

Energy Performance Certificates across Europe

From design to implementation





THE BUILDINGS PERFORMANCE INSTITUTE EUROPE - BPIE

The Buildings Performance Institute Europe (BPIE) is dedicated to improving the energy performance of buildings across Europe, and thereby helping to reduce CO₂ emissions from the energy used by buildings.

Its mission is to support the development of ambitious, yet pragmatic building-related policies and programmes at EU and Member State level and to drive their timely and efficient implementation by teaming up with relevant stakeholders from the policy and research community, the building industry and consumer bodies.

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FOREWORD

This report analyses the current status of implementation of Energy Performance Certificates schemes across selected Member States and puts the spotlight on existing challenges and issues.

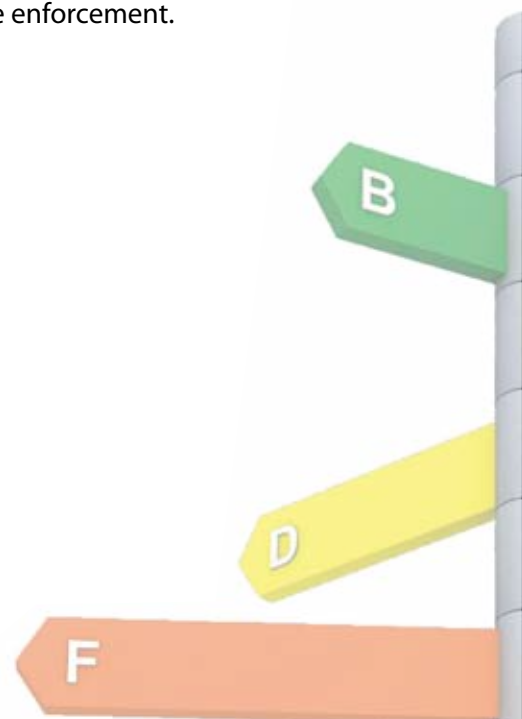
The main objective is to guide policy decision-makers, and to draw their attention to areas of optimisation. Indeed, the implementation of Energy Performance Certification schemes has attracted high attention in recent years, as they are key instruments supporting energy efficiency improvements in buildings across Europe. Many stakeholders have to be involved in both the design and the implementation of certification schemes in order to be successful.

This report has been produced bearing in mind the needs of both those involved in forward planning, strategy development and implementation at regional and Member States level. It is targeted more specifically at potential buildings Energy Performance Certificate scheme designers.

The report identifies best practices and presents how to overcome barriers in the implementation of the EPC schemes at the regional and the Member States level.

This report should increase understanding of:

- ▶ What the different approaches to EPC scheme implementation are;
- ▶ When and where they may be appropriate;
- ▶ How the regional or national context impacts the implementation of an Energy Performance Certification process; and
- ▶ What are the key elements to secure and adequate enforcement.



The authors of this report are convinced of the need for a wider use of Energy Performance Certification approaches. We are equally convinced of the need to undertake adequate preparation before launching buildings EPC schemes, the need to learn from each other's experiences, and the need to better connect technical elements of the scheme and their practical application.

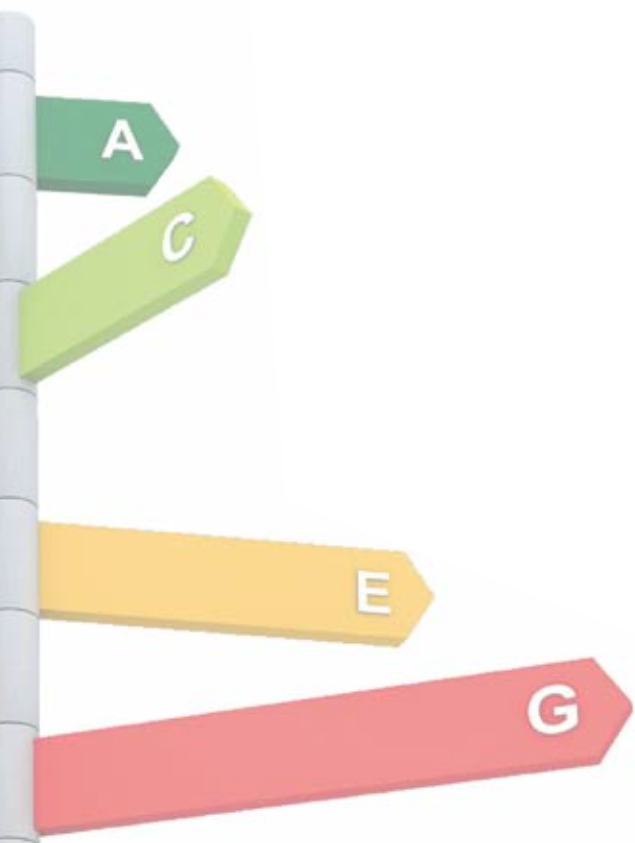
This report has mainly been drafted with the support of BuildDesk Benelux BV (Chantal Tiekstra, Olaf Ooijevaar). It has also leveraged the specialist knowledge of a Consultant to BuildDesk Benelux BV, Bart Poel. In addition, Gerelle van Cruchten and Nyke Greidanus provided substantial research support.



