. It is estimated that 2/3 of all oil and natural gas boilers undergo voluntary inspections within varying intervals (every 1-3 years). Apart from boilers, these voluntary inspections also cover other parts of the heating system, e.g., pumps and hot domestic water containers.

The DEA estimates that, in the end, these measures together will lead to a higher energy saving than that obtained by using a mandatory inspection scheme without binding recommendations, because information and economic incentives in the Danish model are given to all house owners who already have an interest in improving the heating system, and not just to those required to conduct a mandatory inspection.

4.2 Progress and current status on AC systems

Denmark adopted the regular inspections laid down in the Decree number 1104 of the 20th of September 2007 for the implementation of article 15 of the EPBD.

All air-conditioning and ventilation systems of an effective rated output of more than 5 kW are included in the scope of the inspection scheme, except for certain air-conditioning systems for industrial and not for personal use, as well as for systems used less than 500 hours/year.

The air-conditioning and ventilation systems must undergo an inspection every 5 years. The inspections must be conducted by certified companies

Figure 12: Brochure on inspection of boilers.

Figure 13: Brochure on inspection of ventilation systems.

approved by The Danish Accreditation and Metrology Fund (DANAK) or a similar accreditation company. The companies must have inspectors with specific training and experience on quality control procedures. The inspections are reported to the secretariat appointed to handle daily operations. The secretariat also publishes a list of accredited companies in Denmark, and maintains a database of the inspections performed.

The inspection consists of a basic recording of data such as type of system, effective rate and composition, as well as an indication of the condition and the control settings of the system. Moreover, the functioning and effectiveness of the system are examined during the inspection. Finally, DEA recommendations on energy efficiency with respect to retrofitting, maintenance and adjustment of the system are given to the owner in a report.

It is the responsibility of the owner of the air-conditioner to have the required inspections to confirm if the conditions are met. If the mandatory energy measurement or inspections are not carried out, the owner of the air-conditioner may face criminal liability.

5. Conclusions and future plans

The transposition of the recast Energy Performance of Buildings Directive has been completed in Denmark. The energy requirements for new buildings have been tightened, and a definition of Nearly Zero-Energy Building (NZEB) requirements for 2020 has been stipulated.

In order to meet the government's target for a CO_2-emission free country by 2050, the existing buildings need to make their contribution. To achieve this, the component requirements for existing buildings have been tightened in the case of renovation or replacement of these components.

The Danish certification scheme has undergone a major revision. The validity of the certificates is extended to 7 or 10 years for buildings with a high or low energy saving potential, respectively. In the revised scheme, for single-family houses built in the last 25-30 years, the certification can take place without a physical visit to the building. The energy certification of selected buildings can be based on the measured energy consumption. The layout of the Energy Performance Certificate (EPC) has been improved so that it is easier for the end-users to understand, and provides information of added value.

NZEB action plan will be a key tool to reach real energy savings, although it will be a challenge to promote NZEB as a cost-effective approach. The challenge of low-energy buildings is that as the energy requirements become tighter, it is increasingly important to integrate the considerations of energy saving, healthy indoor climate and good architecture, in order to get good overall solutions.

The Danish Energy Agreement of the 22nd of March 2012 commits the government to develop a comprehensive strategy for the energy upgrading of the existing building stock. This strategy should be based on a comprehensive analysis of the existing building stock, including the energy saving potential, in order to ensure that it is targeted at the most cost-effective interventions. The strategy will be discussed by the political parties before the end of 2013. In preparation of the strategy, there is a focus on possible measures for all building types. Also, there is a special focus on incentive structures and new financing models to promote energy renovation. The strategy includes activities and actions to be developed in close co-operation with relevant market stakeholders.

A major challenge remains: to raise the public's awareness on energy use. However, this is gradually being promoted by the focus of the media on energy use. There is still a strong need for new official information campaigns to promote energy efficiency. Moreover, training followed by an examination should be made mandatory for Qualified Experts (QE), to improve their skills for conducting energy audits and giving advice regarding the economic and technological solutions for the energy improvement of buildings.

EPBD implementation in Estonia

STATUS AT THE END OF 2012

Author

Mikk Maivel
Fund KredEx

1. Introduction

In Estonia, the implementation of the Energy Performance of Buildings Directive (EPBD) is the overall responsibility of the Ministry of the Economic Affairs and Communications. More efficient energy consumption in buildings has been one of the priorities for the governmental energy and housing policy in Estonia. The amendments of the Building Act, transposing the main elements of the EPBD (2002/91/EC), came into force in October 2006. However, the regulations transposing all the EPBD requirements were finalised in January 2009, and the main regulations in compliance with the recast EPBD (2010/31/EC) will be coming into force in the beginning of 2013.

During the last years, almost 200 M€ were spent on renovating public and apartment buildings to achieve higher energy efficiency, using different Green Investment Schemes for each building category (subsidies amount to about 30 M€ for apartment buildings, and 147 M€ for public buildings, respectively). The factor of energy efficiency has been introduced as a new argument in cases of sale or rental of property.

This report presents an overview of the current status of the implementation and of the plans for the evolution of the implementation of the EPBD in Estonia. It addresses certification, minimum requirements and inspection systems, including quality control mechanisms, training of Qualified Experts (QE), information campaigns, etc..

2. Energy performance requirements

The minimum Energy Performance (EP) requirements were launched in 2007 and came into force in January 2008. The EP requirements are mandatory for all new buildings (including residential, non-residential and public buildings) and for existing building under major renovation. The national legislation does not foresee any exceptions for public buildings used by the government. The minimum EP requirements include the methodology to prove compliance with these requirements. The calculation methodology is relatively complex compared to the simpler methodology used for the certification of existing buildings.

2.1 Progress and current status

Valid EP requirements have been in use since the 1st of January 2008. Before the EPBD requirements, there were no specific legal obligations, e.g., thermal transmittance values, or requirements for building technical systems.

The minimum EP requirements are expressed as a primary EP indicator calculated for the building on its standardised use. Data for standardised use includes a description of occupant, equipment and lighting usage profiles, as well as indoor climate requirements. The EP calculation takes into account the energy needs for space heating, Domestic Hot Water (DHW), cooling, lighting, ventilation, and electrical appliances. The minimum EP value characterises the primary energy demand of the building; i.e., the net needed energy is multiplied by the weighted factors for the energy

National Websites *www.kredex.ee, www.mkm.ee/hoonete-mn*

Table 1: Comparison of existing and new (mandatory after the 9th of January 2013) minimum EP requirements.

No.	Building type	Energy performance (kWh/m^2) (primary energy)		Revised Energy performance (kWh/m^2) (primary energy)	
		New building	Existing builing	New building	Existing builing
1	Small residential buildings	180	250	160	210
2	Apartment buildings	150	200	150	180
3	Office buildings and libraries	220	290	160	210
4	Commercial buildings	n/a	n/a	210	270
5	Public buildings	300	390	200	250
6	Shopping malls and terminals	n/a	n/a	230	280
7	Schools, universities	n/a	n/a	160	200
8	Kindergartens	n/a	n/a	190	240
9	Hospitals and other medical buildings	400	520	380	460
10	Swimming pools	800	1000	n/a	n/a

Table 2: Weighting factors of different energy carriers.

Renewable energy (wood, biofuel)	0.75
District heating	0.9
Fossil fuels	1.0
Electricity	2.0

carriers. The minimum requirements were firstly adopted for six different building types. In the new regulation, mandatory as of the 9th of January 2013, there are nine different building types. The maximum primary energy consumption values are listed in Table 1.

Compliance with the minimum EP requirements should be proven through an energy calculation of the building using the prescribed methodology. Energy calculations for non-residential must be executed by a dynamic calculation methodology. For detatched houses, the methodology may be simpler. All the input data, including requirements for the calculation tool, is specified in the Act of Minimum Requirements. Major renovation is defined as any renovation involving more than 25% of the construction cost of a similar new building. For smaller buildings (detached homes and row houses), it is allowed to demonstrate compliance with the minimum EP requirements by a simplified calculation of heat losses through the building envelope. This calculation takes into account only the specific heat loss, and requires a mechanical supply and exhaust ventilation system with heat recovery. This simplified method does not take into account DHW, cooling, lighting, etc.. Besides the maximum primary energy consumption, the simplified method takes into account the maximum allowable specific heat loss values for most common heat carriers or heat production sources, e.g., for ground source heat pumps, the maximum specific heat loss value to fulfill the minimum requirements is 1.0 W/m^2.K.

Since the 9th of January 2013, new, more strict minimum EP requirements, in compliance with the recast EPBD, have come into force. The Ministry of the Economic Affairs and Communications plans to adopt yet more strict EP requirements after 2016, but the existing legal acts do not foresee the application of more strict requirements yet.

2.2 Format of national transposition and implementation of existing regulations

Until the 9th of January 2013, the EP requirements for new buildings and major renovations of existing buildings were regulated by the Minimum Energy Performance Requirements Act.[1] After that date, the requirements are regulated by three Acts:

> 'Minimum Energy Performance Requirements'.[2] This Act includes the main requirements, such as the maximum allowable primary energy consumption, recommendations for building envelope elements and building technical systems, and requirements for energy calculation tools. Besides that, it gives the definition and primary EP value for low-energy buildings and Nearly Zero-Energy Buildings (NZEB). This Act also includes weighting factors of different energy carriers.
> 'Calculation Methodology for Building Energy Performance Calculations'.[3] This Act includes all the necessary information about standardised use of the 10 different building types, as well as detailed calculation formulas and guidelines for the energy calculations.
> 'Requirements for Building Service Systems'.[4] This Act includes the main requirements for Heating, Ventilation and Air-Conditioning (HVAC) systems, and for lighting.

1 *www.riigiteataja.ee/akt/13217396*
2 *www.riigiteataja.ee/akt/105092012004*
3 *www.riigiteataja.ee/akt/118102012001*
4 *www.riigiteataja.ee/akt/109112012012*

To help the implementation of new requirements, several training courses have already taken place, and others will be organised during 2013. All Acts include explanatory notes to promote better understanding by stakeholders. Beside the courses, the Fund KredEx prepared guidelines for residential and non-residential building stakeholders.[1]

2.3 Cost-optimal procedure for setting EP requirements

The recast EPBD requires all Member States (MS) to calculate cost-optimal levels of the minimum EP requirements. In Estonia, the calculations were executed in 2011 following the guidelines of the Federation of European Heating, Ventilation and Air-Conditioning Associations (REHVA). Cost-optimal calculations were executed for six building types: detached building; apartment building; nursing home; daycare centre; school building; office building. All the selected buildings were set as reference buildings. The cost-optimal calculation followed a simple 7-step procedure:

1. selection of the reference building(s);
2. definition of construction concepts based on the building envelope optimisation for four fixed specific heat loss levels (from business as usual construction to highly insulated building envelope);
3. specification of building technical systems;
4. energy simulations for specified construction concepts;
5. post-processing of the simulation results to calculate delivered, exported and primary energy;
6. economic calculations for construction cost and net present value calculations;
7. sensitivity analyses for the interest rate, the escalation of energy prices and other parameters.

In the selection process, different professional associations, universities and government agencies, namely, the Union of Estonian Architects, the Estonian Heating and Ventilation Association, the Tallinn University of Technology, etc., were involved. As a result of several meetings, reference buildings were chosen from among recently built buildings representing the current architectural trends. After the selection process, the other steps were followed to get cost-optimal primary energy levels in Estonian conditions. The new, stricter EP requirements coming into effect in 2013 are based on the results of this cost-optimal study.

The new strict Estonian requirements also include the definition of a cost-optimal building (following REHVA definitions, where a cost-optimal building must ensure the lowest lifecycle cost over a period of 30 years for residential, and 20 years for non-residential buildings). The requirements in place before the 9th of January 2013 could not take into account

Figure 1:
Fund KredEx.

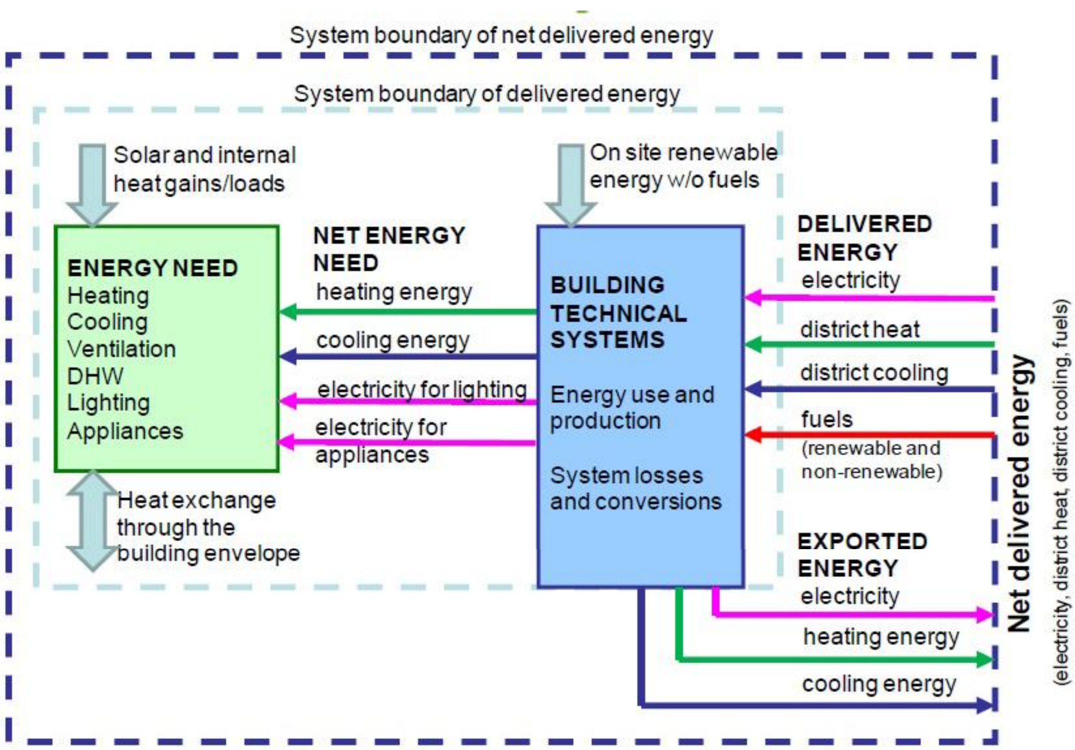
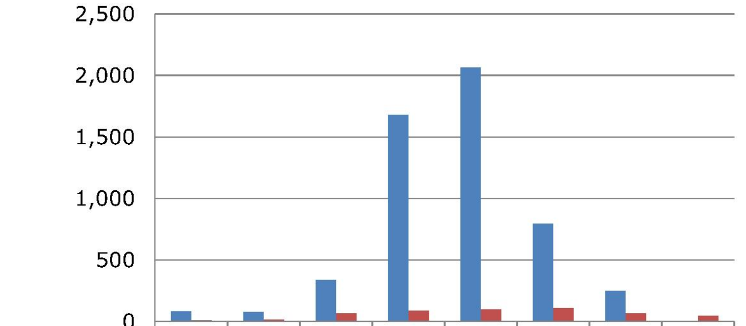


Figure 2:
System boundary of new minimum EP requirements.

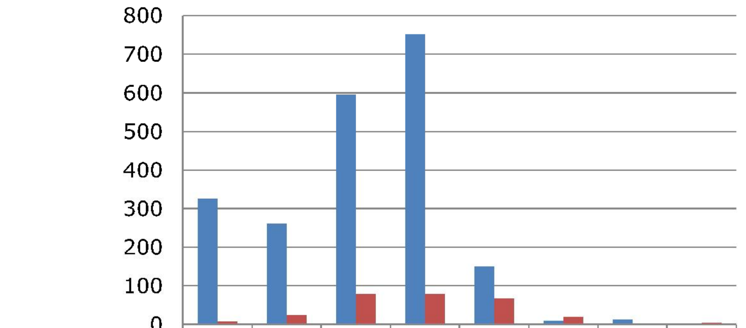
1 *www.kredex.ee/energiatohususest/energiatohusus/uuringud*

Figure 3: Number of certificates issued for existing buildings.



	A	B	C	D	E	F	G	H
Residental	85	77	339	1682	2064	796	248	0
Non-residental	8	14	68	88	101	111	65	48

Figure 4: Number of certificates issued for new buildings.



	A	B	C	D	E	F	G	H
Residental	325	261	595	752	150	10	13	0
Non-residental	7	24	79	79	67	20	2	4

the locally produced energy by Renewable Energy Sources (RES). In the new revised version of the requirements (mandatory after the 9th of January 2013), the system boundaries have been modified so that the locally produced energy by RES has an effect on the EP ratio.

2.4 Action plan for progression to NZEB

The legislation coming into force on the 9th of January 2013 already includes the definitions of NZEB (nearly zero-energy and net zero energy). NZEB is defined as a technically reasonably achievable level, considering the current best practices and the on-site energy production by RES (the share of energy by RES is not fixed). NZEB are buildings for which the annual primary energy consumption is zero (0). The action plan for the coming years will provide the next update of the EP requirements in 2016, and then a final update before the main objective in 2018-2019. After the 31st of December 2018, all new public buildings should be NZEB, and after the 31st of December 2020, all new buildings must be NZEB.

3. Energy performance certificates

Energy Performance Certificates (EPCs) are required in Estonia since January 2009. As of December 2012, approximately 8,200 EPCs were issued (total for new and existing buildings). The legislation divides buildings into two main categories: residential and non-residential. There are no exceptions for public buildings used by the government.

3.1 Progress and current status on sale or rental of buildings

The regulation on the energy certification of buildings ('The template of energy certificate and issuing procedure') was signed by the Minister of Economic Affairs and Communications on the 17th of December 2008. It is published in the website of the State Gazette of the Republic of Estonia.[1] This regulation sets a procedure to determine the energy rating of buildings, and the template of the EPC, which is mandatory for renting or selling property. There are two types of certificates: one for existing buildings, where the calculation methodology is based on the actually used primary energy, and one for new buildings, where the calculation is executed on the basis of standardised use. The EPC template will be updated in 2013; the main changes concern the appearance of the certificate. The calculation methodology of the energy rating is the same for all buildings, residential, non-residential and public.

Certification of the existing buildings is a relatively simple service. It typically costs from 100 € to 200 € per building, depending on its size. For a more in-depth analysis, an energy audit of the building should be conducted. However, building owners, buyers or renters are generally not interested to pay for detailed expertise on the building's condition. The EPC also includes a page with recommendations, where the certifier gives recommendations for the HVAC systems, the electricity use, and the building envelope elements. The new, updated legislation that will come into force during the first half of 2013 will include a more detailed recommendations page for building technical systems.

In order to get a certifier qualification, candidates must attend special courses and pass an exam. In Estonia, there is a publicly available list with all certifiers (at present, 115 certifiers).

1 *www.riigiteataja.ee/akt/13094120*

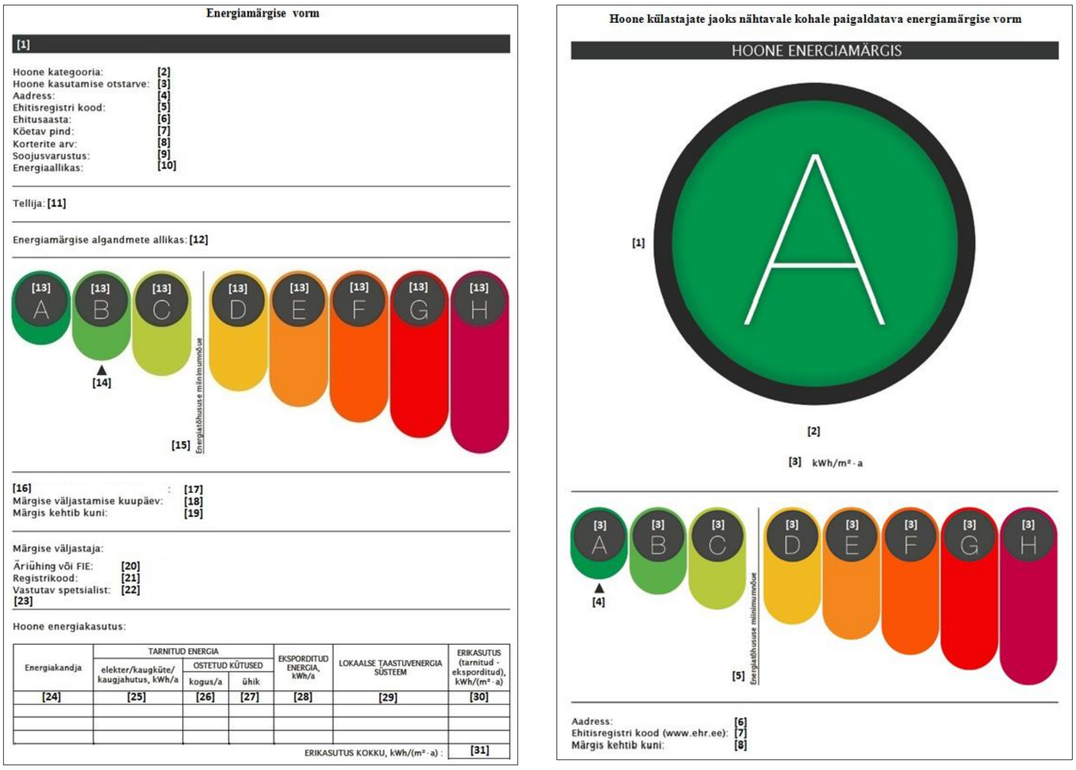


Figure 5:
Left - cover page of the new EPC. Right - the EPC, which must be displayed in a visible place in public building.

Estonia has a public building register where certifiers must upload their certificates. All citizens have access to this register for use or for getting information about the energy label. The register includes all the issued EPCs. The Estonian Technical Surveillance Authority makes random checks on EPCs, and deals with complaints. This Authority has the power to impose penalties for deviations from the Building Act.

3.2 Progress and current status on public and large buildings visited by the public

Current legislation requires an EPC for every public building used by the government and having a floor area larger than 500 m². The EPC must be placed on a place visible to visitors. After the 9th of July 2015, the requirements will be stricter; the display of the EPC in a visible place will be mandatory for all public buildings with a used area larger than 250 m². The EPC is valid for ten years (the old EPC expires after the new one is issued).

3.3 Implementation of mandatory advertising requirement – status

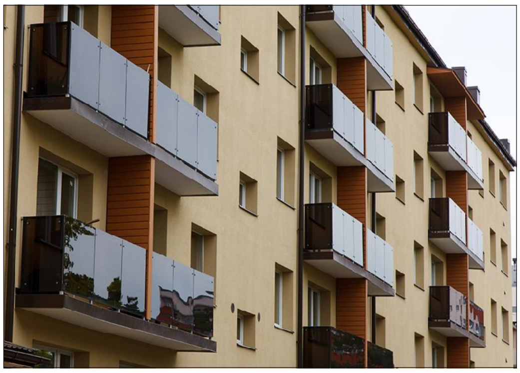
Current regulations require an EPC for the renting and/or selling of buildings. The National Building Act also requires that advertisements must include at least the building energy class and the primary energy consumption per heated area. Occupant awareness on energy efficiency and energy certification systems is in quite good levels in the cases of renting or buying buildings. Occupants generally ask for the EPC. Fund KredEx and the Ministry of the Economic Affairs and Communications, together with the Tartu Regional Energy Agency, organise a national energy week once a year. Fund KredEx has also implemented several promotional campaigns, mostly targeted at apartment buildings, as their share is roughly 70% of the total residential building stock.

3.4 Information campaigns

Fund KredEx has carried out several information campaigns. These campaigns have been arranged on an annual basis, to inform tenants of apartment buildings on energy saving measures, on the potential magnitude of the savings, as well as on getting the expert advice and support

Figure 6: Campaigns in the period 2011-2012.

Figure 7: Major renovation in one case study apartment building in Tallinn; before (left) and after (right).



provided by the state. Several methods have been used in these campaigns: information has been distributed through TV, radio, printed media, internet, advertisements in the streets, training courses for persons responsible for building maintenance, etc.. As a result of these campaigns, energy saving activities have taken off. There was also quite good feedback from different case-study retrofit projects.

4. Inspection requirements - heating systems, air-conditioning

The role of on-site heat generation in water-based heating systems is significantly lower than the heat supply from distinct heating. Therefore, for boilers, Estonia adopted option B of article 8 of the EPBD.

4.1 Progress and current status on heating systems

In accordance with the EPBD, the Building Act includes a requirement for boiler sellers to provide advice on demand to consumers whenever a new boiler is installed, or an existing boiler is replaced. Provision of advice on demand may include an on-site inspection of the system. If such an inspection is carried out, the inspection report should include information on options for boiler replacement, on other modifications to the heating systems, as well as on alternative solutions that would enable the energy-efficient operation of the system.

When a boiler is sold, it must be registered, and its rated output, efficiency and type of fuel must be recorded. The selling company must register the boiler in the National Building Register if its output is higher than 20 kW.

4.2 Progress and current status on AC systems

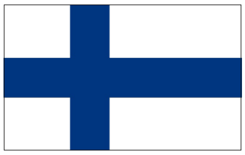
The use of air-conditioning (AC) systems is not widespread in buildings, due to the prevailing cold climate in Estonia. When buildings have an AC, small devices (heat pumps) with a rated output lower than 12 kW are usually installed. Larger systems are usually installed in new buildings that must fulfill the minimum EP requirements in the current regulations. The Estonian Building Act establishes similar rules for AC systems as those for boilers, when their rated power is above 12 kW.

5. Conclusions and future plans

The recast Energy Performance of Building Directive (EPBD) has already been fully transposed into the national legislation. In the near future, updated requirements and new acts will come into force. Afterwards, Estonia will continue conducting information campaigns to improve the level of knowledge of building owners, designers, architects, as well as specialists working in the municipalities. The adoption of the EPBD led to significant energy efficiency improvements of buildings, both new and existing.

EPBD implementation in Finland

STATUS AT THE END OF 2012



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1. Introduction

The Ministry of the Environment is responsible for the transposition and implementation of the Energy Performance of Buildings Directive (EPBD). Finland has had regulations on the energy efficiency of buildings in the National Building Code since 1976. Regulations have been tightened several times, also due to the implementation of the EPBD. Energy certificates were taken into use in the beginning of 2008, based on the Energy Certification of Buildings Act.

Due to the recast EPBD, minimum energy requirements for construction of new buildings have been revised and minimum energy requirements for existing buildings undergoing renovation and retrofitting have been developed. The revised regulations for new buildings came into force in July 2012. The regulations for existing buildings will come into force the 1st of June 2013.

Legislation on the Energy Performance (EP) certification of buildings changes in February 2013 because of the recast of the EPBD. For inspections of boilers and air-conditioning systems, Finland's Parliament chose alternative approaches according to articles 14 and 15 of the recast EPBD instead of compulsory inspections. The changes for inspections will also come into force on the 1st of June 2013.

2. Energy performance requirements

EP regulations are valid for new buildings under the regulations of the National Building Code of Finland. In February 2013, EP regulations become valid for renovation and retrofitting of existing buildings. Regulations are the same for all types of buildings.

2.1 Progress and current status

Finland's National Building Code has set minimum requirements for the thermal insulation and ventilation of new buildings since 1976. These requirements have been amended several times to improve energy efficiency in buildings. Amendments were made in 2003, when the requirements were tightened by 25-30%, and in 2007, when the requirements were amended due to the implementation of the EPBD. The most recent tightening of the requirements (by 30%) was adopted in December 2008 and came into force at the beginning of 2010. The development of minimum requirements is shown in Table 1.

Until now, the National Building Code has mainly regulated the thermal properties (U-values) of building structures. This decreased the space heating demand, but did not do much to encourage other energy-related improvements in buildings. Since the new building code entered into force in July 2012, the overall energy consumption of a building is calculated with weighting factors for different energy sources. Energy consumption is calculated with standard user profiles.

Minimum energy requirements have also been developed for existing buildings when renovation and retrofit are subject to a building permit, when the use of a building is altered or when technical systems are repaired. These regulations will come into force on the 1st of June 2013 as part of the National Building Code.

National Websites   *www.ymparisto.fi, www.motiva.fi/energiatodistus*

Table 1: Development of minimum requirements for new buildings.

U-values for building components W/m²K	1976	1978	1985	2003	2007	2010	2012
Walls	0.4	0.29	0.28	0.25	0.24	0.17 0.40 logwall	0.17 0.40 logwall
Roof	0.35	0.23	0.22	0.16	0.15	0.09	0.09
Floor	0.40	0.40	0.36	0.25	0.24	0.09/0.16/0.17[1]	0.09/0.16/0.17[2]
Windows	2.1	2.1	2.1	1.4	1.4	1.0	1.0
Doors	0.7	0.7	0.7	1.4	1.4	1.0	1.0
Other base values							
n_{50}-value	6	6	6	4	4	2	q_{50}[3]=4
Annual efficiency for heat recovery systems	0	0	0	30%	30%	45%	45%
Maximum values for energy consumption kWh/m².year							Based on building type[4]

1, 2 Base floor bordering on outside air = 0.09 W/m².K, building component against the ground = 0.16 W/m².K, base floor bordering on crawl space = 0.17 W/m².K.
3 q_{50} is the air leakage value of the building envelope.
4 See Table 3.
5 Energy consumption (kWh/m².year) is taking into account the energy source (primary resource factor).

Table 2: Weighting factors (primary resource factors) for energy for the calculation of overall energy consumption of a building in the National Building Code of 2012.

	Weighting factor for energy source in the new building code 2012
Fossil fuels	1.0
Electricity	1.7
District heating	0.7
District cooling	0.4
Renewable fuels	0.5

2.2 Format of national transposition and implementation of existing regulations

Energy requirements for new buildings
The minimum energy requirements have been revised for construction of new buildings due to the recast EPBD. The approach is based on overall energy consumption, which takes into account the energy source (primary resource factor = weighting factor). The new requirements were given in a decree of the Ministry of the Environment as a part of the National Building Code of Finland under the Land Use and Building Act. The decree entered into force at the beginning of July 2012.

The new National Building Code sets maximum values for the energy consumption (E-values) calculated with the weight factors. The maximum values depend on the building type, and for single-family houses, also on the area of the building. The new building code does not exclude any source of heating. However, the code encourages the use of Renewable Energy Sources (RES) and district heating. The aim is to reduce the use of fossil fuels.

Energy requirements for existing buildings
Minimum energy requirements have been developed for existing buildings to be used when renovation and retrofit require a building permit, when the use of a building is altered or when technical systems are repaired. The feasibility of measures to improve the energy efficiency of the building will be assessed on the basis of technical, operational and financial considerations. There are three optional ways for planning the energy efficiency improvements: 1) energy efficiency requirements for each building component; 2) energy consumption requirements for a building by building class; or 3) E-value requirements of a building by building type. In the long term, these three optional ways lead overall to the same energy savings. Requirements for technical building systems have to be applied in all cases.

Table 3: Maximum values for energy consumption[5] (E-value) in different building types.

Type of building	**Maximum value for energy consumption per year (calculated with weight factors of energy source)**	
Single-family houses	*Heated net area, A_{net}* m^2	*E-value* $kWh/m^2.year$
	$A_{net} < 120\ m^2$	204
	$120\ m^2 \leq A_{net} \leq 150\ m^2$	$372 - 1.4 \cdot A_{net}$
	$150\ m^2 < A_{net} \leq 600\ m^2$	$173 - 0.07 \cdot A_{net}$
	$A_{net} > 600\ m^2$	130
Single-family houses (log houses)	$A_{net} < 120\ m^2$	229
	$120\ m^2 \leq A_{net} \leq 150\ m^2$	$397 - 1.4 \cdot A_{net}$
	$150\ m^2 < A_{net} \leq 600\ m^2$	$198 - 0.07 \cdot A_{net}$
	$A_{net} > 600\ m^2$	155
Row houses	150 $kWh/m^2.year$	
Apartment buildings	130 $kWh/m^2.year$	
Offices	170 $kWh/m^2.year$	
Shops etc.	240 $kWh/m^2.year$	
Hotels, motels etc.	240 $kWh/m^2.year$	
Schools and day care centres	170 $kWh/m^2.year$	
Sports halls	170 $kWh/m^2.year$	
Hospitals	450 $kWh/m^2.year$	
Other buildings	Energy consumption has to be calculated but no limit values	

5 Energy consumption ($kWh/m^2.year$) is taking into account the energy source (primary resource factor).

EP regulations are part of the National Building Code, which is published on the website of the Ministry of the Environment: *www.ymparisto.fi/rakentamismaaraykset*. The site includes several technical documents, calculation sheets and support documents. To facilitate the renovation of buildings, the Ministry of the Environment also launched a separate web portal (*www.korjaustieto.fi*) in 2011. The portal offers versatile tools, guidance and examples of best practice cases especially for renovation of residential buildings and single-family houses.

After the amendments to the National Building Code in 2012, the Ministry of the Environment provided training for municipal building inspection authorities, who are responsible for inspecting the compliance of building permit applications. Training is also available via several different training organisations all over the country.

The new energy regulations have been disseminated to both professionals and consumers through versatile means like seminars, building fair events, presentations and articles. An information brochure on the new regulations for new buildings was published in 2012. The brochure has been distributed to the municipal authorities working with building permits and they have been encouraged to disseminate the information forward to their customers.

Figure 1: Web portal for renovating and retrofitting residential buildings: www.korjaustieto.fi.

The regulations were exhibited during the National Housing Fair in July 2012, which had nearly 200,000 visitors.

2.3 Cost-optimal procedure for setting EP requirements

The consultants and the staff of the ministry have been developing the national procedures for cost-optimality

Figure 2: Brochure on the National Building Code of Finland and energy requirements.

calculations. The work concerning both new buildings and existing buildings is expected to be completed by the end of March 2013.

2.4 Action plan for progression to NZEB
In the spring of 2012, the Ministry of the Environment launched an intensive working process to gather valuable input for the preparation of the national plan for Nearly Zero-Energy Buildings (NZEB). More than 300 experts were actively involved in the work in which cost-optimality was one of the viewpoints. A national plan for increasing the number of NZEBs was drawn up and submitted to the European Commission in October 2012. In brief, its aim is to give technical recommendations for NZEBs in 2015. In 2013, a number of collaborative efforts are starting up together with major industry and non-profit stakeholders, to further the process of developing NZEBs.

To encourage construction of low-energy or nearly zero-energy single-family houses, the Ministry of the Environment finances the national 'Energy Efficient Home' information campaign (EEH campaign). Motiva, a state-owned company ('energy agency') promoting energy and material efficiency, is coordinating this information campaign. The EEH campaign – operating since 2006 – is well linked to both the organisations and companies operating in the field, with close to 20 campaign contributors. The core element of the campaign is the website *www.energiatehokaskoti.fi*, which provides comprehensive information, tools and practical guidance towards energy efficiency and NZEB.

Figure 3: Website of the Energy Efficient Home campaign.

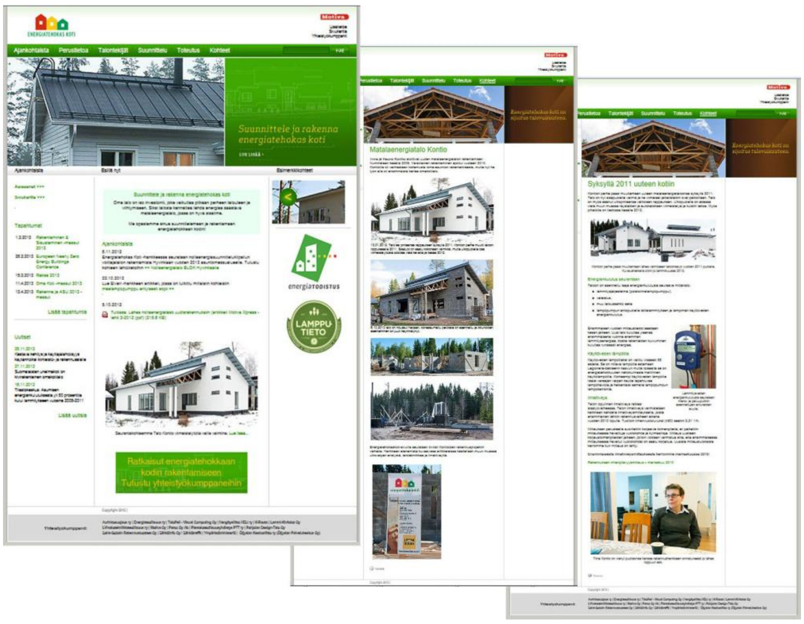


Table 4: Efficiency scale for apartment buildings.

Energy efficiency class	Total energy consumption, E-value (kWh/m^2.year)
A	E-value ≤ 75
B	76 ≤ E-value ≤ 100
C	101 ≤ E-value ≤ 130
D	131 ≤ E-value ≤ 160
E	161 ≤ E-value ≤ 190
F	191 ≤ E-value ≤ 240
G	241 ≤ E-value

NZEBs were discussed in an EEH workshop held in August 2012 with organisations, companies and researchers contributing to the formulation of the national application of the definition of NZEB in practice. The work was continued at a large expert workshop with representatives from both building industry and research organisations. The final definition will be based on cost-optimality calculations being finalised by the Ministry of the Environment.

3. Energy performance certificates

The EP certification was implemented in Finland in 2008 with model certificates for new and existing buildings. Trained experts and building managers have been responsible for certification of residential and service buildings. The certificate is needed when a building is sold or rented, and when constructing new buildings.

Legislation to implement the recast EPBD requirements is being adopted in the beginning of 2013 and it comes into force on the 1st of June 2013.

3.1 Progress and current status on sale or rental of buildings
The Ministry of the Environment is responsible for legislation and guidelines regarding Energy Performance Certificates (EPCs), EPC templates and other instructions concerning the issuance of certificates.

The Housing Finance and Development Centre of Finland (ARA) is the administrative authority ensuring the quality of certificates and of Qualified Experts (QE), and the appropriate preparation and use of the certificates. As the responsible authority, it can also make compliance checks of the certificates issued. Additionally, ARA can initiate enforcement measures in case of negligence on the part of the building owner or the QEs. Measures are administrative, not penal measures, and include requests, warnings, orders, conditional fines and suspension of the

QE. The quality procedures of the EP certification system will be commenced by ARA in the beginning of June 2013.

Method and model of energy certification
According to the new regulations, the EPC is needed when a building is sold or rented and for all new buildings. Certification requirements are the same for residential, non-residential and public buildings. The energy certificate must be displayed, so as to be visible to the public, in buildings with more than 500 m^2 of total useful floor area, occupied by public authorities and visited by the public.

The new legislation, adopted in February 2013, changed energy certification procedures and the layout of energy certificates. The new EPCs will come into use in stages. As soon as the new law comes into force on the 1st of June 2013, new types of EPCs will be needed for all new buildings along with the application for a building permit, and for existing residential apartment buildings and single-family houses when the building is sold or rented. For single-family homes built before 1980, the new requirement takes effect after the 1st of July 2017. The new requirements take effect on the 1st of July 2014 for office and commercial buildings and after the 1st of July 2015 for institutional care, assembly and educational buildings.

The energy label classifies buildings on an efficiency scale, ranging from A (high energy efficiency) to G (poor efficiency). As an example, the efficiency scale for apartment buildings is shown in Table 4. The layout of the new EPC is shown in Figure 4.

Energy performance is based on overall primary energy consumption (kWh/m^2.year) taking into account the energy source (primary resource factor). Weighting factors for energy sources are fixed in the National Building Code as described previously in Table 2. The energy certificate is always based on calculated energy consumption, which makes it possible to compare different buildings, not different users. In existing buildings, information on the available actual energy consumption has also to be reported.

Recommendations are always included in energy certificates. A QE must inspect the building and assess the energy efficiency of the building elements and components, as well as the technical systems (external walls, doors, windows, heating and domestic hot water systems, ventilation systems, lighting and other electrical heating systems).

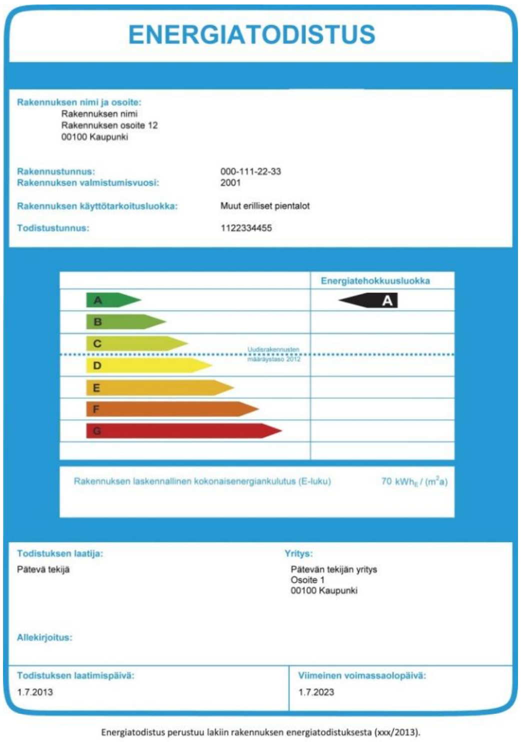


Figure 4: New energy performance certificate.

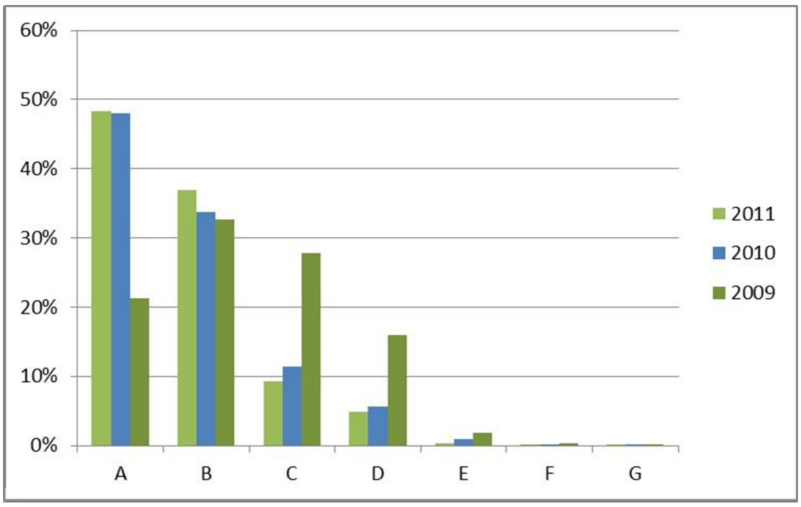
The QE must suggest cost-effective energy-saving measures in the certificate. Because there are no general lists of recommended energy-saving measures, these recommendations depend on the expert's skills and knowledge. Savings in kWh/year must be calculated in detail for each measure for every building.

An energy certificate is valid for 10 years.

New buildings planned according to the National Building Code are typically in class C, older buildings in classes D or E. As seen in Figure 5, the EP certification has had an impact on the energy efficiency of new single-family houses.

The building owner is responsible for ensuring that an EPC is issued for the

Figure 5: Energy performance certification has improved the energy efficiency of single-family houses built in Finland, according to the database on energy certification of new buildings.



building. The cost of the certificate depends on the building size and type. The price for an existing single-family house is about 500–700 € and for an apartment building about 1,000–1,500 €. The market will determine the final cost of the certificate.

According to the new legislation, the energy certificate will always be issued by a QE, as opposed to the current system which allows for other persons to do it (for e.g., building managers and energy auditors). The Ministry of the Environment will designate accreditation bodies to approve QEs. There are two levels of QEs, with the higher level needed for buildings requiring dynamic simulations (e.g., for new buildings with cooling facilities).

All material pertaining EPCs is available on the website of the ministry and via a targeted web portal with detailed information on the certification procedures and an FAQ section (*www.motiva.fi/energiatodistus*).

A national, centralised database for energy certificates on new buildings has been in use from 2009. In the current phase, the database collects only statistical data on the number of certificates. At the end of 2012, the ministry started the development of a comprehensive database for monitoring energy certificates and QEs. A pre-study of the database has already been made in collaboration with experts from VTT Technical Research Centre of Finland and Motiva. The database will be developed as a part of the Ministry of Finance's ICT programme 'Action Programme on eServices and eDemocracy'.

3.2 Progress and current status on public and large buildings visited by the public

The energy certification of public buildings is followed through the voluntary energy efficiency agreement scheme for municipalities since 2009. Information is gathered yearly from participating municipalities, towns and cities into a comprehensive monitoring and reporting system.

According to the new legislation, the energy certificate must be displayed so as to be visible to the public in buildings where over 500 m^2 of total useful floor area is occupied by public authorities and visited by the public. In addition, the energy certificate must be displayed so as to be visible to the public in buildings that already have an energy certificate and where over 500 m^2 of the total useful floor area is visited by the public.

3.3 Implementation of mandatory advertising requirement – status

The new legislation on EP of buildings includes the mandatory requirement to display the energy class of the building in commercial advertisements, starting from the 1st of June 2013.

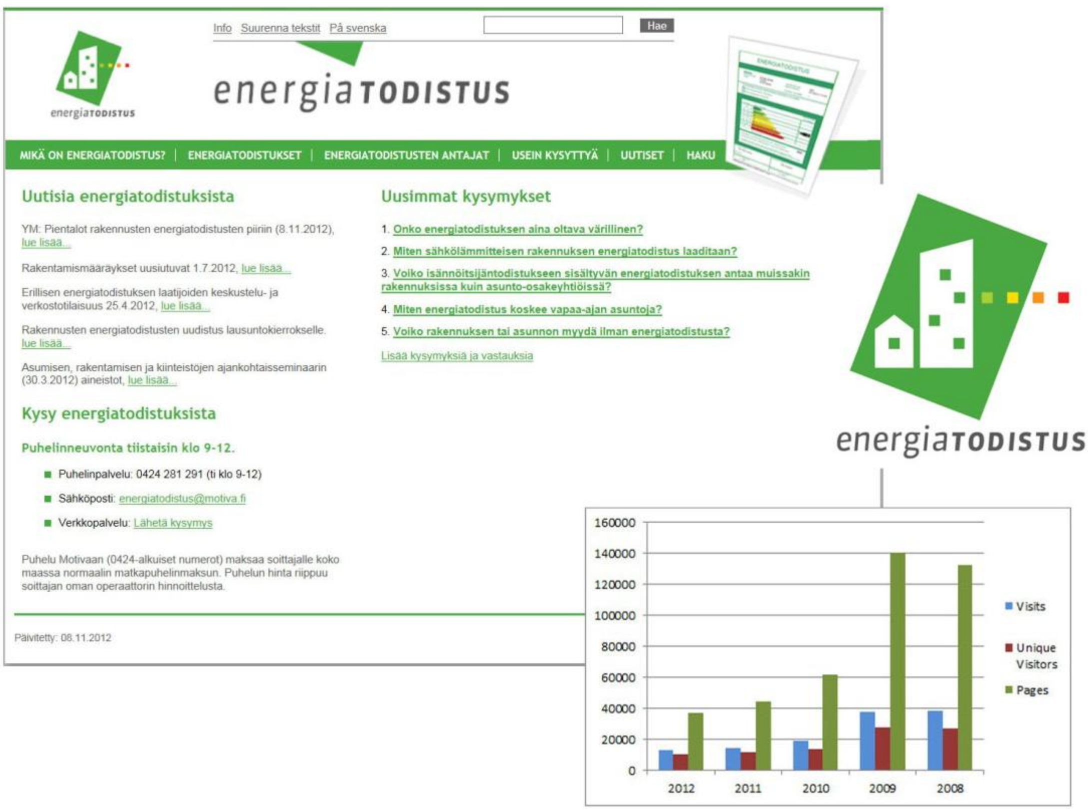


Figure 6: Website for the energy performance certification helpdesk: www.motiva.fi/energiatodistus.

Figure 7: Information on HÖYLÄ is distributed to consumers via the magazine "Lämmöllä" (with warmth).

3.4 Information campaigns

The ministry has given a mandate to Motiva to coordinate a national information campaign on energy certificates. The key information source of the campaign is a web portal (*www.motiva.fi/energiatodistus*) with detailed information on the certification procedures and an FAQ section, links to certification models, materials and guidebooks, as well as other relevant information. Motiva also maintains a helpdesk service centre that answers questions put forth by consumers, homeowners and professionals, including accredited certifiers. According to service centre statistics, the need for information is steady.

Motiva has been encouraging networking between the accredited certifiers through annual workshops since 2009. Motiva has also arranged other seminars and workshops for both professionals and consumers. Seminars have been well attended, with over 100 participants each.

Consumers and home owners have been informed through many channels: news, articles and press releases, as well as annually held popular events such as the Own Home Fair and the National Housing Fair, which are the largest events.

4. Inspection requirements - heating systems, air-conditioning

Finland has adopted the alternative approach (model B) for enhancing the efficiency of boilers since the implementation of the original EPBD. The alternative model will also be adopted for air-conditioning systems when implementing the EPBD recast.

Figure 8: Energy performance certification has been displayed at the annually held national housing fair since 2008.

4.1 Progress and current status on heating systems

An advisory approach has been used to enhance the efficiency of particularly oil-fired boilers. Implementation is based on a voluntary energy efficiency agreement (Höylä, valid till the end of 2016) between the Ministry of Employment and the Economy, the Ministry of the Environment and the oil and gas industry. This agreement consists of measures to promote regular inspections of oil-fired boilers, and measures for the training and certification of inspectors, as well as dissemination of information and advice for consumers.

The Höylä III agreement covers all oil-heated buildings and the results have been good. But, as Höylä does not cover all fuel-based heating systems, the aim is to extend the advisory measures to biofuel heating systems too. The voluntary scheme would cover also all small (under 20 kW) boilers. In total, there are nearly 220,000 biofuel-heated single-family houses, approximately 20% of the single-family-house stock. The advisory measures would consist of instructions and guides for choosing heating systems and technology, information on renovating old systems and on the use of integrated solar energy in bioheating, and would promote increasing the awareness of energy efficiency and environmental issues. Advisory programmes will be done in cooperation with bioenergy organisations, the Ministry of the Environment, and public educational and research institutions and bioenergy lobbies. To monitor the impacts a monitoring and reporting system will be developed.

It is estimated that the voluntary advisory measures will allow for at least the same energy savings as a mandatory inspection system. The key is to activate the building owners to implement energy efficiency measures. As the efficiency of bioheating is influenced by the quality of the fuel and the use and maintenance of the system, it is imperative to increase awareness as much as possible.

4.2 Progress and current status on AC systems

Air-Conditioning (AC) systems have originally been covered by legislation on AC-system inspections (from 2007), according to which the cooling systems had to be inspected every five years. The mandatory requirement has concerned systems with a nominal cooling capacity of 12 kW and above, and which are compressor operated. The legislation has been repealed and it will become a voluntary advisory measure instead, including also smaller systems. The voluntary advisory measure will come into force on the 1st of June 2013.

Voluntary measures can be included in the Finnish voluntary energy efficiency agreement scheme, which has proven to be very efficient and has had a high positive impact on Finnish energy efficiency. Voluntary schemes give good coverage of services, buildings and the public sector. The agreement scheme has a comprehensive monitoring system that can be developed to show the efficiency and impact of the advisory measures.

The advisory measures for AC systems will have a broader focus on the building stock than the mandatory system, as the targets include also smaller cooling systems, as well as district cooling systems.

The advisory measures shall support preventive maintenance of AC systems, which reduces system malfunction and equipment damage and which also prolongs equipment life expectancy and enhances indoor air quality.

5. Conclusions and future plans

Energy use of buildings covers approximately 40% of Finnish energy end use. This means that all possible measures must be taken to achieve the objectives of energy efficiency. Preconditions for an impressive implementation of the recast Energy Performance of Buildings Directive (EPBD) are excellent since new national legislation concerning the EPBD is adopted in February 2013.

After the measures are introduced, it is very important to ensure that all parties have the information and tools they need to be able to comply with the requirements. This means that extensive and continuous work, especially information dissemination to both professionals and consumers, is needed. Detailed guidebooks, practical examples and comprehensive training are essential for different professionals to ensure smooth implementation of the directive. Well-tried practices, such as energy efficiency agreement schemes and existing webportals, give an excellent basis for information, dissemination, training, advisory services, and monitoring and reporting.

The continuing process, the effectiveness of the measures and the quality of the work will be monitored to ensure that the challenging objectives will be achieved and that resources are proportionate.

EPBD implementation in France

STATUS AT THE END OF 2012

In France, the overall responsibility of the Energy Performance of Buildings Directive (EPBD) rests with the Ministry of Housing. The first EPBD has been fully transposed during the period between 2004 and early 2010. The Directive has been enforced and its recast was published in 2010. In order to comply with these new European requirements, Law 2010/788 of the 12th of July 2010 overhauled the previous French legislation, thus expressing the national commitment to the environment. This law was implemented, so as to significantly improve the Energy Performance Certificate (EPC) process, taking the experience of the last 3 years into account.

Firstly, this report presents an overview of the current status of implementation and, subsequently, the planned steps of evolution of the transposition of the recast EPBD in France. It addresses all aspects of the Directive, from the Energy Performance (EP) requirements for new and existing buildings, EPC and inspection systems, information campaigns, incentives and subsidy programs.

2. Energy performance requirements

The first thermal regulation for buildings was issued in France in 1974 and only referred to insulation characteristics. Since then, many legislative developments have been made, taking into account the building envelope, the type of energy used for heating, cooling, Domestic Hot Water (DHW), lighting, types of renewables used, the architecture, etc..

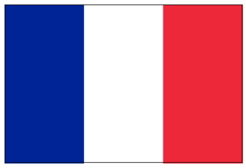
Since 2007, a large amount of work has been put into preparing the latest regulation for new buildings, known as RT2012, which is mandatory for all new constructions from the 1st of January 2013.

Because the main focus has been on new buildings, existing buildings are to be addressed next, although many tools have already been introduced in order to improve their performance.

2.1 Progress and current status

In 2006, the RT2005, the first thermal regulation following the EPBD was introduced. It concerned all new constructions that were from then on to comply with several EP criteria, in order to make them consume as little energy as possible, while implementing common technologies and equipment.

As soon as this regulation was published, the drafting of the next regulation for new buildings commenced, to the extent that France contends for a place amongst the EPBD forerunners. The requirements introduced intend to make the country the most ambitious Member State (MS), as far as new mandatory eco-friendly buildings are concerned. This process led to RT2012, which was the result of numerous consultations and meetings of



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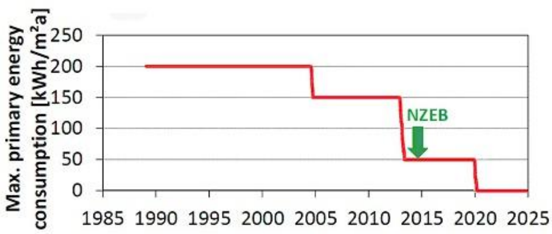


Figure 1: Evolution of requirements.

National Websites *www.developpement-durable.gouv.fr, www.rt-batiment.fr, www.ademe.fr* the stakeholders concerned, and is summarised in the following figures:

> 13 working groups consisting of 25 selected experts from the professional sector;
> 6 meetings for each of these groups;
> repeated public consultations with 120 officials;
> 7 consultative conferences;
> over 500 papers;
> one working group with experts on thermal regulation;
> 40 engineering offices and
> the most prominent technical centres in charge of checking the applicability of the new regulation on real projects.

In 2007, the first regulation for existing buildings was published, which significantly influenced the market of thermal equipment used in building renovations that complied with the EPBD.

All in all, after these five years of in-depth work, with the knowledge gained through successful and unsuccessful actions, as well as provided during Concerted Action (CA) meetings, the findings are very promising in that the regulation has been enforced to a great extent and increasingly more people are paying attention to the EP of buildings. In other words, energy efficiency has become an issue of national importance.

Awareness has also been raised through incentives offered and information campaigns.

2.2 Format of national transposition and implementation of existing regulations

Requirements for new buildings
From 2006 to 2013, the thermal regulation RT2005, mandatory for new buildings, required that buildings consume less than a maximum value calculated on a reference building, architecturally identical, but equipped with reference systems and materials that have a high, although realistic to achieve energy efficiency. These requirements could easily be met using the technologies already in use.

In 2010, in order to anticipate the European requirement of constructing only Nearly Zero-Energy Buildings (NZEB) by 2020 (article 9 of the recast EPBD), the French Government introduced the obligation of each new construction to fulfill the RT2012 up until the 1st of January 2013. The new regulation is very demanding in terms of EP (primary energy), since it defines a 50 kWh/m².year target for residential buildings and a 70 kWh/m².year target for non air-conditioned office buildings (110 kWh/m².year for air-conditioned office buildings), whereas the RT2005 only required a mean of 150 kWh/m².year for dwellings, which was already an ambitious target. These consumption values, expressed in primary energy (C_{pe}), include heating, cooling, DHW, lighting and auxiliaries (pumps and fans).

The performance calculated concerns the whole building and the calculation is based on standard use scenarios. It cannot easily be associated to the measured consumption, which obviously depends on the inhabitants' use of it, actual climate, etc..

As it defines a general target, this regulation provides architects and engineers more freedom in designing buildings. It promotes effective bioclimatic design, since parameters such as orientation, accurate climate data concerning temperature and insulation, and the way in which the architectural project addresses the energy needs of heating, cooling and lighting, are now data that are put into the calculation software. Engineers and architects are thus encouraged to work together to obtain a building permit, from the beginning of the process. Lastly, RT2012 includes the requirement of renewable energy use in houses, and is therefore expected to make the use of solar thermal panels more widespread in the market.

In addition, contrary to the previous regulation, RT2005, and in an effort to reach the ambitious target of 50 kWh/m².year, RT2012 sets the requirement of breakthrough technologies and leading-edge constructions, from high-performance heat pumps and condensing boilers, and the best double glazed windows, to more accuracy in the building process (that is, improved workmanship).

RT2012 includes two further performance requirements:

1. The requirement of minimum energy efficiency of buildings, which imposes a limitation on energy demand based on the bioclimatic conception of the project ($B_{bio} \leq B_{biomax}$).
2. The requirement for summer comfort, where the ambient temperature of the building, reached after the 5 hottest days of the year, cannot exceed a reference level calculated for each project ($T_{ic} < T_{icréf}$).

From an economical point of view, through the reduction of energy bills, buyers will have higher purchasing power, knowing that the cap of additional cost of the construction will be between 5 and 8%.

Th-BCE is the methodology used to calculate the coefficients C_{pe}, B_{bio}, and T_{ic}. Its aim is to describe each component of the building envelope, as well as its energy systems. It is a dynamic simulation using an hourly time step.

Additionally, in order to ensure that residential constructions are correctly built, qualified technicians have to check their airtightness. It cannot exceed 0.6 $m^3/h/m^2$ for single family homes and 1 $m^3/h/m^2$ for collective housing.

Requirements for existing buildings

The implementation of requirements for existing buildings has been introduced into French legislation through the Building Code (amended by law in 2005 and decree in 2007).

In May 2007, the French Government adopted minimum requirements concerning the installation of new components during building renovation, and for extensions to existing buildings, which came into force on the 1st of November 2007. In particular, they concern:

> non-renewable liquid or solid fuel-fired boilers;
> electric heating systems;
> air-conditioning (AC) systems;
> DHW production systems;
> windows and glazed walls;
> energy production systems using Renewable Energy Sources (RES);
> insulation materials of opaque walls;
> ventilation systems;
> lighting systems.

This type of regulation (targeting specific components) is easy for designers to understand and has led to a widespread use of high-performance equipment and improved practice. The downside is that it is very difficult to estimate the actual benefits of this regulation in terms of energy consumption reduction, as it does not require quantification.

If the building is larger than 1,000 m², when renovated it has to respect an overall consumption, with minimum requirements on each piece of equipment. EP is assessed using a complex hourly methodology (called *TH-CE ex*) for new buildings and is appropriate for existing buildings.

Table 1: Minimum requirements for certain components.

Component	Climatic zone	Minimum requirement
Insulation materials of external opaque walls	H1, H2	R* = 2.3 m²K/W
	H3	R* = 2 m²K/W
Glazing	H1, H2, H3	U* = 2 W/m²K For example : Double glazing with little emission or strengthened insulation
Boiler	H1, H2, H3	Minimal return from 89.0% to 90.9% for a nominal power from 20 to 400kW Minimal return over 90.9% for a nominal power over 400kW For example : low temperature boiler or condensing boiler

* R : thermal resistance, U : coefficient of thermal transmission

Table 2: Maximum consumption expressed in primary energy for heating, cooling and production of DHW in existing residential buildings.

Type of heating	Climatic zone	Maximum consumption
Fossil fuel, biomass, heat networks	H1	130 kWh primary/m²/year
	H2	110 kWh primary/m²/year
	H3	80 kWh primary/m²/year

2.3 Cost-optimal procedure for setting EP requirements

RT2012 is based on studies conducted between 2008 and 2010 to establish the requirements that would make new buildings affordable to buyers.

The methodology used was not the same as the one required by the European Commission's cost-optimal regulation. Thus, the French Ministry is analysing the cost-optimality of thermal regulations, so as to comply with the European Directive. This study will be concluded in 2013.

2.4 Action plan for progression to NZEB

Introduction

Whether concerning new constructions or renovations, the construction industry is addressed in two significant blueprint laws, Law 2009/967 of the 3rd of August 2009, relating to the implementation of the *Grenelle Environment* Project, and Law 2010/788 of the 12th of July 2010, stating the country's commitment to the Environment.

These laws apply to all sectors relating to the environment, including the energy management sector, since it accounts for over 40% of total energy consumption and 25% of greenhouse gas emissions.

Their objectives are to:

> generalise NZEBs by 2012 and 'Positive Energy Buildings' by 2020;
> reduce the energy consumption of existing buildings by at least 38% by 2020;
> support and motivate stakeholders to meet the challenges that arise in relation to recruitment, training, qualification and development of industrial clusters.

In France, NZEBs are called 'Low Consumption Energy Buildings' (BBC), that is, the newly constructed buildings abiding to the latest regulation, RT2012. The energy requirements for new buildings are described in section 2.2.

The level required for existing buildings subjected to renovation is at present around 150 kWh/m².year (primary energy) for dwellings (expressed in comparison to a reference building) and, for non-residential buildings, the reduction must be at least 30% in relation to the energy consumption of the building prior to renovation. Although this level is quite high, in 2009 the French Government developed quality labels, in order to encourage owners to go beyond the regulation requirements.

For dwellings, there are two quality labels required after renovation. They each have a different target: the less stringent one, called 'High Energy Performance 2009' (HPE 2009), demands a level of 150 kWh/m².year (primary energy); the one requiring the highest quality, called 'Low Energy Consumption Renovation 2009' (BBCR 2009), can be awarded if the building reaches 80 kWh/m².year.

For non-residential buildings, there is a unique label, the 'Low Energy Consumption Renovation 2009' (BBCR 2009), that can be obtained if, after refurbishment, the building consumes over 60% less energy than before.

These targets are difficult to reach and require the latest energy efficiency materials and systems.

Financial incentives
To encourage the public to opt for the higher EP of buildings, several financial incentives are offered.

For the renovation of existing buildings

> *0% 'Eco-Loan'*. Since 2009, the 0% loan aims to help owners finance deep renovation. It is granted if the owner plans to renovate the dwelling following at least two of the following conditions:

- high thermal performance insulation of roof (R ≥ 5 m².K/W);
- high thermal performance insulation of walls (R ≥ 2.8 m².K/W);
- high thermal performance insulation of windows, glazed walls and doors (U ≤ 1.8 W/m²/K);
- replacement or installment of heating or DHW system (programmer and condensing boiler, low temperature boiler or heating pump with a performance coefficient ≥ 3.3); or,
- provision of evidence that the building reaches a high EP, which means that, in standard conditions, it consumes between 80 and 150 kWhm².year (primary energy).

This last option gives owners the opportunity to reach the NZEB level thanks to a loan that is very attractive, since it amounts to 30,000 € over a 10 year period.

Two hundred thousand eco-loans were granted from 2009 to 2012, with a mean of 20,000 € per renovation. This scheme cost the state 200 M€.

> *Tax credit 'Sustainable Development'*. This financial incentive, introduced in 2005, is a tax arrangement allowing people to reduce their income tax, if they renovate their primary residence improving its EP.

It aims to encourage deep renovation and can be granted when a condensation boiler, micro-cogeneration gas boiler, thermal insulation materials, heating regulation devices, heating pumps, RES, or equipment that connects a heating system to a district heating system running on RES, are installed.

The amount of tax credit can reach 16,000 €, depending on the type of equipment installed, and can be combined with the 0% 'Eco-Loan'.

From 2005 to 2010, nearly 8 million renovations were declared under this tax credit, corresponding to a total of 1.7 M€ investments in deep renovation.

It cost the government 12 billion € for 40 billion € spent by households.

This measure saved an equivalent of approximately 2 tons of oil and is expected to have saved 1.28 tons by 2016 and 1.43 tons by 2020.

> *Others*. France has introduced several other measures aiming at saving energy, such as:

- 'Eco-Loan' for social housing;
- energy saving certificate;
- bonus coefficient of land use.

When the new thermal regulation, RT2012, came into force, financial tools for NZEBs were discontinued, as reaching their standards is now mandatory. The government is awaiting the definition of new labels, in order to make new financial incentives available.

All these measures are described under the NZEB national plan, required by article 9 of the recast EPBD.

3. Energy performance certificates

The EPC was introduced in France in 2006, and is called '*Diagnostic de Performance Énergétique* (DPE)'. Because this new document had to be presented when one sells or rents a property, it forms part of the already existing real estate diagnosis file. Hence, the EPC's French translation, 'Energy Performance Diagnosis'.

The EPC defines two aspects of a building: its energy consumption and the impact of its consumption on greenhouse gas emissions.

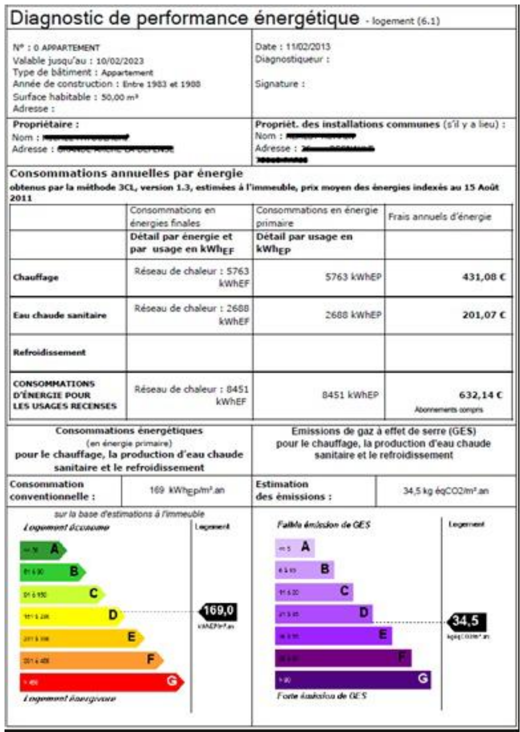
On the first page, it shows the calculated or measured consumption of heating, cooling and DHW, expressed in final and primary energy, and the corresponding annual costs.

The energy label classifies buildings on an energy consumption scale ranging from A (low energy consumption, high efficiency) to G (high energy consumption, poor efficiency). The real benefit of EPCs is in the recommendations given to the building owner. These are summarised on page 4 of the certificate.

As displayed in Figure 3, suggested improvements include a short description, a range estimation of costs, savings and paybacks, and the impact on the energy rating, if all measures were to be implemented. The Qualified Expert (QE) makes recommendations after studying the case of the specific building. EPCs are valid for 10 years.

Issuing an EPC involves a QE visiting the property and assessing the thermal efficiency of the building, taking the construction envelope (walls, windows, insulation, thermal bridges, ventilation and air-tightness, etc.) and the type and quality of Heating, Ventilation and Air-Conditioning (HVAC), as well as DHW systems into consideration.

The QE then calculates the thermal efficiency of the existing building and issues the certificate using the energy bills or a calculation methodology, as appropriate. For new buildings, the



Diagnostic de performance énergétique - logement (6.1)

N° : 0 APPARTEMENT
Valable jusqu'au : 10/02/2023
Type de bâtiment : Appartement
Année de construction : Entre 1983 et 1988
Surface habitable : 50,00 m²
Adresse :

Date : 11/02/2013
Diagnostiqueur :
Signature :

Propriétaire :
Nom : [redacted]
Adresse : [redacted]

Propriét. des installations communes (s'il y a lieu) :
Nom : [redacted]
Adresse : [redacted]

Consommations annuelles par énergie
obtenus par la méthode 3CL, version 1.3, estimées à l'immeuble, prix moyen des énergies indexés au 15 Août 2011

	Consommations en énergies finales	Consommations en énergie primaire	Frais annuels d'énergie
	Détail par énergie et par usage en kWh$_{EF}$	**Détail par usage en kWh$_{EP}$**	
Chauffage	Réseau de chaleur : 5763 kWhEF	5763 kWhEP	**431,08 €**
Eau chaude sanitaire	Réseau de chaleur : 2688 kWhEF	2688 kWhEP	**201,07 €**
Refroidissement			
CONSOMMATIONS D'ÉNERGIE POUR LES USAGES RECENSES	Réseau de chaleur : 8451 kWhEF	8451 kWhEP	**632,14 €** Abonnements compris

Consommations énergétiques (en énergie primaire) **pour le chauffage, la production d'eau chaude sanitaire et le refroidissement**		**Emissions de gaz à effet de serre (GES) pour le chauffage, la production d'eau chaude sanitaire et le refroidissement**	
Consommation conventionnelle :	169 kWh$_{EP}$/m².an	**Estimation des émissions :**	34,5 kg éqCO2/m².an

Figure 2: Cover page of the EPC.

Figure 3: Recommendations' page.

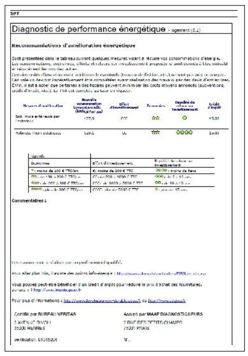


Table 3: Table of methods used.

<table>
<tr><td rowspan="4"></td><td colspan="6">Residential building</td><td rowspan="4">Non-residential building</td></tr>
<tr><td colspan="2" rowspan="2">EPC for the whole building or house</td><td rowspan="3">Flat with collective heating system when there already is an EPC for the whole building</td><td colspan="3">EPC not concerning the whole building</td></tr>
<tr><td colspan="2">Flat with individual heating system</td><td rowspan="2">Flat with collective heating system</td></tr>
<tr><td>Building built before 1948</td><td>Building built after 1948</td><td>Building built before 1948</td><td>Building built after 1948</td></tr>
<tr><td>Performance assessed</td><td></td><td>X</td><td rowspan="2">EPC for the whole building</td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Performance measured</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td>X</td></tr>
</table>

Figure 4:* *Recommendations Guide: Cover page.

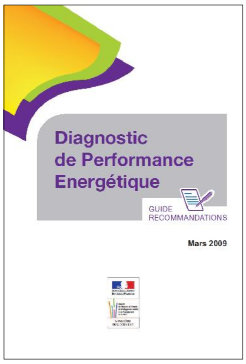
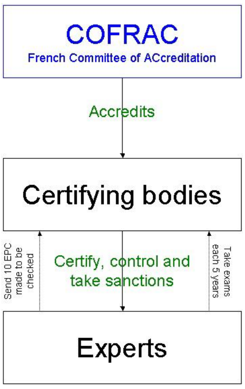


Figure 5:* *On-site Inspection Guide: Cover page.

Figure 6:* *QA scheme.



expert's task is to verify whether the equipment planned at the design stage have really been installed. Thus, the only calculation done is the one required for the building designed to comply with the thermal regulation RT2012.

Two guidebooks have been published to help experts in preparing an EPC, in order to make EPCs more reliable: the first is titled 'Recommendations Guide', and the second 'On-site Inspection Guide'. Using these two books as guides, experts are able to propose appropriate solutions for improving the EP of buildings. As the regulation has just been changed, a new guidebook is being prepared.

3.1 Progress and current status on sale or rental of buildings

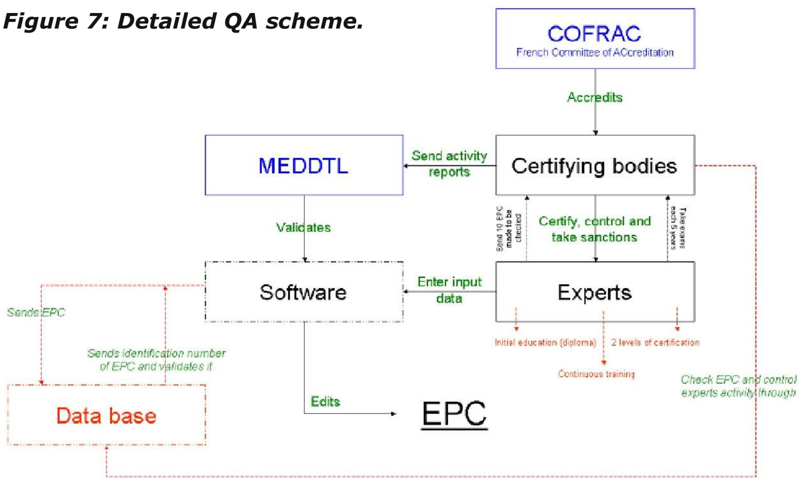
New buildings

For new buildings, the results are drawn from the TH-BCE calculation (RT2012). The role of the QE is to certify that what was planned has actually been implemented and that the building meets the regulations. If there is something wrong with the building, the QE is obliged to include it in the report.

Reliability of EPC

In 2010, the government realised that, despite the increasing importance of the EPC, it was not adequately reliable. Thus, the whole regulation was revised: a new page listing input data has been added, all software used has to be validated by the ministry, a database where all EPCs issued have to be sent has been created, and the control as well as the skills of the stakeholders have been increased (obligation of diploma and training). The experience obtained from other MSs in the Concerted Action (CA) EPBD was very useful in providing guidelines for this recast.

Figure 7: Detailed QA scheme.



Quality Assurance (QA)

The government set up a mandatory QA scheme. It includes three stages, as presented in Figure 6.

To deliver an EPC, experts have to be certified by an accredited body, but did not need any background skills, up until 2012. This body is accredited by the French committee of accreditation (COFRAC). It establishes the reference content that each certifying body has to respect. The training of experts is assessed in two exams: a theoretical exam (multiple-choice questionnaire) and a practical exercise. A certification is valid for five years. Thus, every five years, the expert has to be re-certified. A directory of the 8,000 persons certified to issue EPCs has been set up to make this information available to the public. In this way, it becomes very easy for someone who needs an EPC to find a certified expert and to also have the validity of their certification checked.

The minimum requirements for becoming and continuing to practice as an expert are:

> initial education: 2 years after the French High School Diploma in the field of construction;
> ongoing training: 3 days' training every 5 years in the field of EPC.

After the recast of the EPC, which has been in force since the 1st of April 2013, the QA scheme can be detailed as presented in Figure 7.

The certification body has to check at least 8 reports, representative of the expert's work, during the first three years of the expert's activity. It must verify that each point of the regulation is respected. If some fields in the EPC are not correctly filled, the certification body can temporarily or permanently withdraw the expert's certification. The certifying body must check one EPC with an on-site visit of the building for each certification cycle (5 years) of all experts.

If a consumer becomes aware of the fact that the expert's work was not performed correctly, the certification body can be notified and apply sanctions, if the complaint is justified.

A central database, nearing completion, will, in April 2013, provide various statistics on the EP of the French building stock, which is an important step in the development of an efficient energy policy.

Also, it will help certification bodies check the proficiency of experts, through the review of uploaded reports and the collection of complaints. Up until the end of 2012, 5 million EPCs have been issued.

Costs of certificates are not regulated. Market mean prices are as follows in Table 4.

3.2 Progress and current status on public and large buildings visited by the public

Since 2007, all buildings of over 1,000 m² occupied by public authorities and frequently visited by the public must display an EPC.

Whereas the target set in Law 2009/967 of the 3rd of August 2009, relating to the implementation of the Grenelle Environment Project refers to a 40% reduction in energy consumption, an analysis of the issued EPCs concluded that, at present, the average consumption of public buildings is around 324 kWh/m².year (primary energy) and, with a 200 €/m² renovation cost (the available budget), the building can only save 100 kWh/m².year, corresponding to a 30% of energy reduction, i.e., below the 40% target.

In compliance with article 13 of the EPBD recast, a decree under publication will lower the display threshold of EPCs from 1,000 m² to 500 m² in 2013, and to 250 m² in 2015, and will extend the obligation to all buildings frequently visited by the public that already have an EPC.

3.3 Implementation of mandatory advertising requirement – status

Since the 1st of January 2011, all advertising must include the EPC's results, whether published on the internet, in newspapers or through real estate agencies.

Advertising has been very successful as, now, most people consider the EP of the building they want to buy or rent. A study that is presently in progress aims at evaluating the impact of displaying EPCs in advertisements.

3.4 Information campaigns

The ministry has published guidebooks on several aspects of the regulations, such as thermal regulation, EPC, financial incentives, and renovations, in order to increase public awareness of the link between environment, energy and economy.

Moreover, a national network that informs and advises individuals was created and has been in operation since 2001 by the French energy agency, ADEME, and other local authorities: '*Espaces Info Energies*' (Energy Info Sites). Approximately 400 trained advisors in 230 locations around the country provide information on energy efficiency and RES at the local level.

Table 4: Certificate market prices.

Type	Studio/F1 F1bis	2 room apartment	4 room apartment	3 room house	5 room house
Mean price [€]	80 / 110	90 / 120	100 / 130	110 / 150	120 / 160

Figure 8: Example of EPC displayed in an office building.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems

In 2008, the '*Grenelle de l'Environnement*' included new recommendations towards users of small boilers, during the already required annual maintenance of boilers, and stricter criteria during the maintenance procedure, instead of also setting a periodic inspection of boilers.

Therefore, France has chosen option b) in implementing article 14 of the EPBD, with:

> provision of advice during periodic inspections:
  · for boilers with an output between 4 and 400 kW: advice to users on the replacement of the boiler, other modifications to the heating system and on alternative solutions, given during the required annual maintenance of the boiler;
  · for boilers with an output between 400 kW and 20 MW: periodic control, every 2 years, and advice from ADEME on energy management.
> provision of advice on the most efficient heating systems, improvement of the EP of buildings, and financial incentives.

The French regulation on boilers has been in force since the 31st of October 2009.

Figure 9: Example of advertisement.

In order to perform the periodic maintenance of boilers with an output between 4 and 400 kW, professionals must be qualified, according to the law of the 5th of July 1996.

The decrees specify what the professional must do:

> check the boiler and, if necessary, clean and tune it;
> measure the concentration of carbon monoxide (CO);
> evaluate the energetic and environmental performance of the boiler, through:
  • evaluation of the energy efficiency of the boiler, which is compared to the energy efficiency of the best boilers available on the market today;
  • evaluation of the polluting emissions of the boiler, which are compared to the emissions of the best boilers available on the market today (NO_x for gas and oil boilers, VOC and particulates for biomass boilers).
> provide recommendations: most efficient use, improvement of the boiler and of the heating system in place and, if necessary, advice on the replacement of the installation.

A certificate of maintenance should be issued within 15 days from the visit. The certificate includes the results of the measurements and evaluations listed above, along with recommendations on best use and the improvement of the heating system in place and, if necessary, advice on the replacement of the installation. The reports are not collected on a central database.

In order to perform a periodic control of boilers with an output between 400 kW and 20 MW, the professional must be qualified according to ISO standard 17020 ‘General for the operation of various types of bodies performing inspection’.

The professional must check whether the requirements applicable to boilers with an output between 400 kW and 20 MW are met:

> compliance with minimum efficiency values;
> control devices required in connection with the boiler equipment;
> the boiler room manual.

An inspection report should be issued within 2 months from the inspection. The reports are not collected on a central database.

ADEME provides advice to users for the replacement of boilers, other modifications and alternative solutions, e.g., subsidies for energy audits of heating systems.

Alternative measures

In addition to the measures described above, advice is provided at a national level on heating systems and financial support is available to encourage people to improve the energy efficiency of their heating systems.

> *Financial support*. The Sustainable Development Tax Credit has been available since 2005. It is a tax credit for the purchase of the most efficient materials and equipment in terms of energy saving and reduction of greenhouse gas emissions. In particular, it has contributed towards financing efficient heating systems.

  Since 2006, the value of Energy Efficiency Certificates has become increasingly acknowledged. The French system is based on an obligation for energy savings demonstrated every three years through EECs (1 EEC = 1 kWhcumac of final energy [cumac = net present value of the cumulative energy savings]) that the government authorities require from energy suppliers. The latter are, thus, encouraged to promote energy efficiency among their clients (households, local authorities or professionals). Standardised operation sheets have been produced in an effort to organise energy saving actions. For the most common operations, they establish the flat-rate amounts of energy savings in kWhcumac. There are 269 such sheets available. Some of these focus on heating systems and auxiliaries.

  Since 2009, Zero-rated Interest-free Eco-Loans have financed works that improve the overall EP of buildings and, in particular, heating systems. They are designed for property owners, in order to finance major renovation work.

> *ADEME and the ministry* have conducted publicity campaigns in relation to the most efficient heating systems and the financial support available for their replacement. Campaigns have also covered the improvement of the EP of a building as a whole and available financial or tax support (Sustainable Development Tax Credit, Zero-rated Eco-Loans, etc.).

> The *'Energy Info Sites'* provide information on how to improve the efficiency of boilers and heating systems.

Communication on the new provisions regarding the annual maintenance of boilers
Together with ADEME, the ministry prepared a guide for the public, in order to explain the new provisions regarding the annual maintenance of boilers. It can be downloaded, free of charge, from the ministry's website. On the same website, in the section 'Energy and Climate Change', there are articles dedicated to the new regulation, with links to the official texts, explaining the new provisions of the regulation.

A guide for professionals was prepared by the association '*Énergies et Avenir*'[1], an association of professionals dedicated to the promotion of heating systems using hot water. It was presented to the press in December 2009. The associations and trade unions of professionals have organised information meetings, in order to present the next regulation and the guide. It can be downloaded free of charge.

4.2 Progress and current status on AC systems

The French regulation on AC systems has been in force since the 16th of April 2010. France has chosen to implement article 15 of the EPBD by enforcing the following points:

> inspection of AC systems and reversible heat pumps with an output of 12 kW or more;
> once every 5 years;
> person responsible for the inspection: the owner or the manager of the building;
> inspectors are certified.

A report is issued within one month from the inspection and includes the results of the inspection and advice on best use, improvement of the AC system in place and, if necessary, advice on the replacement of the installation. Standard EN 15240 was used as a basis for the methodology; the inspection methodology is described in detail in the decrees.

The inspection should include:

> inspection of documentation;
> assessment of system performance, at the time of on-site inspection;
> assessment of the size of the system in relation to the cooling requirements of the building, at the time of on-site inspection;
> provision of the necessary recommendations concerning proper use of the system in place, possible improvements to the installation as a whole, any benefit from its replacement, and other potential solutions.

The reports are not collected on a central database. In total, this mechanism covers some 300,000 AC systems in France, which amount to around 10% of the installed stock.

The deadline for the first inspection of AC systems and reversible heat pumps with an output of over 100 kW was the 1st of April 2012; for equipment with an output between 12 kW and 100 kW, it was the 1st of April 2013.

To perform an inspection of AC systems, experts have to be certified by an accredited body, according to ISO standard 17024 'General requirements for bodies operating certification of persons'. This body is accredited by the French committee of accreditation (COFRAC). It establishes the reference content that each certification body has to respect.

There are two levels of certification of the AC systems:

> the 'simple systems' level, for the inspection of AC systems and reversible heat pumps with an output between 12 kW and 100 kW;
> the 'all systems' level: for the inspection of all such systems, large or small.

The organisation of actors is detailed in Figure 11 and the process of certification is described in Figure 12.

Experts have to pass a theoretical and a practical exam, in order to be certified.

Figure 10: Cover pages of guide for owners (top) and for professionals (bottom).

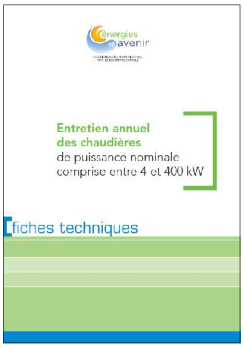
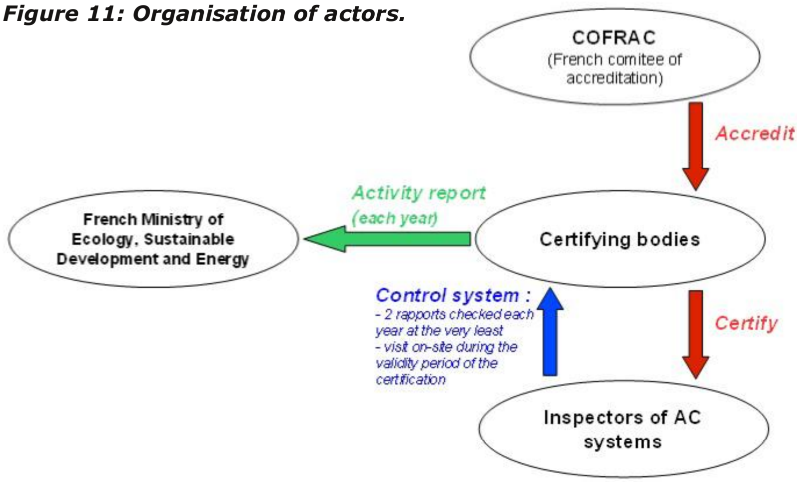
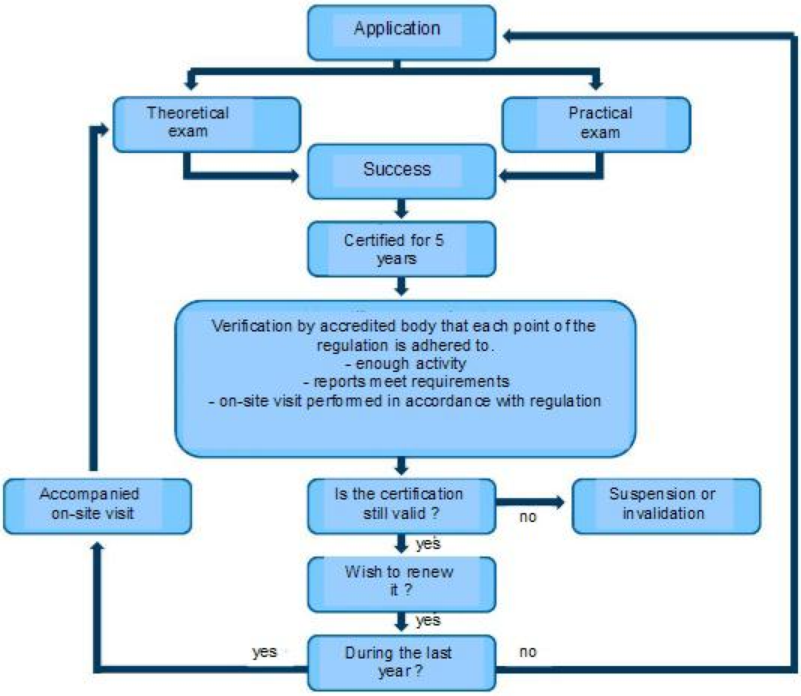


Figure 11: Organisation of actors.



1 *www.energies-avenir.fr*

Figure 12: Process of certification.



These exams evaluate experts' ability to perform inspections and their knowledge of AC systems. The certification is valid for 5 years.

During this period, the certification body has to:

> perform a check on at least two reports per year;
> verify whether the expert performs enough inspections;
> accompany the certified inspector during at least one on-site inspection.

The inspector must verify that each point of the regulation is adhered to. If not, the certification body can temporarily or permanently withdraw the expert's certification. If a member of the public, who requests a certified inspector, becomes aware of the fact that the inspection was not carried out according to the appropriate procedure, the certification body can be notified, and can, in turn, apply sanctions, if the complaint is justified.

At the end of 2012, there are 4 certification bodies, and they have certified around 180 inspectors.

Concerning cost-effectiveness of the inspections, an expert needs one day to perform an inspection and it costs 600 €. Given that inspection occurs every five years, its cost is equivalent to 120 €/year. Concerning energy savings gained, they vary, as inspection does not systematically lead to a change to the system. So, on the one hand, savings depend on the owner's decision to act upon the recommendations, and to the extent of any renovation work performed on the other. According to feedback available, savings can easily reach 20% of the energy consumption of the AC system.

5. Conclusions and future plans

The French Government regards the Energy Performance (EP) of buildings as an issue of central importance in its energy policy, for several reasons.

> Firstly, a large number of people is employed in the construction sector and, thus, the development of this field is crucial in fighting the unemployment rate.
> Next, our modern way of life, in which energy, as well as food and water is wasted, is not sustainable, as far as energy sources are concerned. Therefore, there is a need to move towards sustainability and to educate the general public on issues of energy saving.
> Finally, France aspires to be the leading nation in EP policy, moving beyond the RT2012, by setting new labels for the introduction of surplus energy buildings, which will be ready in 2020, despite the fact that the current regulations are already very ambitious.

Targets, such as the renovation of 800,000 social housing units by 2020, have been included in different laws, in an effort to boost the construction sector.

Lastly, in addition to these legislative targets, support towards individuals and stakeholders is of major importance in the reduction of energy consumption. Therefore, many public authorities, such as ADEME (National Agency for Energy) and ANAH (National Agency for Habitat Enhancement) are working on information campaigns.

EPBD implementation in Germany

STATUS AT THE END OF 2012

1. Introduction

In Germany, the transposition of the recast Energy Performance of Buildings Directive (EPBD) is mainly processed via an amendment of the Energy Saving Ordinance (EnEV). In 2011, the German Federal Government decided on the 'transformation of the energy system' (known in German as the 'Energiewende und Energiekonzept der Bundesregierung'), referring to the move towards the age of renewables and energy efficiency in Germany. This decision added an additional task to be included in the amendment, which resulted in an unforeseen delay in the implementation process. The amendment was adopted as 'governmental draft' on the 6th of February 2013 and is subject to a further procedure, mainly to get the approval of the 'Bundesrat' (2nd chamber of Parliament). This report therefore refers to the status of the 'governmental draft'.

The new aspects of the German energy saving legislation are mainly a first approach to Nearly Zero-Energy Buildings (NZEB), as well as the implementation of an independent control system for Energy Performance Certificates (EPCs) and the compulsory Energy Performance (EP) indicator in commercial advertisements. Furthermore, the calculation method DIN V 18599 has been adapted to future needs such as the integration of a larger variaty of renewables.

In Germany, the Federal Ministry of Transport, Building and Urban Development, together with the Federal Ministry of Economics and Technology, are responsible for the implementation of the EPBD. The Renewable Energy Heat Act, which sets a quota for renewable energy used for heat generation in buildings, as well as some aspects of the 'Energiewende', and the inspection of boilers are the responsibility of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

2. Energy performance requirements

2.1 Progress and current status
Requirements concerning the energy performance of buildings in Germany have been in place since the first Thermal Insulation Ordinance (Wärmeschutzverordnung) in 1977. Over the last 35 years, these requirements have been strengthened in 6 steps. The present Energy Saving Ordinance came into force in October 2009 and strengthened the level of requirements by 30% on average. The current draft of the Energy Saving Ordinance 2012 foresees two steps of strengthening for the years 2014 and 2016: the maximum primary energy demand is lowered two times by 12.5% each and the maximum heat transmission will be cut down in two steps of 10% each.

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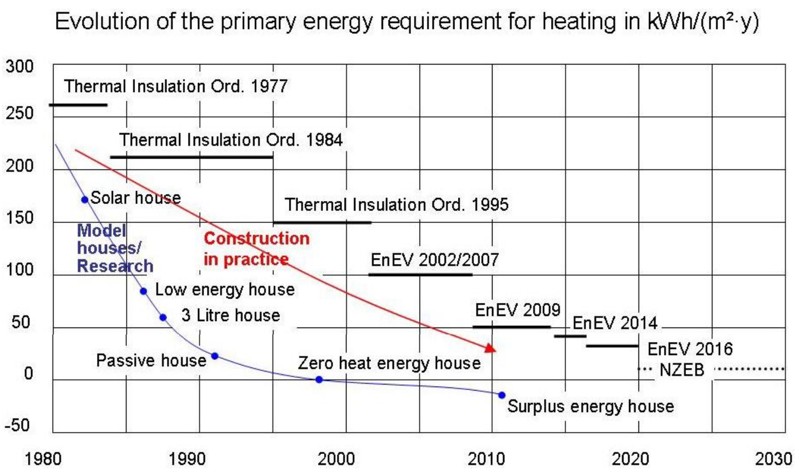
Figure 1: Progress of requirements in Germany (Picture adopted from Fraunhofer IBP).



National Websites

www.bbsr-energieeinsparung.de

For existing buildings, the already strict requirements of 2009 will be kept in place due to a limit of economic feasibility.

Since the beginning of 2009 and in addition to the requirements of the Energy Saving Ordinance, the use of renewable energy for heating in new buildings has been compulsory nationwide according to the Renewable Energy Heat Act (Erneuerbaren-Energien-Wärmegesetz). This obligation has even been expanded to certain refurbishments of existing buildings in some federal states. Obligations to establish the leading role of public buildings have been added in 2011 on national level.

Table 1: Following the draft ordinance, strengthening of requirements is foreseen in two steps, in 2014 and 2016, each accounting for 12.5% (the example is building #3 in Figure 2).

Options to comply with the Energy Saving Ordinance
Example: 6-flat apartment-building

Requirement level			2009	2014***			2016***		
Heat generator			Condensing boiler, solar collector	Condensing boiler, solar collector	Electrical heat pump (air/water)	Electrical heat pump, heat rec.	Condensing boiler, solar collector	Electrical heat pump (air/water)	Electrical heat pump, heat rec.
Ventilation rate, heat recovery	n	[-] [%]	0.55* / 0	0.55* / 0	0.55* / 0	0.6 / 80	0.55* / 0	0.55* / 0	0.6 / 80
Windows	U g	[W/(m²·K)] / [-]	1.3 / 0.6	0.95/0.6	1.3 / 0.6	1.3 / 0.6	0.95/0.6	1.3 / 0,6	1.3 / 0.6
Outer Walls	U	[W/(m²·K)]	0.28	0.28	0.36	0.36	0.24	0.28	0.28
Roof			0.20	0.20	0.25	0.25	0.16	0.25	0.25
Ground Elements			0.35	0.30	0.40	0.40	0.20	0.25	0.25
Thermal Bridges	ΔU		0.05	0.05	0.05	0.05	0.02	0.05	0.05
Transmission Heat Loss	H_T'		0.44	0.38	0.48	0.48	0.31	0.44	0.44
- requirement -			0.65 [0.50**]	0.48	0.48	0.48	0.44	0.44	0.44
Primary Energy Demand	Q_p	kWh/(m²·y)	57	48	42	37	42	36	31
- requirement -			57	48	48	48	42	42	42

* Controlled exhaust air ventilation system ** detached building *** amended climate conditions & PE-factors Red values = determining requirement

Table 2: Strengthening of requirements using factors with reference to the 2009 level of requirements.

Component	Reference design / value	2nd requirement
Strengthening factor January 2014	$Q_{p,max,2014} = 0.875 \cdot Q_{p,ref,2009}$	$H'_{T,max,2009} = 1.1 \cdot H'_{T,ref,2009}$
Strengthening factor January 2016	$Q_{p,max,2016} = 0.75 \cdot Q_{p,ref,2009}$	$H'_{T,max,2009} = 1.0 \cdot H'_{T,ref,2009}$
	Reference 2009	
External walls, Floors	U = 0.28 W/(m²·K)	$H'_{T,max,2009} \cong 1.25 \cdot H'_{T,ref,2009}$
Floor, basement structural element	U = 0.35 W/(m²·K)	[requirement 2009 is legally defined by tabled values according to situation and size of the building]
Roof, upper ceiling	U = 0.20 W/(m²·K)	
Windows incl. French windows	U = 1.3 W/(m²·K) (Skylight U = 1.4 W/(m²·K))	
Entrance doors	U = 1.8 W/(m²·K)	
Boilers	Condensing boilers	Requirements for pipe insulation and controls
Hot water	Central, with solar system	
Cooling	None	Thermal protection in summer
Ventilation	Central exhaust fan, demand-controlled	large systems: SFP_{max}, heat recovery

2.2 Format of national transposition and implementation of existing regulations

For all new buildings, primary energy requirements are specified by means of a virtual reference building, which coincides with the actual building in geometry, usable area, orientation and basic conditions of use. Due to this reference building approach, each new building has an individual EP requirement that takes its specific details into account. In addition, there is also an obligatory minimum requirement for the energy efficiency of the building fabric. The latter ensures a suitable energetic quality for the envelope, also in cases of heat supply with a very low primary energy factor. The above mentioned strengthening of both requirements is done using factors referring to the requirements of 2009.

For all new buildings, a certain share of Renewable Energy Sources (RES) to cover the heating and Domestic Hot Water (DHW) demand is mandatory. The exact ratio depends on the chosen energy source; the given default solutions vary in share from 15%, e.g., in the case of solar thermal power, to 50% in the case of geothermal heat.

Alternatively, the Renewable Energy Heat Act allows either an energy performance of 15% better than required by the Energy Saving Ordinance, or the use of district heating and Combined Heat and Power (CHP) instead of RES. This method of demanding minimum EP requirements for new buildings will also apply to the new Energy Saving Ordinance of 2013.

The Nearly Zero-Energy Buildings (NZEB) are addressed in the amended Energy Saving Act. This law introduces a further amendment before 2019 (probably 2017) in order to further specify the requirements of NZEBs. Meanwhile, the definition given in article 2 of the EPBD recast is cited in the national law. It is foreseen to define the NZEB by a combination of provisions of the Renewable Energy Heat Act and amended requirements in a future Energy Saving Ordinance. As a precondition for this approach, some boundary conditions for energy calculations have to be revised (e.g., the occupied space per person in residential buildings has increased by 25% since the first definition of the boundary conditions for residential buildings in 1996). Definitions of 'nearby' and 'on-site' are already included in the present legislation. These can be summarised as follows: renewable energy can be counted in the building balance as produced ‘nearby’ or ‘on-site’ as far as no public grid is used between their production and use. Renewable energy produced on-site and exported to the grid cannot be taken into account (no bonus).

The public sector complies with its leading role and focusses on more ambitious levels. At present, new buildings of the federal government must comply with the temporary nearly zero-energy standard, which is currently being amended. The new level shall be about 45% more ambitious than currently required. Using RES is obligatory for all public buildings, also in case of major refurbishment.

For existing buildings, there are two different types of requirements: some are mandatory only in the case of major renovation (‘Bedingte Anforderungen’ = conditional requirements) and some are mandatory even without any renovation (‘Nachrüstpflichten’ = retrofitting obligations). Conditional requirements must be complied with in defined cases, either of first-time installation of components or technical systems, or of renovation of the relevant component or building component, whereby the requirements extend, in each case, exclusively to those parts of the building surfaces or parts of the installation that are the subject of the specific measure. Typical measures leading to conditional requirements are e.g., replacement of roof tiles, new layers of plaster or wall coverings on outer walls, as well as the replacement of windows or glazing. There are no requirements imposed for external parts of the building if less than 10% of the relevant parts of the building are concerned. As an alternative for proving conformity with element requirements, building owners are also allowed to fulfill the whole building requirement, which is – and will remain - 140% of the 2009 EP level for new buildings.

Apart from the conditional requirements which result from refurbishment or replacement of a structural element, the Energy Saving Ordinance also contains retrofitting obligations which must be fulfilled by the building owners in each case within a specific time limit. All retrofitting obligations are also subject to the precondition for cost-effectiveness. According to legal requirements, these are measures with short payback periods, e.g., the insulation requirement, which exists since 2002 for all previously non-insulated

Table 3: Since the beginning of 2009, the integration of renewable energy sources is mandatory in every new building.

Options to comply with the Renewable Energies Heat Act

	Option according to annex	Minimum share
Renewable Energies	Energy from **solar radiation** (collectors)	15 %
	or default collector size for residential buildings (m² collector aperture area per m² living space) ≤ 2 dwellings	0.04 [m²/m²]
	> 2 dwellings	0.03 [m²/m²]
	Geothermic energy or **ambient heat** by heat-pumps (performance requirements given for heat-pumps)	50 %
	Biomass from sustainable sources (proof by bills required)	
	• **Gaseous** (mostly restricted to use in CHP-appliances only)	30 %
	• **Fluid** (best affordable boiler technology)	50 %
	• **Solid** (minimum efficiency values given for boilers)	50 %
Substitute measures	Heat from **waste combustion**	50 %
	CHP plants	50 %
	District heat with substantial share of RES / waste / CHP	100 %
	Measures to save energy in buildings	EnEV-req. -15 %
	Combinations of several measures	$\sum_i \frac{share_i}{share_{min,i}} \geq 1$

Table 4: Component requirements for certain major refurbishments (covering more than 10% of component’s total surface).

Refurbished external structural element	Maximum heat transmission coefficient U (normal internal temperatures) [W/m²·K]
External walls	0.24
Windows Windows with special glazing Glazing	1.3 2.0 1.1
Curtain walls Curtain walls with special glazing	1.5 2.3
Top floor ceilings, steep roofs	0.24 0.24 [1]
Flat roofs	0.20
Ground floors, cellar ceilings Ground floors towards outside air Ground-covered walls Floor screeds	0.30 [2] 0.24 [2] 0.30 [2] 0.50

[1] alternative: space between rafters completely filled with insulation with a conductivity of $\lambda \leq 0.35$ W/(m·K)
[2] measures on cold side

and accessible hot water distribution pipes and fittings in unheated rooms. In addition, there is a requirement for the insulation of non-insulated upper ceilings of heated rooms. As an alternative, the roof located above can be insulated, instead of the top floor ceiling. Some system requirements for heating- and DHW-systems are also formulated as retrofitting obligations. For details see table in Chapter 4.

For larger air-conditioning (AC) and ventilation systems, retrofitting automatically operating control devices with separate reference values for the room humidity is mandatory, insofar as these systems are intended to affect the humidity of the indoor air. Because of the high primary energy expenditure in electric power generation in Germany, the present Energy Saving Ordinance requires that electrical heat storage systems be gradually taken out of operation, if the heating of the building is provided exclusively by electrical heat storage systems. This applies to apartment buildings with more than 5 flats, and non-residential buildings with more than 500 m² total useful floor area, whose thermal insulation does not comply with the (former) Thermal Insulation Ordinance '95.

The holistic German method of calculation is described in the pre-standard DIN V 18599, which mainly follows an approach similar to the CEN standards. It is used to prove that the Energy Saving Ordinance requirements have been met, and provides the EP values for Energy Performance Certificates (EPC) based on energy demand (the German system foresees 2 types of EPC: demand-based EPC with information mainly on primary and final energy demand, and consumption-based EPC with information mainly on final energy consumption, in future also primary energy consumption). The German pre-standard DIN V 18599 is a uniform assessment method for the building envelope, the built-in lighting and the systems for heating, ventilation, cooling and hot water.

Table 5: Primary energy factors for use in energy performance calculations (in accordance with DIN V 18599-1, as far as not mentioned otherwise).

Energy carrier [1]		Primary Energy Factor	
		total	non-renewable fraction
Fossil fuels	Light fuel oil	1.1	1.1
	Natural gas (grid)	1.1	1.1
	Liquid gas	1.1	1.1
	Coal	1.1	1.1
	Brown coal	1.2	1.2
Bio fuels	Biogas [2]	1.5	0.5
	Liquid bio fuel [2]	1.5	0.5
	Wood	1.2	0.2
District heat from CHP [3 4]	Fossil fuel (default)	0.7	0.7
	Renewable fuel (default)	0.7	0.0
District heat from heating plant [4]	Fossil fuel (default)	1.3	1.3
	Renewable fuel (default)	1.3	0.1
Electricity	Grid-Mix (2009)	3.0	2.6 [5]
	Grid-Mix (2014)	2.8	2.0 [5]
	Grid-Mix (2016)	2.8	1.8 [5]
	Substitution mix [6]	2.8	2.8
Environmental energy	Solar energy	1.0	0.0
	Ground heat, geothermal energy	1.0	0.0
	Ambient heat	1.0	0.0
	Ambient cooling	1.0	0.0
Waste heat	from (industrial) processes on-site	1.0	0.0

[1] Reference: calorific value [2] restricted to on-site / nearby generation
[3] default values for CHP ≥ 70 % [4] calculation of local PE-factors foreseen
[5] Values given by the Energy Saving Ordinance (deviation from standard)
[6] used for electricity delivered by CHP-plants to the public grid

The basic conditions of climate and use, to be applied in line with the calculations in the Energy Saving Ordinance, are also part of this standard, as well as the boundaries of assesment and the primary energy factors. DIN V 18599 is applicable to all buildings. For residential buildings, additional options are available: a simpler calculating method of DIN V 4701 and DIN V 4108 (in place since 2002) and a new table-based method for standard configuration of simple residential buildings.

In addition to the requirements limiting the primary energy demand and the heat loss of the building fabric, and in accordance with article 8 of the EPBD, the Energy Saving Ordinance also contains a set of requirements for heating, hot water, ventilation and AC systems. The system requirements for heating and hot-water already have a fairly long tradition, for details see table in Chapter 4. They concern new buildings, as well as new, or extended systems and replacements in existing buildings, some of which are retrofitting obligations. The requirements for AC systems follow an equivalent approach. They were introduced in 2007 and amended in 2009 and concern the Specific Fan Power, controls, duct insulation and heat recovery in certain systems.

2.3 Cost-optimal procedure for setting EP requirements

Due to the Energy Saving Act (article 5), in Germany almost all energetic requirements have to be economically feasible, which means that any required measure must repay within a suitable payback period (shorter than the lifetime of the measure) by the resulting energy savings. Therefore, each step of strengthening the legal requirements needs economic calculations to justify the political decision and to limit the burden for property owners. Traditionally, simple calculations of payback periods are carried out for a variety of model buildings. On the other hand, the cost-optimal regulation of the EPBD aims to guarantee the most ambitious threshold, and the calculation method differs from the established method in Germany, which might cause slight differences in the results. First results of the cost-optimal calculation show an extremely wide range of requirement levels with

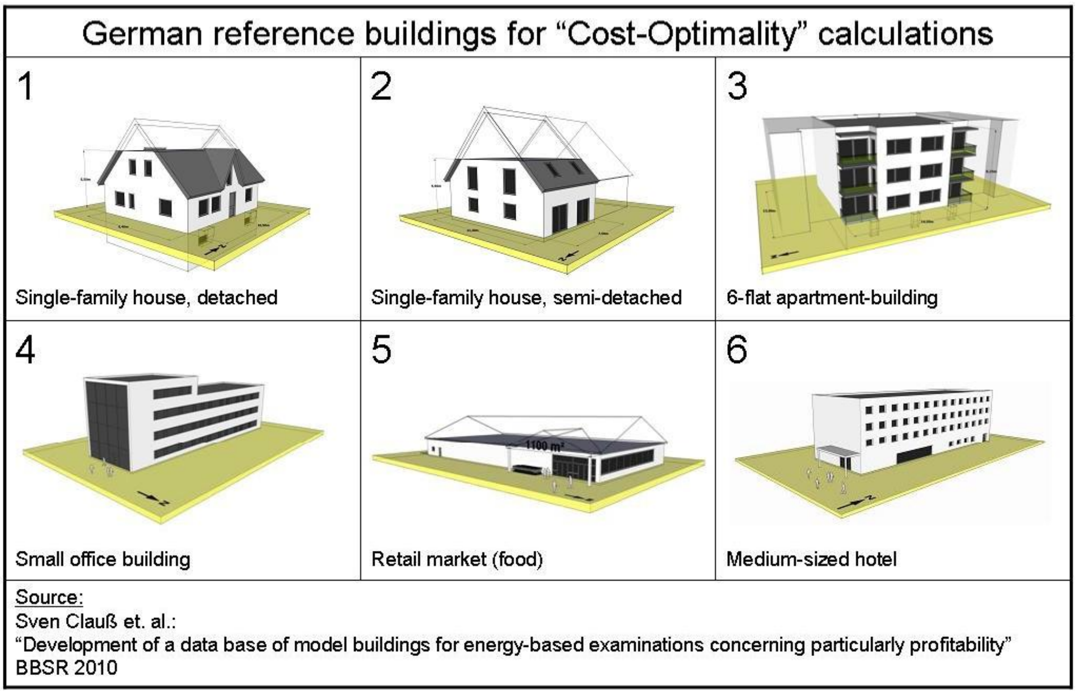


Figure 2: German reference buildings; building #3 served as example for Table 1.

nearly identical results in terms of cost-optimality, but depending on several input parameters. The strongest influence seems to derive from the choice of reference buildings, the assumed investment costs and the estimated energy prices. Against these first results, the cost-optimal calculations presently only give a vague orientation for feasible energy efficiency ranges. First calculations based on a 'conservative' scenario show that Germany's current requirements (from 2009) are in line with the cost-optimal requirements. In contrast, more 'ambitious' scenarios show a potential for stricter requirements.
A report on the cost-optimal study is in preparation and will include an outlook on the upcoming stricter requirements.

2.4 Action plan for progression to NZEB

For the Federal Republic, the priority objective is to achieve the NZEB standards for new buildings in 2020. Taking into account the uncertain price developments for energy, construction materials and labour costs, the federal government relies on flexible instruments to maximise the number of this type of buildings. The national way to NZEB is based on three pillars: legal requirements, financial incentives and information campaigns to promote the energy efficiency in the building sector. In this course, the government will issue two new booklets about residential NZEB and about public buildings on NZEB-level by the end of 2013. Promoting research to develop new materials and processes is also important, as are pilot projects for the development of objectives, methods and ways to

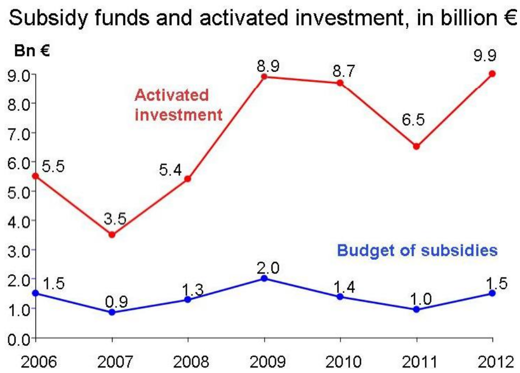
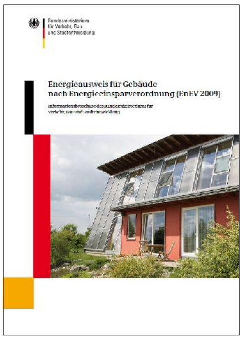


Figure 3: Leverage effect. Financial incentives is one of the three pillars the German action plan for NZEB is based on. Source: KfW bank.

support the local networks e.g., expert groups, local initiatives and municipal programs. The push and pull strategy allows to implement proven requirements in the subsidy programs, which are offered by the 'KfW', a bank owned by the German government, specialised in reduced interest loans and public subsidies. The KfW-energy-efficiency programs focus on new buildings and on refurbishments 'better than legally required'. Nowadays, lots of funded new buildings will easily pass as NZEB; about 50% of new dwellings currently are subject to KfW-funding.

Germany follows a step by step approach towards NZEB: due to the draft ordinance, there will be one step in 2014 and another one in 2016, each with a reduction of about 12.5%. The final definition of NZEB is subject to further economic developments by 2020, particularly in energy prices and construction costs. There is also a need for further development of boundary conditions and assessment procedures in order to adapt them to NZEBs.
Nevertheless, the implementation process formally started with creating the legal base within the Energy Saving Act in 2012.

Figure 4: A Brochure informs about energy certificates, further obligations and enforcement of the Energy Saving Ordinance.

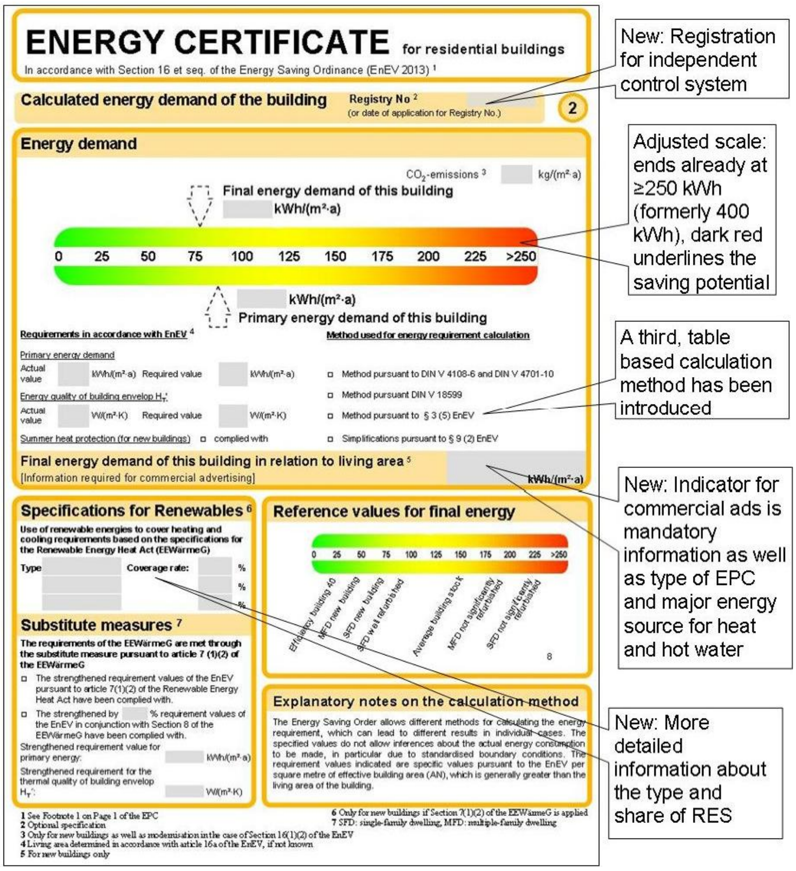


2.5 Any other information

Quality Assurance and ensuring implementation of the Energy Saving Ordinance

In order to ensure the implementation of the ordinance and the quality of execution, there has been since 2009, an obligation to provide proof in the form of a contractor's declaration for all measures concerning existing buildings. This proof is provided in writing by the contractor and certifies that the modified or installed parts of the building or installations meet the requirements of the Energy Saving Ordinance. The contractor's declaration must be given to the owner promptly after the conclusion of the work and must be kept for at least five years by the owner and presented to the authorities on request. If the contractor’s declaration is not issued, or in case it contains false information, the contractor can be prosecuted with a penalty. Furthermore, the district chimney sweeper controls, on behalf of the authorities, a range of requirements concerning newly installed and existing heating appliances (see also Chapter 4). In addition, the impending fines, which are linked to a wide range of requirements, prevent non-compliance. Brochures inform owners and users about the requirements. Their awareness helps a lot in implementation.

Figure 5: Draft of page 2 of the new EPC for residential buildings with its major changes.



3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

EPCs in Germany can be grouped into two categories according to the type of assessment method: certificates on the basis of calculated demand and certificates on the basis of metered consumption. In doing so, all new buildings and cases of major renovation must have an EPC based on a calculation methodology. The simpler metered energy consumption method only applies for:

> existing residential buildings with at least 5 apartments, where the influence of individual user behaviour is statistically balanced by the large number of users;
> smaller existing residential buildings, which at least conform to the first German Thermal Insulation Ordinance for thermal insulation (1977);
> all existing non-residential buildings.

The mandatory standard form of the EPC consists of five pages plus an annexed ‘template for the EPC display’. As an eye-catching first orientation, the EPC shows a continuous reference scale with a colour gradient from green to red. A benchmark indicates the average value of the building stock which defines the central point of the scale, according to the individual use.

Since the first EPC was introduced in 2002, the EPC was modified a couple of times according to changing needs and advanced experience. A new modification will also be introduced with the current amendment of the Energy Saving Ordinance. A new feature is the indication of the assesors registration number related to the introduction of the independent control system (article 18 of the EPBD). For the indicator in advertisments, the new EPC directly points out the mandatory data. In addition, different sources of renewable energy and their particular share must be indicated for new buildings in accordance with the Renewable Energy Heat Act and the RES Directive. Recommendations shall always be given for the specific building. Formerly attached to the EPC, they will in the future form an integrated part of the standard forms. Further details are added in accordance with article 11 subparagraphs 3 and 4 of the EPBD. For residential buildings, the range of the reference scale will be shortened from

400 kWh/m².year to 250 kWh/m².year to take into account the ongoing improvement of the building stock (the average consumption of the German residential building stock is actually about 150 kWh/m².year). Depending on the type of EPC, scales with identical ranges are used to indicate the final and primary energy demand, or the final and — in the future — primary energy consumption.

Despite numerous changes to the forms, all certificates issued in the past, either based on former regulations, or following earlier programmes, and independend of the variations in layout due to transitional regulations, retain their validity of 10 years from the date of issue.

The Energy Saving Ordinance does not contain any regulations regarding the costs incurred for the energy certification. The price may be determined by the assessor and property owner individually and typically ranges between 50 € and 800 € for residential buildings.

For existing buildings, there is the possibility of 'simplified data recording' to facilitate calculated rating. Simplifications described in official bulletins allow the assessor to calculate with default values and to approximate the geometrical shape of the building. Energy consumption is determined on the basis of a record of heating costs, which must normally be made as part of consumption-based billing. A condition for the use of these data in EPCs is that a period of at least 36 consequtive months is recorded during the most recent months preceding the issue of the certificate. The proportion of heating energy has to be corrected from real local weather conditions during the recorded periods, to standard conditions using officially provided climate correction factors.

A system for authorising the issuing of energy certificates, which does not require any additional bureaucracy, was introduced in Germany in 2007. Authorisation to issue certificates is based on the qualification of the persons concerned. For new buildings, the assessors' requirements are defined by regional law. These experts are also entitled to issue certificates for existing buildings of similar use and size. Other experts intending to issue energy certificates for existing buildings must

1 German language only: *www.18599siegel.de*

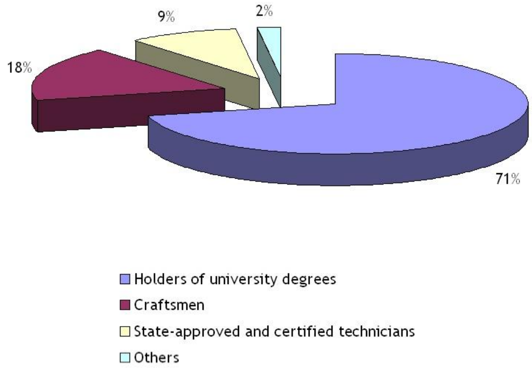


Figure 6: More than 70% of the assessors have a university degree (Source: Weeber / Sahner "The market development of energy certification for existing buildings", BMVBS 2010).

identify their personal qualifications and check whether they meet the conditions set in the Energy Saving Ordinance and fully described in the 2010 EPBD German report. There is no official approval and certification. A person who issues an energy certificate and who is not entitled to do this, breaches the regulations and can be punished by a fine. Due to the large number of certificates required, there is a need to make the circle of certificate assessors as wide as possible to keep the prices low.

As for the enforcement of the regulation in general, the federal states are also responsible for controlling the issuing of EPCs. This task is generally delegated to the local building control authorities.

In Germany there is no official software for energy certificates. Software developers are acting free on the market. The quality of software, i.e., the correct transfer of the technical rules into the software, is an important step regarding the quality of the results. Since there is also great interest by private sector software suppliers in guaranteeing the quality of their products, the great majority have joined together since April 2009 to form a 'Quality community 18599'.[1] The quality community is organised as an association and contributes to further improvements in the products and greater clarity for the users.

The German solution for an independent control system works effectively and allows to keep both efforts and costs as low as possible. The liberal approach of an open market without official approval is an obstacle for the setup of the independent control system. Another important point while establishing the control system was to secure data privacy for property owners, which is held in high esteem in Germany. Therefore, the control system has to work without a general data retention in a central database. A commissioned and authorised body ('Deutsches Institut für Bautechnik') holds a central EPC register without collecting the contents of the EPC. The register collects data from each assesor in relation to the number of EPCs issued per type and location of the building. Each certificate gets an individual registration number and can be part of the random quality check. Checks will be organised in accordance with the three options of the recast EPBD. The first step of plausibility checks will be mainly carried out automatically on behalf of the local authorities by the same organisation that handles the registration. Further and more detailed controls are the responsibility of local authorities, as they are also enabled to impose fines in case of breaches of the regulations e.g., incorrect issuing of certificates, refusal to issue or to submit a certificate, or deliberately include incorrect information in energy certificates.

3.2 Implementation of mandatory advertising requirement – status

The obligation of indicators in advertisements is limited to 'commercial media', which include especially newspapers, magazines or the internet. It will start as soon as the amended ordinance comes in force. Given the fact that German EPCs contain information on the primary as well as on the final energy level in the form of a continuous scale instead of a classification, and because the results in consumption-based certificates are often not directly comparable to the results of calculation-based certificates, it is not possible to provide transparent information in advertisements using a single indicator. Therefore, the advertisement must at least include the type of EPC and the value of final energy demand/consumption, in combination with the significant energy carrier. Thus, the advertisements provide information on both the final energy and the primary energy level. For non-residential buildings, also the electricity demand/consumption has to be indicated separately. To avoid confusion, the relevant advertisements indicator is highlighted in a separate box of the new EPC. An official bulletin will describe the process to obtain the correct data from certificates issued in former layouts.

Figure 7: Guide for Energy Certification of non-residential buildings (addressing assessors).

3.3 Information campaigns

Information campaigns and specialist handbooks play an essential role in the German implementation strategy. In this case, the offers are adapted to the different levels of knowledge and needs of the interested groups (tradesmen, building owners and tenants, as well as engineers and planners). The acceptance of and familiarity with the EPCs should be further encouraged, especially for building owners and tenants. With regard to the next Energy Saving Ordinance, many guidelines will be revised and adapted to the situation. Such information is published mostly free of charge for citizens. An official website will provide information about the understanding of recommendations.

4. Inspection requirements - heating systems, air-conditioning

In the course of the implementation of the first EPBD (Directive 2002/91/EC), Germany decided to have different approaches for heating and bolier inspections on the one hand, and the inspection of air-conditioners on the other. This decision was made based on the background of an already running system for boiler inspection, which was not identical to the provisions of the Directive, as well as the long-term approach in place since 1978 with compulsory requirements for heating systems, which resulted in a relative high standard for existing heating systems, and the absence of such approaches in the area of AC appliances until 2007.

Concerning the recast EPBD, Germany will carry on with both these approaches. For the future, there will be

- for heating systems, a combination of funding and information campaigns, requirements for replacement and compulsory updates, and inspection of boliers, including pumps and boiler controls;
- for AC appliances with an individual rated output exceeding 12 kW, a mandatory inspection scheme, which will be completed by an independent control system for inspection reports, carried out by the same organisations as the control system for energy certificates.

4.1 Progress and current status on heating systems

In Germany, regular inspection of boilers has been mandatory for many years and, in fact, to a much greater extent and at shorter intervals than foreseen by the first EPBD. Energy aspects concern the flue-gas losses of the boilers, the proper insulation of pipes in unheated spaces and the boiler temperature control, which should take into consideration the outside temperature and the hour of the day. If a

Table 6: Tradition of requirements for heating systems.

Subject	Valid for new / extended systems since	Mandatory update requirement since	Special provisions, exceptions	Special enforcement
Heating systems				
Pipe insulation according to inner diameter	1978; requirements / range of application were strengthened / extended with later amendments	2002: Deadline for non-residential buildings & residential buildings with more than 2 flats: end of 2006 Deadline for residential buildings up to 2 flats: 2 years after the change of occupancy (resident owners in 2002 were excepted)	Exception for pipes in heated space which can be shut off by the user Reduced requirements for pipes in walls, ceilings & floors Mandatory update not valid for pipes in heated space, for inaccessible and for insulated pipes	Subject of inspections by chimney sweepers ("Feuerstättenschau")
Boiler efficiency	1994: CE-mark 2009: maximal expenditure coefficient (primary energy): 1,3	2002: Mandatory replacement of boilers installed before 1978; deadlines see above (pipes)	Exception from mandatory replacement: not necessary for low-temperature & condensing boilers	---
Boiler temperature control according to outside temperature & time	1978; requirements / range of application were strengthened / extended with later amendments	1982/1989/1994: In several steps according to building use, boiler efficiency and date of construction, with deadlines from 1987 to 1997,	Equivalent measures allowed; prolonged deadlines for the eastern regions (former GDR)	Subject of inspections by chimney sweepers ("Feuerstättenschau")
Boiler dimensioning	1978 (from2002 in applicable standard only)	---	Simplification for existing buildings	---
Individual room controls	1982; requirements / range of application were strengthened / extended with later amendments	1982/1989/1994: in several steps according to building use, boiler efficiency and date of construction, with deadlines from 1987 to 1997,	Prolonged deadlines for the eastern regions (former GDR)	---
Automatic control of pumps in heating circuits	1994, also in case of replacement	---	In future - due to European regulations (ErP) - national regulations apply to glanded pumps only	Subject of inspections by chimney sweepers ("Feuerstättenschau")
Insulation of storage vessels	1982	---	---	---
Hot water systems				
Pipe insulation according to inner diameter	1978; requirements / range of application were strengthened / extended with later amendments	2002: Deadlines see above (pipes in heating systems)	Exception for branch pipes up to 4 m (in future: up to 3 Litres contents, but only in heated space)	Subject of inspections by chimney sweepers ("Feuerstättenschau")
Time-dependent control of circulation pumps	1994	---	---	---
Insulation of storage vessels	1982	---	---	---

boiler does not comply with the prescribed requirements, it must be replaced. If compulsory insulation or controls are missing, penalties can be issued. The inspections are carried out by a chimney sweeper chosen by the building owner. On behalf of the responsible authorities, the district chimney sweeper in charge of the region keeps track of the compulsory inspections using a register of all boilers. Thus, thousands of boilers have to be modernised every year, which results in a reduction of the average age of the boiler stock in Germany and normally also covers the replacement or technical upgrade of pumps, controls and hydraulic connections. Furthermore, boilers installed before 1978, which do not comply with the status of low temperature boilers, must generally be taken out of operation. For most cases, the deadlines for this obligation have already expired.

Many energy saving features of heating systems have been subject to compulsory requirements, in many cases since 1978 (see Figure 7). As a result, most of the easily detectable means of improvement (control equipment, pipe insulation, efficient pumps) are already common standard in German heating systems. Furthermore, the vast majority of heating systems are subject of contracts for yearly maintainance, which are signed by the owners on a voluntary basis. Thus, a simple and affordable inspection scheme would normally not lead to sufficient results, whereas a more sophisticated system would be too expensive to be economically reasonable.

Against this background, for heating systems, Germany will follow article 14 subparagraph 4 of the recast EPBD with a combination of actions, all together equivalent to the inspections foreseen in article 14, subparagraphs 1 to 3. Among other actions, the German Energy Agency conducts a campaign in order to inform citizens about possible improvements to heating systems. There are also promotional programmes, as well as information campaigns by third parties. The equivalence of these measures will be proven in detail by a report to be sent to the Commission before September 2013.

4.2 Progress and current status on AC systems

Since the 1st of October 2007, regular inspections are mandatory for AC. In addition, the regular maintenance of energy-related components of AC and ventilation systems by a professional technician is mandatory. The intervals should be taken from the manuals and must consider the needs of the individual installation.

Every AC unit with a thermal output of more than 12 kW must also undergo an inspection by a specialist engineer every 10 years. In particular, the engineer must inspect the appliance, to check whether it meets the individual demands of the building and whether it requires modernisation. The inspector must provide recommendations for improving the system efficiency or replacing the system, according to the EPBD. The inspection report is subject to an independent control system run by the regional authorities in the same way and using similar means as the control system for energy certificates. For this purpose, the experts, as well as their reports, will be registered by the 'Deutsches Institut für Bautechnik (DIBt)'. This authority will also provide statistically representative samples of inspection reports issued in a certain year for the purpose of control by the regional authorities.

5. Conclusions and future plans

In order to define the Nearly Zero-Energy Building (NZEB) in detail, the amended Energy Saving Act orders the government to deal with this aspect in an amended ordinance entering into force before 2019, probably in 2017. The legal procedures therefore are due to begin in 2015. Preparations (research projects, standardisation activities, pilot projects, funding schemes, etc.) will already start in 2013. The legal obligation for the government to prove that all mandatory energy saving measures are economically reasonable will also apply to the requirements on NZEBs. At present, this can only be achieved with sophistically designed buildings, constructed by well-trained craftsmen. Therefore, an important task for the upcoming years is vocational education of building designers as well as craftsmen.

The new generation of CEN standards is expected in 2016. The transition to the direct use of CEN standards – probably as an alternative calculation method to the established German standards – will be another important, but difficult task for the foreseen next amendment.

An evaluation report on the current Renewable Energy Heat Act was presented by the federal government to the Parliament in 2012. This report also gives some basic suggestions for an amendment of this law, probably due for the next legislative period, beginning in October 2013. The law has a strong impact on the introduction of the NZEB level, since the prominent use of Renewable Energy Sources (RES) is part of the definition of these buildings.

EPBD implementation in Greece

STATUS AT THE END OF 2012

Authors

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1. Introduction

The implementation of the Energy Performance of Buildings Directive (EPBD) in Greece is the overall responsibility of the Ministry of Environment, Energy and Climate Change (YPEKA). The law for the transposition of the EPBD was approved by the parliament in May 2008 (Law 3661). For the implementation of the EPBD, a Ministerial decision for the new 'Regulation of Energy Performance of Buildings' (KENAK) has been issued in April 2010 (Ministerial decision D6/B/5825 National Gazette 407). The Presidential decree necessary for the definition of the qualifications and training of energy auditors was published in the National Gazette in October 2010 (Presidential Decree 100/NG177). Full implementation started in January 2011, for all types of buildings and building use, new or existing undergoing major renovation.

The implementation and quality control is performed by the Secretariat for the Environment and Energy Inspectorate, a public entity within the Ministry, established for this purpose.

This report presents an overview of the progress and current status of implementation of the EPBD in Greece.

2. Energy performance requirements

2.1 Progress and current status

In the first phase of the implementation, energy performance (EP) requirements were imposed for new and existing buildings over 1,000 m^2 undergoing major renovation. In June 2010, through amendments in the law, the limit of 1,000 m^2 was removed, the definition of the Nearly Zero-Energy Building (NZEB) was introduced and the obligation of at least 60% of Domestic Hot Water (DHW) needs to be covered by Renewable Energy Sources (RES) in new buildings was also introduced, in view of the requirements of the forthcoming recast of the Directive. In January 2011, the obligation for issuing an energy certificate in case of rental of buildings was put into force, and in January 2012 this was extended to flats. The new Regulation on the Energy Performance of Buildings replaced the existing 'Thermal Insulation Regulation' in force since 1979. The thermal insulation requirements were tightened (Table 1), and moreover the climatic zoning of the country was modified, adding one more zone to the existing three zones (Figure 1). Furthermore, the Regulation sets minimum requirements for the efficiency of heating and cooling systems, as well as for hot water production for all buildings, plus lighting for buildings of the tertiary sector.

Figure 1: Climatic Zones.

National Websites *www.ypeka.gr, www.cres.gr, www.buildingcert.gr, portal.tee.gr/portal/page/portal/SCIENTIFIC_WORK/GR_ENERGEIAS/kenak*

Since 1 October 2010, for all new buildings, as well as for existing buildings when renovated, the new Regulation imposed the obligation for an energy performance study to be submitted in order for a building permit to be issued. This study should demonstrate that the new building, after being inspected, will be classified at least in energy class B of the Energy Performance Certificate (EPC).

2.2 Format of national transposition and implementation of existing regulations

The minimum EP requirements are expressed in relation to a reference building of predefined characteristics. The type and level of requirements are a function of the type of building (dwellings, tertiary sector buildings) and cover:

> the design of the building, taking into account orientation, surrounding area, passive solar systems, natural ventilation, daylight etc.;
> maximum U-value for walls, windows, roofs etc., for each one of the four climatic zones in Greece. The main parameter used for the definition of the climatic zones is the annual heating degree-days;

Table 1: Minimum energy performance requirements of building components.

Minimum Requirements according to the new Regulation		U-value [W/m².K]			
		Climatic Zone			
		A	B	C	D
Roofs	U_{V_D}	0.50	0.45	0.40	0.35
External Walls (*)	$U_{V\text{-}W}$	0.60	0.50	0.45	0.40
External Floors	U_{V_DL}	0.50	0.45	0.40	0.35
Floor over ground	U_{V_G}	1.20	0.90	0.75	0.70
External walls in contact with the ground	U_{V_WE}	1.50	1.00	0.80	0.70
Openings (*)	U_{V_F}	3.20	3.00	2.80	2.60
Glass Facades	U_{V_GF}	2.20	2.00	1.80	1.80
Minimum Requirements according to the PREVIOUS Regulation		**U-value [W/m².K]**			
		Climatic Zone			
		A	B	C	
Roofs	U_{V_D}	0.50	0.50	0.50	
External Walls	$U_{V\text{-}W}$	0.70	0.70	0.70	
Floor over ground	U_{V_G}	3.00	1.90	0.70	
External walls in contact with the ground	U_{V_WE}	3.00	1.90	0.70	

(*) Not applied to passive systems except the 'direct solar gain' system

Table 2: Minimum energy performance requirements of building envelope.

F/V (m^{-1})	Max Um [W/m².K]			
	Climatic Zone			
	A	B	C	D
≤0.2	1.26	1.14	1.05	0.96
0.3	1.20	1.09	1.00	0.92
0.4	1.15	1.03	0.95	0.87
0.5	1.09	0.98	0.90	0.83
0.6	1.03	0.93	0.86	0.78
0.7	0.98	0.88	0.81	0.73
0.8	0.92	0.83	0.76	0.69
0.9	0.86	0.78	0.71	0.64
≥1.0	0.81	0.73	0.66	0.60

> maximum value for the average U-value for the whole building;
> at least 50% heat recovery in the central air conditioning units;
> minimum levels of insulation of the heating and cooling distribution networks;
> at least 60% hot water production from solar panels;
> minimum requirement for lighting installations in the tertiary sector buildings (55 lm/W).

The Regulation sets minimum requirements (max U values) for the building elements, as well as for the whole building envelope. The U values required vary per climatic zone. There are no specific seasonal requirements in the regulation and the energy consumption is calculated on an annual basis.

The energy performance calculation procedure is based on the monthly methodology of EN13790 and a set of national parameters defined where necessary. The assumptions and basic parameter calculations are described in a number of Technical Guides, published by the Technical Chamber of Greece in July 2010. These Guides also include the climate files to be used in the calculations, as well as the thermal properties of building materials. The Guides have since been updated in March 2012. The classification of buildings in nine (9) energy classes is done according to the scale shown in Table 3. Class B corresponds to the minimum acceptable class for new buildings and for those undergoing major renovation. 'E.A.' is the total primary energy consumption of the existing building and 'K.A.' refers to the total primary energy consumption of the reference building. The reference building is defined as a building with the same geometrical characteristics as the building under consideration, which has the U values presented in Table 1 for all the structural elements, as well as for the energy efficiency of heating, cooling and lighting installations as described below:

a) boilers must be certified with at least a 3 star (***) energy efficiency rating;
b) heat pumps for heating must have at least a COP=3.2 if air cooled and a COP=4.3 if water cooled;
c) heat pumps for cooling must have at least an EER=2.8 if air cooled and an EER=3.8 if water cooled;
d) central air-conditioning (AC) units with a fresh air supply higher than 60% must have a heat recovery ratio of at least 50%;
e) hot water distribution networks must have at least 13 mm thick insulation material with λ=0.04 W/(mK);

f) solar thermal systems must provide 15% of the hot water demand;
g) air ducts of AC systems must have at least 40 mm thick insulation material with λ=0.04 W/(mK);
h) heating/cooling systems must incorporate a weather compensation system;
i) general lighting systems must have a luminous efficacy of at least 55 lumen/W;
j) separate thermostatic control must be installed in each individual heating zone.

A software tool for the calculation of the energy performance was developed by the Technical Chamber and is provided to engineers at a very low cost. This tool can be used on its own, but it is also available to software companies, in order to integrate it into already existing tools. Any new software that comes into the market is verified by the Secretariat for the Environment and Energy Inspectorate of YPEKA. The main criterion is that the software uses the computational engine developed by the Technical Chamber and produces the same results for a test case.

The Quality Assurance (QA) and the compliance checking for the new buildings is performed upon completion of the construction. An energy audit is conducted when the building is completed, in order to check the compliance of the constructed building with the energy performance characteristics prescribed in the Energy Study that was submitted for the building permit. The building class should be at least B. If this is not the case, then the owner must follow the recommendations of the auditor in order to improve the EP of the building within a year. A second audit is performed after the implementation of the required improvements and, in the case of non-compliance, sanctions are imposed on the building owner.

2.3 Cost-optimal procedure for setting EP requirements
The elaboration of the recast of the Law for the energy efficiency of buildings, for the harmonisation of the Greek legislative framework with the EPBD recast, has been completed and the law has been put in public consultation from 30 August 2012 until 14 September 2012. The new law (Law 4122) has been approved by the Parliament the 19th of February 2013. It introduces the cost-optimal concept and the calculation methodology, according to the EU Regulation 244/2012 supplementing the Directive 2010/31.

2.4 Action plan for progression to NZEB
The Nearly Zero-Energy Building (NZEB)

Table 3: Definition of energy classes.

Class	Limits
A+	E.A. ≤ 0.33K.A.
A	0.33 K.A. < E.A. ≤ 0.50 K.A.
B+	0.50 K.A. < E.A. ≤ 0.75 K.A.
B	0.75 K.A. < E.A. ≤1.00 K.A.
Γ	1.00 K.A. < E.A. ≤ 1.41 K.A.
Δ	1.41 K.A. < E.A. ≤ 1.82 K.A.
E	1.82 K.A. < E.A. ≤ 2.27 K.A.
Z	2.27 K.A. < E.A. ≤ 2.73 K.A.
H	2.73K.A. < E.A.

E.A.: Primary Energy Consumption of the building under consideration (kwh/m^2.year)
K.A.: Primary Energy Consumption of the Reference Building (kwh/m^2.year)

definition has already been introduced to the national legislation, by amendment, in June 2010 and it coincides with the precise EPBD definition. This definition is also included in the recently elaborated recast of the law for the energy efficiency of buildings. The law specifies that, after 1 January 2015, every new building of the public sector should be NZEB. This obligation is also applied to all new buildings constructed after 1 January 2020. However, the national application of the NZEB definition has not yet been made.

3. Energy performance certificates

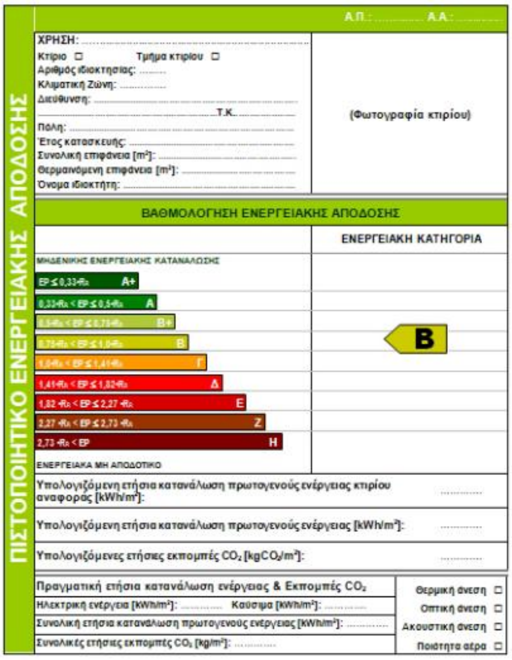
3.1 Progress and current status on sale or rental of buildings
Since January 2011, all new buildings, both residential and non-residential, as well as existing buildings of all uses when renovated, should have an energy certificate issued after the completion of construction. The energy classification should be at least in the B level and comply with the energy class demonstrated in the energy study submitted before construction or renovation.

If the constructed building deviates from the design values, the owner is obliged to perform all necessary improvements within a year.

An Energy Performance Certificate (EPC) is required for all the existing buildings in order to be rented or sold since January 2011. Building owners have to present an EPC to those interested in renting or buying. The EPC constitutes a legal document and it is attached to the contract in case of sale, or it is presented to the Tax Office, together with the signed contract, in case of rental. As of January 2012, this obligation was extended to rental contracts of 'parts' of buildings. Flat owners should present the EPC to the Tax Office when flats are rented.

All EPCs are valid for ten years, unless the building undergoes major renovation, in which case a new certificate is required.

Figure 2: Building Energy Performance Certificate format (1st page and 2nd page).



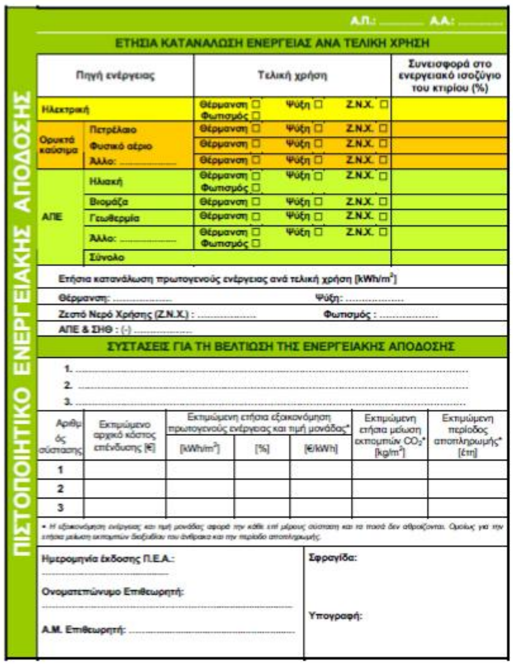
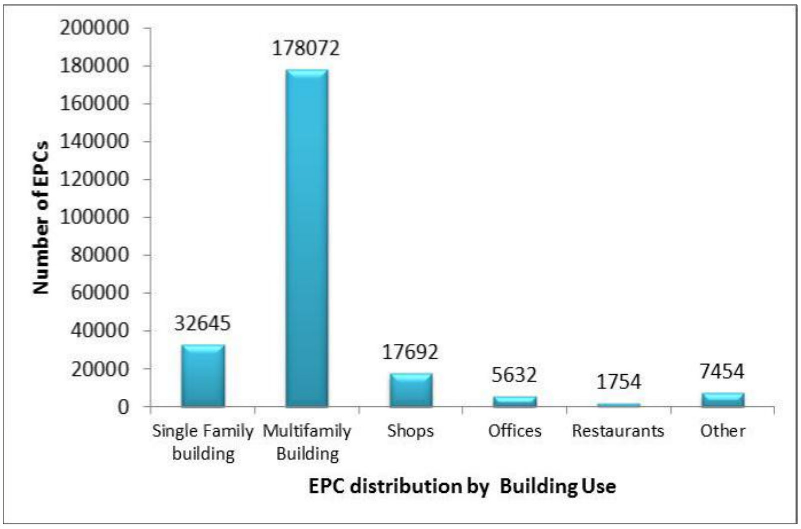
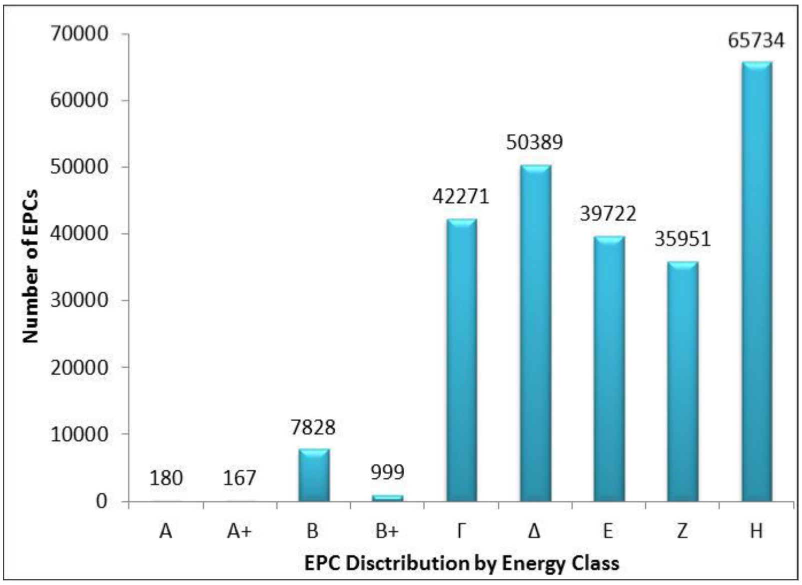


Figure 3: EPC Distribution by building use.



The EPCs are issued by qualified energy auditors. The Secretariat for the Environment and Energy Inspectorate of the YPEKA maintains an electronic database of certificates. An online system, used for issuing EPCs, and the electronic database of certificates and qualified auditors – the 'Buildingcert' Platform - were developed by the Centre for Renewable Energy Sources (CRES) and are operated on CRES' hardware. The online portal is supported by a help desk operated by the YPEKA and CRES. To issue an EPC, the qualified auditor has to visit the building in order to collect all necessary data to calculate the EP of the building, using the official software. Calculation data and results in XML format are then uploaded to the online platform and the EPC is automatically produced and is available to be downloaded in PDF format.

Figure 4: EPC Distribution by energy class.



The EPC format is of similar appearance with the energy labels of electrical domestic appliances with which the public is familiar. It contains a nine level classification scale, from A+ to H, where there are three classes above the B level (A+, A, and B+), in order to stimulate competition towards very efficient building designs in the future.

The first page of the certificate contains the following information:

> the basic data of the building (location, owner, building use, climatic zone, year of construction, total surface area, heated area);
> the classification, based on the primary

energy consumption of the building compared to the primary energy consumption of a reference building;
> the calculated primary energy consumption of the building and of the reference building;
> the calculated CO_2 emissions;
> the metered total energy consumption data and the consumption by energy carrier based on the bills available over the last three years, as well as the calculated CO_2 emissions;
> an indication of the quality of thermal, visual and acoustic comfort and air quality, as a subjective opinion of the auditor.

On the second page of the certificate, there is space for presenting at least three recommendations specific to the building, for which the software calculates the primary energy savings (per m^2 and as a percentage) and CO_2 emissions reduction, investment cost, payback period and the cost of each kWh saved. On this page, an analysis of the calculated primary energy consumption per use and energy carrier is also presented.

Since the starting date of the implementation of the energy certification of buildings (9 January 2011) up to November 2012, 243,250 EPCs were issued and are stored in the national database, of which 87% are for residential buildings (73% multifamily buildings and 14% single houses).

Qualified energy auditors are listed in the national Registry of Auditors, developed and maintained by CRES and the Secretariat for the Environment and Energy Inspectorate.

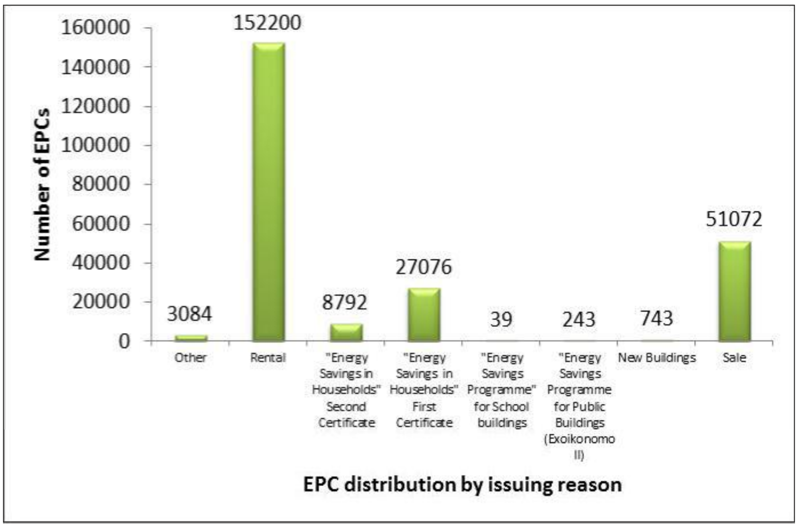
The qualifications and training of the energy auditors is outlined in the new Regulation. The whole procedure foresees 120 hour training courses and exams. The Hellenic Technical Chamber developed the training material and is responsible for the examination process. Training courses are offered by academic institutions and certified vocational training centers following the curriculum elaborated by the Technical Chamber.

After the exams, if successful, the experts will be registered in the National Registry for Energy Auditors. Qualified experts should be engineers and architects with at least 3 years of experience. Experts are classified into three categories: Building inspectors (60 hours of training), Heating systems and/or AC inspectors (30 hours of training in each area). Depending on their academic background, they are also classified into two classes. Class A experts will be allowed to perform inspections and issue EPCs for buildings with heating and/or AC installations up to 100 kW, while class B experts can perform inspections for all sizes of buildings and systems. Training courses started at the end of 2011.

For the implementation of the EPC Regulation, a provisional body of Energy Auditors has been established since 2010. These experts were registered in the National Registry as provisional experts and were allowed to conduct energy audits for a limited time period of 18 months. This period has been recently extended to the end of 2013. Until this date, all auditors in the provisional registry should undergo a training course and successfully pass the required exams, otherwise, they shall be dropped from the registry. Qualifications of the provisional body of experts require an engineering or architecture degree and at least 10 years of experience and no training or exams are required. Up to November of 2012, 8,403 provisional auditors are registered and operate in the market, of which 1,580 are Class A and 6,556 are Class B.

The quality check of the issued EPCs is carried out by the Secretariat for the Environment and Energy Inspectorate of the YPEKA. All EPCs submitted in the framework of the financial incentives program 'Energy Savings in Households' are checked (a total of 27,076 EPCs until October 2012). Also, checks are performed a) when the number of EPCs issued by an auditor is very high, b) when the energy class of existing buildings is B or higher, and c) for a randomly selected sample of 2% of the EPCs submitted. In case a) there are inaccurate data on the EPC, or b) of violation of confidentiality and misuse of personal data, then a first warning is sent to the auditor. If one of

Figure 5: EPC Distribution by issuing reason.



the above faults is repeated, a penalty is imposed to the auditor. The penalty can be either financial (500 € to 20,000 €) or suspension for one up to three years or permanent. The level of the penalty is decided by the Inspectorate, depending on the importance and the frequency of errors. Most of the quality checks are performed ‘on desk’, and a limited number of on site checks is performed when considered necessary.

Figure 6: YPEKA’s website on the EPCs.

Figure 7: Brochure published by the YPEKA.

3.2 Progress and current status on public and large buildings visited by the public
An EPC should be issued for all public buildings and the display of the certificate in areas of the building visited by the public is compulsory. However, this process is progressing very slowly, with a small number of public buildings having an EPC by the end of 2012. These EPCs were all issued in the framework of a national program providing financial incentives for the energy renovation of public buildings. A pre-requisite for the eligibility of the buildings in the program was the issuing of an EPC before the implementation of the renovation. None of these EPCs are yet displayed since the buildings are supposed to go through a renovation and then the new EPC will be displayed.

The requirements and procedure for the EPCs of public and large buildings are the same as for all the other private buildings.

3.3 Implementation of mandatory advertising requirement – status
The recast of the law for the energy efficiency of buildings, for the harmonisation of the Greek legislative framework with the EPBD recast, foresees the mandatory inclusion of the EP level of a building in the advertisements for rental or sale.

3.4 Information campaigns
In the starting phase of the implementation, the Ministry (YPEKA) has produced information material on the new Energy Building Regulation, the EPC and the energy efficiency of buildings. This information is uploaded on the YPEKA’s website and is also included in a brochure produced and distributed in various events.

3.5 Any other relevant information
Information campaigns for EPCs and energy saving measures have been launched in combination with national incentive programmes. A major programme started in 2011 and is still running, providing financial incentives, in collaboration with banks (subsidy of the interest rate of loans) for the energy refurbishment of residential buildings. The programme ‘Energy Saving in Households’ sets as a prerequisite the issuing of an EPC of the house, when applying for a loan and an EPC after refurbishment demonstrating that energy savings of 25% are achieved. A number of radio and TV commercials, targeting the general public were launched by the

banks that are involved in the programme (Alpha Bank, Eurobank, National Bank of Greece, Piraeus Bank), providing information on the programme and presenting the EPC.

Further to the information campaigns launched by banks, trading companies active in the field of energy refurbishment, mainly companies providing insulation materials, have also launched information campaigns related to the programme. On their websites, they provide information on the programme, technical assistance for refurbishment measures and related costs calculation for bank loans, as well as EPC issuing by auditors.

Information campaigns promoting EPCs are being launched in combination with other national programmes providing incentives for energy refurbishment and including EPCs in the eligibility criteria:

> the programme ‘Save Energy II’, which addresses municipalities and provides subsidies for the refurbishment of municipal buildings;
> the programme for the ‘Improvement of Energy Efficiency of Public Buildings’ with funds of the Operational Programme ‘Environment and Sustainable Development’, subsidising the cost of energy efficient measures in ‘School buildings’, ‘Public buildings’ and ‘Hospitals’.

4. Inspection requirements - heating systems, air-conditioning

In Greece, inspections for the heating and AC systems are performed, based on the new Energy Building Regulation and the Technical Guides issued by the Hellenic Technical Chamber which describe in detail the procedures for auditing boilers, heating systems and AC units. There is a total of 1,827 provisional Energy Auditors for the heating systems in the national registry. For the time being, audits of heating and AC systems are performed on a voluntary basis. However, the law foresees the mandatory audit of the systems from January 2014 onwards.

4.1 Progress and current status on heating systems

The same administration and QA system used for building EPCs applies for inspections. As already described, experts are required to attend 30 hours of training and go through an examination. Training courses started at the end of 2011.

For the inspection of the heating systems, a provisional body of auditors has also been established, with a permission to conduct inspections until the end of 2013. In November 2012, there were 510 Class A and 1,317 Class B experts registered.

Energy auditors should carry out audits of boilers using conventional fossil fuels as follows:

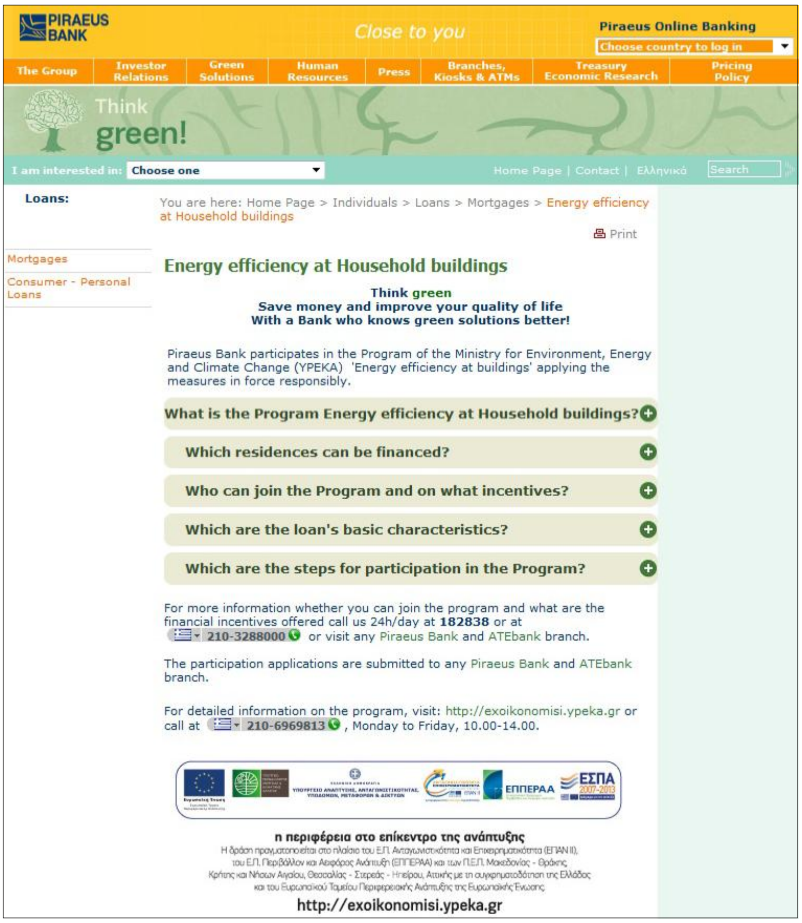
> at least every five years for boilers with an effective nominal rated power between 20 kW and 100 kW;
> at least every two years for boilers rated more than 100 kW for every fuel source, except natural gas (once at least every four years).

Auditors prepare a report assessing the thermal efficiency of the boiler and produce guidelines and recommendations to regulate, maintain, repair or replace, as necessary.

Starting from January 2014, boilers older than fifteen (15) years and with a nominal power over 20 kW should be inspected once together with the whole heating system.

Auditors prepare a report assessing the efficiency of the boiler and its capacity in relation to the energy needs of the building,

Figure 8: A bank website for the programme ‘Energy Saving in Households’.



and give instructions and recommendations regarding the maintenance, replacement of the boiler system, and other alternatives. The inspection reports for boilers and heating systems are submitted to the online platform ‘Buildingcert’ also used for the EPCs, and are subject to the same quality procedures as the EPCs.

4.2 Progress and current status on AC systems

The procedure for AC inspections is identical to boiler inspections. As foreseen for the heating systems inspections, a provisional body of auditors has also been established for AC inspectors. In November 2012 there were 478 Class A and 1,249 Class B registered experts.

Energy auditors should carry out audits of AC systems of buildings with a nominal power of more than 12 kW at least once every five years. The auditors shall report the efficiency and capacity of the installation of the AC system, in relation to the energy needs of the building, and provide appropriate guidelines and recommendations for improvement or replacement of the installation of the AC system.

The inspection reports for AC systems are also submitted to the same online platform ‘Buildingcert’.

5. Conclusions and future plans

Greece has a centrally operated national system for issuing Energy Performance Certificates (EPCs) and an electronic database for storing all the relevant information. This system provides the means for Quality Assurance (QA) mechanisms that are in operation.

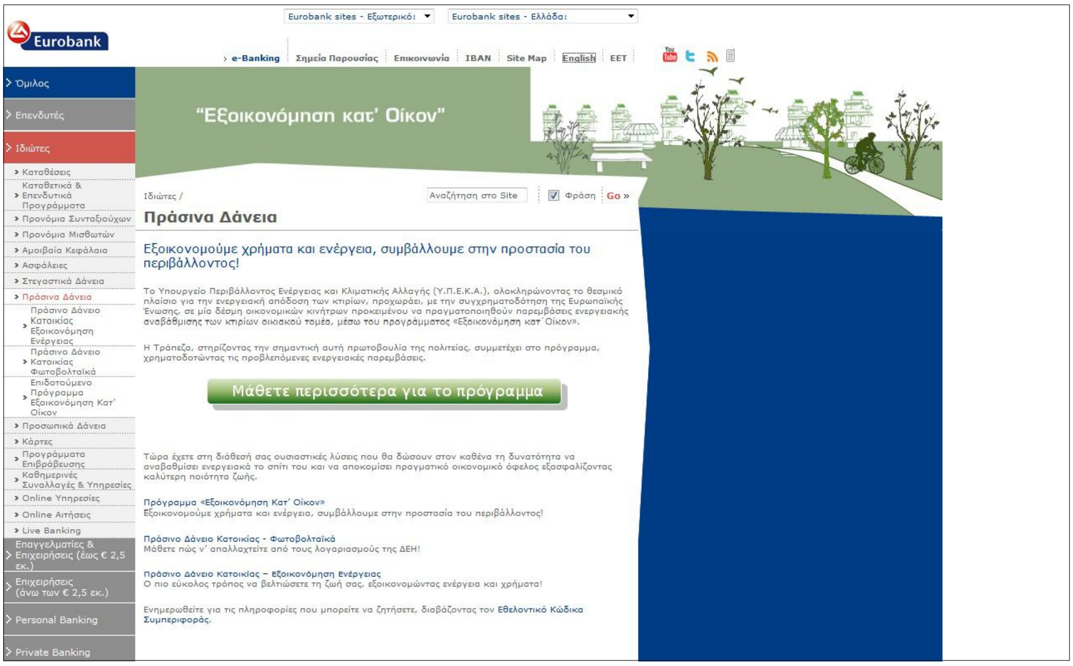
The quality level of the audits so far is rather high and this is due to the academic background of the provisional experts and their required experience. Since the legislation requires a shorter professional experience period for the permanent auditors, an extensive training program is currently running, which will ensure the quality and the smooth operation of the system in the future.

There is a positive reaction from the market which is partly due to the financial incentives provided by existing national programmes. Furthermore, information campaigns proved to be a very effective motivation mechanism for building energy refurbishment.

The full implementation of the energy audit of heating systems and air-conditioning (AC) will start in January 2014. This is expected to lead to the replacement of many existing inefficient installations, which constitute a high share of the stock, resulting in a considerable amount of energy saving.

Approval of the new law for the adoption of the EPBD recast is expected to take place in the beginning of 2013. A revision of the building energy regulation is planned to start immediately after the approval of this law. In this revision, the current Energy Performance (EP) requirements are expected to be modified according to the cost-optimal methodology.

Figure 9: Another bank website for the programme ‘Energy Saving in Households’.



EPBD implementation in Hungary

STATUS AT THE END OF 2012

Authors

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1. Introduction

In Hungary, the implementation of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) was carried out in several steps between 2006 and 2008. Some of the procedures, however, only became binding in January 2012.

The Ministerial Decree TNM 7/2006, issued in May 2006, introduced a regulation covering articles 3, 4, 5 and 6 of the EPBD. The regulation was put in force on the 1st of September 2006. A regulation covering articles 7-10 has been implemented in 2008. As a result, certification of new buildings and the display campaign for public buildings only started in 2009, whilst compulsory certification of existing buildings (in case of sale or rental) was voluntary till the 1st of January 2012. Nevertheless, voluntary certification of existing buildings has already started and certification became a precondition for receiving a subsidy already in 2008.

The implementation of the EPBD recast (2010/31/EU) is still in progress. The first version of the cost-optimal procedure for setting Energy Performance (EP) requirements is available. The action plan for progression to Nearly Zero-Energy Buildings (NZEB) was reported to the Comission in November 2012. In addition, a revision of the EPBD related acts has been carried out, although energy requirements relating to the building envelope and the total EP for new buildings have not changed.

Significant improvements have been made in relation to the registration and quality control of the Energy Performance Certificates (EPCs), as well as major changes regarding advertising activities and public buildings.

2. Energy performance requirements

2.1 Progress and current status

The first Ministerial Order (the 7/2006 (V. 24.) Decree of Minister without Portfolio on the Determination of Energy Efficiency of Buildings), which included the requirements, the design input data and the calculation method, was issued in May 2006 and has been in force since the 1st of September 2006. Although the administration system has been reorganised several times since then, the responsible authority for the transposition is again the Ministry of Interior.

Since that date, the fulfillment of energy requirements is a precondition for obtaining a building permit. Several calculation software have been developed on a commercial basis. As a result, the thermal performance of buildings improved considerably. In terms of building envelopes, it corresponds to 36%, 50% and 43% decreases of the U values of exposed walls, roofs and windows, respectively, in relation to pre-EPBD values. The overall average U value of an envelope (including thermal bridge effects) ranges between 0.45 and 0.65 W/m^2.K, depending on the surface to volume ratio.

National Websites

www.lakcimke.hu, www.e-epites.hu,
www.e-epites.hu/hirek/az-epuletek-energiahatekonysaganak-koltseg-optimalizalt-szintjerol-keszult-tanulmany-velemenye,
www.e-epites.hu/hirek/kozel-nulla-energiafogyasztasu-epuletek-kovetelmenyeire-vonatkozo-tanulmany-velemenyezese

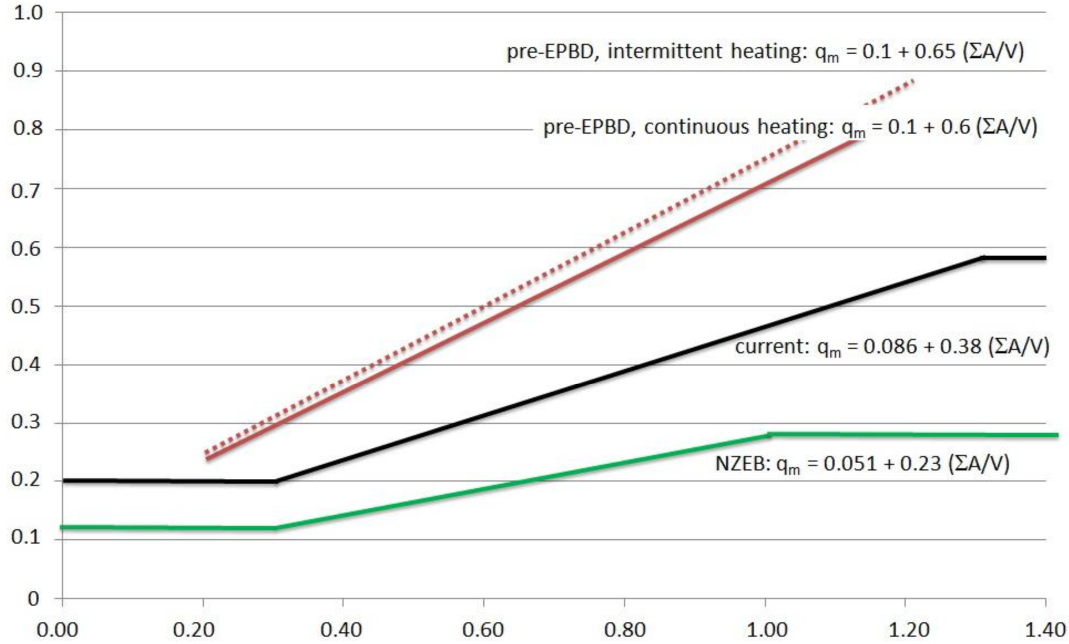


Figure 1: Specific volumetric heating energy need before (pre-EPBD) and after 2006 (current) and foreseen NZEB requirement (under discussion). On the horizontal axis, the surface to volume ratio.

Table 1: Maximum U values of building elements since 2006 and foreseen requirements of the NZEB (under discussion).

	Current requirement	Foreseen NZEB requirements
Building element	**U W/m².K**	**U W/m².K**
Exposed wall	0.45	0.20
Flat roof	0.25	0.15
Attic floor slab	0.30	0.15
Floor slab over basement	0.50	0.25
Window, non-metal frame	1.60	1.00
Window, metal frame	2.00	1.30
Entrance door	3.00	1.30

The governmental order defining the method for the certification of buildings was issued in 2008. It included both the operational and asset methods and was the subject of conciliation in the Chamber of Engineers. However, an official methodology was only developed for the asset method. Thus, in practice, all experts use the asset method. The same order postponed the deadlines for the initiation of the certification process: for new buildings, it started in January 2009, while compulsory certification of existing buildings was launched in January 2012, although it has already been in effect since 2008 on a voluntary basis and in the case of subsidised energy conscious retrofit.

The requirement system has three facets, as far as new buildings and major renovations are concerned. Maximum permitted values are set for the U values of elements and the specific heating energy need ($W/m^3.K$), as a function of the surface to volume ratio. It is to be emphasized that, the application of elements with the allowed U values does not guarantee the fulfillment of the specific heating energy need requirement: depending on the ratio of wall, window and roof area, stricter insulation requirements must often be applied. The losses from thermal bridges are also considered. Finally, the specific yearly primary energy need must not exceed a limit, which depends on the surface to volume ratio and the type of use of the building. Maximum permitted values are given for a few typical uses (residential, school, office), whereas, in case of mixed use, a reference building is to be considered. The primary energy needs include heating, domestic hot water, cooling and, for non-residential buildings, lighting needs.

These requirements applied to new buildings and major renovations of over 1,000 m^2 conditioned floor area. Since then, however, the Hungarian Decree of the Minister of Interior 40/2012 (VIII. 13.) and the amendment of the 7/2006 (V. 24.) has introduced changes in the requirements:

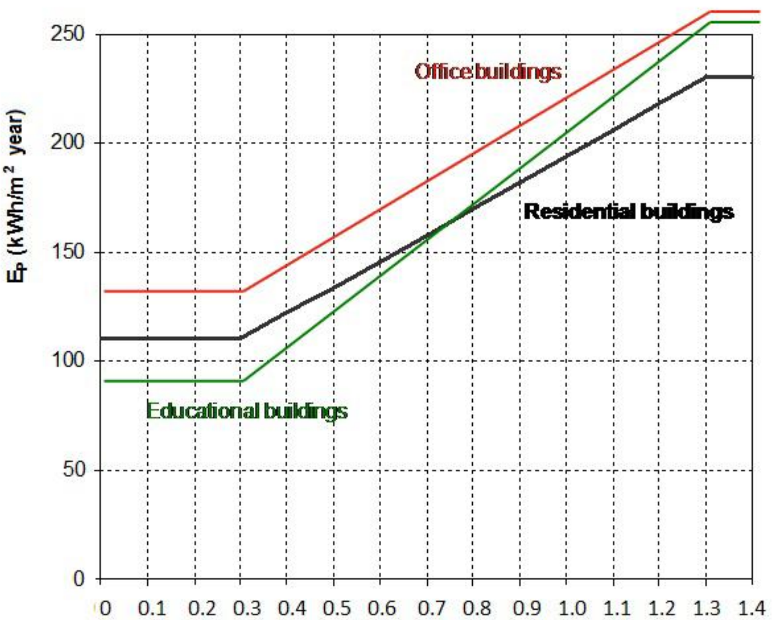
> For new buildings and major renovations, the new requirements are in force since the 9th of January 2013 for the building service system. These requirements are partly recommendations (application of condensing boilers; roomwise control system for heating; in case of a balanced ventilation system, heat recovery efficiency of over 70%; ventilators set to the maximum efficiency operation mode), and partly obligatory (balancing the heating, cooling, ventilation and domestic hot water systems; central control system in buildings of over 1,000 m^2 heated floor area; circulation pumps must be operated according to a time schedule; hydraulic losses are limited for ventilation system elements; air tightness of ventilation ducts is to be maximised).

> If any building element or building service system element of a public building and other buildings of over 1,000 m² net floor area is to be retrofitted energetically after the 9th of January 2013, the element must fulfill the current requirements (regarding U-values of building service system elements). This rule does not apply in case of maintenance measures. For all other buildings, this requirement will enter into force from the 9th of July 2013.
> For public authority buildings owned by the state and other new buildings of over 1,000 m², the analysis of the application possibilities of alternative systems, considering environmental, technical and economic aspects, will be obligatory. The analysis can be carried out for individual buildings, for a group of similar buildings, for buildings at the same location and with similar characteristics or, in the case of a group of buildings, for buildings with common heating or cooling systems. This prescription will enter into force for all other buildings from the 9th of July 2013.

2.2 Format of national transposition and implementation of existing regulations
The most important legislations in Hungary related to the EPBD are as follows:

> Hungarian Decree of the Minister of Interior 40/2012 (VIII. 13.) - The amendment to the 2006 legislation (7/2006 Ministerial Decree of 24 May 2006) is in accordance with the EPBD recast. It includes new requirements for building elements in case of refurbishment, recommendations on the building service system, revised primary energy factors, and corrections of some of the tables regarding the installation system. It also contains an amended definition of major renovation and detailed rules on the investigation of the possibility of applying alternative systems and renewable energy: a major renovation means that at least 25% of the surface of the building envelope is retrofitted. It includes requirements on the U-values of the building shell and on the integrated EP factor for new buildings and major renovations. The detailed calculation methodology of the energy performance of buildings has been revised by the Ministerial Decree 40/2012 of 13 August 2012. According to the decree, the requirements for the U-values, the specific heating energy needs and the specific yearly primary energy needs remained unchanged from the previous (2006) regulation. Requirements were, however, introduced for the Heating,Ventilation and Air-Conditioning (HVAC) elements (explained in 2.1).
> Hungarian Governmental Decree 105/2012 (V. 24.) – Amendment of several governmental decrees on building affairs and territorial design. This new legislation amends the Governmental Decree 176/2008 (VI. 30.) on the energy certification of buildings. In accordance with the EPBD recast, the new legislation introduces the detailed rules for certification and the new rules for display of certificates in public buildings. There is a reference on cost-optimality and the calculation of cost-effectiveness of a renovation. The new legislation introduces a binding electronic registration, which will be the base for the quality control system of certificates and the control review process.
> Hungarian Act 78/2003, on the appropriation and letting of flats and rooms, amended by the 201/2011 Act. The act includes the obligation for a certificate in advertisements and new contracts.
> Hungarian Governmental Decree 211/2012 (VII. 30.), amending the

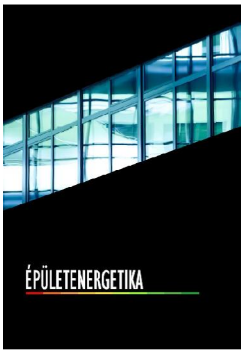
Figure 2: Current requirements for the specific yearly primary energy need. On the horizontal axis, the surface to volume ratio.



	maximum specific yearly primary energy need [kWh/m².year]
RESIDENTIAL BUILDINGS	
1 storey	72
2 storeys	60
3-4 storeys	53
5 or more storeys	50
OFFICE BUILDINGS	
comfort category A, B: 1 storey	102
comfort category A, B: multi-storey	85
comfort category C	115
EDUCATIONAL BUILDINGS	
educational buildings	60

Table 2: Foreseen requirements for the specific yearly primary energy need of the NZEB (under discussion).

Figure 3:* *Baumann et al. (2009) Building Energetics.



Governmental Decree 253/1997 (XII. 20.) on the National Requirements of Building and Town Planning (Building Code). Energy efficiency and comfort requirements are included among the essential requirements for buildings. The new amendment introduces the analysis of the application of renewable energy during the planning process.

Several technical guidance documents and portals are available for professionals and the public. Below are some examples:

> The most detailed and comprehensive technical guidance document for energy experts is the book Building Energetics (by Baumann Mihály et al., 2009, ISBN: 978-963-7298-31-8). It is a step-by-step guide for professionals, including the legislative background, the calculation process of the asset method, the certification process and the analysis of existing buildings.

> One of the two official portals is operated by VÁTI Hungarian Nonprofit Ltd. for Regional VÁTI Development and Town Planning; it contains a set of guidance documents for different user groups.[1]

> The other official portal, *www.lakcimke.hu*, is operated by the Energiaklub Climate Policy Institute and Applied Communications; it contains guidance information for citizens and end users.

Figure 4:* *Homepage of the Energy Club website.

2.3 Cost-optimal procedure for setting EP requirements

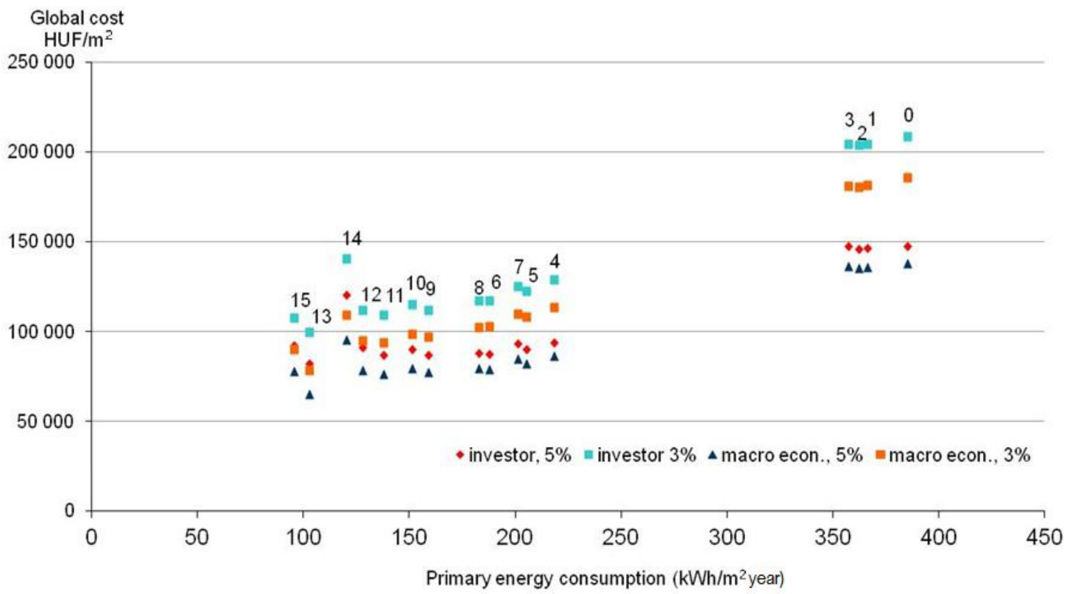
The cost-optimal calculations have been carried out according to the common EU methodology framework issued by the 244/2012 order, on the basis of the EPBD recast. The detailed calculation has been completed and the tables are available at the VÁTI website.[2] Additional calculations were presented in a cost-optimal report at the end of February 2013. The application of most of the renewable sources does not seem to be cost-optimal. In dwellings, solar collectors seem to be cost effective, and in schools photovoltaics may bring advantages. The cost-optimal report was submitted to the Commission in the middle of March 2013. At the same time, a governmental decision was proposed to define the necessary steps, in order to reach the cost-optimal level with the requirements.

The results show that the current requirements are not strict enough. For new buildings, the cost-optimal level is close to the NZEB level. For existing buildings, the cost-optimum is between the current requirements and the NZEB. As a consequence of the study, a revision of the requirements is under way, in view of updating current regulations.

2.4 Action plan for progression to NZEB

The exact number of nearly zero and low-energy buildings in Hungary is unknown, but it is probably a moderate figure, at the maximum a few hundred such buildings in the whole country. Most of them are family houses or public buildings renovated using the support of the Environmental and Energy Operation Program. Taking the usual construction trends into account, it

Figure 5:* *Global cost – energy consumption analysis for different renovation scenarios (family house type 3), exemplary result of the cost-optimal procedure.



1 *www.e-epites.hu/energetikai-tanusitas/modszertani-utmutatok*

2 *www.e-epites.hu/hirek/az-epuletek-energiahatekonysaganak-koltseg-optimalizalt-szintjerol-keszult-tanulmany-velemenye*

is expected that, by the 31st of December 2020, the number of NZEBs shall be about 10 to 30 thousand, 80% of which will be flats. It is predicted that the demand for low energy buildings will significantly increase between 2015 and 2020.

The general national targets for NZEB are set in chapter 3.4 of the '2nd National Energy Efficiency Action Plan until 2016 with an outlook to 2020' (NEEAP) ratified by the Governmental Decree 1374/2011 (XI. 8.). The concrete national targets for the NZEB have not been defined in the NEEAP, but it makes this reference: "The detailed mechanisms of the NZEB requirements will be elaborated in the National Building Energy Strategy under preparation". According to the 1374/2011 (XI. 8.) Governmental Decree, the National Building Energy Strategy is the responsibility of the Ministry of National Development. The strategy is expected to be completed in May 2013.

A first study to set the definition and the requirements of the NZEBs was carried out by the University of Debrecen in May 2012. A revised version, taking into account the results of the cost-optimal requirements at the lowest global cost, was developed in January 2013. It has provided additional recommendations on the requirements for existing buildings.

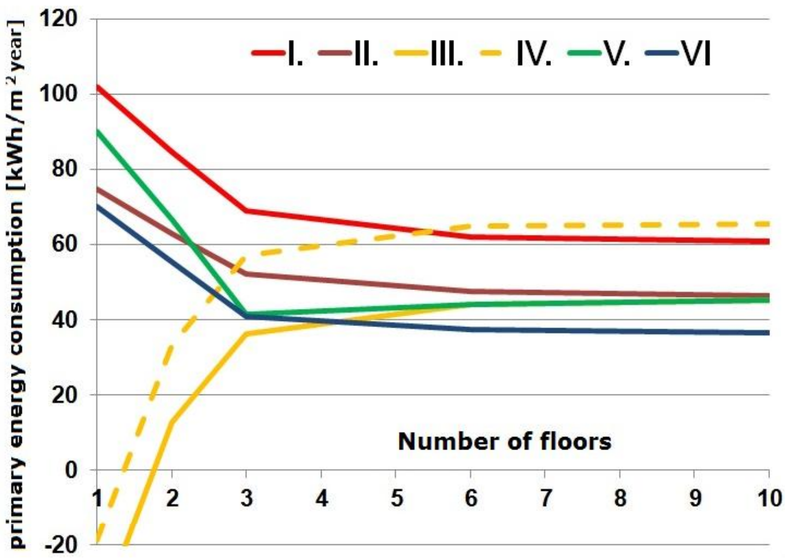
On the 3rd of February 2012, the government decided that the NZEB requirements shall only come into force at the latest possible deadline. Therefore, the current acts do not contain improvements of the requirements for 2018 and 2020.

2.5 Any other relevant information
The Parliamentary Decree 77/2011 (X.14.) on the National Energy Strategy declares that the government should "prepare a building energy strategy with particular attention to the subsidy programs, the cost and energy analysis of heating and insulating measures and the increase of the number of nearly zero-energy buildings."

Chapter 2.2 of the New Széchenyi Plan (the national development plan) contains target values for the period 2011-2020:

> building investments (supported by the state) should achieve an average of 60% energy savings;
> the heating energy consumption of subsidised new constructions should be below 25 kWh/m^2.year.

Figure 6: Primary energy consumption of reference residential buildings using different types of renewables from the NZEB preparatory study.



These principles are applied in the various sub-programs, as follows:

> program for new green homes: it supports new buildings with energy efficiency categories 'A' and 'A+'. The current requirement is 'C';
> program for retrofitting buildings built with prefabricated sandwich panels (a very typical building type for post communist countries);
> program for upgrading district heating systems;
> program for retrofitting existing residential buildings (other than buildings built with prefabricated sandwich panels);
> program for retrofitting heating systems in the residential sectors: it supports the installation of condensing boilers and renewable heat supply systems.

Unfortunately, due to lack of financial resources, these programs are operating with regular interruptions and, in some cases, on a very limited budget.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings
The Energy Perfomance Certificate (EPC) assigns an EP label to residential and non-residential buildings or building units and it lists cost-effective measures for improving their energy performance. The energy label classifies the buildings on an efficiency scale ranging from A+ (high energy efficiency) to I (poor efficiency). The practical benefit of energy performance certification is found in the recommendations that are provided to the building owner. These are summarised on

page 2 of the certificate. The suggestions include a short description of improvements specific for the building proposed and the impact on the energy rating, if all measures were to be implemented. How detailed the calculations are depends on whether the owners of existing buildings are applying for a subsidy. In that case, evidence of the expected outcome of the retrofit in energy terms must be provided and, therefore, a more accurate survey and calculation is necessary to guarantee that the subsidy conditions will be satisfied.

Owners can estimate the rating of their buildings using an online calculator. They can create their own certification which, obviously, does not substitute an official one, issued by a licensed expert.


Energetikai Tanúsítvány

ENERGYQUALITY

ET1-0900539

Épület:	Családiház	Postacím szerinti bejárat
Az ingatlan címe:	4615 Füzesábrány, Nefelejcs u. 24/b	GPS koordinátái: É.sz.: N:47°21'32,1"
Hrsz:	Füzesábrány 5796/4	K.h.: E:16°42'50,4"

Megrendelő:
Név / cégnév: Téko Zoltán
Cím / telephely: 4615 Füzesábrány, Nefelejcs u. 24/b

Az ingatlan / ingatlanrész:

fajlagos primer energia fogyasztása:	98	kWh/m²a
követelmény (viszonyítási alap) értéke:	94	kWh/m²a
fajlagos hőveszteség tényező a követelményérték százalékában:	94,00	%
az épület összesített energetikai jellemzője a követelmény érték:	104,20	%-a,
ez alapján az épület besorolása:	D	

A+	<55
A	56-75
B	76-95
C	96-100
D ← 104	101-120
E	121-150
F	151-190
G	191-250
H	251-340
I	341<

Az ingatlanról készült fénykép

Az épület összesített energetikai jellemzője az épület rendeltetésszerű használatának feltételeit biztosító épületgépészeti rendszerek egységnyi fűtött térfogatra vonatkozó, primer energiában kifejezett, kWh/(m³ a) mértékegységű éves fogyasztása. Az összesített energetikai jellemző tartalmazza a fűtési, légtechnikai, melegvízellátási és (a lakóépületek kivételével) a világítási rendszereinek fogyasztását, beleértve e rendszerek hatásfokát és önfogyasztását.

Nyári túlmelegedés veszélye fennáll: igen X nem

A javasolt korszerűsítések megvalósítása esetén elérhető minősítés: B

Az Energetikai korszerűsítési javaslatok a számítási jegyzőkönyvben találhatóak.

Tanúsító neve, címe, (regisztrációs száma):
Tanúsító Kálmán P.H.
1051 Budapest, Herceg u. 13.
01-11046 EQ-08-10077

Dátum: 2009.01.01

aláírás

P.H.

Ez az energetikai tanúsítvány az épületek energiateljesítményéről szóló, 2002. december 16-i 2002/91/EK európai parlamenti és tanácsi irányelv 2-6. cikkeinek és mellékletének való megfelelést szolgálja.

A tanúsítvány hitelességét a www.tanusitvany.eu weboldalon, vagy a +36 76 519 700-as telefonszámon tudja ellenőrizni.

Figure 7: Cover page of the EPC.

Figure 8: Owners can estimate the rating of their buildings using the online calculator at www.lakcimke.hu/kalkulator.

EPCs are valid for 10 years. The cost of a certificate for flats is prescribed by the law (40 € + VAT per flat or for a family house). It is often criticised by experts as unrealistically low and, thus, has a negative impact on the quality of the certificate. For non-residential buildings, there is no legal prescription on the cost of an EPC.

Starting from January 2012, all existing residential and non-residential buildings need to be certified when sold. The owner must present a valid certificate to the buyer, when the sale contract is agreed upon. For rentals, the EPC is on a voluntary basis until the 31st of December 2015. From then on, the owner must present a valid certificate to the renter, when a rental contract is agreed upon. There is no minimum requirement for an existing building, i.e., it can be labeled from A+ to I, since, according to the EPBD, the aim of certification is only informative.

As of 2006, new buildings must reach at least a C label. The same rule applies in the case of major renovations. If a new unit or wing is added to an existing building, there are two options: either the added unit, or the extended building as a whole, should meet the requirement. Such a retrofit or extension is subject to a building permit, which will be issued only if the required EP level can be demonstrated using the calculations.

For residential buildings, the requirements on the HVAC system will come into force after the 9th of July 2013.

There are significant changes in the registration process of the EPCs since the 9th of January 2013, when an electronic registration system was launched. Since this date, an EPC can be considered official only after it has been uploaded to the online system. The EPC can be uploaded to the system in two ways:

> By manually inserting the set of input calculation data of the building and the predefined results (a set of output data).
> By exporting the calculation results into a pre-defined XML format by any software available on the market. In this case, the software developers have to build an exporting module into the software.

The online system also serves as a basic level of quality control. Firstly, the system automatically checks the permit of the energy expert. The experts are registered with the Hungarian Chamber of Engineers and the Hungarian Chamber of

Architects. At the moment, there are 2,459 registered experts; half have already submitted at least one certificate to the online system, while a quarter of them have submitted more than 5.

Secondly, it automatically implements the check prescribed by paragraph 1.a of annex 2 of the Governmental Decree 105/2012 (V. 24.). In this contol process, unrealistic figures are filtered.

The second control stage (checking the calculation by another expert without visiting the building) and third stage (repeating the whole certification process including a site visit) will be performed by the Hungarian Chamber of Engineers, who will have access to the electronic EPC database. Other construction authorities will also have access to it.

For building sales after the 9th of January 2013, lawyers are required by law to insert the registration code of the EPC generated by the electronic registration system into the contract. In case of a new building, the owner is required to pay a penalty, if the EPC is not prepared before the occupancy permit is issued.

Trainings and courses are regularly organised by universities and training institutions. During these, the Hungarian Chamber of Engineers and the Hungarian Chamber of Architects evaluate participants. In Hungary, engineers and architects are required to get passing grades, in order to keep their licence. This system offers an effective means for maintaining constant interest in continuous education.

3.2 Progress and current status on public and large buildings visited by the public

In Hungary, the definition of a public building includes every state-owned non-residential building. The larger ones, (originally exceeding 1,000 m^2 floor area, criterion which will change soon) are required to display their EPC, so that it is visible to the public. The display campaign for public buildings only started in 2009. It is allowed to use operational ratings only for the purposes of the display campaign.

Since the 9th of January 2013, the EPC is obligatory for public buildings and large buildings of over 500 m^2 visited by the public (after 2015, this limit will be decreased to 250 m^2). The certificate must be displayed in a visible place. Since this date, the requirements in relation to the HVAC system are also in force for public buildings.

3.3 Implementation of mandatory advertising requirement – status

Since the 9th of January 2013, according to the Governmental Decree 176/2008 (VI. 30.) paragraph 3. § (2a), the energy categories must be displayed in all commercial advertisements for all buildings or building units (including flats, family houses and non-residential buildings), when sold or rented, if the energy certification is available. An exception is the rental of flats, where the mandatory advertising requirement only comes into force after the 1st of June 2013, according to the Hungarian Act 78/2003 on the appropriation and letting of flats and rooms, amended by the 201/2011 Act. In case of rental of houses, the EPC is obligatory. Certification is voluntary only for flats or other units, when they are rented. So in some cases, there are advertisements for renting houses and other properties, in which the energy category must be displayed.

This measure is expected to have a major influence on the energy awareness of the public, after information campaigns have been carried out.

3.4 Information campaigns

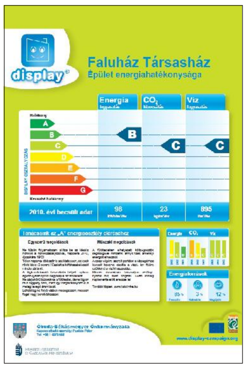
In the early stages of implementation in 2006, a very intensive information campaign was launched. Several TV and radio interviews addressed the general public, while workshops and open forums were available to the professional community. A homepage and an electronic guide provided information on the correct interpretation of the Directive and national regulations. Printed guides for architects and engineers, in addition to popular pocket books for housing associations, were published.

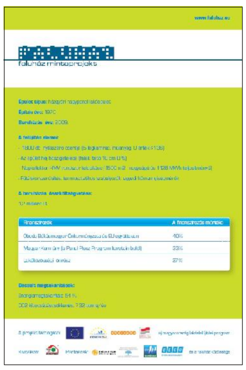
Later on, the emphasis of the campaign shifted to providing information to the general public. The Energiaklub (NGO) created a home page (*www.lakcimke.hu*), on which the basic concepts, such as renewable energy, sustainability, and certification, as well as everyday tips for energy saving, are presented in layperson language, along with many simple illustrations.

Similarly, the Display campaign, developed under the Intelligent Energy Europe Programme, is partly supported by the ministry. Besides printed materials and workshops, the software is also available free of charge for local authorities that are responsible for public buildings. In fact, the ministry supports local governments in training their experts to participate in the campaign, helps them with the translation of manuals, and pays for the annual fee for the software and for the Hungarian partner of the project.

Figure 9: Poster from the energy awareness campaign of Hungarian energy suppliers programme 'Energy Saving in Households'.

Figure 10: Sample certificate from the Display campaign.[1]





1 *display.lechnertudaskozpont.hu*

At the end of 2012, there are only a few information campaigns. New campaigns will be launched in accordance with the implementation of the new Energy Efficiency Directive (EED). However, as energy supply companies are required to carry out energy efficiency campaings, there are still many posters around the country, as well as advertisements in the media.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating and air-conditioning systems
Hungary has adopted option a) of article 8 of the EPBD, establishing a regular inspection of boilers. In spite of this, the inspection of boilers, as well as air-conditioning (AC) systems, has not yet been established. The legislative basis is the Governmental Decree 264/2008 of the 6th of November, 'Governmental Decree on the inspection of heat generation equipment and air-conditioning systems', which has been in force since the 1st of January 2009. The following deadlines were defined:

> 1st of January 2011 – inspection of all heating installations, 15 years or older, with boilers with an effective rated output of over 20 kW;
> 1st of January 2013 – first inspection of boilers and AC systems that were installed before the 1st of January 2007;
> 1st of January 2015 – first inspection of boilers and AC systems that were installed after the 1st of January 2007.

Inspections can be carried out by:

> experts who already have a license of expertise in HVAC systems or energy, issued by the Hungarian Chamber of Engineers;
> engineers with at least one year of experience, who must take an exam at the Hungarian Chamber of Engineers;
> technicians with at least five years of experience, who must take an exam at the Hungarian Chamber of Engineers.