Dr. Tudor Constantinescu

Executive Director

Brussels, December 2010



EXECUTIVE SUMMARY

Energy Performance Certification of buildings is an important element of Europe's energy and climate policy. The certificate can potentially influence builders and real estate owners to build with greater energy efficiency and implement energy savings measures in renovation projects. As a consequence of the 2002 European Energy Performance of Buildings Directive (2002/91/EC), EU Member States have to implement Energy Performance Certificates. The recast of the EPBD (Directive 2010/31/EU) in 2010 increases even further the policy attention and the importance of the EPCs. The dynamics and conclusions of this report should support also the implementation of these new more ambitious approaches.

CONTENT OF THE REPORT

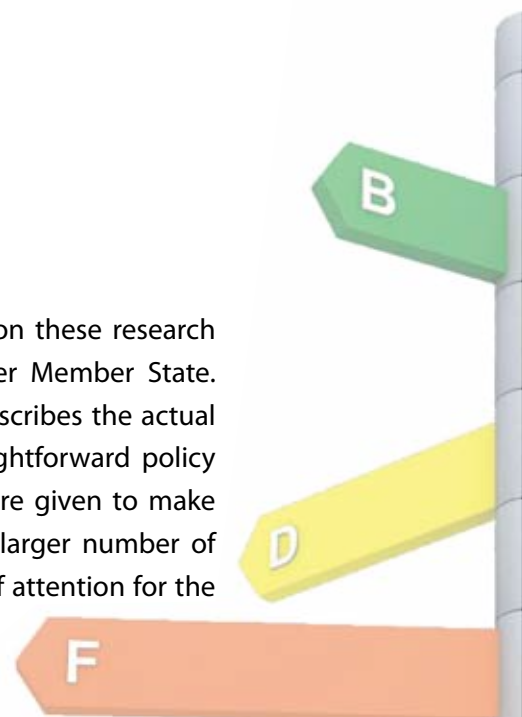
This report describes the implementation of Energy Performance Certificates in twelve EU Member States: Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Ireland, the Netherlands, Poland, Portugal and Spain.

It provides an overview of the implementation of Energy Performance Certification in the selected Member States and investigates barriers to implementation and success factors. The study also elaborates on practical national experience with the implementation process. Such information should be helpful for Member States in evaluating and improving their own implementation processes for Energy Performance Certificates.

The study encompasses the following topics:

- ▶ The basic implementation approach;
- ▶ The use of certificates;
- ▶ Public acceptance by consumers and professional stakeholders;
- ▶ The cost of certificates;
- ▶ Administration/registration;
- ▶ Quality control;
- ▶ Promotion;
- ▶ Compliance and enforcement;
- ▶ Market barriers;
- ▶ Future anticipated changes.

The study provides an analysis of the information available on these research themes and a detailed overview of EPC implementation per Member State. The report also contains a chapter on policy issues, which describes the actual experience in Member States and identifies key issues, straightforward policy conclusions and recommendations. Best practice examples are given to make the information more easily accessible and applicable for a larger number of Member States. The policy chapter concludes with a "Points of attention for the



implementation of the EPC schemes”, which should be useful to policy-makers across EU Member States in structuring the implementation process for Energy Performance Certificates.