The Governmental Decree 264/2008 (of the 6th of November) is still in force, but the National Ministry of Development has already informed the EC that Hungary will follow option b) of the recast EPBD. This means that the inspection system will be replaced by other alternative actions, such as information campaigns on the exchange of obsolete, low efficiency boilers, air-conditioning and heating systems. Such a campaign has already been integrated in the NEEAP.

5. Conclusions and future plans

The Energy Perfromance of Buildings Directive (EPBD) requirements for new buildings and major renovations will certainly bring important energy savings in the near future, although new and renovated buildings only represent a small share of the entire building stock in Hungary (around 4.3 million dwellings). In the last four years (2008-2012), the number of new flats has decreased from 35,000/year to around 10,000/year and there is still not a large number of major renovations. Therefore, the impact of applying Energy Performance (EP) requirements to new and renovated buildings is obviously limited and will not lead to a relevant reduction in energy consumption in the building sector, within a useful timeframe.

In spite of the difficult current economic situation, the introduction of energy requirements on partial renovations from 2013 can have a remarkable effect but, in order to achieve real energy savings in the building sector, significant incentives towards the improvement of existing buildings are needed and certification can play a fundamental role. The introduction of the electronic registration of Energy Performance Certificates (EPCs) and the new obligations on advertisements and sale contracts will also have a significant impact.

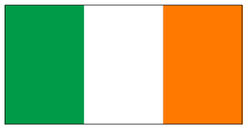
The recommendations made by experts in the certificate are important guidelines that the owner of the building can make good use of, either in the context of a renovation, or as an individual cost-effective measure. Financial concerns about the investment costs of using energy efficient technologies are, however, a major obstacle in the present economic environment.

A breakthrough may take place in the field of subsidised projects, as the state administration has already adopted the methodology of offering subsidies on the basis of energy certifications that motivate project developers to apply increasingly more efficient technologies. On the other hand, although there already are promising action plans, until now the financial sources available for such incentives were very limited.

The near future will be determined by the completion and application of the National Building Energy Strategy that is under development, on the basis of the cost-optimal procedure and the Nearly Zero-Energy Building (NZEB) concept.

EPBD implementation in Ireland

STATUS AT THE END OF 2012



1. Introduction

Implementation of the Energy Performance of Buildings Directive (EPBD) in Ireland is the formal responsibility of the Department of the Environment, Community and Local Government (DECLG). Operationally, responsibility is assigned between DECLG and the national energy agency Sustainable Energy Authority of Ireland (SEAI). Oversight and co-ordination is through an EPBD Implementation Group, comprising senior officials from DECLG, the Department of Communications, Energy and Natural Resources (DCENR) and SEAI. The enforcement authorities for both Energy Performance (EP) requirements and energy certification are the Building Control Offices within the local authorities/municipalities.

Commencing with legal transposition in 2006, Ireland has made strong progress in implementing the requirements of the original EPBD (2002/91/EC), with momentum continued in transposing and implementing the EPBD recast (2010/31/EU). This report outlines the status of current and planned implementation. It focuses on EP requirements (including Nearly Zero-Energy Buildings (NZEB)), Energy Performance Certificates (EPC, termed 'Building Energy Rating' or BER), inspection systems and building energy renovation initiatives.

Key achievements include the further strengthening of building EP requirements to approach 'near zero' levels, the issuing to date of 354,000 BER certificates covering 18% of the national building stock, the energy efficiency upgrading of 230,000 buildings to date and the strengthening of quality guidelines and standards.

2. Energy performance requirements

2.1 Progress and current status
The Building Regulations Part L, covering energy and CO_2 performance, have been strengthened on three occasions in the period 2006 – 2011. Each substantive amendment followed a regulatory impact assessment, as well as an industry and public consultation process. The 2011 review resulted in a required 60% energy performance improvement relative to the year 2006 standards for dwellings.

The resultant long term progression of energy performance improvements for new dwellings towards a 'net zero' standard is illustrated in Figure 1, with indicative BER bands shown alongside.

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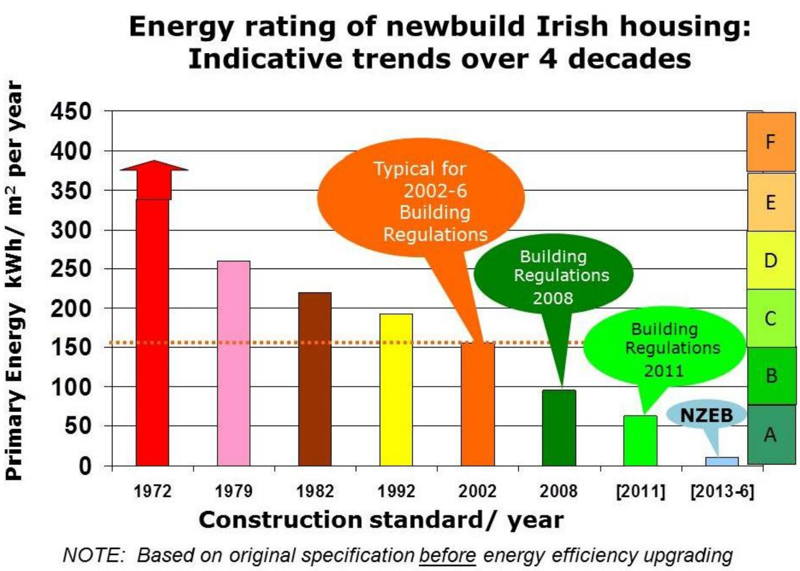
Figure 1: Long term progression of energy performance standards in newbuild dwellings in Ireland.



National Websites *www.seai.ie/epbd, www.seai.ie/ber, www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards*

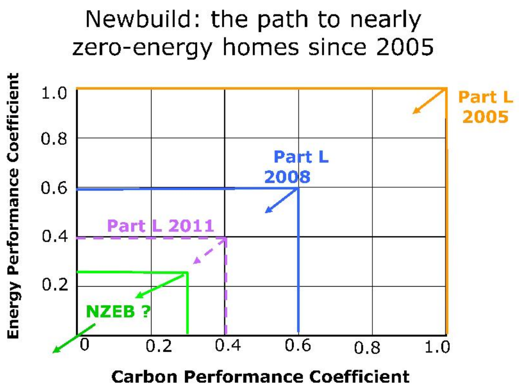
In 2013, DECLG plans to commence a review of Part L in relation to buildings other than dwellings, with a view to strengthening the performance requirements.

2.2 Format of national transposition and implementation of existing regulations

a. Regulations

The EPBD energy performance provisions were transposed into Irish law through the EC Energy Performance of Buildings Regulations 2006 – 2011. The Dwelling Energy Assessment Procedure (DEAP) and Non-dwelling Energy Assessment Procedure (NEAP) frameworks are compliant with EN 13790 and calculate primary energy use and associated CO_2 emissions for space heating and (where applicable) cooling, ventilation, associated motive power and lighting under standardised conditions of use. The performance requirements for new and renovated dwellings were subsequently improved by 40% in 2008 relative to 2005-2006 requirements, with the improvements extended to 60% in 2011.[1]

Figure 2: Progression of new housing energy performance coefficient (EPC) since introducing EP criteria in the 2005 Building Regulations.



b. Technical guidance documents

Technical Guidance Document (TGD) Part L provides detailed guidance for architects, engineers and other building professionals on compliance with the new requirements. In tandem with the technical guidance, other tools and support documents have been published by SEAI and DECLG – including updating of DEAP and NEAP software to assess compliance, accompanying user manuals, acceptable construction details, air permeability testing, database of performance data for mechanical ventilation systems, database of seasonal efficiencies of heating appliances including solar, database of acceptable renewable energy products, guidance on heating and Domestic Hot Water (DHW) services and a code of practice for solar heating panel installations.

The 2011 Technical Guidance Document for dwellings can be viewed on an official website.[2]

Table 1: Maximum permissible elemental U values for dwellings.

Table 1	Maximum elemental U-value (W/m²K)[1, 2]	
Column 1 Fabric Elements	**Column 2 Area-weighted Average Elemental U-Value (Um)**	**Column 3 Average Elemental U-value – individual element or section of element**
Roofs Pitched roof - Insulation at ceiling - Insulation on slope Flat roof	 0.16 0.16 0.20	0.3
Walls	0.21	0.6
Ground floors[3]	0.21	0.6
Other exposed floors	0.21	0.6
External doors, windows and rooflights	1.6[4]	3.0

Notes:
1. *The U-value includes the effect of unheated voids or other spaces.*
2. *For alternative method of showing compliance see paragraph 1.3.2.3.*
3. *For insulation of ground floors and exposed floors incorporating underfloor heating, see paragraph 1.3.2.2.*
4. *Windows, doors and rooflights should have a maximum U-value of 1.6 W/m²K when their combined area is 25% of floor area. However areas and U-values may be varied as set out in Table 2.*

Figure 2 outlines the changes in EP requirements in domestic dwellings since the introduction of energy performance criteria in the 2005 Building Regulations. The 'Energy Performance Coefficient' and 'Carbon Performance Coefficient' (CPC) are defined as the ratios of calculated primary energy consumption and corresponding CO_2 emissions for the proposed dwelling relative to that of a 'reference dwelling' incorporating energy features approximating to the standards of 2005.

Irrespective of these overall performance targets, further maximum transmission heat loss limits remain in place for building elements (wall, roof, floor, glazing), as shown in Table 1, and oil or gas fired boilers must achieve a minimum seasonal efficiency of 90%. In addition, from 2008 a minimum of 10 kWh/m².year thermal (or 4 kWh/m².year electrical) energy is required to be supplied from Renewable Energy Sources (RES) – typically achievable through solar, heat pump or biomass technologies.

1 *www.environ.ie/en/Legislation/DevelopmentandHousing/BuildingStandards/FileDownLoad,27314,en.pdf*
2 *www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,27316,en.pdf*

Alternatively, installation of a Combined Heat and Power (CHP) system of equivalent savings is deemed acceptable. Since 2005, SEAI has developed nationally accredited training courses for renewable energy system installers and has maintained a registered list of installers.

For non-domestic buildings, limits are placed on transmission heat loss in a similar manner to Table 1, with the options of employing either an Overall Heat Loss method covering all building elements collectively, or an individual Elemental Heat Loss method.

Work is well advanced on developing a Code of Practice for energy efficiency retrofitting/ renovation of dwellings with the aim of providing practical and comprehensive guidance for builders, developers, designers, building trades, energy consultants, public bodies, utility companies, homeowners, landlords and other interested parties. The finalised code will focus primarily on upgrading the energy efficiency of building elements (i.e., roofs, floors, walls, windows and doors), and will also address building services with a high energy impact, such as heating and lighting systems and components.

c. EP methodology/methodologies

For both dwellings and non-domestic buildings in Ireland, maximum permissible heat loss requirements have been progressively strengthened since first being introduced around 1980. However, overall energy performance targets were not introduced into building regulations until the EPBD implementation. The regulations for dwellings and other buildings are respectively aligned with the methodology requirements of the EPBD by means of the EN 13790 compliant frameworks of DEAP and NEAP.

Dwellings: For dwellings, a primary energy/CO_2 target was first introduced in 2005, equating to a maximum permissible primary energy requirement (and associated CO_2 emissions) of around 156 kWh/m^2.year (30 kg/m^2.year) for a typical 100 m^2 dwelling. Arising from national policy, this was subject to accelerated review in 2007 and improved by 40% from 2008 onwards, i.e., typically to around 95 kWh/m^2.year. A further review in 2011 introduced more stringent energy and CO_2 performance requirements equating to a 60% improvement relative to 2005 requirements, i.e., typically to around 63 kWh/m^2.year. This strengthening of the requirements is reflected in the progressive improvement in the Maximum Permitted (MP) levels for the EPC and CPC, expressed as 'MPEPC' and 'MPCPC' (currently 0.40 and 0.46) and shown in Figure 2. These current targets broadly correspond to the A3 band on the BER scale as shown in Chapter 3.

Non-Domestic Buildings: Similar to the case for dwellings, the EPC and CPC are defined as the ratios of calculated primary energy consumption and corresponding CO_2 emissions for the proposed building relative to that of a 'reference building' incorporating energy features approximating to the standards of 2005 and with a 'mixed mode' ventilation system. The legislative update in 2008 introduced the MPEPC and the MPCPC for non-domestic buildings and set both of these limits at 1.0. These current targets broadly correspond to the boundary of the B/C bands on the BER scale as shown in Chapter 3. A review of the requirements for non-domestic buildings is proposed for 2013 which is envisaged to apply the cost-optimal methodology requirement.

2.3 Cost-optimal procedure for setting EP requirements

The comparative methodology framework for calculating cost-optimal levels of minimum energy performance is being developed by DECLG, in consultation with DCENR and SEAI, on the basis of a societal cost-perspective. Consultants appointed through a request for tender in October 2012 have performed detailed calculations across a representative sample of dwellings and other building types, both new and existing, with a view to identifying cost-optimal levels of minimum EP requirements for buildings and building elements. A report presenting the findings and the cost-optimal methodology has been completed and submitted to the EC in March 2013.

2.4 Action plan for progression to NZEB

A framework for meeting the NZEB requirements has been prepared by DECLG, including work on the detailed NZEB performance standards, and will be issued for public consultation, giving a clear indication to industry of the future regulatory requirements.

Dwellings: From 2013, a voluntary NZEB standard will be in place for new dwellings and this will become mandatory by 2020, with the Building Regulations Part L being amended at an appropriate time prior to 2020. For a typical dwelling, this is expected to equate to 45 kWh/m^2.year primary energy (or a BER of A2 or better) a very significant proportion of which will be covered from RES.

Non-domestic buildings: Currently, new buildings other than dwellings must comply with TGD Part L 2006. By 2020, subject to cost-optimal calculations, it is proposed that all new buildings other than dwellings in Ireland will achieve a 50-60% aggregate improvement in terms of energy efficiency and reduction in CO_2 emissions relative to present requirements.

Further details will be available from DECLG regarding the NZEB targets as the roadmap emerges during 2013. Within the public sector, all buildings must be NZEB by 2018 and a roadmap is currently being developed to detail how this will be achieved.

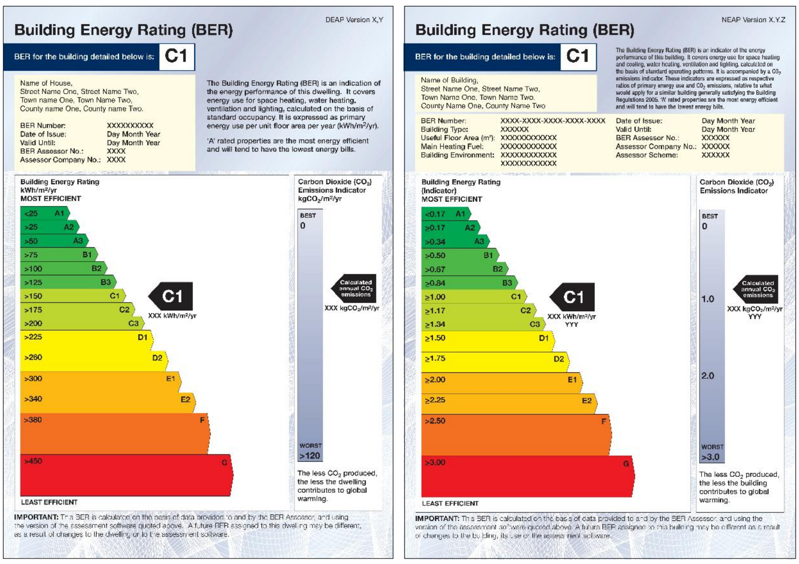
3. Energy performance certificate

3.1 Progress and current status on sale or rental of buildings

a. Transposition

For the EPBD provisions other than building EP requirements, the original transposing legislation was SI 666 of 2006.[1] This was superseded by SI 243 of 2012, which reaffirms many previous provisions and gives legal effect to various EPBD recast provisions - including alternative energy systems, BER, training and accreditation, administration of the BER system, advertising, enforcement, and heating and air-conditioning systems.

Figure 3: Domestic BER (left side) and non-domestic BER (right side) formats.



b. Oversight and administration system

SEAI is designated as the ‘issuing authority’ responsible for administering the BER system, and has established a range of provisions – including the DEAP and NEAP calculation methodologies and software, a central database of BERs, rules for training and registration of BER assessors, rules for BER publication, rules for maintenance of records, a code of practice, a Quality Assurance (QA) regime, disciplinary and complaints code, helpline facilities and promotion of the scheme. BERs are published on-line on the central database through the portal *www.seai.ie/ber* which includes a live tool[2] showing all BERs registered and may be accessed for research purposes.

c. Calculation methodology

New and existing buildings are assessed using a calculated/asset rating, conforming to EN ISO 13790, based on the same methodologies, DEAP and NEAP, used for assessing compliance with EP requirements as set out in Chapter 2. These calculations relate to primary energy use and associated CO_2 emissions for space heating and (where applicable) cooling, ventilation, associated motive power and lighting under standardised conditions of use. DEAP may be downloaded from *www.seai.ie/DEAP*. Within the non-domestic NEAP framework, a default calculation tool called the ‘Simplified Building Energy Model’ (SBEM) may be used (downloadable from *www.seai.ie/SBEM*). Alternatively, and particularly for more complex buildings, approved NEAP software[3] may be used. The validation procedure for approval of such software is based on a series of standardised validation test runs on a set of model building typologies.

d. EPC format

The BER consists of a label on a seven band linear scale ranging from A (best) to G (worst), with three subdivisions in the higher bands A to C and two subdivisions in bands D to F, and no subdivision in band G. This scale is based on primary energy use under standard conditions for space heating and cooling, ventilation, water heating, lighting and associated pumps and fans. In the case of a dwelling, the position on the scale is proportionate to the calculated absolute primary energy intensity of the building, with each full band having a width of 75 kWh/m^2.year (and with each sub-band in

1 *www.seai.ie/Your_Building/BER/EPBD/SI_666_EPBD.pdf*
2 *www.seai.ie/Your_Building/BER/National_BER_Research_Tool/*
3 *www.seai.ie/Your_Building/BER/Non_Domestic_buildings/Download_SBEM_Software/Download_SBEM_Software.html*

the A to C ranges being 25 kWh/m^2.year). For other building types, the BER is proportionate to the ratio of calculated primary energy of the building compared with a 'reference building', which is an imaginary building with the same geometry, building functions, and building envelope and technical systems of an energy performance standard required by regulations of 2005. The ratios of 0.5, 1.0, 2.0 and 3.0 correspond to the shared boundaries of the A/B, B/C, D/E and F/G bands respectively. A secondary scale shows a CO_2 rating in relation to these same energy uses. The formats are respectively illustrated in Figure 3.

Each BER is accompanied by an 'advisory report' outlining a series of options and recommendations for improving the energy performance of the building. For existing buildings, these recommendations relate mainly to physical upgrading actions whereas for new buildings they relate mainly to good operational and maintenance practices.

The boundary of the bands B/C (more precisely, between bands B3 and C1) represents the typical performance requirement for a new building in 2006, which is used as a reference case against which future performance improvements are measured.

e. EPC activity levels

BER activity levels up to the end of year 2012 are summarised in Table 2.

f. Profile of EPC grades

The profiles of BERs published from the initiation of the scheme up to the end of year 2012 are shown in Figure 4. This shows BERs predominantly in the range for new dwellings. For existing dwellings and for non-domestic buildings there is a wide range generally from B to G, averaging D2 to D3.

g. EPC costs

There is no set fee and building owners are advised to shop around for the best price. Fees can be expected to vary widely for non-domestic buildings based on size and complexity, but in the case of dwellings available indications are that an overall fee (including levy) of less than 200 € has become typical. Domestic and non-domestic BER assessors are charged a levy of 25 € and 50 € respectively to submit a BER assessment for publication on the national BER register.

h. Assessor corps - qualification/ training/CPD requirements

All registered BER assessors are listed and can be accessed through the web portal *www.seai.ie/ber*.

The prequalification requirement for BER assessors of domestic buildings is a National Qualifications Authority of Ireland (NQAI) Level 6 Award (equating to technician diploma) in construction studies or equivalent. Training providers must be registered with a national accreditation body. The training programme must meet SEAI's BER Training Specification in full. The learner must achieve an examination mark of at least 70% in the training programme. To register, trained candidates must then pass a national domestic BER Examination. The national examination also acts as a test of Continuing Professional Development (CPD), which must be repeated every two years following initial registration. Since commencement of the scheme, over 2,500

Table 2: BER activity levels.

Item	Domestic buildings	Non-domestic buildings
Cumulative number of BERs published	334,724	10,779
Number of BER assessors	788	147
Number of BERs in 2012	72,451	2,738

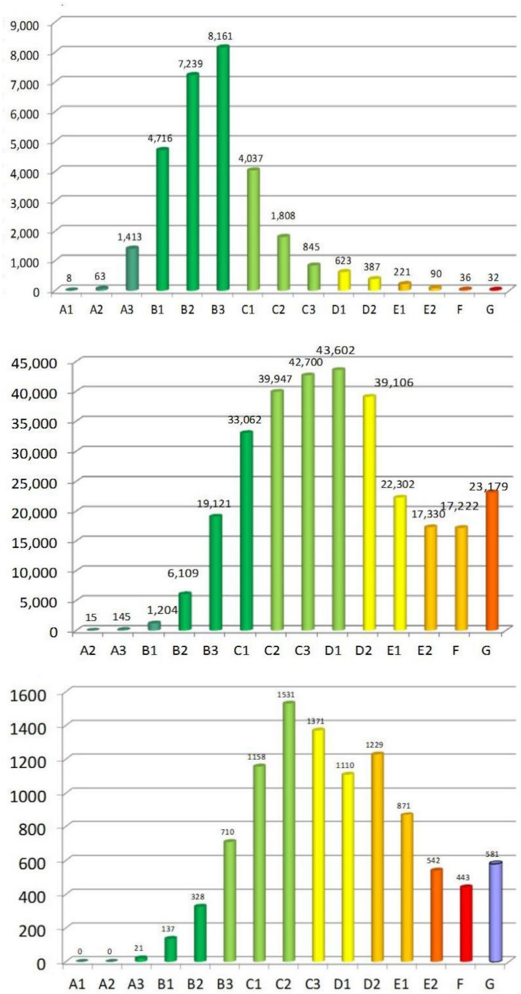


Figure 4: BER profiles to December 2012: domestic new (top), domestic existing (middle), non-domestic (bottom).

persons have been registered as domestic BER assessors but, as of April 2013, there were 830 registered active assessors, which is sufficient to meet market demand. The decline may be attributed to a number of possible factors: excessive initial expectations, insurance and other contractual conditions, the periodic examination hurdle, and natural wastage.

The prequalification requirement for BER assessors of non-domestic buildings is a NQAI Level 7 or 8 Award (equating to ordinary or honours degree) in a building related discipline or equivalent, plus membership of a professional qualifying organisation at an appropriate grade listed for the assessor level. Further training is optional, but the candidate must pass the national non-domestic BER Examination. As with the domestic examination the learner must achieve an examination mark of at least 70%. In addition, applicants wishing to register as non-domestic BER assessors using an approved software tool within the NEAP framework other than the software version of SBEM (called iSBEM) are required to pass the approved qualifying examination from the relevant software provider. As of April 2013, registered active numbers of non-domestic BER assessors were 165.

i. Examinations

SEAI developed national domestic and non-domestic examinations as an important element of the QA framework to ensure consistent minimum standards across the community of BER assessors. Delivery of this service is outsourced, with 41 test centres comprising 16 fixed centres and 25 mobile centres. Examinations are held Monday – Saturday. The contracted service includes: booking online or by phone, rescheduling, ID verification on arrival, photographing candidates (images will be used in future for ID cards), administering examinations, issuing results (immediately), dealing with complaints, communicating results to SEAI, issuing VAT receipts for payments and making VAT returns. 4,415 domestic assessor examinations were taken over the 3.5 years to December 2012 while 242 non-domestic assessor examinations were taken over the 1.5 year period to December 2012. As seen from the earlier figures on active numbers of BER assessors, numbers of examinations attended significantly exceeds the current number of registered assessors. In addition to the factors mentioned above, it is understood that large numbers of architects and engineers have attended BER training and examination in order to improve their professional skills, without necessarily wishing to practice as BER assessors.

j. Quality Assurance (QA)

The BER QA framework has a fundamental objective that the BERs published on the National Administration System (NAS) are a reliable and faithful reflection of the energy performance of the subject property. QA is regarded as a vital reputational issue to give the market confidence in the certificates published, and is resourced accordingly. Three strategy pillars underpin the QA framework:

> Upstream: including assessor prequalification, training and the national examination.
> In-line: calculation tool features and output validation checking of BERs prior to publication.
> Downstream: QA auditing of published BERs, disciplinary procedure and CPD.

The aim of the audit programme is to identify technical, procedural or system faults in a timely manner and to feed these back to assessors and/or to process system revisions to minimise recurrence. There are three different levels or depths of audit, in order of depth: high volume data review audits checking individual data items on-line, medium intensity desk review audits and comprehensive documentation and practice audits. The full implementation of these pillars comprises an integrated approach to ensure that good assessors undertake ratings properly and it entails a combinations of filters, checks and guidance. In 2012, 318 desk review audits (looks for patterns or anomalies across a number of ratings by a selected assessor) and 577 documentation and practice audits (full detailed audit of a complete rating carried out on site or at the BER assessor's premises) were completed.

In addition to the disciplinary process outlined below, the associated system improvement process includes technical bulletins issued regularly to provide QA and technical feedback to assessors,[1] updating of technical notices on the national BER administration system, and updating of the BER calculation software and manual.

k. Disciplinary penalty points system

Breaches of the BER technical methodology or code of practice that are detected through the audits are graded into three levels of severity with corresponding penalty points applied since May 2010:

1 *www.seai.ie/Your_Building/BER/BER_FAQ/FAQ_BER/Assessors/SEI_BER_Reports.html*

> *Severity 1*: a breach with a high potential to compromise the fundamental integrity of the BER scheme, to damage public confidence or otherwise negatively impact the reputation of the scheme (3 penalty points).
> *Severity 2*: a significant breach but, while not an acceptable procedure, it is unlikely on its own to affect the reputation of the BER scheme (2 penalty points).
> *Severity 3*: a less significant breach that would not affect the reputation of the BER scheme (1 penalty point).

Penalty points are attached to the assessor's record and a suspension of 3 months is invoked if a BER assessor's record shows 10 or more points accumulated within the previous two-year period. Summary suspension can also apply in specified cases of severe individual breaches. Where a case from the same assessor arises within two years, the suspension period is increased to 12 months, and a third such repeat will result in termination of registration. An appeal process applies to all suspensions.

On this basis, as of April 2013, a total of 45 persons had served a suspension and had registration reactivated, a total of 47 were currently suspended and 65 had accumulated enough penalty points to place them one breach below the threshold limit. On this basis, suspensions equate to 5% of total registered numbers. As yet, there is no clear trend to what proportion of suspended persons would seek to meet the conditions for re-registration after their suspension is served.

I. Compliance and Enforcement
Legislation assigns responsibility for enforcement of compliance by building owners to building control offices within the local authorities, in addition to similar enforcement powers for building standards (including energy performance), workmanship and access for people with disabilities. Building control officers are empowered to carry out inspections and, where necessary, undertake enforcement action in order to ensure compliance. Penalties include a fine of up to 5,000 €, or up to three months in prison, or both.

A key factor in ensuring compliance with the provision of the BER certificate at the time of transaction has been the Law Society of Ireland's Conveyancing (property transactions) Committee direction of 2008 to members (solicitors or notaries) acting for an owner or prospective buyer/tenant, giving a clear instruction on their legal obligations. This has been underpinned by DECLG directions and reminders to building control authorities emphasising their duties to ensure compliance by building owners within their jurisdictions and consequent direct notifications by building control authorities to estate/property vending agencies within their jurisdictions.

Enforcement is complemented by a 'rights based' approach, focussed on creating a compliance culture. Examples of such activities include:

> Major industry awareness campaign over four years: about 200 events, 22,000 attendees.
> Meetings with key industry players and professional bodies.
> Public awareness campaigns in 2010, 2011 and 2012 involving national press, radio and TV advertising. An example is shown in Figure 5.
> SEAI liaison with building control authorities.
> SEAI monitoring of training standards.

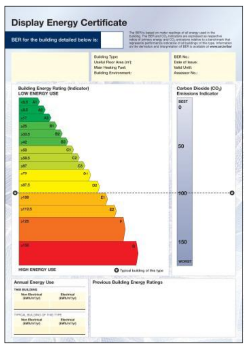
Figure 5: Example of press advertisement highlighting BER.

3.2 Progress and current status on public and large buildings visited by the public
Under the original legislation, the Display Energy Certificate (DEC) requirement was introduced for public service buildings over 1,000 m^2 from January 2009. This is a similar format to the BER in terms of A1-G scale for primary energy and a secondary CO_2 indicator, but is based on the measured energy use in the building compared to a benchmark for similar buildings (benchmarks were obtained for 29 functional types of buildings based mainly on reviewing CIBSE energy performance indicators). The format is shown in Figure 6. The DEC is valid for one year from the date of issue. The calculation tool can be downloaded from the SEAI website.[1]

From the 9th of January 2013, any building in excess of 500 m^2 and frequently visited by the public is required to display either a BER certificate or a DEC in a prominent place clearly visible to members of the public. From the 9th of July 2015, this requirement will be extended to all buildings in excess of 250 m^2 which are frequently visited by the public when occupied by public bodies.

As of December 2012, the number of valid DECs was 99 and there were 75 active

Figure 6: Display Energy Certificate format.



1 *www.seai.ie/Your_Building/BER/Download_Buildings/*

registered DEC assessors. The most typical rating is E1. This represents less than 10% of the estimated number of buildings required to have a DEC. In the two previous years, the numbers had been significantly higher, but in the majority of cases the public bodies concerned had not proceeded to renew and update the DEC after its one year term of validity had lapsed. However, by way of contrast, in pursuit of the public sector provisions within the EU Energy Efficiency Directive (EED), there has been a very high level of co-operation by public bodies in enabling automatic monitoring and reporting of their energy consumption (over 30,000 meters registered, representing over 90% coverage). This system being developed by SEAI, for automatic tracking and reporting of EP improvement, will include a facility for automatic generation of DECs and thus greatly assist towards meeting the dual obligations of the EED and the EPBD.

There is no set fee for DECs and the advice for building owners is to shop around for the best price.

Registration as a non-domestic BER assessor is a precondition for DEC assessors, which in turn entails a prequalification requirement of a NQAI Level 7 Award (equating to ordinary or honours degree) in a building related discipline or equivalent. Candidates must also attend and successfully complete a half day workshop.

Legislation assigns responsibility for enforcement of compliance by building owners/occupiers to building control offices within the local authorities.

3.3 Implementation of mandatory advertising requirement – status

Under the transposing legislation SI 243 of 2012, it is mandatory that all advertising, in print or on-line media, of buildings offered for sale or rental from the 9th of January 2013 must include the BER. SEAI, as the issuing authority, has developed and published guidance on the format of the BER positioning and held information events for the property industry on the requirements which must be followed. Market analysis of compliance rates has not yet been concluded but it is clear that this requirement is being reflected through high visibility of BER ratings on key property websites, press advertisements and property literature.

3.4 Information campaigns

A national information campaign on BER using national press, radio, television and on-line media has been run since 2008. A campaign was run in 2012 to reinforce awareness of the BER, increase compliance, especially within the rental market and particularly highlight the benefits of having a BER. Impact indicators include compliance levels, i.e., BER uptake and web traffic – increased unique visits. An 'omnibus' market assessment survey in early 2013 indicates that 64% of participants (76% of homeowners, 50% of renters) understood the term BER in relation to homes/buildings. This has grown from 55% in 2011 and 30% in 2009. 92% of respondents indicated that the BER would have some influence on their property choice. Moreover, in the 12 month period to April 2013, there have been over 76,000 unique visitors to the BER website and almost 590,000 page viewings.

3.5 Any other relevant information

SEAI in conjunction with the Central Statistics Office (CSO) has put in place an agreement where all registered BERs will be geocoded. This will enable analysis of BER information using Geographical Information Software (GIS).

National programme for energy efficiency renovation and retrofitting of buildings

The Better Energy Programme, administered by SEAI, was established in 2009 aimed at supporting energy efficiency upgrades to buildings and facilities in all end use sectors. To date, there are four strands in the programme:

- Better Energy Homes (BEH) aimed at private households investing in home improvements;
- Better Energy Warmer Homes (BEWH) aimed at low income housing;
- Better Energy Workplaces (BEW) aimed at business and public sector buildings and facilities; and
- Better Energy Communities (BEC) aimed at supporting cross-sectoral actions.

In housing, the supported technologies have included insulation and heating systems (including solar), while in the non-domestic sector there has been a wide range of eligible technologies, with lighting and Heating, Ventilation and Air-Conditioning (HVAC) improvements being most popular. The scheme has leveraged energy certification with the provision of a BER following completion of works becoming mandatory since 2011 in the case of the BEH scheme.

Across the programme, over 315 M€ has been provided in support funding, leveraging investments of 500 M€ in 230,000 buildings to date and estimated annual energy cost savings of over 135 M€, equating to a cumulative lifetime saving of 2,500 M€. Early studies have indicated that the lifetime savings from such investments are typically valued at five times the cost of the initial investment.

This programme is in a process of migrating from a grant based model towards a full market model in conjunction with financial institutions (using "Pay As You Save" (PAYS) and Energy Services Companies (ESCO) type models) and with energy suppliers and service companies.

4. Inspection requirements - heating systems, air-conditioning

Regarding boiler and air-conditioning (AC) inspections, Ireland has chosen option B of articles 14 & 15 of the EPBD recast - information campaigns:

> To develop effective information campaigns and other support actions aimed at encouraging regular inspection and maintenance of residential and commercial boilers and the replacement of inefficient boilers or heating installations.
> To provide advice to users on the replacement of AC systems or on other modifications to the AC system which may include inspections to assess the efficiency and appropriate size of the AC systems.

4.1 Progress and current status on heating systems

National promotional/advertising campaigns are run yearly to promote regular servicing of boilers. An example of a press advertisement from the autumn 2012 campaign is shown in Figure 7. Given that a baseline study had indicated that the bulk of non-domestic boilers received an annual maintenance service, householders have been the target audience for the campaigns. The campaign has used a combination of advertisements in newspapers and journals, radio, television and internet. The advertising directed readers and viewers to a portal web page reinforcing the key benefits of safety and reliability, as well as energy efficiency/cost savings of regular boiler servicing.

As an example of impact, the campaign in 2011 reached daily and Sunday newspapers each with a readership of 3.6 million, broadcast listenership of 3.1 million and online advertising achieved 100,000 visits. The campaign led to an increase of over 20% in visits to the relevant web pages, and the residual effect was sustained for a significant period after the primary campaign ceased. Table 3 shows changing consumer attitudes to the frequency of boiler servicing relative to a pre 2010 baseline, with a significant shift towards more efficient practice. On average, 71% of boilers were serviced annually in 2011 compared to 58% before 2010. The annual 1,047 GWh and 262,988 tonnes CO_2 savings attributable to direct actions including the multiannual media campaign exceed the realistic and hypothetical baselines.

Under the Greener Homes scheme, domestic renewable energy systems - solar, heat pumps and biomass – had been installed in almost 32,000 homes by the end of 2010 and have been assessed to yield annual energy and CO_2 savings of 126 GWh and 56,800 tonnes respectively. A similar scheme for non-domestic heating installations had by the end of 2010 supported 500 installations, yield annual energy and CO_2 savings of 500 GWh and 96,000 tonnes respectively.

Under the Better Energy Homes scheme of grants for efficient heating installations, by December 2012 high efficiency boilers and heating controls upgrades were installed in 33,000 homes. Annual savings attributable to these upgrades are energy and CO_2 savings of 90 GWh and 24,000 tonnes respectively. In addition, the Heating Appliance Register of Performance (HARP) database, on *www.seai.ie/harp*, encourages more efficient choices of home-heating appliances in Ireland.

4.2 Progress and current status on AC systems

Under the original EPBD, inspection of AC systems was addressed by transposing legislation and publication of a procedural manual for inspectors. EPBD recast article 15 enables Member States (MS) to opt to take measures to ensure the provision of advice to users concerning the replacement of AC systems, other modifications to AC systems and alternative solutions to assess the efficiency and appropriate size of the AC system. The overall impact of this approach shall be equivalent to that arising from a regular inspection regime.

***Figure 7:* Example of press advertising of boiler efficiency campaign 2012.**

Table 3: Progression in servicing frequency of domestic boilers.

Servicing frequency	Every Year	Every 2 Years
Pre 2010	49%	18%
2010	57%	11%
2011	64%	14%

An aligned set of actions contributing to improving AC system efficiency in Irish building stock is in place. These consist of actions yielding energy savings and CO_2 abatement of a direct nature from capital investment in high efficiency systems, plus actions of an indirect nature that influence such capital upgrading works or influence improvements to operational AC system efficiency.

Ireland intends to run national communications campaigns in relation to regular servicing of AC systems, using website and trade media. SEAI and key industry stakeholders, including the Institute of Refrigeration Ireland Ltd. and Refrigeration Training Network Ltd., will use F-Gas registration as an important communications channel. In collaboration with industry stakeholders, the campaign will target specialist media streams including web advertising and promotional literature. The campaign will direct AC system operators to appropriate resources and networks which will link to the web sites and panels of specialist AC system maintenance service providers maintained by key stakeholders.

An effective communications campaign coupled with other support actions will encourage regular inspection of AC systems with associated maintenance, modification and replacement of inefficient installations.

Under the EC F-Gas and Ozone Depleting Substances (ODS) regulations, currently 143 businesses have an F-Gas certificate to install, maintain or service stationary refrigeration, stationary fire protection systems and extinguishers, air-conditioning and/or heat pump equipment containing or designed to contain F-Gas refrigerants.

The on-line Triple E product register of energy efficient products at *www.seai.ie/aca*, sets minimum criteria that products must meet to be listed. These criteria are regularly updated, and aim to ensure that only the top 10 - 15% most energy efficient products in any technology are listed. Installers must also pass up-to-date, relevant training, and, in some circumstances, approved manufacturer training as well.

SEAI provides information and advice services to non-domestic sectors including large industry and Small Medium Enterprises (SMEs). Included in these programmes are information and advice highlighting high efficiency technologies and operational and maintenance practices to maximise AC system efficiencies.

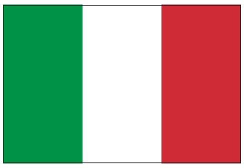
5. Conclusions and future plans

While achieving considerable success in establishing ambitious Energy Performance (EP) requirements and a robust and widely recognised 'Building Energy Rating' (BER) system, there are a number of remaining and new challenges and associated plans for strengthening the implementation of the Energy Performance of Buildings Directive (EPBD) in Ireland. These include:

- adopting and implementing the cost-optimal methodology for setting new performance standards;
- establishment, training and enforcement of the Nearly-Zero Energy Buildings (NZEB) definition;
- achieving robust compliance with EP requirements for new buildings and major renovations;
- achieving robust compliance and enforcement of BER in the property rental market;
- maintaining public awareness of BER through campaigns and consumer advocacy, including enforcement of the advertising requirement;
- strengthening the functionality and guidance value of advisory reports accompanying BERs;
- further leveraging BERs and advisory reports in building renovation programmes;
- expansion of BER Quality Assurance (QA) activity: impact on assessors, disciplinary consequences of penalty points system;
- support and promotion of Display Energy Certificate (DEC) compliance in publicly visited buildings;
- Irish localisations of dynamic simulation models for non-domestic buildings;
- continuous service functionalities and improvements of the ICT tools;
- achieving growing market leverage of BERs towards energy efficiency upgrading investments, through informational, financial and institutional measures;
- designing and delivering appropriate campaigns for regular servicing of boilers and air conditioning (AC) systems, and where appropriate, for replacement;
- review and public consultation on the operation of the BER system.

EPBD implementation in Italy

STATUS AT THE END OF 2012



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1. Introduction

In Italy, the overall responsibility for the implementation of the Energy Performance of Buildings Directive (EPBD) rests with the Ministry for Economic Development.

The first decree setting the basis for the national legislative EPBD framework was enacted in 2005. After that, a number of legal acts (legislative, ministerial and presidential decrees) have been issued to progressively define and specify all aspects of the national EPBD transposition.

According to the Constitution, energy-related topics are a shared task between the State and the 21 Regions and Autonomous Provinces. Consequently, regional authorities may implement autonomous transpositions of the EPBD, as long as they do not contradict the general principles and requirements provided by national and EU regulations. The national regulation stays in force for those regions which have not published their own legislation. At present, 11 Regions and Autonomous Provinces (Liguria, Emilia Romagna, Toscana, Val d'Aosta and Lombardia, Friuli Venezia-Giulia, Puglia, Sicilia, Toscana and the Autonomous Provinces of Trento and of Bolzano) out of 21 have enacted their local transposition of the EPBD. All the others follow the national legislation. At the end of 2012, 6 Regions (Liguria, Emilia Romagna, Toscana, Val d'Aosta, Lombardia and the Autonomous Province of Bolzano) have transposed the EPBD recast.

2. Energy performance requirements

This report presents an overview of the current status of implementation of the EPBD at national and regional level, and of the plans for its future evolution.

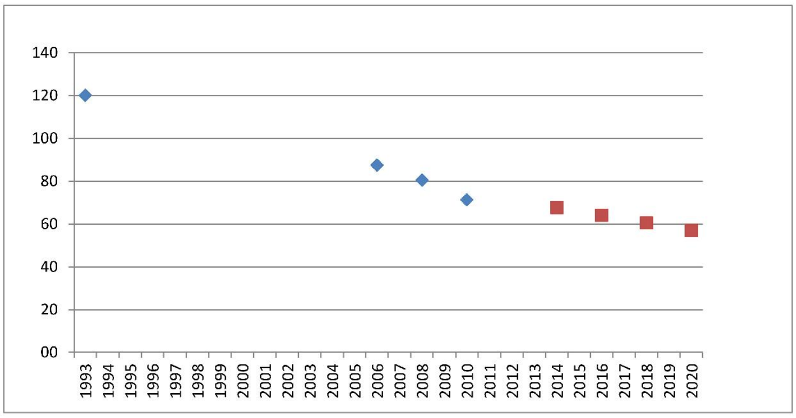
2.1 Progress and current status
Except for the inspection of air-conditioning systems, the Legislative Decree 192/2005 has drawn the general framework for the transposition of the EPBD at national level, setting the minimum requirements for the Energy Performance (EP), and the U-values for windows, walls, floors and roofs, in case of new buildings and major renovations. In 2009, the Presidential Decree n. 59 extended the calculation methodologies and minimum requirements to the summer EP of cooling and lighting systems; it also updated the minimum requirements for the EP of buildings and of heating systems.

With the Legislative Decree 28/2011 transposing the Renewable Energy Services (RES) Directive, the requirements regarding the share of renewable energy for new buildings and major renovations were increased, establishing a calendar with a progressively larger share of renewable quota for Domestic Hot Water (DHW), heating and cooling energy demand:

a) 20% renewable quota for all building permits requested between the 31st of May 2012 and the 31st of December 2013;
b) 35% renewable quota for all building permits requested between the 1st of January 2014 and the 31st of December 2016;
c) 50% renewable quota for all building permits requested from the 1st of January 2017 onwards.

National Websites *www.sviluppoeconomico.gov.it, www.enea.it*

Figure 1: Estimate of the decrease of the maximum legal EP over time for a new building with a shape factor of 0.5 in climatic zone E.



A draft regulation has been developed to introduce newly defined cost-optimal building performance requirements and the nearly-zero energy concept, as well as the new standard values for cooling, ventilation and lighting; the last one only for non-residential buildings.

2.2 Format of national transposition and implementation of existing regulations

Requirements for new buildings

Since January 2010, after a transition phase with intermediate requirements, new residential and non-residential buildings must fully comply with the minimum requirements for winter performance, set by the Legislative Decree 192/2005. EP values vary according to building type (EP for residential buildings is expressed in terms of kWh/m^2.year of primary energy, while EP for non-residential buildings is expressed in terms of kWh/m^3.year of primary energy), climatic zone, local degree days, and surface area to volume ratio of the building, as depicted in Tables 1 and 2. Tables 3 and 4 show the EP requirements for summer cooling as set by the Presidential Decree 59/2009.

Figure 1 shows how the EP requirements for a new building with a shape factor of 0.5 in climatic zone E have changed until 2010. In 1993, the requirements set the EP to approximately 120 kWh/m^2.year; in 2006, new EPBD requirements were introduced and were progressively reduced every 2 years until 2010 (87.5 kWh/m^2.year in 2006, 80.5 kWh/m^2.year in 2008, 71.2 kWh/m^2.year in 2010). In red, a projection until 2020 is illustrated, with approx. 5% decrease every 2 years.

Furthermore, in case of new buildings and major renovations, the designer is expected to:

> introduce compulsorily window sun shades, and calculate their contribution to the winter and summer performance;
> either check that i) the mass of the external walls, except North-East to North-West, is larger than 230 kg/m^2, or that ii) their value for periodic thermal transmittance (a dynamic parameter introduced with the Standard UNI EN ISO 13786:2008) is lower than 0.12 W/m^2.K;
> check that the periodic thermal transmittance for North-East to North-West external walls only, is lower than 0.20 W/m^2.K.

Requirements for existing buildings

Minimum requirements are differentiated according to the degree of the planned renovation. The minimum EP requirements for new buildings apply fully in case of:

> demolition/reconstruction or renovation of all the building elements (for buildings with heated floor area > 1000 m^2);
> building enlargements over 20% of the original volume, only for the newly built section.

In case of any degree of refurbishment, a set of basic requirements applies to single building elements (e.g., Table 5 shows the minimum U-values for different building elements).

Already in 2006, the minimum requirements for systems had been regulated. In case of renovation of the heating system, just as with new systems, the seasonal efficiency should be higher

Table 1: Minimum EP requirements for heating in residential buildings (kWh/m^2).

surface area to volume ratio	Climatic zones (by degree days)									
	A	B		C		D		E		F
	≤600 dd	*>601 dd*	*≤900 dd*	*>901 dd*	*≤1400 dd*	*>1401 dd*	*≤2100 dd*	*>2101 dd*	*≤3000 dd*	*>3000 dd*
≤0.2	**8.5**	**8.5**	**2.8**	**12.8**	**21.3**	**21.3**	**34**	**34**	**46.8**	**46.8**
≥0.9	**36**	**36**	**48**	**48**	**68**	**68**	**88**	**88**	**116**	**116**

Table 2: Minimum EP requirements for heating in non-residential buildings (kWh/m^2).

surface area to volume ratio	Climatic zones (by degree days)									
	A	B		C		D		E		F
	≤600 dd	*>601 dd*	*≤900 dd*	*>901 dd*	*≤1400 dd*	*>1401 dd*	*≤2100 dd*	*>2101 dd*	*≤3000 dd*	*>3000 dd*
≤0.2	**2**	**2**	**3.6**	**3.6**	**6**	**6**	**9.6**	**9.6**	**12.7**	**12.7**
≥0.9	**8.2**	**8.2**	**12.8**	**12.8**	**17.3**	**17.3**	**22.5**	**22.5**	**31**	**31**

than (75 + 3 log Pn)%, where Pn is the nominal output power of the boiler. In case of boiler substitution, the minimum boiler efficiency (at maximum nominal power) should be higher than (90 + 2 log Pn)%.

Today, heat pumps are regulated too. In case of heat pumps, the minimum efficiency should be higher than (90 + 3 log Pn)%, where the heat pump efficiency is the ratio of the delivered energy to the electric energy converted to primary energy, according to the national conversion rate. The efficiency will be higher than 1 whenever the Coefficient of Performance (COP) of the heat pump exceeds the conversion rate.

Minimum requirements in specific Regions

When designing their local EPBD implementation, regional governments and Autonomous Provinces are allowed to set stricter minimum requirements. Table 6 shows the state of EPBD implementation among Regions and Autonomous Provinces.

Requirements for public buildings

Public authority buildings are expected to set an example, and to play a leading role. Therefore:

> EP and U-values are set 10% lower than those required for private buildings;
> seasonal efficiency for heating systems should be higher than (75 + 4 log Pn)%;
> only centralised heating systems are allowed.

The leading role of public buildings in the progression to nearly zero-energy performance has been emphasised in the National Energy Efficiency Action Plan (NEEAP). In order to promote and support energy efficiency measures in the public sector, the NEEAP foresees that an observatory will be set up. The aim of this observatory will be to build a reference framework on the status of implementation of energy efficiency programmes and their effectiveness at local level, as well as to support the process of defining policies and specifying the implementation measures in a system shared among institutions and stakeholders, both public and private.

Climatic zones (by degree days)					
A	B	C	D	E	F
<600	*from 601 to 900*	*from 901 to 1400*	*from 1401 to 2100*	*from 2101 to 3000*	*over 3000*
40	40	30	30	30	30

Table 3: Minimum EP requirements for cooling in residential buildings (kWh/m²).

Climatic zones (by degree days)					
A	B	C	D	E	F
<600	*from 601 to 900*	*from 901 to 1400*	*from 1401 to 2100*	*from 2101 to 3000*	*over 3000*
14	14	10	10	10	10

Table 4: Minimum EP requirements for cooling in-non residential buildings (kWh/m³).

	U-values (W/m².K)				
Climatic zones	walls	roof	floors	windows	window glass only
A	0.62	0.38	0.65	4.6	4.6
B	0.48	0.38	0.49	3.0	3.0
C	0.40	0.38	0.42	2.6	2.6
D	0.36	0.32	0.36	2.4	2.4
E	0.34	0.30	0.33	2.2	2.2
F	0.33	0.29	0.32	2.0	2.0

Table 5: Minimum required U-values for building elements (W/m².K).

Regions and Autonomous Provinces	**Regional EPBD regulation**	**Regional EPBD recast regulation**		**Issued EPCs***	**EPC database***
Abruzzo				1,151	○
Basilicata				-	○
Bolzano	●	●		6,364	○
Calabria				334	
Campania				4,000	
Emilia-Romagna	●	●		260,000	●
Friuli Venezia-Giulia	●			12,400	●
Lazio				29,700	○
Liguria	●	●		66,329	○
Lombardia	●	●		710,000	●
Marche				-	
Molise				-	
Piemonte	●			233,931	●
Puglia	●			2,300	○
Sardegna				2,500	
Sicilia	●			3,181	○
Toscana	●	●		16,000	○
Province of Trento	●			1,644	○
Umbria				3,255	○
Valle d'Aosta	●	●		2,854	●
Veneto				19,080	○
				1,375,023	

● active
○ in course of development

*CTI report 2012

Table 6: State of EPBD implementation among Regions and Autonomous Provinces.

Calculation methodologies of EP of buildings
EP calculation methodologies refer to the National Standard UNI TS 11300, which is an application of the European Standard EN ISO 13790:2008. Regional calculation methodologies refer almost entirely to the National Standard, while only Lombardia and the Autonomous Province of Bolzano adopted standards derived directly from the EN ISO 13790:2008.

Compliance and Quality Assurance (QA)
The compliance check of minimum requirements is performed systematically by municipal authorities. In fact, building owners are required to present to the municipal authority a technical report showing EP and thermal transmittance calculations. The issue of the building permit is bound to such a compliance check. Local authorities may carry out on-site visits during or after the construction works. A final report signed by an engineer confirming compliance with the town planning rules, the construction regulations and the EP requirements, is also compulsory.

Monitoring activities
The Ministries of Economical Development and of Environment, as well as the regional governments, monitor the state of implementation of the EPBD, and periodically provide a report to the Parliament.

2.3 Cost-optimal procedure for setting EP requirements
The Ministry for Economical Development is coordinating a working group for the definition of the reference buildings and the development of a comparative methodology. ENEA, the National Energy Agency, the Italian Thermo technical Committee (CTI) and the regional governments are involved in the working group. Results are expected in late 2013.

2.4 Action plan for progression to NZEB
The Second National Energy Efficiency Action Plan, issued in July 2011, carried some preliminary milestones for setting a national strategy for Nearly Zero-Energy Buildings (NZEB). Namely, it is stated that:

> New minimum requirements for building EP and for building elements will be set: the requirements should be laid down with a view to achieving cost-optimality.
> Incentive schemes: the Ministry of Economy and Finance, and the Ministry for Economical Development shall join in a task force to programme and manage a national incentive scheme.
> Social housing: introduction of an incentive/bonus for projects adopting innovative solutions (cool roof, active building envelope systems, etc.), integration of renewables, use of ecologic components and materials, optimisation of local economic resources.
> Introduction of standardisation in the use of Building Energy Management Systems (BEMS) for public buildings.
> Residential buildings: focus on the cluster of existing buildings built before 1976 (which sums up to more than 70% of all buildings). Provide incentives through low interest rate revolving fund schemes for renovations leading to a 50% decrease in energy consumption.
> Stakeholders involvement: the National Energy Agency (ENEA) will involve stakeholders in working groups, with the goal of proposing new lines of action.
> An observatory will be set up in order to monitor the effectiveness of the programmes and schemes.
> School buildings: simplified procedures to involve Energy Service Companies (ESCOs).

2.5 Any other relevant information
There is an incentive scheme launched in 2007 and still in operation, based on a tax credit for an amount equal to 55% of the investment in building energy renovation. ENEA provides regular reports on the state of implementation of this incentive. Latest official results refer to 2010, with:

> 4,600 M€ total investments;
> 2,000 GWh primary energy savings;
> 430,000 ton CO_2/year avoided emissions.

An extension of the tax rebate mechanisms is proposed by the National Energy Strategy released by the Ministry for Economic Development in October 2012, and under public consultation at the end of 2012. The same document states the will to further improve energy efficiency and to promote it with incentives, by:

> tightening the minimum requirements in building and transport sectors;
> providing direct incentives for public buildings renovations;
> strengthening the White Certificates mechanism, which proved to be effective so far.

The two last items have already been implemented through two ministerial decrees published on the 28th of December 2012.

3. Energy performance certificates

Regional authorities may implement autonomous transpositions of the EPBD, and regional EP certification schemes, as long as these do not contradict the general principles and requirements provided by national and EU regulations (Figure 2). Before 2012, it was allowed to omit the certification of a building if its performance was in the lowest class (G). A ministerial decree issued on the 22nd of November 2012 has eliminated this possibility.

3.1 Progress and current status on sale or rental of buildings

According to the Decree 28/2011, in sale and rental contracts (of buildings or single units, e.g., apartments or individual offices), a specific clause must be added confirming that the buyer or manager has received information and documents concerning the building's Energy Performance Certificate (EPC). Up to now, in case of rental, it was not compulsory to produce this certification, unless a certificate was already available (in cases of newly constructed or recently sold buildings). A new draft regulation extends the certification to all buildings when rented. In the Regions of Emilia-Romagna, Lombardia and Piemonte, and in the Autonomous Province of Bolzano, the EPC must be appended to all sale and rental contracts.

The legal validity of an energy certificate is 10 years. The EPC needs to be updated whenever the building envelope or systems are modified.

According to the CTI report 2011 on the state of implementation of the EPBD in Italy, 1,375,000 EPCs (710,000 in Lombardia alone) had been delivered in 18 of the 21 Regions and Autonomous Provinces.

Supervision and administration system

The Italian EPC administration system is based on regional systems with distinct registries and databases. Six regional EPC databases have been put in place until the end of 2012, while 11 will be implemented in the future, as shown in the map (Figure 3).

EPC format

The building EP is expressed in terms of primary energy in kWh/m^2.year for residential buildings, and in kWh/m^3.year for non-residential buildings, with classes ranging from A+ to G. The building performance is expressed for the whole energy used in the building, and for the single end uses: heating, DHW, cooling. The global Energy Performance (EP_{gl}) is the sum of partial EP indicators.

Figure 5 shows the standard graphic layout of the dashboard. While the EP for heating is calculated in terms of primary energy, in case of summer cooling, the EP refers to the load only because the system performance is not considered. The summer EP is calculated as prescribed by the Standard UNI/TS 11300, and expressed in terms of kWh/m^2.year for dwellings, and in terms of kWh/m^3.year for all other uses. In a later phase, lighting will be considered, for non-residential buildings only.

The Regions of Emilia-Romagna, Liguria, Lombardia, Piemonte, Valle d'Aosta and the Autonomous Provinces of Trento and Bolzano have developed different regional EPC formats.

Figure 2: In gray: regional EPBD regulations.

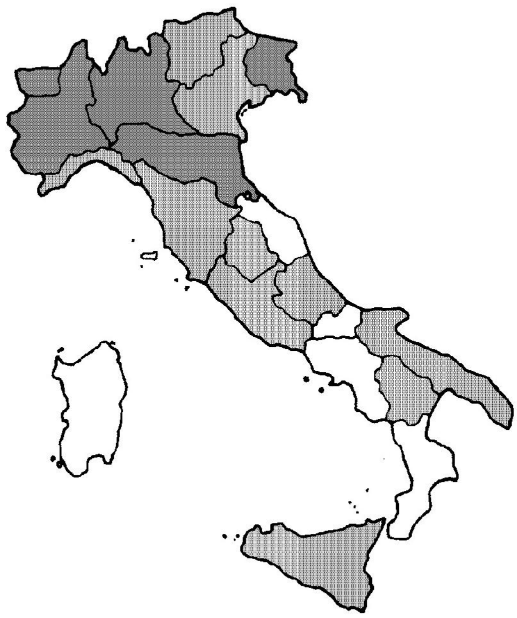


Figure 3: Dark grey: existing regional EPC databases; light gray: oncoming regional EPC databases.

Figure 4: National EPC format.

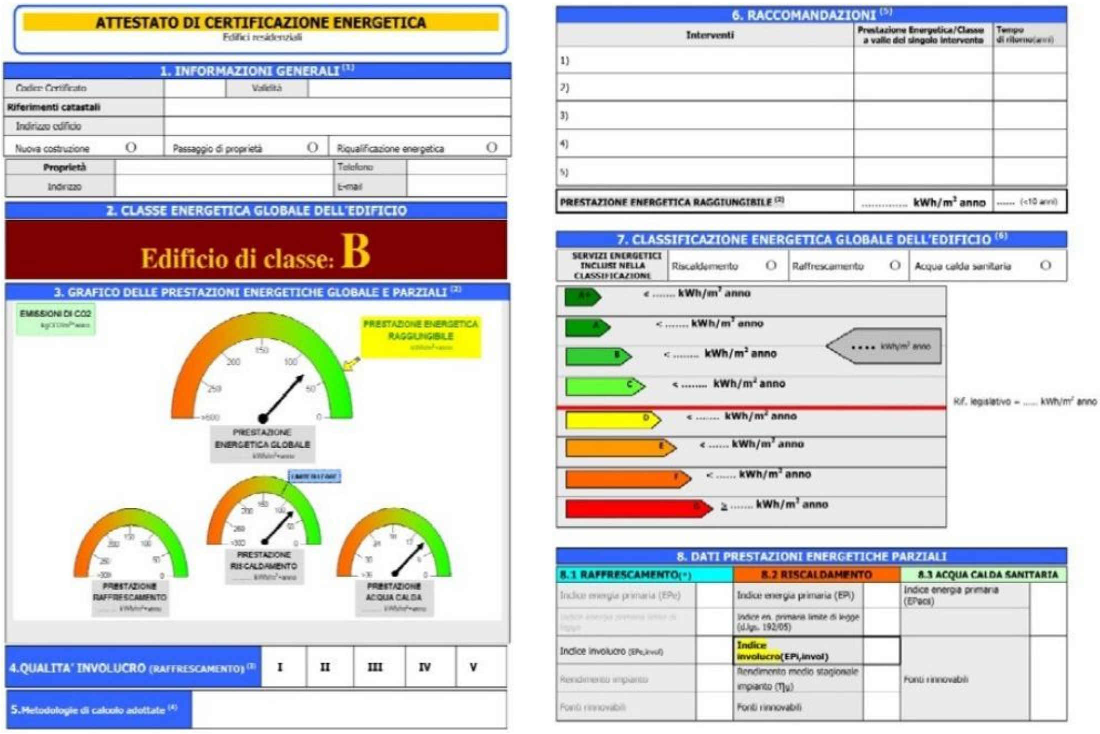
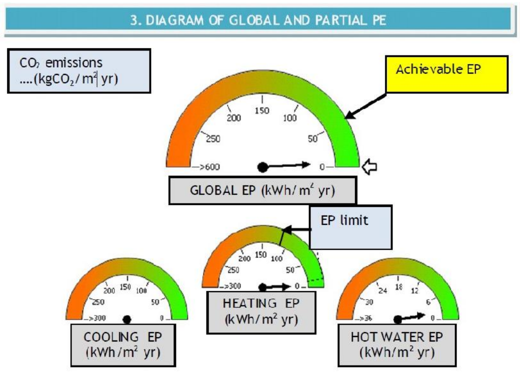


Figure 5: EPC dashboard with overall and single use EP.



Recommendations are summarised on page 2 of the certificate: for each action proposed specifically for the certified building, the EP, class improvement, and payback time are provided.

EPC activity levels - Profile of EPC grades
The structuring of the EP classes in the Italian procedure is based on percentage variations in respect to a reference, expressed by the EP minimum requirements for new buildings: the class corresponding to the minimum EP requirements (and up to 25% less) is class C, while, for example, class B is more than 25% up to 50% less than the minimum EP requirements. In some Regions (namely Emilia-Romagna, Lombardia, Piemonte, Valle d'Aosta and the Autonomous Provinces of Trento and Bolzano), the classes are expressed in terms of absolute values, unrelated to the minimum requirements.

The classes for DHW are defined in absolute terms.

Heating classes are defined with reference to the minimum EP requirements, which came into force on the 1st of January 2010. The EP of a class varies with the climatic zone and with the shape factor of the building (ratio of envelope surface to heated volume).

The summer EP is evaluated on the basis of the building cooling load. The classes are defined as shown in Table 9.

Table 7: Global classes (in relation to the minimum global requirements).

	Class A+	$< 0.25\ EP_{Lim\,(2010)} + 9\ KWh/m^2$.year
$0.25\ EP_{Lim\,(2010)} + 9\ KWh/m^2$.year $\leq$	**Class A**	$< 0.50\ EP_{Lim\,(2010)} + 9\ KWh/m^2$.year
$0.50\ EP_{Lim\,(2010)} + 9\ KWh/m^2$.year $\leq$	**Class B**	$< 0.75\ EP_{Lim\,(2010)} + 12\ KWh/m^2$.year
$0.75\ EP_{Lim\,(2010)} + 12\ KWh/m^2$.year $\leq$	**Class C**	$< 1.00\ EP_{Lim\,(2010)} + 18\ KWh/m^2$.year
$1.00\ EP_{Lim\,(2010)} + 18\ KWh/m^2$.year $\leq$	**Class D**	$< 1.25\ EP_{Lim\,(2010)} + 21\ KWh/m^2$.year
$1.25\ EP_{Lim\,(2010)} + 21\ KWh/m^2$.year $\leq$	**Class E**	$< 1.75\ EP_{Lim\,(2010)} + 24\ KWh/m^2$.year
$1.75\ EP_{Lim\,(2010)} + 24\ KWh/m^2$.year $\leq$	**Class F**	$< 2.50\ EP_{Lim\,(2010)} + 30\ KWh/m^2$.year
	Class G	$\geq 2.50\ EP_{Lim\,(2010)} + 30\ KWh/m^2$.year

EPC costs
The cost of an EPC is not subject to predefined tariffs. The average EPC cost for a flat ranges from 130 € to 300 €, according to the city and the taxes/costs imposed by the respective regional scheme.

Assessor corps
The Decree 115/2008 establishes the requirements for assessors: they must be building and system designers registered in their professional association. Regional governments and Autonomous Provinces may include other professional figures among those able to deliver EPCs, after training and final examination. In the CTI Report 2012, there were 42,200 registered assessors in 8 Regions.

In the Regions of Liguria, Lombardia, Puglia, Valle d'Aosta and the Autonomous Provinces of Bolzano and Trento, attendance of a training course is mandatory. Piedmont accepts as assessors engineers and architects registered in their professional associations, and requires a mandatory course and exam for the other categories of experts. Bolzano has adopted a continuous training scheme. Lombardia and Emilia-Romagna are also implementing a similar training configuration scheme.

The Autonomous Province of Bolzano has adopted EPC delivery and quality assessment procedures which are significantly different from other regions: the EPC may be only delivered by the CasaClima Agency, which manages calculations, controls, and assessment and delivery procedures.

Compliance levels
In a few Regions, there is information about pilot compliance checks underway, but no official report is available.

Enforcement with building owners - sale, rental
In case of sales, the responsibility for the main procedure of an enforcement strategy lies with the notary, who has to check the existence of the EPC document, and to mention it in the sale act. A second procedure, in case of existing buildings, is binding the access to financial support schemes to the requirement to have an EPC: the enforcement is then a control mechanism on the efficient expenditure of public money.

Table 8: Domestic Hot Water requirements (residential buildings).

	A_{DHW}	< 9 KWh/m^2.year
9 KWh/m^2.year ≤	**B_{DHW}**	< 12 KWh/m^2.year
12 KWh/m^2.year ≤	**C_{DHW}**	< 18 KWh/m^2.year
18 KWh/m^2.year ≤	**D_{DHW}**	< 21 KWh/m^2.year
21 KWh/m^2.year ≤	**E_{DHW}**	< 24 KWh/m^2.year
24 KWh/m^2.year ≤	**F_{DHW}**	< 30 KWh/m^2.year
	G_{DHW}	≥ 30 KWh/m^2.year

Table 9: Performance classes for cooling.

EPe, envelope (kWh/m^2)	**Evaluation**	**Performance class**
$EP_{e,\ envelope}$ < 10	Optimal	I
10 ≤ $EP_{e,\ envelope}$ < 20	Good	II
20 ≤ $EP_{e,\ envelope}$ < 30	Medium	III
30 ≤ $EP_{e,\ envelope}$ < 40	Sufficient	IV
$EP_{e,\ envelope}$ ≥ 40	Poor	V

Quality assessment
The management of a quality assessment system for the EPC is the responsibility of the Regions, which have to guarantee the compliance with the national quality standard.

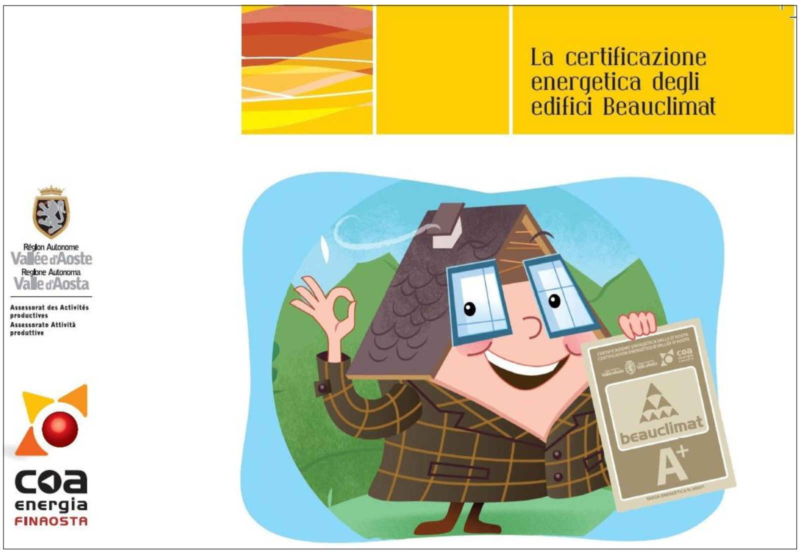
Independence of assessors
Assessors should have no direct or indirect involvement in the design or construction process of the assessed building, nor with material and component suppliers, nor with any sort of benefit possibly obtained by the owner. In case of a simple boiler substitution, the renewal of the certificate may be issued by a technician from the boiler supplier, or by the installer.

In case of new buildings, the person in charge of the energy certification process must be nominated before the building works begin.

Sanctions
In the case that the EPC is not compliant with the allowed methodologies, or is falsified, the author of the EPC is sanctioned with a fine (the national legislation indicates an amount corresponding to 30% to 70% of the EPC cost, calculated according to the standard professional tariffs). In case of a falsified EPC, the authority enforcing the sanction communicates it to the professional association for further disciplinary measures. Lombardia, Piemonte, Liguria and Valle d'Aosta have adopted different legislative solutions in terms of sanctions (actual amounts of fines according to the floor area of the building). In Lombardia, sanctions have been applied with success.

Figure 6: Info campaign in Emilia-Romagna.

Figure 7: Info campaign in Valle D'Aosta.



3.2 Progress and current status on public and large buildings visited by the public
Public buildings include buildings owned by the State, Regional or Local Administrations, or other public organisations, as well as any building not publicly owned that is used by a public body.

Any public building with a floor area larger than 1,000 m² is required to display the EPC in a place clearly visible to the public: in most Regions, public buildings have the same obligation to be certified as all other buildings, but there is no deadline for compliance, nor any fine for non-compliance with this requirement. However, Valle d' Aosta decided that all public buildings had to be provided with an EPC by the 31st of December 2012. Lombardia has also promoted the certification of public buildings and, by January 2012, there were 4,650 public buildings displaying an EPC.

Moreover, an EPC has to be issued within six months after the signature of an energy service contract proposing energy efficiency investments. The EPC has to reflect the improvements achieved by the implemented measures. In the case of public buildings, an EPC has to be issued at the signature of any new energy service contract.

3.3 Implementation of mandatory advertising requirement – status
The Law 28/2011 introduced the obligation of displaying the EPC class of buildings or flats in sale advertisements, and is in force since January 2012. However, no sanctions are foreseen for non-compliance. In Lombardia, the obligation extended to rental advertisements; sanctions have been set in case of negligence.

A recent national survey carried out by an important private operator in the field of property sales, reported that, in 2012, 53% of the sale advertisements and 37% of the rental ads have included building EPC information.

3.4 Information campaigns
Regional information campaigns are launched autonomously. Emilia-Romagna and Valle d'Aosta have recently published guidelines explaining and promoting the use of the EPC, as shown in Figures 6 and 7.

4. Inspection requirements - heating systems, air-conditioning

Boiler inspections campaigns were launched in Italy in 1993, as required by the Law 10/1991. A new inspection decree on boiler and air-conditioning (AC) systems will soon come into force: the drafting procedure of the decree is almost finalised. The approach for cooling systems follows the same line as that applied since 1993 for heating systems.

4.1 Progress and current status on heating systems
According to the existing national inspection scheme, the building owner/user is responsible for the periodic maintenance of the heating system, which has to be performed by qualified maintenance staff. The measurement of combustion efficiency, among other maintenance operations and safety

checks, is carried out according to the National UNI Standard 10389. Maintenance and energy efficiency assessment are compulsory, their frequency varying according to fuel used, boiler nominal power, age, and specific safety requirements.

An inspection report is filled out by the maintenance staff and is delivered to the Local Administration, which is in charge of the compliance control. The control consists of documental checks on the received reports, and of on-site verifications on a sample of the systems.

Regions and Autonomous Provinces have further detailed the national rules. Local Administrations are in charge of implementing a report inventory.

Quality Assurance
Regions and Autonomous Provinces can establish methods for gathering the data needed to set an inventory of their heating systems. Local authorities can assign the control procedures to external qualified bodies meeting the requirements of independence fixed by law. The control staff can be trained by public and private organisations, according to a programme defined by ENEA; this staff must also pass an examination. On the other hand, maintenance operators are trained through entrepreneurial associations.

Impact assessment
In a medium up to a long-term assessment period, one can see that the percentage of regularly maintained systems has progressively increased from 50-60% in 1998, to 80-90% by 2012. Local Administrations have generally experienced difficulties in providing regular on-site controls, but there are positive examples, where up to 5% of the total systems were checked every few years. Studies performed by some Local Administrations (the City of Florence, for example) estimate that the potential savings are as high as 6% of the overall heating consumption.

As anticipated, a new regulation on inspection and control will soon come into force. The main change will be the periodicity of inspections (Table 10) and controls (Table 11). The future regulation foresees that control checks on inspection reports may fully substitute on-site visits for gas systems with power lower than 100 kW.

Table 10: Periodicity of efficiency assessment on boilers (new decree).

System	System type - fuel	Power range [kW]	Frequency (years)
Flame generator	Liquid or solid fuel	10<P<100	2
		P≥100	1
	Gaseous fuel	10<P<100	4
		P≥100	2
Heat pump	Compression heat pump coupled to electric engine	12<P<100	4
		P≥100	2
	Compression heat pump coupled to endothermic engine	P≥12	4
	Absorption heat pump	P≥12	2
District heating	Heat exchange substation	P>10	4
CHP	Micro CHP	$P_{el}<50$	4
	Cogenerative units	$P_{el}\geq 50$	2

Table 11: Periodicity of control on heating systems (new decree).

Heating system	Frequency of control
Liquid and solid fuel P >100 kW	Every 2 years
Gas P >100 kW	Every 4 years
Liquid and solid fuel 10 kW < P < 100 kW	Every 4 years
gas 10 kW < P < 100 kW	Every 4 years (check on reports)

Table 12: Periodicity of efficiency assessment on AC systems (new decree).

System	System type - fuel	Power range [kW]	Frequency (years)
AC systems	Vapour-Compression and absorption cooling systems	12 < P <100	4
		P ≥ 100	2

Table 13 : Periodicity of control on AC systems (new decree).

AC system	Frequency of inspection
P >100 kW	Every 4 years
12 kW < P < 100 kW	Every 4 years (check on reports)

4.2 Progress and current status on AC systems

So far, no required inspection of AC systems is in place.

According to the new decree expected to be published in 2013, cooling system inspections shall follow the same procedures set for heating systems inspections. Tables 12 and 13 show the periodicity for mandatory energy efficiency checks, and for control procedures. As the operational phase has not started yet, no impact assessment can be provided.

5. Conclusions and future plans

The decrees set by the Ministry for Economic Development to transpose the recast Energy Performance of Buildings Directive (EPBD) defined the milestones which will gradually lead the building sector towards the Nearly Zero-Energy Buildings (NZEB) era. These two decrees shall introduce the detailed definition of these concepts in the national context, and shall impose the new cost-optimal requirements.

The National Energy Efficiency Action Plan (NEEAP) and the National Energy Strategy define a roadmap to tackle the renovation of the existing building stock. The performance of the refurbished buildings will get closer to the NZEB definition. The proposed pathway foresees the relevant involvement of private capital, e.g., refurbishment of school buildings through Energy Performance Certificates (EPCs) guaranteed by Energy Service Companies (ESCOs), as well as the use of financially sustainable incentive programmes, such as the revolving funds, which will be devoted to promote retrofitting of the oldest and less efficient residential buildings, those for which the payback time of the investment is shorter. The revolving funds are a financing scheme which must be repaid; the refunded loans can be re-issued to new applicants. For social housing, the new decrees foresee the introduction of incentives for cost-effective technical solutions.

The recent Decree for the promotion of energy efficiency measures in public buildings, the ‘Conto Energia Termico', sets the conditions for providing public authorities with the financial resources for getting the desirable leading role in the improvement of Energy Performance (EP) of public buildings, as called for by the EPBD. The public administrations can recover up to 40% of the investment costs for thermal insulation and refurbishment.

The 55% tax rebate for the energy retrofitting of private buildings will be in force until the 30th of June 2013, and shall then be lowered to 36%. Possible revisions to this incentive will be made, in order to improve its cost-effectiveness.

EPBD implementation in Latvia

STATUS AT THE END OF 2012

Authors

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Ministry of Economics (ME)

1. Introduction

The implementation of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) in Latvia is the overall responsibility of the Ministry of Economics. The Ministry of Economics develops and implements energy efficiency policy including the transposition of the EPBD.

All laws and regulations for the transposition of the EPBD were adopted in 2009 and are still in force at the end of 2012. The necessary laws and regulations for transposition of the recast EPBD (2010/31/EC) are under development and adoption: the new Law on the Energy Performance of Buildings (LEPB) was drafted by the Ministry of Economics and adopted in the *Saeima* (Latvian Parliament) on the 6^{th} of December 2012. The Law provides norms for transposition of the recast EPBD as well as some new approaches for certification of building parts and inspection of heating and air-conditioning systems. The transposition is expected to be in place by the 30^{th} of June 2013 and the cost-optimal requirements by the end of 2013.

This report presents an overview of the current status of transposition and implementation of the EPBD in Latvia. It addresses Energy Performance (EP) requirements, energy performance certification requirements and inspection of heating and air-conditioning system requirements, as well as future plans.

2. Energy performance requirements

With regard to new building requirements, there is an active discussion ongoing and opinions vary. Currently, Latvia is in the process of carrying out a detailed examination of the situation.

2.1 Progress and current status

The EP requirements are set out for external envelope structures of buildings.

Before 1980, building envelope characteristics were based on calculations to prevent moisture forming on the inner surface of the outer walls and to prevent freezing through the walls. For properly constructed buildings, the envelope heat transfer coefficient U value was usually less than 1.3 W/m^2.K. From 1980, buildings were built in accordance with a formal USSR Standard for the thermal resistance of envelope, e.g., improving wall U values to 1.1 W/m^2.K. Significantly more demanding requirements were adopted by the Ministry of Architecture and Construction of the Republic of Latvia in September 1991. Since 2003 until now, the Latvian Building Norm LBN 002-01 'Thermal requirements of the buildings envelopes' (approved by the Cabinet of Ministers on the 27^{th} of November 2001) has been in force.

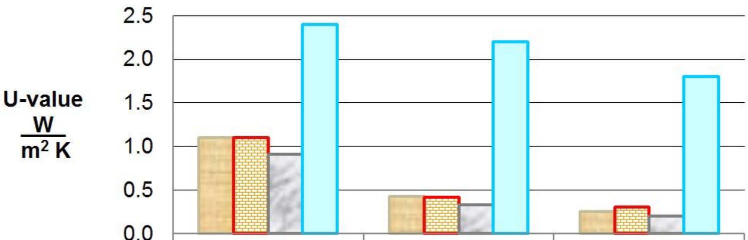
The changes of requirements of building envelope for residential buildings are shown in Table 1 and Figure 1. In accordance with the EC regulation

National Website *www.em.gov.lv*

***Table 1:* Change of requirements for the building envelope for residential buildings and approximate energy consumption for heating.**

Element of envelope		1980	1992	2003
Roofs and external coverings	W/m².K	0.90	0.25 – 0.40	0.2 k*
Floors on the grounds		-	0.5	0.25 k
Walls with mass less than 100 kg/m²		1.1	0.33 – 0.50	0.25 k
Walls with mass 100 kg/m² or more				0.3 k
Windows, doors and glazed walls		2.4	1.9 – 2.4	1.8 k
Thermal bridges		-	-	0.2 k
Temperature factor* ***k* *= 19/(Θ_{int} – Θ_e), depending on the climate zone for dwellings, k ranges from 0.95 (southwest) to 1.09 (northeast)*				
Energy consumption for heating	kWh/m².year	150 – 200	100 – 130	70 – 90

Figure 1: Normative U-values for residential houses.



	1979	1992	2003
Walls (heavy)	1.1	0.42	0.25
Walls (light)	1.1	0.42	0.30
Roofs	0.9	0.33	0.2
Windows	2.4	2.2	1.8

244/2012 (cost-optimal), new demands are under development and are planned to be implemented during 2013.

2.2 Format of national transposition and implementation of existing regulations

Regulations

Existing requirements for building envelopes were approved in 2001 and came into force on the 1st of January 2003. Requirements for normative and maximum permissible transmission heat loss coefficient of external envelope structures of buildings, and requirements for maximum permissible heat loss of buildings apply, depending on the type of building. These requirements (Table 2) are included in the Latvian Building Norm LBN 002-01 'Thermal requirements of building envelopes'.

The minimum requirements are set out for external envelope structures of buildings and should apply for newly built, reconstructed and renovated heated buildings, as well as for new heated spaces to be added in existing buildings when their temperature during the heating season is maintained at 8°C or higher. By the amendment to LBN 002-01 from the 26th of September 2006, the requirement to indicate total heat losses of the whole building and specific heat losses per m² of floor space were also included.

National legislation does not include exact EP indicators. Therefore, they can be calculated taking several factors into account:

> For residential houses, homes for the elderly, hospitals and kindergartens, the normative value HTR may be determined in accordance with the formula HTR= h_A A, where:
- h_A the calculated heat loss coefficient, W/m².K,
- A is the sum of floor areas to be heated on all storeys of a building, m².

> For buildings which have parts with a different number of storeys, the value HTR shall be determined for each part of the building separately.

For residential houses, homes for the elderly, hospitals and kindergartens, the specific heat consumption h_A per m² for one-storey and two-storey buildings shall be 1.1 W/m².K, for three-storey and four-storey buildings 0.9 W/m².K, and for five or more-storey buildings it will be 0.7 W/m².K.

The calculated heat loss coefficient HT of a building must not exceed the normative value HTR.

Technical guidance documents

There are no officially approved guidance documents regarding calculation of the EP requirements, but training materials issued by Riga Technical University can be used.

EP methodology

The EP calculation methodology is applicable for new and reconstructed buildings, as well as for existing buildings. The EP calculation methodology is described in the Cabinet regulations 'Building energy performance calculation method' (No. 39 of the 13th of January 2009) and it includes calculations for heating, cooling, Domestic Hot Water (DHW) and lighting, using measured rating and calculated rating. For residential buildings, lighting consumption is not included in the

Table 2: Normative and maximum values of Heat Transmittance Coefficients.

Heat transmission coefficients / Type of building	Residential, homes for the elderly, hospitals and kinder gardens	Public, excl. pensions, hospitals and kinder gardens	Industrial
Envelope U_{RN}	W/m^2.K		
Roofs and external coverings	0.2 k/0.25 k	0.25 k/0.35 k	0.35 k/0.5 k
Floors on the grounds	0.25 k/0.35 k	0.35 k/0.5 k	0.5 k/0.7 k
Walls: - with mass less than 100 kg/m^2	0.25 k/0.3 k	0.35 k/0.4 k	0.45 k/0.5 k
- with mass 100 kg/m^2 or more	0.3 k/0.4 k	0.4 k/0.5 k	0.5 k/0.6 k
Windows, doors and glazed walls	1.8 k/2.7 k	2.2 k/2.9 k	2.4 k/2.9 k
Thermal bridges Ψ_{RN}	W/m.K		
	0.2 k/0.25 k	0.25 k/0.35 k	0.35 k/0.5 k

k – temperature factor. k=19/$\Delta\Theta$, where $\Delta\Theta$ depends on the indoor and outdoor air normative values.
(For residential buildings in different regions, k ranges from 0.95 to 1.09).

calculation. The EP calculation methodology is based on the corresponding CEN Technical Report CEN/TR 15615 'Explanation of the general relationship between various European standards and the Energy Performance of Buildings Directive (EPBD) - Umbrella Document' and standard EN ISO 13790:2008 'Conditions', and includes references to the 15 other standards. There are no national annexes of EPBD standards in Latvia.

Support documents
In order to promote the proper use of the calculation methodology, the Ministry of Economics developed a software tool for calculating the energy performance of buildings. The software runs on Microsoft Excel and is available free of charge on the Ministry of Economics' website (*www.em.gov.lv/em/2nd/?cat=30723*). The programme is available for the evaluation of the energy performance of buildings and for issuing an Energy Performance Certificate (EPC) for existing buildings, or a temporary EPC for designed buildings (new and reconstructed). Although the programme makes the work of the energy auditors and the construction designers substantially easier, its proper use requires knowledge of building construction, building materials, heating equipment, technical building systems, as well as of the building energy performance calculation methodology. The programme use is limited: it can do the calculations for most existing buildings with no more than three heating zones, but it does not detail what is required for energy performance calculations of Nearly Zero-Energy Buildings (NZEB) or buildings needing complex solutions. The software is complemented with a guidebook (Figure 2).

Training, CPD and accreditation systems
The designer is responsible for the building design and its compliance with EP requirements. Calculation of the EP can be carried out either by the designer or by an energy auditor. There is no official requirement for the training of designers, but professional associations offer 1 – 2 day training courses providing general understanding of energy performance calculations.

The requirements for energy auditors are described in 3.1.

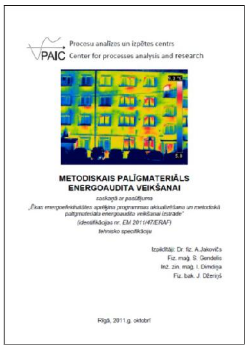
Compliance checking
The construction company is responsible for building in compliance with the normative requirements. It is a general requirement and the regulations do not specify procedures for compliance with the energy performance. The quality conditions for the building's energy efficiency can be included in the contracts. In practice, most common quality checks consist of thermography and air leakage tests.

Monitoring and enforcement statistics
There is no such system that could accurately provide monitoring of compliance with EP requirements. Some elements of monitoring energy performance certification of buildings are included in the Building Information System (BIS):

> register of designers;
> register of energy auditors;
> register of energy performance certificates.

The analysis of BIS data will help to identify unrepresentative performance indicators and select cases for detailed examination. It is planned that the BIS will operate from 2013 onwards.

Figure 2: The cover page of the energy audit guidebook.



2.3 Cost-optimal procedure for setting EP requirements
Until December 2012, Latvia did not adopt EP requirements in accordance with the cost-optimal procedures specified in article 5 of the recast EPBD.

Although the EC Regulation 244/2012 and its guidelines clearly specify the methodology for calculation of the cost-optimal procedure for setting EP requirements, its practical use involves a series of tasks, whose completion needs careful planning and time consuming actions. Latvia has not been involved in IEE projects (TABULA, ASIEPI), whose data is suggested to be used for reference buildings. For the existing building sector, the reference building is planned to be defined from the state cadastre information system: it contains data about the buildings usage, area, number of floors, wall materials, etc.. Establishing the new EP requirements in accordance with the EPBD and Regulation 244/2012 will have to solve a series of challenges, and there is thus a need for a new approach:

> the usage of EPBD CEN standards till this moment is only partly approved at the national level, mostly for evaluating the energy performance of existing buildings, but a detailed solution for NZEB evaluation is limited;
> there is no reliable construction price database that would reflect the real market data. Since the crisis in 2008, the market activity in new constructions has been low and construction costs are variable;
> Latvian Construction Regulations define 10 different climatic zones, but Latvia does not intend to run the calculation for all of them because differences among local climates are too small to impact significantly the cost-optimal results;
> there is a need for discussion on issues, such as:
  · defining energy efficiency measures, their packages and variants for the reference buildings;
  · the approach for taking into account Renewable Energy Resources (RES) in the calculation;
  · primary energy factors in Latvia, including central heating in different regions;
  · local fuel energy price change forecast.

Work on the new EP requirements is already started. The new requirements are expected to come into force during 2013.

2.4 Action plan for progression to NZEB
First experience with the construction of low energy buildings in Latvia started in 2012, when the Ministry of Environmental Protection and Regional Development started a project called Low Energy Buildings (LEB) within the Latvian governmental program of Climate Change Financial Instrument (CCFI).The CCFI is funded from sales of state-owned greenhouse gas emissions of assigned amount units by the international emissions trading under the Kyoto protocol. The LEB project supported the construction of new buildings and the reconstruction of existing ones to achieve target values (Table 3). Within the LEB, 31 different projects were realised for different building types. The results can be discussed after the first full heating season, in 2013. The next steps at national level will be planned taking into account the experience and results of the LEB project.

In the new LEPB, NZEB is defined as a high energy efficiency building, in which high efficiency energy systems for energy supply are used. Detailed requirements will be set by Cabinet regulations.

Table 3: CCFI competition 'Low-energy building' criteria - Requirements for the performance of the Low-Energy Building (annex 2 of Cabinet Regulation 'Climate Change Financial Instrument funded projects open competition 'Low-energy building' regulation' (No.1185 of 28 December 2010).

Criteria / Requirement level	Energy consumption for heating (internal dimensions)		
	< 15 kWh/m^2.year	< 25 kWh/m^2.year	< 35 kWh/m^2.year
U-values windows	U_w =< 0.8 W/m^2		U_w =< 1.0 W/m^2.K *(If window replacement is not performed, it is acceptable U_w =< 1.8 W/m^2.K)*
walls, including thermal bridges	U =< 0.30 W/m^2		U =<0.40 W/m^2.K
Roofs and external coverings	0.2 W/m^2.K		0.2 W/m^2.K
Ventilation system	recuperation rate >75%, energy consumption 0.4 Wh/m^3.h		
Ventilation with infiltration air exchange rate for whole building (n50 (h^{-1}), pressure difference 50 Pa)	n =<0.6 h^{-1} for residential and public buildings	n =< 1.0 h^{-1} for residential buildings, n=<1.2 h^{-1} for public buildings	n =< 1.2 h^{-1} for residential buildings, n=< 1.8 h^{-1} for public buildings
Primary energy consumption for the whole building (heating, domestic hot water, electric)	< 150 kWh/m^2.year		

3. Energy performance certificates

The existing EPC system in Latvia is transposed based on the original EPBD (2002/91/EC) and it has been operating since 2009. Transposition of the recast EPBD is already started and it is partly included in the new LEPB, whose new requirements are for parts of the building (previously it was not mandatory to certify building parts). The new law is adopted, with entry into force on the 9th of January 2013. For fully implementing the new law, new Cabinet Regulations will be adopted by the 30th of July 2013.

3.1 Progress and current status on sale or rental of buildings

Energy performance certification of buildings is regulated by the LEPB. Under the latest regulation, the EPC of a building is necessary for:

> new (designed) buildings, renovated or reconstructed buildings, for acceptance into operation or selling;
> part of the building (new, renovated, reconstructed) for selling, if the part has, or is intended to have, individual energy carrier or heat metering;
> existing buildings that are being sold or rented, if the buyer or tenant is requesting an EPC;
> existing building parts (with heated floor area over 50 m^2) that are being sold or rented, if the buyer or tenant is requesting an EPC and if this part of the building has individual energy carrier or heat metering;
> state or municipality owned existing public buildings with heated floor area over 500 m^2 (after the 9th of July 2015, with heated floor area over 250 m^2);
> existing buildings, if the owner has decided to obtain energy performance certification.

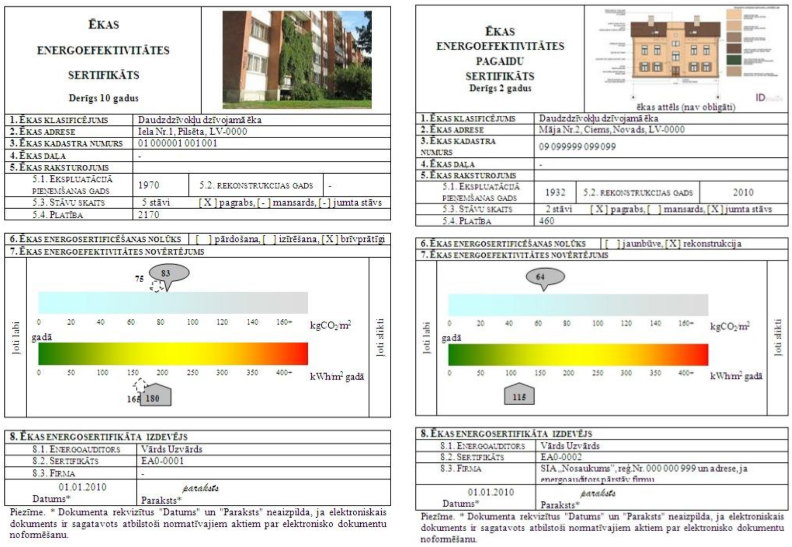
For existing buildings, energy certification is not needed for selling or renting part of a building if that part does not have a separate energy carrier or heat metering.

The EPC format is set out in the Regulation regarding the Energy Certification of Buildings (No. 504, 8 June 2010).

For all building types, EPCs are in the same format, although there are two kinds of certificates:

> energy performance certificate for existing buildings (Figure 3a);
> temporary energy performance certificate for new, reconstructed or renovated buildings (Figure 3b).

Figure 3: (a - left) Energy performance certificate for existing buildings; (b - right) temporary energy performance certificate for new, reconstructed or renovated buildings.



(a)

ĒKAS ENERGOEFEKTIVITĀTES SERTIFIKĀTS
Derīgs 10 gadus

1. Ēkas klasificējums	Daudzdzīvokļu dzīvojamā ēka		
2. Ēkas adrese	Iela Nr.1, Pilsēta, LV-0000		
3. Ēkas kadastra numurs	01 000001 001001		
4. Ēkas daļa	-		
5. Ēkas raksturojums			
5.1. Ekspluatācijā pieņemšanas gads	1970	5.2. rekonstrukcijas gads	-
5.3. Stāvu skaits	5 stāvi	[X] pagrabs, [-] mansards, [-] jumta stāvs	
5.4. Platība	2170		

6. Ēkas energosertificēšanas nolūks: [ ] pārdošana, [ ] izīrēšana, [X] brīvprātīgi
7. Ēkas energoefektivitātes novērtējums

8. Ēkas energosertifikāta izdevējs	
8.1. Energoauditors	Vārds Uzvārds
8.2. Sertifikāts	EA0-0001
8.3. Firma	-
01.01.2010 Datums*	paraksts Paraksts*

Piezīme. * Dokumenta rekvizītus "Datums" un "Paraksts" neaizpilda, ja elektroniskais dokuments ir sagatavots atbilstoši normatīvajiem aktiem par elektronisko dokumentu noformēšanu.

(b)

ĒKAS ENERGOEFEKTIVITĀTES PAGAIDU SERTIFIKĀTS
Derīgs 2 gadus

ēkas attēls (nav obligāti)

1. Ēkas klasificējums	Daudzdzīvokļu dzīvojamā ēka		
2. Ēkas adrese	Māja Nr.2, Ciems, Novads, LV-0000		
3. Ēkas kadastra numurs	09 099999 099099		
4. Ēkas daļa	-		
5. Ēkas raksturojums			
5.1. Ekspluatācijā pieņemšanas gads	1932	5.2. rekonstrukcijas gads	2010
5.3. Stāvu skaits	2 stāvi	[X] pagrabs, [ ] mansards, [X] jumta stāvs	
5.4. Platība	460		

6. Ēkas energosertificēšanas nolūks: [ ] jaunbūve, [X] rekonstrukcija
7. Ēkas energoefektivitātes novērtējums

8. Ēkas energosertifikāta izdevējs	
8.1. Energoauditors	Vārds Uzvārds
8.2. Sertifikāts	EA0-0002
8.3. Firma	SIA „Nosaukums", reģ.Nr. 000 000 999 un adrese, ja energoauditors pārstāv firmu
01.01.2010 Datums*	paraksts Paraksts*

Piezīme. * Dokumenta rekvizītus "Datums" un "Paraksts" neaizpilda, ja elektroniskais dokuments ir sagatavots atbilstoši normatīvajiem aktiem par elektronisko dokumentu noformēšanu.

For the certification of existing buildings, both a calculated energy rating (asset rating) and a measured energy rating (operational rating) must be determined. The EPC, valid for 10 years, must be issued by an energy auditor.

For the certification of new, reconstructed or renovated buildings, a calculated energy rating (asset rating) must be determined and the temporary certificate, valid for 2 years, must be issued by an energy auditor or building designer.

The energy performance must be expressed using annual EP indicators:

> final energy consumption, in kWh/m^2.year;
> carbon dioxide emissions, in kg CO_2/m^2.year.

The EPC must contain information about the total final energy consumption (MWh per year) and the overall energy performance indicator (kWh/m^2.year) for: heating, cooling, DHW, lighting (optional for residential buildings), ventilation, other needs (must be indicated).

In addition, the EPC or temporary certificate must be appended with an annex, in which the values of the input data used for the calculations are indicated, specifying the method for the acquisition of the data and the data source:

> area of premises, zones, and the temperature therein;
> area of building envelopes, length of thermal bridges and their heat

transmission coefficients;
> consumption of accounted energy and energy carriers;
> values adopted by the expert, in order to observe the factors affecting the energy performance;
> coefficients used for the correction of calculations.

For existing buildings, the EPC must include a summary of cost effective measures for improving the energy performance of the building.

EPC activity levels

For new and reconstructed buildings, the EPC is mandatory and control is provided by a municipal construction inspection while accepting the building for service. For existing buildings, certification requirements are the responsibility of both contracting parties and there is no check performed by any third party. The current situation for energy performance certification for existing buildings is rated as low, but growing.