RESEARCH FINDINGS IN A NUTSHELL

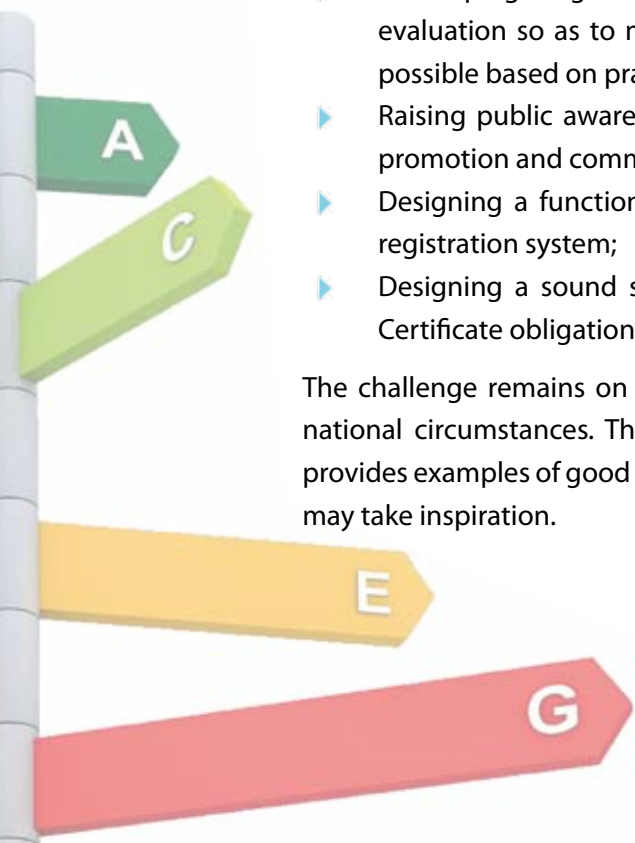
This study reveals that many individual EU Member States encounter difficulties in implementing Energy Performance Certificates within their national legal frameworks. These difficulties sometime lead to delays and suboptimal implementation solutions.

A lot of the implementation problems and difficulties experienced are inherent in the complexity of implementing Energy Performance Certificates. Different national backgrounds and circumstances in Member States lead to varying implementation solutions, particularly with respect to the chosen calculation methods, the registration procedures, promotional activities undertaken, quality control mechanisms and enforcement systems. This inevitably leads to significant differences between countries in the ultimate effectiveness of Energy Performance Certificates in bringing about real change in energy efficiency in the building stock.

The research results show that the effectiveness of implementation can be increased and public acceptance of the Energy Performance Certificates can be enhanced by:

- ▶ Designing the scheme to involve multidisciplinary stakeholders and paying attention to the exchange of experience and knowledge development;
- ▶ Paying close attention to the responsibilities at different legislative levels in the implementation process;
- ▶ Making the implementation approach fit with everyday practice;
- ▶ Developing a good registration system suitable for monitoring and evaluation so as to make the adoption of the implementation approach possible based on practical experience;
- ▶ Raising public awareness of the Energy Performance Certificate through promotion and communication;
- ▶ Designing a functional system for quality assurance, making use of the registration system;
- ▶ Designing a sound system for the enforcement of Energy Performance Certificate obligations, also making use of the registration system.

The challenge remains on how to put this in practice taking into account the national circumstances. The report does not offer one universal solution, but provides examples of good practices from which policy-makers and practitioners may take inspiration.





INTRODUCTION

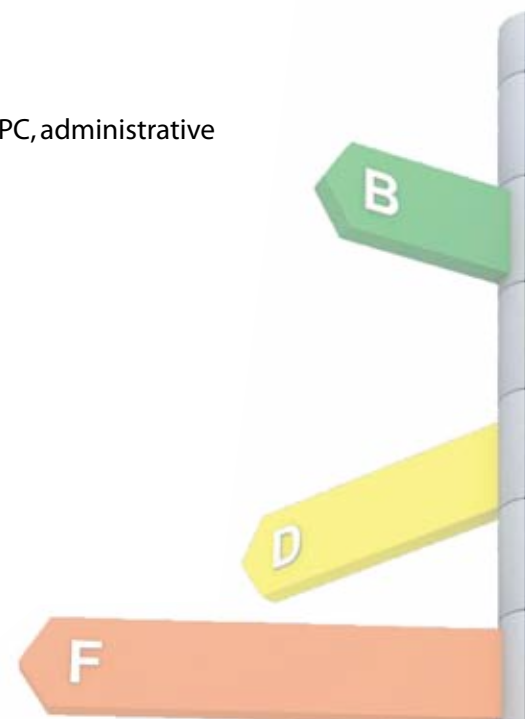
Since January 2009, EU Member States have been required to effectively comply with the 2002 Energy Performance of Buildings Directive (EPBD). One of the requirements set by the EPBD is to introduce Energy Performance Certificates (EPCs) which are required to be issued when a building is constructed, sold or let, i.e. as a part of a property transaction.

As defined by the EPBD, the Energy Performance Certificate is a document recognised by a Member State or by a legal person designated by it, which indicates the energy performance of a building or building unit, calculated according to a methodology adopted in accordance with Article 3.