Profile of EPC grades

Energy performance indicators must be presented on an energy performance scale (Figure 4), the one side of which is marked as 'very good' and the other side as 'very bad'. At the end of 2012, there were no classes for energy efficiency, but the new LEPB intends to implement a classification system by Cabinet regulations till the 30th of July 2013.

Figure 4: Building energy performance scale.

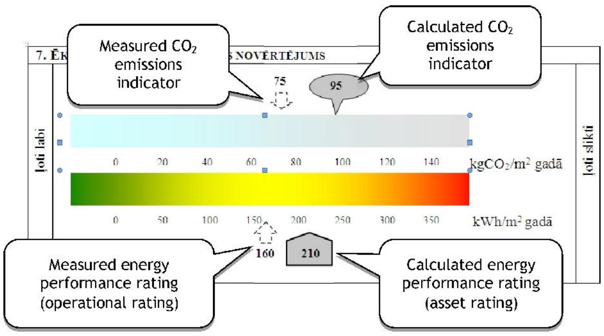
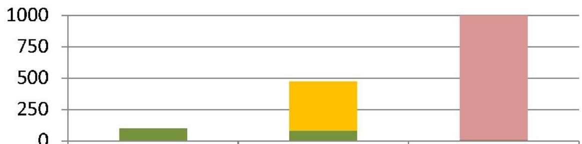


Figure 5: Qualified Experts by category at the end of 2012.



	Energy performance certification of existing building	Energy performance temporary certification of new and reconstructed building	Inspection of heating and air conditioning systems
Heating engineers and technicians			1145
Building structural engineers		393	
Energy auditors	96	81	7

EPC costs

The cost of the assessment of energy performance of buildings is not regulated. For typical apartment buildings (usually of a simple geometric shape, with district heating and natural ventilation), the EPC costs typically range between 300 € and 500 € for the whole building.

Assessor corps

The requirements concerning energy auditors are provided in the Regulations of the Cabinet of Ministers (No. 26, 13 January 2009). An energy auditor must have the required theoretical knowledge and practical experience, and must also pass a proficiency exam. In accordance with the regulations, an energy auditor is certified for the following actions:

> energy performance certification of existing buildings;
> energy performance certification of new and reconstructed buildings (temporary certificates);
> inspection of boilers and air-conditioning systems.

To evaluate the energy performance of a building and to issue an EPC or a temporary EPC of a building, theoretical knowledge is required in the following fields: thermal performance of building envelopes, technical systems of buildings (heating, ventilation, air-conditioning, water supply and lighting), and building climatology and indoor climate.

A temporary EPC for new buildings and for buildings to be reconstructed can also be issued by professionals who have received a Building Practice Certificate in the field of structural design of buildings, in accordance with the procedures specified by regulatory enactments concerning construction.

The certification of energy auditors is performed by three accredited certification bodies: PSI Grupa Ltd. (*www.psi.lv*), Certification Body of The Latvian Association of Heat, Gas and Water Technologies Engineers (*Latvijas siltuma, gāzes un ūdens tehnoloģijas inženieru savienības Būvniecības speciālistu sertifikācijas centrs*) (*www.lsgutis.lv*), and Certification Body of '*Mācību un konsultāciju centrs ABC Ltd*' (*www.abc.edu.lv*).

Certification bodies perform the supervision of professional activities of the certified energy auditors.

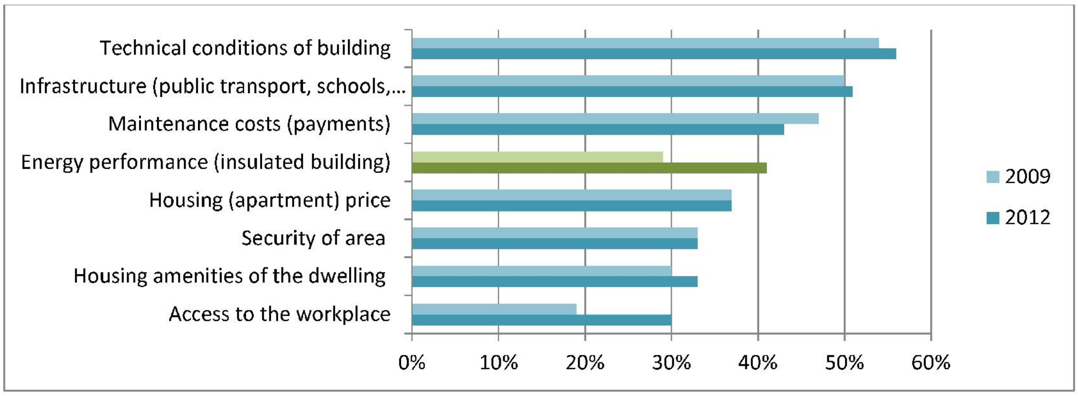


Figure 6: Criteria used when purchasing housing.

Source: 'DNB Latvijas barometers' research Nr.46. (12.04.2012.) Housing. *https://www.dnb.lv/lv/publikacijas/dnb-latvijas-barometers*

Energy auditors' certificates issued by certification bodies must be registered in a central register maintained by the Ministry of Economics. The Ministry of Economics provides public access to the energy auditors' register (*www.em.gov.lv/em/2nd/?cat=30272*). The number of Qualified Experts (QEs) is shown on Figure 5.

Enforcement with building owners - sale, rental
The requirement for issuing a building EPC receives more support from professionals (like energy auditors) than from the owners, tenants or buyers who just see EPC as another bureaucratic burden. Therefore, energy performance certification of buildings still has only a minor effect on the real estate market. There is hope that this situation could change after the new LEPB requirement comes into force. The law prescribes that EP indicators must be included within the advertisements for sale or rent. It will increase the public's interest on energy performance of buildings.

A research on the criteria commonly used while purchasing a house or apartment made by banks shows that energy efficiency criteria (like insulated buildings) were considered important to 41% of survey participants in 2012, against 29% in 2009 (Figure 6).

Quality Assurance of EPCs - system, activity level and penalties
At the end of 2012, the monitoring of the work of the energy auditors is not yet completely implemented. Regulations prescribe the conditions in which an energy auditor's certificate is suspended or withdrawn. If violations of regulatory enactments in the field of the energy performance of buildings are detected in the professional activities of an energy auditor, the certification body takes a decision regarding the suspension of the certificate until the energy auditor has eliminated the consequences caused by his/her activities, and specifies a deadline for elimination of the consequences.

A certification body takes the decision regarding the cancellation of an energy auditor's certificate:

> if after the certification body has made a decision regarding the suspension of the certificate, the energy auditor does not eliminate the consequences caused by his/her activities within the deadline specified by the certification body;
> if it is proven that an energy auditor has deliberately violated regulatory enactments in the field of evaluation of the energy performance of buildings.

Infringement cases are initiated when violations have been detected. Usually violations are detected in state financed activities, where the examination of documents is detailed. Since 2009, the Ministry of Economics initiated more than 50 cases on violations from energy auditors and, in 20 cases, the certification bodies decided to suspend the certificate.

The Ministry of Economics is monitoring the certification system as a whole, and is considering appeals on the certification body decisions. In turn, the decision of the Ministry of Economics may be appealed against in court.

3.2 Progress and current status on public and large buildings visited by the public
The requirement to display the EPC in a visible place is set by law. The current legislation does not specify the procedure for display of the EPC or its format. The actual rate of display of EPCs is low and should be better promoted. The new LEPB sets the obligation for building owners (for state and municipalities) to ensure the display of the EPC in a place visible

for the visitors. The legislation does not set specific requirements for experts regarding the certification of public buildings and sanctions for administrators of public buildings who fail to obtain an EPC and to display it.

The energy performance of public buildings is characterised in the same way as other buildings: asset rating for new and reconstructed buildings and asset rating validated by operational rating for existing buildings.

3.3 Implementation of mandatory advertising requirement – status

The new LEPB sets obligatory requirements for the owners to include energy efficiency indicators for the whole building or its part (e.g., an apartment) in the advertisements for selling or renting. This obligation does not apply for buildings exempted from having a certificate:

> unconditioned buildings;
> buildings which are historical monuments or located within a historical area, if the fulfilment of the requirements endangers the preservation of those historical monuments;
> buildings designed and built for worship and other religious activities;
> buildings designed and built for use only during the warm season (e.g., summer residences);
> buildings with a total heated floor area of less than 50 m^2.

3.4 Information campaigns

Information on energy certification of buildings and other EPBD related issues for entrepreneurs, professionals and citizens are distributed through information campaigns, publications and the internet. Information campaigns for building energy efficiency often take place at different levels, such as initiatives of state and local government institutions, or private and non-governmental organisations.

Since 2010, the campaign 'Living warmer' (Figure 7), on the energy performance of buildings in Latvia, is running. The 'Living warmer' campaign was launched on the 25th of February 2010, when the Ministry of Economy, industry associations and business signed a memorandum of cooperation at the conference 'Housing renovation - Latvian investment in the future'. Within the memorandum of cooperation, the parties agreed on joint cooperation in the housing renovation market.

Figure 7:* *Information campaign 'Living warmer' logo.

The key objectives of the 'Living warmer' campaign are:

> to activate apartment owners to start their home renovation using European Union funds (EU funds);
> to inform and advise house managers, apartment owner associations and trustees on the EU funding programmes, conditions, and benefits;
> to encourage construction companies, construction material manufacturers and traders to take the initiative of housing renovation;
> to raise awareness of energy efficiency and reduce heat consumption.

As part of the campaign, more than 20 events, meetings and workshops are held annually.

4. Inspection requirements - heating systems, air-conditioning

Latvia initially chose option (b) from article 8 of the original EPBD. Prior to the new legislation with entry into force on the 9th of January 2013, inspection of boilers and AC systems was voluntary except in the case of energy performance certification of a building where it is mandatory. To facilitate voluntary inspections, the Ministry of Economics is providing information for residents.

In the new LEPB, the inspection regulation is changed and regular inspections of heating systems and AC systems shall become mandatory.
The new requirements will be fully implemented with Cabinet Regulations by the 30th of June 2013.

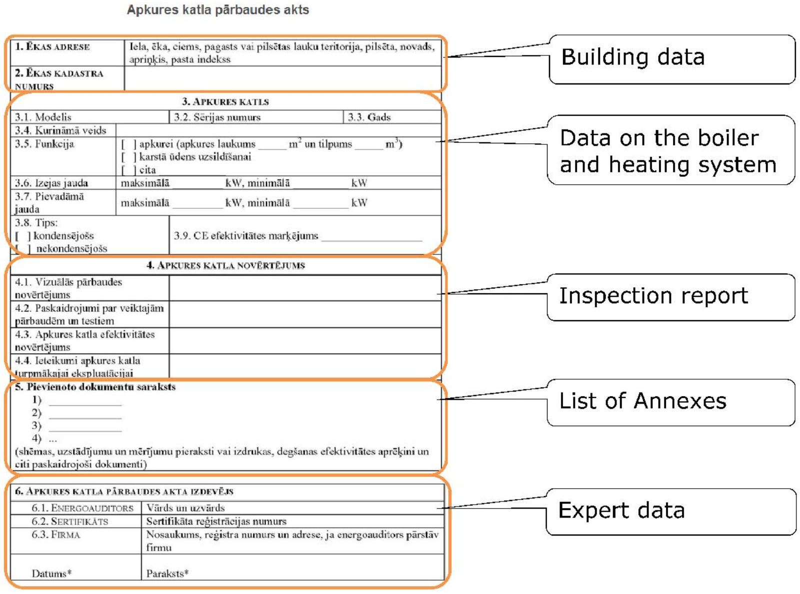
4.1 Progress and current status on heating systems

Inspections of boilers were implemented during 2009. The mandatory inspection of boilers is performed during the certification of the building, otherwise on a voluntary basis. The inspection includes an evaluation of effectiveness and recommendations. Energy auditors then make a report on the inspection of boilers. The inspection of boilers must be done in accordance with standard LVS EN 15378:2007 'Energy performance of buildings: Inspection of boilers and heating systems'.

The format of the inspection reports is prescribed in the legislation and follows a standard prototype (Figure 8). The report includes reference to the building (address), technical information about the system (model, power, operating spaces), visual inspection assessment, details of the inspections and tests, system performance evaluation, and recommendations for improving the future operation of the system, including possible replacement of the boiler.

If the rated output of the boiler of a building is more than 20 kW, or the heating system is older than 15 years, the energy auditor shall assess the boiler together with the heating system, shall provide an opinion regarding the boiler efficiency and shall provide recommendations regarding the change thereof, or other possible changes of the heating system of the building, and alternative solutions in order to reduce the energy consumption and the amount of carbon dioxide emissions.

Figure 8: Boiler inspection report form.


Apkures katla pārbaudes akts

1. Ēkas adrese	Iela, ēka, ciems, pagasts vai pilsētas lauku teritorija, pilsēta, novads, apriņķis, pasta indekss	
2. Ēkas kadastra numurs		
3. Apkures katls		
3.1. Modelis	3.2. Sērijas numurs	3.3. Gads
3.4. Kurināmā veids		
3.5. Funkcija	[ ] apkurei (apkures laukums ______ m^2 un tilpums ______ m^3) [ ] karstā ūdens uzsildīšanai [ ] cita __________	
3.6. Izejas jauda	maksimālā __________ kW, minimālā __________ kW	
3.7. Pievadāmā jauda	maksimālā __________ kW, minimālā __________ kW	
3.8. Tips: [ ] kondensējošs [ ] nekondensējošs	3.9. CE efektivitātes marķējums __________________	
4. Apkures katla novērtējums		
4.1. Vizuālās pārbaudes novērtējums		
4.2. Paskaidrojumi par veiktajām pārbaudēm un testiem		
4.3. Apkures katla efektivitātes novērtējums		
4.4. Ieteikumi apkures katla turpmākajai ekspluatācijai		
5. Pievienoto dokumentu saraksts 1) __________ 2) __________ 3) __________ 4) ... (shēmas, uzstādījumu un mērījumu pieraksti vai izdrukas, degšanas efektivitātes aprēķini un citi paskaidrojoši dokumenti)		
6. Apkures katla pārbaudes akta izdevējs		
6.1. Energoauditors	Vārds un uzvārds	
6.2. Sertifikāts	Sertifikāta reģistrācijas numurs	
6.3. Firma	Nosaukums, reģistra numurs un adrese, ja energoauditors pārstāv firmu	
Datums*	Paraksts*	

Additional checking of boilers is supported by:

1. Cabinet Regulations on Fire Safety (No.82 of 17 February 2004) provides the requirements for operation of heating systems (boilers for heating and DHW):
   - maintain equipment in working condition and operate it in accordance with the manufacturer's specification and fire safety requirements;
   - inspect twice a year, unless the operational rules state otherwise.
2. 'Regulations for the Supply and Use of Natural Gas' (No.1048 of 16 December 2008) prescribe that the user has the duty to maintain the natural gas supply system in running order and to ensure the technical maintenance thereof in accordance with LVS 445:2003/A1:2004 'Operation and technical maintenance of natural gas distribution and consumer supply systems with max operation pressure 1.6 MPa (16 bar)';

Standard LVS 445:2003/A1:2004 is now replaced by two others:

- LVS 445-1:2011 'Operation and Maintenance of natural gas distribution and Consumer supply systems with max operation pressure 1,6Mpa (16 bar): Part 1:General requirements' and
- LVS 445-2:2011 'Operation and Maintenance of natural gas distribution and Consumer supply systems with max operation pressure 1,6Mpa (16 bar): Part 2: Maintenance terms, kinds of work and the execution organization'.

According to Standard 445-2:2011, maintenance of the supply systems includes boiler inspection and adjustment according to the technical specifications of the boiler to ensure the effective operation of the equipment.

There are not so many voluntary inspections being made because of the low interest of the population.

4.2 Progress and current status on AC systems

Considering the climatic conditions in Latvia, legislation does not specify requirements for AC or its inspections. Apartment buildings in Latvia are generally not equipped with AC systems for cooling. When they are installed, the total power of the AC systems in separate rooms usually does not exceed 12 kW.

Inspections of AC systems were implemented during 2009. The inspection of AC systems is performed during the certification of the building, or on a voluntary basis. The inspection includes an evaluation of effectiveness and recommendations. Energy auditors then make a report on the inspection of AC systems. The inspection of AC must be performed in accordance with the Standard LVS EN 15240:2007 'Ventilation for Buildings - Energy performance of buildings: Guidelines for the inspection of air conditioning systems'.

Additional checking of AC systems is supported by:

1. Cabinet Regulations on Fire Safety (No.82 of 17 February 2004) prescribe: “Ventilation and air-conditioning equipment shall be installed and

operated in accordance with the manufacturer's technical regulations, as well as ventilation and air conditioning construction standards governing fire safety requirements".
2. Latvian Construction Norms LBN 231-03 'Heating and ventilation of residential and public buildings' (approved by the Cabinet Regulation No. 534 of 23 September 2003) provides the following requirements:
   - the building design must include measures for ventilation and air-conditioning system commissioning, regulation and operation;
   - ventilation and air-conditioning systems shall be tested and put into service in accordance with LVS EN 12599 and LVS ISO 10780;
   - a commissioning of the ventilation system shall be reported. The report shall be accompanied by the system description and the use of safety instructions as well as a protocol for ensuring that the staff is trained to operate the system.

There are not so many voluntary inspections being made because of the low interest of the population.

4.3 Any other relevant information

Information from the Ministry of Economics about promoting inspections of heating and AC systems is available at the website (*www.em.gov.lv/em/2nd/?cat=30627*) and includes: general information, documentation of inspections, experts, regulations and standards.

The majority of apartment buildings and large public and office buildings in Latvia are usually supplied by district heating systems. As 80% of the heating for buildings is provided by district heating systems, and the number of buildings equipped with AC systems is very small, voluntary inspections of boilers and AC systems have received little interest from the market. Buildings with individual (separate) heating systems mostly use wood and natural gas. In 2008, natural gas was used by 52,000 clients, including 46,000 households. The share of other fuels like coal, or peat is negligible.

Given the high proportion of district heating, there are additional requirements for efficiency of district heating in Latvia. Energy efficiency requirements for heating systems are set in 'Regulations Regarding Requirements of Energy Efficiency to the District Heat Supply Systems Existent in the Possession of a Licensed Energy Supply Merchant and the Procedures for the Inspection of the Conformity Thereof'. This regulation states certain efficiency requirements for energy production plants and permissible values for heat losses in heat supply.

There has not yet been an assessment of the equivalence of the EPBD option b) compared to actual inspections.

5. Conclusions and future plans

Professionals have a good understanding of energy certification of buildings, but society lacks understanding and awareness on these issues. In Latvia, housing energy efficiency is mostly associated with housing insulation and some other measures to increase energy efficiency, but the Energy Performance of Buildings Directive (EPBD) requirements for energy certification of buildings still causes confusion and sometimes is considered as a bureaucratic burden.

Short-term plans (until the 30th of June 2013) include the elaboration of Cabinet Regulations for the implementation of a new Law on the Energy Performance of Buildings according to the recast EPBD:

- Regulation regarding independent experts (significant additions are planned regarding control of experts by the register of EPCs);
- Regulation regarding the Energy Certification of Buildings (significant additions are planned regarding classification of energy performance of buildings for their comparison);
- Regulation regarding the calculation of energy performance of buildings;
- Regulation regarding high energy performance buildings (Nearly Zero-Energy Buildings).

New requirements according to the EC Regulation 244/2012 (cost-optimal) are planned to be adopted in Cabinet Regulations before the end of 2013.

In the mid-long term, there is a need to set up plans for financial and other instruments for deep renovation of all types of buildings, construction of NZEBs, and an additional review of the EPBD standards to better adapt them to Latvian conditions.

EPBD implementation in Lithuania

STATUS AT THE END OF 2012

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1. Introduction

Directive 2002/91/EC on the Energy Perfomance of Buildings (EPBD) was fully transposed into Lithuanian legal acts in 2006. All laws, regulations and administrative provisions necessary to comply with this Directive, pursuant to article 15(1), came into force on the 4th of January 2006. The implementation of the EPBD in Lithuania started in 2007. At first, the implementation of the Directive was the overall responsibility of the Ministry of the Environment and the Ministry of Economy. At present, the Ministry of Environment and the Ministry of Energy are jointly responsible for the transposition and implementation of the recast EPBD in Lithuania. The transposition of the recast EPBD (Directive 2010/31/EU) and the national calculation of the cost-optimal levels of minimum Energy Performance (EP) requirements are successfully completed, and now Lithuania is on the way of implementing the recast EPBD.

2. Energy performance requirements

In Lithuania, the EP requirements are obligatory for new buildings (building units) and for existing buildings (building units) after major renovation, reconstruction or building repair works, when the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the building's value, excluding the value of the land upon which the building is situated.

2.1 Progress and current status

Certification requirements for new buildings came into force on the 1st of January 2007. The EP class of new buildings (building units) must be at least C. This requirement is valid for all new buildings for which the set of the design terms (references) was issued after the regulation came into force on the 4th of January 2006. The new buildings (building units) must be certified after completion of the construction. The new EP requirements for new buildings in relation to the recast EPBD (article 6) are in force since the 9th of January 2013.

When a building (building unit) is offered for sale or rent, the EP indicator of the Energy Performance Certificate (EPC) of the building, or the building unit, should be stated in the advertisements in commercial media. This requirement is also in force since the 9th of January 2013.

The EP requirements for the EP class are not obligatory for existing buildings (building units) for sale or rent, but the evaluation procedure and certification requirements for existing buildings, as well as for buildings after major renovation (refurbished), are in force since the 1st of January 2009.

The EP class of large buildings (building units) with a heated area (total useful floor area) over 1,000 m^2 after major renovation must be at least D. Since the 9th of January 2013, the 1,000 m^2 threshold for buildings either occupied by a public authority, or frequently visited by the public, has been lowered to 500 m^2. The requirement for their EP after major renovation remains unchanged (it must be at least D).

National Websites *www.am.lt, www.enmin.lt, www.spsc.lt, www.bkagentura.lt, www.ena.lt, www.vei.lt*

2.2 Format of national transposition and implementation of existing regulations

The main provisions on the EP and the certification of EP of buildings are described in the Law on Construction and the Law on Energy of the Republic of Lithuania. The Lithuanian calculation procedure is defined in the Building Technical Regulation STR 2.01.09:2005 'Energy Performance of Buildings; Certification of Energy Performance', adopted on the 20th of December 2005 by the Order No. D-1-624 of the Minister of Environment, as well as in the amendments introduced by the Order of the Minister of Environment 2011-06-07 No. D1-462, according to the new requirements of the recast EPBD. Additional rating definitions of low-energy buildings, applicable to buildings of energy efficiency classes B, A and A^{+}, and to Nearly Zero-Energy Buildings (NZEB) as A^{++} class buildings, are introduced in the recent edition of the Regulation.

The Experts Training Programme (the methodical material for the certification of experts, as well as the rules and procedures for experts), were also corrected. The institutions responsible for the training and certification of experts, and the commission established for the certification of experts, remain unchanged since they were established in 2005.

The calculation procedure is based on the standards EN 15217:2005 'Energy performance of buildings. Methods for expressing energy performance and for energy certification of buildings' and EN 15203:2005 'Energy performance of buildings. Assessment of energy use and definition of ratings'. The calculation software tool was updated according to the changes in calculation methods as well. The default data in the selection tables of the software tool were enlarged.

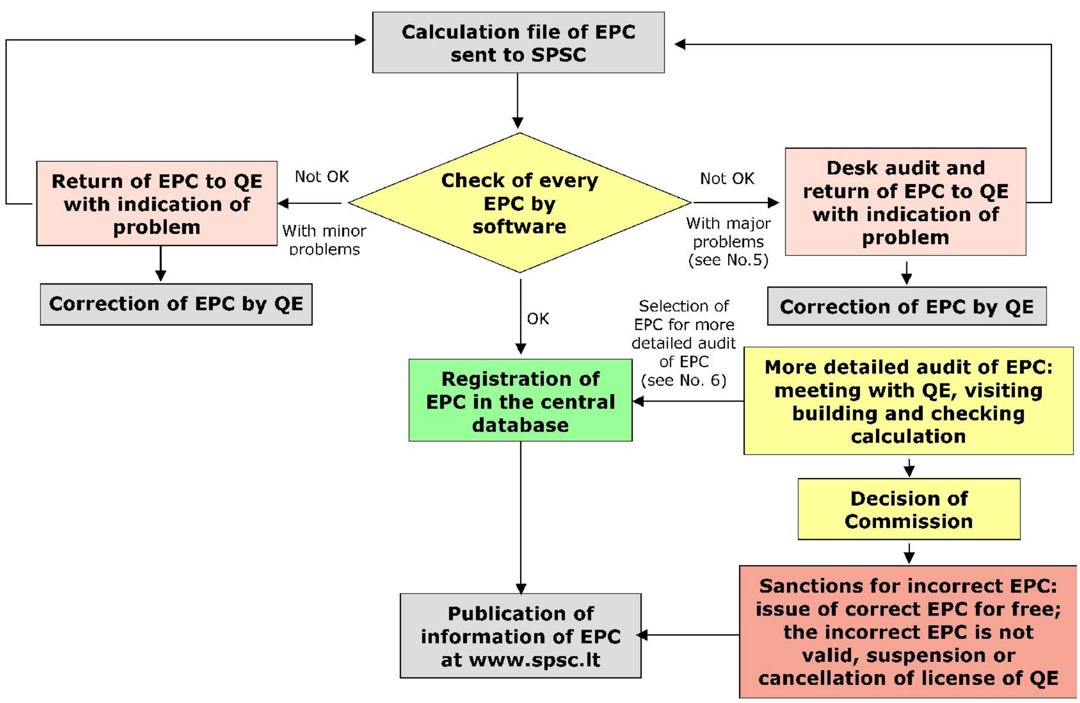
The ventilation-related energy consumption is assessed only during the heating season. The energy consumption due to air-conditioning and cooling is not included in the calculation, as at present there are no normative values for the cooling and air-conditioning of buildings.

The recent calculation scheme is slightly different for new buildings and existing buildings before and after major renovation. If some refurbishment is made in the considered existing building, an EP indicator C is required.

The new training programme and the methodical material for Qualified Experts (QE) were prepared and adopted by the Ministry of Environment. According to the updated Building Technical Regulation, the license of QEs is valid for an unlimited period, but the QE must go through training and exams every 5 years. This is for the improvement of the expert's qualification. If an expert does not upgrade the qualification, the institution responsible for certifying expert's can suspend the validity of the qualification certificate for six months.

In Lithuania, all the EPCs are collected in a central database and register. This allows the quality control of issued EPCs, as well as the statistical analysis according to the scheme described in Figure 1.

Figure 1: Quality assurance system in Lithuania.



Building element	Normative U-value, W/m².K			
	Class B	*Class A*	*Class A+*	*Class A++*
Roofs Ceilings in contact with outdoor air	0.16·κ	0.10·κ	0.09·κ	0.080·κ
Building elements in contact with ground Ceilings over unheated basements and crawl spaces	0.25·κ	0.14·κ	0.12·κ	0.10·κ
External walls	0.20·κ	0.12·κ	0.11·κ	0.10·κ
Windows and transparent building elements	1.6[1)]·κ	1.0·κ	0.85·κ	0.70·κ
Doors and gates	1.6·κ	1.0·κ	0.85·κ	0.70·κ

1) If total area of windows and other transparent building elements exceeds 25% of total external wall area, the U-value of transparent elements shall not exceed 1.3 W/m².K

2) $\kappa = 20/(\theta_i - \theta_e)$: temperature correction factor, where θ_i: indoor air temperature, °C, θ_e: outdoor air temperature or design temperature of adjacent space, °C. Temperature of unheated spaces is determined separately

If indoor air temperature $\theta_i = 20$°C, outdoor air $\theta_e = 0$°C, then $\kappa = 1$

Table 1: Normative requirements for thermal protection of residential building envelope.

	For class C buildings	*For class B of low energy buildings*	*For class A, A+ and A++ buildings*
1.	a) heat transfer coefficient, W/K	a) heat transfer coefficient, W/K	a) heat transfer coefficient, W/K
2.	b) energy performance indicator 'C' value	b) energy performance indicator 'C' value	b) energy performance indicator 'C'value
3.		c) calculated annual energy consumption for heating, kWh/m².year	c) calculated annual energy consumption for heating, kWh/m².year
4.			d) air-tightness test of building
5.			f) efficiency of heat recovery equipment in ventilation system of building

Table 2: The following factors shall conform to requirements at design of buildings and certification of EPBD.

A++ class	A+ class	A class	B class	C class	D class	E class	F class	G class
$C < 0.25$	$0.25 \le C < 0.375$	$0.375 \le C < 0.5$	$0.5 \le C < 1$	$1 \le C < 1.5$	$1.5 \le C < 2$	$2 \le C < 2.5$	$2.5 \le C < 3$	$C \ge 3$

Table 3: Energy performance indicator 'C' values.

2.3 Cost-optimal procedure for setting EP requirements

In Lithuania, buildings are classified into 9 Energy Performance (EP) classes. The evaluation of buildings does not refer to their purpose of use, but to their technical specifications. Every building is evaluated individually, according to the requirements of national legal acts.

According to the requirements of the 2005 Building Technical Regulation STR 2.01.09:2005, all buildings had to conform to the following energy efficiency classes:

> new buildings – at least C;
> existing buildings under major renovation – at least D.

The new 2012 Building Technical Regulation STR 2.01.09:2012 includes the requirements for cost-optimal levels of minimum EP for all categories of buildings. This Regulation is in force since the 9th of January 2013. The Regulation STR 2.01.09:2012 foresees that all new buildings must be:

> at least class B from 2014;
> at least class A from 2016;
> at least class A+ from 2018;
> at least class A++ from 2021.

From 2014, all existing buildings under major renovation must be at least class C.

New buildings

The requirements for new single-family, multifamily, office and education buildings on cost-optimal level are based on the financial calculation with the value of 3% of real discount rate (calculations based on 1,080 different cases). The results of the study show that the difference between the cost-optimal level of new buildings and the normative requirements of the Regulation No. 244/2012 delegated by the Commission (EU) will be within the allowable limits. The maximum value of this difference is about minus 6.73% until 2016 and will be minus 1.47% after 2016.

The requirements for cost-optimal levels of minimum EP requirements conform to the requirements established in the National Regulation for buildings of class A.

Existing buildings

New legal requirements for the EP of existing buildings after major renovation are established in the aforementioned Regulation.

The requirements for existing single-family, multifamily, office and education buildings after major renovation on cost-optimal level are based on the financial calculation with the value of 3% of real discount rate (calculations based on 720 different cases).

***Figure 2:* Energy Performance Certificate.**

According to the results of the calculation, from the 1st of January 2014, the difference between cost-optimal level of existing buildings and the normative EC requirements will be within the allowable limits, and between minus 0.35% and minus 1.38%. The requirements for cost-optimal levels of minimum EP requirements conform to the requirements established in the National Regulation for buildings of class C.

2.4 Action plan for progression to NZEB

The national definition of Nearly Zero-Energy Building (NZEB) is a building with almost no energy consumption.

The main purpose of the prepared national NZEB plan was to describe the main steps to increase the number of buildings with almost no consumption in Lithuania. The new calculation methodology conforming to the recast EPBD requirements was prepared and has been valid since February 2012. The calculation software tool was adopted according to the changes in calculation methods as well. The default data in the selection tables of the software tool were enlarged.

Additional rating definitions of low-energy buildings, applicable to buildings of energy efficiency classes B, A and A^+, and to buildings with almost no energy consumption (NZEB) as A^{++} class buildings (with mandatory use of renewables), are introduced in the recent edition of the Building Technical Regulation STR 2.01.09:2012. All requirements regarding the use of renewables are stated in the Law on Renewable Energy.

Regarding default heat transmission coefficient values of each element in the building envelope of the considered buildings:

> normative values are taken from the requirements of the National Building Technical Regulation STR 2.05.01:2005 'Thermal Technique of Envelopes of the Buildings' for classes B and C;
> normative values are taken from the supplementary tables - for classes A, A^+ and A^{++};
> reference values are corrected according to the changes in construction during the considered period;
> calculated values are determined by the same mode as in the previous edition.

Future plans for progression to NZEB

The first fully functioning passive house in Lithuania was designed and built in 2009. Since then several passive houses were designed and built.These houses were certified as passive by the Certification Center of Building Products (SPSC). One passive house in Lithuania was certified by the German Passive House Institute. In 2012, four passive houses were built, and six new passive houses were designed.

Now, according to the national legal acts requirements, the EP class of new buildings (building units) must be at least C but, looking to the future, Lithuania is planning to achieve a higher EP class for new buildings (building units). These purposes are described in the national NZEB plan:

> From 2014, the EP class of new buildings (building units) must be at least B.
> From 2016, the EP class of new buildings (building units) must be at least A.
> From 2018, the EP class of new buildings (building units) must be at least A^+.
> From 2021, the EP class of new buildings (building units) must be at least A^{++}.

3. Energy performance certificates

All new buildings (building units) must be certified after completion of the construction, or when the buildings (building units) are offered for sale or rent. The EP indicator of the Energy Performance Certificate (EPC) of the building (building unit) should be stated in the advertisements in commercial media. This requirement has been in force since the 9th of January 2013.

3.1 Progress and current status on sale or rental of buildings

The EPC of a building (building unit) must include the following data: reference number, address, purpose and useful area of the building, EP class, estimated energy inputs per m^2 of useful area, data about the main source of heating by specifying one of the heating sources, energy consumption for heating, reference number of the certificate, date of issuing of the certificate, expiry term of the certificate, name, certificate number and signature of the expert who issued the EPC of the building. Every EPC also includes calculation results and recommendations for improvement. The valid EPC – not more than 10 years old – shall be placed in all public buildings in a prominent place clearly visible to the public. The new calculation methodology has been valid since February 2012; approximately 2,770 EPCs were issued and registered by the end of October 2012 according to the new calculation methodology.

At the moment, about 9,400 EPCs are issued in Lithuania. In comparison, 359 EPCs were issued till the 1st of January 2008. Collection and registration of EPCs in the central database allows for quality control, statistical analysis and monitoring processes.

At the moment, there are about 6,580 EPCs for residential buildings and 2,820 EPCs for non-residential buildings. About 300 EPCs are registered each month. Approximatelly 5,300 EPCs were issued and registered since 2011. The certified buildings were classified into nine classes: A++, A+, A, B, C, D, E, F, G. Class A++ indicates a NZEB, while class G indicates an energy-inefficient building. The assessment of the EPCs according to the classes is represented in Figure 5.

In Lithuania, there are no fixed or predefined prices for the EP certification of buildings. The EPC costs are regulated by the market, and vary between 100 € and 5,000 €, depending on type, location, complexity, size, construction details and many other factors of the building. The fixed registration fee is approximately 6 €, and is used to finance Quality Assurance (QA) activities.

The main qualification requirements for experts for building certification are the following: engineer diploma with three years of experience in the construction branch, a special 32-hour training courses and exam, and required certification of three buildings as practical experience.

The Experts Training Programme and software tool were prepared and adopted by the Minister of Environment in 2006 and updated in 2011.The QE for the EP certification of buildings must attend the additional 20-hour training course and pass an exam every 5 years. At the moment, Lithuania has approximately 320 QEs for the certification of EP of buildings; about half of these QEs are actively working in the market. In Lithuania, only a QE can issue an EPC and is also responsible for an objective certification process.

Lithuania has the same QA scheme for all types of buildings. All the EPCs are collected and registered in the central database since 2007/2009 (new buildings/existing buildings). Every received EPC is checked by software to look for incorrect or incomplete data and to identify the calculation software version that was used. EPCs are selected

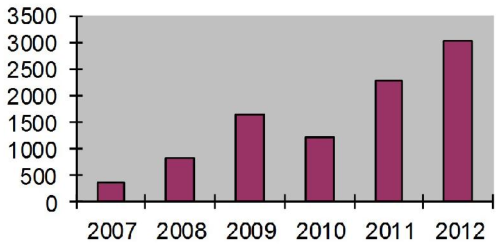


Figure 3: Evolution of certification process in Lithuania 2007-2012.

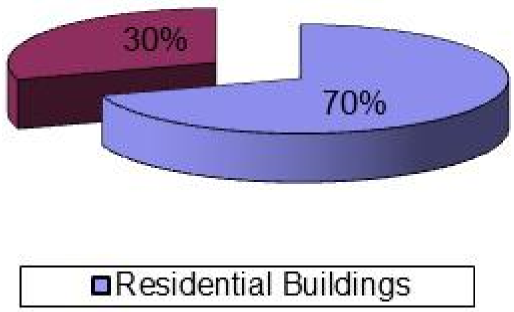


Figure 4: Certification of residential and non-residential buildings.

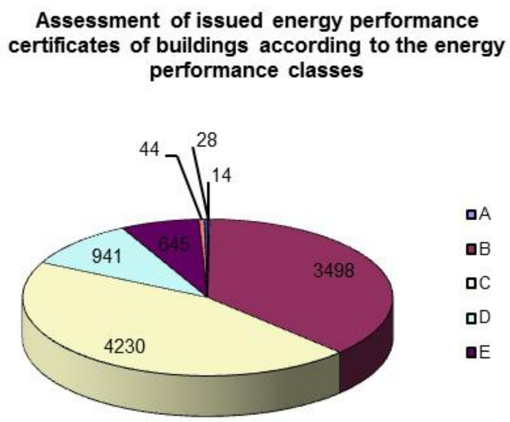


Figure 5: Evolution of certification process in Lithuania.

for desk audit in the following cases: when the values are out of range and when the EPC has very high EP class. EPCs are selected for more detailed audit in the following cases: by complaints of clients, when a QE has submitted many EPCs, and, simply, by random selection.

The experts are informed and warned about frequently made mistakes during training, and are asked to issue the correct EPC for free. The controllers shall be independent QEs hired by SPSC. Sanctions for incorrect EPCs can be: warning, obligation to issue the correct EPC for free, declaring the incorrect EPC as not valid, suspension or cancellation of licence of the QE.

3.2 Progress and current status on public and large buildings visited by the public

According to the requirement on the Law on Construction, valid since the 4th of January 2006, for buildings with a total useful floor area over 1,000 m^2 constructed for hotel, administrative, trade, services, catering, transportation, cultural, educational, healthcare and leisure purposes, the EP certification of

Figure 6: License of Qualified Expert.

Figure 7: The energy efficiency certificate placed in the Ministry of Justice.

buildings is mandatory. An energy certificate, not more than 10 years old, must be placed in the building in a prominent place clearly visible to the public.

Since the 9th of January 2013, the Law on Construction has extended this requirement to buildings with a total useful floor area over 500 m^2. From the 9th of July 2015, this threshold of 500 m^2 shall be lowered to 250 m^2.

3.3 Implementation of mandatory advertising requirement – status

The Lithuanian Housing Strategy was approved by the Lithuanian Government on the 21st of January 2004. One of the goals of this document was to ensure efficient use, maintenance and major renovation of the existing housing, as well as efficient energy use. With the view of accelerating the insulation of multi-apartment houses and the modernisation of their energy systems, the Programme for the Modernisation of Multi-apartment Houses was approved by the Resolution No 1213 of the Government of Lithuania on the 23rd of September 2004. It is now being revised, foreseeing additional financial and other measures aimed at encouraging apartment owners to renovate multi-apartment houses, and involving low-income population in the implementation of such projects.

The main attention was focused on the implementation of the energy efficiency measures. For the majority of multi-apartment buildings, heating systems are renovated and/or modernised, roof structures are renovated and insulated, windows and doors are renovated or replaced. Defective wall joints in residential apartment buildings constructed with multilayer reinforced concrete panels are corrected and the thermal resistance of their walls is improved. The costs in relation to heat energy and fuel ratio per unit of useful residential floor space will be reduced by at least 30%.

The main task of the above mentioned programme was to provide support to home owners of multifamily buildings for the implementation of energy efficiency measures. The programme started at the end of 2005. The participants of the programme were the apartment owners, the Housing and Urban Development Agency (HUDA, Programme administrator), municipalities, commercial banks, housing loans insurance companies, housing administration companies, engineering consultant companies (preparing energy audits and investment proposals), contractors, etc..

Therefore, the Lithuanian Government negotiated the establishment of the JESSICA Holding Fund (JHF), to offer an attractive financing scheme in order to speed up the major renovation process. In 2010, a financing mechanism (JESSICA) was developed, by which state support comprises about 30% of the rehabilitation project value from 2011 onwards: 100% support for technical documentation preparation and expenses for supervision of construction works if D class (according to the EPC classification) is achieved; 15% support for energy efficiency measures implementation if D class (according to the EPC classification) is achieved; 100% support for low-income families.

Lithuania is one of the first countries in the European Union which uses the initiative of JESSICA for the improvement of the energy efficiency in multi-apartment buildings. Originally, the fund size was projected at 227 M€ (127 M€ from European Regional Development Fund (ERDF), as well as 100 M€ from the Lithuanian National budget). The overall aim of the JESSICA Holding Fund is to contribute to the increased energy efficiency in the housing sector by means of offering long term loan financing at preferential terms and conditions.

A JESSICA loan (maturity up to 20 years at a fixed annual interest rate of 3%) is offered to the owners of apartments or other premises in multi-apartment buildings, provided that they commit themselves to implement energy efficiency measures and other measures set forth in the Investment Plan, which would result in (i) achieving at least 20% of energy savings as compared to the baseline, and (ii) meeting at least the energy efficiency class D requirements. If these targets are met, the beneficiaries qualify for a 'bonus' - an interest subsidy of 15% of the loan principal. At the end of 2011, the Lithuanian Parliament introduced an additional timelimited incentive to compensate an additional 15% of the investment cost, provided that the overall calculated energy savings reach at least 30% (for grant) as compared to the baseline, i.e., a total of 30% grant on the investment. This additional grant will be financed by the Special Climate Change Programme. To date, JHF has 43 JESSICA projects signed, as well as 189 projects in the pipeline.

At a later stage, the scheme was extended to cover student dormitories and other buildings under the jurisdiction of the Ministry of Education and Science. Detailed official information, texts and tools are available on the national websites. Primary information and related legal acts are already available on the national websites: *www.am.lt*; *www.spsc.lt*; *www.bkagentura.lt*; *www.enmin.lt*.

According to the Law on Construction, in Lithuania, from the 9th of January 2013 onwards, when existing buildings (building units) are offered for sale or rent, the EP indicator of the EPC of the building or the building unit, as applicable, should be stated in the advertisements in commercial media.

3.4 Information campaigns

In 2009, the Ministry of Environment arranged the international conference on energy efficiency in buildings 'The Brokerage of Project Ideas' during the annual Construction and Renovation exhibition in Lithuania RESTA 2009. The presentations were made by speakers from the European Commision, The Netherlands, Poland, France, Spain, Norway, Austria, Energy Associations and Lithuania. During the International Exhibition on Construction and Renovation RESTA 2010, the Certification Centre of Building Products (SPSC) has organised several seminars about energy efficient and passive houses. The exhibition RESTA 2010 was dedicated to specialists of the construction branch, responsible authorities, institutions, owners of buildings, as well as to the general public. SPSC has also participated in radio and television broadcasts, and has made 5 presentations in several conferences, meetings and seminars. The promotional brochures about the certification of EP of buildings were produced and presented during annual international exhibitions on construction and renovation.

Figure 8: Multi-apartment building renovated using the JESSICA financial scheme.

This multi-apartment building (Panevezys, Marijonu str. 31, year of construction 1958) was renovated using the JESSICA financial scheme in the beginning of 2012. Modernisation process started in the end of 2010. At the first renovation stage: the new heating system was installed. The second stage started in July 2011: installation of sun collectors, facade and roof insulation.

Achieved results: energy savings 74%. Energy consumption before renovation: 349 kw/h/m², after renovation: 90 kw/h/m². Sun collectors produce 40% of the energy needed for the preparation of hot water. Modernisation reduced not only the energy consumption, but the heating costs as well. It also improved social and economic conditions (households' quality of life and health) and activated the construction sector.

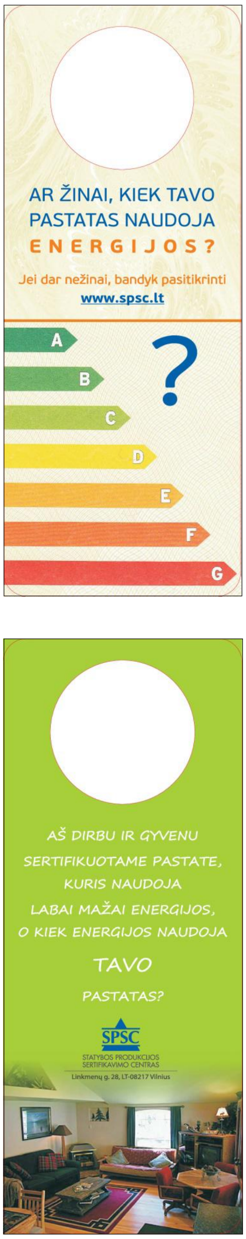
Nine Lithuanian companies and institutions involved in or closely related to construction, building materials and real estate joined their endeavours to design and construct the first Lithuanian passive house near Vilnius in 2009. The second Lithuanian passive house was designed and built in Klaipeda. SPSC, together with other partners, has organised seven excursions-seminars on the passive house construction site. Nine articles on 'passive houses' were published in journals and newspapers.

The Housing and Urban Development Agency (HUDA) provides support to municipalities, building administration, maintenance companies and home owners. Subdivisions of the Housing and Urban Development Agency are located in Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys, Alytus, Marijampolė, Telšiai and Utena. HUDA is organising seminars and training courses for participants of the housing and energy sectors. In 2012, seminars on the Programme for the Modernisation on Multi-apartment Houses were organised for 36 municipalities and their enterprises. From January 2012 till November 2012, HUDA also organised 350 meetings with inhabitants and prepared 4 international presentations in Cyprus, Poland and Romania on the financing mechanism JESSICA used in Lithuania. HUDA also participated in media broadcasts and arranged more than 30 seminars and conferences on renovation during several national and international exibitions.

Table 4: Main data on building modernisation projects in Lithuania.

Indicator	As of 10 December 2012
1. Decisions made by home owners to participate in the JESSICA programme (Total)	377
2. Number of Investment Plans approved by HUDA	239
3. Number of loans UDFs have signed (around 30 projects in pipeline for signature)	77
4. Number of renovation projects in progress	71

Figure 9: The promotional brochure on energy efficiency.



The Architecture and Building Institute of the Kaunas Technological University and the Quality Management Centre of Vilnius Gedimino Technical University also had a great involvement in the dissemination of building energy certification, as they represent a considerable number of the whole group of entities lecturing in training processes for the recognition of professionals as QEs.

3.5 Any other relevant information

The website of the Ministry of Environment *www.am.lt* provides the main information on NZEB, on the buildings modernisation programme and on the national legal acts transposing the recast EPBD. SPSC *(www.spsc.lt)* provides detailed information about certification of buildings, training and certification of experts for the EP of buildings; it also includes related legal acts, as well as all the necessary information. The website *www.spsc.lt* lists recognised experts and valid certificates of buildings. This information can be accessed by building owners and users, as well as by the general public. The Housing and Urban Development Agency (HUDA) *www.bkagentura.lt* is the institution of the Ministry of Environment that seeks to ensure proper implementation of the programmes and measures defined in the Lithuanian Housing Strategy, in order to create and develop urban planning concepts and, effective housing management and maintenance systems, promote the effective use of energy and enhance the energy-efficient modernisation of private and public buildings in Lithuania.

4. Inspection requirements - heating systems, air-conditioning

The Lithuanian legislation for boilers, heating systems and air-conditioning (AC) systems was approved in 2006 (Regulations on inspections of boilers, heating and air-conditioning systems and Methodologies). The main purposes of these Regulations and Methodologies regarding the inspections of heating and AC systems are to reduce fuel consumption (save money) and limit carbon dioxide emissions.

Figure 10: The first passive house in Lithuania, 2009.

Lithuania adopts a mixed model: a combination of regular inspections for large-scale heating and AC systems, and alternative measures for small capacity systems.

In 2012, the Ministry of Energy of Lithuania, together with the Lithuanian Energy Institute, carried out a study to assess the economic impact (cost-benefit analysis) of the new requirements of the EPBD regarding the inspection of heating and AC systems. Considering the national circumstances (system inspection cost, number of systems, etc.) the study led to the following key findings:

> heating and AC systems of an effective rated output above 100 kW should be regularly inspected, but less frequently;
> regular inspections of heating and AC systems of an effective rated output below 100 kW are not cost-effective, and alternative measures should be implemented.

Respecting the requirements of the EPBD and the results of the cost-benefit analysis, measures were thus set in the amended Law of Energy and Regulations as presented in Table 5.

The State Energy Inspectorate under the Ministry of Energy is the appointed responsible institution for the implementation, administration and control of the process of regular inspections or implementation of alternative measures.

Inspections of boilers and AC systems are based on the assessment of energy efficiency under normal working conditions. Measurement methods and the procedure for evaluation of boilers, heating systems and AC systems are established in the Methodologies on Inspection. The main steps involved in the inspection are as follows:

> analysis of project and/or technical documentation;
> visual inspection, evaluation of system's condition and assessment of its conformity with the Methodologies and Regulations on inspection;

> measurements of calculation using actual data;
> inspection of equipment operation;
> calculation of overall efficiency and other indicators;
> report on the inspection (recommendations) and labelling of the inspected system.

These reports are kept both by the State Energy Inspectorate and by the energy equipment user. The report should list the recommendations for efficient use of energy and energy recources.

Users of heating or AC systems of an effective rated output below 100 kW have the option to implement alternative measures instead of regular inspection. The State Energy Inspectorate applies two types of measures:

1. Users receive a booklet consisting of the following information:

> recommendations on how to identify heating and AC systems, and how to evaluate the average system's efficiency by its type and age;
> recommended capacity sizes for heating and AC systems according to building characteristics (condition, purpose, heated or cooled area, hot water demand, etc.);
> expected benefit from operating various types of heating and AC systems and energy savings after replacing the present system with a more efficient one;
> expected benefit after performance of regular technical supervisions;
> information on system adjustments for optimal operation.

The State Energy Inspectorate also provides regular consultations regarding system efficiency assessment and efficiency increase, via telephone or internet.

2. Users fill the questionnaire-forms provided by the State Energy Inspectorate. Questionnaire-forms include the following information:

> fuel type and energy consumption/production of the system;
> average room temperature;
> frequency of system's technical supervision;
> building purpose, size, construction year, envelopes, windows, etc..

Data provided by users are evaluated by

Table 5: Measures set in the amended Law of Energy and Regulations.

System type and capacity	Heating systems with boilers of effective rated output >20–100 kW	Heating systems with boilers of effective rated output >100 kW	Heating systems with gas boilers of effective rated output >100 kW	A/C systems of effective rated output >12–100 kW	A/C systems of effective rated output >100 kW
Measures applied	Inspection every 5 years or alternative measures	Inspection every 2 years	Inspection every 4 years	Inspection every 3 years or alternative measures	Inspection every 3 years

State Energy Inspectorate specialists, and an individual conclusion is prepared. It assesses fuel or energy saving potential when replacing or modifying the system in operation with a more effective one, and provides respective recommendations to users. Users failing to fill the questionnaire forms and to provide the required data are obliged to perform a system inspection according to the respective Regulations and Methodologies.

The energy companies in Lithuania provide inspection on boilers, heating and AC systems. All recognised energy companies are registered in the central database of the State Energy Inspectorate and published on the website *www.vei.lt*.

5. Conclusions and future plans

Lithuania shall furthermore develop policies and take measures such as setting targets to increase the number of Nearly Zero-Energy Buildings (NZEB). The main targets are described in 2.5.

Lithuania will continue the Programme for the Modernisation of Multi-apartment Houses with the support of the European financing mechanism JESSICA for the improvement of energy efficiency measures in buildings.

The Ministry of Environment of the Republic of Lithuania, the Ministry of Energy of the Republic of Lithuania and many involved institutions, such as the Certification Centre of Building Products (SPSC), the Housing and Urban Development Agency (HUDA), the State Energy Inspectorate, municipalities and their enterprises, will be more involved in the future in information campaigns to influence owners to adopt energy saving measures. They will be involved in organising conferences, seminars, presentations on building renovation and energy efficiency measures to achieve the tasks described in the national NZEB plan.

Figure 11: Cover page of the booklet 'Inspection of Energy Eficiency of Boilers, Heating Systems and Air Conditioning Systems'.

In 2013, Lithuania will start the inspection of boilers fired by renewable fuel of an effective rated output above 100 kW, and the implementation of alternative measures (advice campaigns, questionnaires) for heating and air-conditioning systems of an effective rated output below 100 kW.

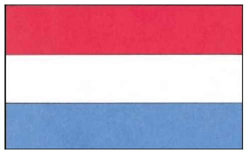
Lithuania intends to continue the Experts Training Programme for experts carrying out the Energy Performance (EP) certification of buildings. Future plans include increasing the number and quality of training courses for accredited experts.

Lithuania intends to participate in the project BUILD UP Skills supported through the Intelligent Energy Europe (IEE) Programme. The final aim of the project is to increase the number of qualified workers across Europe to deliver renovations offering a high EP, as well as new NZEBs.

Lithuania is making large efforts to influence apartment owners in multifamily residential buildings to join the national energy saving initiative and improve the EP of their buildings. The main measures are defined as described in the Programme for the Modernisation of Multi-apartment Houses.

EPBD implementation in Luxembourg

STATUS AT THE END OF 2012



Authors

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Ministry of the Economy and Foreign Trade

1. Introduction

In Luxembourg, the implementation of the Energy Performance of Buildings Directive (EPBD) is the overall responsibility of the Ministry of the Economy and Foreign Trade. The General Directorate of Energy is the managing body. The EPBD was implemented by regulations set on the basis of the *'loi du 5 août 1993 concernant l'utilisation rationnelle de l'énergie'*. This law offers the government a legal basis to set up the requirements for the thermal insulation of buildings. In 1995, Luxembourg implemented the first mandatory requirements for residential and non-residential buildings, by a regulation setting up requirements for new buildings, as well as for the renovation of the existing building stock. The regulation fixed a maximum average U-value for the whole building, taking into account several aspects, such as the ratio volume/surface and the inside temperature for buildings with a floor area over 200 m².

In 2008, the requirements for residential buildings were modified in order to transpose the EPBD on the basis of the '*règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation*'.

The implementation of the EPBD for non-residential buildings is based on the '*règlement grand-ducal modifié du 1 août 2010 concernant la performance énergétique des bâtiments fonctionnels*', which came into force on the 1st of January 2011.

This report presents an overview of the current implementation status of the EPBD in Luxembourg, and of its further evolution.

2. Energy performance requirements

2.1 Progress and current status

In December 2012, the Energy Performance (EP) requirements for new and existing buildings were fully implemented.
The regulations implement:

- a methodology to calculate the energy performance of buildings;
- the minimum requirements for new buildings, and for extensions and renovated elements of existing buildings;
- the Energy Performance Certificate (EPC).

Each time a building permit (new building, extension and renovation of existing building) is required, the documents providing the calculation of the requested EP standards and the EPC must be attached to the application. The obligation to provide those documents arises from the legal requirements in order to submit a request for a building permit. The building license is required for new buildings and, depending on municipal rules, for modifications and extensions to existing buildings.

For new and existing residential buildings, the calculation of the EP is based on energy needs; the calculation methodology for these buildings includes heating, hot water, ventilation and auxiliary needs. The results of the calculation are expressed in terms of absolute levels of primary energy needs, final energy needs and CO_2 emissions.

Figure 1: Performance class.

National Websites *www.energyefficient.lu, www.eco.public.lu, www.myenergy.lu*

***Figure 2:* Energy efficient symbols for non-residential and residential buildings.**

In case of non-residential buildings, the EP calculation is based on energy needs (final energy, primary energy and CO_2 emissions) for new buildings, and on the energy consumption (final energy for heating and electricity) for existing buildings. The calculation methodology for both new and existing buildings includes, in addition to the calculation of energy needs for residential buildings (heating, hot water, ventilation and auxiliary needs), the calculation of energy needs/consumption for cooling and lighting, as well as for humidification and dehumidification. The results of the calculation are expressed in relation to a reference building of the same type and utilisation as the analysed building. The 100% mark represents the minimum requirement for new non-residential buildings. This means that no building permit is granted for new buildings with energy needs above this mark. For existing non-residential buildings, the scale of classification ranges from 0% to 400%, where the 100% mark represents a typical existing building of the same type.

Since 1996, the national regulation sets minimum requirements for all types of buildings (with just a few exceptions, e.g., officially protected buildings, technical infeasibility, violation of other legal requirements). Tables 1 and 2 illustrate the minimum required U-values applicable from 1996 to 2008, as well as those currently in force.

These U-values are applicable to new residential buildings, new non-residential buildings and public buildings, as well as to renovated parts of all buildings and extensions. Since 2008, the new regulation also sets up new minimum and global requirements for residential buildings. For non-residential buildings, this is only required since 2011. Table 3 shows the different stages and sorts of requirements for residential and non-residential buildings from the 1st of January 2008 on, up to the present.

***Tables 1 & 2:* U-values for residential buildings 1996-2008.**

1996 **Building component**	To outdoor air	To soil or unheated spaces
Outdoor walls	0.40	0.40
Windows and doors	2.00	0.30
Ridget/flat roof and attic	0.30	2.00
Foundation, Cellar	0.40	2.50

2008 **Building component**	To outdoor air	To weakly heated spaces	To soil or unheated spaces
Wall and floor	0.32	0.5	0.40
Roof and ceiling	0.25	0.35	0.30
Domes	2.7	2.7	2.7
Window or balcony door including frame	1.50	2.00	2.00
Door including frame	2.00	2.50	2.50

Global requirements are expressed in terms of absolute primary and final energy needs. The absolute level depends on how compact the building is. For instance, the primary energy requirement currently in force for new residential buidings is shown in Figure 3.

The new regulation of 2012 reinforces the primary energy requirement in stages up to 2017 for new residential buildings, as well as the final energy requirement for new residential buildings and extensions of existing residential buildings exceeding 80 m^2. The timetable in Figure 4 illustrates the roadmap.

***Table 3:* Energy performance in buildings requirements 2008-2012.**

The principles of legislation - REQUIREMENTS			
	Before 1.1.2008	**After 1.1.2008**	**After 1.1.2011**
ENERGY eFFICIENT (residential)	**RGD 22.11.1995**	**RGD 30.11.2007**	**RGD mod. 30.11.2007**
	U-Values	* Minimal values ° U-Values ° Tightness ° Pipes ° Ventilation * Heating energy index * Primary energy index	
ENERGY eFFICIENT (non-residential)	**RGD 22.11.1995**	**RGD 30.11.2007**	**RGD 2010**
	U-Values	**U-Values**	* Minimal values ° U-Values ° Sun protection ° Tightness ° Thermal bridges ° Pipes and storage ° Ventilation ° Regulating & measurement devices * Heating energy index * Primary energy index

2.2 Format of national transposition and implementation of existing regulations

In Luxembourg, the transposition of the EPBD, as well as the EP requirements and the EPC have been implemented by a grand-ducal regulation having its legal basis in a law.

The following regulations implement the EPBD:

1. '*Règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments Mémorial A N° 221 de 2007*';[1]
2. '*Règlement grand-ducal modifié du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels Mémorial A N° 173 de 2010*'.[2]

1 *www.legilux.public.lu/leg/a/archives/2007/0221/2007A3762A.html*
2 *www.legilux.public.lu/leg/a/archives/2010/0173/2010A2850A.html*

These regulations set the details about the methodology to calculate the EP of buildings, and implement the obligation to establish the EPC. A few modifications to these regulations have been undertaken until now, in order to adapt some details.

The General Directorate of Energy of the Ministry of the Economy and Foreign Trade has developed software packages to calculate the EP, and to draw up the EPC of buildings for the experts. These software packages are an important support tool used by nearly all the experts.

Furthermore, the Ministry of the Economy and Foreign Trade has created an internet support site on which general information, the list of the experts having completed special courses, etc., are published for the public. This website also has a secured part aiming to the authorised experts, containing instructions, technical issues, etc..

The regulations offer to the ministry the possibility to control the issued EPCs. A random control of these certificates showed a nearly overall compliance with the regulations. In case of non compliance, experts can be blocked from issuing EPCs for a certain time. In case of recurrence, experts can lose the accreditation to issue EPCs.

The ministry is currently working on the constitution of an EPC database which will allow the monitoring and statistical evaluation of the EPCs. This database shall also permit to carry out plausibility checks of all EPCs, as well as to choose experts for controls in a preconfigured manner, depending on the average results of plausibility checks of the EPCs issued by these experts.

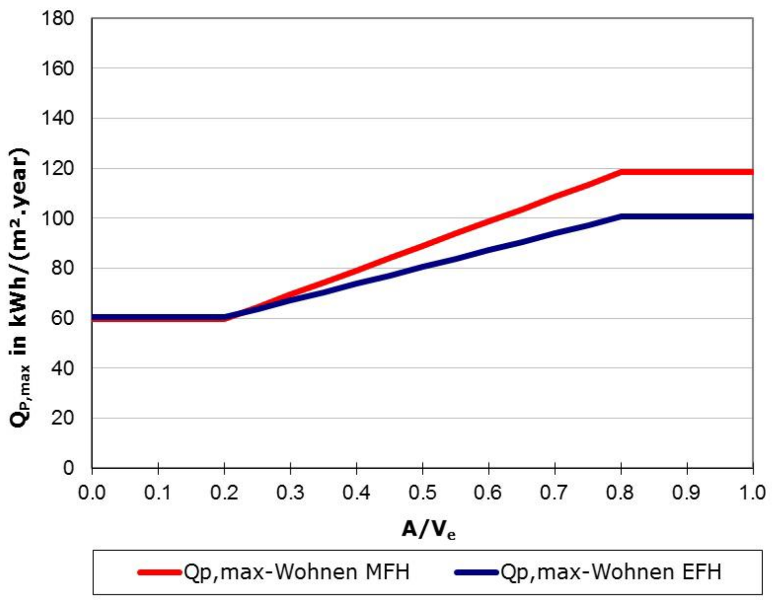
2.3 Cost-optimal procedure for setting EP requirements

Luxembourg started working on the elaboration of a calculation method to compare the optimal costs in relation to the EP requirements on the basis of the European Regulation (EU) 244/2012. Results are not yet available.

2.4 Action plan for progression to NZEB

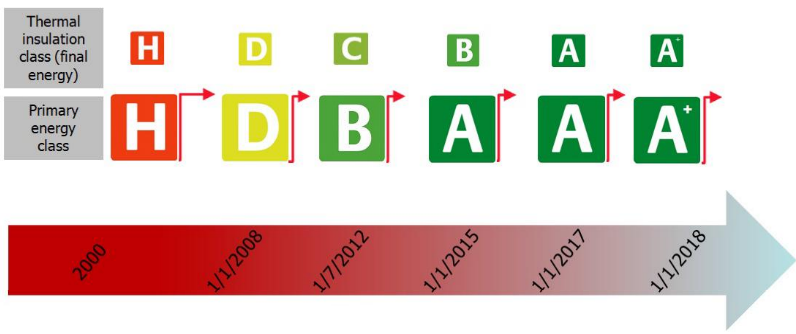
At the end of 2012, Luxembourg is still designing its Nearly Zero-Energy Building (NZEB) action plan. The definition of NZEBs will be given in that plan, and a roadmap containing different actions to implement NZEBs will be proposed.

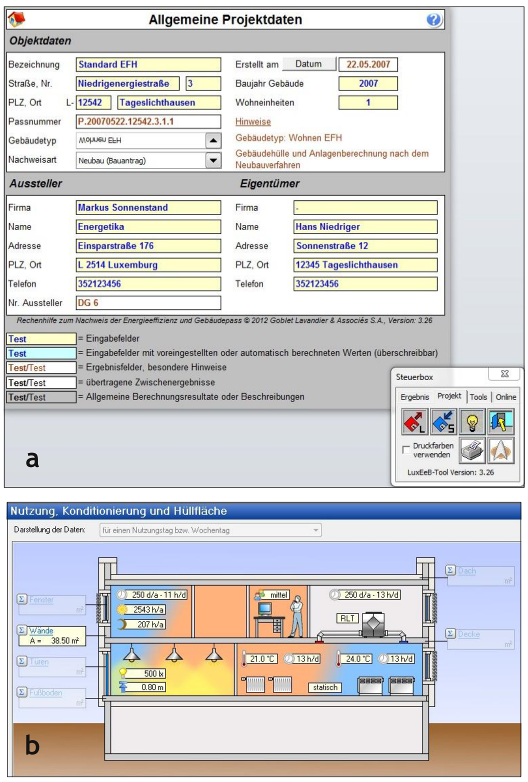
Figure 3: Primary energy requirements for residential buildings.



Building category		$Q_{P,max}$ [kWh/m².year] $0.2 < A/V_e < 0.8$	$Q_{P,max}$ [kWh/m².year] $A/V_e \leq 0.2$	$Q_{P,max}$ [kWh/m².year] $A/V_e \geq 0.8$
1	Multifamily building (Wohnen MFH)	$40+98(A/V_e)$	59.6	118.4
2	Single-family building (Wohnen EFH)	$47+67(A/V_e)$	60.4	100.6

Figure 4: Roadmap – new residential buildings.





Figures 5: Software for issuing the energy label of (a) residential and (b) non-residential buildings.

3. Energy performance certificates

The General Directorate of Energy, as the managing body of the ministry, designed, developed and currently supports the entire certification system, with the help of external experts, if needed.

The timeframe for the certification of the various types of buildings was divided into two major phases, until its full implementation in mid 2011, as all the required buildings were included in the certification system: new buildings, major renovations, residential and non-residential buildings, and all buildings when sold or rented.

3.1 Progress and current status on sale or rental of buildings

The National System for Energy Performance Certification of Residential Buildings came into force on the 1st of January 2008 for new buildings, and on the 1st of September 2008 for existing buildings.

The Energy Performance Certification of Non-Residential Buildings came into force on the 1st of January 2011 for new buildings, and on the 1st of June 2011 for existing buildings.

Since the 1st of September 2008, all existing residential buildings need to be certified when sold or rented. The owner must present a valid EPC to the buyer, when the selling or renting contract is established. This involves a qualified expert visiting the property and assessing the building in terms of the type of construction (walls, windows, insulation, thermal bridges, ventilation and airtightness, etc.), as well as of the type and quality of Heating, Ventilation and Air-Conditioning (HVAC), and hot water systems. The qualified expert will then calculate the thermal and primary energy efficiency of the building and issue the EPC. There is no minimum requirement for an existing building, i.e., it can be labelled A through G.

For new non-residential buildings, this requirement started on the 1st of January 2011, and for all existing non-residential buildings the certification became mandatory on the 1st of June 2011 in case of selling or renting.

After the calculation of the energy rating and, in the case of existing buildings, the required description of worthwhile improvement measures, the expert compiles the EPC for delivery to the building owners.

The energy label classifies all new buildings on an efficiency scale ranging from A (high energy efficiency) to I (poor efficiency), and is based on asset rating. Each building is assigned an energy performance rating according to Tables 4 to 6.

The energy label classifies existing non-residential buildings on a scale from 0-400% with regard to a reference building. The scale of classification of non-residential buildings is shown in Figure 6.

Table 4: Classes for total primary energy performance (kWh/m².year) in residential buildings.

Building category		Class A	Class B	Class C	Class D	Class E	Class F	Class G	Class H	Class I
1	Multifamily building	≤ 45	≤ 75	≤ 85	≤ 100	≤ 155	≤ 225	≤ 280	≤ 355	> 355
2	Single-family building	≤ 45	≤ 95	≤ 125	≤ 145	≤ 210	≤ 295	≤ 395	≤ 530	> 530

Table 5: Classes for heating energy performance (kWh/m².year) in residential buildings.

Building category		Class A	Class B	Class C	Class D	Class E	Class F	Class G	Class H	Class I
1	Multifamily building	≤ 14	≤ 27	≤ 43	≤ 54	≤ 85	≤ 115	≤ 150	≤ 185	> 185
2	Single-family building	≤ 22	≤ 43	≤ 69	≤ 86	≤ 130	≤ 170	≤ 230	≤ 295	> 295

Table 6: Definition of the limits of the energy performance classes related to the reference building for non-residential buildings.

	Class A	Class B	Class C	Class D	Class E	Class F	Class G	Class H	Class I
Primary energy demand	≤ 55%	≤ 70%	≤ 85%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
CO_2 emission performance figure	≤ 55%	≤ 70%	≤ 85%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Heating energy demand	≤ 45%	≤ 60%	≤ 80%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Heating primary energy demand	≤ 45%	≤ 60%	≤ 80%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Cooling primary energy demand	≤ 45%	≤ 60%	≤ 80%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Ventilation primary energy demand	≤ 65%	≤ 75%	≤ 85%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Lighting primary energy demand	≤ 55%	≤ 70%	≤ 85%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%
Weighted final energy demand	≤ 55%	≤ 70%	≤ 85%	≤ 100%	≤ 150%	≤ 200%	≤ 300%	≤ 400%	> 400%

The EPC is the most visible aspect of the regulation concerning the EP of buildings. This document assigns an energy performance label to residential and non-residential buildings or building units. It also lists cost-effective measures for improving the EP of existing buildings.

The EP certification allows consumers to compare the EP of buildings. This could be a criterion for a better choice when buying or renting a building. An added value of the EP certification of existing buildings lies in the recommendations given to the building owner. These are summarised on page 5 of the certificate. These recommendations should be the first step towards the renovation of existing buildings.

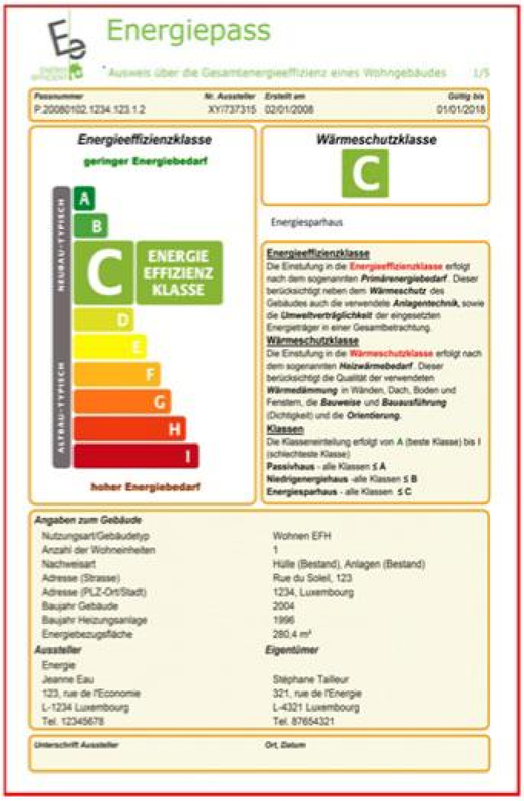
As shown in Figures 9 and 10, suggested improvements include a short description, estimates of the costs of each improvement measure, savings and paybacks, and the impact on the energy rating if all measures were to be implemented. Recommendations made by the expert are the result of specifically studying each particular building.

Certificates can only be issued by Qualified Experts (QE). QEs are either architects or engineers, who are members of the '*Ordre des Architects et des Ingénieurs-Conseils (OAI)*', as well as experts holding an accreditation from the Minister of the Economy and Foreign Trade, but with some restrictions concerning non-residential buildings: the experts accreditated by the Ministry of the Economy and Foreign Trade are not allowed to issue EPCs for new non-residential buildings. All experts accredited by the ministry have to prove, among other criteria, certain qualifications and independency. Members of the OAI are automatically assumed to have the minimum qualification and the independency required to issue EPCs. The total number of all experts (OAI and accreditated by the ministry) was 936 by the end 2012; 112 have been accreditated by the ministry. The validity of the EPCs is 10 years.

The government has set up non mandatory courses to ensure the quality of the issued EPCs. For residential buildings and existing non-residential buildings, a one-day course is available for all experts, whereas a four-day course is at the disposal of the experts for new non-residential buildings.

As the EPC is offered on the free market, the prices may vary from expert to expert. According to a short unofficial survey, the range of prices for the EPC is between 500 € and 1,300 € for a single-family house, and between 125 € and 250 € per apartment for a residential building with 4 to 10 dwellings.

Figure 6: Energy scale for existing non-residential buildings.



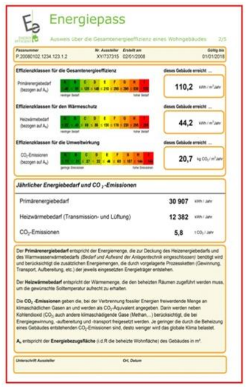


Figure 7: Cover and second page of the EPC of residential buildings.

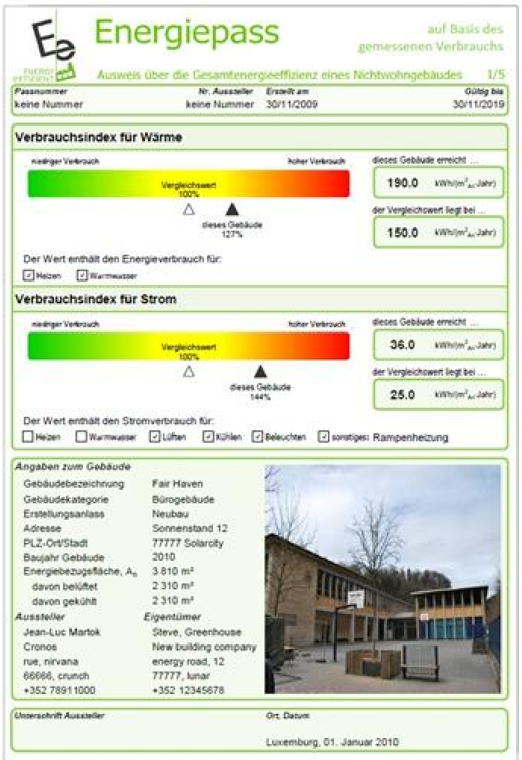


Figure 8: Cover of the EPC of existing non-residential.

Figure 9: EPC Energy saving measures recommendations for residential buildings.

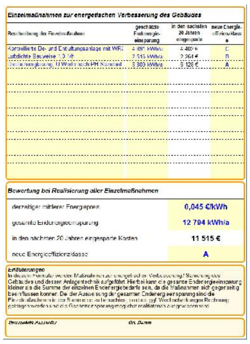


Figure 10: EPC Energy saving measures recommendations for non-residential buildings.

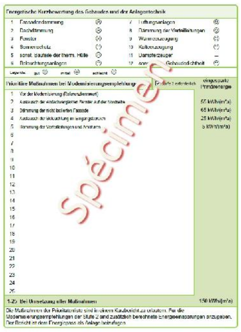


Figure 11: Examples of advertising.

The responsibility of having an EPC always belongs to the building owner. An owner who fails to deliver the EPC to a buyer or tenant can be penalised, according to the law on the rational use of energy.

The Ministry of the Economy and Foreign Trade can collect from the experts all the EPCs they issued, in order to proceed to a quality control, or to store them in a database. The experts have the obligation of keeping all data on calculation and issued EPCs for at least 10 years, and of making them available to the ministry upon demand. The ministry is currently working on setting up such a database.

3.2 Progress and current status on public and large buildings visited by the public

For residential buildings and non-residential buildings occupied by the State, by the local authorities or by associations of local authorities with more than 1,000 m^2 useful floor area, which are frequented by a significant number of people, the EPC must be displayed at the entrance of the building.

This provision is to be modified in 2013, in order to adjust the floor area triggering the obligation to display the EPC. This floor area will be reduced to 500 m^2, starting on the 1st of January 2013, and to 250 m^2 from the 9th of July 2015 onwards.

Public authorities are aware they have to lead by example, and have been sensitised to establish and display the EPCs in all relevant buildings.

3.3 Implementation of mandatory advertising requirement – status

The modification of the EP regulation has introduced the obligation to insert the overall EP class and the heating performance class in advertisings concerning residential buildings to be published in all commercial media. This obligation came into force on the 1st of July 2012. A large number of the advertisements already comply with the obligation but, as it has been implemented recently, it is still too early to draw conclusions on its effectiveness. The ministry is currently raising the awareness in the relevant sectors to fully comply with this requirement.

3.4 Information campaigns

After the entry into force of the new regulation on EP in residential buildings in 2008, the Ministry of the Economy and Foreign Trade initiated an information campaign about the new regulation, and especially about the new EPC. A flyer was distributed to all households in Luxembourg. Beside this general information campaign, the ministry organised information meetings with the syndicates of building owners, in order to raise their awareness on the EP of buildings, and to inform them about the new procedure on the EPCs.

Advertising campaigns about the energy certification of buildings are continuously developed, and are being promoted on television, in the cinema, in the press and on the internet. The message of these campaigns is to show that the EPC is promoting market transparency, and that it is the first step towards undertaking energy saving measures. 'myenergy', the national structure for the promotion of energy efficiency and renewable energy, is very active in this field.

The Ministry of the Economy and Foreign Trade created a site (*www.energyefficient.lu*) providing detailed information on the EPC regulation and on the procedure to become an accredited expert. A list of all experts that have completed the training courses is published on this website, which also offers the possibility to register online for the training courses.

Furthermore, the government created a virtual online desk (*www.guichet.lu*) where people may get all information on all kinds of procedures, etc.. This online desk includes a section with all the necessary information on the EP certification of buildings, authorised experts and governmental subsidies.

Detailed information on the energy efficiency of buildings and on the EPC is available at the 'myenergy' (*www.myenergy.lu*) website. During the last years, 'myenergy', the national structure for the promotion of energy efficiency and renewable energy, was present in many events, fairs, seminars and workshops, disseminating information about the certification process, and promoting among citizens the awareness regarding the added value of building EP certification that is based on clear and reliable information.

In order to reach people directly, 'myenergy' has set up a network of so called 'myenergy infopoints' over the country. In these infopoints, the citizens can get professional and impartial information about the EP and its certification for free.

In addition to the activities of ‘myenergy’, the ministry organised several conferences to explain the certification process to municipalities, as well as to economical and institutional actors in the concerned sectors.

4. Inspection requirements - heating systems, air-conditioning

Luxembourg had already established a mandatory acceptance procedure in new buildings, as well as regular inspections of oil fired boilers in existing buildings in 1989. For gas fired boilers, this system became mandatory in 2000.

The acceptance procedure and the regular inspection of air-conditioning systems became mandatory in 2009, both for residential and non-residential buildings.

The installers have the obligation to make the application for the acceptance procedure to the Chamber of Handicrafts, which acts under the mandate of the government on the basis of a special agreement.

4.1 Progress and current status on heating systems

Each new oil or gas fired heating system in new and existing buildings is submitted to an acceptance procedure. After this procedure (checking the location of the boiler, carbon dioxide emissions, temperature of exhaust gas, combustion efficiency, black carbon index, safety of the installation, etc.), a periodic control of the heating system is mandatory: gas fired heating systems are subject to inspection every four years, whereas the inspection interval is two years in case of oil fired boilers. The results of these certifications and inspections are centralised in a database. Existing boilers are subject to periodic controls, where the checking list is the same as that of the acceptance procedure.

The certificate of oil fired heating systems includes, besides information on the user of the heating system and on the controller, the following information:

> location of the boiler;
> fuel-type;
> nominal power of the installation;
> black carbon index and residual fuel in the exhaust gas;
> carbon dioxide emissions;
> temperature of exhaust gas;
> combustion efficiency;
> inspection result (if not OK, the installation has to be changed in order to be OK. If dangerous, the installation has to be switched off).

Figure 12: Advertising campaigns.

In the case of gas fired boilers, the certificate contains, in addition to the information mentioned above, a safety check of the installation, including the whole exhaust system and the location of the system inside the building.

Since 2010, each heating system containing boilers older than 15 years is subject to a unique inspection including an analysis concerning the power of the boiler in relation to the heating energy needs of the building, as well as the location of the boiler, carbon dioxide emissions, temperature of exhaust gas, combustion efficiency, black carbon index, safety of the installation, etc..

On the basis of an agreement between the Chamber of Handicrafts and the government, the aforementioned inspections are carried out by installers who have completed special training courses.

Figure 13: (a) www.energyefficient.lu, (b) www.guichet.lu, (c) www.myenergy.lu

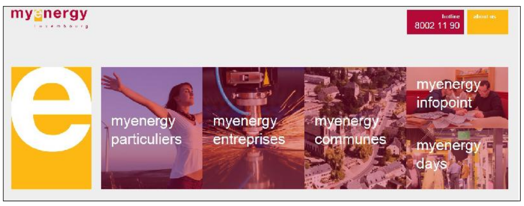


Figure 14: myenergy infopoint.

All inspections are centralised in a database. If an owner fails to conduct an inspection, sanctions which are defined by the basic law can be applied (fines).

At the end of 2012, a regulation related to wood-fired heating systems is in the legal procedure for adoption. This regulation will introduce almost the same acceptance and inspection procedures as for oil and gas fired heating systems.

4.2 Progress and current status on AC systems

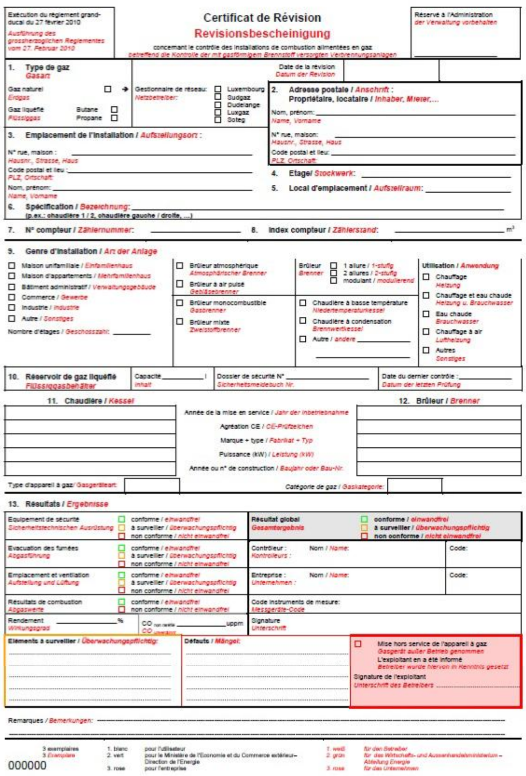
Inspections of new air-conditioning systems are mandatory; the systems are certified by experts of the Chamber of Handcrafts. This certification includes the dimensioning and overall efficiency of the air-conditioning system.

In existing buildings, inspection of air-conditioning systems, including dimensioning, overall efficiency and leak-tightness of the installation, takes place every 5 years. Inspections are paid by the end user or by the owner of the building.

The inspections are carried out by specialised experts of the Chamber of Handicrafts, mandated by the government.

Regular controls are made by the installers who have successfully completed special training sessions. The authorisation to carry out these inspections is valid for 5 years, and can only be renewed if a continuing course is completed. Sanctions are defined by the basic law which is the legal basis of the regulation.

Figure 15: Inspection certificate of heating systems.



Certificat de Révision
Revisionsbescheinigung

5. Conclusions and future plans

The Energy Performance of Buildings Directive (EPBD) requirements for new buildings shall bring important energy savings in the near future, although new buildings only represent a small share of the entire building stock. Currently, about 2,000 new single-family house buildings are built each year in Luxembourg. The efforts concerning the renovation of existing buildings have yet to be increased, in order to achieve more savings in the existing building stock.

In order to accelerate the main goals of the EPBD, the government has implemented significant incentives for the improvement of existing buildings and the construction of low energy and passive buildings. Certification can play a fundamental role, especially in the renovation of existing buildings. The recommendations made by the experts in the Energy Performance Certificate (EPC) are important guidelines to the building owner, who can make good use of them, either in the context of a fundamental renovation, or as an individual cost-effective measure.

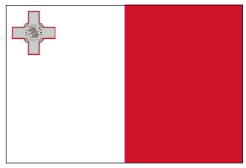
Additional training should be offered for qualified experts, to improve their skills in energy audits, and their ability to offer the best economic and technologic building improvement solutions. The government intends to work on these issues in the coming years, also in the context of the transposition of the EPBD recast into national law.

The main challenges and future developments of the certification system for the short and medium term are, thus, to:

> develop a methodology for the quality control of issued certificates;
> define a roadmap until 2020 for the Energy Performance (EP) of non-residential buildings;
> set up a database for all delivered EPCs;
> define the calculation of the cost-optimal levels of the energy performance requirements, based on the methodology framework by the Commission.

EPBD implementation in Malta

STATUS AT THE END OF 2012



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1. Introduction

Malta transposed and implemented Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) and its recast, Directive 2010/31/EU, by means of three successive legal notices that were issued between 2006 and 2012. The first law, Legal Notice 238 of 2006, introduced the first set of regulations on the 'Minimum requirements on the Energy Performance of buildings' in Malta. The second law, Legal Notice 261 of 2008 retained the original minimum requirements of buildings and introduced Energy Performance (EP) certification and inspection requirements transposing the original EPBD into national law. The most recent legislation, Legal Notice 376 of 2012, issued under the legal chapter of the Building Regulation Act, supersedes the previous legal notices, but retains the original technical guidance on the minimum requirements and has now transposed the EPBD recast into national law.

Up to October 2012, the responsibility for the implementation of the EPBD in Malta rested with the Malta Resources Authority (MRA). After that date, the implementation of the EPBD recast in Malta was passed on to the Building Regulation Office (BRO) and the Building Regulation Board (BRB) within the Ministry for Resources and Rural Affairs (MRRA).

This report describes the current status of implementation of the EPBD recast including EP certification and the logistics of certificate registration, upgrading of the current minimum requirements according to the cost-optimal framework methodology, quality control and auditing, calculation methodology tools, inspection systems, training and registration of qualified EP assessors, information campaigns, incentives and subsidies.

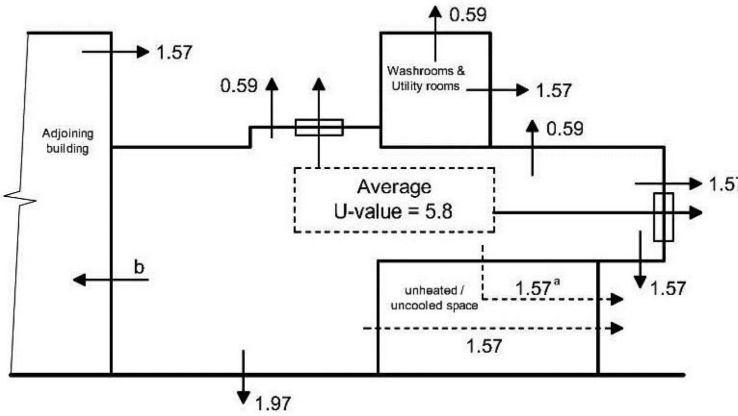
2. Energy performance requirements

Before Legal Notice 238 of 2006 was introduced, there was no legislation regulating minimum EP requirements in buildings. This legislation introduced new requirements for thermal insulation in roofs, limits on window sizes depending on solar gains, improved glazing, the imposition of power and timing regulating controls on heating and cooling systems, the conservation and re-use of rainwater in specially designed systems and increased awareness on the benefits obtained from Renewable Energy Sources (RES). The thermal efficiency of walls that was adopted reflected the local practice of building double walls with an inner and outer leaf constructed with stone blocks and separated by a cavity, a practice which was being replaced in new construction by the use of single leaf hollow concrete blockwork with lower thermal efficiency.

2.1 Progress and current status
Before 2006, there were no minimum EP requirements or certification methodologies for buildings in Malta. Since 2006, Malta introduced the first minimum EP requirements' guidance document and supporting legislation, an EP certification system supported by

National Website *epc.gov.mt*

Figure 1: National requirements showing maximum U-values for the building fabric.



"a" - includes the effect of the unheated / uncooled space.
"b" - for calculation purposes only, in the case of adjoining buildings the U value of "would-be" unexposed party walls is to be taken as equal to the value of the exposed walls.

Limitation of the passage of heat through the building fabric

Maximum U values in W/m².K for all building categories	
Exposed walls*	1.57
Exposed floors	1.57
Non-exposed floors	1.97
Roofs	0.59
***Note:** Exposed walls of bathrooms, sanitary conveniences and utility rooms having an area of 5.6 m² or less, are excluded from this requirement*	

mandatory legislation, national calculation tools and certified assessors for the energy performance of buildings, as well as measures to control and quality check the certificates.

Since 2009, the Building Regulation Office (BRO) was consulted by the Malta Resources Authority and the Malta Environment and Planning Authority on a small number of large residential and office projects in order to assess the compliance of the buildings with the minimum requirements. The BRO conducted its analysis and issued recommendations on such projects.

The minimum requirements published in 2006 were maintained, but in 2012 the new legislation introduced the concept of cost-optimality for future mandatory revisions of the minimum EP requirements of buildings.

A sizeable data sample of Maltese residential Energy Performance Certificates (EPCs) in the central EPC registry has been analysed. Preliminary data analysis indicates that an energy rating benchmark representing a reduction in calculated energy use of nearly 50% over the current average value can be introduced as a short-term goal for 2016 (Source: Abela A. et al, An investigation into the practical application of residential energy certificates, Nottingham, Trent University, 2012).

2.2 Format of national transposition and implementation of existing regulations

The Minister responsible for Resources and Rural Affairs issued Legal Notice 376 of 2012 on the 'Energy Performance of Buildings Regulations' in October 2012 in order to transpose the EPBD recast and to give effect to its provisions. All new and existing buildings that undergo major renovation, as well as the retrofits or replacements of building elements, and the installation, replacement or upgrade of all technical building systems have to comply with these regulations.

The original technical guidance document issued in 2006, containing the minimum requirements on the energy performance of building regulations, has been retained and is part of the regulations.

The set minimum requirements prescribe limits on:

> thermal values of the building fabric, limitation on areas of glazing, both in connection with loss of heat, as well as with solar heat gain and summer shading;
> controls and insulation of heating and cooling systems;
> controls of artificial lighting systems;
> conservation and re-use of rainwater.

These requirements apply to all new buildings and existing buildings that undergo major renovation.

Table 1: National minimum requirements for buildings – Winter mode.

Building type	**Windows and rooflights with the following U values in W/m².K**	**Aggregate area as % of the area of the exposed walls bounding the building.**	
		Windows & doors	*Rooflights*
Residential buildings*	5.8	20%	10% of roof area
Industrial and storage buildings	5.8	15%	
Offices, places of assembly	5.8	25%	
Showrooms, shops	5.8	50%	
***Note:** This category includes hotels and institutional buildings*			

The calculation methodology for the Energy Performance of Residential Dwellings in Malta (EPRDM) takes account of the climate and net energy required for space heating and cooling, water heating, lighting, and ventilation, after subtracting any savings from energy generation technologies. It calculates the annual values of delivered energy consumption (energy use), primary energy consumption, and CO_2 (carbon dioxide) emissions. The procedure is designed to be compliant with the national transposition of the EPBD and is based on CEN standards. It consists of a monthly calculation within a series of individual modules. The individual modules contain equations or algorithms representing the relationships between various factors which contribute to the annual energy demand of the dwelling.

The Malta National Calculation Methodology (MNCM) for non-residential buildings, the Simplified Building Energy Model for Malta (SBEMmt), was adapted from the UK's SBEM national calculation tool. The calculation process within the MNCM for producing EPCs uses building zones for the calculations in which identifiable, standardised activities take place. It also compares the carbon emissions of the actual building with those of a 'reference building', which are subjected to a specified 'improvement factor'.

EPCs are intended to send market signals about the relative performance of comparable buildings, and so it is necessary that the reference building should be the same for all buildings of a

Table 2: National minimum requirements for buildings – summer mode.

Orientation of opening	Maximum allowable area of opening (%) using a minimal correction factor of 0.95 for glazing/blind combination
N	25
S	20
NE	17
E/SE/SW/NW	12
W	9
Horizontal (rooflights)	7
Note: The maximum allowable area of glazing for windows with an orientation falling in between the compass directions indicated in the table may be calculated by interpolating the values shown above.	

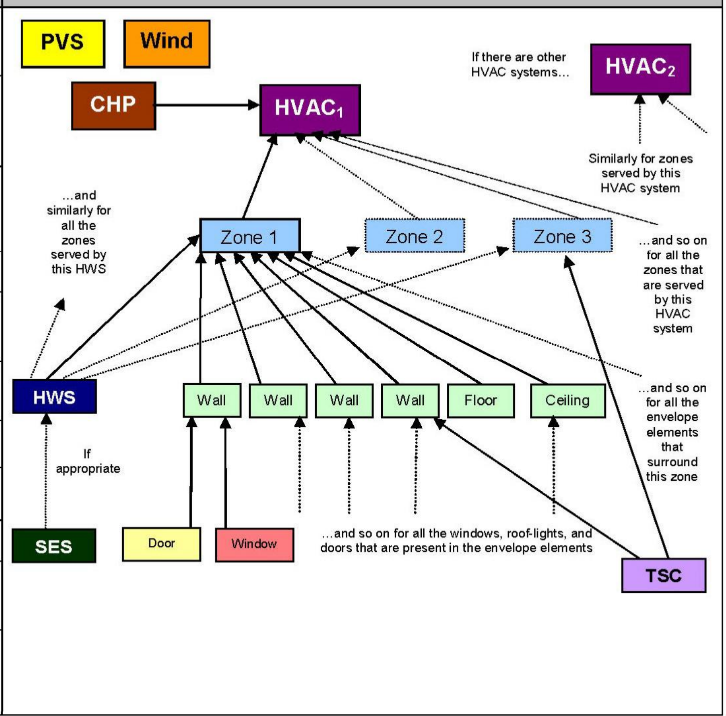
Table 3: Minimum requirements for rainwater cistern sizes.

Building Type	Size of cistern (m^3)
1. Domestic dwellings (incl. apartment blocks)	Total roof area (m^2) x 0.6 m
2. Hotels, schools, offices, factories, industrial buildings and hospitals	Total roof area (m^2) x 0.6 m
3. Shops and showrooms, and places of public gathering and entertainment not integrated in 2 above	Total roof area (m^2) x 0.45 m
4. External paved areas (incl. open terraces and balconies)*	Total paved area (m^2) x 0.6 m
***Note:** *This requirement applies only if the total open paved area is greater than 300 m^2*	

Figure 2: Definitions and key parameters of SBEMmt building objects.

Building object	Key parameters needed to define this building object	Object(s) to which it needs to be linked	Where it is defined in iSBEMmt
Zones	Dimensions, activity type, details on lighting, heating, and ventilation strategy.	HVAC and HWS	Geometry form > Zones tab and in the Building Services form > Zones tab
Envelope elements	Type of envelope (wall/floor/roof), area, orientation, construction type, thermal bridges, perimeter length, and condition of adjoining space.	Zone	Geometry form > Envelopes tab or the Geometry form > Zones tab > Quick-Envelopes sub-tab
Windows	Dimensions, glazing type, thermal bridges, shading system, frame factor, aspect ratio, and whether it is a display window or not.	Envelope element	Geometry form > Windows & Rooflights tab or the Geometry Form > Zones tab > Quick Envelopes sub-tab
Doors	Area, construction type, thermal bridges, and type of door.	Envelope element	Geometry form > Doors tab
HVAC	System type, heat source, fuel type, further details on efficiencies, duct leakage, specific fan power, and controls.	Zone	Building Services form > HVAC systems tab
HWS	Generator type, fuel type, details on efficiency and whether it is a storage system.	Zone	Building Services form > HWS tab
SES	Dimensions, orientation, inclination, storage.	HWS	Building Services form > SES tab
PVS	Dimensions, orientation, inclination and type.	-	Building Services form > PVS tab
Wind generator	Terrain type, dimensions, and power.	-	Building Services form > Wind generator
CHP generator	Fuel type, details on efficiency, building heat and hot water supplied, and thermal and electrical efficiencies.	HVAC	Building Services form > CHP tab
TSC	Type, operation, control type, absorptivity, and design air flow.	Zone and Envelope element	Building Services form > TSC tab, Geometry form > Envelopes tab, and Building Services form > Zones tab

Hierarchy of SBEMmt building objects



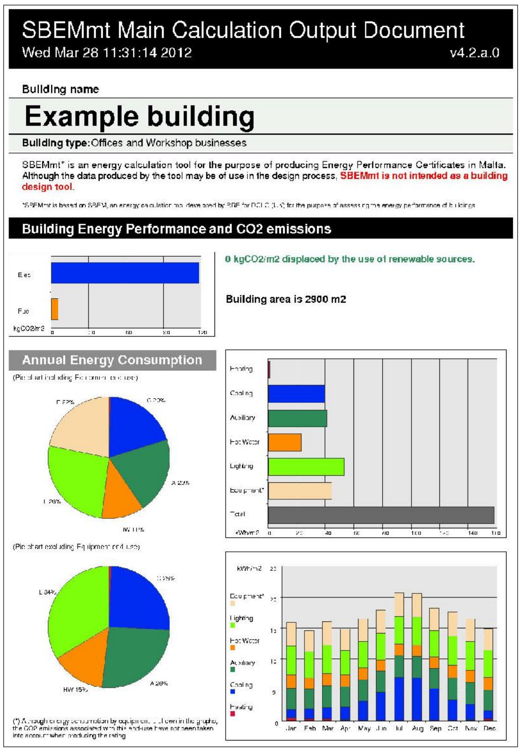


***Figure 3:* Calculation of building EP and CO_2 emissions in SBEMmt.**

given type. In order to provide this consistency, the reference building has a building envelope and orientation that are identical to that of the actual building. The reference building has fixed thermal performance characteristics in the building fabric based on the minimum requirements, while Heating, Ventilation and Air-Conditioning (HVAC) system efficiencies assumed are typical ones for reverse cycle heating and cooling generators. Parameters related to the heating and hot water service, and space heating, and cooling and temperature set points defined in the activity databases are fixed, irrespective of features such as fuel choice in the actual building. The CO_2 emissions arising from the use of the fixed building services in the reference building (in kg CO_2/m^2.year) are calculated, and then adjusted by an improvement factor of 20%.

The reference building will be defined with these parameters irrespective of any changes in the minimum requirements, thereby ensuring that the energy rating calculation methodology will not change.

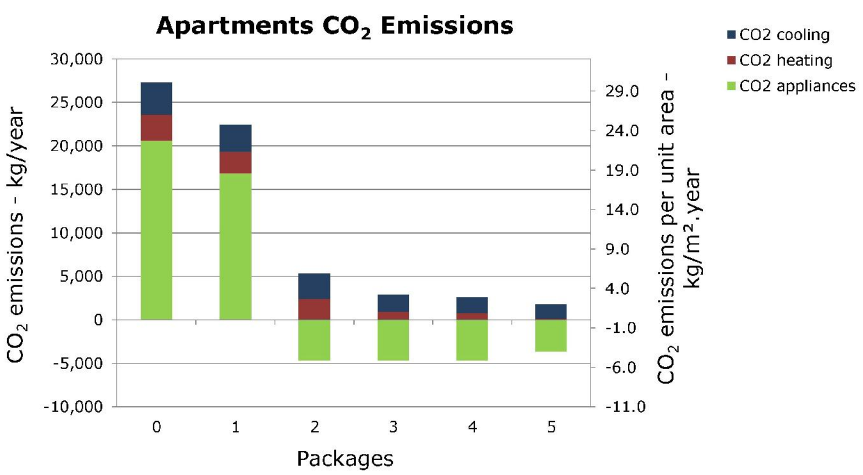
2.3 Cost-optimal procedure for setting EP requirements

According to the provisions set out in Legal Notice 376 of 2012, the national minimum requirements shall be reviewed at least once every 5 years by the Building Regulation Board (BRB).

Towards this end, tenders have been issued to commission a series of studies that will analyse the existing minimum EP requirements for buildings in the Maltese islands by utilising mathematical models established by the Commission Delegated Regulation (EU) No 244/2012 to work out the cost-optimal increase and tightening of the minimum requirements (Technical Guidance Document F presently legislated through Legal Notice 376 of 2012) enabling the setting up of realistic and economically feasible 2018 and 2020 national plans for Maltese Nearly Zero-Energy Buildings (NZEBs). Results from this study are expected to be published during 2013.

Reference benchmarks for each building category, i.e., at least one reference building for new buildings and two for existing buildings subject to major renovation, shall be established. The results of this assessment, including all input data and assumptions used for such standards and the results thereof, will be

***Figure 4:* Effect of the application of energy efficient packages in a local cost-optimality dissertation study. Source: DeGiorgio, M., Cost-optimal energy efficiency measures for residential buildings in Malta, London, Bartlett School of Graduate Studies University College, September 2012.**



PACKAGES

1. Roof insulation, energy efficient lighting, aluminium paint on roof
2. Package 1 + draughtstripping, PV panels, solar water heater
3. Package 2 + double glazing, wall insulation (50mm), heat/cool using GSHP
4. Package 3 + floor insulation (40mm), shading and low emissivity glazing
5. Package 4 + increase of roof insulation (100 mm), increase wal insulation (100 mm), heat recovery

N.B. The contribution of Renewable Energy is deducted from *Appliances* reported to the Commission in mid 2013. If the minimum requirements are outside cost-optimal limits, changes suggested by the studies will have to be introduced in phases during 2014 - 2017. Feasibility studies have to be commissioned during 2013 to analyse the impact of the required changes and propose roadmaps for the building construction industry.

The MRA shall also be informed about the results of such reports, and the projected changes in the minimum requirements during 2013. This will help clarify and determine the roadmap in the 2014 National Energy Efficiency Action Plan (NEEAP).

2.4 Action plan for progression to NZEB

Legal Notice 376 of 2012 defines 'Nearly Zero-Energy Buildings' as buildings that have a very high EP. The degree of energy efficiency and performance shall be determined through cost-optimal studies which shall be in accordance with the common general framework for the calculation of EP of buildings defined in the same legislation. The nearly zero or very low amount of energy required shall be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby, the latter being, possibly concentrated in communal renewable energy facilities.

The MRA, in collaboration with the BRB and the BRO, shall draw up the NEEAP and other national plans in order to increase the number of NZEBs and measures concerning the use of energy from renewable sources in new buildings and existing buildings undergoing major renovation.

The strategies for achieving the national targets for zero-energy buildings may be twofold:

> tightening existing minimum requirements for the building envelope in new buildings and buildings undergoing major renovation;
> increasing the energy harvest from RES to decrease the use and dependency on fossil fuels by regulating the use of roof space in new buildings or investing in communal RES.

Incentives for the construction or major renovation of buildings shall be set up in schemes that take into account the cost-optimal levels of energy performance for those consumers who want to make the best use of energy resources. The refurbishment and transformation of existing buildings into NZEB stock will be encouraged by means of positive fiscal measures and financial benefits such as rebates, tax credits and advantageous bank loans for those owners who will enter into a commitment that clearly shows that their building will have a higher energy efficiency and nearly-zero net energy use.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

The EPCs are the end-product of the certification process and include reference values based on the design rating of the building, if the building is not yet constructed and/or finished, or the asset rating, if the building is already constructed and in use. The certificate is valid for ten years from the date of its first issue.

Since the 2nd of January 2009, all residential buildings have to be certified when they are being newly designed, sold or rented. Since the 1st of June 2009, all other buildings have to be certified when they are being newly designed, sold or rented.

All the issued EPCs must be registered in the central database. A registration fee is charged per EPC issued.

The owner of a building shall ensure that when buildings or building units are constructed, sold or rented out the EPC, or a copy thereof, is shown to the prospective new tenant or buyer and handed over to the buyer or new tenant on the date of entering the contract of promise of sale or rent agreement at the latest.

The real benefit of any EPC lies in the recommendations which are mandatory by law. Recommendations are not automatically generated by the EPRDM software but are worked out specifically for each building and officially given to the building owner in the certificate.

When carrying out an EP assessment on an existing building, an EPB assessor has to inspect the property and assess the building taking note of its geometry, construction and finishing material characteristics, any space conditioning installations, lighting installations, hot water systems and any renewable energy systems including rainwater re-use. The

Figure 5: Asset rating EPC (dwellings) – pages 1, 2 and 3.

EPB assessor then calculates the energy use rating of the building and issues a registered EPC. The same energy use rating scale is used for all buildings, including those buildings that were constructed before the introduction of the minimum requirements.

Once the energy use rating is calculated and the required improvement measures are identified, the EPB assessor logs into the secure web-based central registration system and uploads the data file which is checked by the system for consistency and compatibility with the then current version of the methodology calculation software. Graphic data files are also uploaded. Before officially registering the EPC, the assessor may save the certificate in a temporary format online and access it later. The system has been designed to handle the registration fee payment and certificate creation in real time. When the certificate is created, the certificate and data files are stored in a secure area which can be accessed by the department for verification and auditing purposes.

Under Maltese legislation, the building owner is responsible for commissioning an EPC and will typically pay from 250 € to 450 € for a design rating residential EPC and between 400 € and 750 € for an asset rating residential EPC to cover professional fees. The professional fees for non-residential building EPCs vary considerably. The BRO charges a 75 € registration fee for each certificate registration, which covers part of the expenses used to run and update the EPC web portal. An owner who fails to produce the certificate to the authorities, when requested to do so, can incur a fine between 500 € and 1,500 €.

In Malta, prospective EPB assessors must already have a degree in engineering or architecture. Those wishing to qualify as EPB assessors have to successfully undertake a period of training approved by the BRB on the assessment of the energy performance of buildings constructed in Malta. Successful participants have to obtain an overall pass mark of at least 80% after having attended at least 80% of the course lectures. EPB assessors registered in other EU Member States (MS) can register directly with the BRO.

The participants must undergo a test at the end of the course that will:

> assess the participants' understanding of the EPRDM or SBEMmt methodology, EPC policy, Quality Assurance (QA) requirements, and surveying buildings;
> examine the participants' ability to recall and apply theory, define information and identify those products and systems in a building that affect the EPC;
> oblige learners to demonstrate their ability to use the EPRDM or iSBEMmt software during a practical supervised session for a previously unseen dwelling and to produce an EPC and advisory report. The practical test requires the candidates to apply all aspects of the EPRDM or SBEMmt software.

The BRO has successfully organised a number of courses for EPB assessors (dwellings and non-dwellings). Most of the course participants, around 165, managed to qualify and register as EPB assessors (dwellings) – their list can be viewed by the public on the BRO web portal at *epc.gov.mt*.

EPB assessors registered in other EU MS can inform directly the BRO of their registration, so that they can issue EPCs for buildings in Malta.

Quality Assurance

The quality of the EP calculations and the EPCs relies to a large degree on self-regulation, which is reinforced by the training background of EPB assessors. The first quality check on the certificates and accompanying calculations is carried out on the EPC web portal which is the official website for registering EPCs. The site engine automatically verifies the pattern in the uploaded XML data file and rejects it if found to be in a non-compliant format.

Since the system was first launched, about five hundred EPCs were registered. A number of these EPCs are visually checked and verified by BRO's internal auditors. If errors are detected in the visual inspection, a data check review on the XML data and on the result it produces would be carried out. The EPC may undergo a deeper audit if more errors or inaccuracies are detected. An on-site inspection of the building may also be carried out. Detailed audits, especially of complicated buildings, can also be outsourced to external independent auditors.

A random sample of at least 10% of all certificates is routinely audited for QA purposes. Other quality controls include checks that are performed on at least one EPC per assessor per year, checks on EPCs that are repeatedly issued on the same property, checks on EPCs with out-of-range values and checks following complaints from clients.

Depending on the quality of the work encountered and the degree of errors in the EPC being audited, the certificate may have to be revoked and the EPB assessor may be required to re-issue the EPC at his expense. In serious cases, the authorities may issue fines or suspend the assessor's registration, but this has not happened so far.

The different authorities involved, such as the Malta Environment and Planning Authority (MEPA), the Commissioner of Inland Revenue and the BRO, have co-ordinated their efforts to enable the BRO to start enforcement. However, the enforcement system and quality control checks have to be automated to a higher degree to get the desired results and ensure that EPCs are carried out on a more forceful level.

3.2 Progress and current status on public and large buildings visited by the public

Public display certifications have not yet been enforced as the methodology calculation software iSBEMmt has only been made available in May 2012. Prospective EPB assessors for non-residential buildings will be undergoing exams and should qualify as registered assessors after April 2013.

The government had set up a program for energy audits targeting over 170 buildings used by the public service, including offices, courtrooms, town halls, police and fire stations, schools and community centres. Recommendations for improving the EP of these public buildings, including energy efficient refurbishment measures, such as roof insulation, were listed in the audit reports.

There are plans to measure the footprint for energy and water consumption within government buildings, and to set up a framework with benchmarks and targets for energy use reduction.

Following a successful pilot energy saving project, the Housing Authority began to incorporate energy saving features, where possible, in its new housing projects. Typical measures implemented by the authority in almost 150 newly built social housing units include double glazing, louvers and external shading devices for glazed apertures, roof insulation, installation of solar water heaters, efficient cooling/heating systems and rainwater run-off collection for use as second class water.

Figure 6: Energy efficient secondary school building at St Benedict's College, Kirkop, Malta.

Figure 7: Brochure explaining the energy performance of dwellings.

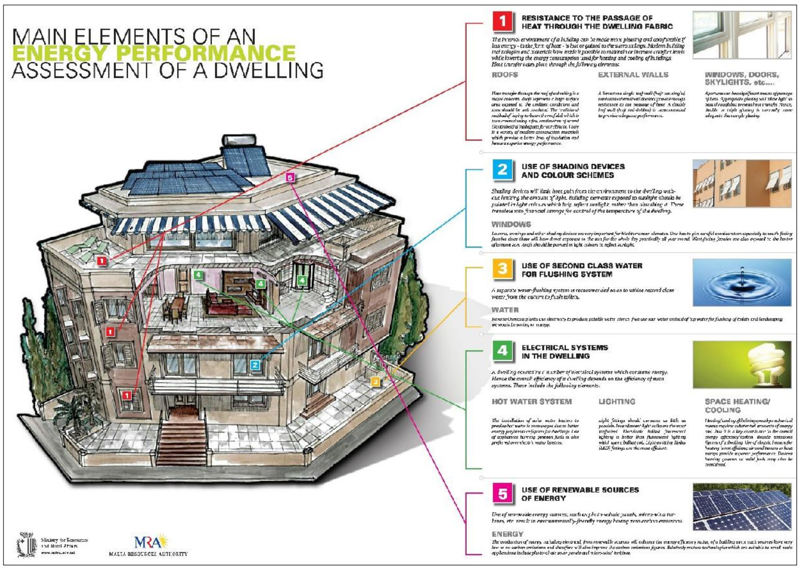


Figure 8: Talks and discussions on energy efficiency in buildings with schoolchildren.

The Foundation for Tomorrow's Schools has been building, upgrading and refurbishing State schools with the following features: sun pipes for maximising the use of natural daylighting, double glazing and polyurethane roof insulation for increased thermal comfort, efficient lighting systems with Plug-In Light Bulb technology, automated dimmer lights, etc., solar water heaters, photovoltaic systems to meet part of the buildings' electricity demand, water conservation systems including collection and reuse of rainwater for cleaning, flushing and irrigation.

3.3 Implementation of mandatory advertising requirement – status

According to the current legislation, Legal Notice 376 of 2012, the owner or his agent shall ensure that, where buildings having an EPC are offered for sale or for rent, the EP indicator of the EPC of the building or the building unit, as the case may be, is stated in the advertisements in commercial media.

Regulations to administer, implement and enforce the inclusion of such indicators in the advertisements still have to be set up by the authorities.

3.4 Information campaigns

Citizens have to be well informed on the value of EP certification as a marketing tool and basis of comparison between building properties. The BRO, in co-ordination with the MRRA Public Relations Office, has been actively involved in informing the public on the EPCs by taking part in several events such as:

> Regular information sessions and programmes on radio and television broadcasts with live phone-ins from the public and video footage on energy efficient design principles in local buildings.
> Several seminars and presentations targeted towards different audiences, such as the general public, architects and engineers, building contractors, estate agents, research bodies and students. Seminars have been sometimes organised as single events or as part of a larger trade fair venue or conference setting.
> Promoting energy efficiency themes with brochures and videos in various events through a supporting campaign called the Switch campaign.
> Preparing and delivering a series of lectures for an in-service course for teachers on Climate Change and Energy Efficiency in Buildings.
> Delivering lectures on the EPC and the centralised web portal during the EPRDM Energy Performance Assessors' courses for Dwellings.
> Coordinating summer courses for young students on energy efficiency of buildings & climate change.
> Contributing towards the creation of brochures and web information material with frequently asked questions on the EPC and tips on energy saving measures.

3.5 Any other relevant information

The government provided incentives mainly in the form of rebates/subsidies or grants on the purchase and installation of:

> provision of energy efficient light bulbs to every family in Malta;
> air-conditioning with a minimum energy efficiency class A and an output equal to or less than 12 kW;
> double glazing;
> solar water heaters;
> roof insulation;
> photovoltaic panels;
> micro wind turbines.

The RES installations all have a positive effect on EPC ratings. Awareness on renewable technologies is progressively increasing by the government's continued promotion of these technologies.

There is scope to give incentives to owners of buildings with lower energy use ratings, thereby making EPCs more popular with prospective buyers and property developers.

4. Inspection requirements - heating systems, air-conditioning

Malta adopted mandatory inspections under option A of the EPBD and their transposition into law was incorporated in Legal Notice 238 of 2006. Regular inspections have to be carried out on the accessible parts of systems used for heating buildings, such as the heat generator, control system and circulation pump(s), with boilers of an effective rated output for space heating purposes of more than 20 kW. Regular inspections also have to be carried out on the accessible parts of air-conditioning (AC) systems having an effective rated output of more than 12 kW.

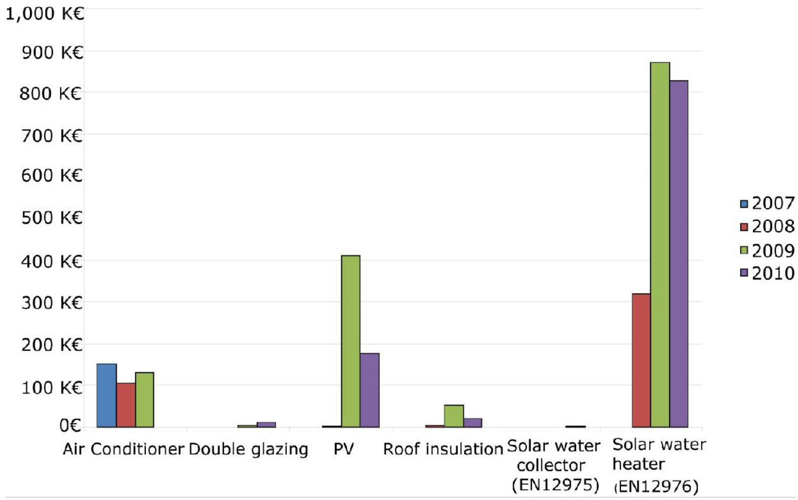
4.1 Progress and current status on heating systems

Inspections on boilers are still in their early stages and no reports have been registered at this stage. The methodology for boilers has been based on the CEN standard MSA EN 15378:2007 'Heating systems in buildings - Inspection of boilers and heating systems'. The methodology, reporting and recommendation formats on how to carry out these inspections have already been set up by the BRO but the practical implementation of the system has yet to be reviewed by the BRB as stipulated by law. The inspection report includes the running condition, efficiency and design adequacy of the installations, and accompanying recommendations include practical details on how to improve the overall system efficiency.

The inspection reports will be centrally registered on the EPC web portal, which will allocate a unique authentication number for each inspection report. Audits will be carried out on the reports to check their quality and effectiveness.

The frequency of such inspections shall be decreased or increased as appropriate, where an electronic monitoring and control system is in place. The BRB shall set different inspection frequencies depending on the type and effective rated output of the heating system whilst taking into account the costs of the inspection of the heating system and the estimated energy cost savings that may result from the inspection.

Figure 9: Government subsidies and rebates on installations, fixtures and renewable energy systems.



Heating systems with boilers of an effective rated output of more than 100 kW shall be inspected at least every two years. For gas boilers, this period may be extended to four years.

4.2 Progress and current status on AC systems

Inspections on air-conditioning (AC) systems are still in their early stages and no reports have been registered at this stage. The methodology for AC installations follows guidelines in TM44: 2007 'Inspection of Air Conditioning Systems' issued by the Chartered Institution of Building Services Engineers. The methodology, reporting and recommendation formats, on how to carry out these inspections, have been prepared by the BRO, but the practical implementation of the system has yet to be reviewed by the BRB as stipulated by law. The inspection report includes the running condition, efficiency and design adequacy of the installations and accompanying recommendations include practical details on how to improve the overall system efficiency.

The inspection reports will be centrally registered on the EPC web portal which will allocate a unique authentication number for each inspection report. Audits will be carried out on the reports to check their quality and effectiveness.

The BRB shall set different inspection frequencies depending on the type and effective rated output of the AC system, whilst taking into account the costs of the inspection of the AC system and the estimated energy cost savings that may result from the inspection.

5. Conclusions and future plans

The impact of the introduction of the Energy Performance (EP) requirements in new and renovated buildings has not yet been accurately quantified. According to the Second National Energy Efficiency Action Plan (NEEAP) for Malta, the savings in energy consumption levels achieved in 2010 as a direct effect of the minimum requirements were estimated between 5% and 10%. There are new legal requirements ensuring that incentives for the construction or major renovation of buildings require cost-optimal levels to be applied, thus ensuring that consumers make the best use of energy resources. The renovation of privately owned buildings can be pushed to new levels by introducing subsidised schemes based on Energy Performance Certificate (EPC) ratings and practical recommendations. Further reductions in energy consumption will probably be achieved when Nearly Zero-Energy Buildings (NZEBs) are promoted and constructed on a wider scale by the building sector. Currently, less than 6,000 new buildings are built each year in Malta and, with the recent growth in the rehabilitation market, major renovations start to have a significant impact especially in the commercial sector. Therefore, the requirements of the recast Directive on the Energy Performance of Buildings (EPBD) for new buildings and major renovations will bring important energy savings in the near future, although new and renovated buildings only represent a small share of the entire building stock in Malta.

Figure 10: Thermally insulated concrete blockwork used in local construction.

On the other hand, additional free training should be offered to architects, engineers and qualified experts, to improve their skills in energy audits and to share best practices in economic and technological building improvement solutions.

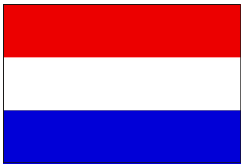
Malta is acquiring experience through the EPBD implementation and will use it to achieve the final goal of NZEB by 2020.

The main challenges and future developments of the minimum requirements, monitoring, enforcement and certification systems for the short and medium term are to:

- introduce new ICT monitoring systems to increase co-ordination between the various entities;
- introduce new incentives to popularise certifications;
- continue the improvement of the EPC web portal and back-office, including online audit reports, data entry validation, preview facilities and automation of the Quality Assurance (QA) process;
- upgrade the Energy Performance of Residential Dwellings Malta (EPRDM) software to include various enhancements and data input checks;
- reinforce the QA scheme, increasing the number of light checks on input and creating customised auditing track software for assigning and tracking audits;
- provide additional training for qualified experts on Heating, Ventilation and Air-Conditioning (HVAC), Domestic Hot Water (DHW) and Renewable Energy Sources (RES) systems, as well as more effective auditing techniques;
- carry out changes to the minimum requirements as a result of the cost-optimal studies;
- carry out more studies and gather more data on EPBD implementation in order to make the general public more aware of the benefits that can be derived out of the EPC schemes.

EPBD implementation in The Netherlands

STATUS AT THE END OF 2012



1. Introduction

In The Netherlands, the implementation of the Energy Performance of Buildings Directive (EPBD) is the overall responsibility of the Ministry of the Interior and Kingdom Relations. NL Agency, the Dutch energy agency is the executive body for the implementation process.

The EPBD has been gradually implemented in The Netherlands over recent years. The date of implementation of the Directive as to the Energy Performance Certificate (EPC) was the 1st of January 2008. For social housing companies, this was one year later, on the provision of the completion of the certification of their entire building stock. Public buildings are required to always have a valid EPC since the 1st of January 2009. The first major update of the EPC scheme was introduced on the 1st of January 2010. The next major update of the EPC scheme, incorporating requirements from the EPBD recast, is planned in the course of 2013/2014.

For the implementation of the inspection of heating systems, The Netherlands has chosen to do so by means of a voluntary scheme. The inspection of air-conditioning systems is currently dispersed amongst different parts of national law. A new law on this subject is under development and planned to be implemented in the course of 2013/2014, taking into account the EPBD recast.

In September 2012, the Dutch national plan to encourage Nearly Zero-Energy Buildings (NZEB) was submitted to both the European Commission and the Dutch Parliament. The plan sketches a strategy to achieve NZEBs at the end of 2018 for public buildings and 2020 for other new buildings respectively.

New requirements that relate to technical building systems, such as minimum system requirements, will be transposed into national law in 2013.

2. Energy performance requirements

Energy Performance (EP) requirements have been in place for new buildings in The Netherlands since 1995 and are updated on a regular basis towards NZEB by 2020. In 2011 and 2012 a study was performed to establish cost-optimal minimum requirements for existing buildings. These requirements will come into effect in 2013/2014.

Table 1 gives an overview of the EP requirements for both the residential and the non-residential sector for the period 1995 – 2020, indicating that the so-called EP coefficient was and will be tightened for both sectors every couple of years. Future requirements are however subject to political decision.

2.1 Progress and current status

The so called Energy Performance Standard (EPN), established in 1995, was replaced in July 2012 by a new standard, the Energy Performance Standard for Buildings (EPG). The EPG (Figure 2) combines both the residential and the non-residential standards into one new and updated standard. The Dutch building legislation sets an integral requirement for the energy efficiency of new buildings and major renovations of existing buildings. Included in the integral requirement is a

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Figure 1: EPBD Logo.

National Websites

www.energielabelgebouw.nl
www.rijksoverheid.nl/onderwerpen/energielabel-woning

Figure 2: Energy Performance Standard for Buildings (EPG) or NEN 7120.

calculation of the building performance, taking into account the current level of insulation (roof, walls, floor, windows) and installation (heating, cooling, hot water, ventilation, lighting). Table 1 gives an overview of this EP requirement for new buildings in both the residential and the non-residential sector. This is expressed in an EP coefficient which can be calculated with the new EPG, expressed in terms of primary energy. This coefficient is a dimensionless number to indicate the energy efficiency of a new building. Next to the integral building requirements, also minimum requirements for building components are in place. The current minimum requirement for all building envelop parts is Rc = 3.5 m^2.K/W. For windows (including framework) a maximum U-value of 1.65 W/m^2.K currently applies. These minimum requirements apply to new buildings as well as major renovations of existing buildings. Every couple of years, both sets of requirements are evaluated in terms of their cost effectiveness, among other aspects, and, if possible, the requirements are tightened. The Dutch policy for new buildings hereby already incorporates most of the requirements resulting from the EPBD recast towards NZEB in 2020. As another intermediate step towards NZEB the minimum Rc-value for (new) building envelope parts is intended to be tightened to Rc = 5 m^2.K/W in 2015.

Apart from cost-effective requirements for new buildings, in order to meet the recast EPBD equirements, also a set of cost-effective EP requirements was developed for building components in existing buildings, both residential and non-residential. The requirements for existing buildings are still under discussion and will become mandatory in the course of 2013/2014.

2.2 Format of national transposition and implementation of existing regulations

Preceding the implementation of the original EPBD directive, a Decree (BEG) and Regulation (REG) on the EP of buildings were published in 2006 (Figure 3). These publications still regulate the conditions on which an EPC is issued. A Quality Assurance (QA) scheme was also appointed in these publications. The QA scheme is built on a national quality standard for energy consultants and qualified auditors: ‘BRL9500’ for QA on the certification of buildings by qualified assessors, and ‘BRL9501’ for QA on accredited software. The original standard or methodology for non-residential buildings was published as an ISSO 75 publication, and the original standard or methodology for residential buildings was published as an ISSO 82 publication. Another ISSO publication, ISSO 54, covers the accreditation of software.

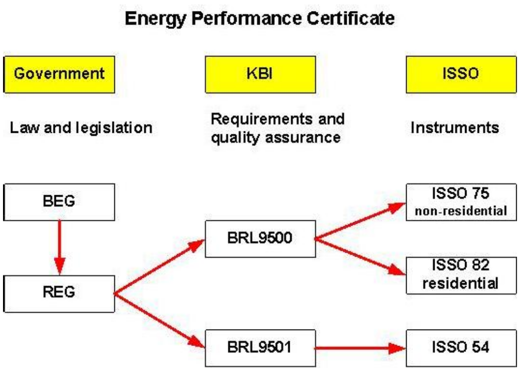


Figure 3: Legal context of the EPC.

A new standard for the calculation of EP requirements (EPG) was developed for several reasons. First of all, the aim of this standard was to combine the residential and non-residential standards. Secondly, the new standard meets the current CEN standards and was set up in a way to be ready for the future path towards NZEB, therefore allowing new and innovative techniques to be easily rewarded. Through a system of audited quality declarations, innovative

Table 1: Energy Performance requirements for new buildings, overview 1995 - 2020.

	Residential	Non-residential building categories (different function types)								
Year	**Dwellings**	**Meeting**	**Detention**	**Health, clinical**	**Health, non-clinical**	**Offices**	**Lodging**	**Educational**	**Sports**	**Retail**
1995	1.4	3.4	2.3	4.7	2.0	1.9	2.4	1.5	2.8	3.6
1998	1.2									
2000	1.0	2.4	2.2	3.8	1.8	1.6	2.1	1.5	2.2	3.5
2003		2.2	1.9	3.6	1.5	1.5	1.9	1.4	1.8	3.4
2006	0.8									
2009		2.0	1.8	2.6	1.0	1.1	1.8	1.3	1.8	2.6
2011	0.6									
2015	0.4*									
2017		-50%*	-50%*	-50%*	-50%*	-50%*	-50%*	-50%*	-50%*	-50%*
2018/ 2020	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*	Nearly zero*

** indicates future national policy intention* techniques, or high-performance measurements that are currently not a part of the standard, can be rewarded and included in the calculation. Lastly, the new standard is developed with the possibility to expand to include in the future also existing buildings. The Energy Performance Standard for Buildings (EPG) is in place since the 1st of July 2012.

A substandard of the EPG is the newly developed Energy Performance Standard for alternative systems, such as district or block heating and decentralised energy supply systems based on energy from renewable sources. This so-called EMG standard for 'area measures' can be used in combination with the EPG and is also in place for new buildings since July 2012.

Both EPG and EMG are currently used by architects and building developers to calculate and meet new building requirements, as set in the national building decree (Bouwbesluit). From the beginning of 2013, the software that is used for these calculations must meet a new set of QA requirements that are laid out in the updated software assessment guideline BRL9501. Also, the QA guidelines for assessors, as laid out in the BRL9500, are updated to meet the new EPG and EMG standards.

Minimum cost-effective building requirements for existing buildings were developed in 2011 and 2012 based on the existing standard for EPCs. This simplified Energy Performance Advice Standard (EPA) has been in use to determine the energy performance of national buildings for the purpose of energy performance certification since 2008. The minimum requirements for existing buildings are component based and will be published in the national building code (Bouwbesluit) in 2013/2014.

In order to meet requirements for technical building systems, a set of minimum system requirements was also developed during 2011 and 2012 for heating, hot water, air-conditioning and ventilation systems in both residential and non-residential buildings. These cost-effective minimum system requirements will also be published in the national building decree (Bouwbesluit) in 2013/2014.

Training of experts is currently available based on the existing standards for new and existing buildings. As the same standards are used to determine minimum requirements and EPCs, also the training for both objectives is largely in accordance.

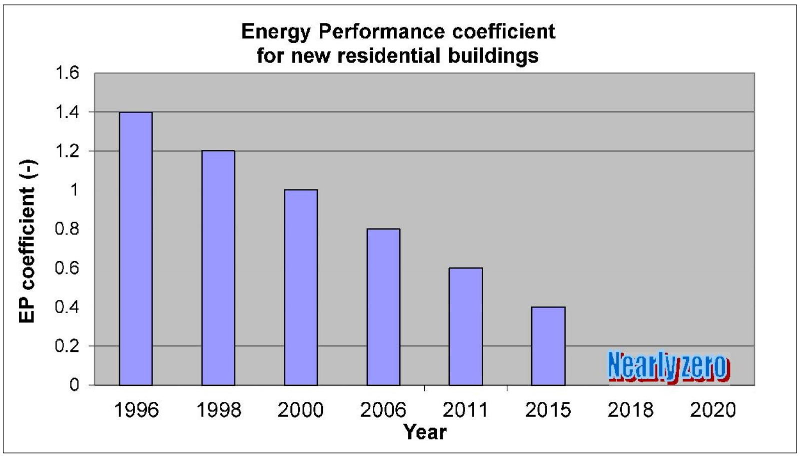
2.3 Cost-optimal procedure for setting EP requirements

Minimum EP requirements for new buildings, both residential and non-residential and major renovations of existing buildings, have been in place in The Netherlands since 1995. The so-called Energy Performance coefficient is determined using the appropriate standard for new buildings, which currently is the Energy Performance of Buildings Standard (EPG) that has been in place since the 1st of July 2012, and if applicable, combined with the Energy Performance Standard for area measures (EMG).

Dutch policy aims to tighten the requirements for new buildings every couple of years, as shown in Table 1 and Figure 4. Over the years, the Energy Performance coefficient for residential buildings has been tightened from 1.4 at the start in 1995, to 0.6 from January 2011 onwards. Building companies have agreed with the Dutch government on a further tightening of the requirements in the near future, in order to move towards NZEB in 2018 and 2020. The Energy Performance coefficient requirement for the residential sector is scheduled to decrease to 0.4 in 2015. For the non-residential sector, this requirement is scheduled to be lessened by 50% by 2017 compared to the requirements of 2007.

Apart from the integral requirement for new buildings, also minimum requirements for building components are in place. In 2012 a study was performed to examine more stringent cost-optimal minimum requirements for new buildings. As a result, minimum requirements for building components have been partially updated in 2013: Rc-values for building envelope parts were tightened from 2.5 to 3.5 m^2.K/W; the U-value for glazing was tightened from 2.2 to 1.65 W/m^2.°C. Further tightening is scheduled to take place in 2015 (Rc-values for building envelope parts = 5 m^2.K/W).

Figure 4:* *EP coefficient for new residential buildings, towards NZEB.



Also, during 2011 and 2012, a study was performed to examine the cost-optimal level of minimum requirements for building components of existing buildings. In this study, minimum system requirements were determined also for heating systems, hot water systems, ventilation and air-conditioning systems. As a result, minimum requirements for existing buildings will be introduced in the Dutch building legislation through the adaptation of an updated building decree (Bouwbesluit), which is expected in 2013/2014.

2.4 Action plan for progression to NZEB

The government encourages the development of NZEBs by:

> setting clear goals for all stakeholders and establishing clear legislation;
> acquiring a broad support among all stakeholders, including residents and building users;
> appraisal of collective solutions;
> stimulating sufficient knowledge to all actors;
> stimulating cooperation in the chain (i.e., optimising performance of the construction sector through continuous improvement: cooperation of chain partners and stakeholders in the building process);
> providing room for experimentation, e.g., facilitating low-energy use pilot projects;
> encouraging good government orchestration;
> taking action as 'Launching Customer' (the exemplary role of the public sector).

Jointly with the building and construction sector, this will be the route the government must follow to achieve NZEBs over the next eight years. Several activities are already underway. The building and construction sector joined with government ministries to form the 'Lente Akkoord' in 2008. The 'Lente Akkoord' is a covenant of the new buildings sector, aimed at reducing the energy consumption of new buildings over time, towards NZEB in 2020. In this signed agreement between the public and private sectors, a number of mutual efforts have been agreed to reduce the energy use of new buildings by the year 2015 by at least 50% compared to 2007 levels.

The definition of a NZEB is determined by the new Standard for Energy Performance of Buildings (EPG) that was introduced in 2012, in combination with the Standard for Energy Performance of area measures (EMG). It is argued that a zero-energy building has an EP coefficient equal or close to zero. The aim is to set requirements that will allow reaching close to zero energy needs at the end of 2018 (public buildings), and 2020 (other buidlings), respectively. This level will then be defined as a nearly zero-energy performance. Studies to be performed in upcoming years will have to define the exact level of nearly-zero in The Netherlands.

The exact value of the EP coefficient that will be used for NZEB cannot yet be determined. At least two future studies are foreseen to get a better indication of the feasibility and costs of an intermediate tightening of the EP coefficient, whereupon the cost-effectiveness of the nearly zero-energy level has to be determined.

3. Energy performance certificates

The EPC has been in place in The Netherlands since the beginning of 2008. During the period from 2008 until the end of 2012 over 2.4 million residential EPCs were issued, covering over 30% of the residential building stock. In the non-residential sector, a total of nearly 15,000 EPCs were issued in the same period, mainly for offices, retail and shops or shopping malls, covering an estimated 30-35 million m^2 surface area (Figures 5, 7-9).

3.1 Progress and current status on sale or rental of buildings

The EPC is the most visible aspect of the EPBD. This document assigns an Energy Performance Indicator (EPI) to residential and non-residential buildings including building units and it lists individually tailored cost-effective measures for improving their energy performance.

The EPC consists of a minimum of 3 pages. On the first page, the EP class indicator of the building is indicated (Figure 6). The current indicator runs from A^{++} (many energy saving measures taken) to G (many energy saving measures possible), where EP class A is equal to the EP level of new buildings from the year 2000 and onwards. The EP class indicator is determined by the calculated EPI that can be found on page three of the EPC. On the front page, furthermore, the standardised annual primary energy use in MJ is displayed, including a sub-division into electricity (kWh), gas (m^3) and heat (GJ). The EPC for non-residential buildings also displays the annual CO_2 emission. The first page also mentions the building type for which the

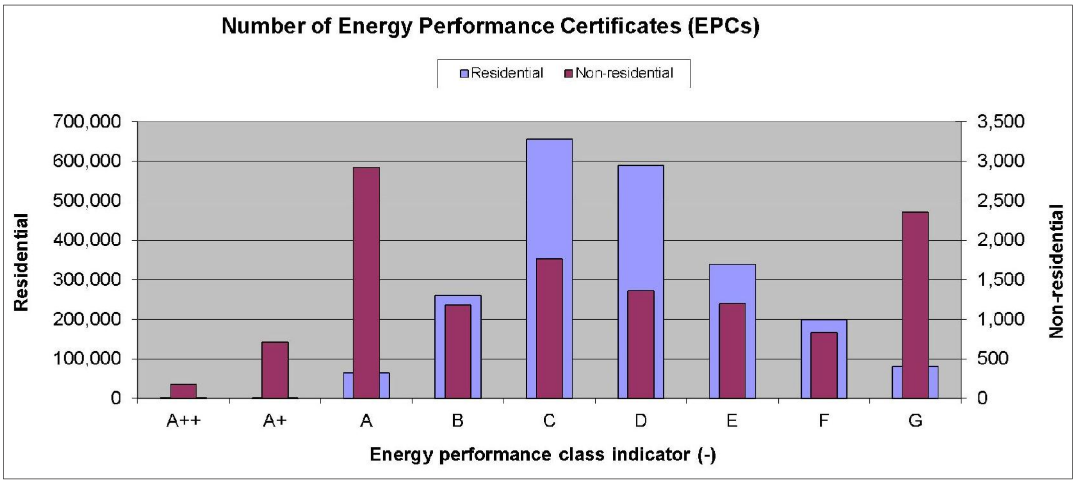


Figure 5: Number of EPCs in 2008-2012, residential and non-residential.

energy certificate is issued, the assessor of the certificate and the expiration date (with a maximum validity of 10 years).

The energy saving measures that are recommended for a specific building are described on page 2 of the certificate. Suggested improvements include a short general description for each energy-saving measure. Page 3 gives a description on how the EPI is calculated, according to a standardised methodology.

In December 2006 the 'Decree on Energy Performance of Buildings' (BEG) as well as the 'Regulation on Energy Performance of Buildings' (REG) were legally implemented in The Netherlands. This enabled The Netherlands to develop an EPC specifically tailored for existing buildings. The EPC first came into force on the 1st of January 2008. This EPC can also be used for new buildings. However, in order to display the low EP levels of new buildings in a more distinguished way, it is expected that in the course of 2013/2014 current energy label classes will be extended from A++ to A++++.

For each building or building unit, an EPI is calculated according to a fixed methodology. This is a dimensionless number expressing the energy efficiency of the building in relation to its type and size. An EP class indicator is then assigned based on the EP calculation. Certificates can only be issued by qualified assessors. There are voluntary educational programs for assessors, but examination by a national board is mandatory. The assessors who may issue an EPC must meet certain minimum qualifications, including the ability to assess the quality and condition of materials, building envelope parts and installations present in a building. A list of qualified assessors is permanently updated and always available online for the public at the website of KBI, the Dutch QA association (*www.kbi.nl*).

Certification of existing residential and non-residential buildings started on the 1st of January 2008 and is mandatory when a building or building unit is sold or rented out. The owner must present a valid EPC at the moment of transaction. This involves a qualified assessor to visit the property and assess the building, in terms of the type and quality of constructions and installations. The qualified assessor will then calculate the EPI with an accredited software program and issue the EPC. This is done by sending an automated report to the central database managed by NL Agency, which returns a unique identification number for each certificate that can then be printed.

Although it is mandatory by law to have an EPC at the moment of transaction, there is currently no penalty for not having an EPC at the moment of transaction. The compliance level is highest in the social housing market where social housing

Figure 6: Front layout of the EPC with an A++ indicator.

Figure 7: Growth of number of residential EPCs.

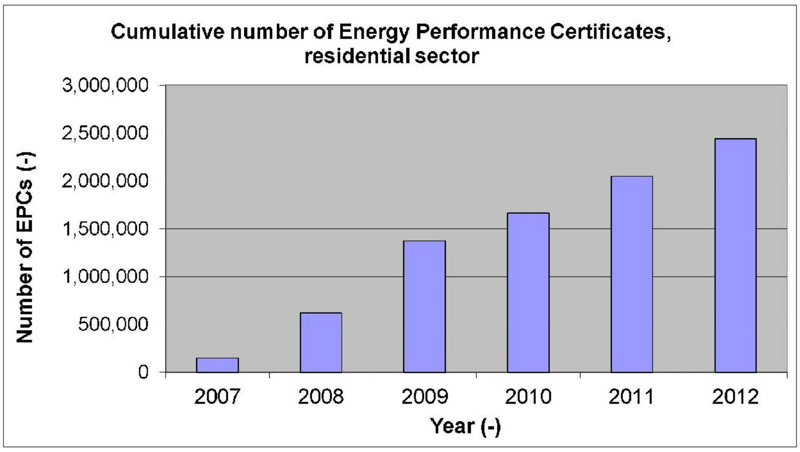


Figure 8: Growth of number of non-residential EPCs.

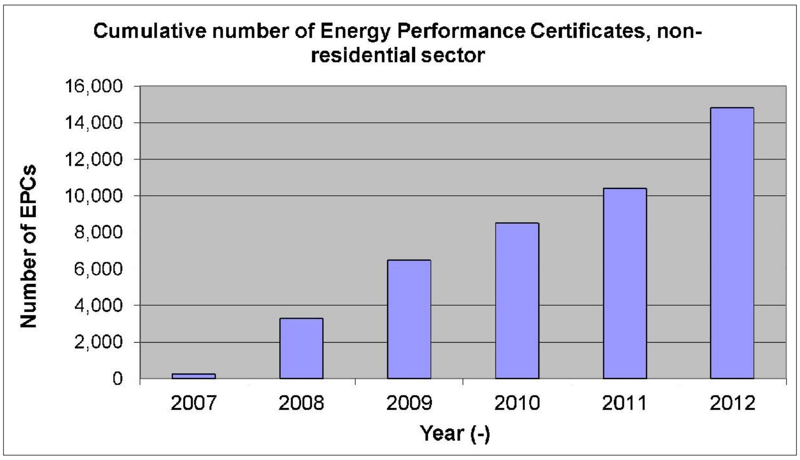
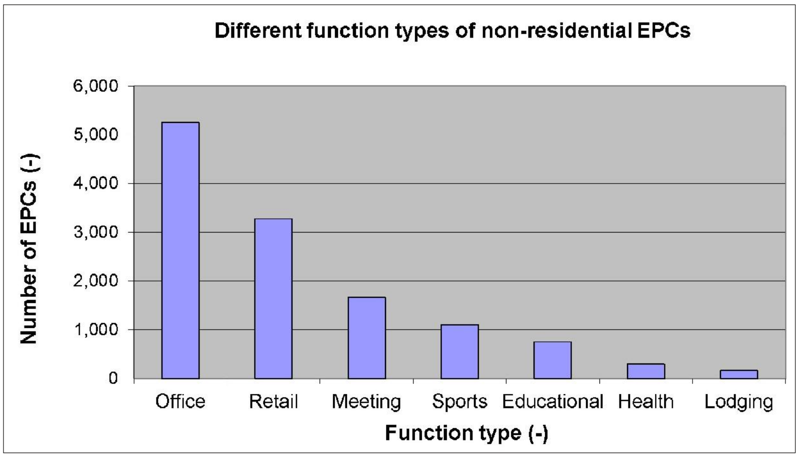


Figure 9: Function types of non-residential EPCs.



corporations have an incentive to issue EPCs for their buildings and units. A better EPC means that the social housing corporations can ask for a higher maximum rental price by law, if this is feasible for that particular location. So, there is not only incentive to issue EPCs, it is even encouraged to take energy saving measures and improve the EP of dwellings.

For other market sectors, such as the private sector, including non-residential buildings, the Dutch government is still studying and discussing the best possible type of sanctioning to achieve a high compliance also in these sectors. A new law was proposed to the Parliament in 2012, but was rejected in November 2012.

Sanctioning of assessors takes place through the QA scheme (BRL9500). At the end of 2012, a total number of 193 companies (with a multitude of registered people) were certified to issue EPCs for residential buildings, and 104 companies for non-residential EPCs. For the residential sector, in the course of 2012, a total number of 50 companies was penalised. This meant additional checks and inspections by certified institutions, after too many critical deviations in EP calculations, leading in 3 cases to the loss of licence. In the non-residential sector, in 2012, a total of 17 companies were penalised, of which 2 lost their licence in the end.

3.2 Progress and current status on public and large buildings visited by the public

The EPC is widely applied in public and governmental buildings. Results from early 2010 show that, from a random sample of 365 public buildings, a number of 254 buildings would need to display the EPC. Further research showed that approximately 70% of buildings actually had an EPC displayed, or was in the process of certifying the building. About one year earlier, a similar random check was done and the result then was that only about 30-35% of the buildings had the EPC displayed, or were in the process of acquiring it.

Checks on the compliance of applying for an EPC and displaying it when available are done by a governmental inspection authority, the 'Inspectie leefomgeving en transport' (ILenT). It is important to know that the checks are done without pre-announcement, so that results are quite reliable. There are no sanctions involved at this stage yet, so this is purely done to check compliance and evaluate if, and whether, sanctions are necessary.

3.3 Implementation of mandatory advertising requirement – status

Advertising the Energy Performance class indicator, when a certificate is available, is not mandatory at the moment in The Netherlands. However, for a very small number of buildings that is for sale, this is already done on a voluntary basis. When analysing the largest website of joined real estate agents (*www.funda.nl*), in the residential sector about 2% of houses that are for sale at the end of 2012 have an EPC available. However, not all of these houses actually need to have an EPC, because there will, more than likely, be some monumental buildings amongst the buildings for sale, which slightly increases the actual percentage where the EPC is displayed. Research in recent years showed that approximately 15-20% of houses that are sold in one year, actually have an EPC available at the transaction moment.

3.4 Information campaigns

Public awareness concerning the EPBD and in particular the EPC in The Netherlands, is the main responsibility of the Ministry of the Interior and Kingdom Relations. Evolving out of the entry into force of the EPBD and implementation of the EPC in 2008, a national information campaign was launched in The Netherlands at the end of 2007 and repeated again in the spring of 2008. The campaign consisted of short commercials on radio and television, items in housing programs, advertisements in national newspapers and a campaign website with guidelines to inform the broad public ('Postbus 51').

In 2009 and 2010, a more general campaign ran to raise public awareness on the topic of energy saving in the built environment. Under the current circumstances, at the end of 2012 it is not possible to have such large national campaigns, because of budget cuts and other restraints. However, both NL Agency and the consumer information organisation 'Milieu Centraal' offer continuous information about the implementation of the EPBD guideline, the EPC and other subjects, through their websites, in workshops and brochures, with online tools like the 'Energiebesparingsverkenner' (energy savings scout) *www.energiebesparingsverkenner.nl* or *www.verbeteruwhuis.nl*, and through social media (Figures 10 & 11). The main NL Agency website which acts as a portal to other sources of information is *www.energielabelgebouw.nl*.

4. Inspection requirements - heating systems, air-conditioning

In The Netherlands, the implementation of inspection requirements is different for heating systems and air-conditioning (AC) systems. Whereas the inspection of AC systems is done by means of legal implementation, the inspection of heating systems is based on a voluntary system. This approach was already opted for in 2006 because a large number of heating systems are already inspected and replaced on a voluntary basis, so there is no need to regulate this by law.

Figure 10: EPC information folder.

4.1 Progress and current status on heating systems

Inspections of heating systems are not regulated by new legislation, because already a large number of systems is regularly being checked. It is estimated that in the social housing sector there is nearly full coverage of maintenance and inspections by professional companies, without the need for legislation to do so. For larger systems, mainly in the non-residential sector, there already is a law in place that forces the owner to do regular inspections. So it is mainly for the private residential market that additional activities are necessary and under development in order to stimulate home owners to have their heating system inspected on a regular basis. The heating systems manufacturing association (VFK) and the representative organisation for installers (Uneto-VNI) are collaborating where, with the support of the government and public consumer organisations, they are currently developing an inspection with the focus aimed at both energy saving potential as well as safety.

Figure 11: EPC information card.

Figure 12: Market share of different heating systems for the residential sector.

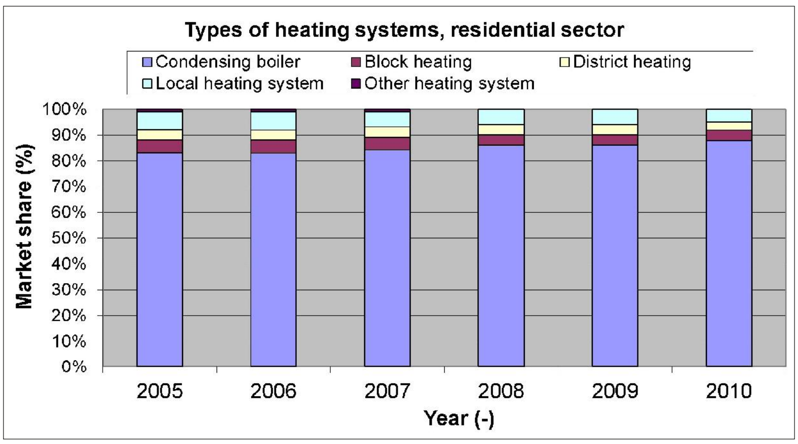
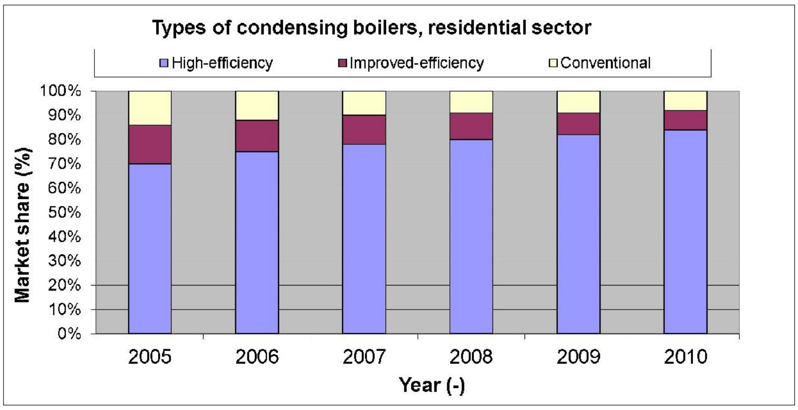


Figure 13: Coverage of high-efficiency condensing boilers in the residential sector.



After a number of deadly and other accidents, there is a lot of attention to safety issues relating to carbon monoxide poisoning. For this reason, safety organisations and insurance companies are interested in this new voluntary inspection as well.

4.2 Progress and current status on AC systems

New regulations are in preparation in The Netherlands to enforce regular inspections of AC systems. These regulations are laid out in a part of the law that, had it been enacted at the end of 2012, would have introduced an adequate system of sanctioning to the EPC, as described in paragraph 3.1. However, this law was rejected by the Parliament. It is expected that the regular AC inspections will be taken up in a different part of the legislation and still be implemented in the course of 2013/2014.

According to the current proposal submitted to the Parliament, the inspections will have to be carried out every 5 years for all AC systems with an effective output over 12 kW (total per building). The inspections must be carried out by Qualified Experts (QEs). Training and examination for these experts are currently under development. Precise requirements are therefore not available yet. The purpose of the inspection for an expert is to determine whether an improvement of the energy performence of the system is possible. This will lead to a report that contains an assessment of the efficiency of the AC system, as well as an evaluation of the capacity in relation to the cooling needs of the building. The user or owner of the AC system will receive advice on possible improvements to the system, the need to replace the system and possible alternative solutions. The reports will be stored in a central database.

5. Conclusions and future plans

Implementation of the Energy Performance of Buildings Directive (EPBD) is progressing in The Netherlands, despite turbulent political times. A new law that was in preparation to transpose a number of provisions from the recast EPBD has been rejected by the Parliament at the end of 2012. In the beginning of 2013, the Ministry of the Interior and Kingdom relations will start to work on a new law. Positive progress can be seen in other areas, such as the implementation strategy towards Nearly Zero-Energy Buildings (NZEBs), where The Netherlands already has relevant legislation in place since 1995. Energy Performance (EP) requirements will be further tightened in the next couple of years, not only for new buildings, but also for existing buildings. A lot of effort is put into the inspections of air-conditioning (AC) systems and heating systems, whereas the first will be implemented into national legislation and the second is expected to succeed on a voluntary basis.

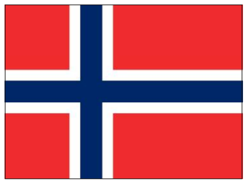
Communication will be the keyword in a lot of projects relating to the EPBD in the near future with the aim of actually stimulating building owners to take energy saving measures following the certification of a building, or the inspections of an installation. One of the main concerns in the residential sector will be to ensure that home-owners expenditures remain affordable. In the non-residential sector, and in the social housing sector, the Energy Performance Certificate (EPC) is considered a useful benchmarking tool where one can distinguish oneself from competitors with an energy efficient building stock.

The Concerted Action (CA) EPBD will remain of great value to The Netherlands in upcoming years to share best practices and learn from other Member States (MS) experiences.

Figure 14: Advisory tool for inspection of an air-conditioning system.

EPBD implementation in Norway

STATUS AT THE END OF 2012



1. Introduction

Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) has been fully implemented in Norway since 2010. The transition period for the minimum requirements for new buildings is over, and the schemes for the certification of buildings, as well as for the inspection of boilers, heating systems, ventilation and cooling systems, are effective.

By the end of May 2013, approximately 301,000 energy certificates had been issued. The larger part concerns dwellings, whereas 15,000 concern non-residential buildings.

The recast EPBD has not been formally included in the Agreement on the European Economic Area (EEA), and is thus not implemented in Norway. The content of this Directive is, however, actively pursued in the planning of future regulations.

This report presents an overview of the current status of implementation, as well as of the further plans for the improvement of the EPBD schemes in Norway. It addresses certification and inspection systems, including the status for quality control mechanisms, the status for qualified experts in the market, information campaigns, incentives and subsidies.

2. Energy performance requirements

In 2012, the Norwegian government stated that all new buildings should be at passive house level in 2015, and Nearly Zero-Energy Buildings (NZEB) by 2020. Until now, the Norwegian requirements have been the same both for new buildings and major refurbishments. The Norwegian Building Authority is currently considering the need for separate requirements for refurbishments, as well as how these requirements could be designed.

2.1 Progress and current status

Following the implementation of the EPBD, the energy requirements in the Norwegian building regulations were revised in 2007.

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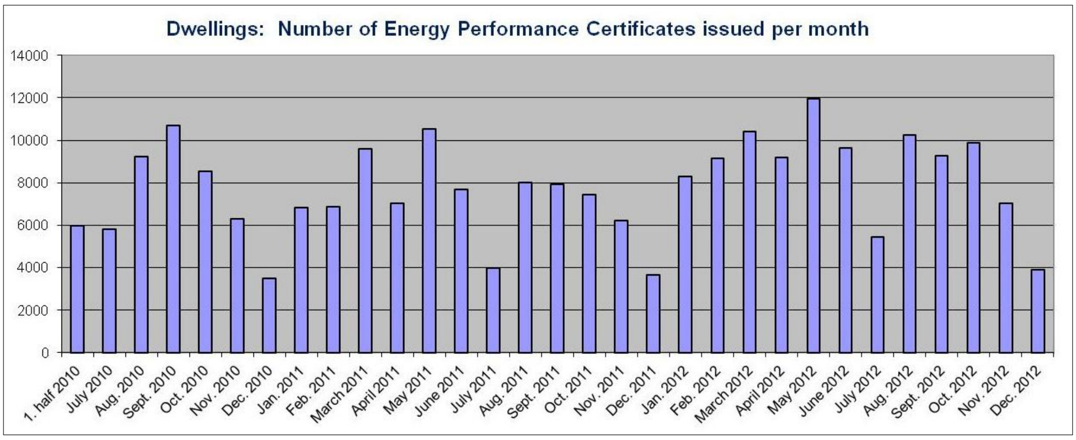


Figure 1: Number of Energy Performance Certificates issued per month for dwellings since start of certification scheme.

National Websites *www.nve.no, www.dibk.no, www.energimerking.no*

In 2010, the requirements were further adjusted. The Norwegian Parliament has agreed that all new buildings should be at passive house level by 2015. The definition of the coming minimum requirements is currently under development, but two Norwegian standards regarding the criteria for passive houses and low-energy buildings are already in place. These are the NS 3700 for residential buildings and the NS 3701 for non-residential buildings. However, the definition of the passive house level to be implemented in the building regulations in 2015 will most likely not be identical to the requirements set in these standards.

2.2 Format of national transposition and implementation of existing regulations

The Norwegian building regulation has two options for how to fulfill the requirements. The first option contains specific energy limits for different building types. The requirements are set in kWh/m² useful energy demand per year within the building envelope, considering heat recovery from ventilation systems, but not considering system losses and energy export. If this option is chosen, one must also fulfill a set of absolute minimum requirements. The other option addresses different components of the building envelope, as well as technical installations and solutions. The requirements will be considered fulfilled if it is shown that 11 specific energy measures are applied. In addition to requirements concerning insulation and envelope airtightness, there are specific requirements for the heat recovery of ventilation air in the ventilation apparatus (yearly mean heat recovery rate), the specific fan power (SFP) factor, and the equipment for shading or other precautions to avoid the use of cooling systems. Energy demands for lighting, hot water and all technical equipment are also considered, but so far only standard values are applied. Requirements for an environmentally friendly energy supply for heat purposes are an important, supplementary part of the regulations.

Table 1: Progress over time, of certain aspects which are necessary to fulfill the Norwegian minimum energy requirements, for: commercial buildings, single-family houses, and apartment buildings.

Requirement	1997	2007	2010
Net energy demand (kWh/m².year)	-	Single-family house: 125 + 1,600/m² heated floor area	Single-family house: 120 + 1,600/m² heated floor area
		Apartment: 120	Apartment: 115
		Commercial building: 165	Commercial building: 150
Total area of glass/doors	20% of heated floor area	20% of heated floor area	20% of heated floor area
U-value: exterior wall	0.22 W/m².K	0.18 W/m².K	0.18 W/m².K
U-value: roof	0.15 W/m².K	0.13 W/m².K	0.13 W/m².K
U-value: exposed floors	0.15 W/m².K	0.15 W/m².K	0.15 W/m².K
U-value: glass/doors	1.6 W/m².K	1.2 W/m².K	1.2 W/m².K
Thermal bridges	-	Single-family house: 0.03/m².K	Single-family house: 0.03/m².K
		Other buildings: 0.06/m².K	Other buildings: 0.06/m².K
Heat recovery of ventilation air	60%	70%	Dwellings: 70%
			Commercial building: 80%
Air tightness	Single-family house: 4.0	Single-family house: 2.5	Single-family house: 2.5
(Air changes/hour at 50 Pa pressure difference)	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5
SFP factor	-	Dwellings: 2.5 kW/(m³/s)	Dwellings: 2.5 kW/(m³/s)
		Commercial building: 2.0 kW/(m³/s)	Commercial building: 2.0 kW/(m³/s)
Screening factor for glass/window (gt)	-	-	0.15 (all buildings)

Table 2: Absolute minimum requirements one must fulfill if using the option of net energy demand limit.

U-value exterior wall [W/m².K]	U-value roof [W/m².K]	U-value exposed floors [W/m².K]	U-value glass/doors [W/m².K]	Air tightness (air changes/hour at 50 Pa pressure difference)
≤ 0.22	≤ 0.18	≤ 0.18	≤ 1.6	≤ 3.0

The Norwegian energy requirements are set with regard to 13 different building categories. Indicatively, Table 1 shows the progress over time, of certain aspects which are necessary to fulfill the Norwegian minimum energy requirements, for: commercial buildings, single-family houses, and apartment buildings.

Table 2 shows the absolute minimum requirements one must fulfill if using the option of net energy demand limit.

Since the 1st of January 2013, all new buildings are required to be checked by an independent expert; air leakage testing will be mandatory for all building types. For larger residential buildings and for non-residential buildings, the control will be more extensive than for single-family houses.

The Norwegian standard for the calculation of the energy performance of buildings is called NS 3031. This standard is built on the EN 15603.

The Norwegian regulations also include requirements for energy supply. It is not permitted to install a boiler using fossil oil to accommodate the baseload. Buildings with more than 500 m² floor area shall be designed and constructed so that a minimum of 60% of the net energy need for space and water heating may be obtained by an energy supply other than electric resistance heating or fossil fuels at the point of the end user. For buildings with less than

Figure 2: New administrative building for Norwegian Meteorological Institute, Oslo. Built in 2012 according to the Norwegian Passive House standard for non-residential buildings. Photo by Baard Gudim.

500 m² usable floor area, the requirement is 40% of the net energy need for space and water heating. These requirements do not apply in cases where it can be documented that it is practically impossible to fulfill them due to local conditions. For residential buildings, the requirements do not apply if the net heat demand is calculated to be below 15,000 kWh/year, or where the requirements result in higher costs over the life cycle of the building. Residential buildings that are exempted from these requirements must, however, install a chimney and an enclosed heating unit suitable for biofuels. This requirement shall not apply to dwellings with less than 50 m² usable area or dwellings that fulfill the passive house criteria set in the NS 3700.

2.3 Cost-optimal procedure for setting EP requirements

The cost-optimal procedure is under evaluation. An undergoing investigation is currently gathering information regarding the development of construction costs in relation to the development of building requirements. The costs of renovating different types of buildings from various periods are gathered as well. The results will be used when the requirements for 2015 are to be set.

2.4 Action plan for progression to NZEB

The Norwegian Government stated that the building requirements in 2020 will be NZEB. A private consultancy company has been contracted by the National Building Authority to develop a proposal for the national definition of NZEB, evaluating different approaches for both residential and non-residential buildings. The proposal is the first milestone in the work towards NZEB. The national standards for passive houses, as well as the 2015 building regulations, will also be an important background material for the development of a NZEB definition.

3. Energy performance certificates

The scheme for the certification of buildings is under the responsibility of the Ministry of Petroleum and Energy. The Water Resources and Energy Directorate (NVE) is the managing body for certification and inspection schemes. The legislation is in place since the 1st of January 2010, but following a political discussion, the regulation was revised as of the 1st of July 2010[1]. The main change was the design of the label, to highlight the two dimensions: the energy performance and the share of renewables in the heating system. There were also clarifications on the exemptions from the obligation to certify. Another revision was effective as of the 1st of January 2012, taking account of the new comments from the European Surveillance Authority (ESA). The changes should clarify and limit exemptions from the obligations. Further, buyers who do not receive an energy certificate have the right to order a certification by an expert, at the expense of the seller.

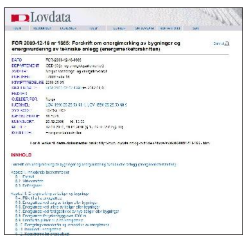
The regulation requires that every residential dwelling shall have an energy certificate. This applies to both apartments and single-family houses. The political background for this was the wish to stimulate the households' own interest and activity related to energy qualities and energy performance.

At the same time, the Directive's requirements for public buildings in Norway relate to all non-residential buildings. Thus, the regulation does not distinguish between public and private buildings.

3.1 Progress and current status on sale or rental of buildings

More than 300,000 energy certificates have been issued over a period of 3 years. It is estimated that this implies that more than 250,000 buildings/apartments have been certified.

Figure 3: The regulation for energy certification and inspections.[1]



1 *www.lovdata.no/cgi-wift/ldles?doc=/sf/sf/sf-20091218-1665.html*

Figure 4: The logo of the Norwegian scheme for energy certification.

More than 90% of the certificates are issued for dwellings. It is assumed that the sale of dwellings is the main trigger for the certification process – more so than the rental of dwellings. In December 2011 and in June 2012, a control was held for 5 announced sales from each county, all together 95 dwellings. In December 2011, only 52% of the dwellings were certified. This modest first result led to an improved dialogue with the estate agents, who then established better routines. Six months later, the result was considerably better: by then, more than 75% were certified.

The rate of certification appears to be slower for non-residential buildings. In the autumn of 2012, a corresponding control was held, which showed that only 37% of the buildings in question were certified. This result will be used in the information to stimulate an improved result.

The Energy Certificate is the legal document produced during the energy certification. The regulation requires that this document be shown to potential buyers and renters. However, parts of the certificate, for instance the Energy Label, can be used as a short version.

The Energy Certificate (Energiattesten) has the following content:

Identity data
On top of the front page, there are the address and the necessary data for the identification of the building or the apartment, the name of the person or organisation responsible for the certification (normally the owner), as well as the name of the person who has registered the data.

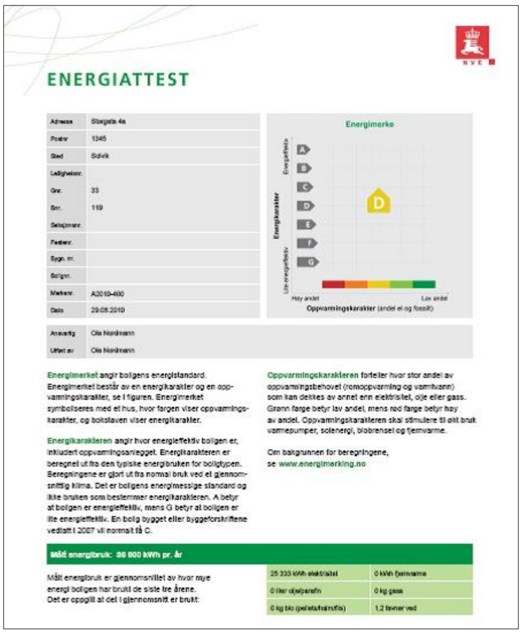


Figure 5: The first page of the Energy Performance Certificate. The label is shown in its two dimensions; the Energy and the Heating character.

The Energy Label
This matrix presents the result of the calculation in two dimensions. Firstly, on the vertical axis, the Energy Grade (grades A to G) represents the calculated delivered energy needs. New buildings will normally achieve the energy grade C, although this depends on the efficiency of the heating system in place. Grades A and B are normally reserved for buildings with energy quality better than that required. Secondly, on the horizontal axis, the Heating Grade represents the extent to which the heating of space and water can be accomplished with renewable energy sources - other than electricity and fossil fuels. The character represents the Energy Grade and the colour represents the Heating Grade, where green is predominantly based on renewables, and red means heating based on fossil fuels or electricity. An explanation is given on the front page of the certificate.

Measured energy consumption
An average of the energy use per energy carrier for the last three years is shown on the bottom of the front page. For non-residential buildings, this is obligatory, but for residential buildings it is only encouraged.

User influence
On page 2, a paragraph is devoted to general advice on energy use which can save energy, even if it does not affect the calculation of energy performance.

Recommendations
A summary of the recommendations is listed, whereas a more extensive description is given in the Appendix.

Central input data
On page 3, most of the key input data given by the owner are presented, in order to allow the reader to check obvious data such as the building type, the year of construction, etc..

Information and Help Desk
The last page is devoted to general information on the Energy Certification, as well as to contact data for the helpdesk established by the Norwegian authorities.

A short version of the Energy Label is the profile of a building with the same combination of letter and colour as that in the Energy Label matrix.

There are small differences between certificates for residential and non-residential buildings. The differences mostly conern the language and the relevance of content.

For the certification of new buildings and of all non-residential buildings, a high level of technical competence is required. Certification of non-residential buildings requires a bachelor degree in building techniques or energy systems, as well as two years of relevant experience. For new buildings, a certificate can only be issued by a person with the same level of competence that is required for the building designer, as defined in the building regulations. By performing the certification, the expert declares that he/she meets the requirements and can document this on request. For existing dwellings, there is a system of self-registration, where the owner or another person is guided through a menu of registration with restricted options. The main input used for the calculation is printed on the certificate for the reader (i.e., buyer) to check. This option has been developed to give the owner of the dwelling the option of a quick and low-cost registration, as well as to stimulate the individual owners' interest in their own energy use, as well as in possible efforts towards greater efficiency. The system uses built-in conservative default values, so that the owner will normally obtain a better energy rating from a more detailed registration or from an expert's registration.

When using the self-registration option, the owner gives input data on-line to the Energy Certification System. The system takes the input concerning the building's year of construction, room area, type, etc. and finds the corresponding typical values for the parameters needed for the calculation. Then, the certificate is immediately produced. The user can choose between a 'simple registration' version, which is the quickest and is suited only for buildings with typical values, and a 'detailed registration', where a larger amount of details is needed. A detailed registration is required for a person to be able to get recognition for refurbishments or to get a building standard that is better than the norm for the building's year of construction. The list of recommendations following the self-assessment can only be a vague indication of the best efficiency efforts for this building. However, when an expert performs the certification (see requirements above), he/she is responsible for all input data, as well as for detailing of recommendations for improvement. This implies that the recommendations in certificates generated by a non-expert will be more general than those of an expert.

The validity of energy certificates is 10 years.

Tiltaksliste: Vedlegg til energiattesten

Attesten gjelder for følgende eiendom (Vedlegg 1)

Adresse: Storgata 4a	Gnr: 33
Postnr/Sted: 1345 Solvik	Bnr: 119
Leilighetsnummer:	Seksjonsnr:
Bolignr:	Festenr:
Dato: 29.06.2010 18:13:14	Bygnr:
Energimerkenummer: A2010-400	
Ansvarlig for energiattesten: Ola Nordmann	
Energimerking er utført av: Ola Nordmann	

Bygningsmessige tiltak

Tiltak 1: Montere tetningslister
Luftlekkasjer mellom karm og ramme på vinduer og mellom karm og dørblad reduseres ved montering av tetningslister. Lister i silkon- eller EPDM-gummi gir beste resultat.

Tiltak 2: Tetting av luftlekkasjer
Det kan være utettheter i tilslutning mellom bygningsdeler, rundt vinduer/dører og ved gjennomføringer som bør tettes. Aktuelle tettematerialer er f.eks. bunnfyllingslist med fugemasse, fugeskum eller strimler av vindsperre. Utettheter ved tilslutninger mellom bygningsdeler kan være kompliserte å tette, og må ofte utføres i sammeheng med etterisoleringstiltak.

Tiltak 3: Etterisolering av yttertak / loft
Tak / loft etterisoleres ved utlegging av isolasjonsmatter eller ved innblåsning av isolasjon i hulrom. Utførelse/metode avhenger av dagens tilstand. Tetting av loftsluke må alltid gjennomføres samtidig for at det ikke skal oppstå kondens i taket over loftsluka.

Tiltak 4: Isolering av gulv mot grunn / mot det fri
Gulv mot grunn / mot det fri isoleres. Utførelse avhenger av dagens løsning. Utvendig isolering av ringmur reduserer varmetap langs randen.

Tiltak 5: Randsoneisolering av etasjeskillere
Kald trekk i randsonen av trebjelkelag kan utbedres ved å isolere bjelkelaget i randsonen. Utvendig kan man forsøke å tette vindsperra nederst på utsiden av veggen.

Tiltak 6: Isolere loftsluke
Loftsluken isoleres og tettes ved bruk av tettelister for å redusere varmetap og direkte luftlekkasjer.

Tiltak 7: Utskifting av vindu
Gammelt vindu som isolerer dårlig skiftes ut med nytt vindu. Det anbefales en U-verdi på 1,2 W/m2K eller lavere (medregnet karm og ramme).

Tiltak 8: Termografering og tetthetsprøving
Bygningens lufttetthet kan måles ved hjelp av metode for tetthetsmåling av hele eller deler av bygget. Termografering kan også benyttes for å kartlegge varmetap og lekkasjepunkter. Metodene krever spesialutstyr og spesialkompetanse og må utføres av fagfolk.

Tiltak på sanitæranlegg

Tiltak 9: Isolere varmtvannsrør
Uisolerte varmtvannsrør isoleres for å redusere varmetapet.

Tiltak på luftbehandlingsanlegg

Tiltak 10: Montere blafrespjeld på kjøkkenventilator
Det monteres blafrespjeld på kjøkkenventilator for å redusere luftutskiftningen og dermed varmetapet.

Figure 6: The list of recommendations is provided in an annex to the EPC.

Certification of new buildings requires a Qualified Expert (QE). The Energy Certification System is designed to import the result of the calculations from external energy calculation systems. This is beneficial particularly for developers of new buildings who can use the same expert, the same software and, for the most part, the same input data as that in the calculation, in order to check the compliance with minimum requirements. This way, the developer can easily take the energy grade into consideration at an early stage of the project. The QE will also be able to set the data for technical installations that are not accessible to unqualified people making a self-registration, e.g., efficiency of recovery units in ventilation, COP of heating and cooling installations.

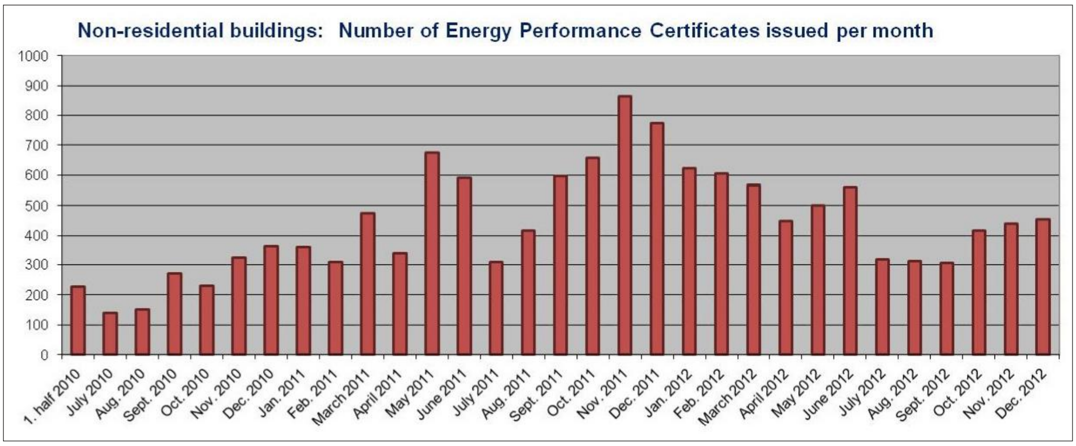
The developer is obliged to present a certificate when the building is at the market, even if it is only at the planning stage, and correct this later if the actual building differs from the project plans. As an alternative, they can choose to give a guarantee of Energy Label, and document this at the time of completion.

Major renovations require the same certification as the new buildings; reference is made to the building regulation.

3.2 Progress and current status on public and large buildings visited by the public

The Directive has some special requirements for public buildings. The government has decided that all non-residential buildings shall have the same obligation. This implies that all non-residential buildings with a floor area above 1,000 m^2 shall have a valid energy certificate, and a summary of it has to be displayed to the public.

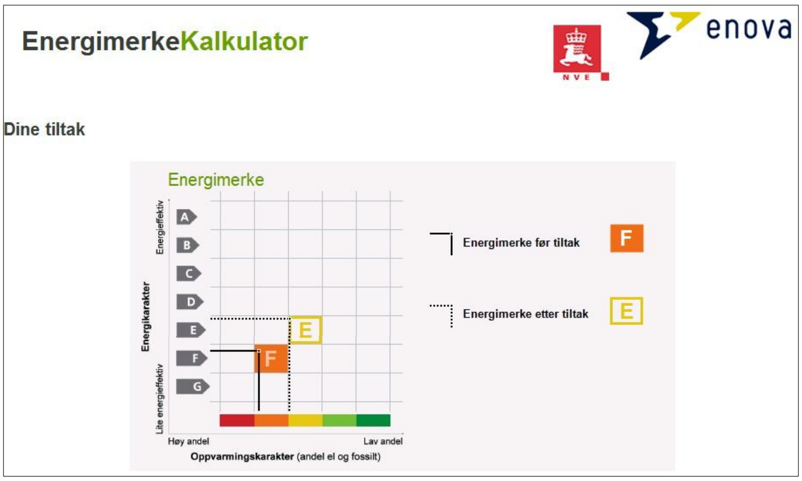
Figure 7: Number of EPCs issued per month for non-residential buildings since the start of the certification scheme.



For non-residential buildings, the rate of certification seems to have been slower in 2012 than in 2011. At the same time, control activities are in the start-up phase, firstly concerning the existence of certificates and secondly concerning their quality. Information activities will also focus on this issue.

The calculation method (NS 3031) describes a normalised use of the building. The measured energy use is required to be submitted, but is not part of the calculated label. This basis for the label is very well suited for a situation of sale or rental, but less suited for a number of public buildings which are never on the market for sale and rental. In the early phase after certification became mandatory, municipalities have been slow at certifying their own buildings. The message to the municipalities is that certification is a requirement, it shall be on display for users and, last but not least, can serve as a basis for long term improvements in the building management. The message is also that the establishment phase is over, that controls will be stepped up, and that sanctions will be levied.

Figure 8: Energy Label Calculator: display of the result where a number of recommendations are simulated on an existing dwelling. The label has improved from 'Orange F' to 'Yellow E'.



3.3 Implementation of mandatory advertising requirement – status

Implementation of the recast Directive is pending. The current regulation requires that the energy certificate shall be part of the marketing of apartments and buildings. At least, the certificate shall be included in the property description. The dominant market place for advertising on the Internet (*Finn.no*) has already facilitated the inclusion of the Energy Label in advertisements, but on a voluntary basis. For a considerable share of internet advertisements, the label is already in use. In newspaper advertisements, only a few estate agents practice the use of Energy Labels.

3.4 Information campaigns

The first year (2010) of operation had the most intense information activity. This was also a period of great demand for information about the new requirement.

In 2012, the most important information activities were:

- Advertisements in magazines, etc..
- Production of editorial material, which is offered in relevant media. One example is the description in the trade agents' media of the regulatory amendment which states that the buyer can order an expert certification at the expense of the seller, if the latter cannot present a certificate.
- The Help Desk gives advice for the certification process and the regulation, as well as for possible measures to improve the buildings' energy qualities.
- Energy Label Calculator: The Calculator was launched in September 2012 for the use of dwelling owners. Its aim was to make the effect of rehabilitation measures visible on the label. The Calculator can also be the starting point of formal certification.
- A guide for experts on energy certification and inspection of technical systems is under preparation.

4. Inspection requirements - heating systems, air-conditioning

Articles 8 and 9 of the original EPBD are implemented in the same regulation as the energy certification, and the requirements for inspections are in force since the 1st of January 2010, without any transition period. It must, however, be noted that the practical implementation is slower. Up to the 1st of July 2010, the regulation had a transition period, which was later withdrawn. This change came as a surprise to the building owners. Also, in the public information campaigns over the first two years (2010-2011), the main emphasis was on energy certification.

Norway has adopted option a) of the article 8 of the EPBD, establishing a regular inspection of boilers, in line with the inspections according to article 9. The regulation has been set according to the size limits given in the Directive. However, regarding article 9, the inspections must cover both air-conditioning (AC) and ventilation systems. Rather than the EPBD's minimum size defined in effective rated output, the regulation sets the threshold in the area (m^2) served by the system. This is considered more practical to the building owners. In addition, the regulation:

> Includes split units.
> Enables the inspection of pure ventilation systems without cooling devices. This is a fairly common way of heating and cooling in Norway.

The inspection requirements, thus, are the following:

> Boilers fueled by fossil fuels with an effective rated output above 20 kW are to be inspected every 4 years (every 2 years for boilers with an output above 100 kW).
> Heating systems fueled by fossil fuels with an effective rated output above 20 kW, and older than 15 years: one time inspection.
> AC systems with an effective rated output above 12 kW or serving a heated area above 500 m^2: every 4 years.

The building owner has the duty to have an inspection made by a competent inspector. The report from the inspection shall be uploaded to the Energy Certification System at NVE; it shall also be available on the premises. The content of the report is outlined in the regulation:

> identification of building and system;
> description of system;
> summary of evaluation with any deviations from normal situation;
> registered data;
> recommendations;
> signature of the expert;
> general information on the inspection report, including dates, sources of information, etc..

NVE has presented a template form for each type of inspection. These forms can be downloaded in excel format and used directly by the expert. Other formats and technical systems are allowed as long as the data and evaluations are given at a level comparable with the template produced by NVE. The minimum level of competence is stated in the regulation according to each type of inspection. The requirements include formal competence and practical experience. By performing the inspection, the expert declares that he/she meets the requirements and is ready to document this on request.

The template given by the NVE defines a large number of check-points and data to be registered. These are considered necessary to fulfill the objectives of the inspection and to give a reasonable return of the cost. For building owners who have good documentation of the systems and carry out regular maintenance works, the task of inspection will not cause high extra cost,

Figure 9: Advertisement for Energy Label Calculator for dwellings.

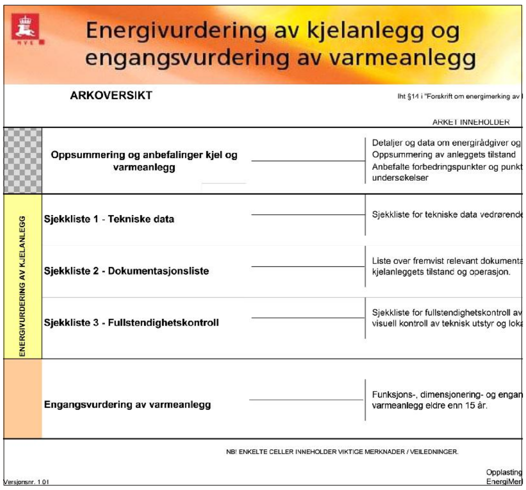


Figure 10: First page of template form for inspection of boilers and heating systems.

Figure 11: Advertisement on inspection of boilers and air-conditioning systems.

Figure 12: Advertisement for buyers/renters in the housing market.

because it is allowed to use an expert who is already involved in the maintenance – as long as he/she meets the requirements of competence. For building owners who neglect the continual need for maintenance, the cost of inspection can be very high. The first objective of the government is to give an incentive to all owners of technical systems to establish good regular routines for service and maintenance.

The duty of inspection is not connected to the duty of energy certification. However, there are obvious benefits in coordinating the tasks. Any inspection report will be for the benefit of the certification expert. It will be useful for the expert who inspects a heating system to use the calculations for the energy performance of the building in question. And, for the owner, the whole process can be more effective if done by a limited number of experts working in cooperation.

4.1 Progress and current status on heating systems

The number of heating systems that have been inspected by November 2012 is less than 1,000. This low number shows that this scheme has hardly been established, in spite of the voluntary schemes running for several years. It is of major concern to find better ways of communication, and to seek to integrate the inspections with the voluntary activities already in place.

Reports from experts show that:

> The forms introduced by the NVE require relevant and important information.
> The task is well suited to integrate with normal maintenance activities.
> The combination with energy certification can effectively lower the total cost of the processes.
> Control is needed to enforce the regulation. The commencement of control is vital.

Due to the government policy to phase out fossil fuels for buildings, the number of systems using fossil fuels is in decline, as well as the use of each system. This development will naturally influence the building owners' motivation for long term strategies for their oil and gas fired systems.

4.2 Progress and current status on AC systems

By November 2012, approximately 10,000 inspection reports from air-conditioning (AC) systems have been uploaded. The largest share represents ventilation systems, which is natural under Norwegian climate conditions. Still, this is a small part of the systems that must be inspected, and a large task lies ahead. This task includes more intense information activities, including guidance, as well as the commencement of controls for compliance.

Reports from experts prove that this inspection can be accomplished quite satisfactorily in combination with the energy certification. Reuse of expertise and input data enables cost to be kept down.

5. Conclusions and future plans

In December 2012, the Norwegian Government had not yet decided as to the European Economic Area (EEA) relevance of the recast Directive on the Eenergy Performance of Buildings (EPBD). Still, it is widely expected that the contents of the recast Directive will be included in Norwegian regulations. The investigation to define the level and the steps towards Nearly Zero-Energy Buildings (NZEB) by 2020 has started on the basis of the recast EPBD and of political commitments for increased energy efficiency in buildings in the years to come.

Regarding the energy certification and inspections, the most obvious development ahead is to move, from mere guidance, to control and sanctions.

EPBD implementation in Poland

STATUS AT THE END OF 2012

Authors

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In Poland, the requirements resulting from the first edition of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) have been implemented in the period 2007-2009. Changes in the Construction Act concerning energy assessment and certification of buildings and also inspection of boilers and systems were accepted by the Polish Parliament on the 17th of September 2007. The detailed requirements on these issues were set out in three Ministerial Ordinances in force since the 1st of January 2009. The implementation of the Directive 2002/91/EC was completed by introducing new amendments to the Construction Act in August 2009.

The implementation of the recast EPBD (Directive 2010/31/EU) started in 2011. A new Act on Energy Performance of Buildings is currently under preparation. The implementation of the EPBD to the national law is supervised by the Polish Ministry of Transport, Construction and Maritime Economy (former Ministry of Infrastructure). Under the guidance of the Ministry, draft amendments to the regulations on energy requirements for buildings, the methodology for the calculation of the Energy Performance (EP) of buildings and on selected issues relating to the preparation of building projects were developed during the last two years.

2. Energy performance requirements

2.1 Progress and current status

Mandatory energy requirements for buildings are an essential tool for the creation of the state policy in the construction sector in Poland. They are published in the Ministerial Ordinance on the technical criteria to be met by buildings. The current requirements in force in Poland were introduced at the beginning of 2009. The building stock in the country is divided into five basic categories, i.e.: single-family houses, apartment blocks, collective residential buildings - like hotels and dormitory houses, public buildings and buildings for production, storage and outbuildings. The current energy regulations allow two alternative ways of fulfillment. The first is the prescriptive method, consisting of satisfying the requirements for the building components. The second, which is used for the first time in the regulations, has a performance character based on the EP indicator expressing the demand of non-renewable primary energy in a building. The application of this method is complicated but it gives more freedom for building designers in their choices concerning the energy quality of the building and systems components. Both methods can be applied to new and modernised buildings but, in this last case, threshold values specified in the requirements may be exceeded by 15%. For the first time, the regulations also introduced requirements concerning the protection of buildings against overheating in the summer period.

2.2 Format of national transposition and implementation of existing regulations

Prescriptive method

The maximum heat transfer coefficient values (U values) for walls, roofs, flat

National Websites *www.transport.gov.pl, www.itb.pl*

Table 1: Evolution of requirements concerning thermal insulation for opaque building elements.

Fabric element and internal temperature in the room	**Building category**	**Maximum U-value [W/m².K]** Before the implementation of the EPBD	After the implementation of the first version of the EPBD (from 2009 – current regulations)	After the implementation of the recast EPBD (forecast from 2014)
External walls: t_i >16 °C	Residential and collective buildings	0.30 - 0.50	**0.30**	0.25
	Public buildings	0.45 - 0.65	**0.30**	0.25
	Production, storage and outbuildings	0.45 - 0.55	**0.30**	0.25
External walls: t_i ≤ 16 °C	Residential and collective buildings	0.80	**0.80**	0.45
	Public buildings	0.70	**0.65**	0.45
	Production, storage and outbuildings	0.75 - 0.90	**0.65 - 0.90**	0.45
Walls between heated and unheated spaces	Residential and collective buildings	-	**1.00**	0.30
	Public buildings	-	**-**	0.30
	Production, storage and outbuildings	-	**-**	0.30
Roofs and flat roofs t_i >16 °C	Residential and collective buildings	0.30	**0.25**	0.20
	Public buildings	0.30	**0.25**	0.20
	Production, storage and outbuildings	0.30	**0.25**	0.20
Roofs and flat roofs t_i ≤ 16 °C	Residential and collective buildings	0.50	**0.50**	0.30
	Public buildings	0.50	**0.50**	0.30
	Production, storage and outbuildings	0.50	**0.50**	0.30
Floors over unheated and closed spaces t_i >16 °C	Residential and collective buildings	0.60	**0.45**	0.25
	Public buildings	0.60	**0.45**	0.25
	Production, storage and outbuildings	-	**0.80**	0.25
Floors over unheated and closed spaces and on the ground t_i ≤ 16 °C	Residential and collective buildings	0.60	**0.45**	0.30
	Public buildings	0.60	**0.45**	0.30
	Production, storage and outbuildings	-	**1.20**	0.30
Floors on the ground t_i >16 °C	Residential and collective buildings	0.60	**0.45**	0.30
	Public buildings	0.60	**0.45**	0.30
	Production, storage and outbuildings	0.60	**0.80**	0.30
Floors on the ground t_i >16 °C	Residential and collective buildings	0.85	**0.45**	1.20
	Public buildings	0.85	**0.45**	1.20
	Production, storage and outbuildings	0.85	**1.20**	1.20

Table 2: Evolution of requirements concerning thermal insulation for windows, skylights and doors.

Type of window or door	**Building category**	**Maximum U-value [W/m².K]** Before the implementation of the EPBD	After the implementation of the EPBD (from 2009 – current regulations)	After the implementation of the recast EPBD (forecast from 2014)
Windows and balcony doors	Residential and collective buildings	2.0 - 2.6	1.7 - 1.8	1.3 - 1.8
	Public buildings	2.3 - 2.6	1.8 - 2.6	1.3 - 1.8
	Production, storage and outbuildings	2.6 - 4.0	1.7 - 1.9	1.3 - 1.8
Roof windows and skylights	Residential and collective buildings	2.0	1.8	1.5 - 1.8
	Public buildings	2.0	1.7	1.5 - 1.8
	Production, storage and outbuildings	2.6 - 4.0	1.8	1.5 - 1.8
External doors	Residential and collective buildings	2.6	2.6	1.7
	Public buildings	2.6	2.6	1.7
	Production, storage and outbuildings	3.0	2.6	1.7

roofs and floors over unheated and closed spaces are given in Table 1.

The maximum heat transfer coefficient values (U values) for windows, balcony doors and entrance external doors are given in Table 2.

The total area of all transparent elements installed in the building envelope is limited. In residential and collective buildings, the limit concerns components with thermal transmittance U ≥ 1.5 W/m².K and the maximum area of transparent elements A_{Omax} for a building is then given by the equation:

$$A_{Omax} = 0.15\ A_Z + 0.03\ A_W$$

where:

A_Z - the part of the floor area adjacent to the exterior walls, with a width of 5 m, on all floors above the ground;

A_W - the remaining part of the floor area on the floors above ground level.

For public buildings, the total area of all transparent elements installed in the building envelope can exceed A_{Omax} due to requirements concerning daylight illumination.

For production, storage and outbuildings, the total area of all transparent elements installed in the building envelope is limited regardless of their thermal insulation. This area cannot exceed 15% of the area of external walls in single-storey buildings and 30% in case of multi - storey buildings.

To ensure sufficient supply of fresh air, given the high airtightness of modern windows, each occupied room is required to install air inlets placed in windows or in external walls. According to the national standard setting ventilation requirements in residential, collective and public buildings, the nominal air flow through a fully open air inlet under a pressure difference of 10 Pa should be in the range of 20 to 50 m^3/h in buildings with natural ventilation, and 15 to 30 m^3/h in the case of mechanical exhaust ventilation systems.

The requirement also sets the reference values of electric specific power PN for lighting, depending on the time of use, as well as on the minimum thickness of insulation for components of heating and cooling systems.

Performance method

The maximum permitted values of the EP indicator representing annual demand on non-renewable primary energy in the building per m^2 of heated or conditioned area are determined as follows:

1) In residential buildings, the permissible value of the EP_{H+W} indicator for energy use for heating, ventilation and hot water supply depends on the shape coefficient of the building and its heated area:

a) for $A/V_e \le 0.2$

$EP_{H+W} = 73 + \Delta EP$;
[kWh/m^2.year]

b) for $0.2 \le A/V_e \le 105$

$EP_{H+W} = 55 + 90\ (A/V_e) +.\ \Delta EP$
[kWh/m^2.year]

c) for $A/V_e \ge 1.05$

$EP_{H+W} = 149.5 + \Delta EP$;
[kWh/m^2.year]

where:

$\Delta EP = \Delta EP_W$ - addition to the EP indicator for heating due to unitary annual demand of non-renewable primary energy for water heating.
Its value is calculated by:

$\Delta EP_W = 7800/(300 + 0.1 \cdot A_f)$ [kWh/m^2.year]

A - the area of whole envelope separating the heated part of a building from the

Type of building	Reference electric power P_N [W/m^2]	Mean annual operating time t_0 [h/year]
Office	20	2500
Educational buildings	20	2000
Hospitals	25	5000
Restaurants	25	2500
Railway and bus stations, airports	20	4000
Trade services buildings	25	5000
Sports facilities	20	2500

Table 3: Reference electric power and mean annual operating time for lighting according to the type of building.

No	Pipe or component	Minimum thickness of thermal insulation (material λ = 0.035 W/m.K) [mm]
1	d_i < 22 mm	20
2	22 ≤ d_i < 35 mm	30
3	35 ≤ d_i < 100 mm	equal to the diameter d_i
4	100 ≤ d_i	100
5	Pipes passing through walls or ceilings, cross of pipes	50% of the thickness given in rows 1 - 4
6	Pipes in heating systems in the walls separating different uses (for instance in walls separating two dwellings)	50% of the thickness given in rows 1 - 4
7	Pipes according to row 6 embeded in the floor	6
8	Pipes of air heating (inside of the heated area of the building)	40
9	Pipes of air heating (outside of the heated area of the building)	80
10	Pipes of ice water cooling (inside the building)	50% of the thickness given in rows 1 - 4
11	Pipes of ice water cooling (outside the building)	As given in rows 1 - 4

Table 4: Requirements for thermal insulation of pipes and components in heating, hot water and cooling systems.

Figure 1: Manuals

a) Thermal protection and energy performance of buildings, written by Leszek Laskowski

b) Energy certification of residential buildings containing examples, written by Karolina Kurtz and Dariusz Gawin

outdoor air, the ground and adjacent unheated spaces, measured from the outside;

V_e - the volume of the heated part of a building, not including balconies and galleries;

A_f - heated floor area of a building (apartment).

2) In residential buildings, the permissible value of the EP_{H+W} indicator for energy use for heating, ventilation, cooling and supply of hot water (EP_{HC+W}) is calculated as follows:

$$EP_{HC+W}=EP_{H+W}+(5+15 \cdot A_{w,e}/A_f)\cdot(1-0.2 \cdot A/V_e)\cdot A_{f,c}/A_f \quad [kWh/m^2.year]$$

where:

$A_{w,e}$ - area of the external walls of a building, measured from the outside;

$A_{f,c}$ - cooled area of the building (apartment);

A_f - heated area of the building (apartment).

3) In other categories of buildings, i.e., collective residential buildings, public buildings, and production, storage and outbuildings, the permissible values of the EP_{H+W} indicator for energy use for heating, ventilation, cooling, supply of hot water, and lighting (EP_{HC+W+L}), is calculated as follows:

$$EP_{HC+W+L}=EP_{H+W}+(10+60 \cdot A_{w,e}/A_f)\cdot(1-0.2 \cdot A/V_e)\cdot A_{f,c}/A_f \quad [kWh/m^2.year]$$

where:

EP_{PH+W} - as defined in 1), but $\Delta EP=EP_W+EP_L$;

$EP_W = 1.56 \cdot 19.10 \cdot V_{CW} \cdot b_t/a_t$ $[kWh/m^2.year]$;

V_{CW} - the specific daily use of hot water related to the typical user of a building, $[dm^3/(j.o.)\cdot day]$.

The typical user (j.o.) depends on the category of building: in residential buildings this is an inhabitant, in office buildings it stands for an employee, etc. and

a_t - the area A_f divided by the total number of typical users $[m^2/j.o.]$, according to design assumptions;

b_t - the dimensionless time of operation of the hot water system during a year, according to design assumptions - it varies from 0.55 in schools to 0.90 in hospitals.

The rules for determining the EP indicator are given in the Ministerial Ordinance on the methodology of EP calculations and the template of the certificates. They are based on the monthly method of calculation of energy needs for heating and cooling given in EN ISO 13790:2008.

The final energy delivered to a building is calculated in a simple way, using typical efficiencies of thermal processes in heating, cooling and hot water systems, i.e., heat generation, distribution, storage and emission. The typical values of these efficiences are given in the Ministerial Ordinance that specifies the methodology for calculating energy efficiency of buildings. The amount of non-renewable primary energy is calculated using energy factors, depending on the type of fuel or energy delivered to the building. These factors promote the use of renewable energy. Standardised climatic data from meteorological stations are available on the official website of the Ministry: *www.transport.gov.pl*. No official technical guidance document has been published, but several manuals prepared by experts are available.

2.3 Cost-optimal procedure for setting EP requirements

The study to determine cost-optimal levels of thermal insulation of building components and EP of buildings in Polish conditions was made during the spring of 2012. This study showed that the maximum EP values currently in force for certain categories of buildings were set on too high in relation to their cost-optimal level. Thus, there is a potential for energy savings that are cost-effective. For example, for single-family houses, the cost-optimal level of the indicator EP is 120 kWh/m².year, between 10 to 25% lower than the current requirement. At the end of 2012, the study is still being analysed and discussed by experts. Publication of the amendment to the Ordinance on the technical criteria of buildings is to take place during 2013. These new requirements will be in force the latest beginning of 2014. This period from publication to implementation of the amendment is necessary for manufacturers of building products to adapt their product range to these new requirements.

2.4 Action plan for progression to NZEB

The proposals for the action plan were prepared and submitted to the ministry in 2011. In December 2012 the ministry gave its own proposals concerning the evolution of the energy requirements for buildings, which are now the basis for the action plan for progression to Nearly Zero-Energy Buildings (NZEB) in Poland. These proposals can be modified depending on the outcome of discussions to be held in 2013. The official adoption of the detailed action plan will occur in 2014, after setting the new energy regulations for buildings, the starting point for this plan.

3. Energy performance certificates

The Energy Performance Certification (EPC) system is governed and administrated by the Ministry of Transport, Construction and Maritime Economy. The legal framework of implementing acts was introduced by the amendment of the Construction Act (Journal of Laws No 191, item 1373, as amended) defining delegations for the secondary legislation:

> an Ordinance of the Ministry of Infrastructure of the 6th of November 2008, on the methodology of energy performance calculations for whole buildings, separate apartments, or building parts constituting separate technical – functional areas, along with the scope of energy performance certificates (Journal of Laws No 201, item 1240);
> an Ordinance of the Ministry of Infrastructure of the 21st of January 2008, on the training and examination of experts requesting to have the authority to issue energy performance certificates (Journal of Laws No 17, item 104);
> an Ordinance of the Ministry of Finance of the 28th of December 2009, on the obligatory civil liability insurance of persons issuing energy performance certificates (Journal of Laws No 224, item 1802).

As a result, the EPC became an obligatory document since the 1st of January 2009.

3.1 Progress and current status on sale or rental of buildings

According to the Construction Act, the energy assessment must be executed for new buildings and buildings undergoing major renovations at the planning stage, when the conformity with regulatory EP requirements is verified, and at the start of the operation (use permit stage), when an EPC is required by the building control authorities. For the existing buildings, an EPC is required in every case when the property is subject to change of ownership, is being sold or rented. In the second case, there is no control system and no penalties may be applied. There is no central register of EPCs in Poland and therefore it is not possible to estimate the number of issued EPCs. In 2010, over 92,000 buildings obtained regulatory use permits.

The price of the certificate is fully market driven. The lowest price of the EPC offered in the publicly available transaction service may go below 10 €, the highest offer for an EPC for public building exceeds 1,000 €.

An Ordinance of the Ministry of Infrastructure of the 6th of November 2008 specifies the basic requirements and methodology of the EP calculations for buildings, apartments and building parts constituting separate technical – functional areas, as well as defined formats for EPCs. The calculation methodology, based on the monthly balance method described in PN-ISO-EN 13790 standard, is given in the Annex 5 (without cooling) and Annex 6 (with cooling) of the Ordinance.

The EPC templates in Annexes 1 – 4 of the Ordinance are given for 4 types of EPCs:

Table 5: Primary non-renewable energy factors.

End energy carrier		**Primary non-renewable energy factors**
Fuel/energy source	Oil	1.1
	Natural gas	1.1
	LPG	1.1
	Coal	1.1
	Lignite	1.1
	Biomass (Wood log, shavings and pellet)	0.2
	Solar collector (thermal)	0
Heat from cogeneration[1]	Coal, natural gas[3]	0.8
	Renewable energy (biogas, biomass)	0.15
Local district heating (without cogeneration)	Heat from coal heat plants	1.3
	Heat from gas/oil heat plants	1.2
	Heat from biomass heat plants	0.2
Electricity	Mixed production[2]	3.0
	PV systems[4]	0.7

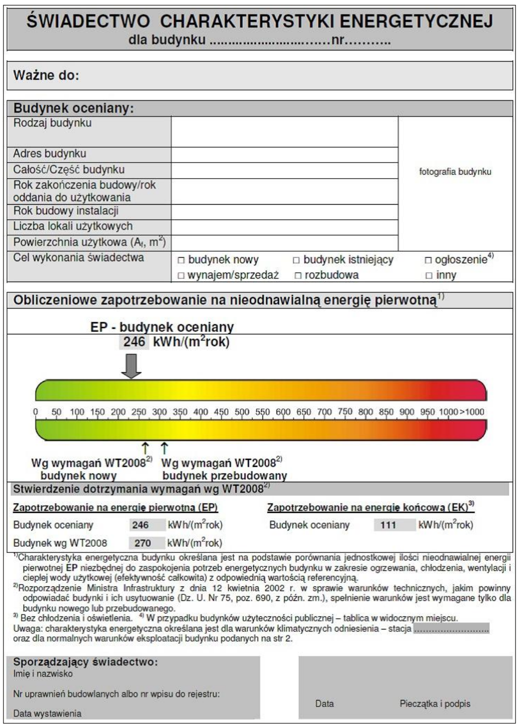
1) *combined production of electricity and heat*
2) *relates to the electricity supply from the national network*
3) *in case of lack of information on energy parameters of heat from the cogeneration plant, the primary energy factor =1.2*
4) *photovoltaic plants (production of energy from solar energy)*

Table 6: Proposed evolution of energy requirements for buildings EP_{H+W} (energy demand for heating and hot water).

Building category	**Maximum EP_{H+W} [kWh/m^2.year]**		
	From 1 January **2014**	From 1 January **2017**	From 1 January **2021*)**
Single family houses	120	95	70
Apartment blocks	110	90	70
Hotels	110	90	70
Offices	130	100	70
Educational buildings	180	145	110
Hospitals	390	300	210
Restaurants	180	145	110
Sports facilities	120	100	80
Wholesale and retail trade services buildings	130	100	70
Other types of energy-consuming buildings	85	70	55
Production, storage and outbuildings	150	120	90

*) In case of buildings occupied and owned by public authorities from 1 January 2019

Figure 2: Front page of the EPC.



ŚWIADECTWO CHARAKTERYSTYKI ENERGETYCZNEJ
dla budynku ....nr...........

Ważne do:

Budynek oceniany:

Rodzaj budynku		fotografia budynku
Adres budynku		
Całość/Część budynku		
Rok zakończenia budowy/rok oddania do użytkowania		
Rok budowy instalacji		
Liczba lokali użytkowych		
Powierzchnia użytkowa (A_f, m²)		
Cel wykonania świadectwa	□ budynek nowy □ wynajem/sprzedaż	□ budynek istniejący □ rozbudowa □ ogłoszenie[4] □ inny

Obliczeniowe zapotrzebowanie na nieodnawialną energię pierwotną[1]

EP - budynek oceniany
246 kWh/(m²rok)

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 >1000

Wg wymagań WT2008[2] budynek nowy
Wg wymagań WT2008[2] budynek przebudowany

Stwierdzenie dotrzymania wymagań wg WT2008[2]

Zapotrzebowanie na energię pierwotną (EP)			Zapotrzebowanie na energię końcową (EK)[3]		
Budynek oceniany	246	kWh/(m²rok)	Budynek oceniany	111	kWh/(m²rok)
Budynek wg WT2008	270	kWh/(m²rok)			

[1] Charakterystyka energetyczna budynku określana jest na podstawie porównania jednostkowej ilości nieodnawialnej energii pierwotnej **EP** niezbędnej do zaspokojenia potrzeb energetycznych budynku w zakresie ogrzewania, chłodzenia, wentylacji i ciepłej wody użytkowej (efektywność całkowita) z odpowiednią wartością referencyjną.
[2] Rozporządzenie Ministra Infrastruktury z dnia 12 kwietnia 2002 r. w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie (Dz. U. Nr 75, poz. 690, z późn. zm.), spełnienie warunków jest wymagane tylko dla budynku nowego lub przebudowanego.
[3] Bez chłodzenia i oświetlenia. [4] W przypadku budynków użyteczności publicznej – tablica w widocznym miejscu.
Uwaga: charakterystyka energetyczna określana jest dla warunków klimatycznych odniesienia – stacja .... oraz dla normalnych warunków eksploatacji budynku podanych na str 2.

Sporządzający świadectwo:
Imię i nazwisko
Nr uprawnień budowlanych albo nr wpisu do rejestru:
Data wystawienia

Data Pieczątka i podpis

> Energy Performance Certificate for residential buildings (Annex 1).
> Energy Performance Certificate for non-residential buildings (Annex 2).
> Energy Performance Certificate for apartments (Annex 3).
> Energy Performance Certificate for building parts constituting separate technical – functional areas (non-residential) (Annex 4).

The EPC format provides a pre-defined template consisting of:

> The front page, containing essential information on the building, including basic data, a photograph, reason for certification, calculated EP illustrated on a linear scale and compared with regulatory requirements for new and renovated buildings, as well as basic information on the expert issuing the EPC.
> A page containing technical - functional characteristics of the assessed building and its technical systems, along with the results of energy demand calculations.
> A page containing categories of recommendations on potential reduction of final energy consumption (notes on building envelope, installations and energy sources, Domestic Hot Water (DHW) installations, building use). There is no standardised list of improvements in use.
- A page with clarifications and additional information.

At the end of 2012, there was no direct mechanism of Quality Assurance (QA) of EPCs in Poland. According to the Construction Act, any EPC containing false data on energy use is understood as a product having physical failure in interpretation of the Civil Law of the 23rd of April 1964. Potential conflicts between the Qualified Expert (QE) and the client in this matter will be settled in court. An Ordinance on the obligatory civil liability insurance of the person issuing EPCs defines an obligatory scope of the insurance and the minimum insurance (25,000 €).

According to the Construction Act, an EPC may be issued by a QE having full civil rights, engineer degree in architecture, civil engineering, environmental engineering, energetic or equivalent or a M.Sc. degree in other disciplines. Such a person shall complete a training course and pass the state exam at the responsible ministry, or complete (at least) one year of post-graduate study in the field of architecture, civil engineering, environmental engineering, energetic for energy auditing for thermo-modernisation, or energy certification purposes. According to the Ordinance on the training and examination of experts, such courses shall consist of 50 hours of lessons (both theoretical and practical), concerning regulatory basics, national provisions and regulations, assessment of thermal protection of buildings, assessment of heating systems and DHW, assessment of the ventilation and air-conditioning (AC) systems, assessment of the lighting systems, calculation methods and certification methodology. A list of post graduate studies is available.[1] Until November 2012, the central registry of experts (established at the dedicated website of the Ministry of Transport, Construction and Maritime Economy[2] who have passed the state exam or completed post-graduate studies, contains data of over 9,600 people. According to art. 5.1 of the Construction Act, the state authorisation of a QE may be withdrawn when an expert is sentenced of crime as described in art 5, par. 8, point 3, lost the civil rights, in case of total or partial incapacitation, or when failure to comply with the requirements or violation of rules described in art. 5, par. 4a and art 5.2, par. 1 (e.g., false information, lack of obligatory insurance) has been proven after investigation from the responsible ministry. So far, 2 experts have been withdrawn from the database.

Eligible (licensed) architects or engineers, being responsible for specialised architectural designs and the construction of buildings or installations, are not required to complete the training course

1 *www.transport.gov.pl/files/0/1786502/wykazuczelni20130611.pdf*
2 *www.transport.gov.pl/2-4fb20981e64ff.htm*

and pass the state exam. The requirements for a practice period and an examination conducted by the Chamber of Engineers are specified in the Construction Act and are not directly connected with the EPC issue. The central register of members of the Polish Chamber of Civil Engineers may be found online.[1]

3.2 Progress and current status on public and large buildings visited by the public

The certification process for public buildings or buildings with a useful floor area exceeding 1,000 m^2 undergo the same regulation as previously described. According to art. 64, paragraph 2 of the Construction Act, the EPC shall be visible to the public in case of large buildings (1,000 m^2) used by public authorities, or for public services as railway stations, airports, museums, exhibition halls and others. The total number of buildings having a certificate on display cannot be estimated.

3.3 Implementation of mandatory advertising requirement – status

A mandatory advertising requirement (recast EPBD, art. 12, p. 4) has not been implemented in Polish law yet. Therefore, there are no legal requirements enforcing the use of the EP indicator of the EPC of the building in commercial media. There is also no common voluntary scheme developed. Some of the market participants voluntarily use the EP indicator and a graphic energy label similar to those included in the EPC template. This is more frequent with sellers of new single-family houses.

3.4 Information campaigns

In the period of 2005-2008, the responsible ministry conducted the ‘Dom przyjazny’ (Friendly house) program, under which two leaflets on the benefits and obligations resulting from the EPBD implementation were published. In 2010, the ministry published a brochure (Figure 4), containing basic information on EPCs, for those who want to buy, rent or sell a flat or a house, and also information about regulations and procedures related to certification of QEs.

There is also some information on the ministry’s webpage (Figure 5), including the following topics:

> central register of QEs;
> database of organisations entitled to certify QEs;
> database of climate information for Poland;
> QE’s examination procedures.

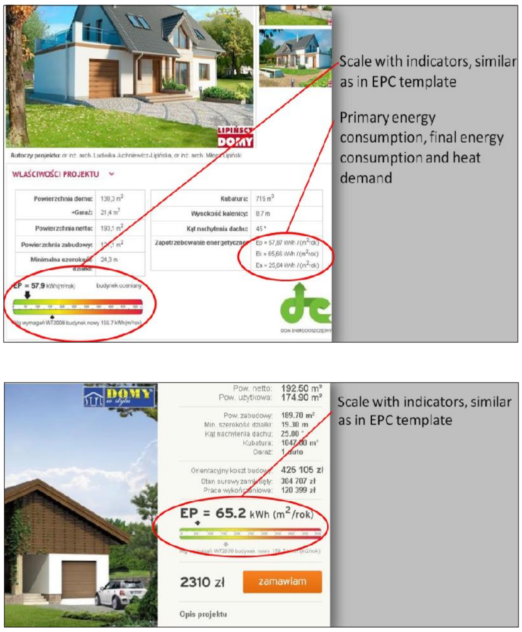


Figure 3: Examples of energy assesment for new buildings.

4. Inspection requirements - heating systems, air-conditioning

In Poland, the law concerning inspections of heating and air-conditioning (AC) systems was introduced by the EPBD implementation in 2010 and remains unchanged since then. It resulted in two obligations for periodical inspections of boilers and cooling systems.

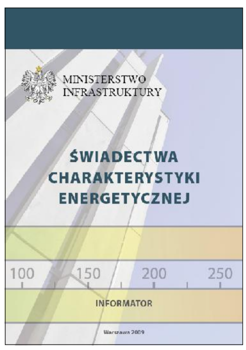
4.1 Progress and current status on heating systems

Poland adopted the model A – regular inspection of boilers. Regulations and requirements are mentioned in the Construction Act (article 62). The document states that building owners or managers are required to have a periodic inspection of boilers carried out. The inspection includes checking the technical condition of boilers and takes into account their energy efficiency and their size, as well as the assessment of the heating needs of the building. Periodic inspections must be performed not less than:

> every 2 years for boilers of an effective rated output over 100 kW which use non-renewable liquids or solid fuels;
> every 4 years for boilers of an effective rated output between 20-100 kW which use non-renewable liquids, solid fuels or gas.

Additionally, heating installations with boilers of an effective rated output of more than 20 kW and older than 15 years should be subject to an one-time inspection, which includes an efficiency assessment and sizing of the boiler compared to the heating requirements of the building.

Figure 4: The official brochure about Energy Performance Certificates (cover page).



1 *piib.org.pl/index.php/lista-czsonkopmenu-45*

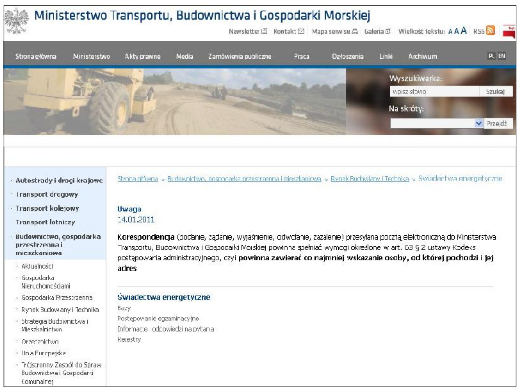


Figure 5: EPBD related topics on the Ministry of Transport, Construction and Maritime Economy website.

Failure to have an inspection carried out results in an obligatory fine to the owner or manager of the building in accordance with article 93, point 8. The mandatory inspection of boilers does not apply to owners or managers of single-family residential buildings, as well as homestead construction and holiday housing.

In accordance with the Construction Act (article 64), minutes of boiler inspections should be included in the construction site book.

4.2 Progress and current status on AC systems

Regulations and requirements concerning AC systems are also mentioned in the Construction Act (article 62). It is stated that "periodical inspections of air-conditioning systems with an effective rated output > 12 kW require inspection which includes efficiency assessment of the devices and their size in comparison to cooling needs."

4.3 Any other relevant information

Boilers and AC sytems inspections can be performed only by engineers and technicians who have a proper licence to supervise installation works.

Although the law exists, inspections of boilers and AC systems are not performed. Until now, the procedures and methodology for energy efficiency inspections have never been developed. Only safety aspects of boilers are inspected.

5. Conclusions and future plans

Implementation of the requirements of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) in the period 2009-2012 resulted in improvements in the energy efficiency of buildings. The thermal insulation of components applied in new buildings is usually better than required. For example, a national survey shows that the average U value is 0.29 $W/m^2.K$ for external walls and 1.4. $W/m^2.K$ for windows, smaller than required. There is also a significant increase in the use of renewable energy: the total installed capacity of solar collectors in Poland was equal to 633 MW in 2011.

But the energy assessment system currently in use is far from perfect. The alternative way to meet the energy requirements for the building that was introduced in Poland in 2009 (see chapter 3) is not effective. It does not work in practice: in about 50% of buildings for which the prescriptive method has been adopted, the Energy Performance (EP) indicator exceeds the permissible value required according to the performance method. On the other hand, application of the performance method in the case of buildings for which non-renewable energy is used, does not provide adequate thermal insulation of the building envelope components.

Besides the amendments to the Ministerial Ordinances on energy requirements for buildings, methodology on energy performance of buildings and selected issues relating to the preparation of building projects, there are plans to introduce significant legislative changes in the area of building energy assessment in 2013, involving the adoption by the Parliament of a new Act on energy performance of buildings, including energy certification of buildings and inspections of heating, and air-conditioning systems. This new act is expected to address the following issues:

> increasing the accessibility for the profession of energy experts authorised to issue energy certificates;
> introducing energy classes for buildings and flats;
> creating a central register of issued energy certificates;
> creating a quality control system to verify schemes for Energy Performance Certificates (EPCs);
> creating a validation system for the software used in energy assessment procedures.

The consecutive tightening of energy requirements on the way to Nearly Zero-Energy Buildings (NZEB) is only planned for the year 2016.

EPBD implementation in Portugal

STATUS AT THE END OF 2012

Authors

Paulo Santos, Pedro Mateus, Rui Fragoso
ADENE

1. Introduction

The implementation of the Directive 2002/91/EC on Energy Performance of Buildings (EPBD) in Portugal is reaching the maturity stage. Field implementation started in 2007, based on the three decrees published in 2006 that were recently revised to transpose the tighter requirements of the recast EPBD (2010/31/EU). Nearly 100 different stakeholder institutions made contributions that resulted in the actual revision, aimed among others at improving the methodologies and certification processes, based on the extensive experience gained over the last 5 years. It is expected that the updated legislation will fit better to the market needs and reality. The new regulations should be officially adopted by the government during 2013.

This report presents an overview of the current status of implementation and of the plans for the EPBD evolution in Portugal. It mainly focuses on the Energy Performance (EP) requirements, the Energy Performance Certificates (EPCs) and inspection systems, including quality control mechanisms, training of Qualified Experts (QEs) and information campaigns.

2. Energy performance requirements

This chapter presents an outline for the transposition and implementation of the EPBD energy performance requirements in Portugal. It also describes the transition to the cost-optimal EP requirements and the action plan towards Nearly Zero-Energy Buildings (NZEBs).

2.1 Progress and current status

Energy efficiency requirements for residential buildings were first introduced in Portugal in 1991, and in 1998 for non-residential buildings. In 2006, the building codes were revised for all buildings due to the transposition of the EPBD 2002/91/EC. The building energy efficiency codes are again being revised to transpose the 2010 recast EPBD (the process started in 2010 and the technical committees completed their job in September 2012). The following sections describe how the national requirements evolved from the 2006 to the currently proposed updated version, addressing the most relevant aspects of the revised building codes.

2.2 Format of national transposition and implementation of existing regulations

Besides the reinforcement of the EP requirements in 2006, the EPBD transposition introduced for the first time in the building codes the need to issue an Energy Performance Certificate (EPC). To effectively implement these requirements, ADENE designed, developed and currently supports the National System for Energy and Indoor Air Quality Certification of Buildings (SCE), which is based on a central registry and database. The quality of the EPC is guaranteed by training the Qualified Experts (QE), performing periodic Quality Assurance (QA) assessments of their work and supporting them through a telephone and e-mail helpdesk. The QEs are also technically supported by guidance documents available online, namely FAQ’s and manuals to issue the certificates using the central registry’s online platform.

National Websites *www.adene.pt, www.dgeg.pt, www.apambiente.pt, www.casacertificada.pt, www.casamais.adene.pt, www.sce.adene.pt*

Figure 1: Training sessions for qualified experts.

To become a QE, candidates (engineers or architects) must undergo training and pass an exam. Recently, complementary training sessions were promoted by ADENE to improve the qualifications in specific areas such as lighting, Heating, Ventilation and Air-Conditioning (HVAC), renewable energy systems and building simulation programs.

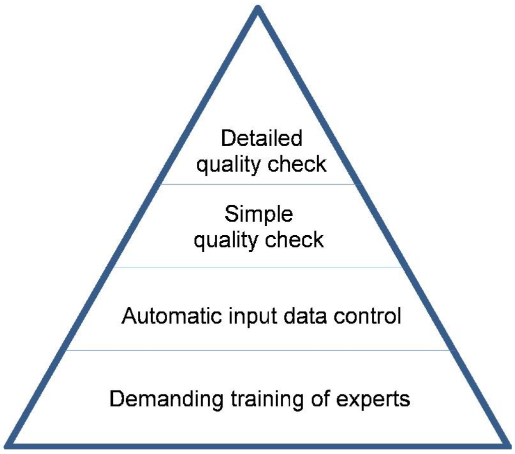


Figure 2: Quality assurance scheme.

The QA system is based on the assessment of a random sample of the EPCs issued daily. It has been proven to be an important tool in improving quality of the work of the experts. Until the end of 2012, about 14,000 EPCs have undergone (or are undergoing) a QA assessment. In the worst case scenario, the QA process can lead to a fine, (so far, fines have been imposed on 7 experts). In general, when the QE does not comply with the regulations, he is required to correct the calculations and issue another EPC, supporting himself the corresponding costs. In order to evaluate the work of QEs and consumer satisfaction, a mystery client strategy has also been put in place. These mechanisms have contributed to an evident quality improvement of the information and accuracy in the EPCs issued by the experts.

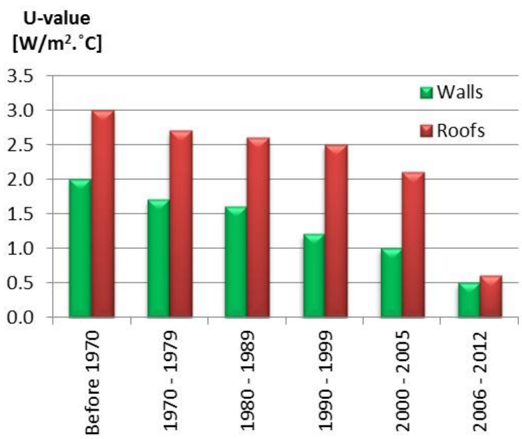


Figure 3: Mean wall and roof U-values for new construction.

ADENE has been compiling and publishing statistics based on the data stored at the central database, aiming at characterising different aspects related to the EP of the building stock. These include general aspects like the distribution of ratings in EPCs issued in new and existing buildings, to detailed technical information like average envelope characteristics for new construction in different decades. The statistics are periodically published at ADENE´s website and also sent to relevant stakeholders, such as real estate agents, magazines and the National Statistics Institute.

2.3 Cost-optimal procedure for setting EP requirements

The requirements adopted in the 2006 building code were already established on the basis of cost-effectiveness, assuming values with a reasonable payback period. For the revised 2013 code requirements will take into consideration the comparative methodology framework for calculating cost-optimal levels published by the European Commission. As these values were not yet available by September 2012, provisional values have been estimated. The building code is however structured in a way that it allows a quick and easy update of requirements according to cost-optimality, if necessary. Besides tightening the envelope requirements for residential buildings, the revised codes will also include technical systems requirements.
For residential buildings, the system requirements include ventilation, space heating, air- conditioning (AC), Domestic Hot Water (DHW) and renewable energy systems. For non-residential buildings and in addition to the requirements applicable to the residential sector, requirements for lighting, lifts (after 2015), and Building Energy Management (BEM) systems will also be set.

2.4 Action plan for progression to NZEB

The national action plan for the progression to Nearly Zero-Energy Buildings (NZEBs) is now under development, and the key targets and milestones defined. The adopted definition of the NZEB, establishes a relation with cost-optimal evaluations and NZEBs are defined as buildings that cumulatively offer:

Time interval		Before 1990	1990-2006		2006-2012		2012-2016		2016-2021		After 2021	
			Lisbon	Bragança	Lisbon	Bragança	Lisbon	Bragança	Lisbon	Bragança	Lisbon	Bragança
U-value [W/(m2.K]	External walls	None	1.4	0.95	0.7	0.5	0.5	0.35	0.4	0.3	0.35	0.25
	External roof/floor		1.1	0.75	0.5	0.4	0.4	0.3	0.35	0.25	0.3	0.2
	External window		4.2	4.2	4.2	3.3	2.9	2.4	2.8	2.2	2.4	1.8
	Flat thermal		None		2xU-value (closest element)							
Maximum energy needs kWh/(m2.year)	heating[1]		64	135	52	117	Currently not available					
	cooling[1]		18				18	15	18	15	18	15
	DHW[1]		None		38.9		Requirements on equipments efficiency					
Maximum window solar gain factor **g-value**			0.15 (light inertia) 0.56 (medium/heavy inertia)									
Ventilation (ACH)			None		≥ 0.6		≥ 0.4					
Renewable energy systems			None		RES mandatory							
Minimum air conditioning eficiency			None				Label C[2]		Label B[2]		Label A[2]	
Minimum boiler efficiency			None				86%		89%		92%	

1- Values for an average size (120 m^2) building

2- Eurovent label

Table 1: Evolution of minimum requirements for building components and final energy needs from 1990 to 2021 (expected).

i) components compatible with the upper level of the cost-optimal evaluations;
ii) implementation of renewable energy that covers a very significant fraction of the minimised building needs. This energy must be produced on site (whenever possible) and/or, alternatively, when the local production may be insufficient, e.g., in urban areas, as nearby as possible. Numerical indicators are also being studied and will be made available following the conclusion of the cost-optimal procedures. The primary energy factors, that also play an important role, will be gradually revised until 2020, to incorporate the effort made by Portugal to have clean and renewable electricity.

To support the implementation of the action plan, several measures were identified and will be made operational until 2020. The measures that are related not only to financial aspects but also to policies and campaigns, will support the transition towards a more efficient building stock by 2020. These measures are based both on national strategies, including those envisaged in other action plans (the Energy Efficiency Action Plan and the National Renewable Action Plan), and on European support initiatives that are foreseen to become available throughout the following years. Specific measures include, for instance, the current review of the building codes to transpose the recast EPBD, followed by the training of the building workforce and experts, which will be supported by the promotion of financial incentives and the development of real NZEB case studies.

2.5 Any other relevant information

In order to bring the QEs closer to the citizens that need an EPC, ADENE has supported the development of an online platform named *www.casacertificada.pt*. In this platform, the citizens can advertise their intention to obtain an EPC and receive several proposals from different QEs. The platform contains also information and mechanisms to bridge the gap between suppliers of energy efficient materials or equipments, and homeowners who intend to implement the EPC recommendations.

3. Energy performance certificates

By December 2012, more than 555,000 EPCs were issued since the scheme was launched in July 2007. About 80% of these were issued since January 2009, for existing buildings, upon sale or rent.

Since 2009, around 2,500 EPCs for new buildings and 9,000 EPCs for existing buildings are being issued every month, covering nearly 90% of the licensing and selling processes that take place in the country. This way, a national database of certified buildings is being fed with up-to-date information that will be useful for monitoring the progress of different aspects of the implementation of the

Figure 4: SCE logo.

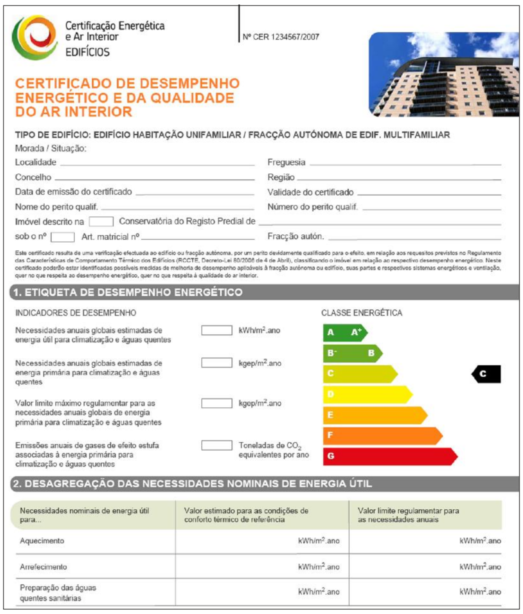


Figure 5: Cover page of the EPC.

Directive, from basic statistics, such as the number of certified buildings, to impact assessment, including estimated energy savings. 90% of EPCs in the database were issued for residential buildings and 10% for non-residential buildings. In Portugal, the definition of a public building includes every non-residential building owned by private or public entities. This definition is wider than the strict interpretation of the EPBD requirements. Currently, 1% of the total number of EPCs issued corresponds to public buildings.

The database has been used to produce information useful for the revision of the technical regulations, such as tightening of minimum requirements and optimisation of operational rules. Figures 6 & 7 present information extracted from the database on the evolution of EPCs issued and the energy label distribution.

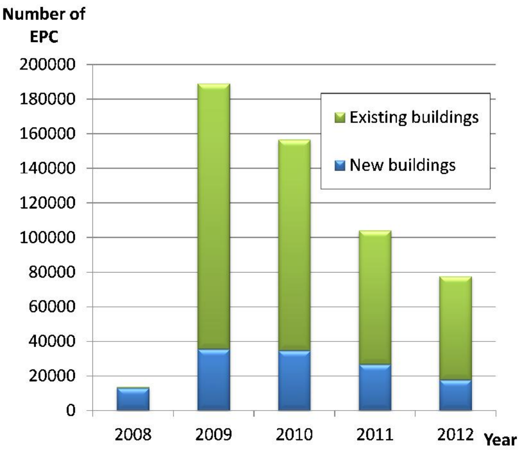


Figure 6: EPC evolution for new and existing buildings.

3.1 Progress and current status on sale or rental of buildings

The database contains mainly EPCs of existing residential buildings. Comparing the number of EPCs issued for this type of buildings with the existing building stock, we can conclude that nearly 10% of the building stock already has an EPC. Building sales has been one of the most successful market segments for the implementation of the EPBD. The rental

Figure 7: Energy label distribution for new and existing buildings and breakdown for residential, non residential and public buildings.

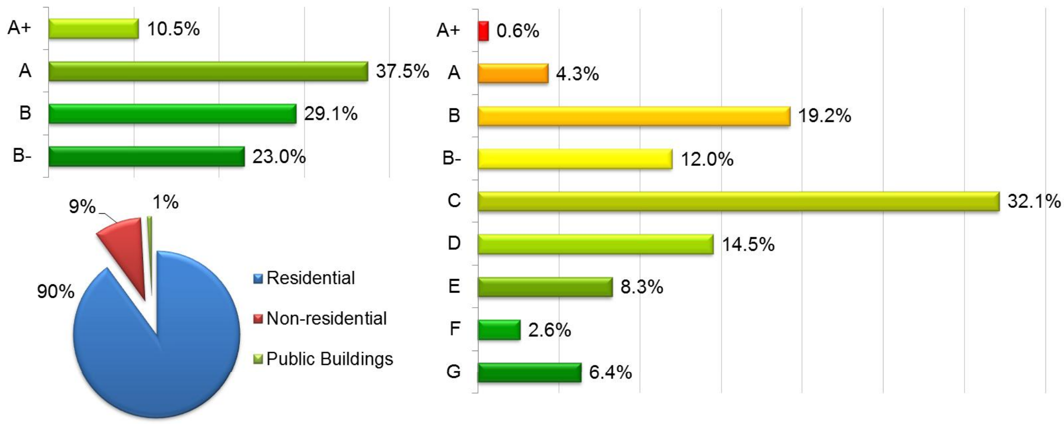


Table 2: Limit values established by the Portuguese IAQ legislation.

Parameter	Limit value
CO_2	1,800 mg/m^3
CO	12.5 mg/m^3
PM_{10}	0.15 mg/m^3
H_2CO	0.1 mg/m^3
VOC	0.6 mg/m^3
O_3	0.2 mg/m^3
Rn	400 Bq/m^3
Bacteria	500 CFU/m^3
Fungi	500 CFU/m^3
Legionella	100 CFU/l

Table 3: IAQ index matrix.

IAQ Index	PM_{10} (µg/m^3)		$PM_{2,5}$ (µg/m^3)		VOC (µg/m^3)		CO (mg/m^3)		H2CO (µg/m^3)		CO_2 (mg/m^3)		Rn (Bq/m^3)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Very good	-	<30	-	<15	-	<400	-	<3	-	<50	-	<1600	-	<200
Good	31	50	16	25	401	600	3.1	5	51	75	1,601	2,250	201	300
Average	51	100	26	50	601	1,200	5.1	10	76	100	2,251	2,925	301	400

market hasn’t been so successful in providing EPCs, mainly due to difficulties on having suitable control mechanisms. The current trend in the market however, shows a decline in the number of building sales and an increase of rentals. The new regulations therefore contain stronger control mechanisms to overcome the factors that prevented EPCs in rental from being issued. Such mechanisms are the obligatory advertisement of the energy label before the building is rented or sold and when offered to the market.

3.2 Progress and current status on public and large buildings visited by the public
Every non-residential building larger than 1,000 m^2 is required to display an EPC at the main entrance. Currently, there are more than 5,000 public buildings certified and many more in the process of being certified. EPCs in public buildings are updated every six years. The indoor air quality part is updated depending on the building typology, varying from two years for critical typologies (e.g., schools, hospitals and nursing homes), to six years for other typologies.

The Indoor Air Quality (IAQ) is a complementary issue in the Portuguese EPCs. For new buildings, legislation was based on a prescribed method to establish the ventilation requirements for indoor compartments, in terms of fresh airflow rate per person and per unit of floor area. In the revised building codes, this aspect will be fine-tuned to ensure a good balance between IAQ and energy efficiency. For existing buildings, the requirements are based on maximum indoor air pollutant concentrations.

In the new legislation, a two stage approach will be established: a first diagnosis based only on CO_2 and particles levels, followed by a full IAQ audit of a full set of pollutants if a certain threshold, of either CO_2 or particles, is exceeded.

3.3 Implementation of mandatory advertising requirement – status
Advertising the EP indicator was not a requirement before the recast EPBD although some real estate agents have advertised the energy performance of A-class buildings, like the example presented in Figure 9.

ADENE together with the Portuguese real estate association (APEMIP), is developing a preferential access to the Portuguese Certification System for buildings (SCE) database for real estate agents, in order to enhance the information exchange between the EPC and the advertisement. Advertising the EP indicator will become mandatory in the revised regulations and there will be penalties for those who will not comply with this requirement.

3.4 Information campaigns
To promote/enhance the SCE, ADENE launched an advertising campaign. In the first year (2007) the campaign slogan, ‘Let's save energy to save Portugal’, was displayed on television channels, in the press and on the internet. The concept conveyed was that all residential or non-residential buildings would have a colour classification and one day, all would become ‘green’, i.e., economically efficient and environmentally friendly.

Figure 8: Public building.

Figure 9: Energy label in advertising houses for sail.

Figure 10: Model for energy efficiency certification in Portuguese buildings - 'One Day, all buildings shall be green'.

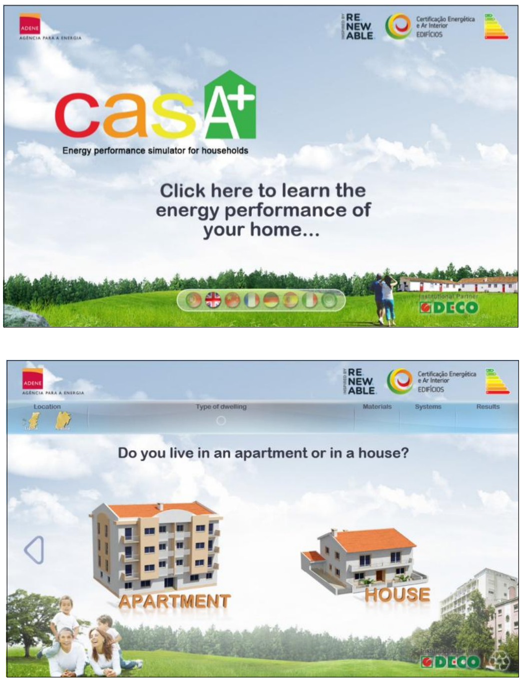
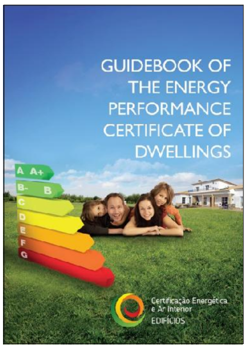


Figure 11: Energy performance simulator for households.

This was represented by the image of a Rubik's cube in a clear reference to the SCE's ultimate goal: to turn all of the cube's sides the same colour, in this case green.

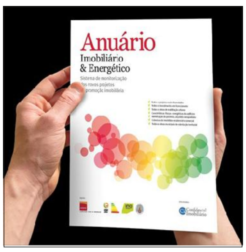
Figure 12: Guidebook of the EPC.



During 2011 and 2012, the promotion of EPCs was based on the presence at more than 100 different kinds of events like fairs, workshops, conferences and seminars all over the country, with the opportunity to reinforce and disseminate the advantage of the EPC and to stress the importance of implementing the improvement measures.

In these events, ADENE also displayed an online interactive EP simulator for households 'CasaA+' *www.casamais.adene.pt*. This simulator is used only for promotional purposes and is based on a straightforward calculation methodology and simple questions about the building. It is not intended (nor accepted) to replace the work of the QEs. Through the simulator it is possible to estimate an energy rating for a specific house and, more importantly, to try out different improvements and simulate their impact on the energy performance. Since its development in 2009, the software has been upgraded and is now available in eight different languages, with specific versions for some countries, like Luxembourg, China, Angola or Mexico, which shows its attractiveness to the general public.

Figure 13: Real state energy performance yearbook.



In order to specifically promote the EPC, ADENE produced a flyer named 'Guidebook of Energy performance certificate for dwellings'. This guidebook aims at helping the general public to understand the information that appears in the EPC, explaining in simple words the different items and concepts listed in the EPC. This flyer is available both in Portuguese and English.

To further promote the EPC, ADENE established a number of protocols with relevant entities in the sector, including professional associations, universities and public institutes. In this context, the first edition of the real state energy performance yearbook ('Anuário Imobiliário & Energético') was published in 2010 to provide a statistical compilation of main characteristics of new buildings in Portugal, namely the distributions of the EPC label, main energy consuming equipment, type of building, floor area, location, etc..

ADENE has also been involved in energy efficiency awards for the buildings sector, such as the annual Lisbon Real State exhibition (SIL) and the Arquitetar award. This award assessed a range of buildings (residential and non-residential) and the EPC label played a relevant role to select the winners.

The impact of the information campaigns was assessed in 2010. The results revealed that 76% of the inquired participants had already heard about the EPC and, among those that already had an EPC, 75% would recommend friends and relatives to obtain an EPC. This study also revealed the importance of the EPC recommendations for those who implemented them.

3.5 Any other relevant information

The EPC is being progressively required for obtaining public funding and tendering processes, e.g., to apply and receive financial incentives from the national Energy Efficiency Fund (FEE) and from the National Strategic Reference Framework (QREN).

In order to promote energy savings and boost the relevance of recommendations identified by the QEs, an additional report is produced automatically by the central registry to each EPC issued. This report provides complementary information and further details on how to implement the recommendation, stating the materials, equipment performance and possible technical hitches on its practical execution. It is a document produced to bridge the gap between home owners and contractors. The aim is to provide added value information to the home owner in order to enhance the uptake of the recommendations and to define the individual impact of each recommendation before and after its implementation.

4. Inspection requirements - heating systems, air-conditioning

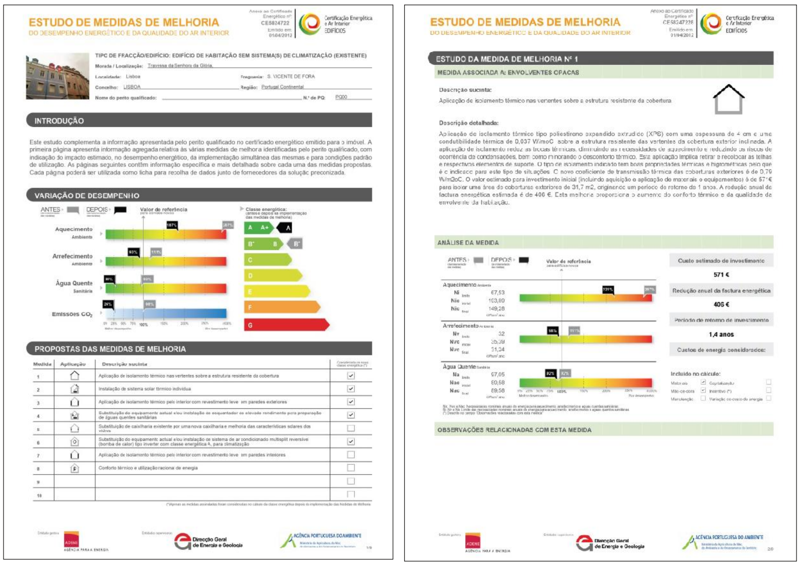
Portugal officially adopted option a) on article 8 of the EPBD, establishing a regular inspection of boilers. The inspection of boilers as well as air-conditioning (AC) systems is however still a challenging issue due to the specific climate characteristics of the country. In residential buildings the boilers and air-conditioners only operate for relatively short periods of time during the year, the real energy consumption is very low, and this hardly makes regular inspections a cost effective strategy.

In Portugal, the QE is responsible for the validation and supervision of inspections to boilers and AC systems that are usually performed by boiler and AC technicians.

4.1 Progress and current status on heating and AC systems

The inspection of boilers takes place every 1, 2, 3 and 6 years, depending on the fuel used and on its power, while the inspection of AC systems takes place every 1 or 3 years depending mainly on the power of the system. Inspections are paid by the end user or by the owner of the building. Moreover, each time a new EPC is issued, the QE checks if the inspection report is valid and includes this information on the EPC, as well as the date for the next inspection and a short summary of the inspection results. There is no template for the inspection reports, but a common set of required minimum information is defined. Inspections of boilers and AC systems are based on the assessment of efficiency under normal working conditions. Currently, inspections

Figure 14: Recommendations report for improving energy performance.



must simply follow the reference methodologies defined in the relevant CEN standards.

The experience from the implementation of the inspections scheme reveals that the major difficulty is still the lack of properly trained technicians, as well as the difficulty in demonstrating to home owners the benefits of the inspections.

For residential buildings, recommendations are only implemented on a voluntary basis by the home owner. For non-residential buildings that exceed a specific consumption, the law requires the implementation of all the cost-effective measures (payback less than 8 years) recommended by the QE following an inspection. Failure to implement the recommendations within a reasonable period of time may result in a fine to the building owner.

4.2 Any other relevant information

Considering the previously described difficulties, the transposition of the recast EPBD for Portugal will no longer impose regular inspections and change to the campaigns option instead. There is a plan to provide advice to users concerning the

Figure 15: Chiller.

replacement of boilers and AC units, other modifications to the heating and cooling system and alternative solutions to assess the efficiency and appropriate sizing of the boiler or AC unit. This plan is based on delivering information together with the EPC whenever the QE finds a boiler and/or an AC system in the building. Information about inspections will also be distributed to relevant stakeholders in the market and technicians dealing with boilers and AC systems, to cover the rest of the existing building stock.

Figure 16: Typical recommendations proposed by the experts for residential buildings.

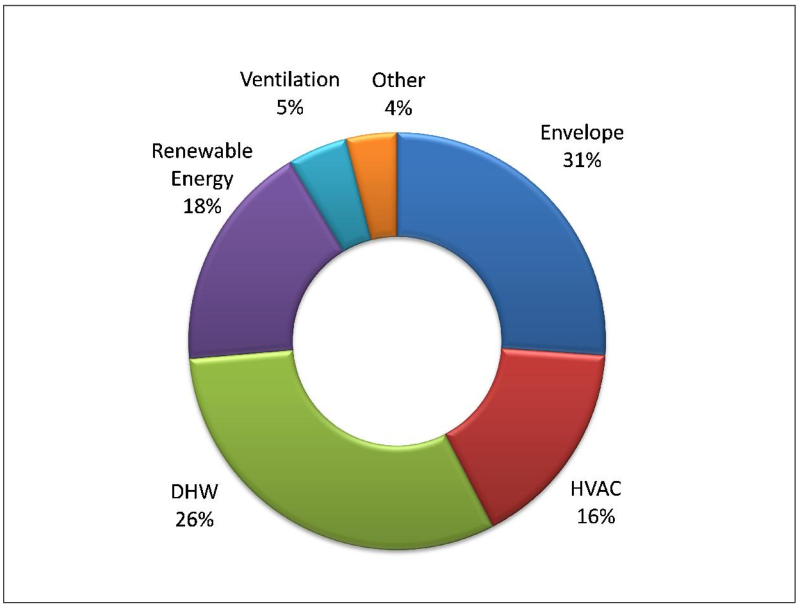
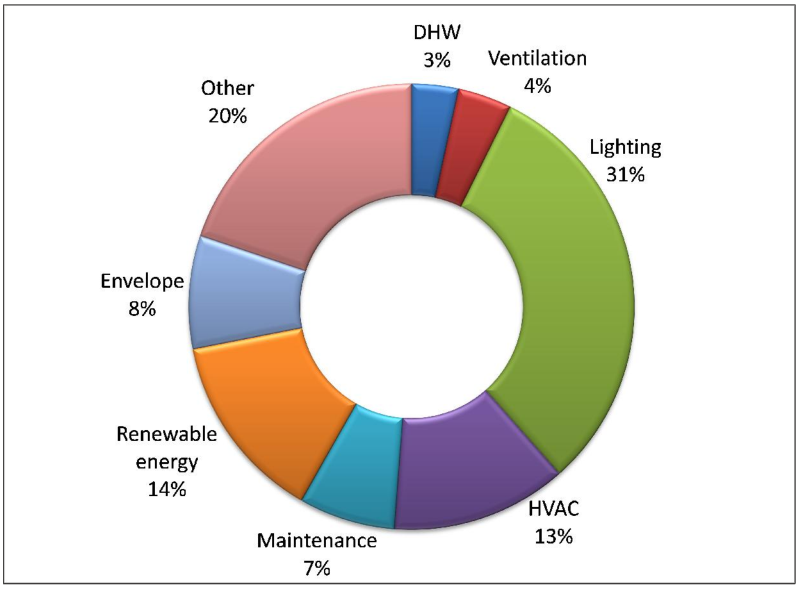


Figure 17: Typical recommendations made by the experts for non-residential buildings.



5. Conclusions and future plans

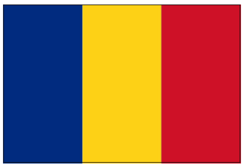
The Portuguese Certification System for buildings (SCE) has by now been in place for five years. During this period many efforts and developments took place to reach the current high level of implementation of the Energy Performance of Buildings Directive (EPBD). The recast EPBD brings new challenges to the SCE which will inevitably lead to its evolution aiming also to improve the gaps identifiyed during its development. The new legislation to be published in 2013 paves the path towards Nearly Zero-Energy Buildings (NZEB) and sets up a roadmap tightening the Energy Performance (EP) requirements progressively until 2020. Nevertheless, the legislation by itself will not be enough to push the market towards the recast EPBD goals. Thus several other strategies are being implemented to address this issue. This includes enhanced control mechanisms to promote the full SCE implementation, training the building workforce and promotion of financial incentives.

The NZEB action plan will be a key tool to reach real energy savings. However, the challenge will be on how to promote NZEB in a cost-effective way. The continuous increase of energy prices will certainly stimulate the adoption of energy efficient materials and technologies. In this process, the end user needs to be aware of how efficient the products are. One of the strategies for achieving that relies on strengthening the role of energy labels and proper communication to the public. Building components and systems are a natural target for these labeling systems aiming at moving from the building labeling perspective to the component labeling perspective in close cooperation with relevant market stakeholders.

To evaluate the impact of the EPBD implementation in the market, it will be fundamental to monitor the implementation of recommendations proposed in the EPC. One of the strategies to achieve this is the exemption of the EPC issuing fee after the implementation of recommendations. The EPC layout will also be enhanced in order to become more comprehensible for the end user and to provide added value information.

EPBD implementation in Romania

STATUS AT THE END OF 2012



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1. Introduction

In Romania, the implementation of the Energy Performance of Buildings Directive (EPBD) is the overall responsibility of the Ministry of Regional Development and Public Administration (MDRAP). This report presents an overview of the current status and of the planned implementation of the recast EPBD in Romania. It concerns mainly the Energy Performance (EP) requirements and the certification system, and gives some information on the impact of the energy efficiency and of the tools used, such as financial support and inspections systems.

The EPBD has been implemented in Romania to its full extent, resulting in better energy performance of the building stock. On the 1st of January 2007, Romania adopted the appropriate measures for the transposition of the EPBD, which was transposed into the national Law 372/2005. The Law 372/2005 started to be amended in 2012, in order to be in compliance with the recast EPBD. Further steps for the introduction of standards for Nearly Zero-Energy Buildings (NZEB) and for the implementation of an independent control system for Energy Performance Certificates (EPCs) are under consideration.

2. Energy performance requirements

2.1 Progress and current status

Regulations
In Romania, the building code requirements for newly constructed buildings concern providing thermal performance indicators, both at component level and at the level of the whole heated space. The building code contains prescriptive element-based criteria for thermal insulation, as well as an overall thermal coefficient (G-value). The global heat transfer coefficient, G ($W/m^3.K$), of the heated volume, is an overall minimum requirement, and is a function of the number of the building floors and the external area per volume ratio (A/V).

There is no minimum EP requirement in terms of global indicator, neither for new buildings nor for renovations, except for residential buildings, where there is a maximum allowed heat demand (per total heated volume) that varies from 15 kWh/m^3.year to 37.5 kWh/m^3.year, depending on the external area per volume ratio (A/V). The maximum indicated heat demand is expressed in terms of final energy, without taking into account the system efficiency. Cooling and Domestic Hot Water (DHW) are also not considered.

For new buildings, the Order 2055/2005 concerning the revision of the thermal regulations for buildings (C107) was approved on the 13th of December 2005. This regulation has been amended in October 2010 (C107/2010 Annex 3) by improving the thermal resistance values (Tables 1 & 2). The type and level of thermal performance requirements for new buildings depend on the building type (dwellings, office buildings, schools etc.) and the building envelope:

- minimum thermal resistance corrected with thermal bridges R' – value (for residential buildings only);
- maximum overall thermal coefficients G-values.

For non-residential buildings, there are no explicit minimum thermal resistance values for the building envelope. There is, instead, a global maximum reference G-value (overall thermal transmittance coefficient), based on the following 'a' to 'e' coefficients (Table 2):

a Thermal resistance value of external walls [m².K/W]
b Thermal resistance value of terraces [m².K/W]
c Thermal resistance value of floors above unheated basements [m².K/W]
d Thermal linear resistance value of building perimeter at the ground [m².K/W]
e Thermal resistance value of external windows [m².K/W]

The proof of compliance must be made in two stages:

> when requesting for the building permit;
> after completion of the building (commissioning).

The control of the regulation is the responsibility of both the Qualified Experts (QEs), registered in the Building Certification System (see Chapter 3), who verify the design, and the municipality where the building is located.

Following the EPBD implementation, the responsibility of the local authorities and citizens was increased (through information campaigns and by requiring the EPC when issuing a building permit). Technical measures for the better EP management of buildings were implemented, including individual metering of heating and hot water consumption, and individual thermal regulation of heating units (radiators).

When upgrading an existing building, a combined technical and economical assessment must be conducted. The EP values and the economic assessment are the result of the Romanian methodology application in the process of building energy audit reporting (the investment return is calculated based on net present value). The final solution is based on the investment cost, energy consumption reduction and payback time value, compared with the maximum accepted value of 10 years and the conventional lifetime of the technical solution.

Table 1: Minimum requirements for new residential buildings.

ENVELOPE UNITS	U'_{max} [W/m^2.K] Maximum thermal transmittances corrected with the influence of the thermal bridges C107/2010
	Residential buildings, newly built
External walls	0.56
External windows	1.30
Terraces	0.20
Floors of unheated basements	0.35
Ground floors (no basements)	0.22
Floors of heated basements	0.21
External walls of heated basements	0.35

(C107/1997 and C107-2005 – amended in 2010)

Table 2: Minimum requirements for new and existing non-residential buildings.

Non-residential buildings with full-time occupation or part-time occupation and high thermal inertia						
Building Type	Climatic Zone	a [m².K/W]	b [m².K/W]	c [m².K/W]	d [m².K/W]	e [m².K/W]
Hospitals, kindergartens and clinics	I	1.70	4.00	2.10	1.40	0.69
	II	1.75	4.50	2.50	1.40	0.69
	III, IV	1.80	5.00	2.90	1.40	0.69
Educational and sports facilities	I	1.70	4.00	2.10	1.40	0.50
	II	1.75	4.50	2.50	1.40	0.50
	III, IV	1.80	5.00	2.90	1.40	0.50
Offices, commercial buildings and hotels	I	1.60	3.50	2.10	1.40	0.50
	II	1.70	4.00	2.50	1.40	0.50
	III, IV	1.80	4.50	2.90	1.40	0.50
Other types (normal conditions)	I	1.10	3.00	1.10	1.40	0.40
	II	1.10	3.00	1.20	1.40	0.40
	III, IV	1.10	3.00	1.30	1.40	0.40

(C107-2005 – amended in 2010)

Non-residential buildings with part-time occupation but no high thermal inertia						
Building Type	Climatic Zone	a [m².K/W]	b [m².K/W]	c [m².K/W]	d [m².K/W]	e [m².K/W]
Hospitals, kindergartens and clinics	I	1.50	4.00	2.00	1.40	0.69
	II	1.60	4.50	2.30	1.40	0.69
	III, IV	1.70	5.00	2.60	1.40	0.69
Educational and sports facilities	I	1.50	4.00	2.00	1.40	0.50
	II	1.60	4.50	2.30	1.40	0.50
	III, IV	1.70	5.00	2.60	1.40	0.50
Offices, commercial buildings and hotels	I	1.50	3.50	2.00	1.40	0.50
	II	1.60	4.00	2.30	1.40	0.50
	III, IV	1.70	4.50	2.60	1.40	0.50
Other types (normal conditions)	I	1.00	2.90	1.00	1.40	0.40
	II	1.00	2.90	1.10	1.40	0.40
	III, IV	1.00	2.90	1.20	1.40	0.40

(C107-2005 – amended in 2010)

Technical guidance documents
The most important government decisions, with significant impact on the existing building stock, are the following:

> The *Government Ordinance O.G. 18/2009* regarding the thermal rehabilitation of blocks of flats and single-family buildings built between 1950 and 1990. The aim is to increase the EP of buildings, to reduce the energy consumption for heating, and to improve the aesthetical aspect of the town. This ordinance has an important impact on the existing building stock, due to the clear specification of financing and EP requirements. According to this ordinance, the costs of the EP audit and of the technical project are supported by the government. The execution works are supported as follows: 50% by the government, 30% by the local authorities, and 20% by the owners. According to the ordinance, the expert must propose the appropriate solutions for the thermal rehabilitation of the building envelope and the technical systems of buildings, achieving a decreased heating consumption below 100 kWh/m^2.year.

> *The Government Emergency Order No 69/2010* on the thermal rehabilitation of residential buildings with funds from bank loans, granted under a government guarantee. This act ensures the non-discriminatory access of owner associations and of single-family building owners to bank loans for the thermal rehabilitation of buildings, granted under a government guarantee and having a subsidised interest rate. The value of the loan may account for up to 90% of the value of the works to be executed, limited to 1,850 €/room for residential blocks, and 7,400 €/room for individual residences. Local public administration authorities are allowed to contribute up to 30% of the expenses incurred by the thermal rehabilitation of residential buildings.

EP methodology(ies)
On the 1st of February 2007, the Order 1057/2007 enacted the new calculation methodology for the energy performance of buildings (Mc 001/1, 2, 3 – 2006), taking into account the EPBD standards, especially the EN 13790 for heating and cooling, which was not available up till then. In part II, chapter 5 of the new methodology, the alternative calculation methods for heating and hot water consumption have been included, based on the previous Romanian research activity.

The Order 1071/2009 supplements and amends the Order 157/2007 with a calculation summary of the energy performance of buildings and apartments.

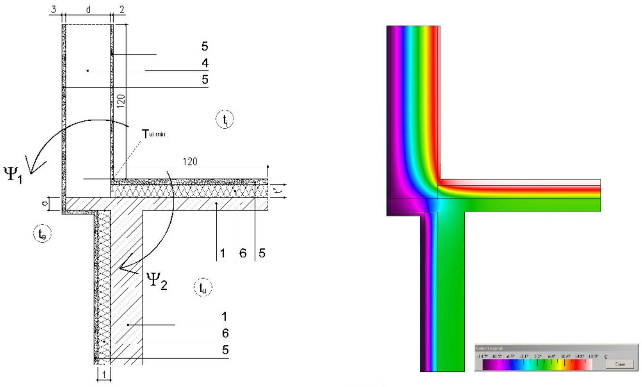
The new methodology is available both for new and existing buildings, as well as for residential and non-residential buildings. National databases of the typical annual hourly-climatic data are to be prepared and published for every municipality in Romania. The software tools, created according to the Mc001-2006, are available on the market.

The current regulations for new buildings are limited to conventional buildings. Some new and efficient solutions are omitted (e.g., passive and active solar systems, endothermic (e.g., solar energy and high performance) facades, phase change energy storage structures, etc.). The calculation methodology will start to be revised in 2013, in order to include calculation procedures for all such systems used in buildings with high energy efficiency.

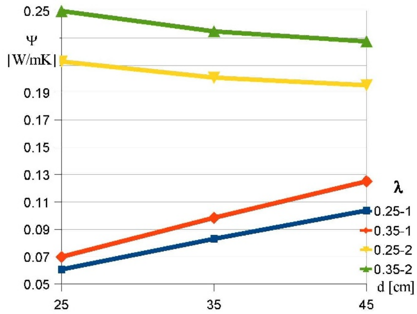
Detailed support documents, e.g., technical systems, accredited construction details
Technical guidelines and support documents were developed in order to facilitate the application of the calculation methodology. These include the climatic data necessary for the methodology application and for the design of building components and systems, the atlas of thermal bridges, as well as guidelines for the thermal rehabilitation of existing residential buildings (together with framework technical solutions/construction details) (Figure 1).

Training, CPD and accreditation systems
There are various programmes to ensure training at university and post-graduate level for architects and designers, as well as for QE for the certification of buildings. For the qualification of the building workforce relating to energy efficient technologies or renewable energy systems, there is no fully coherent system in place yet. The National Qualification Framework is being adapted to align with the European Qualifications Framework (EQF), and the occupational standards need to be revised or developed to include skills on the energy efficiency and

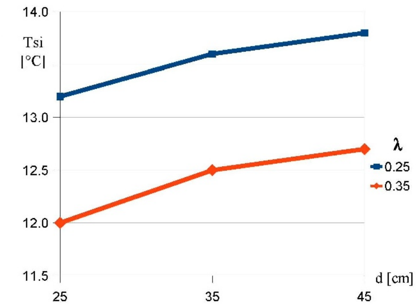
Figure 1: Characterisation of thermal bridges (a typical example).



d	t	pentru λ = 0.25 Ψ1	Ψ2	pentru λ = 0.35 Ψ1	Ψ2
cm	cm	W/mK	W/mK	W/mK	W/mK
25	5	0.061	0.213	0.070	0.250
35	5	0.083	0.201	0.099	0.235
45	5	0.104	0.195	0.125	0.228



d	t	$T_{si\ min}$, pentru λ = 0.25	
		0.25	0.35
cm	cm	°C	°C
25	5	13.2	12.0
35	5	13.6	12.5
45	5	13.8	12.7



the Renewable Energy Sources (RES). A national qualification roadmap including the continuous education and training of the workforce in the building sector, which should be endorsed by all relevant stakeholders, is under preparation within the BUILD UP Skills Romania project (ROBUST), included in the BUILD UP Skills initiative of the Intelligent Energy Europe (IEE) Programme. For RES installers, the certification system or equivalent qualification schemes shall be set up in June 2013 (a mandatory action according to the RES Directive, 2009/28/EC).

Quality Assurance (QA)/Compliance checking process

Compliance with the building requirements (including the minimum thermal performance of building components and the global indicator G) is controlled at the stage of the authorisation of the construction (building permit). If a construction is built without a permit or infringes its permit, the control authorities may order the demolition of those elements which are not compliant with the permit, or were built without a permit. In such cases, the construction works can be suspended, and the administrative fine to be paid by the investor is up to approximately 2,300 €, in addition to indemnities for the damage caused. The main responsible body for the compliance control in constructions is the State Inspectorate in Constructions (SIC), a public institution that is a legal personality, subordinated to the MDRAP. SIC controls the execution of works. The actual inspection for compliance, after issuing the building permit and the authorisation of works, is performed by either construction inspectors employed by SIC and site inspectors/project supervisors (subject to authorisation by SIC) employed by the beneficiary (investor)/building owner, or by technical inspectors (subject to authorisation by Ministry for Regional Development and Public Administration) employed by the contractor.

During the final commissioning phase, an EPC is required. With the exception of apartments in blocks of flats, the EPC also displays the EP indicator for a reference (national) building (with the same geometry as the actual building, but with the minimum thermal requirements fulfilled). This would be equivalent to the energy performance of the same building meeting the minimum EP requirements at component level. However, the indicated value is purely informative. No additional checks are carried out in order to verify compliance.

Monitoring and enforcement statistics

SIC inspectors (special licensed technicians or engineers) usually control only public buildings and large constructions, although the control is theoretically mandatory for all buildings. Random controls of residential constructions are also carried out. However, no reliable data exists on the compliance levels in Romania.

2.2 Format of national transposition and implementation of existing regulations

The legal act to transpose the recast EPBD (2010/31/EU) was approved by the government and the Romanian Parliament, and has already been adopted. It ensures the inclusion in the basic legal system of all EPBD provisions, and the revision of the existing EP calculation methodology, which will start in October 2013. It is foreseen that SIC, together with appointed experts, will control the application of the energy certification system, for which the procedures are yet to be developed.

Regarding the implementation of the RES Directive in buildings, the modified law also foresees that a feasibility study concerning the potential use of renewable energy in the designed building has to be provided for each new building when requesting a building permit. This should be supplemented with incentives for the owner in order to ensure the application of the proposed technologies.

2.3 Cost-optimal procedure for setting EP requirements

The process of defining the EPC requirements based on the cost-optimal procedure is under preparation during 2013. Reference buildings, as well as the detailed input data for the calculation methodology, are under definition.

2.4 Action plan for progression to NZEB

There are several actions under discussion, which may be included in the NZEB action plan: building codes, EP certification, research and development, raising awareness, and other support measures. The reinforcement of the current building codes will be the first set of actions, resulting in a gradual tightening of the EP requirements, as well as in their systematic implementation and in increased compliance controls. A good starting point for the definition of the NZEB national action plan might be the recently developed study by the BPIE 'Implementing Nearly Zero-Energy Buildings (NZEB) in Romania' – published in August 2012 -, which proposes several actions for detached residential and office buildings. This should be discussed and detailed further for all building categories and for relevant climatic zones in Romania. The requirements for the primary energy consumption and for the related CO_2 emissions will be defined. Furthermore, an inventory of public buildings is planned for the next period, in order to ensure the definition of a coherent plan for the renovation of the existing public building stock, with evaluation of the economic implications.

Further steps for the introduction of NZEB standards and for the implementation of an independent control system for EPCs are under consideration. An increase of the number of qualified workers across the country (craftsmen and other on-site construction workers and systems installers in the building sector) will lead to more renovations, resulting in high performing NZEB. Moreover, ambitious NZEB requirements in the Romanian building codes will generate a wider market deployment of the energy efficient and renewable technologies, which will reduce their prices and will overall lower the costs for NZEB. This study was evaluated for compliance with the NZEB principles as elaborated by the BPIE team. The economic and financial implications of each variant were analysed in order to determine the most suitable and affordable solutions under the specific circumstances of the country. The selected optimum solutions were extrapolated at national level, in order to determine the direct and indirect benefits and impacts. The last chapter presents the key policy recommendations, as well as an indicative roadmap for the implementation of the NZEB in Romania.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

Overview and administration system

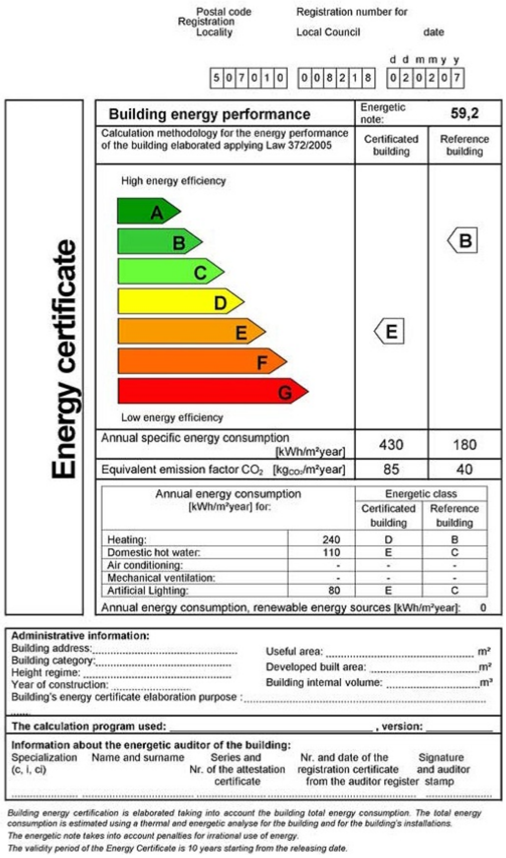
The energy consumption of buildings and the energy certification were subjects of the national regulation long before the EPBD. Since 2000, Romania technical norms for the energy consumption evaluation, building certification and building audit were already available before the transposition of the EPBD on the 1st of January 2007. In Romania, the building certification activity started in 2005, based on the national regulation.

The EPC is mandatory since 2007 for all buildings when constructed, sold or rented, except for existing residential buildings, where the obligation only exists since the 1st of January 2011. The Romanian EPC takes into account the final energy consumption of the actual building and of the reference (notional) building. However, in case of apartments, the certificate refers only to the actual flat.

Format

The EPC has two pages (Figures 2 & 3). The first page displays the characteristics of the building performance, such as the final annual specific energy consumption for heating, cooling, ventilation, hot water and lighting, the total specific energy consumption and CO_2 emissions and RES. The energy class for the existing and the reference building, as well as the energy consumption, are also included in the first page. The second page indicates the energy scale, ranging from A to G, for each type of installation, as well as information on the reference building.

Figure 2: EPC – first page.



Postal code Registration Locality | Registration number for Local Council | date

5 0 7 0 1 0 | 0 0 8 2 1 8 | 0 2 0 2 0 7

Energy certificate

Building energy performance	Energetic note:	59,2
Calculation methodology for the energy performance of the building elaborated applying Law 372/2005	Certificated building	Reference building
High energy efficiency: A, B, C, D, E, F, G – Low energy efficiency	E	B
Annual specific energy consumption [kWh/m²year]	430	180
Equivalent emission factor CO_2 [kg_{CO_2}/m²year]	85	40

Annual energy consumption [kWh/m²year] for:		Energetic class: Certificated building	Reference building
Heating:	240	D	B
Domestic hot water:	110	E	C
Air conditioning:	-	-	-
Mechanical ventilation:	-	-	-
Artificial Lighting:	80	E	C

Annual energy consumption, renewable energy sources [kWh/m²year]: 0

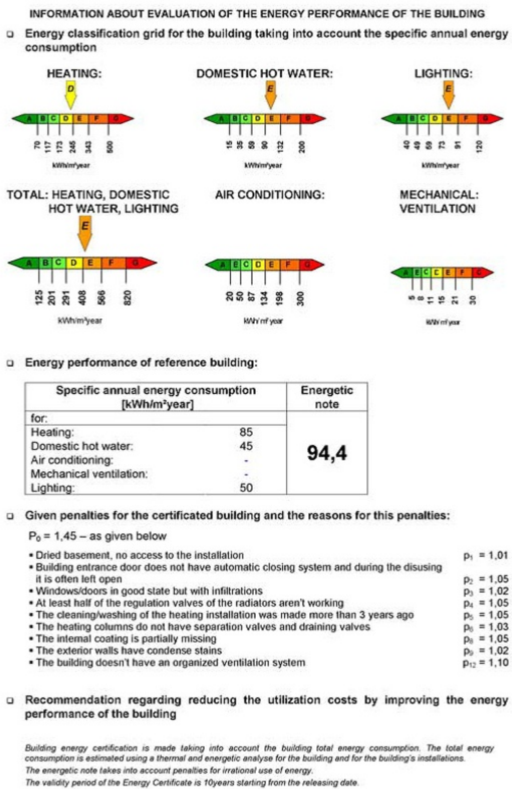
Administrative information:
Building address: … Useful area: … m²
Building category: … Developed built area: … m²
Height regime: … Building internal volume: … m³
Year of construction: …
Building's energy certificate elaboration purpose: …

The calculation program used: …, **version:** …

Information about the energetic auditor of the building:
Specialization (c, i, ci) | Name and surname | Series and Nr. of the attestation certificate | Nr. and date of the registration certificate from the auditor register | Signature and auditor stamp

Building energy certification is elaborated taking into account the building total energy consumption. The total energy consumption is estimated using a thermal and energetic analyse for the building and for the building's installations.
The energetic note takes into account penalties for irrational use of energy.
The validity period of the Energy Certificate is 10 years starting from the releasing date.

Figure 3: EPC – second page.



INFORMATION ABOUT EVALUATION OF THE ENERGY PERFORMANCE OF THE BUILDING

- Energy classification grid for the building taking into account the specific annual energy consumption

- Energy performance of reference building:

Specific annual energy consumption [kWh/m²year]		Energetic note
for:		
Heating:	85	94,4
Domestic hot water:	45	
Air conditioning:	-	
Mechanical ventilation:	-	
Lighting:	50	

- Given penalties for the certificated building and the reasons for this penalties:

P_0 = 1,45 – as given below

- Dried basement, no access to the installation p_1 = 1,01
- Building entrance door does not have automatic closing system and during the disusing it is often left open p_2 = 1,05
- Windows/doors in good state but with infiltrations p_3 = 1,02
- At least half of the regulation valves of the radiators aren't working p_4 = 1,05
- The cleaning/washing of the heating installation was made more than 3 years ago p_5 = 1,05
- The heating columns do not have separation valves and draining valves p_6 = 1,03
- The internal coating is partially missing p_8 = 1,05
- The exterior walls have condense stains p_9 = 1,02
- The building doesn't have an organized ventilation system p_{12} = 1,10

- Recommendation regarding reducing the utilization costs by improving the energy performance of the building

Building energy certification is made taking into account the building total energy consumption. The total energy consumption is estimated using a thermal and energetic analyse for the building and for the building's installations.
The energetic note takes into account penalties for irrational use of energy.
The validity period of the Energy Certificate is 10years starting from the releasing date.

The energy performance of the building is expressed by the total specific assessed final annual energy consumption [kWh/m².year], including all installations in use for normal building operation.

The classes in the EPCs range from A (the most efficient) to G (the most energy-consuming). Class A ranges from 125 kWh/m².year (heating, DHW and lighting) to 150 kWh/m².year (all energy uses). The EPC covers heating, cooling, ventilation, DHW and lighting. For a building with no cooling system and no mechanical ventilation system, the energy use class A is below 125 kWh/m².year. In Romania, the vast majority of existing buildings have an EPC of class C or D.

Every building and its reference building have an energy benchmark, calculated as a function of the total specific annual energy consumption and the penalty, as follows:

$$N = \exp(-B_1 \cdot q_T \cdot p_o + B_2)$$

$$\text{for } (q_T \cdot p_o) > q_{Tm} \text{ [kWh/m}^2\text{.year]}$$

$$N = 100$$

$$\text{for } (q_T \cdot p_o) \leq q_{Tm} \text{ [kWh/m}^2\text{.year]}$$

where: q_T is the specific final total calculated annual energy consumption for space heating, hot water, lighting and ventilation/air-conditioning (AC), and p_o is the penalty coefficient taking into account the rational operation of the building and its installations:

1) For buildings with heating, hot water and lighting installations:
   q_{Tm} = 125 [kWh/m².year] is the final specific energy consumption;
   B_1 = 0.001053 and B_2 = 4.73724

2) For buildings with heating, ventilation/AC, hot water and lighting installations:
   q_{Tm} = 150 [kWh/m².year] is the final specific energy consumption;
   B_1 = 0.000742 and B_2 = 4.71556

The penalty coefficient (p_0) is the result of poor management of the existing building, and its use decreases the benchmark of the building. There are 12 penalty types (∏) for the building envelope, as well as for the systems and equipment of Heating, Ventilation and Air-Conditioning (HVAC): $p_0 = \prod p_j$. The penalty coefficient values vary between p_o=1 for a very good building envelope without cracks or air and water infiltrations, and with a very efficient installation, up to p_o=2.12 for a building with a very low maintenance (a listing of the penalty factors is included in the EPC).

Frequency of updating

The validity of the EPC is 10 years, starting from the date of issue. When a building or a building part is refurbished, a new EPC is issued, with the same validity period.

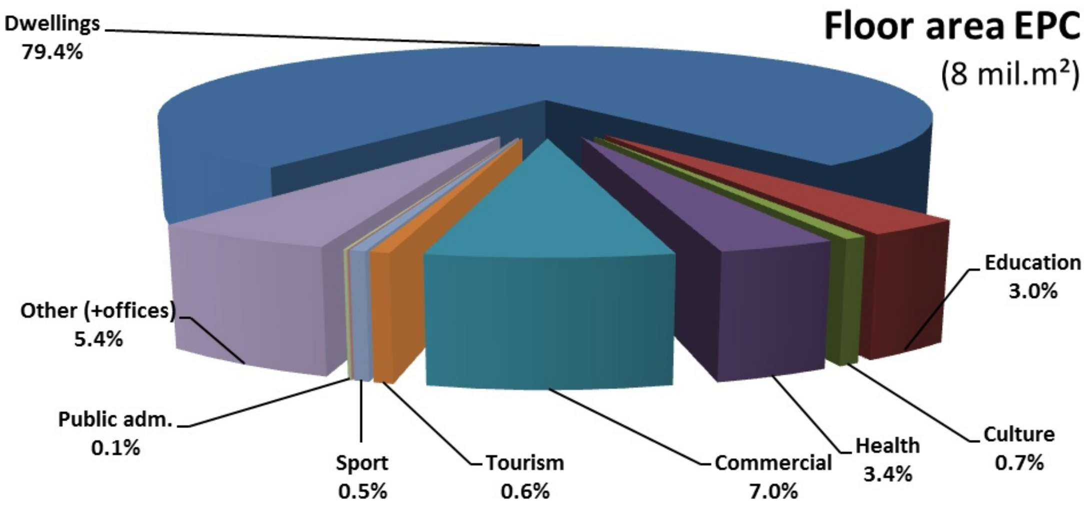


Figure 4: Distribution of analysed EPCs per building category.

Activity levels
The information contained in the issued EPCs permits the evaluation of the average EP of the existing building stock by the building type, provided that the number of issued certificates and the shape factor (building envelope to internal volume ratio) are ensuring a representative statistical sample in terms of conditioned space floor area of the building type, and climatic consistency. This will be possible in the future, when a sufficient number of EPCs is registered.

The central database of EPCs issued by QEs for the certification of buildings is in MDRAP. By the end of 2012, about 30,000 EPCs in electronic format have been registered in the database of INCERC. The preliminary analysis of approx. 20,000 EPCs permits a provisional evaluation of the EP of existing buildings. Most of the EPCs analysed were issued for residential buildings (Figure 4). Figures 5 and 6 present the results of this analysis regarding the final energy use and CO_2 emissions indicators.

Costs
The costs for issuing an EPC vary between 50 € and 150 € for an individual dwelling, and between 500 € and 1,000 € for a collective residential building. For other types of buildings, the cost may be greater. The market of EPC issuing has increased in the last two years, and the prices per unit have decreased dramatically. However, an increase is expected after the EPC control system will come into force in 2013.

Assessor corps – qualification/training/ CPD requirements
QEs are the only persons recognised to issue EPCs and carry out inspections. They must have all the skills necessary for performing inspections and for providing system improvement recommendations. They must be qualified engineers or architects with at least 3 years of experience in EP calculations for residential buildings, and 5 years of experience in EP calculations and overall building audits for all other types of buildings (Figure 7).

Figure 5: Average energy performance from analysed EPCs.

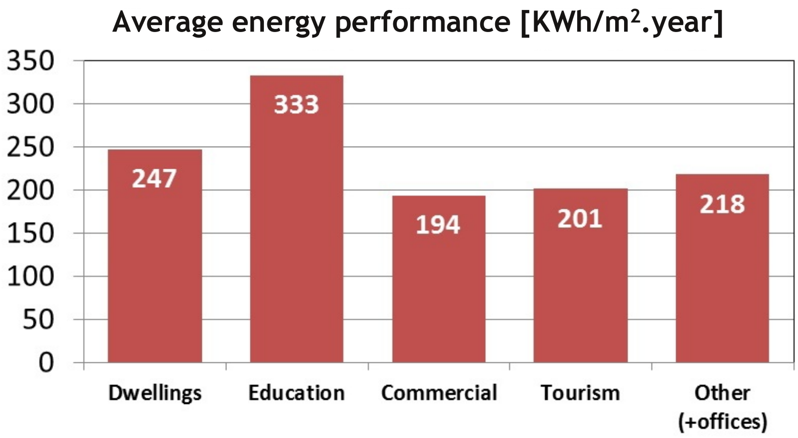


Figure 6: Average CO_2 emission index from analysed EPCs.

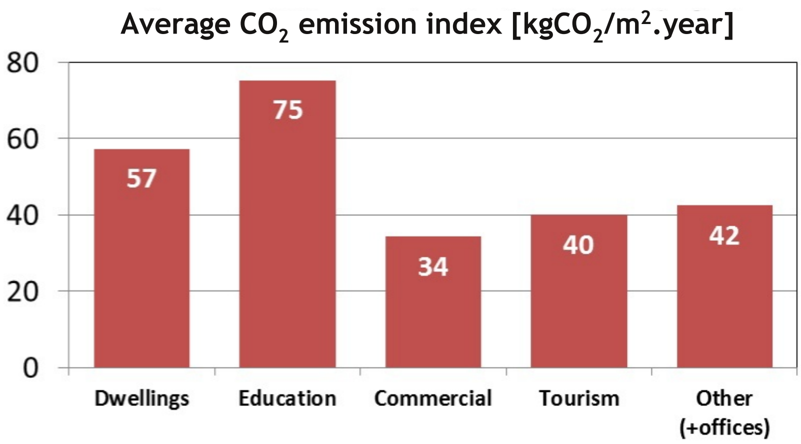


Figure 7: Scheme for the certification of energy auditors for buildings.

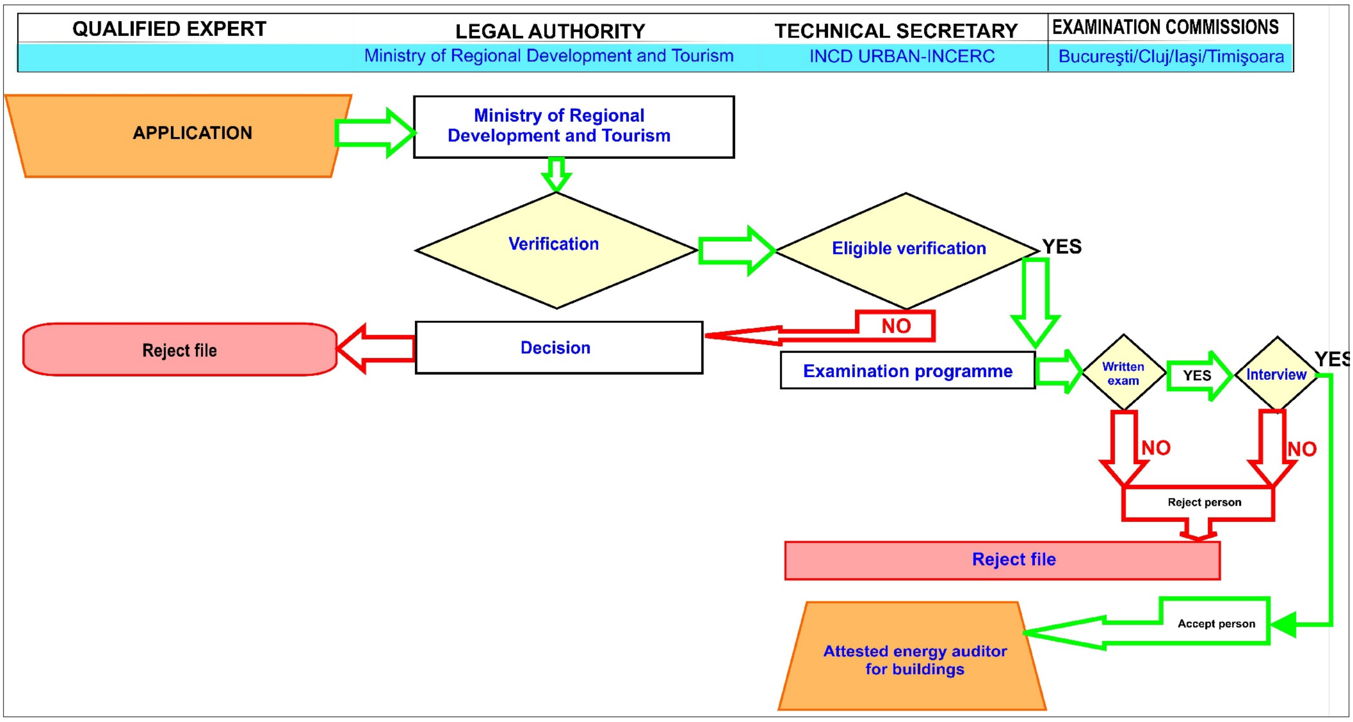
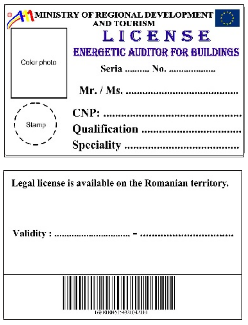


Figure 8: Qualified Expert Professional License model.



In addition, QEs must attend recognised training courses (short courses of 80 hours, or MSc university courses of 1 to 2 years), and pass a demanding national examination that evaluates their knowledge on the technical requirements of the building regulations, and on the details of the certification system itself. The examination consists of two parts: a theoretical examination and a practical exercise based on a simulation of an audit activity (an existing building certification and an audit report for a detailed upgrading solution, combined with an economic efficiency assessment).

MDRAP coordinates the training of the QE, and is responsible for all aspects of the energy certification scheme. QEs are granted a professional license (Figure 8), valid for 5 years, which is subjected to renewal with proof of continuous training and lack of malpractice. The demanding QE qualifications are a guarantee of correct professional attitude, and increase the credibility of the certificates.

QEs can act on an individual basis or be integrated in public or private organisations. Recognised courses are already offered by the Technical Universities in Bucharest, Timisoara, Iasi and Cluj, accredited by the MDRAP.

In Romania, there are over 1,400 QEs authorised to perform certification and energy audits on buildings. The ministry maintains the list of authorised experts. This list is published in the ministry's website *www.mdrap.ro*.

QA of EPCs - system, activity level and penalties

QEs are the only persons accredited to issue EPCs. According to the norms of the application of the Law 372/2005, all QEs must keep the documents for each certificate in order, and maintain a register for all the EPCs they have issued.

The quality of the EP certification is controlled by periodic checks on the central database, conducted by a commission designated by the ministry. At least once every 5 years, each expert receives a recommendation from a professional association for the evaluation of their correct use of methodologies and tools. In case of serious infringement of the EPC process, the control commission can propose to the ministry the suspending of the expert's license. From 2013, the State Inspectorate in Construction (ISC) will verify certificates and apply sanctions according to the law.

Any authority or building owner can appeal to the ministry if there is a doubt concerning certification compliance with the standards or the national regulation. A more detailed regulation concerning this subject will be issued after the transposition of the recast EPBD is approved by the Romanian Parliament.

Enforcement to building owners - sale, rental

For the buildings or building units on sale or rental, the owner/investor/manager of the building is responsible for the EPC elaboration and presentation to the potential buyer or tenant. The selling contracts made without the existence of an EPC may be cancelled according to the provisions of the Civil Code.

For new buildings, the document formalising the reception of the building by its owner from the contractor at the commissioning stage is not valid without the EPC copy attached.

3.2 Progress and current status on public and large buildings visited by the public

For buildings owned or occupied by public authorities, with a total useful floor area over 500 m^2 and frequently visited by the public, the EPC must be displayed in a prominent place, clearly visible to the public. A national programme for increasing the EP of public buildings in the health and education sector is under preparation, and is expected to come into force in 2013. ISC will check display certificates and apply sanctions according to the law.

3.3 Implementation of mandatory advertising requirement – status

At the end of 2012, the requirements and format of the EPC information to be included in the real estate advertising are still under preparation.

3.4 Information campaigns

In Romania, in the period 2010-2012, government experts, building owners, the key players in the residential building sector (including appliance, HVAC and lighting manufacturers), residential energy efficiency experts and the academia, utilities and Energy Services Companies (ESCOs), consumer organisations, retailers and policy makers with a view to exchange information on latest developments in energy efficiency and sustainable energy solutions, independent energy consultants, university professors and students, members of the Chamber of Commerce and Civil Engineers, have been present in more than 200 events, seminars and workshops regarding information on the thermal rehabilitation, quality performance of buildings and EPCs.

MDRAP, as one of the bodies responsible for strategies concerning the building sector, is also involved in the activities for the information on the national BUILD UP Skills Roadmap and its promotion.

4. Inspection requirements - heating systems, air-conditioning

Romania adopted option a) of article 8 of the EPBD, establishing a periodical inspection for boilers and heating systems, as well as article 9 for air-conditioning (AC) systems. The inspection of boilers and AC systems is still in its early stages. The energy inspection guides for heating and AC have been elaborated and are based on the CEN standards and the national regulation. The QEs in charge of the energy inspections are HVAC engineers certified by MDRAP, such as thermal experts. In Romania, safety checks of boilers are mandatory, as regulated by the State Inspection for Controlling Installations, Boilers and Elevation Equipment Control (ISCIR). According to the ISCIR regulation, an initial technical inspection is performed when the system is put into operation. After that, regular technical safety checks are carried out, depending on the power of the system and the fuel used. The cost-effectiveness of the inspection of boilers, heating and AC systems is not assessed in Romania.

4.1 Progress and current status on heating systems

The inspection of boilers and heating systems is settled by the national energy inspection guide based on the EN 15378 standard, as well as on the existing national procedures for the system operation and maintenance. The period for regular boiler inspections is every two 2 years for boilers with a power over 100 kW, using non-renewable fuels (4 years for boilers using gas), and every 5 years for boilers with a power between 20 kW and 100 kW, using non-renewable fuels. For heating installations, the inspection refers to systems older than 15 years, with an effective power of more than 20 kW.

The main objectives of the inspection are:

> Screening – the state of installation and equipment, the weak points of energy consuming systems, and the energy efficiency;
> Advice – solutions to improve the EP of existing heating systems, to decrease consumption and cost, to increase the return of the investment of a possible boiler replacement, and to increase energy savings.

Figure 9: Inspection procedure for boilers and heating systems.

No.	BOILERS INSPECTION PROCEDURE	No.	HEATING SYSTEM INSPECTION PROCEDURE
1	Identification of the boiler	1	Identification of the heating system
2	Collection of documentation	2	Checking the functionality of the heating system
3	Visual inspection of the boiler	3	Level of heating system maintenance
4	Status of boiler maintenance	4	Visual inspection of control heating system
5	Checking the functionality of the boiler	5	Control of heat emission system
6	Check the control system of the boiler	6	Control of heat distribution system
7	Meter reading	7	Control of heat generation system
8	Evaluation of boiler energy performance	8	Comparing the capacity of heat generating system with the heating requirements
9	Boiler inspection report and recommendations	9	Control of DHW system
		10	Heating system inspection report and recommendations

Figure 10: Boiler and boiler room inspection report.

No.	CONTENTS
1.	Beneficiary identification - Name owner / manager - Address: city, street, no
2.	Date of inspection
3.	Purchase identification expert for heating - Name, certificate number
4.	Description of boiler - Thermal station type (apartment, building, area) - Thermal power plant (kW) - Type of product heat (warm water, hot water, steam) - User heat (heating, DHW, air conditioning, technology process) - Type of fuel used (natural gas, LPG, liquid, solid) - Boiler location (above ground, half buried, underground, in the building) - Dimensions (length, width, height, area, total volume, net volume) - Building structure (including access to thermal station) - Location of the chimney (in the building, attached building, independent) - CT windows surface (check according to the regulation) - Providing combustion air (grid, channels, preheated, etc.,)
5.	Technical documentation of thermal station (project execution, technical report, functional scheme, etc.,)
6.	Technical operation and maintenance documentation of thermal station (maintenance reports, recorded values, etc.,)
7.	Technical data and thermal power of boiler - Number and type of boilers - Operation of the boiler system (continuous, cascade, winter / summer) - Inspection files of boilers: FIC 1,..... n
8.	Type of heat distribution a) distributor - collector b) pressure equalizing - BEP c) direct distribution
9.	Technical data of pressure protection system - Local protection devices - Pressure protection system, inspection file: FA
10.	Technical data of circulating pumps - Type of pumps (recirculating pumps, heating circulating pumps, technology, supply pump, etc.) - Inspection files of pumps: FP 1 ... n
11.	Domestic hot water system inspection - Type of heat exchanger (no accumulation, with accumulation) - Number and capacity of heat exchangers - Number and capacity of storage tanks - Domestic hot water supply system (route, pipes, pumps)
12.	Technical data concerning the fuel system - Tank / fuel store (location, capacity, day tank, etc.,) - The supply of fuel (automobile, railway, gas pipelines, etc.,) - Intangible reserve of fuel - Energy consumption to improve the fluidity of heavy liquid fuel
13.	Information on thermal station utilities (water, sewer, electricity, etc.,)
14.	Thermal station own energy consumption (electrical, thermal)
15.	Information on water losses in the system (volume, temperature)
16.	Information on treatment addition water station (type, capacity, etc.,)
17.	Consumption of chemicals for water supply treatment
18.	Equipment and devices for recording the consumption (heat meter, electricity meter, water meter, etc.,)
19.	Record fuel consumption (gas meter, fuel bills, etc.,)
20.	Automation and control of heat supply (quality control, quantity control, three-way valves, etc.,)
21.	Equipment and measuring devices installed on the boiler (thermometers, flow meters, pressure gauges, etc.,)
22.	Hydraulic balancing devices and systems (at thermal station level and consumer level)
23.	Balancing systems and devices on the route of the flue gas exhaust
24.	General information on the state of thermal station and equipment (state of physical wear, state of thermal insulation, loss of water and fuel, etc.)
25.	Analysis of records of hot water temperature and outdoor temperature (if any)
26.	Conclusions and recommendations of the expert regarding thermal station and boiler inspection (see under: - Annex M, measures to increase the energy efficiency - Annex H, investment evaluation to replace the boiler)
27.	ATTACHMENTS: (documents, data sheets, measured and recorded values, etc.)

Date Name and signature

The complexity of the energy inspection is related to one or more of the following parameters: type of boiler, type of fuel used, nominal boiler power, heated surface or volume, type of heat distribution, type of heating equipment. The general procedure of the inspection of boilers and heating systems is given in Figure 9.

The inspection guidebook includes: area of application, general procedure of inspection, boiler inspection methodology, heating systems inspection methodology, inspection reports (art. 16 of 2010/31/EU) and 13 informative annexes (A - M).

The energy inspections guidebook also contains the template of the inspection report, which must be completed and signed by the expert. A copy is handed to the beneficiary, and another is kept by the experts in their personal archive.

For the boiler and the thermal installation, the inspection report includes the detailed characteristic data for boilers, pumps and security system. The heating installation inspection report includes the inspection characteristic data for emission devices, distribution system, generation system and DHW supply. The informative annexes give detailed information, reference values and methods for:

> visual inspection of boilers, and check of the basic settings;
> fuel gas analysis;
> evaluation of fuel consumption and auxiliary energy consumption for heating and DHW;
> fuel gas exhaust check;
> boiler combustion power;
> boiler or generation system sizing;
> evaluation of building energy demand;
> assessment of the energy efficiency of the boiler;
> return of the investment of the boiler replacement;
> space heating distribution inspection;
> space heating emission control inspection;
> stratification in high ceiling rooms;
> DHW inspection;
> list of possible improvement actions.

The template of the boiler and boiler room inspection report is shown in Figure 10.

The template of the heating system inspection report is shown in Figure 11.

No.	CONTENT
1.	Beneficiary identification - Name owner / manager - Address: city, street, no
2.	Date of inspection
3.	Purchase identification expert for heating - Name, certificate number
4.	Description of building - Destination and category of building (residential, non residential) - The climate and outdoor temperature (using SR 1907) - The operation of the building (permanent, intermittent - hours / day) - Age of building - The height of the building - Height level - Total area built - Total area heated - Heated volume of building - Type of construction (load-bearing walls, frames + masonry, precast panels, ventilated facades, etc..) - Type of building thermal insulation (exterior, interior, intermediate) - Quality of thermal insulation (original, improvised, good, damaged) - Heated areas (room type)
5.	Description of the heating installation - Year of heating system installation - Technical documentation of the installation (project execution, technical report, the layout of the heating elements, functional scheme, etc.. - Metered values of heat and fuel consumption - Type of heat (warm water, hot water) - Heat demand for heating (W) (the technical report or under Annex G) - The connection of the heating supply system with heat (direct connection, connection through heat exchangers, etc.) - Appropriate location of the main components of the heating system (heating fixtures, equipment control and monitoring, etc..) - Operating within normal parameters (yes / no) - Auxiliary heating systems (electric, renewable, etc..)
6.	Characteristics of emission heating elements – FIE file
7.	Characteristics of heat distribution system – FID file
8.	Characteristics of heat generation system and size verification– FIG file
9.	Characteristics of DHW system – FIA file
10.	General comments about the quality of the heating and hot water supply (thermal insulation condition, loss of water or fuel, etc.)
11.	Conclusions and advices (refer to: - Annex M, for measures on the operation and efficiency of heating, Annex I, for advice on heat distribution system , Annex J and K, for advice on heat emission system and Annex L, for advice on domestic hot water)
12.	ATTACHMENTS: (documents, data sheets, measured and recorded values, etc..)

Date Name and signature

Figure 11: Heating system inspection reports.

4.2 Progress and current status on AC systems

The Romanian ventilation and AC inspection scheme is based on the partial implementation of the EN 15240 and the EN 15239 standards, as well as on the national existing procedure.

The inspection of AC systems will be performed for an installed cooling load P > 12 kW, considering:

> the cooling load of a centralised AC system; or
> the total installed cooling load for a decentralised AC system, for the whole building or building area having its own administration.

In air-conditioned buildings/areas, ventilation system inspection will be performed according to the type of ventilation system (mechanic or natural).

The methodology of AC inspection describes in detail the procedures regarding the 'all-air' AC systems and the 'air-water' AC systems using fan coil units. Two mandatory stages are stipulated:

a) pre-inspection procedure;
b) inspection procedure.

The pre-inspection includes:

> check of technical documents;
> check of the air and hydraulic balance;
> occupants questionnaire about the system performance.

The inspection regards:

> building inspection and evaluation of indoor comfort and air quality;
> inspection of air and water distribution in the air-water systems;
> check of the operation of terminal devices;
> check of the operation of air handling unit;
> refrigeration system inspection;
> inspection of the control system and the Building Management System (BMS).

The inspection guidebook also includes:

> proposals to improve the functional and energy efficiency of AC systems;
> preparation of the inspection report;
> annexes (15 A – P).

The annexes have been elaborated to help the experts in their work. The EN 15240 annexes were modified, to include the investigation of the energy efficiency of AC systems, in relation to the building. Annex P of the guidebook outlines the recommended measures to be taken, in function with three different criteria: the adaptation of the AC system to the real use of the building, the reduction of the building cooling load, and the increase of the energy efficiency for the couple 'building-system'.

5. Conclusions and future plans

In Romania, the new obligations deriving from the recast Energy Performance of Buildings Directive (EPBD) have set forward the planning of more actions, such as: technical solutions for achieving the level of Nearly Zero-Energy Buildings (NZEB), redefinition of reference buildings, minimum requirements for the integration of Renewable Energy Sources (RES). According to the National Action Plan, energy savings can be achieved by applying the EPBD requirements for new buildings and major renovations. Heating and cooling account for 20% to 40% of the total energy use in a building, depending on the building efficiency. Existing buildings are responsible for the greatest part of the energy use, and their renovation offers a huge potential for the reduction of energy consumption and CO_2 emissions, while offering enormous economic growth prospects for the coming decades. An essential effort has to be undertaken for existing buildings, raising the actual rate of major renovation from 2% to 3% yearly.
Policy makers can help by implementing measures to remove obstacles for retrofitting projects, combining the required improvements of the efficiency level with incentives for monitoring the energy consumption after the implementation. This can facilitate the increase of the number of higher efficiency buildings.

The need for a transparent regulatory framework includes clear financial and fiscal policies, as well as increased funding for investments in the energy efficiency of buildings.

The elimination of the existing legislative barriers is more important for reducing the energy consumption, and should also accelerate the implementation of technological solutions. The next stage of the national transposition is the definition of the minimum requirements for NZEB. Also, the regulations must be followed by the use of renewable energy in buildings.

Furthermore, the training of Qualified Experts (QEs) and of the workforce specialised in energy efficiency and the use of RES is also very important in the next years. The positive impact of the energy efficiency in buildings on the economy and the construction sector relies on qualified energy consultants, on a coherent regulatory framework, and on effective information campaigns for the public. As the national authorities will soon begin to define the national laws implementing the EPBD recast, there is now a greater need for the development of campaigns on national level.

Romania will have to achieve innovative, long term, stable measures that take the national conditions into account. In the same time, the building strategies should be in line with the complementary national and EU energy strategies. The main challenge is financing solutions for the energy efficiency in buildings, to promote further investments in renovating the existing building stock, to adopt ambitious strategies for smart metering systems, and to integrate renewable energy in efficient schemes, as RES will become the world's second largest source of power production by 2015.

EPBD implementation in Slovakia

STATUS AT THE END OF 2012

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1. Introduction

The full responsibility for initiating the implementation of the Energy Performance of Buildings Directive (EPBD) in the Slovak Republic originally rested with the Ministry of Construction and Regional Development (MVRR). From the 1st of July 2010, the MVRR was merged with the Ministry of Economy, while from the 1st of November 2010, construction and regional development issues are under the responsibility of the Ministry of Transport, Construction and Regional Development (MDVRR). Legislative activity relating to the Energy Performance (EP) of buildings also lies with the MDVRR from the 1st of November 2010.

The implementation of the EPBD started in 2006 through the Act 555/2005 on the Energy Performance of Buildings. It came into force on the 1st of January 2006. The execution order for this act was published as Decree 625/2006 of the MVRR that fully came into force on the 1st of January 2007. According to this act, a design rating became a requirement for obtaining a building permit. A new decree, published by the MVRR, came into force on the 1st of October 2009, making Energy Performance Certificates (EPCs) obligatory for buildings sold or rented after the 1st of January 2008, and for new buildings and those undergoing major renovation with permits issued after this date.

The recast EPBD (Directive 2010/31/EU) was implemented through Act 300/2012 of the 18th of September 2012. It amended and supplemented Act 555/2005. This act was further amended and supplemented by the MDVRR's Decree 364/2012 of the 12th of November 2012. Both these documents fully came into force on the 1st of January 2013.

This report presents an overview of the current status of implementation and plans for its further evolution in the Slovak Republic. It addresses energy certification and inspection of heating and air-conditioning (AC) systems, including quality control mechanisms, training of Qualified Experts (QE) and information campaigns.

2. Energy performance requirements

This chapter focuses on the changes that have been made in the conditions, requirements and the whole process of implementation of the recast EPBD, using the past five years' experience in energy certification of buildings as a guide.

2.1 Progress and current status
Requirements on the heating needs of buildings were first applied in 1979, but requirements on the thermal properties of building components had already been introduced as an obligation since 1964 (Tables 1 and 2). EP requirements (such as, requirements on energy use for heating, hot water preparation, ventilation and cooling, lighting, and the global indicator of energy use for all needs in the building) were introduced in 2007, through the transposition of the EPBD. The global indicator (final energy) requirement was that the upper border of Class B, defined through the process of certification (see Chapter 3), was achieved, as the minimum acceptable EP level for new buildings.

National Websites *www.mindop.sk, www.mhsr.sk, www.inforeg.sk, www.sksi.sk, www.tsus.sk, www.siea.sk, www.byvajusporne.sk*

Table 1: Development of the requirements on U-values of building components.

Technical standard ČSN 73 0540 or STN 73 0540 (since 1993) / Year	U-value in W/m².K: External walls θ_e[°C] -15	-18	-21	Roofs θ_e[°C] -15	-18	-21	Windows	
1964	1.45	1.37	1.37	0.89	0.83	0.83	2.9	
1979 (mandatory since 1984)	0.89	0.86	0.79	0.51	0.47	0.43	2.9	
1992 – Modification 4 (mandatory since 1 May 1992)	0.46 When adding insulation 0.73			0.32			2.9	
Modification 5 - Recommended values (effective since 1 February 1997)	0.46	Renovated buildings		0.32	Renovated buildings		2.7	Renovated buildings
	0.32	New buildings		0.19	New buildings		2.0	New buildings
Revised STN 73 0540-2: 2002 (since 1 October 2002, obligatory values for renovated buildings, recommended values for new buildings)	0.46	Renovated buildings		0.32	Renovated buidings		2.0	Renovated buildings
	0.32	New buildings		0.19	New buildings		1.7	New buildings

Table 2: Requirements on U-values according to technical standard STN 73 0540-2: 2012.

Type of building structure	U-value in W/m².K: The maximum value $U_{W,max}$	Standardised value (required from the 1st of January 2013) $U_{W,N}$	Recommended value (required from the 1st of January 2016) $U_{W,r1}$	Recommended target value (required from the 1st of January 2021) $U_{W,r2}$
External wall and sloping roof over used area with a slope > 45°	0.46	0.32	0.22	0.15
Flat and sloping roof with a slope ≤ 45°	0.30	0.20	0.10	0.10
Ceiling above an open space	0.30	0.20	0.10	0.10
Ceiling over unheated space	0.35	0.25	0.15	0.15
Windows and doors in external walls	1.7	1.4	1.0	0.6

Table 3: Minimum requirements on EP of buildings – examples for residential buildings.

Indicator/ Global indicator	Requirements in force from	Minimum required Energy Class	Upper border of the required Energy Class [kWh/m².year]: Family houses	Apartment buildings
Heating	1 January 2013	B	86	53
	1 January 2016	A	42	27
	1 January 2021	A	42	27
DHW preparation	1 January 2013	B	24	26
	1January 2016	A	12	13
	1 January 2021	A	12	13
Total energy use in building	1 January 2013	B	110	79
	1 January 2016	A	54	40
	1 January 2021	A	54	40
Primary energy	1 January 2013	B	216	126
	1 January 2016	A1	108	63
	1 January 2021	A0	54	32

In order to transpose the recast EPBD, the laws regulating the EP of buildings and setting the Building Code were revised. The new legal documents call for certain changes in the process of EP certification of buildings. They also introduced a new definition of major renovation, namely, that the area of the renovated building structure exceeds 25% of the building envelope, and the obligation to obtain an EPC for major renovations.

The global indicator used for certification until 2012 (based on final energy calculations) was changed to a primary energy indicator in 2013. However, the minimum requirements for energy use for heating, hot water, ventilation, cooling and lighting, as well as the global energy use in a building, based on final energy, also remain in force in 2013. Thus, in order to comply with the regulations' minimum requirements, new buildings and major renovations are required to achieve the new upper border of Class B for primary energy, as well as the indicated requirements on final energy for each of the building's energy uses (Tables 3 and 4), as far as this is technically, functionally or economically feasible. Additionally, the building envelope structures have to fulfil the U-value requirements (given in Tables 1 and 2).

The requirements on primary energy will be changed to stricter levels in 2015 (buildings will be required to achieve the upper border of Energy Class A1 – see Chapter 3) and, from 2020, they will be required to achieve the even stricter upper border of Class A0. Requirements regarding national plans for Nearly Zero-Energy Buildings (NZEB), compliance and EPC control processes, as well as information campaigns have also been established. In addition, a new template of the EPC has been published.

2.2 Format of national transposition and implementation of existing regulations
A methodology based fully on European Standards is used for the calculation of the EP of buildings. A national amendment to EN ISO 13790 with climatic data and default data to be used in the calculation has also been published.

The scales for all ratings (Tables 3 and 4) are defined according to the guidelines provided in EN 15217. Class D was adopted as the reference value for the existing building stock. The Energy Class scale, regarding the energy use for space heating, is described in Table 4a.

According to the national ammedment to EN 15603, it is also possible to use an operational rating for existing buildings.

2.3 Cost-optimal procedure for setting EP requirements
Cost-optimal levels of minimum EP requirements are currently in preparation. Eleven reference buildings (Figure 1) have been defined: two existing and one new apartment building, family houses and office buildings, one existing school, and one new sports building. Ten packages of measures have been proposed for the different generators for heating, Domestic Hot Water (DHW) and cooling. The investment cost, along with energy and maintainance costs, have also been calculated. Furthermore, the global costs' calculation for micro- and macro-economic perspectives is in progress. Cost-optimal levels of minimum requirements on the EP of buldings will be finalised in May 2013.

2.4 Action plan for progression to NZEB
The definition of NZEBs was introduced and established by the law on the energy performance of buildings. According to this, stricter thermal properties of building components are required, while the consideration of Renewable Energy

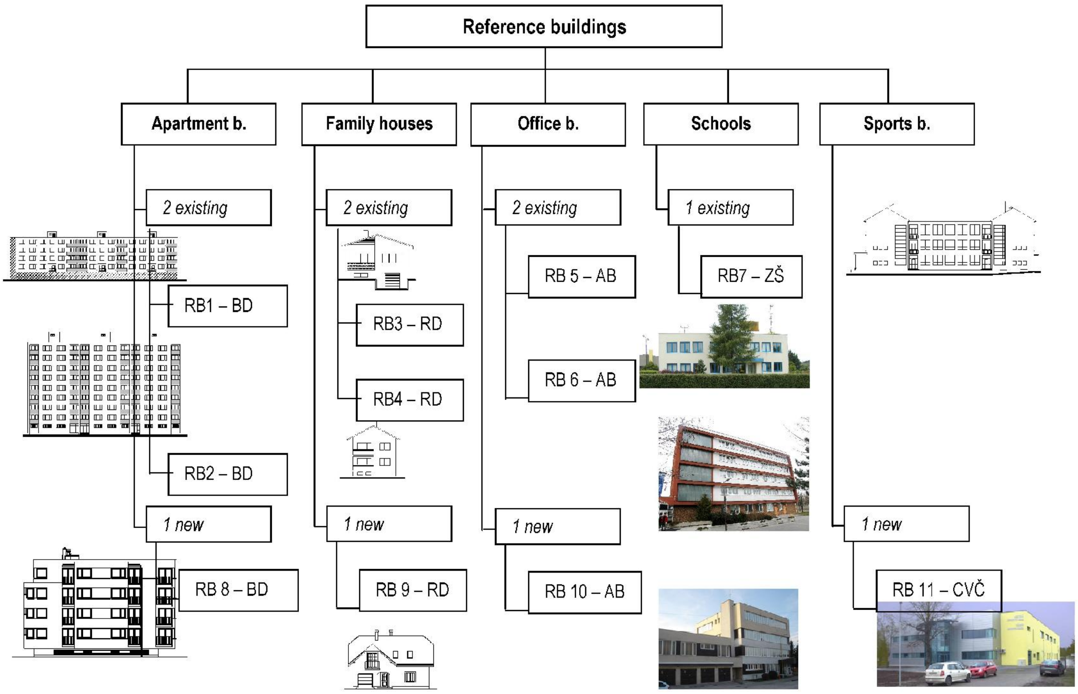
Energy use	Category of buildings	Energy Performance of building Classes						
		A	B	C	D	E	F	G
Heating	Family houses	≤ 42	43-86	87-129	130-172	173-215	216-258	> 258
	Apartment buildings	≤ 27	28-53	54-80	81-106	107-133	134-159	> 159
	Office buildings	≤ 28	29-56	57-84	85-112	113-140	141-168	> 168
	Schools	≤ 28	29-56	57-84	85-112	113-140	141-168	> 168
	Hospitals	≤ 35	36-70	71-105	106-140	141-175	176-210	> 210
	Hotels and Restaurants	≤ 36	37-71	72-107	108-142	143-178	179-213	> 213
	Sports facilities	≤ 33	34-66	67-99	100-132	133-165	166-198	> 198
	Buildings for trade and services	≤ 33	34-65	66-98	99-130	131-163	164-195	> 195

***Table 4a:* Energy Class scale for energy use for space heating in kWh/m²․year.**

	Category of buildings	Energy Performance of building Classes							
		A0	A1	B	C	D	E	F	G
Global indicator – primary energy	Family houses	≤ 54	55-108	109-216	217-324	325-432	433-540	541-648	> 648
	Apartment buildings	≤ 32	33-63	64-126	127-189	190-252	253-315	316-378	> 378
	Office buildings	≤ 60	61-120	121-240	241-360	361-480	481-600	601-720	> 720
	Schools	≤ 34	35-68	69-136	137-204	205-272	273-340	341-408	> 408
	Hospitals	≤ 96	97-192	193-384	385-576	577-769	770-961	962-1153	>1153
	Hotels and Restaurants	≤ 82	83-164	165-328	329-492	493-656	657-820	821-984	> 984
	Sports facilities	≤ 38	39-76	77-152	153-258	259-304	305-380	381-456	> 456
	Buildings for trade and services	≤ 85	86-170	171-340	341-510	511-680	681-850	851-1020	>1020

***Table 4b:* Energy Class scale for global indicator from 2013, in kWh/m²․year - primary energy.**

Figure 1: Options of reference buildings.



Sources (RES) within the building and in its surroundings is also precisely defined. The payback period of proposed measures should be less than 15 years. The law specifies that, after the 31st of December 2018, all new public buildings and, after the 31st of December 2020, all new buildings should be constructed as NZEBs. The national plan was approved by the administration of the MDVRR. It introduces the starting points and determines the requirements on the energy levels of constructions. The national plan also focuses on the requirements, conditions and methods for increasing the number of NZEBs, in order to meet the legal requirements. In new buildings, a minimum of 50% of primary energy should be covered by RES by 2020 (a 12% of energy needs in the housing stock and an 8% in the public sector should be covered by RES). The document was approved as a dynamic document, which will be updated annually.

3. Energy performance certificates

From January 2008, all new buildings, both residential and non-residential, as well as existing buildings after major renovation, are required to have an EPC issued, after works have been completed. The owner is obliged to obtain the EPC also when the existing building is rented or sold.

3.1 Progress and current status on sale or rental of buildings

The implementation of EPCs came into force for various categories of newly constructed, majorly renovated, sold or rented buildings (family houses, apartment buildings, office buildings, educational buildings, hospitals, hotels and restaurants, sports buildings, buildings for trade and services, as well as mixed-use buildings) on the 1st of January 2008. From this date onwards, the duty for labelling large public buildings of over 1,000 m^2 was introduced. This figure was reduced to 500 m^2, on the 1st of January 2013, and will become 250 m^2, from the 9th of July 2015 onwards. All buildings, except those constructed before 1947, monuments, buildings of historical and architectural heritage, buildings used less than 4 months per year, and with a total floor space of less than 50 m^2, are assigned an energy rating. If there are different uses in a building in more than 10% of the building's total floor area, the rating is calculated as referring to a mixed-use building. According to the act, EP certification of units (e.g., flats) becomes obligatory from the 1st of January 2016.

All certificates are issued by QEs. QEs are engineers qualified and recognised by their professional association. According to the legal requirements, the applicant should have a minimum of three years' professional experience and pass the exam following the training. The list of QEs is constantly updated and always available online to the public, at the Slovak Chamber of Civil Engineers (*www.sksi.sk*).

An energy certificate and report, as annexes to the EPC, are prepared by four QEs (for thermal protection, heating and

DHW, cooling and ventilation, and lighting). At the end of 2011, there were 357 QEs in Slovakia: 188 qualified on the thermal performance of buildings and building components, 216 on heating and hot water preparation, 16 QEs on cooling and ventilation, and 37 on lighting. The EPC is issued and signed by the QE for thermal protection. The trainings and exams were put on hold in 2012, in anticipation of the new legal documents implementing the recast EPBD. The new training cycle will focus on the changes in legal documents and on the calculation methods for the EP of buildings, and will start in June 2013.

The QEs' duty is to visit the building to be certified and assess the building in terms of type of construction (walls, windows, insulation, thermal bridges, ventilation and air-tightness, etc.), type and quality of Heating, Ventilation and Air-Conditioning (HVAC) and hot water systems, as well as type and quality of lighting. The QEs then calculate the EP of the building.

The calculation methodology is described in the regulations (Ministerial Decree 364/2012) and includes heating (including thermal protection and the calculation of heating needs), cooling, ventilation, DHW and lighting energy use, expressed in terms of total energy use and primary energy, as well as CO_2 emissions. For apartment buildings and family houses, heating and DHW energy use is taken into account. Cooling, ventilation and lighting are included in the calculation methodology for non-residential buildings. Cooling is calculated when over 80% of the building's floor area is cooled. The calculation methodology is based on the full implementation of CEN standards in the calculation procedure. In addition, a national amendment to EN ISO 13790 has been issued. It includes default data on climatic conditions, worked out according to EN ISO 15927, and on building structures and material properties, as well as a total floor area calculation. It is also possible for an operational rating to be used for existing buildings. The technical standards show the method of correcting the measured energy consumption for heating using standardised values. A national amendment to the technical standard EN 15603 has also been issued.

The EPC is the most visible aspect of the whole process of EP rating. The energy label is similar to the first page of the EPC. The template is the same for residential and non-residential buildings. The EPC consists of 8 pages (Figure 2). The energy rating is normally based on a calculated standardised rating (Table 3).

The real benefit of EP certification is the impact on decreasing the energy consumed by buildings mainly for heating (40 – 60%) and in the recommendations given to the building owner. These are summarised on page 1 of the EPC. Measures for improving their EP are proposed separately for thermal protection and for each type of energy consumption, and are described on pages 3-7 of the EPC, together with the results of a standardised calculation and energy ratings. Some of the suggested

Figure 2: Template of the EPC (first, second and last pages).

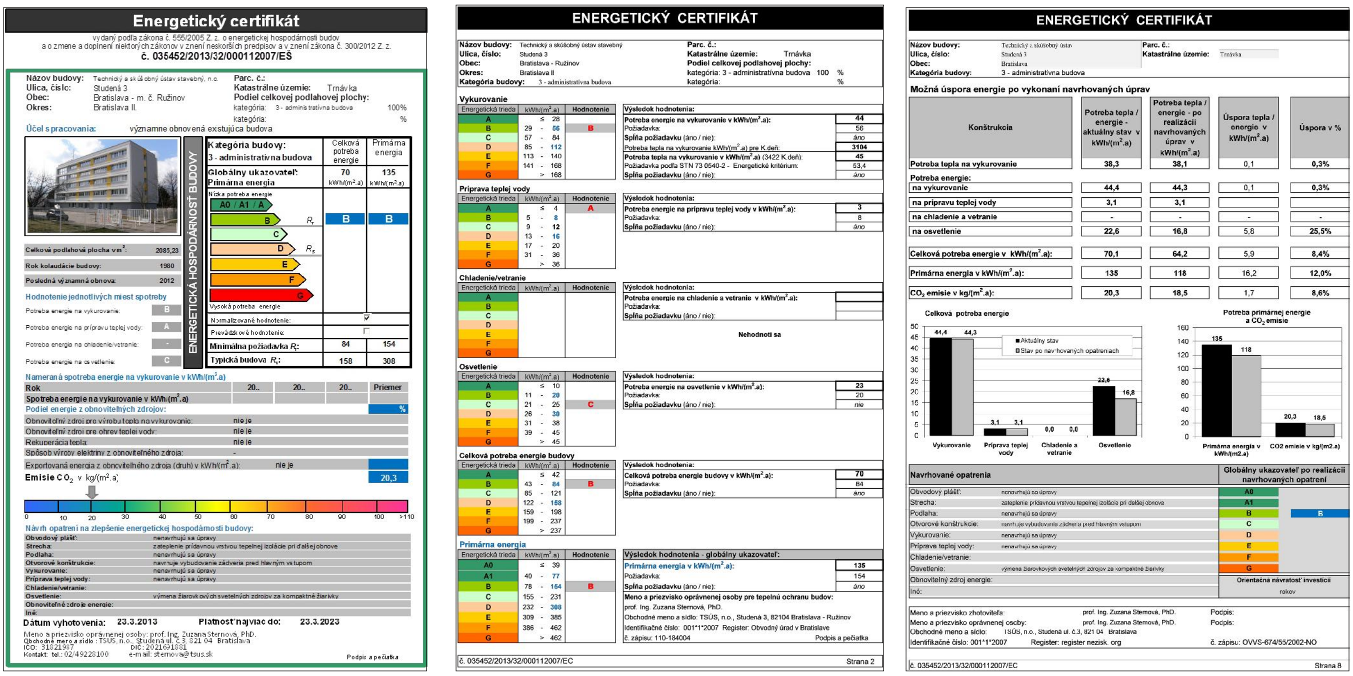


Figure 3: Number of EPCs issued in 2010, 2011 and 2012.

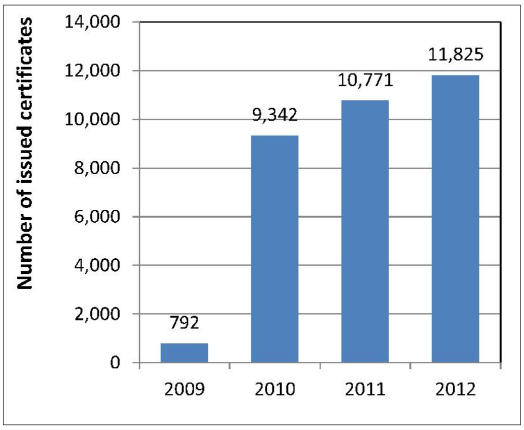


Figure 4: Number of EPCs issued for new, majorly renovated, and other buildings (for sale and rent).

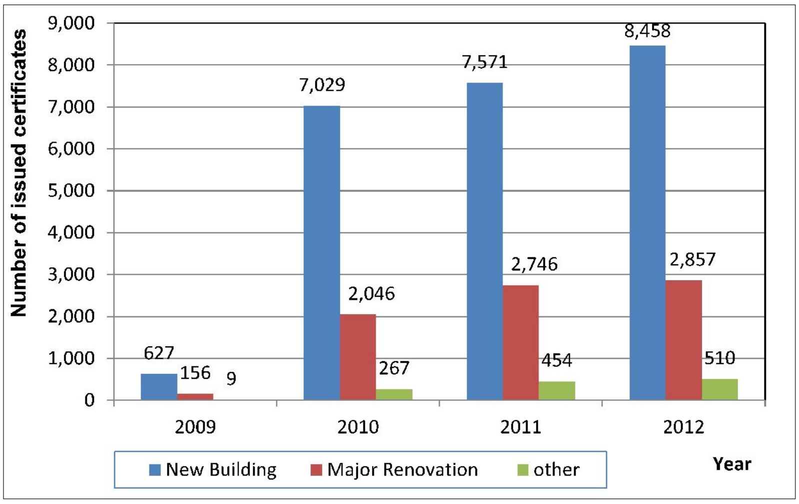
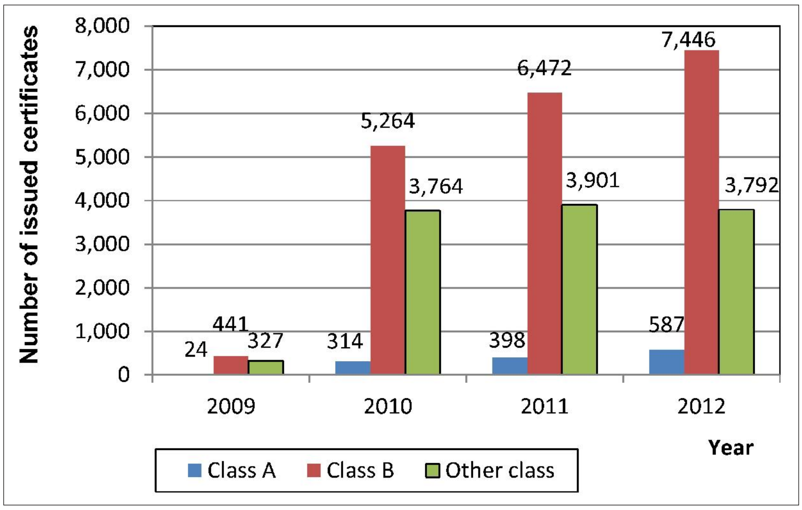


Figure 5: Number of EPCs issued for buildings rated in Class A, B and other Classes.



improvements are presented on the last page of the EPC, along with a short description, estimates of savings, potential paybacks, and the impact on the energy rating, if proposed measures are to be implemented.

The data used to prepare the EPC is reported in an annex. All the data are registered on a central register at the MDVRR. Following the calculation of the energy rating and the definition of required improvement measures, it is necessary to log into the online platform (central registration system), in order to fill out the form with the building description, energy rating indicators, description of the opaque envelope, windows, HVAC, DHW, ventilation, RES and other energy systems, all the particulars, and final calculation results. Only after completing the data in the tables is it possible to get a registration number and to issue the EPC. The central register has been operational since the 1st of January 2010. There are also statistical data on EPCs available on *www.inforeg.sk* (Figures 3, 4 and 5). The number of EPCs issued in the country's various regions is shown in Figure 6. There is still a very small number of EPCs issued for buildings for sale or rent.

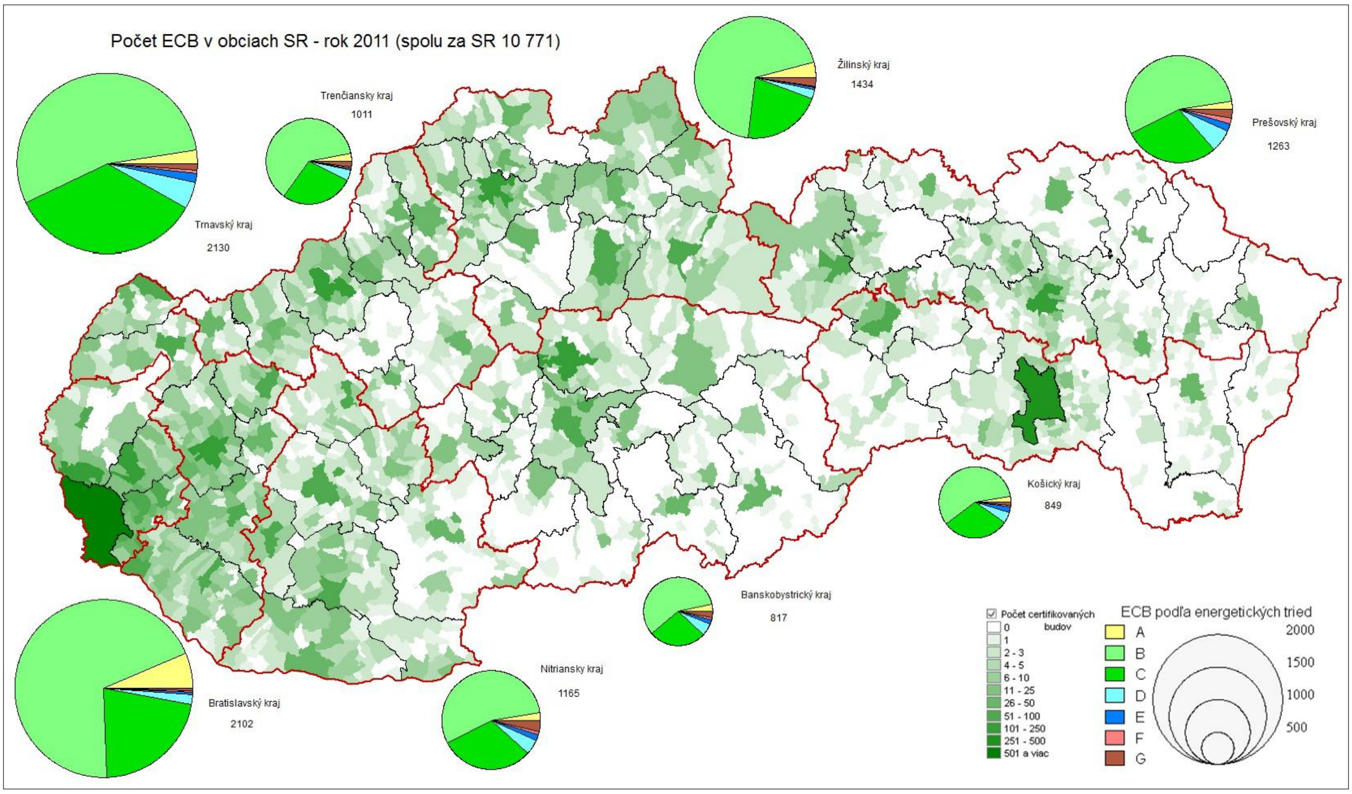
The owner or administrator is obliged to obtain the EPC, when constructing a new building and after a major renovation, in order to comply with the requirements. A new EPC should be issued within two months from the date of expiration of the original EPC. The owner may be fined, if the legal requirements are not fulfilled. The penalty for a natural person may reach 2,000 €, and 3,000 € for a legal person.

3.2 Progress and current status on public and large buildings visited by the public

A 'public building' was defined during the implementation of the recast EPBD as a non-residential building owned or used by a public authority. The requirements and procedure for obtaining EPCs for public and large buildings are the same as for all other buildings. The administrator of a public building, or a large building often visited by the public is obliged to obtain an EPC. This requirement applies to buildings with a total floor area of over 500 m^2, from the 1st of January 2013, and will be reduced to 250 m^2, on the 9th of July 2015. The owner or administrator of a public building or a large building often visited by the public is required to display the energy label in a visible place within five days after receiving the EPC and energy label. If this obligation is not fulfilled, the Energy Inspection is authorised to issue a penalty ranging from 500 € to 3,000 €.

In order to implement article 5 of the Directive 2012/27/EU on Energy Efficiency (EED), the ministry began preparing a database of the public buildings constructed in the country.

Figure 6: Distribution of Energy Classes in the EPCs for each region (2011).



3.3 Implementation of mandatory advertising requirement – status
From the 1st of January 2013, the building owner is obliged to include the information on the EP rating of the building for rental or sale in advertisements published in commercial media.

3.4 Information campaigns
In September 2012, the MDVRR, together with the Slovak Innovation and Energy Agency (SIEA), began preparing an information campaign, mainly addressed towards end users, that also attempted to reach relevant stakeholders. The information campaign is at an initial stage; it focuses on the explanation of the measures proposed for major renovations in the housing stock and public buildings, as well as on the content and importance of EPCs (Figure 7). Over the last two years, numerous different events, conferences (Figure 8), seminars, workshops and fairs have been organised. During these promotional activities, the MDVRR, SIEA and TSUS had a strong presence and stressed the importance of implementing the measures focused on saving energy. Information for owners and users of apartment buildings and family houses is available on *www.byvajusporne.sk*.

Figure 7: Flyers for informing building owners.

Figure 8: First announcement of the Thermal Protection of Buildings' Conference.

4. Inspection requirements - heating systems, air-conditioning

Slovakia has adopted option a) on article 8 of the EPBD and has decided to use the option presented in article 14(1) of the recast EPBD, both for heating and AC systems. Regular inspections have been mandatory since the 1st of January 2008.

4.1 Progress and current status on heating systems

The Ministry of Economy is responsible for the regular inspection of heating systems in buildings. The legal basis consists of the new Act 314/2012, through which relevant articles of the recast EPBD are implemented. This act replaces the previous Act 17/2007 that came into force on the 1st of January 2008. Two new decrees replace other existing decrees:

> Decree 422/2012 sets out the requirements on the procedure of regular and extended type of inspection of relevant heating systems.
> Decree 44/2013 defines in detail the examination procedure that QEs need to follow, in order to carry out the regular inspection of heating and AC systems.

In Slovakia, only companies and professionals licensed for the regular inspection of heating systems are authorised to carry out inspections. There are 161 registered licensed bodies for performing regular inspections. There is a common set of minimum required information in the inspection reports and a report template is provided by SIEA. Once a year, by the 31st of January at the latest, QEs are required to electronically send a copy of all the inspection reports issued in the previous year for monitoring, in accordance with the act to the SIEA, on behalf of the ministry.

Inspections of heating systems are based on the assessment of efficiency under defined normal working conditions. Currently, inspections of heating systems must follow the reference methodologies, partially based on EN standards, e.g., EN 15378. A detailed national methodology is defined in Decree 422/2012. The regular intervals of inspection depend on the thermal output of the heating system, the type of fuel and the type of building (residential/non-residential). The intervals for boilers fueled by biomass and biogas were reduced by the 2012 act (Table 5).

Inspections are ordered and paid for by the owner of the building or the contractual administrator of the building or the system. Building owners (or administrators of buildings or systems) are required to:

Table 5: Intervals of regular inspection of boilers and heating systems (from the 1st of January 2013).

Nominal output of boiler [kW]	Fuel	Interval of regular inspection [years]	
		Single family houses and residential buildings	Office buildings, schools and educational buildings, hospitals, hotels and restaurants, sports facilities, wholesale and retail trade buildings, other types of energy-consuming buildings
Between 20 (incl.) and 30	Fossil solid, liquid and gaseous fuels except natural gas	10	7
	Natural gas	15 (first inspection at the latest on the 31st of December 2022)	12 (first inspection at the latest on the 31st of December 2019)
	Biomass, biogas	15	**12** (until the 31st of December 2012 it was 15)
Between 30 (incl.) and 100	Fossil solid, liquid and gaseous fuels, except natural gas	4 (first inspection at the latest on the 31st of December 2011)	4 (first inspection at the latest on the 31st of December 2011)
	Natural gas	6	6
	Biomass, biogas	**6** (until the 31st of December 2012 it was 10)	**6** (until the 31st of December 2012 it was 10)
From 100 (incl.)	Fossil solid, liquid and gaseous fuels, except natural gas	2 (first inspection at the latest on the 31st of December 2009)	2 (first inspection at the latest on the 31st of December 2009)
	Natural gas	3 (first inspection at the latest on the 31st of December 2010)	3 (first inspection at the latest on the 31st of December 2010)
	Biomass, biogas	**2** (until the 31st of December 2012 it was 6)	**2** (until the 31st of December 2012 it was 6)

Table 6: Intervals of regular inspection of AC systems.

Nominal cooling output of AC system [kW]	Interval of regular inspection [years]
Between 12 (incl.) and 50	8
Between 50 (incl.) and 250	6
Between 250 (incl.) and 1,000	4 (first inspection at the latest on the 31st of December 2011)
From 1,000 (incl.)	2 (first inspection at the latest on the 31st of December 2009)

> arrange a regular inspection of the heating system;
> keep the inspection report until the report from the next periodic inspection is received;
> in the case of transfer or assignment of ownership of the building, submit the last inspection report to the new owner;
> when renting a building or heating system, provide a copy of the latest inspection report to the tenant.

The owner or administrator of a building or a system may be fined, if an inspection before a set date is not arranged, the inspection report is not kept until the report from the next periodic inspection is received, a report from the last inspection is not submitted to a new owner, or a certified copy of the report from the last inspection is not provided to a tenant. Owners, however, are not fined for a negative inspection result. The owner (or administrator) is in no way required to implement the recommendations that the QE includes in the inspection report.

Market surveillance (that is, implementation of the requirements set out by the legal act) is now performed by the State Energy Inspection (municipalities were in charge before the 1st of January 2013). All inspection reports received are registered in the monitoring system administered by the SIEA. The ministry (or SIEA on behalf of the ministry) checks a statistically significant percentage of inspection reports received every year, and at least one inspection report issued by any authorised person. When the control concludes that the inspections of a QE are not in accordance with Decree 422/2012, the ministry has the right to remove a QE from the register of QEs.

Once a year, SIEA is obliged to send the ministry a summary report on the results of inspections performed by QEs during the previous year. The first summary report was prepared for inspections performed in the year 2010. At the end of 2011, the SIEA received a total of 1,381 inspection reports for boilers (mainly natural gas boilers, corresponding to a 97.25%). The percentage of boilers not fulfilling the requirements was 6.4%, while the percentage of boilers older than 15 years was 24.5%. Ninety-two individual inspections of heating systems have been performed. The 2012 inspection reports were delivered by the 31st of January 2013 and are being assessed in 2013.

4.2 Progress and current status on AC systems

The Ministry of Economy is responsible for the regular inspection of AC systems in buildings. The legal basis for regular AC system inspections consists of the same act and decrees as in relation to the regular inspection of heating systems.

There are 24 licensed bodies registered for the regular inspection of AC systems. There is a common set of minimum required information in the inspection reports and a report template is provided by the SIEA.

Inspections of AC systems are based on the assessment of efficiency under defined normal working conditions and must follow the reference methodologies, partially based on EN standards, e.g., EN 15240. A detailed national methodology is defined in Decree 422/2012. The regular intervals of inspection depend on the cooling output of the inspected AC system (Table 6) and remain unchanged. Inspections are ordered and paid for by the building's owner or the contractual administrator of the building or the system. Building owners (or administrators of buildings or systems) are required to abide by the same obligations described for inspections of heating systems, and are subjected to the same penalties, if failing to comply with the law.

All inspection reports are registered in the monitoring system administered by SIEA. The ministry (or SIEA on behalf of the ministry) checks a statistically significant percentage of inspection reports received every year, and at least one inspection report issued by any authorised person.

Once a year, SIEA is obliged to send the ministry a summary report on the results of inspections performed by QEs during the previous year. The first summary report was prepared for inspections performed in the year 2011. At the end of 2011, the SIEA received 32 inspection reports for 32 AC system units. The total cooling output of inspected systems was 4,325 MW. A large percentage (40.6%) of the equipment was in office buildings, and only one inspected AC system was older than 4 years. The 2012 inspection reports were delivered by the 31st of January 2013 and are being assessed in 2013.

5. Conclusions and future plans

Energy certification has been established since 2008. The Energy Performance Certificates (EPCs) are centrally registered. Starting in 2013, information on building structures and technical systems, details and final calculation results are also being registered. These serve as a base for monitoring and compliance control.

The market has a positive reaction towards the requirements on Energy Performance (EP) of buildings, which is partly influenced by the incentives provided for major renovation programmes.

The compliance control system is now being developed, and should be fully in function in 2013. Information campaigns are also in their initial phase. The inclusion of the information on the building's rating in advertisements has been a requirement, since the 1st of January 2013.

Setting the cost-optimal levels for minimum requirements on the EP of buildings will be finalised by the end of June 2013.

The preparation of the Nearly Zero-Energy Buildings (NZEB) action plans will be one of the biggest challenges and an essential tool in achieving real energy savings. The prices of Renewable Energy Sources (RES) and the level of subsidies will stimulate and influence the extent to which energy efficient structures and technical systems are adopted.

Additional training for Quality Assurance (QA) will start in 2013. It will focus on the changes in legal and technical documents that have influenced the process of energy certification of buildings.

EPBD implementation in Slovenia

STATUS AT THE END OF 2012

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1. Introduction

In Slovenia, the implementation of the Energy Performance of Buildings Directive (EPBD) is the overall responsibility of the Ministry of Infrastructure and Spatial Planning. The EPBD was transposed into the national legislation by the Building Construction Act, the Environmental Protection Act, and the amended Energy Act (on the 17th of November 2006). The secondary regulation on new minimum requirements, calculation methodology, feasibility studies and regular inspection of air-conditioning (AC) systems was promulgated in 2008, while the regulation on Energy Performance (EP) certification was accepted in 2009. The training and licensing of independent experts working on the building EP certification and AC systems inspection, as well as the protocols related to the certificates registry, were defined in detail in the 2010 Regulation. The regular inspection of boilers was implemented by an existing scheme, upgraded in November 2007.

Since mid 2010, the revision of the current legislation has been in progress, in order to comply with the requirements of the recast EPBD in 2010. Slovenia is also in the process of establishing and improving the certification process.

This report presents an overview of the current status of implementation, and of the plans for the evolution of the recast EPBD implementation in Slovenia.

2. Energy performance requirements

2.1 Progress and current status

Slovenia implemented the first EPBD based on minimum requirements for energy-efficient buildings in 2002. Since then, these requirements have been revised twice, in the 2008 and 2010 Building Codes. In the 2002 Regulation on the efficient use of energy in buildings (PTZURES 2002), the minimum requirements for new buildings and major renovations were expressed by the maximum energy needs for heating (useful energy), and were complemented by the maximum U values for the building envelope, the envelope components and the windows. In the 2008 Regulation (PURES 2008), an intensive reduction of transmission losses through the building envelope, as well as new requirements on the obligatory 25% use of Renewable Energy Sources (RES) in the final energy use, were introduced. More recently, as a part of the implementation of the recast EPBD, the 2010 Building Code (PURES 2010) placed the focus also on the calculation of primary energy and CO_2 indicators, set additional minimum requirements for the primary energy for heating, limited the heating and cooling needs, both in terms of useful and primary energy, and added many new minimum requirements for energy systems.

The minimum requirements at the end of 2012, in line with the recast EPBD, were defined in the revised Regulation on the efficient use of energy in buildings

Table 1: The annual energy need classes for heating reflect the thermal quality of the building and the building envelope.

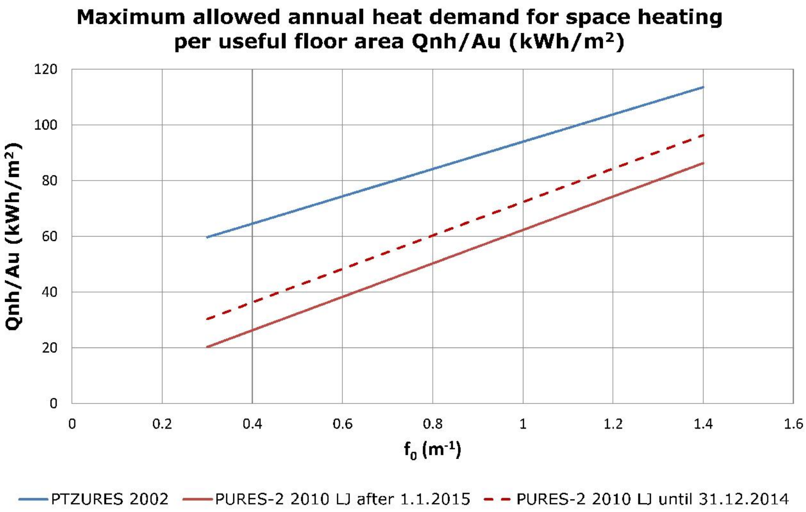
Classes are:
A1 – 0 to 15 kWh/m^2.year
A2 – 10 to 15 kWh/m^2.year
B1 – 15 to 25 kWh/m^2.year
B2 – 25 to 35 kWh/m^2.year
C - 35 to 60 kWh/m^2.year
D - 60 to 105 kWh/m^2.year
E - 105 to 150 kWh/m^2.year
F - 150 to 210 kWh/m^2.year
G - above 210 kWh/m^2.year

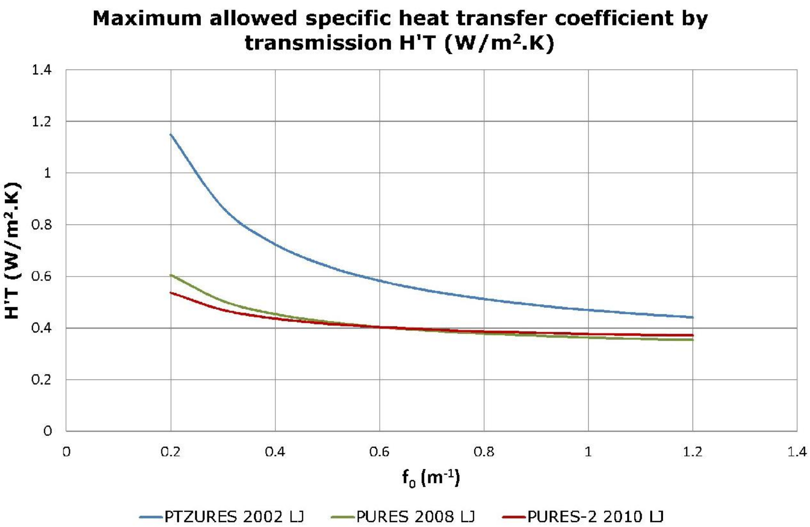
National Website *www.mzip.gov.si*

Minimum requirements of PURES 2010 building code	
Element of building envelope	Umax (W/m².K)
WALL	0.28
WALL BETWEEN APARTMENTS.	0.90
WALL AGAINST GROUND	0.35
CEILING BETWEEN APARTMENTS.	0.90
FLOOR ON THE GROUND	0.35
CEILING AGAINST UNHEATED ATTICS	0.20
CEILING ABOVE UNHEATED CELLAR	0.20
CEILING, OPEN PASSAGE	0.30
FLAT ROOF	0.20

***Figure 1:* Minimum requirements of the PURES 2010 Regulation for the building envelope elements in case of new buildings and renovation of existing buildings, U_{max} (W/m².K).**

Figure 2 : Annual heat demand requirements for space heating, and specific heat transfer coefficient by transmission for new buildings depending on the building's shape factor f_o (thermal envelope vs. heated volume) from the PURES 2010 Regulation, in comparison to the previous regulations.



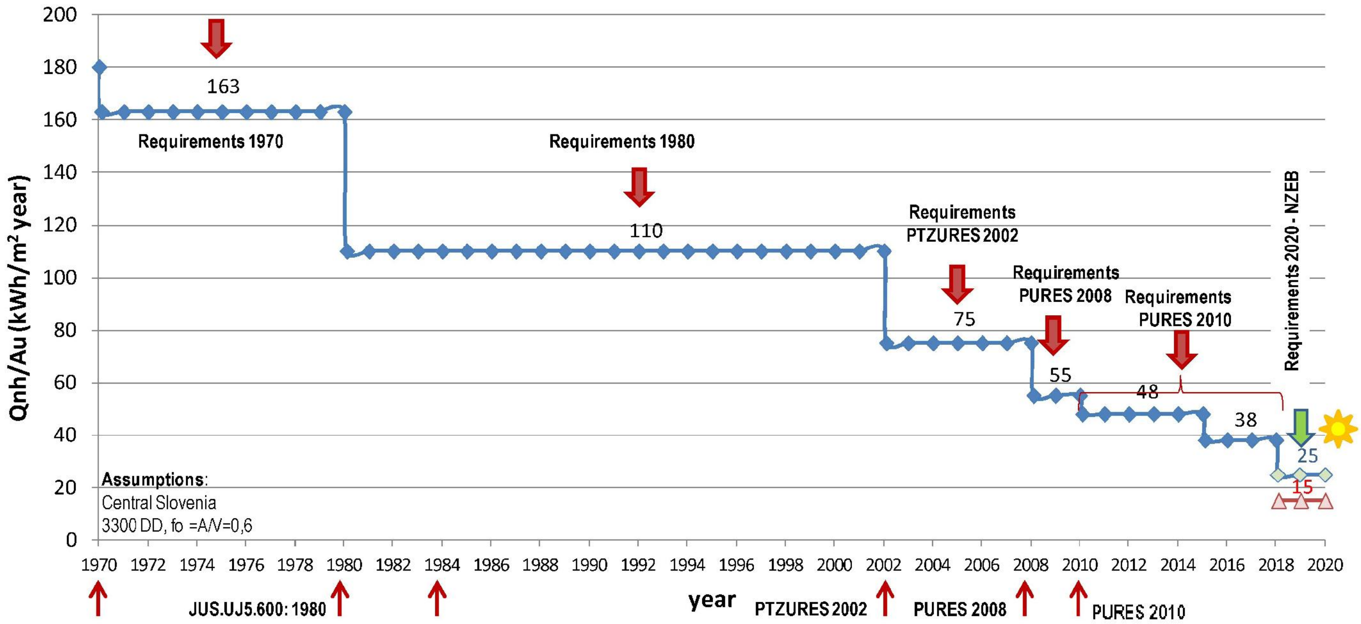


(PURES 2010), applied on a voluntary basis since July 2010, and fully in force since January 2011. Minimum requirements are expressed using performance-based requirements, energy-related requirements, and detailed technical requirements for building components and systems.[1]

Performance-based minimum requirements are focused on bioclimatic architectural concepts and on low energy losses in building envelopes with high airtightness. They also treat thermal bridges by limiting the linear thermal transmission coefficients (therefore, the simulation of thermal bridges is becoming a frequent design practice). A special set of minimum requirements refers to the energy efficiency of components and systems. As required by the recast EPBD, before the design of Heating, Ventilation and Air-Conditioning (HVAC) systems, the potential of shading, passive cooling and night ventilation must be utilised to reduce the energy needs below the required levels. Mechanical ventilation with heat recovery is not a mandatory technology (natural ventilation is also allowed) but, in practice, it is needed for buildings with Energy Class B or higher, as the reduction of ventilation heat losses by heat recovery systems leads to correspondingly low energy need for heating, which is required for Class B and higher. If mechanical ventilation is used, then heat recovery is mandatory.

1 Regulation on the efficient energy use in buildings: *zakonodaja.gov.si/rpsi/r00/predpis_PRAV7050.html*

Figure 3: Progress of the energy efficiency regulation for buildings since 1970. Maximum energy need for space heating per useful floor area according to Slovenian building codes, Qnh/Au (kWh/m².year).



Compliance with the PURES 2010 Regulation must be demonstrated by fulfilling the following energy-related minimum requirements: maximum allowed specific transmission heat losses (Ht'), maximum annual heat demand for space heating (Qnh,) and, for residential buildings only, maximum energy needs for cooling (Qnc), as well as maximum primary energy for the energy systems operation (HVAC and lighting). Maximum U-values of the envelope elements are prescribed for all buildings.

Public buildings must comply with 10% more strict requirements. The energy-related minimum requirements expressed in annual heating needs (Qnh) are imposed in two steps: for the period from 2010 to 2014, and for the period beyond 2014. The gradual reduction of minimum requirements over time is presented in Figure 3.

The use of RES is mandatory in all new buildings since 2008, i.e., min. 25% of the total final energy use for the building energy systems operation must be covered by RES. Alternatively, the RES requirement is also considered to be fulfilled if the share of RES used for space heating, space cooling, and Domestic Hot Water (DHW) is obtained in one of the following ways: 25% from solar energy, 35% from gas biomass, 50% from solid biomass, 70% from geothermal energy, 50% from heat from the environment (through heat pumps), 50% from Combined Heat and Power (CHP), 50% from energy efficient district heating/cooling. The requirement is also considered fulfilled if the building demonstrates at least 30% lower annual heat demand than that defined in the minimum requirements, or if solar collectors for hot water are installed (min. 6 m²/residential unit).

The additional minimum requirements refer to the maximum U-values of building envelope and windows, and to the airtightness of the envelope (n_{50} < 3 for natural ventilated buildings, and n_{50} < 2 for buildings with mechanical ventilation, with obligatory heat recovery).

A comprehensive list of requirements refers to energy efficiency characteristics of installations. Heat recovery in ventilation must be used due to the strict requirements for maximum allowed ventilation heat losses. The minimum required heat recovery in ventilation and/or AC systems is 65%, and 75% in low-energy buildings. Individual electrical heaters for DHW are not allowed, unless they are economically reasonable. Low temperature heating systems (max.55 °C), as well as condensing gas boilers, are obligatory in new buildings. In case of district heating and cooling, the heating and cooling energy consumption must be measured per individual building. In case of central heating, the allocation of heating costs according to the energy use per individual unit is subject of a separate regulation. Additional requirements for cooling refer to obligatory shading of the envelope, and to efficiency requirements for cooling systems. The total shading

Table 2: Minimum allowed efficiency of cooling generators, required by the PURES 2010 Building Code.

Type of generator cooling (GC)	EER	COP	ESEER	COP*	IPVL
Test by:	SIST EN 14511	SIST EN 14511	Euro vent	ARI 550/ 560/590	ARI 550/ 560/590
air-cooled GH					
air-cooled GC	2.9	3	3	2.8	3.1
air-cooled GC with connection channels	2.5	2.8	3	–	–
air-cooled GC for radiant heating / cooling	3. 7	3.9	4.2		–
water-cooled GC - all up to 1,500 kW	4.7	4.2	4.3	–	–
GC piston compressors				4.5	5.1
water-cooled GC - helical. screw compressor. up to 500 kW	–	–	5	4.5	5.2
water-cooled GC - screw compressor. 500 kW - 1,000 kW			5	4.9	5.6
water-cooled GC - spin. compressor 500 kW - 1,000 kW	–	–	5.2	5	5.3
500 kW - 1,000 kW			5.8	5.6	5.9
above 1,000 kW			6.3	6.1	6.4
air-cooled GC for radiant heating / cooling	4.9	4.2	5	–	–
GH with remote condenser	3.4	–	3.6	3.1	3.5
absorption - air / water-cooled. single-stage	–	–	–	0.6/0.7	–
two-step	–	–	–	1	1

**COP is valid for measurements accoring to ARI (The American Refrigeration Institute), and it is equivalent to EER – Energy Efficiency Rating without taking into account the additional electrical power.*

factor resulting from the positioning of natural or artificial objects, as well from the position and type of the shading device on the window, with consideration to glazing characteristics, must be lower than 0.5 ($g < 0.5$). Internal shading devices are not considered as solar protection.

The minimum requirement for lighting defines the maximum allowed specific power of lighting devices per building category. Energy-saving lamps are obligatory; at maximum, only 20% of lighting may be covered by incandescent light bulbs.

At the design stage, it is obligatory to prepare a 'summary of the building thermal characteristics', where the main building and system characteristics, as well as the energy and CO_2 indicators are given. After the building is completed, the calculation and the summary have to be repeated (by the designer, for the building as built). This is the proof for the final control of compliance with the regulation. This final proof is part of the building certificate of compliance with the essential requirements, and it is a precondition for the use permit. Fulfillment of the minimum requirements has to be demonstrated in the design in order to obtain a building permit, and after the building is completed, when applying for a use permit. This is the core technical documentation used by the independent expert in the next step, when preparing the Energy Performance Certificate (EPC).

Table 3: Maximum allowed lighting power density required by the PURES 2010 Building Code.

Description of the space	**Lighting power density (W/m²)**
Residential buildings	8
Hotels, office buildings	11
Restaurants	15
Libraries, industrial buildings	14
Conference rooms. courts, pavilions, educational and research buildings, health buildings	13
Post offices, dancing halls, museums, galleries, sport's halls	12
Small shops	16
Shopping malls	9
Garages	3

Minimum requirements apply to all new buildings, as well as to major renovations, i.e., if at least 25% of the surface of the building envelope is subject to renovation. The minimum requirements for major renovations must be implemented regardless of the building size (the 1,000 m^2 threshold allowed by the EPBD is not used).

If a renovation (i.e., when a building permit is needed) is limited to less than 25% of the thermal envelope surface, in case of maintenance works on the building envelope, and in case of buildings with a floor area smaller than 50 m^2, only the minimum requirements for the U-values of the envelope must be considered (i.e., an additional insulation layer will be mandatory).

In case of major renovation of the heating system, and in case of maintenance and replacement works, minimum requirements for the systems, subsystems and elements of the same level as that required for new buildings are to be implemented.

2.2 Format of national transposition and implementation of existing regulations

In order to demonstrate compliance with the minimum requirements, the calculation of the building energy performance was updated in July 2010 (PURES 2010) as well as the obligatory technical guidelines for construction TSG-1-004: 2010 Efficient use of energy. The PURES 2010 has already covered some elements of the recast EPBD transposition, i.e., the implementation of CEN EPBD standards in the calculation methodology and the setting of minimum requirements for very low-energy new buildings and public buildings.

The calculation methodology is based on the SIST EN ISO 13790 and the respective set of CEN EPBD standards, with some national adjustments. It includes the energy needs for space heating and space cooling, hot water preparation, and operation of ventilation systems, (de)humidification and lighting. The methodology calculates energy needs, expressed in terms of both delivered and primary energy, as well as CO_2 emissions.

The respective software was developed by various market actors (three tools were available at the end of 2012; additional ones are in progress). The tools are available on the market free of charge. Frequent trainings for software users are offered since 2009. Additional effort was put into the preparation of climatic data (climatic data available in a 1 km - wide grid since 2007), due to the considerable regional climatic variety.

Once the construction process is completed, the independent expert prepares the EPC, which is a precondition for issuing the building's use permit. In the EP certification process, the documentation of the implemented works (designer's calculations), as well as a building survey, are used in order to reflect in the EPC the real status of the building and the building systems.

2.3 Cost-optimal procedure for setting EP requirements

In order to investigate the cost-optimality of the minimum requirements in the Slovenian Building Code, a national study was initiated in 2012, based on the EC comparative methodology framework. Firstly, the effort was focused on the cost-optimality at financial level (with consideration of the end user perspective), aiming at the definition of cost-optimal minimum requirements for new single-family houses (single-family houses are the most numerous, representing 75% of the residential sector floor area, and 55% of the entire Slovenian building sector).

The assumption of the calculation period of 30 years for residential buildings differs from the building lifetime of 60 years defined in the national regulation for the maintenance of residential buildings, although in practice the most common period for major renovations in the residential sector is 30-40 years. The other boundary conditions are based on the National Energy Programme (NEP 2030). This defines the energy scenarios, taking also into account the assumption on the energy price increase, as well as the anticipated increase of CO_2 prices based on the emission trading system, for the calculation at the macroeconomic level (in line also with the figures in Annex I of the EC methodology framework). The recent establishment of the national real estate database (REN 2008) gave the necessary support for the categorisation of the building stock according to the type of use, period of construction, main architectural characteristics, and implemented renovation measures. Thus, the selection of reference buildings was based on the typology of the Slovenian national residential building stock, elaborated in the IEE project TABULA. The reference buildings are characterised by architectural type (single-family buildings, terraced houses, small apartment buildings, and highrise apartment buildings), and by the construction period reflecting the energy efficiency level (i.e., buildings built until 1970, 1971-1980, 1981-2002, 2003-2010, 2011 and beyond). The typology of the non-residential building stock has not been elaborated at the end of 2012. Although there are some early activities in the country, it is clear that the variety of non-residential buildings is much bigger that that of the residential sector. The residential reference buildings are thus example buildings, while the non-residential reference buildings are expected to be virtual buildings based on the available relevant indicators from the national real estate registry.[1]

1 IEE TABULA Building typology: *www.building-typology.eu*

The EC methodology allows Member States (MS) to complement the methodology framework in certain elements. The economic lifecycles of the building and building elements are assumed in line with the findings of the IEE LCC DATA project, the national regulation on maintenance of buildings and building elements, and the EN 15459: 2007 standard (for energy systems). The comparison with related EU studies on Life Cycle Cost (LCC) showed that the lifetime of building elements may differ significantly. The discount rates of 3% and 5% (required in the national procurement documentation) are taken into consideration. The cost categories for LCC are based on the prEN 15643-4 (and the standardisation from CEN/TC 350), with consideration of the Annex I of the methodology framework. Disposal costs are excluded. Costs that are the same for all variants, and costs that have no influence on the building EP (i.e., building structure, plot, communal infrastructure) are also omitted. The primary energy factors are determined in the national regulation, i.e., the Building Code PURES 2010. Energy performance is determined according to the national calculation methodology, based on the EN ISO 13790 and the CEN EPBD standards. The climate in central Slovenia may be considered relevant for the majority of settlements in the country. Only the small coastal area has milder, Mediterranean climate. At the end of 2012, the preliminary results can be given only for a single-family reference building. For a single-family house with a useful floor area of 150 m^2, a group of 130 variants is defined. Alternatives refer to different insulation thickness (5 – 35 cm), windows with thermal transmission between 1.2 W/m^2.K and 0.8 W/m^2.K, natural and mechanical ventilation with heat recovery, and energy systems with condensing gas boiler, wood pellet biomass boiler, ground/water heat pump, air/water heat pump, solar collectors for DHW and/or space heating.

The results also demonstrate clearly that the minimum requirements set for new residential buildings -single-family houses- in the PURES 2010 Building Codes are stricter than the minimum requirements corresponding to the cost-optimal level, mainly due to the national energy and climate policy objectives in the building sector. All cases in compliance with the 2010 National Building Codes are based on the implementation of insulation levels and windows, resulting in overall specific transmission heat losses of the building envelope (Ht') bellow 0.4 W/m^2.K, as well as on the use of condensing gas boiler and solar collectors for DHW, and other systems, e.g., heat pump or biomass boilers, that lead to the share of over 25% of RES in the delivered energy.[1]

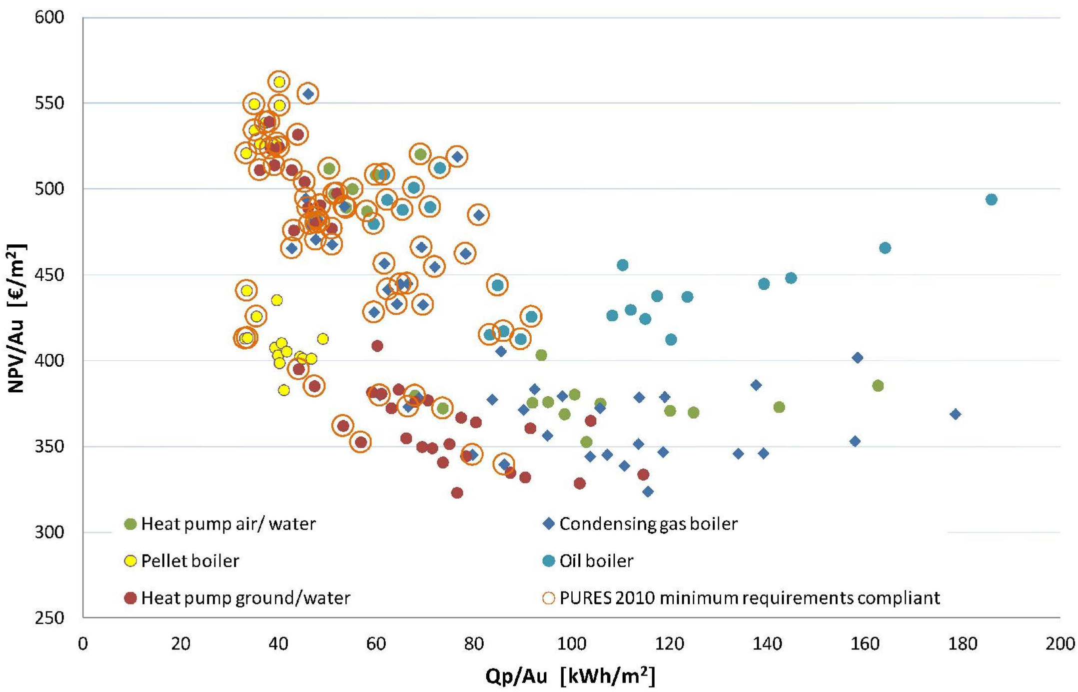


***Figure 4:** Net present value of the energy related investment, running and maintenance costs for a typical new single-family building with various energy efficiency levels, energy systems and energy sources (discount rate 3%, 30 years life-time, state subsidies included). Net present value (NPV/Au) is presented depending of the primary energy use (Qp/Au) to enable to identification of cost-optimal building design.*

1 E.g., relevant quotes in: ŠIJANEC-ZAVRL. Marjana. GJERKEŠ. Henrik. TOMŠIČ. Miha. Integration of nearly zero energy buildings: a challenge for sustainable building stock. V: World Engineering Forum. 17-21 September 2012. Ljubljana. Slovenia. Sustainable construction for people. Ljubljana: Inženirska zbornica Slovenije. 2012. str. 161-166. Available from: *www.wef2012.si/fileadmin/dokumenti/WEF_2012_final-version.pdf*

2.4 Action plan for progression to NZEB

In Slovenia, the transposition of the Nearly Zero-Energy Buildings (NZEB) principle into the real conditions demonstrated a need for integration of the building design and the energy planning. Sustainable energy planning is an opportunity for municipalities to create favourable boundary conditions for NZEB. It is expected that the solutions for decreasing the energy demand in buildings, which are often beyond the cost-optimal level, will be compensated not only with on-site RES, but also with a growing share of green energy in the national energy networks.

In the period 2011-2016, in relation to the 2010 building stock area, plans call for a 3% (0.2 million m^2) increase in the construction of new residential buildings meeting the NZEB standard.

2.5 Any other relevant information

Considering the natural resources in Slovenia and the current stage of the development of RES technologies the most appropriate RES for power production seem to be wood biomass and hydropower. The sun is a free and evenly distributed energy source; however, the exponential increase of installed capacity of the solar power plants in Slovenia, exceeding 6% of all RES capacity in 2011, with high subsidy rates of more than 10%, did not provide more than 1.4% of all the electricity produced by RES. The use of municipal waste is also very promising, with a large supply, but requires complex and interrelated systems, which inhibits its faster deployment. On the other hand, anaerobic fermentation of organic matter for biogas production has great potential, well-developed technology and all prerequisites to be a key technology for the self-supply of sustainable energy.

Hydropower is already well utilised in Slovenia; actually, there are only a few opportunities left for further increasing the capacity of hydropower plants without coming into conflict with the sustainable conservation of nature. In contrast, there is an abundance of wood, which has a great development potential. Wood is already recognised as a strategic resource, which should be principally used in wood industry for products with high added value, as well as a byproduct for energy production. In one way or another, a rational synergy between the still largely unexploited potential of some RES, and the cost-effective energy optimisation, could become one of the cornerstones for sustainable buildings, as well as for the successful development of Slovenia.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

The regulation on detailed methodology for the EP certification of buildings (in force since November 2009, revised in December 2012) defines the certification protocols for new and existing buildings, the methodology for residential and non-residential buildings in case of sale and rental, as well as the procedure for the public display of the certificate. The regulation determines in which cases certificates based on calculations ('calculated') or certificates based on measurements ('measured') are to be applied, how the indicators should be obtained, as well as the responsibilities for the provision of data. It also defines the EPC electronic database and the responsibilities in relation to this database.[1]

The regulation on the training, licensing, and registering of licenses of the independent experts for EP certification of buildings was adopted in January 2010, and was recently revised (February 2013).[2]

According to the Energy Act, certificates for new buildings and public buildings are obligatory since the 1st of January 2008. Large public buildings have to provide and publicly display an EPC since January 2008 and by December 2010 at the latest. The changes in the Energy Act also prescribe sanctions in case of failure to display the EPC. An EPC can be issued either for a building part (a flat or a residential or non-residential unit), or for the building as a whole.

According to the law, the EPC is a public document. Thus, it can only be issued by authorised organisations, and elaborated by licensed experts. The validity of the EPC is 10 years. A new certificate can be issued upon the request of the building owner; e.g., although not obligatory, this is recommended after the implementation of RES and Rational Use of Energy (RUE) measures.

1 Regulation on the EP certification *zakonodaja.gov.si/rpsi/r01/predpis_PRAV8151.html*

2 Regulation on the training of independent experts *zakonodaja.gov.si/rpsi/r00/predpis_PRAV10090.html*

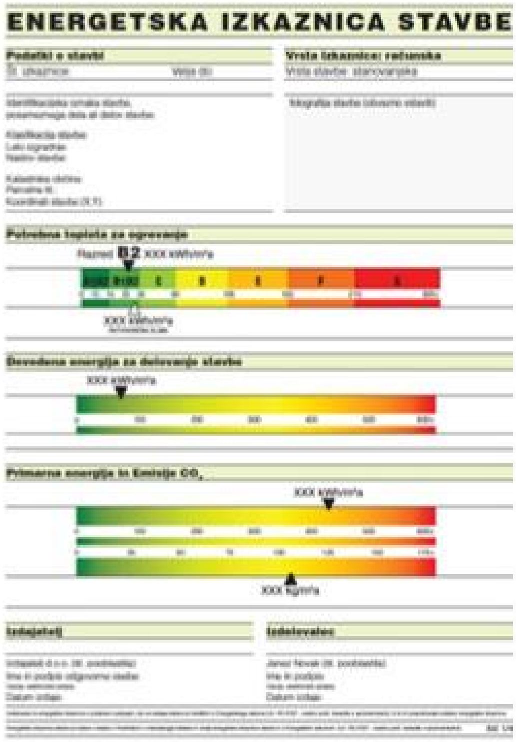


Figure 5: 'Calculated' EPC and 'measured' EPC.

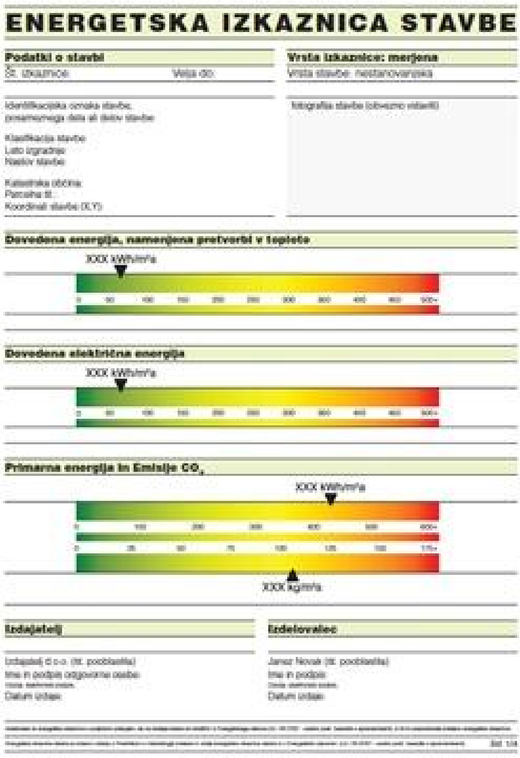


Figure 6: 'Measured' EPC.

According to the forthcoming revision of the Energy Act, the price of the EPC is not defined by the ministry. The ministry and the stakeholders discussed the minimum and maximum prices of the EPC, and defined an unofficial price list. Currently, this serves as a recommendation. Recently, a fee for the maintenance of the national EPC registry and to pay for the Quality Assurance (QA) scheme was prescribed in the last revision of the Energy Act (2012 revision).

A 'calculated' certificate is considered for all new buildings, as well as for existing residential buildings. The calculation procedure is based on the SIST EN ISO 13790, and is defined in detail by the technical regulation. 'Measured' certificates are foreseen for all existing non-residential buildings.

The 'calculated' EPC contains four calculated indicators (based on the SIST EN ISO 13790) of equal importance but with different and complimentary messages behind them:

> energy needs for heating (reflects the building architectural concept and the thermal quality of the building envelope) (kWh/m^2.year);
> final energy use (delivered) for HVAC systems and lighting (kWh/m^2.year);
> primary energy use (kWh/m^2.year);
> related CO_2 emissions (kg/m^2.year).

At present, the energy efficiency classes are foreseen only in the 'calculated' certificate, based on the heating energy needs during one year. Seven classes, from A to G, are defined. Classes A and B are further divided into two sub-classes.

A second indicator covers the final energy (kWh/m^2.year) delivered for space heating and space cooling, hot water preparation, operation of ventilation systems, (de)humidification and lighting. The third and fourth indicators describe primary energy (kWh/m^2.year) and CO_2 emissions (kg/m^2.year), calculated from the primary energy demand. All four indicators are presented on the front page of the certificate, in a coloured scale.

A 'measured' certificate is considered for existing non-residential buildings (based on the SIST EN 15603). The core indicators in the operational rating are:

> final energy for heating (kWh/m^2.year);
> electricity consumption (kWh/m^2.year);
> primary energy (kWh/m^2.year);
> CO_2 indicator (kg/m^2.year).

The indicators are presented with the use of a sliding scale.

In the case of public buildings and existing buildings planned for sale, energy efficiency measures must be included in the certificate, according to the revised Energy Act 2012. Generic recommendations are accepted; tailored comments are welcome.

Currently, there are no explicit requirements for the energy class in the case of new buildings and major renovations. However, many Slovenian public and private investors tend to follow green (public) procurement guidelines and designs, or purchase B2, B1 or A class buildings. Together with the minimum requirements in force since July 2010 (PURES 2010) on system efficiency and RES share, these buildings may be considered as being in line with the recast EPBD objectives.

In the case of new buildings, if sold before construction works are completed, a summary of the EP indicators is used as an EPC (i.e., the design rating). This summary is part of the design documentation submitted with the request for a building permit (in place since 2002). When the building is completed, the investor must replace the summary with the (official) 'calculated' certificate. A 'calculated' EPC must be issued for new buildings and submitted along with the rest of the documentation in the application for a use permit. Since 2002, all new buildings must have a design certificate in the construction planning documentation.

All existing residential and non-residential buildings need to be certified when sold or rented. The owner must present a valid certificate to the buyer before the selling or renting contract is established. The sanctions for failing to do so will be prescribed in the forthcoming revision of the Energy Act. Certificates for residential buildings always use calculated energy ratings, while certificates for non-residential buildings use measured energy ratings. Calculated certification is also possible, in case of incomplete and/or unreliable measured data. This involves a Qualified Expert (QE) visiting the premises and assessing the building, with the support of the plans of the building as built (required along with the certificate), and of various additional energy-related studies (i.e., energy audits, meter readings, Infra Red thermography, blower door test, etc.). These studies are voluntary but, if existing, they must be submitted to the QE, who will then either calculate the thermal efficiency of the building, or analyse the measured energy consumption data and, finally, issue the certificate.

The typical cost of the EPC for a single-family house corresponds to one day of an expert's work, i.e., between 300 € and 500 €. In general, the certification cost is subject to the size and complexity of the building, as well as to the quality of the available technical documentation.

Qualified Experts and Quality Assurance

The training of experts is the first stage to guarantee a system's high quality level. A specific training course with high passing grades in the exam is required.

The training courses and exams for QE for the EP certification are conducted by an authorised organisation (the Building and Civil Engineering Institute - ZRMK) for the period 2011-2014. The obligatory training (27 hours in classes and 2 weeks of homework for both 'calculated' and 'measured' EPCs) covers the following topics: regulations on building EP certification, special topics related to the energy efficiency of building elements and systems, brief information on the calculation and measurement rules, evaluation of the energy efficiency data for the certificate, recommended measures, as well as certification protocols and issuing procedures. Basic knowledge about energy flows in buildings is not a subject of the training, as candidates are professionals with a technical university degree in architecture or engineering. The preparation of the training material is coordinated at state level. By the end of 2012, around 120 independent experts on EP certification were trained. They are offered further support via a forum and a club of experts.[1]

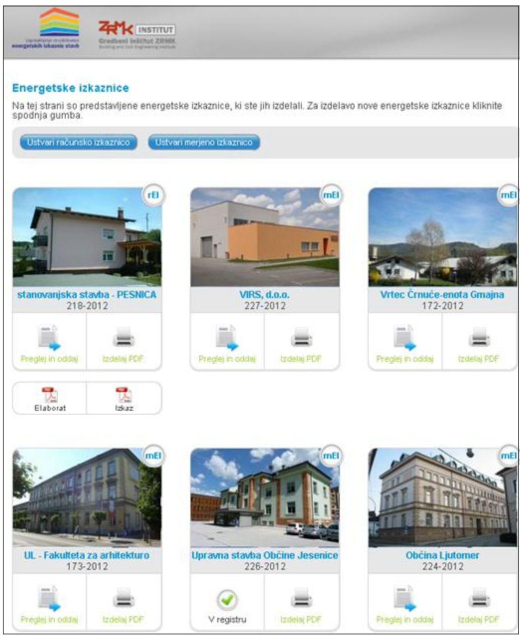


Figure 7: Registry of EPCs used for the training of EPC experts.

1 Official website for the training of independent experts for EP certification *www.energetskaizkaznica.si*

Figure 8: Promotion of the 2012 revision of the EPC.

The second stage to guarantee the EPC quality is an automatic system software check of the data input (feasibility check), in order to avoid potential mistakes even before issuing the EPC. Slovenia is currently establishing a QA check after the EPC is issued. It will include a full data review of the calculations, as well as a building audit in order to check the accordance with the requirements and methodologies. The quality of the certificates will be assured by checking about 3% of the issued EPCs. The electronic database with the collected EPC energy indicators will be used.

The Energy Act has also imposed a set of protocol requirements that contribute to the QA:

> Independence of assessors: the assessor shall refuse an order for certification in the cases defined by the regulation, due to general administrative procedures: if he/she is employed by a customer or by the person ordering the certification; if he/she performs any other payable services for the client ordering the certification.
> The assessor must issue a statement to the client, declaring that he/she meets all the necessary conditions to issue the energy certificate, and that he/she has no legal impediments to do so.
> The ministry may withdraw the authorisation if an organisation issuing certificates does not fulfill the prescribed conditions.
> The ministry has the authority to withdraw an independent expert's license if he/she issues incorrect certificates, and/or if he/she does not respect the conditions regarding independence. No fines are foreseen in the legislation yet.

Figure 9: Training of independent experts in April 2012.

3.2 Progress and current status on public and large buildings visited by the public

In public buildings, the EPC is subject to the same general rules explained previously. In all public buildings with a floor area above 1,000 m^2, the building manager must place the EPC in a clearly visible place. The revision of the Energy Act will reduce the threshold to 500 m^2, and later to 250 m^2. The law is awaiting approval by the Parliament during 2013.

3.3 Implementation of mandatory advertising requirement – status

The EPC-based advertising became a part of the revision of the Energy Act in February 2012. No additional rules are set besides the necessary placement of the energy indicators and/or the energy class of the building in the advertisement. A revision of the Energy Act is in preparation, which will prescribe sanctions on this topic.

3.4 Information campaigns

Information campaigns on the certification system have primarily been focused on municipalities, technical experts and professionals in the building sector. The ministry intends to organise more meetings in 2013. During the last two years, the EPBD was presented in more than 100 events, fairs, seminars and workshops, where the content was promoted, and the awareness of citizens on the added value of quality performance buildings, was raised.

Of particular importance in this respect are also the IEE projects BUDI (development of the EPC market), ENFORCE (complementary training of EPC auditors, promotion of the EPC, audits and renovation measures), DATAMINE (building energy indicators based on EPCs) and TABULA (building typology and simplified energy analysis). In the frame of a national Research and Technological Development project, new tools for simplified EP pre-analysis are being developed (ZEVS), aiming at the promotion of tools for preliminary energy surveys of existing buildings.[1]

1 Website promoting the IEE ENFORCE energy auditing and simplified tools for assessing the building EP
www.gi-zrmk.eu/enforce/?page_id=312

Figure 10: Information leaflets and brochures supporting EPC recommended measures.

Figure 11: Promotion of the public placement of EPCs in the Municipality of Ljubljana.

Figure 12: Information package on the EPC for end users.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems

Slovenia has a well established inspection scheme for boilers, which is covered by the Decree on the procedure, the scope and conditions for the execution of obligatory state economy public services of performing measurements, inspection and cleaning of boilers, chimney ducts, and ventilation ducts, aiming at the protection of the environment and the efficient use of energy (Official Journal, Nr. 105-5223/2007, of the 19th of November 2007). The Decree defines the frequency of regular boiler inspections, the extent of the service, the conditions for permit concession to chimney sweeping companies, as well as the professional requirements for the experts conducting the service. The Decree also defines the protocols for the service-related database. 350,000 boilers per year are inspected under this scheme.

Slovenia decided to adopt the alternative option allowed by the EPBD for the inspection of heating systems. New mandatory inspections will be developed only for large heating systems usually found in larger private and public buildings. Alternative measures will be taken for smaller heating systems, and the energy savings obtained by the regular inspection of such systems will be evaluated.

4.2 Progress and current status on AC systems

The regular inspection of AC systems is defined in the Regulation on obligatory inspection of AC systems (Official Journal, nr. 26/2008, of the 17th of March 2008). A regular inspection is needed every 5 years. Phased implementation was planned for new AC systems since the 25th of March 2008, and for existing AC systems from the 1st of October 2009 to the 1st of October 2012, depending on the age of the AC system and the available technical documentation (no documentation is a reason for inspection in the first period). Inspection of AC systems is currently still not in place, due to the delay in the training and licensing system.

5. Conclusions and future plans

The following activities are planned for the short and medium term:

> further intensive training of independent experts for Energy Performance (EP) certification and regular inspection of air-conditioning (AC) systems;
> establishment of a higher quality control system;
> development of the electronic database and software support;
> establishment of the database of energy indicators and, based on that, provision of feedback regarding the energy indicators, for ranking per different building types (as needed in case of complex and mixed-use buildings);
> validation of calculation tools.

Especially in the residential sector, it is important to support the EP certification with subsidies and/or soft loans. Eco fund, a Slovenian environmental public fund, also offers subsidies and soft loans for the energy renovation of existing residential buildings, as well as for the construction of very low-energy new residential buildings. Most of the subsidies are given for building components and systems, which are the most frequently recommended measures in the Energy Performance Certificates (EPCs).

Figure 13: Number of subsidised investments by Eco fund.

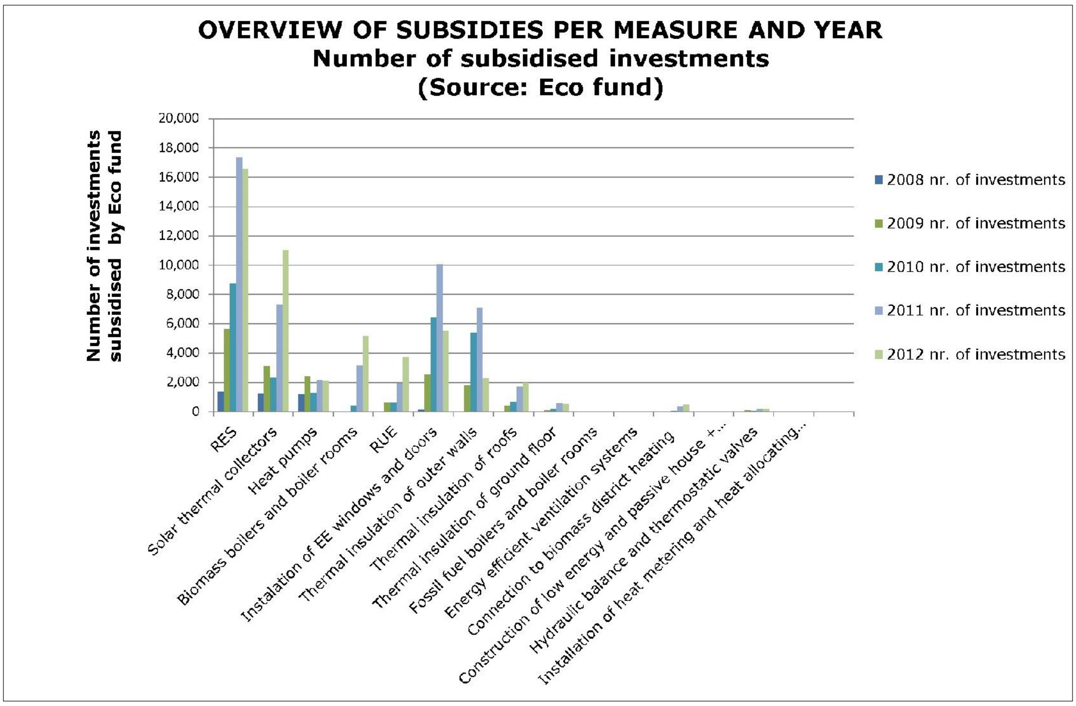
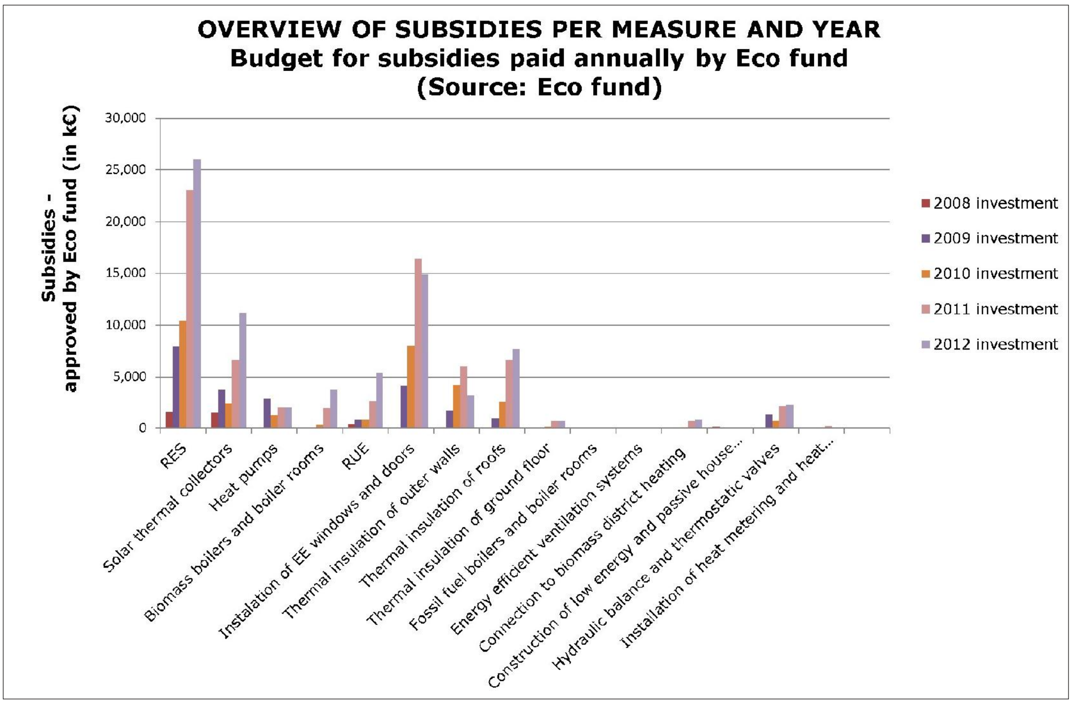


Figure 14: Budget for subsidies paid annually by Eco fund.



EPBD implementation in Spain

STATUS AT THE END OF 2012

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1. Introduction

The implementation of the Directive 2002/91/EC on the Energy Performance of Buildings (EPBD) in Spain is the responsibility of the Ministry of Industry, Energy and Tourism, and of the Ministry of Public Works and Transport. The Institute for Energy Diversification and Saving (IDAE) also contributes to this process.

Since the publication of the EPBD, Spain has worked to implement its transposition into national law. The initial transposition of this Directive consisted of the following Royal Decrees:

> Royal Decree 314/2006, of the 17th of March, approving the Technical Building Code (TBC).
> Royal Decree 47/2007, of the 19th of January, approving the basic procedure for the energy certification of new buildings.
> Royal Decree 1027/2007, of the 20th of July, approving the Thermal Building Regulations, modified by the Royal Decree 1826/2009, of the 27th of November.

A new Royal Decree was published in April 2013, replacing the Royal Decree 47/2007, for the legislation regarding the energy certification of existing buildings, taking into consideration the 2010/31/EU Directive (recast EPBD). The Royal Decree 235/2013 of the 13th of April, and the update of the Thermal Building Regulations with the Royal Decree 238/2013 of the 13th of April, were also published.

Moreover, a revision process of the current regulations is almost completed, involving the TBC. The revised regulations are expected to be published before the end of 2013.

In parallel, the roadmap to guide Spain towards the objectives established in the recast EPBD in terms of all new buildings becoming Nearly Zero-Energy Buildings (NZEB) from the year 2020 onwards, is already under way.

2. Energy performance requirements

The transposition of the EPBD related to the Energy Performance (EP) requirements consists of the Royal Decree 314/2006 approving the TBC. It sets the minimum requirements that must be met by all new buildings (residential, non-residential, public and private buildings), as well as by existing buildings undergoing a renovation of more than 25% of their area.

2.1 Progress and current status

With the enforcement of the TBC in 2006, building energy efficiency received a large boost. This basic standard consists of 5 documents:

> CTE DB HE1 - Limitation of energy demand.
> CTE DB HE2 - Performance of thermal installations (RITE).
> CTE DB HE3 - Energy efficiency in lighting installations.
> CTE DB HE4 - Minimum solar contribution for hot sanitary water.
> CTE DB HE5 - Minimum photovoltaic contribution for electric power.

These documents set the minimum requirements in comparison with the previous regulations. For example, for Madrid, the differences in those minimum requirements are shown in Table 1.

The revision which is currently under way should lead to a new TBC before the end of 2013. This revision constitutes the framework for the cost-optimal requirements. The first leap in the requirements will take place in 2013, as a first step on the way leading to NZEB in the year 2020; the second one will take place in 2016.

2.2 Format of national transposition and implementation of existing regulations

The document CTE DB HE1 replaced the former regulation, NEB-CT-79, on the thermal conditions of buildings, considerably tightening the requirements demanded for the building envelope. As an example, in the case of Madrid, the maximum thermal transmittance for the facade was cut back from 1.20 W/m².K to 0.66 W/m².K.

Table 1: Differences in thermal conductance for Madrid, NBE-CT-79 and TBC 2007.

Component	NBE CT 79	TBC (CTE 2007)
Roof	0.9	0.61
Light building facade (<200 kg/m²)	1.2	0.69
Heavy building facade (>200 kg/m²)	1.4	0.69
Forged on open space	0.8	0.69
Wall in contact with unheated local	1.6	0.69
Floor/roof in contact with unheated local	1.2	0.69
Floor		0.69

Table 2: VEEI limits.

Group	Differentiated activity areas	VEEI Limit
No representing areas	Warehouses, archives, technical rooms, kitchens	5
	Common areas	4.5
	Parkings	5
	Administrative areas	3.5
	Classrooms and laboratories	4
	Hospital rooms	4.5
	Diagnostic rooms	3.5
	Sports areas	5
	Transport station platforms	3.5
	Exhibition halls	3.5
	Other indoor areas	4.5
Representing areas	Common areas	10
	Transport stations	6
	Common areas in residential buildings	7.5
	Administrative areas	6
	Religious areas	10
	Halls, auditoriums, etc.	10
	Hotel rooms	12
	Hotels and restaurants	10
	Shops and stores	6
	Shopping centers	8
	Shops and small businesses	10
	Libraries, museums and art galleries	6
	Other indoor areas	10

The CTE DB HE2, despite being part of the TBC, is, for historical reasons, usually dealt with as an independent document: the Regulation on Building Thermal Installations, known as RITE. As a result of the EPBD, this document, whose former version dated back to 1998, was revised in 2007, introducing the concept of periodic inspections on energy efficiency to be implemented by the Autonomous Communities.

The document was modified by the Royal Decree 1826/2009, which introduced winter and summer limit temperatures for indoor air in administrative, commercial and public buildings when fossil energy is used to heat or cool the building: 21 ºC for winter and 26 ºC for summer. It is also required to display these temperature values in a visible place on these buildings. In addition, the modification introduced the obligation of using a mechanism to keep the doors of all building parts directly connected with the street closed, when fossil energy is being used, to condition the building.

The CTE DB HE3 defines requirements on lighting, limiting the minimum energy efficiency of the tertiary building lighting systems. For so doing, the concept of the Energy Efficiency Value of the Installation (VEEI) is introduced. VEEI is the relation between the lamp power plus auxiliary equipment, the illuminated surface and the average maintained illuminance. The minimum value of this factor is limited as a function of the use of the various rooms in the building.

For the first time, the use of Renewable Energy Sources (RES) became compulsory in order to meet part of the energy needs of buildings, either to produce sanitary hot water (for both residential and non-residential buildings), as set forth in the CTE DB HE4, or to produce electric power in tertiary buildings as set in the CTE DB HE5. As this requirement is included in the TBC 2006, which is a national regulation, the use of RES in new buildings is mandatory in the whole Spanish territory.

Compliance with the requirements of this document is compulsory for any new building; its usage is not allowed in case of non-compliance. Each region manages

Table 3: Buildings selected for the cost-optimal study.

Existing buildings		New buildings	
Residential	Non-residential	Residential	Non-residential
4 buildings: 2 single-family 2 multifamily	**2 buildings:** Educational Office	**6 buildings:** 3 single-family: detached, semi-detached, terraced 3 multifamily: isolated building, building between adjacent buildings, building occupying a whole block	**4 buildings:** Office Commercial Cultural activities Sport facilities

the schedules and inspection procedures to ensure compliance with inspections of thermal installations.

2.3 Cost-optimal procedure for setting EP requirements

Cost-optimal levels are being calculated as established in articles 4 and 5 of the recast EPBD and in the Delegated EC Regulation 244/2012. The cost-optimal study consists of: selection of reference buildings, selection of measures/variants, calculation of the energy demand of the building with measures/variants, calculation of costs, calculation of energy consumption, and cost-optimal calculation for the microeconomic and macroeconomic studies. Finally, comparison with the minimum building energy requirements will be carried out.

The main factors taken into account for the selection of the reference buildings have been:

> a database containing the typical characteristics of existing buildings;
> typical new buildings built in Spain;
> compactness of the building.

Table 3 shows the buildings selected for the study.

Twelve climatic zones have been considered in the cost-optimal study, because there are different building energy requirements depending on the climatic zone. For each climatic zone, the study included each type of building placed in different orientations.

The packages of measures or variants are the result of the combination of several individual measures.

The energy demand is calculated with a calculation engine based on an hourly multi-zone method, using several assumptions and the modelling scale of the official Spanish calculation tools. Thousands of cases have been calculated in the cost-optimal study, in order to obtain a sufficient number of cases as to determine the cost-optimal energy level for each type of building in each climatic zone. So far, most of the cost-optimal calculations have been already completed, and further analysis and comparison with the building energy requirements are still under way. The first results indicate that the cost-optimal levels are more demanding than the current minimum requirements in the regulations. Since the current energy requirements set in the Code 2006 are being updated, the results of the cost-optimal study are expected to be implemented in the near future. More cost-optimal studies should be conducted in the future, in order to take into account other parameters which might be relevant in certain areas or climatic zones, such as adaptive comfort.

As a conclusion, in a country like Spain, cost-optimal levels may vary significantly from one climatic zone to another. Consequently, different measures/variants for the optimal cost can be found if the analysis is on cooling, heating, or both. In warm areas, cooling and demand on domestic hot water and/or lighting become relevant, and might be responsible for most of the energy consumption.

The cost-optimal study showed that the interest rate used for the financial study of cost-optimal levels must be realistic, because the results on cost-optimality are very sensitive to this parameter.

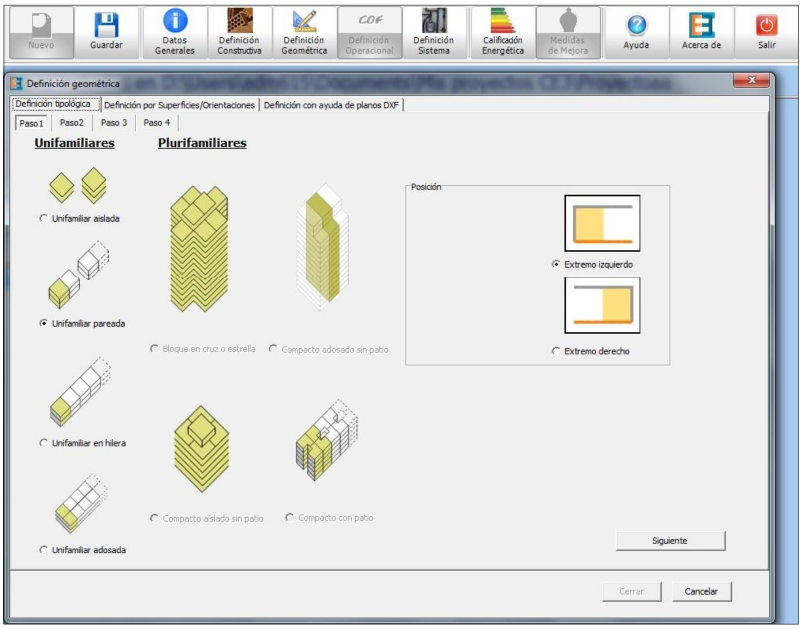
2.4 Action plan for progression to NZEB

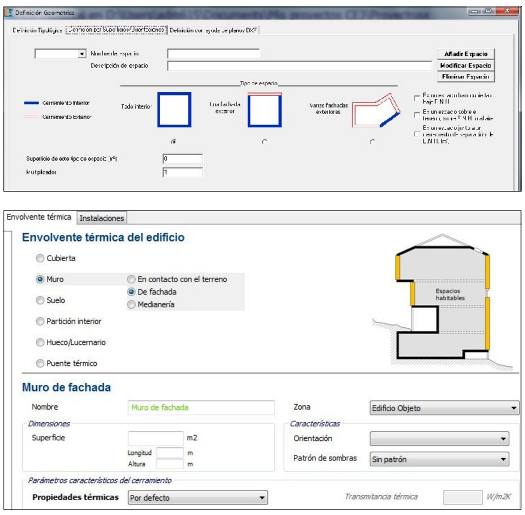
The regulatory approach of the building code to the NZEB requirements will be done in a gradual way, based on the results of cost-optimal studies, which are virtually completed.

The updating of the building energy requirements in order to approach the 2020 target is planned in two steps. The first updating of the current energy Code 2006 (CTE- DB HE) will be accomplished during 2013. This will represent a major change in the manner of considering the building energy efficiency requirements with regard to the current requirements, and a substantial reduction of the energy demand and maximum consumption values, if compared to those of the building Code 2006 (in many cases, over 50%).

A second updating is expected to be accomplished in the period 2016-2017. Then, a regulatory definition of NZEB and the respective requirements will be established, in accordance with the recast EPBD, and will become mandatory after December 2018 for new buildings occupied and owned by public authorities, and by 2020 for all new buildings. An intermediate value of building energy efficiency between the values of 2013 and those of NZEB will also be established, which will be mandatory until new requirements regarding NZEB come into force. The conduction of cost-optimal studies in the years to come will be crucial in order to adjust the minimum requirements associated to NZEB.

Figure 1: Software programmes for existing building certification.





3. Energy performance certificates

According to the Royal Decree 235/2013 on the Energy Certification of Buildings, the Autonomous Communities are in charge of the registration, inspection and control of the Energy Performance Certificates (EPCs). All the legislation in force can be downloaded from the websites of the ministries in charge of the EPBD.[1,2,3]

3.1 Progress and current status on sale or rental of buildings

The certificate for new buildings came into force in November 2007. CALENER is the name of the software that implements the official calculation methodology.

The Royal Decree 235/2013 transposes the recast EPBD, in relation to the energy certification of existing buildings. This is a key point to reduce the energy consumption of the housing stock. To support the technical certifying officers (Qualified Experts (QE) who must be architects or engineers authorised to sign building projects) responsible for the energy certification of existing buildings, IDAE has published two new procedures for the energy certification of existing buildings, establishing the official calculation methodology for EPCs (named CE3 and CE^{3}X). The procedures for existing buildings account for the assessment of energy efficiency measures, both from technical and economical point of view. This analysis is stated in the final report issued by the indicated software programmes.

1 *www.codigotecnico.org*
2 *www.minetur.gob.es/energia/desarrollo/EficienciaEnergetica/RITE/Paginas/InstalacionesTermicas.aspx*
3 *www.minetur.gob.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Paginas/certificacion.aspx*

Since August 2012, the two software procedures, CE3 and CE³X, are already recognised as official documents, according to the procedure established by the Ministry of Industry, Energy and Tourism, and the Ministry of Public Works. These free programmes, along with their manuals, can be downloaded from the website of the Ministry of industry, Energy and Tourism.[1]

Both include specific modules according to the type of the building:

> housing 'ViV';
> small and medium tertiary 'PYMT';
> great tertiary 'GT'.

Each of the programmes has been available to technical certifiers and citizens in general, together with the necessary technical documentation for correct understanding and use:

> user manual;
> technical foundations manual;
> examples of application for the three typologies (ViV, PYMT, GT);
> guide for the preparation of the energy certificate.

Both procedures enable the energy certification of existing residential buildings, as well as of small and large tertiary buildings, establishing a degree of energy efficiency based on CO_2 emissions and primary energy consumption, arising from consumption related to heating, cooling, water heating, ventilation and lighting needs.

The energy label classifies the buildings on a scale from G (least efficient building) to A (most efficient building). Additionally, computer tools CE3 and CE³X provide energy efficiency improvement measures, and enable the definition of sets of measures by the technical certifying officer, as well as the realisation of an economic analysis of these measures from the aspects of investment costs, energy savings achieved and actual building energy bills.

With this information, the building owner can assess and voluntarily undertake actions of renovations in order to improve the building energy rating. Finally, the tools automatically generate a certificate that indicates the energy label, along with the new letter after applying the improvement measures.

The report of the official EPC that is currently approved for the energy certification of existing buildings may be seen in Figure 2.

As stated, the global energy rating is assessed according to the CO_2 emitted per unit floor area per year [$kgCO_2/m^2$.year], as well as the primary energy consumption [kWh/m^2.year]. Moreover, there are partial ratings depending on the demand and energy consumption for the various energy-consuming services (heating, cooling, sanitary hot water and lighting for tertiary buildings).

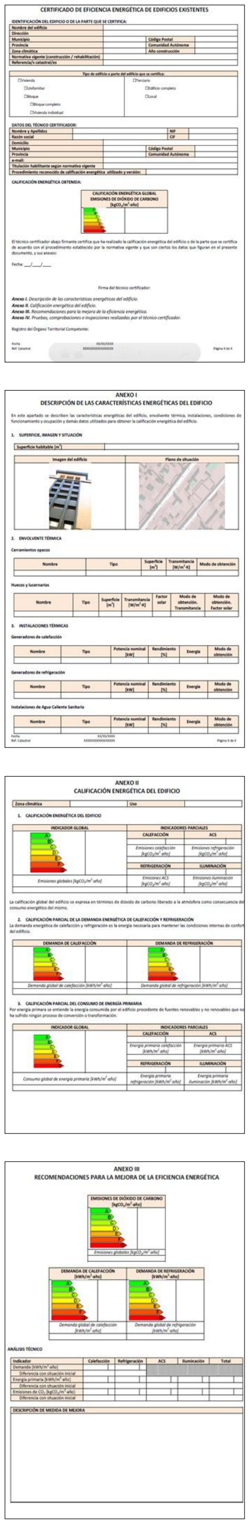
The calculated values are compared with a series of reference values that vary according to the local climate, and with a reference building of the same shape, which abides by the building energy regulations, depending on whether it is a new or existing building, or a residential or non-residential one.

The new building energy certification procedure, called CALENER, developed with IDAE's sponsorship and following CEN standards to a large extent, is now also adapted for the certification of existing buildings, so that there are three procedures for the EP certification of existing buildings.

Registration, costs and sanctions
The registration of the energy certificates, as well as the quality control to be applied on the certificates, fall within the competence of the Autonomous Communities. Some communities have so far legislated on this issue, whereas others have legislation drafts which will be enforced in the near future.

There is neither a fixed cost nor an administrative tax applied to certificates at national level, but Autonomous Communities can establish the aforementioned tax. For instance, Castile and Leon have done so in the Regional Law 10/2009, establishing a cost in terms of €/m², which depends on the size and type of the building (0.40 €/m² for residential blocks, 0.97 €/m² for single-family houses, 0.79 €/m² for small non-residential

Figure 2: Extract of the official EPC for existing buildings.


CERTIFICADO DE EFICIENCIA ENERGÉTICA DE EDIFICIOS EXISTENTES

ANEXO I
DESCRIPCIÓN DE LAS CARACTERÍSTICAS ENERGÉTICAS DEL EDIFICIO

ANEXO II
CALIFICACIÓN ENERGÉTICA DEL EDIFICIO

ANEXO III
RECOMENDACIONES PARA LA MEJORA DE LA EFICIENCIA ENERGÉTICA

1 www.minetur.gob.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/DocumentosReconocidos/Paginas/documentosreconocidos.aspx

Figure 3: Practical Guide of Energy.

buildings, and 0.89 €/m^2 for big tertiary buildings). This administrative tax varies between a minimum of 150 € for single-family houses and a maximum of 1,200 € for large tertiary buildings. Extremadura also charges an administrative cost of 21.79 € per registered certificate.

The cost of the certificates is established by the market. For new projects, the cost is usually integrated in the price charged by the designer and the project manager to the promoter of the building. For existing buildings, there is not yet experience on the cost of certification. Nevertheless, the estimates by the Administration show costs from 40 €/ apartment for blocks of flats, to 250 € for detached houses, and 0.5 €/m^2 for tertiary buildings. Nevertheless, these prices will be fixed by the market.

The external control carried out on the project certificates and on the finished building project includes a verification of the information specified in the project, what was really executed in the building works, and a comparison with the data introduced in the certificate. Apart from this control, the regional Administration is also entitled to an independent inspection of any certificate, should it be deemed necessary.

Sanctions specified in the Royal Decree 235/2013 are established in the Law 26/1984, whose recast text is published in the Legislative Royal Decree 1/2007. They range from 3,005.06 € to 601,012.10 €, and are related to consumer protection.

The sanctions in this law are going to be completed with a new law about sanctions concerning the EP certification; the new law is under preparation. Examples of actions that could lead to a penalty are: false information on the EPC, not giving the EPC to the buyer or tenant, not registering the EPC, advertising a false EPC, or not placing the energy label in an advertisement, etc..

Figure 4: Information campaigns in Spain.

3.2 Progress and current status on public and large buildings visited by the public

The current legislation requires that public buildings must obtain a certificate of energy efficiency.

Buildings or parts of buildings of a public authority, occupying a total useful floor area over 500 m^2 and frequently visited by the public, have currently the obligation to possess the EPC. If the floor area of the building exceeds 250 m^2, this obligation is mandatory from the 9th of July 2015 onwards.

Moreover, all buildings occupied by public authorities, with a total useful floor area over 250 m^2, must exhibit an EPC label in a prominent place.

All buildings frequently visited by the public, other than those owned or occupied by public authorities, with a total useful floor area greater than 500 m^2, must display an EPC label in a place clearly visible to the public.

The EPC may be issued by competent qualified technicians, according to the Royal Decree 235/2013, and in case of public buildings, by employees of public administration.

3.3 Implementation of mandatory advertising requirement – status

The EPC label will always be included in any offer, promotion and advertising concerning the sale or lease of the building or building unit, according the Royal Decree 235/2013.

3.4 Information campaigns

Specific information campaigns have been conducted for citizens with the objective to explain the aims of the building energy rating, as well as the rest of the features related to the building energy certification.

Furthermore, various conferences on the introduction and promotion of the building energy certification have taken place in all the Autonomous Communities, addressed both to the professionals in the sector and to citizens. In like manner, IDAE takes part in many sectorial fairs promoting, among other issues, the building energy certification.

IDAE's website and the website of the Ministry of Industry, Tourism and

Commerce, provide information on the building energy certification, as well as on the basic rating procedures and the recognised energy certification documents. The publication called 'Guia Practica de la Energia. Consumo eficiente y responsable' (Practical Guideline on Efficient Energy Consumption) informs the citizens about the building energy certification.

IDAE has published a collection of 12 guides called 'Calificacion de Eficiencia Energetica de Edificios' (Building Energy Efficiency Rating), describing the basic certification procedures, as well as the energy rating scale.

Apart from these specific campaigns, there were others of a more general nature that raise the awareness on energy saving in Spain. At national level, the brand 'Save Energy' was created, largely visible through the sponsorship of the Spanish national football team and of other events such as the Spain Cycling Tour, where the jersey of the race leader was also sponsored.

IDAE is developing a specific plan for the training and information on the energy certification of existing buildings. This plan was launched in 2012, and is dedicated to the training of certifying technicians, real estate agents, and citizens.

4. Inspection requirements - heating systems, air-conditioning

The energy efficiency inspection of cold and heat generators is regulated by the Regulation of Thermal Installations in Buildings, compulsory for all heat generators with a nominal heating capacity over 20 kW, and for all cold generators whose nominal capacity is over 12 kW.

4.1 Progress and current status on heating systems

Inspections are intended to analyse and assess the performance of the installation. Thermal Building Regulations, to be applied nationwide, establishes the minimum intervals for inspections of heat generators, depending on the kind of fuel used and the nominal capacity of the installation. The periodicity of the inspections may be increased if the Autonomous Community where the buildings are located chooses to do so, but currently all the Autonomous Communities in Spain are using the periodicity established in the national legislation.

Figure 5: Information campaigns in Spain.

4.2 Progress and current status on AC systems

The periodicity of the inspections for cold generators is not the same nationwide, and it is up to each regional Administration to fix the periodicity of these inspections. The Royal Decree 1027/2007 only establishes that periodicity must depend on the rated output of the generators (between 12 kW and 70 kW, and more than 70 kW). As an example, the periodicity set by the Autonomous Community of Navarre in the Formal Order 242/2009 is given in Table 4.

Galicia has reduced the periodicity for cold generators with a capacity higher than 70 kW to 2 years since the 24th of February 2010.

4.3 Any other relevant information

An inspection of the whole installation it is to be performed every 15 years according to the national regulations. The first inspection should be conducted at the same time as the first inspection of the heat or cold generator, and every 15 years thereafter.

The various Autonomous Communities have regulated the content of the energy efficiency inspections of thermal installations. Some Autonomous Communities have already regulated the

Table 4: Periodicity of heating systems.

Thermal Capacity [kW]	Fuel	Minimum periodicity
20 ≤P≤70	Gas and renewables	Each 5 years
	Other	Each 5 years
P>70	Gas and renewables	Each 4 years
	Other	Each 2 years

Table 5: Periodicity of AC systems.

Thermal Capacity [kW]	Minimum periodicity
12 ≤P≤70	Each 5 years
P>70	Each 3 years

Figure 6: Inspection guide.

detailed content of these inspections, taking into account the relevant CEN standards, which include the assessment of some aspects such as document registration, performance of the energy efficiency demands, evaluation of the generators output, safety conditions of equipment. These inspections also include a report on the installation, and a proposal of the improvement measures of the aforementioned safety.

IDAE, in collaboration with the Spanish Technical Association of Air-Conditioning and Refrigeration (ATECYR), published a collection of guides about energy saving and efficiency in buildings, including some on the energy efficiency inspection of heating and cooling installations.

Quality Assurance (QA)

The external control of the inspection also falls within the competence of the Autonomous Communities, which can decide on the type of controls to apply and the penalties to be imposed in case of finding deficiencies.

For the external control, the Autonomous Communities can count on authorised agents - which may be accredited bodies or organisations for the building regulatory field and its thermal installations - or independent technicians qualified by each Autonomous Community. The procedure to obtain this authorisation as qualified technician is defined by each Autonomous Community for its territorial scope. The Autonomous Communities that have regulated the external control make use of the so-called building quality control bodies, i.e., private companies that are hired by the Administration to perform that task. The specific requirements can vary from one region to another, but usually they include a series of technical and economical reliability requirements (experience, civil responsibility insurance, sufficient human resources). Autonomous Communities such as Galicia, Extremadura or Castilie – La Mancha have regulated the requirements set to the external control bodies in greater detail.

5. Conclusions and future plans

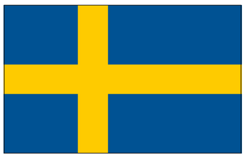
The adoption of the Energy Performance of Buildings Directive (EPBD) has significantly increased the number of requirements that buildings in Spain must meet. Nonetheless, the Royal Decree 235/2013 on the energy certification of existing buildings is still necessary to fully transpose the EPBD recast. This Royal Decree endows the energy certification of existing buildings with a regulatory framework. The next logical step will be to combine the subsidies of the Energy Saving and Efficiency Plan with the improvement of the building energy rating. In addition, given the compulsory consolidation of the recast EPBD, the Energy Performance (EP) requirements for buildings will have to be tightened in order to meet the cost-optimal requirements set forth therein. This revision will have to tighten the compulsory requirements for the building thermal envelope and the performance of thermal installations, as well as the efficiency demanded of lighting systems. The demands regarding the integration of Renewable Energy Sources (RES) should also be enlarged. A precise definition of a Nearly Zero-Energy Building (NZEB) will have to be developed for the different Spanish climatic zones, taking into account the heating and cooling demands, the use of the building, etc..

This process of revision of the current regulations (RITE) and the rules concerning the Energy Performance Certificate (EPC) has already started. The Spanish normative will be tightened gradually, to achieve the NZEB objective by 2020.

The legislation related to the certificate registration and the external control will also be extended to all the Autonomous Communities, which are also working in coordination with the ministries and a group created specifically to address issues concerning the building energy certification.

EPBD implementation in Sweden

STATUS AT THE END OF 2012



Authors

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1. Introduction

The work of implementing the Energy Performance of Buildings Directive (EPBD) is fulfilled partly by the National Board of Housing, Building and Planning and, regarding the information part within the articles 14 and 15, by the Swedish Energy Agency, on behalf of the Ministry of Health and Social Affairs, and by the Ministry of Enterprise, Energy and Communications, respectively.

Swedish regulations of energy management in new and renovated houses have existed on national level since 1948. Regulations on the Energy Performance (EP) certification, known in Sweden as ‘energy declaration’, came into force in October 2006. The first energy experts were certified in the summer of 2007, and the first accredited company registered the first Energy Performance Certificate (EPC) in the national register in September 2007. Since then, about 420,000 EPCs have been registered, as shown in Figure 1.

2. Energy performance requirements

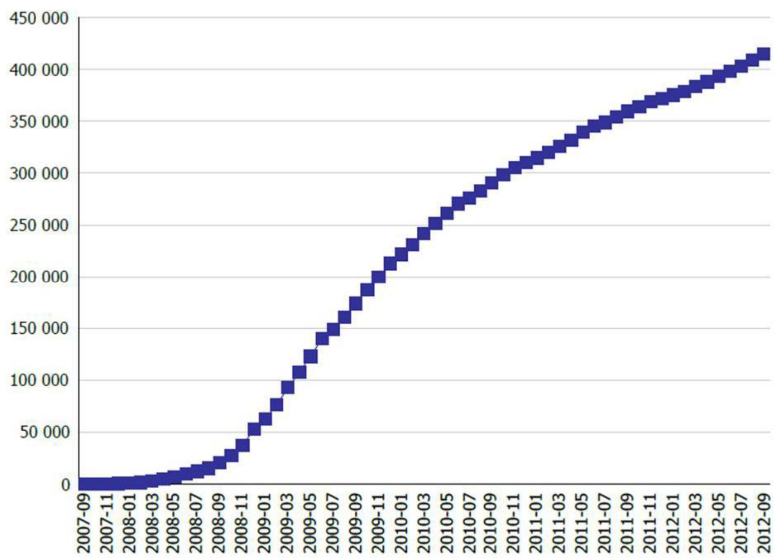
Swedish building regulations refer to both residential and non-residential buildings. Also, they cover both new buildings and buildings under renovation. Public buildings are included in non-residential buildings. Furthermore, the Swedish building code on energy is divided into three different climatic zones and has different requirements for electrically heated buildings including heat pumps, and buildings heated with other heating sources.

2.1 Progress and current status

Since 2006, the Swedish building regulations have been based on measured energy consumption. The measured values for heating, cooling, hot water and auxiliary energy are summed up to an energy usage figure. This figure, divided by the heated area (10 °C), as well as the maximum overall U-value, must not exceed the values listed in Table 1 for residential buildings in the different climatic zones. The maximum permissible installed power in electrically heated residential buildings is listed in Table 2.

For non-residential buildings, the maximum energy use and the maximum overall U-values are listed in Table 3. There is also a limit for the maximum installed power in non-residential buildings (Table 4). Since 2006, the regulations have been updated twice: first in 2009, when demands on all buildings heated with electricity were

Figure 1: Accumulated amount of energy certificates.



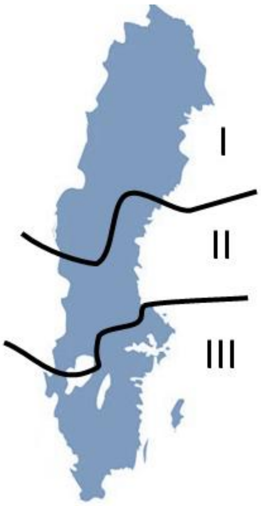


Figure 2: The three climatic zones in Sweden.

increased; and for the second time in 2012, when demands on buildings with other heating sources were increased. The 2006 changes resulted in an increase of the degree of compliance; thus, more buildings are now fulfilling the maximum stipulated energy use. In the southern part of each climatic zone, the EP of the buildings is about 30-40% higher than that required by the code, because the construction companies want to build only one type of building in each zone to avoid introducing changes in their production sites. The new detailed renovation rules which came into force in 2012 allowed a transition period until the 1st of January 2013. Before these regulations, renovation requirements were not so detailed: prior to 2012, the law simply stipulated that every change in a building should aim to comply with the requirements for new buildings, taking into consideration the size of the alteration and the possibilities of the building. The 2012 regulations specified more details to make the interpretation and implementation of the regulations easier.

2.2 Format of national transposition and implementation of existing regulations

In order to allow the building board of the municipalities to follow the development of the building project, the compliance check system in Sweden is divided into two parts: first, there is an asset rating during the construction of the building. This is then followed by the second, final verification under use, with measurements during the second heating season of the building, to see how the building fulfills the requirements. As this second part of the compliance check is the reference method, it does not matter which type of calculation programme was used or what air tightness value the building really has, as long as the measured energy consumption does not exceed the limit of the requirements.

In mixed use buildings, the energy use allowed is calculated according to the percentage of heated area in the respective part.

For all buildings, the building boards of the municipalities stipulate compliance checks to be carried out by a certified control responsible representative of the 'Byggherre'. If there is no compliance, the 'Byggherre' can be fined, or the further use of the building can be prohibited.

2.3 Cost-optimal procedure for setting EP requirements

Whenever the National Board of Housing, Building and Planning changes the regulations, it makes an analysis of the economical, technical and environmental consequences, as well as of the consequences on the children, the elderly and the persons with disabilities. The Board also asks itself, "is this regulation needed?" At the latest revision of the energy regulations, the Board concluded that Sweden has reached the limit for what is economically reasonable with the techniques available today. Calculations according to the cost-optimal regulation so far show that the current Swedish requirements comply with the cost-optimal levels. The plan for the future is to monitor the low-energy buildings built in Sweden during the last few years, as well as in the next years to come, to see if the demands can be tightened at the Control station (see 2.4, below) of the action plan for Nearly Zero-Energy Buildings (NZEB), 2015. Requirements towards buildings with very high EP could then continue to develop based on the results. Presently, in Sweden, the buildings with an EP by 25% higher than that stated in the building regulations are referred to as low-energy buildings and those with an energy performance by 50% higher are classified as having very low energy use.

2.4 Action plan for progression to NZEB

The Swedish action plan for NZEBs consists of four parts:

'Part 1 The Swedish implementation of the concept of nearly zero-energy buildings'.
The consequence analysis that was carried out the last time Sweden altered the energy requirements showed that, with the available technologies, the requirements had reached as far as they could towards NZEB, and still have economic viability.

Table 1: Maximum allowed bought energy use per area heated to 10°C, and maximum overall U-value in residential buildings.

Requirements for residential buildings Bought energy[kWh/m²]								
	Other heating source				Electrical heating [>10W/m², installed heating]			
Climatic Zone / Year	North	Middle	South	U-Value [W/m².K]	North	Middle	South	U-value [W/m².K]
2006	130		110	0.5	95[1]		75[1]	0.5
2009	150	130	110	0.5	95	75	55	0.4
2012	130	110	90	0.4	95	75	55	0.4

1 Electrical panes in one or two-family houses

'Part 2 Promotion measures for knowledge and an efficient implementation'.
The second part is the starting point for the evaluation of low-energy buildings. 120 million SEK are dedicated to promote and follow up projects concerning low-energy buildings.

'Part 3 Control station and milestone 2015'.
The third part consists of an evaluation of the promoted projects and, based on the results, an estimation of the right moment to decide on the future steps and policies.

'Part 4 The role of renewable energy in nearly zero-energy buildings'.
The last part concerns Renewable Energy Sources (RES) in Swedish buildings and the Swedish energy supply system as such. Sweden must also find out a way to show the renewable energy produced on-site or nearby the buildings which are not showed today. The document 'Vägen till Nära nollenergibyggnader' ('On the road to NZEB'), describing the role of renewables, is available on the government website.

3. Energy performance certificates

The changes in the EPBD that came into force in December 2010 were implemented in Sweden by new regulations, through changes in the Law (2006:985) on Energy declaration of Buildings, the Ordinance 2006:1592 and the regulations enacted by the National Board of Housing, Building and Planning. The changes came into force in July 2012. The major change is that the certificate ('declaration') has to be presented at an earlier stage in the process, when a sale or renting of the building or part of the building takes place. The certificate shall be presented to the presumed renter or buyer.

Sweden has a central register for certificates since 2007. This register will also be used for future validation checks. The Swedish Parliament also decided that the National Board of Housing, Building and Planning takes over the compliance checks of the certificate, when the certificate is issued, displayed or handed over, as well as when the EP is displayed in commercial advertisements. Before that, the local authorities have had the role of compliance checkers.

Table 2: Maximum installed electrical power for heating in residential buildings.

Maximum installed electrical power for heating in residential buildings			
Climate zone	North	Middle	South
Maximum installed Power [kW]	5.5	5.0	4.5
Addendum when A_{temp}> 130 m^2	0.035*(A_{temp}-130)	0.030*(A_{temp}-130)	0.025*(A_{temp}-130)

Table 4: Maximum installed electrical power for heating in non-residential buildings.

Maximum installed power for heating in non-residential buildings			
Climate zone	North	Middle	South
Maximum installed Power [kW]	5.5	5.0	4.5
Addendum when q_{DVUT}^{1}>0.35l/s	0.030*(<q>-0.35)	0.026*(<q>-0.35)	0.022*(<q>-0.35)
Addendum when A_{temp}> 130 m^2	0.035*(A_{temp}-130)	0.030*(A_{temp}-130)	0.025*(A_{temp}-130)

1) q maximum specific outdoor airflow at dimensioning winter air temperature

Table 3: Maximum allowed bought energy use per area heated to 10°C, and maximum overall U-value in non-residential buildings.

Requirements for non-residential buildings Bought energy[kWh/m^2] Area heated to more than 10°C								
	Other heating source				Electrical heating [>10W/m^2, installed heating]			
Climatic Zone / Year	North	Middle	South	Overall U-Value [W/m^2.K]	North	Middle	South	Overall U-value [W/m^2.K]
2006	120		100	0.7	<-See other heat source		<-	<-
Addendum if $q^{1}_{hygiene}$>0,35 l/s	90*(q-0.35)		70*(q-0.35)	-				
2009	140	120	100	0.7	95	75	55	0.6
Addendum if $q^{1}_{hygiene}$>0,35 l/s q_{max}^{2}=1.0 l/s	110*(<q>-0.35)	90*(<q>-0.35)	70*(<q>-0.35)	-	65*(<q>-0,35)	55*(<q>-0.35)	45*(<q>-0.35)	-
2012	120	100	80	0.6	95	75	55	0.6
Addendum if $q^{1}_{hygiene}$>0,35 l/s q_{max}^{2}=1.0 l/s	110*(<q>-0.35)	90*(<q>-0.35)	70*(<q>-0.35)	-	65*(<q>-0,35)	55*(<q>-0.35)	45*(<q>-0.35)	-

1) Average specific outdoor air flow during heating season, 2) maximum airflow counted for addendum

The content of the certificates also includes recommendations. If these recommendations were realised, the energy savings would be about 25% in single-family houses, between 15 – 20% in multifamily houses and 10-15% in non-residential buildings.

3.1 Progress and current status on sale or rental of buildings
A certificate shall be presented at the latest at the time when a building is sold. This is the most common situation for sales of single-family houses. In this case, the compliance is very high: when comparing the numbers of certificates with buildings sold, a certificate is available in 90 to 95% of the cases. In some cases, this depends on the exemptions from the obligation, for example, when a single-family house is sold within the same family. In other words, non-compliance is limited to only a few cases. So far, no authority has performed any compliance checks in these cases. Compliance checks have been activated by consumer complaints, because the buyers had the opportunity to demand an energy certificate at the cost of the seller within 6 months from the date of the transaction. To increase the overall compliance rate, the checks are now the responsibility of the National Board. BOVERKET has sent letters to property owners of buildings not having an energy certificate registered at the official database. Until now, owners of several thousands of buildings have been contacted; some of them are ordered to have a certificate issued and others are advised on the actions necessary to 'declare' their buildings.

BOVERKET also started with reactive compliance checks in 2013, acting after complaints from tenants and others stating that the building owner/seller failed to deliver a certificate. BOVERKET will also increase its cooperation with other authorities, such as the Energy Agency and the Consumers Agency.

Random quality checks are also to be conducted as a validation of the incoming certificates. All certificates are so far validated only for the declared values but, starting in 2013, more thorough quality checks will be developed on a random basis. So far, the validations make it impossible to overlook cases in which the figures are out of range, as the programme asks the expert to verify the unreasonable figures when filling in the form. If errors are found, BOVERKET gives the building owner the chance to contact their assessor in order to have the certificate corrected.

Rented buildings should have had a certificate since the 1st of January 2009. The degree of compliance in these cases has been lower so far. About 35% of the rented buildings do not have a certificate. This is the main reason for the transfer of compliance checks from the Municipalities to the National Board.

The National Board has chosen to change the display of the certificates during 2013, to increase the interest of consumers. Certificates will become more similar to those in the rest of Europe, with classes from A to G, with colors from green to red, as shown in Figure 3. The intervals have also been changed to obtain a bigger spread of the declared classes of the buildings. So far, most of the buildings fall in three out of the seven possible categories or classes, between 50 and 200 kWh/m^2.

The cost of a certificate is at least 1,000 €. The price has been rather stable since the start.

The assessors are divided into two different levels: the lower level refers to assessors for simple buildings, single-family houses and smaller multi-family houses with low or non-integration among the technical systems, or with a simple system for monitoring and adjusting. The higher level refers to assessors for complicated buildings (for example buildings with air-conditioning), public buildings, as well as all buildings with cultural value. So far, Sweden also has had a system according to which the companies issuing certificates had to be accredited. Experts acknowledged in other EU countries were excluded from accreditation; they only had to fulfill the regulations for being an expert in their own country. Within the standards for accreditation, the handling of complaints, Quality Assurance (QA) systems and all other requirements that companies must meet are controlled by the accreditation authority once a year. The consumers can also turn to the accreditation authority, Swedac, if their complaints are not followed upon by the assessors.

So far, only three accreditations have been withdrawn.

From the beginning of 2014, the Swedish system of accreditation will be replaced by the personal responsibility of a certified expert, in order to increase the quality of the certificates, but also to lower the price of the certificate for smaller building owners in regions where there are long distances and huge areas to be covered (Sweden is a long country with not so many persons living in the north, so the distance between them and their closest neighbors can be 100 km). By giving the assessor personal responsibility, it will be cheaper for smaller businesses to act on the market.

Sweden believes that the quality of the certificates has already been improved. The new law increased the demand on audits to buildings when issuing the certificate, if the EP is lower than that required of a new building.

The number of assessors has decreased from 1,100 to 800, as the market has gone smaller since the beginning. This was an expected development, since the buildings that needed a certificate already have one; now, new certification is only needed for new and sold buildings. Rented and public buildings shall have a certificate all the time since the 1st of January 2012. The certificates are valid for 10 years.

A new private association of assessors called VETIC has appeared; it has been a source of experience in the field for the National Board. They inform BOVERKET when assessors are doing a bad job, or when they see a potential for improvements, like the Toyota example.

3.2 Progress and current status on public and large buildings visited by the public

The original regulation (2006:985) for public buildings included all buildings with an area bigger than 1,000 m^2. It has been altered in 2012 to include all buildings with an area bigger than 500 m^2, either public or visited by the public. As the regulations on certification in Sweden covered all kinds of buildings from the beginning, the development as described above for sold and rented buildings also applies to public and large buildings.

3.3 Implementation of mandatory advertising requirement – status

EP indicators in advertisements are mandatory since the 9th of July 2012, but are so far rare. Until now, the EP has been indicated by a number, but Sweden is working on changing it to a symbol with a letter showing the EP class. This will come

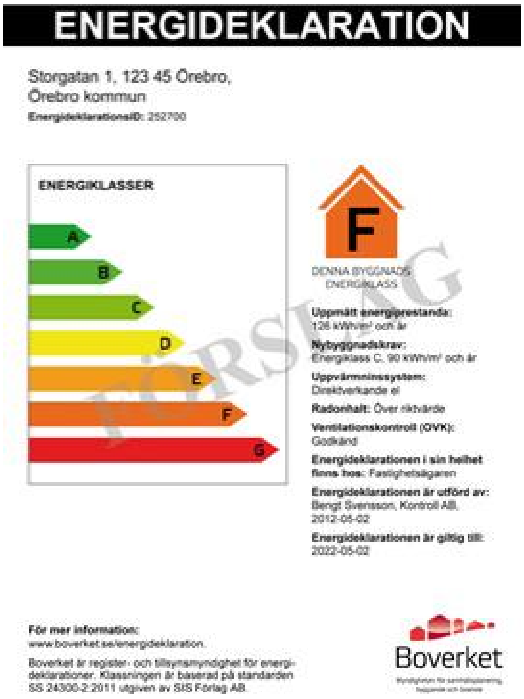


Figure 3: Suggested new certificate and symbol for energy performance indicator or advertisement.

Table 5: Different levels in the proposed labeling system.

Class A	< 51% of the requirements for new buildings
Class B	Between 51 and 75% of the requirements
Class C	Between 76 and 100% of the requirements
Class D	Between 101 and 125% of the requirements
Class E	Between 126 and 150% of the requirements
Class F	Between 151 and 175% of the requirements
Class G	> 175% of the requirements

into force before the end of 2013. Swedish authorities believe that this will increase the use of EP indicators in advertisements, as the symbols will be easier to be communicated, and ordinary people will recognise them from the ones on their refrigerators and washing machines; therefore, they will ask for information more often. At the same time, the compliance checks will increase, partly through the National Board, but also through reactive compliance checks due to information from the Consumers Agency that has the task to inform consumers about their rights and interest.

3.4 Information campaigns

To begin with, the first information campaign was directed to the real estate brokers, as they are closely connected to the transaction of buildings, they cover a great part of the advertisements and are most of the time those doing the paper work for the transactions and the displaying of facts when selling a house or a condominium. BOVERKET has direct communication with the association of real estate brokers. The certificates were made available to real estate brokers through electronic channels. This has been a success, since the brokers are collecting, on average, 300 certificates a day from the official register.

A broader information campaign will be launched, directed towards the building owners and users, as soon as the new classification is in place.

4. Inspection requirements - heating systems, air-conditioning

Sweden started off with option B (information campaigns) for boilers, as well with an inspection scheme for air-conditioning (AC) systems with an output above 12 kW. There is also an inspection scheme for mandatory ventilation checks. One of the problems has been that there is no control of the location of the few cooling systems that are not attached to ventilation systems. Therefore, Sweden decided that a broad information campaign would have bigger effect regarding those systems.

Figure 4: Example of information given by real estate brokers, describing the energy certificate system.

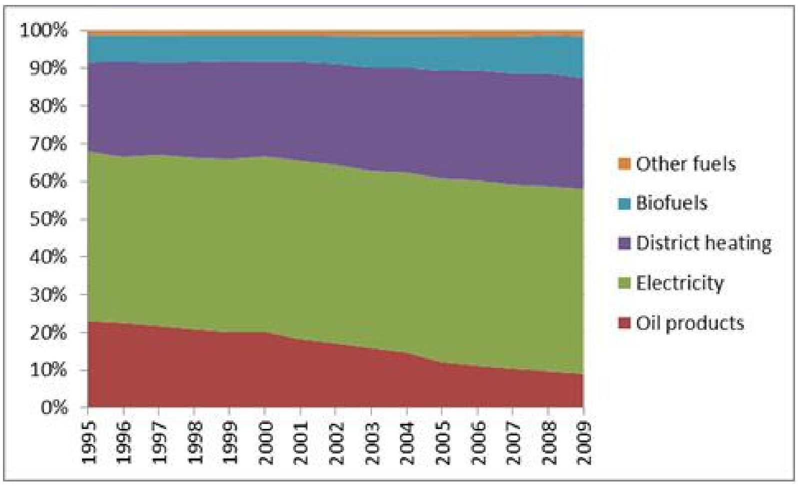


Figure 5: The energy mix in Swedish heating.

4.1 Progress and current status on heating systems

Since the end of the 1990s, Sweden had an environmental target to become free from fossil-fueled boilers for heating and hot water production by 2020. The prognosis on this target is quite positive.

Since 1992, Sweden also has a mandatory ventilation check regarding ventilation in multifamily houses, schools and offices. These shall be carried out every two or three years, depending on the type of ventilation system. The assessors certified for performing ventilation checks must also give advice on energy efficiency measures; if a cooling system is attached to the ventilation system, information about how to make the system more efficient will be given to the building owner. This way, this ventilation control system will be part of the information system to fulfill the alternative on information included in the directive for AC installations integrated with the ventilation system. To cover the comfort cooling systems not installed as attached to the ventilation system, the national Energy Agency is preparing information to be spread via their regional Energy Agencies and the local energy and climate advisors of the municipalities. Each one of the 290 municipalities of Sweden has either an energy advisor or an energy and climate advisor in their staff, in order to inform private and public players about energy efficiency and climate issues. These advisors are financed by the Energy Agency.

4.2 Progress and current status on AC systems

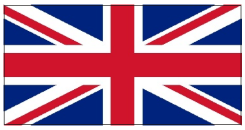
The regional and local energy offices will continue to spread the information, and the experts conducting the mandatory ventilation system checks will continue to provide energy efficiency advice.

5. Conclusions and future plans

Sweden has had a history in the field of energy efficiency since the 1970s and the oil-crisis. However, some of the energy saving initiatives back then ended in personal disaster in certain cases. Some people tightened their houses too much and got mold problems, while some energy saving measures made the ventilation systems get out of balance due to poor implementation. Although Sweden now continues to work hard towards an energy efficient society, taking the example of the past into account, the Swedish authorities this time have to scrutinise the measures from different points of view to avoid future failure.

EPBD implementation in the United Kingdom

STATUS AT THE END OF 2012



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1. Introduction

This report provides information about the implementation of the Energy Performance of Buildings Directive (EPBD) and its recast in the four UK jurisdictions (England, Wales, Scotland and Northern Ireland), updating the earlier report dated 2010.

The implementation of the EPBD in England & Wales is the responsibility of the Department for Communities and Local Government (CLG)[d]. Implementation in Northern Ireland and Scotland is the responsibility of the devolved administrations, respectively: the Department of Finance and Personnel (DFPNI)[d] (supported by the Department for Social Development, DSDNI) and the Scottish Building Standards Division (part of the Directorate for Communities and Local Government)[d].

In England & Wales, transposition is achieved through: the Building Regulations (amendments) Regulations 2012[a] (SI[b] 2012/3119) and the Energy Performance of Buildings (England & Wales) Regulations[a] (SI 2012/3118). Responsibility for the Welsh Building Regulations has been devolved to the Welsh Government, and new regulations are expected in 2013.

In Scotland, the relevant regulations are: the Building (Scotland) Act 2003, the Building (Scotland) Regulations[a] 2004, the Building (Procedure) (Scotland) Regulations[a] 2007, the Building (Forms) (Scotland) Regulations[a] 2007 and the Energy Performance of Buildings (Scotland) Regulations[a] 2008, as amended. The latter regulations were amended in 2012.

In Northern Ireland, the governing legislation is the Building Regulations (Northern Ireland) 2012 (SR[c] 2012 No 192), and The Energy Performance of Buildings (Certificates and Inspections) Regulations[a] (Northern Ireland) 2008 (SR[c] 2008 No 170) (as amended). New regulations will come into force in February 2013 to implement requirements of the EPBD recast.

The above regulations have resulted in changes to mandatory requirements and associated guidance, and the publication of new documents. This report also addresses certification and inspection systems including quality control mechanisms, the training of Qualified Experts (QE), information campaigns, incentives and subsidies. For more details please visit the referenced websites or contact the responsible institutions.

REFERENCES

> England & Wales *www.gov.uk/government/organisations/department-for-communities-and-local-government*
> Wales (Building Regulations only) *www.wales.gov.uk/consultations/planning/buildingregspartl/?status=closed&lang=en*
> Northern Ireland *www.buildingregulationsni.gov.uk and www.epb.dfpni.gov.uk*
> Scotland *www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards*

([a]) This is the main regulation, subsequent amendments must also be considered;
([b]) SI = Statutory Instrument; ([c]) SR = Statutory Rule; ([d]) see UK Governments websites.

National Websites
www.gov.uk/government/organisations/department-for-communities-and-local-government, wales.gov.uk/topics/planning/buildingregs/?lang=en, www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/enerperfor, www.dfpni.gov.uk/index/buildings-energy-efficiency-buildings/energy-performance-of-buildings.htm

Figure 1: Standard Assessment Procedure (SAP) logo.

2. Energy performance requirements

2.1 Progress and current status

England & Wales

Energy Performance (EP) requirements, for all new and existing buildings (residential and non-residential buildings), are set in the Building Regulations which came into effect on the 1st of October 2010. In England, public consultation is complete and the 2013 update of the regulations is being drafted. Responsibility for the Welsh Building Regulations was devolved to the Welsh Government in 2011. Public consultation on the new Building Regulations for Wales closed in October 2012. Consultation responses are being analysed and new regulations are expected in 2013 with further improvements to standards expected in 2015.

Northern Ireland

Building Regulations (including the requirements and provisions of Part F Conservation of Fuel and Power) were reviewed and enhanced, and came into force on the 31st of October 2012: SR 2012 No 192 as amended by SR 2012 No 375. Work has commenced on the next review of Part F standards.

Scotland

Energy Performance (EP) requirements, for new buildings and work to existing buildings are set out in the Building (Scotland) Regulations 2004. Technical Handbooks provide guidance on achieving the standards set in the regulations. Regulations and guidance on these performance standards were last amended in October 2010. Consultation on the next review of the energy standards was published in January 2013.

Figure 2: Building Regulations improvements (historical and anticipated), residential buildings, England.

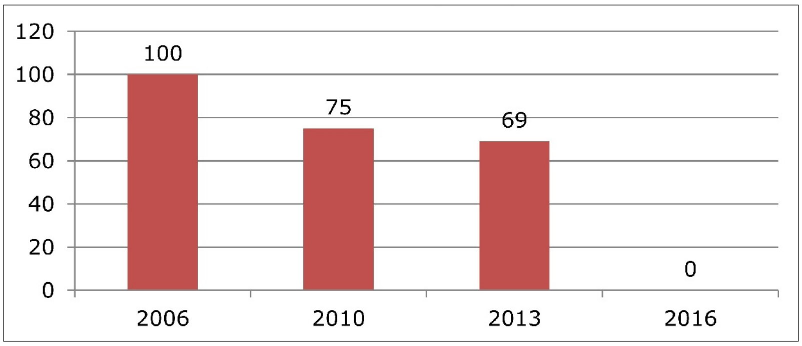
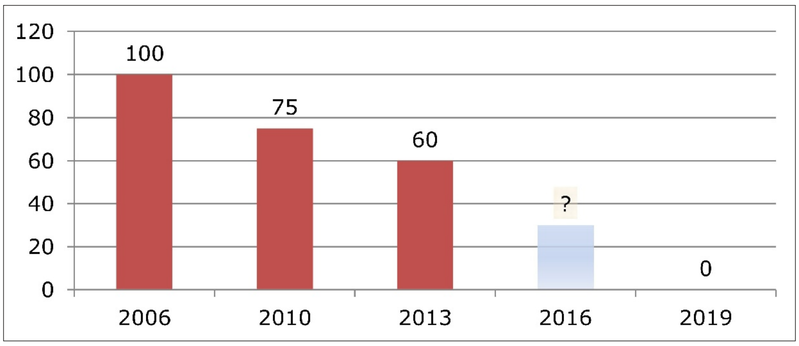


Figure 3: Building Regulations improvements (historical and anticipated), non-residential buildings, England.



2.2 Format of national transposition and implementation of existing regulations

England & Wales

The procedures for a National Calculation Methodology (NCM) have been established. For dwellings the NCM is the Standard Assessment Procedure (SAP) which includes a procedure for existing buildings (Reduced SAP – RdSAP). An updated version (SAP 2009) was released in 2010. For non-residential buildings, the NCM is the Simplified Building Energy Model (SBEM) which was updated in 2010. Both procedures (for dwellings and non-residential buildings) are based on an asset rating approach, i.e., predicted energy consumption calculated based on standard conditions. A separate procedure has been set to produce Energy Performance Certificates (EPCs) for display: the Operational Rating Calculation (ORCalc). This procedure is based on an operational rating approach, i.e., a measured energy consumption which has been normalised to allow cross sector comparison of performance. EPCs for display are referred to as Display Energy Certificates (DECs).

Compliance with the NCM to assess the building energy performance and produce EPCs and DECs is achieved through a suite of software tools approved by Government. Software tools include SBEM and ORCalc which have been developed by Government. Other software packages (e.g., Dynamic Simulation Models – DSMs) and software interfaces may be used, provided they have been approved by Government. DSMs are typically used for complex buildings.

England

Figures 2 & 3 show the simplified historical and anticipated Building Regulations improvements in England for both residential and non-residential buildings. The graphs are based on: 2006 Building Regulations (the reference year); historical improvements from 2006 to 2010; Building Regulations Part L 2013 consultation and Government's preferred options; and Government announcements on the 2016 and 2019 zero carbon targets.

Northern Ireland and Scotland

The above procedures and software tools are available for use in England & Wales, and in the devolved administrations (i.e., Northern Ireland and Scotland). Procedures and software tools must be specifically approved by the devolved administrations for use in their respective jurisdiction.

Northern Ireland has approved the NCMs referenced above for England & Wales. Procedures and software tools are automatically updated in line with England & Wales.

In Scotland, the asset rating methodology has been adopted for all EPCs, including certificates for display in public buildings, and has been incorporated in the software packages approved for use in Scotland, including SAP, RdSAP, SBEM, and DSMs.

Quality Assurance (QA)

Building Regulation-compliant outputs, produced by the approved software tools, are submitted to local authorities (e.g., Building Control Officers (BCOs) in England & Wales) for checking and approval as part of the building permitting process. Submissions are required at both design and post-construction stages. Although not a regulatory requirement, Local Authorities are increasingly requesting that Building Regulations outputs be produced by accredited EPC assessors (see details below). A similar approach has been adopted in Northern Ireland where District Councils are responsible for the enforcement of Building Regulations requirements within their council boundaries. Details are available at *www.buildingcontrol-ni.com*. In Scotland, Local Authorities also administer the Building Standards system and are responsible for granting permission for work to be done (Building Warrant) and for a completed building to be occupied (Completion Certificate).

Accredited Construction Details

England & Wales Building Regulations (for residential and non-residential buildings) allow the use of Accredited Construction Details (ACDs).[a]

Northern Ireland also allows the use of ACDs (for residential and non-residential buildings). The Building Regulations guidance (Technical Booklet) references the England & Wales ACDs[b] (Figures 4 and 5).

Scotland also allows the use of ACDs.[c]

2.3 Cost-optimal procedure for setting EP requirements

A carbon dioxide-based cost effectiveness approach has been used in the past across all four UK jurisdictions to inform the setting of EP requirements, for example in Building Regulations.

The UK jurisdictions are working together with the European Community to clarify available guidance and establish a suitable approach. The UK will deliver its first cost optimal report by March 2013.

2.4 Action plan for progression to NZEB

The UK national plan 'Increasing the number of Nearly Zero-Energy Buildings' covers all four jurisdictions: England, Wales, Northern Ireland and Scotland. The plan was submitted to the European Commission, and it confirms the UK's legally binding commitment (under the Climate Change Act 2008) to greenhouse gas emission reduction targets of at least 34% by 2020 and 80% by 2050. To meet these targets, the emissions footprint of buildings will need to be almost zero which will mainly be achieved through:

> reducing demand for energy in buildings, for example through heat efficiency improvements, lighting and appliances efficiency improvements, behaviour change;
> decarbonising heating and cooling supply, for example through building- and network-level technologies.

The UK is committed to successive improvements in new-build energy standards through changes to the Building Regulations in England and their equivalents in the devolved administrations (Wales, Scotland and Northern Ireland); see Figures 2 and 3.

England has a target for all new homes to be zero carbon from 2016 and an ambition

Figure 4: Technical Booklet F1, Conservation of fuel and power in dwellings, October 2012, Northern Ireland.

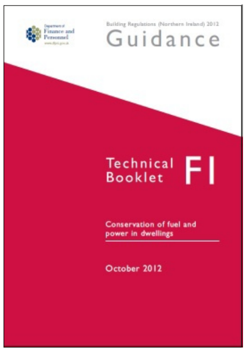
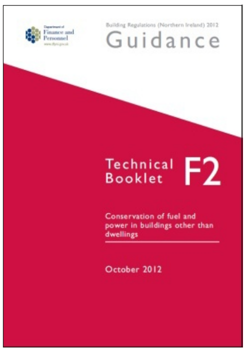


Figure 5: Technical Booklet F2, Conservation of fuel and power in buildings other than dwellings, October 2012, Northern Ireland.



REFERENCES

> NCM: *www.ncm.bre.co.uk* and *www.gov.uk/government/publications/national-calculation-methodology-modelling-guide-for-buildings-other-than-dwellings-in-england-and-wales*
> SAP 2009, RdSAP 2009, and other approved software tools: *www.bre.co.uk/sap2009* and *www.bre.co.uk/filelibrary/SAP/2009/SAP2009_9-90_software.pdf*
> SBEM: *www.ncm.bre.co.uk*

([a]) *www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/bcassociateddocuments9/acd*
([b]) *www.dfpni.gov.uk/tb_f1_online_version.pdf and www.dfpni.gov.uk/tb_f2_online_version-2.pdf*
([c]) *www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks*

for all new non-residential buildings in England to be zero carbon from 2019 (2018 for new public sector buildings).

Wales expects all new homes and non-residential buildings to be built to zero carbon (and nearly zero-energy) standards at the latest by 2020. This will be subject to review in 2015/2016.

Northern Ireland proposes to apply the same standards as England by 2017 for all new homes and all new non-residential buildings in England to be zero carbon from 2020.

Scotland shares the ambition for zero carbon buildings, and has given a commitment to further reviews of building standards for 2013 and beyond.

The UK considers that its approach for zero carbon buildings will meet the recast's definition of Nearly Zero-Energy Buildings (NZEB) as:

> Although a range of low and zero carbon technologies will count towards meeting its zero carbon standard, in practice the policy is expected to drive high levels of on-site Renewable Energy Sources (RES).
> This is expected to encourage the development of heat networks which could eventually be connected to renewable heat sources.
> Low carbon technologies not classified as renewable still have a significant role to play in meeting the aims of the Directive.
> The building regulation standards for zero carbon buildings will take into account all the energy uses covered by Annex I of the recast. This will be delivered through an energy efficiency standard covering space heating and cooling. The remaining energy demand for fixed services will be covered by broader carbon emissions standards set in the regulations.

3. Energy performance certificates

3.1 Progress and current status on sale or rental of buildings

England & Wales

Government has licensed Accreditation Schemes to accredit energy assessors for the production of outputs under the Energy Performance of Buildings Regulations such as EPCs, recommendations reports, etc.. National Occupational Standards (NOS) specify the qualifications and skills which energy assessors should meet to be accredited to produce regulatory outputs. Different types of accreditations are available to would be energy assessors, depending on the building type (residential or non-residential), the complexity of the building and software to be used, and the type of regulatory outputs to be produced (EPC, DEC, air-conditioning report, etc.). Further details are provided in Table 1 below. Accredited energy assessors must use Government-approved software tools to produce regulatory outputs. A suite of software tools (including free Government-sponsored and proprietary tools) are available to accredited energy assessors to produce regulatory outputs. Regulatory outputs are lodged on a national register, and may be retrieved from the register.[a,b]

Asset rating based EPCs are produced for buildings on construction, sale and rent. Operational rating based certificates (Display Energy Certificates – DECs) are produced and displayed in large public buildings (details in 3.2). The format and content of residential and non-residential EPCs vary (Figures 8 & 9). Both types of EPCs are valid for 10 years. All EPCs become legally valid after they have been lodged on the national register. Lodgements data to October 2012 is included in Table 2 and Figures 6 & 7.

Table 1: Energy assessors qualifications and numbers.

Jurisdictions	England & Wales, Northern Ireland	Jurisdictions	Scotland
Assessor Types	Sub-types	Assessor Types	Sub-types
EPC Domestic Buildings	Existing Buildings	EPC Domestic Buildings	See Note 1
EPC Domestic Buildings	New Buildings		
EPC Non-domestic Buildings	Level 3	EPC Non-domestic Buildings	See Note 1
EPC Non-domestic Buildings	Level 4		
EPC Non-domestic Buildings	Level 5		
DEC Public Buildings	Void	Public Buildings	See Note 2
AC Inspection	Void	AC Inspection	Void
Total Assessors	11,929	Total Assessors	1,734

EPC: Energy Performance Certificate
DEC: Display Energy Certificate
AC: Air Conditioning
Level 3: simple non-domestic buildings
Level 4: medium complexity non-domestic buildings
Level 5: complex non-domestic buildings

Note 1: In Scotland, no sub-types are used for domestic and non-domestic EPC assessors.
Note 2: In Scotland, EPC produced by non-domestic buildings assessors may be displayed in Public Buildings.

(a) Residential buildings register: *www.epcregister.com*
(b) Non-residential buildings register (all certificate types and air-conditioning inspection reports): *www.ndepcregister.com*

Quality Assurance (QA)
Government introduced Scheme Operating Requirements (SORs) in 2010 to ensure that all Accreditation Schemes achieve a common set of minimum quality standards. These requirements were updated in 2012 to strengthen the existing procedures, and ensure a high quality of regulatory outputs.

Under the SORs, Accreditation Schemes are mandated to undertake QA of the outputs produced by their accredited energy assessors. Government also carries out QA audits of the quality systems implemented by Accreditation Schemes and compliance with the SORs. These provisions ensure that a statistically significant percentage of certificates is checked by independent experts for QA purposes.

In the most severe instances (for example following multiple failures to remedy a defective QA system) Government may suspend or revoke an Accreditation Scheme's license to operate. These powers have not been used by Governments in any of the UK jurisdictions to date.

Content of the EPC for residential buildings
The EPC provides a rating of the overall energy efficiency of the building on a scale from A to G, where A is very efficient and G is the least efficient. This is an asset rating, based on the characteristics of the building itself, its services and a standardised occupancy profile. The EPC refers to the average rating for a dwelling in England & Wales: band D rating 60. As shown on the certificate (Figure 8) each EPC band (A to G) refers to a range of asset ratings (see Table 3).

In 2012, the format of the EPC for residential buildings was revised based on consumer research. See the first page of the EPC (Figure 8). The new look of the EPC for residential buildings is shorter, uses plain English throughout and has an improved design and layout. Its primary focus is on the potential costs and savings of different energy efficiency measures, rather than CO_2 emissions.

The EPC for residential buildings also contains an environmental impact rating, which is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The EPC includes a list of cost-effective recommendations to improve the energy ratings specific to the dwelling, and indicates the potential energy efficiency and environmental impact ratings if all cost-effective measures were installed.

Content of the EPC for non-residential buildings
Energy Performance (EP) is shown as a single CO_2 based asset rating against an A to G scale (see Figure 9 and Table 4). The EPC for non-residential buildings includes two benchmarks: the energy rating if the property were newly-built and the energy rating if it were typical of the existing stock of similar properties. Cost-effective recommendations are included in the accompanying Recommendations Report and for non-residential properties are categorised as:

Table 2: Lodgements to October 2012, England & Wales.

EPC type	Percentage by band							Totals
	A	B	C	D	E	F	G	
Domestic	0.07	9.03	28.47	36.37	18.86	5.69	1.71	8,521,432
Non-domestic	0.49	7.43	27.17	29.5	16.81	8.5	10.08	382,276

Table 3: EPC bands and equivalent asset ratings for residential buildings.

Asset Rating (domestic buildings)	Equivalent EPC Band	Energy Efficiency
92 plus	A	Very energy efficient - lower running costs
81 to 91	B	
69 to 80	C	
55 to 68	D	
39 to 54	E	
21 to 38	F	
1 to 20	G	Not energy efficient - higher running costs

Figure 6: Residential EPCs (E&W) percentage of lodgements by band at October 2012.

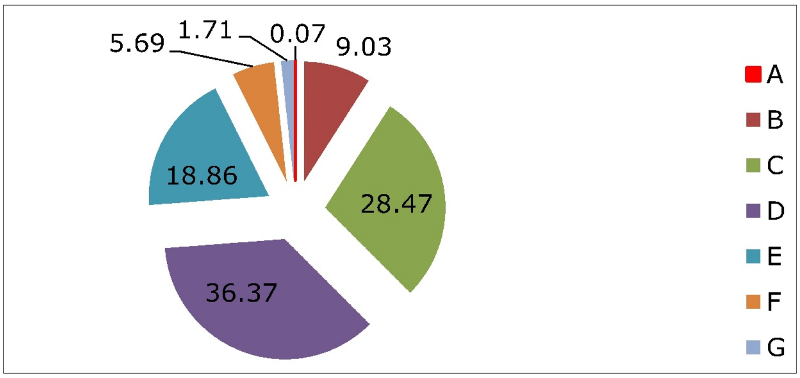


Figure 7: Non-residential EPCs (E&W) percentage of lodgements by band at October 2012.

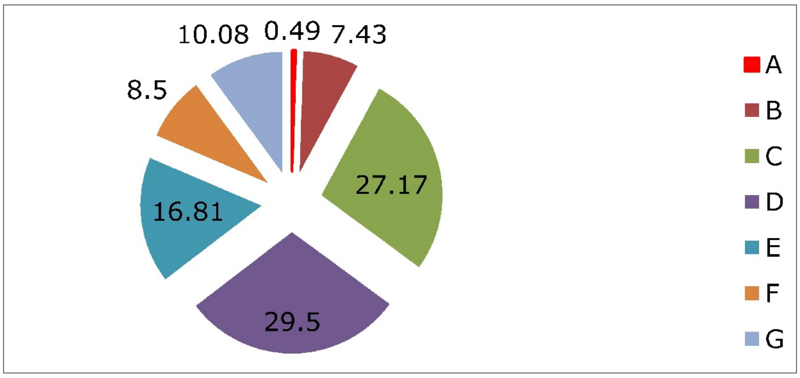
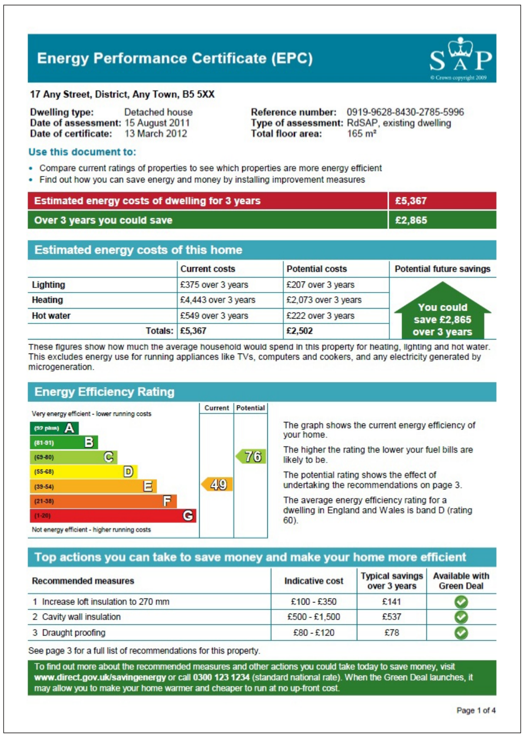


Figure 8:* *Residential EPC, England & Wales.



Energy Performance Certificate (EPC)

SAP © Crown copyright 2009

17 Any Street, District, Any Town, B5 5XX

Dwelling type: Detached house
Date of assessment: 15 August 2011
Date of certificate: 13 March 2012
Reference number: 0919-9628-8430-2785-5996
Type of assessment: RdSAP, existing dwelling
Total floor area: 165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	£5,367
Over 3 years you could save	£2,865

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	£5,367	£2,502	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

Very energy efficient - lower running costs
(92 plus) A
(81-91) B
(69-80) C
(55-68) D
(39-54) E
(21-38) F
(1-20) G
Not energy efficient - higher running costs
Current: 49
Potential: 76

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.

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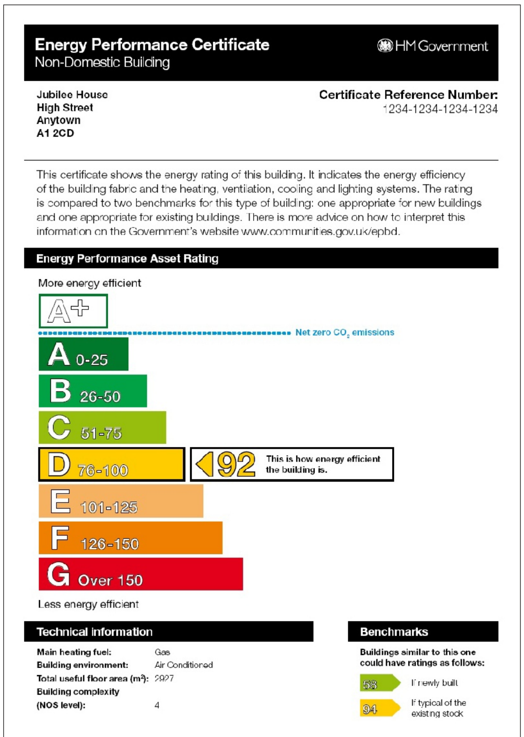
Figure 9:* *Non-residential EPC, England & Wales.



Energy Performance Certificate
Non-Domestic Building
HM Government

Jubilee House
High Street
Anytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient
A+
Net zero CO_2 emissions
A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150
Less energy efficient

92 This is how energy efficient the building is.

Technical information

Main heating fuel: Gas
Building environment: Air Conditioned
Total useful floor area (m²): 2927
Building complexity (NOS level): 4

Benchmarks

Buildings similar to this one could have ratings as follows:
58 If newly built
94 If typical of the existing stock

Table 4:* *EPC bands and equivalent asset ratings for non-residential buildings.

Asset Rating (non-domestic buildings)	Equivalent EPC Band	Energy Efficiency
Below 0	A+	More energy efficient
0 to 25	A	
26 to 50	B	
51 to 75	C	
76 to 100	D	
101 to 125	E	
126 to 150	F	
Over 150	G	Less energy efficient

> short term - payback less than three years;
> medium term - payback between three and seven years;
> long term - payback more than seven years.

Other recommendations may be provided based on the energy assessor's knowledge.

The cost of certificates varies greatly. Indicative start costs (i.e., lowest market costs) in December 2012 based on Google search are:

> for residential buildings: from 40 to 70 GBP (circa 50 to 90 €);
> for non-residential buildings: from 150 to 200 GBP (circa 190 to 250 €).

Enforcement

Local Authorities Trading Standard Officers (TSOs) have the powers to require the 'relevant person' to produce copies of the EPC for inspection and to take copies if necessary. In 2012 these powers were extended to include persons acting on behalf of the 'relevant person' e.g., estate or letting agents.

Penalties

For residential properties the penalty is 200 GBP (circa 250 €).

For non-residential properties the penalty is a sum equivalent to 12.5% of the rateable value of the building, subject to a minimum of 500 GBP (circa 625 €) and a maximum of 5,000 GBP (circa 6,250 €).

Northern Ireland

The provisions for producing certificates on the sale and rent of properties in Northern Ireland (licensing Accreditation Schemes, accrediting energy assessors, QA, software tools, etc.) mirror those for England and Wales, including the penalty regime. The EPC for new dwellings is shown in Figure 10. The EPC for existing dwellings is very similar, although it excludes the 'typical new build' benchmark. The EPC for non-residential buildings is very similar to the England & Wales EPC (Figure 9).

Lodgements data to November 2012 is included in Table 5 and Figures 11 & 12.

EPC costs in Northern Ireland are comparable to EPC costs in England & Wales (see details above).

District Councils enforce the EPC Regulations (with similar powers as provided in England & Wales). Regulations will be amended in February 2013. They will require all marketing material to include the EPC rating and will extend regulatory requirements to the 'relevant person's' agent.

Scotland

The national provisions for the production of EPCs are broadly similar to those implemented in England & Wales. Key differences are detailed next.

Administration: Government has appointed Approved Organisations. Those Approved Organisations may accredit members to produce regulatory outputs in Scotland. Approved Organisations have been tasked with specific QA responsibilities under an agreed Operational Framework. Government will audit Approved Organisations to ensure compliance.

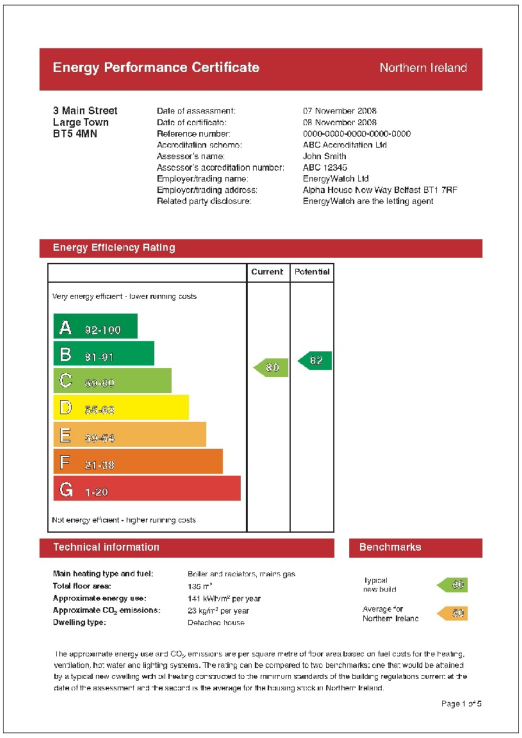
Residential EPC: the EPC for residential buildings is very similar to the England & Wales residential EPC, and is also valid for 10 years. The main difference being that an additional scale is included in Scotland to provide an environmental impact (CO_2) rating (Figure 13).

Non-residential EPC: the first page of the EPC for non-residential buildings is as shown in Figure 14. It is valid for 10 years and differs significantly from the England & Wales EPC. The banding is based on absolute CO_2 emissions, rather than the relative approach adopted in England & Wales (i.e., 'actual building' vs 'reference/notional building'). Absolute primary and delivered energy consumptions are shown on the EPC, which also includes key recommendations for the cost-effective improvement of energy performance. Other pages of the certificate include additional building background information, recommendations for improvement, and guidance.

Register: until October 2012, only EPCs for existing dwellings were lodged on a national register: the Home Energy Efficiency Database (HEED). EPCs for new dwellings were submitted to the Local Authority as part of the building warrant process, and EPCs for existing non-dwellings were not lodged. From January 2013, a new register will be used for all future lodgements, for new and existing buildings. The register *www.scottishepcregister.org.uk* is accessible by nominated individuals of Approved Organisations and Local Authorities (the enforcement authorities). Members of the public looking for a replacement copy of an EPC must contact the Approved Organisation whose member produced the original EPC. The total number of dwellings, with an EPC at September 2012, is circa 570,000. Details are included in Table 6 and Figure 15.

EPC costs in Scotland are comparable to EPC costs in England & Wales (see details above).

Penalties: for dwellings a fine of 500 GBP (circa 625 €), and for any other building type a fine of 1,000 GBP (circa 1,250 €) may be charged for non-compliance.



Energy Performance Certificate Northern Ireland

3 Main Street
Large Town
BT5 4MN

Date of assessment: 07 November 2008
Date of certificate: 08 November 2008
Reference number: 0000-0000-0000-0000-0000
Accreditation scheme: ABC Accreditation Ltd
Assessor's name: John Smith
Assessor's accreditation number: ABC 12345
Employer/trading name: EnergyWatch Ltd
Employer/trading address: Alpha House New Way Belfast BT1 7RF
Related party disclosure: EnergyWatch are the letting agent

Energy Efficiency Rating

Current | Potential

Very energy efficient - lower running costs
A 92-100
B 81-91
C 69-80
D 55-68
E 39-54
F 21-38
G 1-20
Not energy efficient - higher running costs

80 | 82

Technical information

Main heating type and fuel: Boiler and radiators, mains gas
Total floor area: 135 m²
Approximate energy use: 141 kWh/m² per year
Approximate CO_2 emissions: 23 kg/m² per year
Dwelling type: Detached house

Benchmarks

Typical new build 80
Average for Northern Ireland 50

The approximate energy use and CO_2 emissions are per square metre of floor area based on fuel costs for the heating, ventilation, hot water and lighting systems. The rating can be compared to two benchmarks: one that would be attained by a typical new dwelling with oil heating constructed to the minimum standards of the building regulations current at the date of the assessment and the second is the average for the housing stock in Northern Ireland.

Page 1 of 5

Figure 10: EPC for residential buildings (new dwelling), Northern Ireland.

The Northern Ireland registers of certificates are available at:

- > Residential buildings: *www.epbniregister.com*
- > Non-residential buildings: *www.epbniregisternd.com*

Table 5: Lodgements to November 2012, Northern Ireland.

EPC type	Percentage by band							Totals
	A	B	C	D	E	F	G	
Domestic	0.11	7.65	21.9	35.83	22.83	9.74	1.95	182,825
Non-domestic	0.9	10.7	29.85	23.77	13.07	8.5	13.22	4,010

Figure 11: EPCs for residential buildings (NI) percentage of lodgements by band at November 2012.

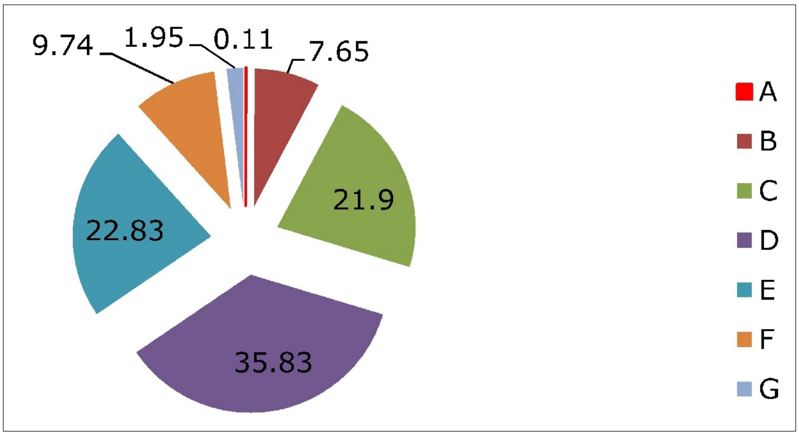
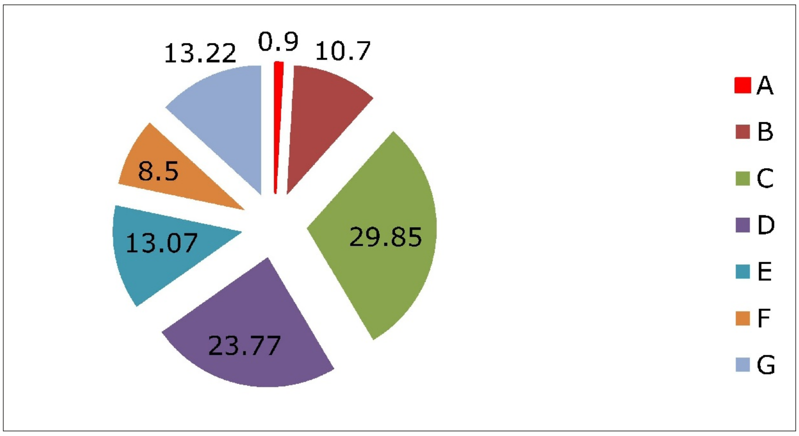


Figure 12: EPCs for non-residential buildings (NI) percentage of lodgements by band at November 2012.



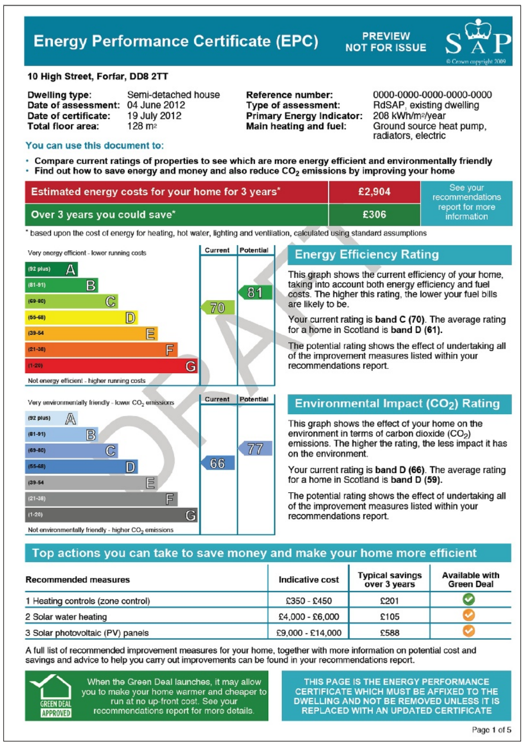


***Figure 13:* EPC for residential buildings, Scotland.**

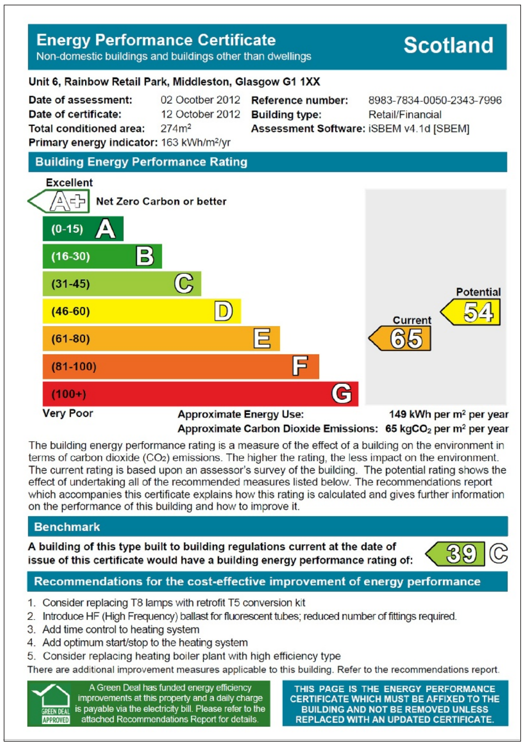


***Figure 14:* EPC for non-residential buildings, Scotland.**

3.2 Progress and current status on public and large buildings visited by the public

England & Wales

Display Energy Certificates (DECs) have been produced by public authorities and institutions providing public services to large numbers of persons where they occupy buildings with floor areas greater than 1,000 m². In line with the requirements of the EPBD recast, DECs will be issued and displayed in buildings larger than 500 m² that are occupied by a public authority and frequently visited by the public. This threshold will fall to 250 m² in 2015. EPCs (as defined in 3.1) will be displayed in commercial premises larger than 500 m² that are frequently visited by the public, and where an EPC has previously been issued. Lodgements data to October 2012 is included in Table 7 and Figure 16.

DECs content

DECs show the EP of a building based on the actual energy consumption for the previous year in the form of an Operational Rating (OR) (Figure 17). Information on performance recorded over the previous three years is also shown on the DEC when available. The historic data illustrates whether there has been an improvement in a building's performance. The OR gives a numerical indicator of a building's CO_2 emissions on a scale of A to G, with A being the best performance. An asset rating may also be shown on the DEC as a numerical indicator, if an EPC is available for the building.

The building's performance is compared to a benchmark. For each building category, the benchmark is set at the median performance for all buildings in each category. Buildings which have zero CO_2 emissions over the year achieve an OR of zero. Buildings which perform at the benchmark level achieve an OR of 100 at the D to E boundary. Buildings which emit twice as much CO_2 as the benchmark level achieve an OR of 200. Buildings which are net energy generator are given an OR of zero. The approved benchmarks are set out in the Technical Memorandum No. 46 (TM 46) Energy Benchmarks published by the Chartered Institution of Building Services Engineers (CIBSE).

DECs for buildings with a total useful floor area of more than 1,000 m² are updated annually. The accompanying Advisory Report, which includes cost-effective recommendations, has a validity of seven years maximum. DECs for buildings with a total useful floor area of less than 1,000 m² are updated every 10 years. Recommendations are categorised by payback in the same way as in Recommendations Reports which accompany non-residential EPCs (see 3.1 for details).

In 2011, CIBSE undertook a review of 45,000 DECs lodged between 2008 and 2010. The review concluded that overall the benchmarking system worked well, with a good correlation between ORs and benchmarks in 94% of the DECs analysed.

Recommendations were made for consideration by Government and included:

> Investigating the extent to which new separable energy uses could be included in the DEC process. Separable energy uses are non building-related energy uses which may be discounted from the DEC calculation.
> A review of occupancy hours to help refine the adjustments incorporated in the DEC process.

Administration, enforcement, and costs

The administration processes (energy assessors accreditation, QA, etc.) and enforcement powers for DECs are identical to those implemented for EPCs (see details in 3.1).

The cost of DECs varies greatly. Indicative start costs (i.e., lowest market costs) in December 2012 based on Google search are:

> public buildings DEC: from 300 GBP (circa 375 €).

Penalties

Occupiers of buildings qualifying under the regulations who fail to:

> possess or control a valid advisory report may be subject to 1,000 GBP (circa 1,250 €) penalty;
> display a valid DEC may be subject to a 500 GBP (circa 625 €) penalty.

Northern Ireland

The provisions (including administration, accreditation of assessors, certificate format, penalties) relating to display certificates in Northern Ireland are similar to those in England & Wales. Guidance, including 'A guide to Display Energy Certificates and advisory reports for public buildings' were published in 2012 and are to be updated in February 2013.[a]

New regulations (coming into force in February 2013) will implement the new display requirements of the recast EPBD.

Lodgements data to November 2012 is included in Table 8 and Figure 18.

Scotland

The asset rating based, non-residential EPC (Figure 14) is used for display in qualifying public buildings. Historical lodgement data is not available as the new non-residential register started

Table 6: Dwellings with an EPC at September 2012, Scotland.

EPC type	Percentage by band							Totals
	A	B	C	D	E	F	G	
Domestic	0.01	5.91	34.25	35.47	16.29	6.13	1.94	570,399

Figure 15: Residential EPCs (Scotland). Percentage by band at September 2012.

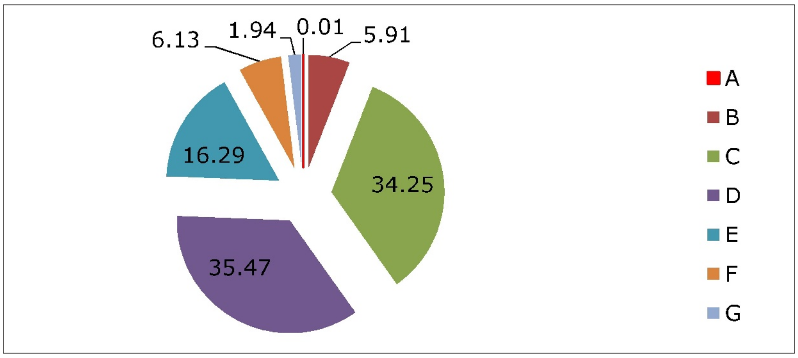
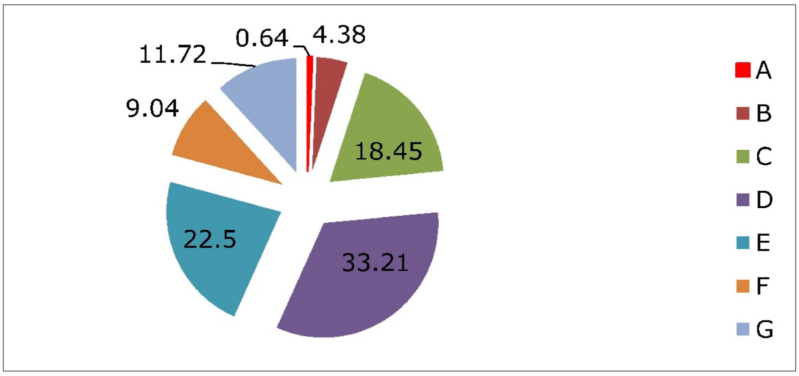


Table 7: Lodgements to October 2012, England & Wales.

EPC type	Percentage by band							Totals
	A	B	C	D	E	F	G	
Public buildings (DEC)	0.64	4.38	18.45	33.21	22.5	9.04	11.72	133,511

Figure 16: Public buildings DECs (E&W) Percentage of lodgements by band at October 2012.



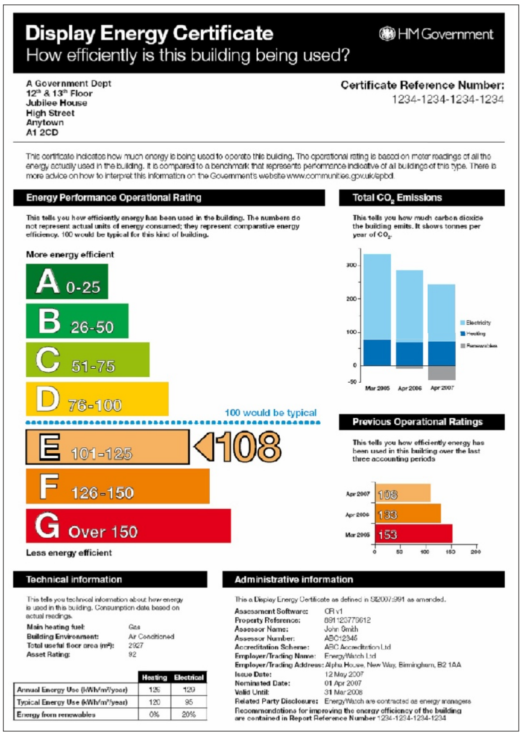


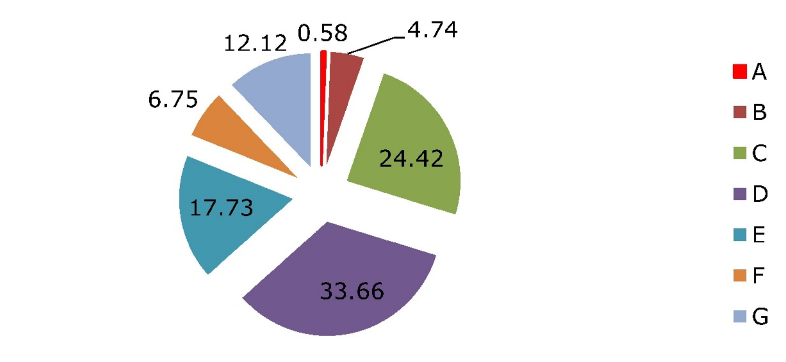
Figure 17: Display Energy Certificate (DEC), England & Wales.

([a]) *www.dfpni.gov.uk/index/buildings-energy-efficiency-buildings/energy-performance-of-buildings/content_-_energy_performance_of_buildings-download_epb_publications/content_-_energy_performance_of_buildings-display_energy_certificates_guide.htm*

Table 8: Lodgements to November 2012, Northern Ireland.

EPC type	Percentage by band							Totals
	A	B	C	D	E	F	G	
Public buildings (DEC)	0.58	4.74	24.42	33.66	17.73	6.75	12.12	5,528

Figure 18: Public buildings DECs (NI) percentage of lodgements by band at November 2012.



operating in January 2013. New regulations have been enacted to implement the new display requirements of the recast EPBD.

From January 2013, there are provisions for financial penalties in those instances where a qualifying public building does not comply with the regulations. A fine of 1,000 GBP (circa 1,250 €) may be charged for non-compliance.

3.3 Implementation of mandatory advertising requirement – status

England & Wales
From 2012, an EPC must be commissioned before the property is marketed. Sellers and landlords are ultimately responsible for commissioning an EPC. Estate or letting agents (acting on behalf of sellers or landlords) must be satisfied that an EPC is available or has been commissioned before the property is marketed.

Northern Ireland
The EPC must be made available at the earliest opportunity before the conveyancing process commences and, as a constituent document in this process, it must be provided as part of the completion of the sale. These requirements will be amended in February 2013 to require that an EPC is lodged on the register prior to marketing a building, and that the EPC rating is included in marketing material.

Scotland
An EPC must be available on commencement of marketing and to prospective buyers or tenants. From January 2013, the EP indicator of the EPC must be included in any advertisement in commercial media, with such situations defined in regulations. These responsibilities rest with the building owner.

3.4 Information campaigns

England & Wales
Publicity campaigns were run in 2008 and 2009 to introduce a range of initiatives, including air-conditioning inspections. At present, Government does not intend to run a publicity campaign about regulatory requirements which building owners should be aware of.

Northern Ireland
National information campaigns have used a diversity of outlets including: website, advertising (through radio, press and information leaflets), targeted seminars, guidance documents, roadshows, and proactive enforcement by a dedicated team. Information is also available on the Government's website.[a]

Scotland
Government invested in excess of 40 million GBP (circa 50 million €) in non-residential energy efficiency advice and support programmes since 2007. Government continues to fund the Carbon Trust and the Energy Saving Trust to provide advice and support to businesses, public sector organisations, and the wider public at large to reduce energy consumption and associated costs through improved energy efficiency and carbon management.

3.5 Any other relevant information

England & Wales - Certificates content (additional information)
Other key pieces of information conveyed on certificates (EPCs and DECs) include:

> reference information: the unique certificate reference number (as stored in the national register);
> energy assessor details: this includes the assessor's name, accreditation number, and Accreditation Scheme;
> information on how to complain or how to confirm that the certificate is genuine.

The Northern Ireland certificates mirror the England & Wales certificates content described above.

([a]) *www.dfpni.gov.uk/index/buildings-energy-efficiency-buildings/energy-performance-of-buildings/epb-notices.htm*

England & Wales - Access to certificates

All certificates must be lodged on the national register to be legally valid. The register contains over 7 million certificates and this number is growing by over 1 million per year, which represents a valuable source of information about the energy efficiency of buildings. From 2012 this data is publicly available, free of charge, thus allowing individuals to look up certificates online, allowing comparison of the energy performance of properties.

Selected organisations have access to limited data in bulk. These limitations are designed to protect consumers and there is a charge for this service. Allowing access to this data has a number of benefits, including: supporting the implementation of other Government energy efficiency programmes (such as the Green Deal) and facilitating research and analysis which can inform Government policy.

Anyone with an EPC can opt-out of having their data publicly available.

Northern Ireland & Scotland - Access to register data

In both jurisdictions, the England & Wales provisions making certificates publicly available have not been reflected. Data lodged on the relevant national registers is typically available to: anyone with the unique reference number of the certificate or report (currently available in Northern Ireland, and from January 2013 in Scotland), Accreditation Schemes and Approved Organisations (for example to monitor outputs from their accredited members), enforcement authorities, Governments, and organisations delivering national energy efficiency initiatives. In particular circumstances, regulations require data to be anonymised, for example in Scotland where data is intended to be used by Government for research and statistical purposes. In February 2013, regulatory amendments will bring Northern Ireland broadly in line with the England & Wales provisions for wider access to and use of data held on the national register.

Levying of penalties

> England & Wales: No penalties levied to date.
> Northern Ireland: While a number of penalty charge notices have been issued, all have been withdrawn because the certificate was then obtained.
> Scotland: This information is not currently held centrally by the Scottish Government.

4. Inspection requirements - heating systems, air-conditioning

4.1 Progress and current status on heating systems

All the UK jurisdictions (i.e., England, Wales, Northern Ireland and Scotland) decided to pursue the option to provide advice on boilers, rather than implement an inspection regime, and in continuation of the extensive programme of information, grant schemes and regulation it had followed historically (see example in Figure 19). An equivalence report was issued to the Commission in 2008. Further updates were prepared in 2010.[a]

The report concludes that option (b) (provision of advice) will save more carbon compared with option (a) (an inspection regime). The main reason is because of the respective boiler populations captured by the two options: option (a) is targeted at a relatively small proportion of boilers (11.5%) whereas option (b) addresses all boilers in the UK. Option (a) is likely to be more effective in generating action since option (b) is dependent on a response to the advice programme, but the far larger population of boilers covered by option (b) outweighs the effect.

Government continues to tighten energy efficiency requirements, for example through Building Regulations updates. Building regulations are a very effective vehicle to generate carbon savings, particularly when they are applied to existing buildings subject to building work. In support of the Building Regulations, guidance has been made available:

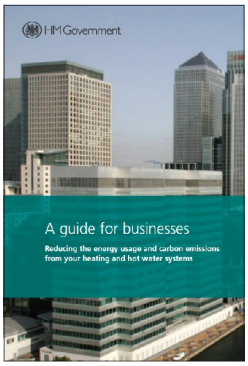
> Residential Building Services Compliance Guide;[b]
> Non-Residential Building Services Compliance Guide.[c]

Government developed a UK annex to the CEN standard designed to assist Member States (MS) to implement option (a). This annex corresponds closely to the Government boiler checklists and guidance produced with industry to provide advice on boilers. Government

REFERENCES

> Residential buildings register: *www.epcregister.com*
> Non-residential buildings register (all certificate types and air-conditioning inspection reports): *www.ndepcregister.com*

Figure 19: A guide for businesses, Reducing the energy usage and carbon emissions from your heating and hot water systems, HM Government.



([a]) *www.gov.uk/government/uploads/system/uploads/attachment_data/file/28668/BRE2.pdf*
([b]) *www.planningportal.gov.uk/uploads/br/domestic_building_compliance_guide_2010.pdf*
([c]) *www.planningportal.gov.uk/uploads/br/non-domestic_building_compliance_guide_2010.pdf*

also held discussions with industry on how advice may be provided under a competent persons' scheme. Therefore, as the checklists form part of industry recommended good practice guidelines, existing service visits may be regarded as meeting some of the inspection requirements of option (a).

These policies have been highly successful. Of the 1,305,000 gas boilers sold for installation in dwellings in the UK in 2009, 98.9% were of the condensing type, and of the 50,000 oil boilers sold in the same period 85.5% were condensing.

4.2 Progress and current status on AC systems

England & Wales

In England & Wales, the inspections of air-conditioning (AC) equipment was phased between 2009 (for systems >250 kW) and 2011 (for systems >12 kW). Installations must be inspected every five years which is the validity of an inspection report. From 2012, all new AC Inspection Reports must be lodged on the national EPC register (SI 2011/2452). This replaces the previous voluntary lodgement approach, and aims to ensure reports may be assessed for QA. It is the first step in a series of proposals to improve compliance, and will also support the development of future policies.

The approved guidance to undertake AC inspections is set out in the Technical Memorandum 44 (TM 44) Inspection of Air-Conditioning Systems published by CIBSE.

The administration, energy assessors accreditation and QA processes have been incorporated as a separate strand of the EPCs processes described in 3.1. The penalty levied for failing to have an inspection done is 300 GBP (circa 375 €).

Figure 20: A guide to air-conditioning inspections for buildings, Northern Ireland.

Northern Ireland

The national requirements broadly mirror the England & Wales requirements (administration, accreditation, QA, penalty regime). The requirements were also phased between 2010 (for systems >250 kW) and 2011 (for systems >12 kW). The validity of inspection reports, therefore the frequency of the inspection regime, is identical to the England & Wales, i.e., five years. The requirement to lodge the AC inspection report on the national EPC register will come into force in February 2013. 'A guide to air-conditioning inspections for buildings' (Figure 20) was published in 2008. It is due to be updated in February 2013 and is available at *www.dfpni.gov.uk/air_con_guide-4.pdf*.

Scotland

Requirements were phased between 2009 (for systems >250 kW) and 2011 (for systems >12 kW). Inspections may only be carried out by members of those organisations that have entered into a protocol with The Scottish Government.[a]

As in England & Wales, the frequency of inspections is five years and CIBSE TM44 may be used as guidance to undertake inspections, subject to the provisions set out in the TM44 Scottish addendum.[b]

The benefits of joint inspection (AC and F-gas) will be considered in consultation with the industry in 2013.

5. Conclusions and future plans

The UK jurisdictions have adopted various approaches to transpose the requirements of the Energy Performance of Buildings Directive (EPBD) and its recast. The English approach has been mirrored in most jurisdictions, or wholly adopted, e.g., EPCs in Wales. In a few instances, the four jurisdictions have adopted a common approach, namely for heating systems and cost-optimal requirements.

The transposition of the EPBD, its recast and associated benefits have been and continue to be reviewed by each UK jurisdiction as part of their respective programmes to achieve national energy efficiency objectives and carbon emissions reduction.

In some instances, these reviews validated the current implementation approach, for example the DECs review by CIBSE. In other cases, the reviews resulted in changes, for example the new residential EPC format adopted in England, Wales and Scotland. Changes have and will continue to be made to the implementation instruments where deemed appropriate.

([a]) *www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/enerperfor/inspectaircon*
([b]) *www.cibse.org/content/Certification/website/AC/addendum.pdf*

ISBN 978-972-8646-28-8

www.epbd-ca.eu

Co-funded by
the European Union