The EPBD sets several general requirements to be adopted in the EPC scheme but gives enough flexibility for Member States to adjust these requirements to appropriately fit their national context. In addition, the CEN standards supporting the implementation provide the possibility to choose a particular approach for each country.

This results in a wide range of differences in the implementation of specific aspects of the EPBD and EPCs among Member States, namely in:

- ▶ The calculation method;
- ▶ Setting energy performance requirements;
- ▶ Requirements, training, accreditation of energy experts;
- ▶ Communication and promotion;
- ▶ Quality control;
- ▶ Enforcement and sanctioning;
- ▶ Policy goals (apart from meeting the EU Directive);
- ▶ Financial issues such as budget and cost of an individual EPC, administrative burdens.

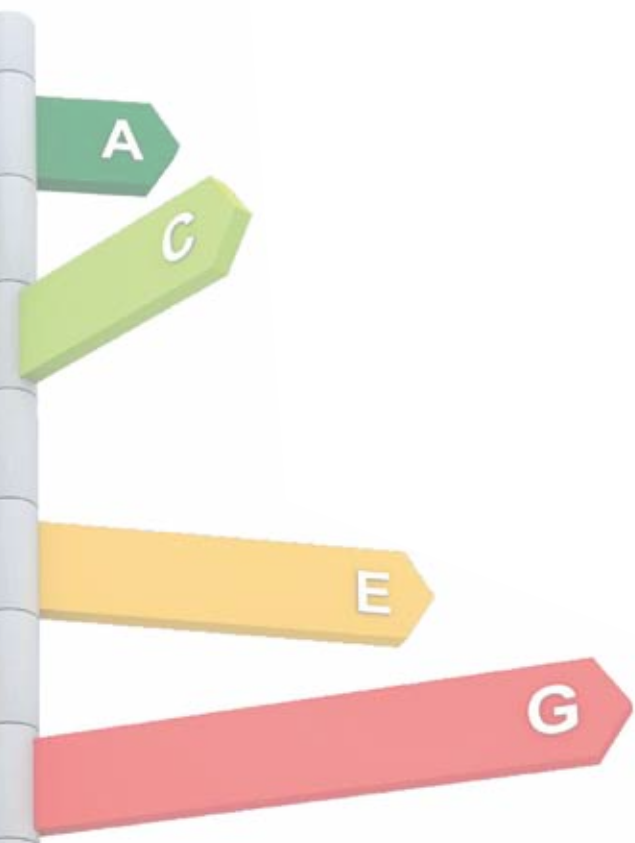


These differences are inevitably expected as many national differences exist between EU Member States regarding their culture, politics, national policy and legislation, building traditions, financial situation, energy infrastructure, climate, etc. Consequently, the approach associated with the successful implementation of the EPBD may differ from country to country.

The current development of Energy Performance Certificates in selected EU Member States was reviewed in order to identify market failures and key success factors. The specific research topics and the selected Member States are described in the annex.

The study is structured as follows: a “policy overview” is presented in Chapter 2 which presents the key findings from the analysis of the research topics (listed in the Executive Summary page 6). This section first presents information on policy formulation, describes the overall findings drawn from experience related to EPBD implementation and concludes with some policy recommendations.

In Chapter 3, a detailed analysis of the results for each research topic is presented followed in Chapter 4 by a concise overview of the EPC implementation experience in the selected Member States. The information in Chapters 3 and 4 form the basis for the policy overview.



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POLICY OVERVIEW

In this chapter, a policy overview outlining the findings from the analysis of the research topics listed in the Executive Summary (page 4) is presented. The first section describes policy formulation relating to the EPC scheme and EPBD. The section on “Experiences so far with EPBD implementation” describes the overall findings drawn from experience so far in EPBD implementation. In the final section, policy advice is given and a series of focus points, recommendations, best practice and a checklist for EPC implementation are presented.

POLICY FORMULATION

To assist in the effective legal, policy and practical implementation of the EPC schemes, the main issues to be considered for both the EPC scheme and EPBD as a whole are discussed firstly, followed by a number of trade-offs relevant to the assessment process of the scheme.

Implementation of the EPC scheme as part of the EPBD: a complex matter¹

The successful implementation of the EPC scheme and overall EPBD requires the design of interdependent instruments that are compatible with the everyday practice of the stakeholders involved with the structure of the market. It also requires that the scheme is in line with the specific characteristics of the building stock. At the same time, the approach should be embedded in the legislative and political structure and fit into the culture of each Member State. This is depicted in figure 1.

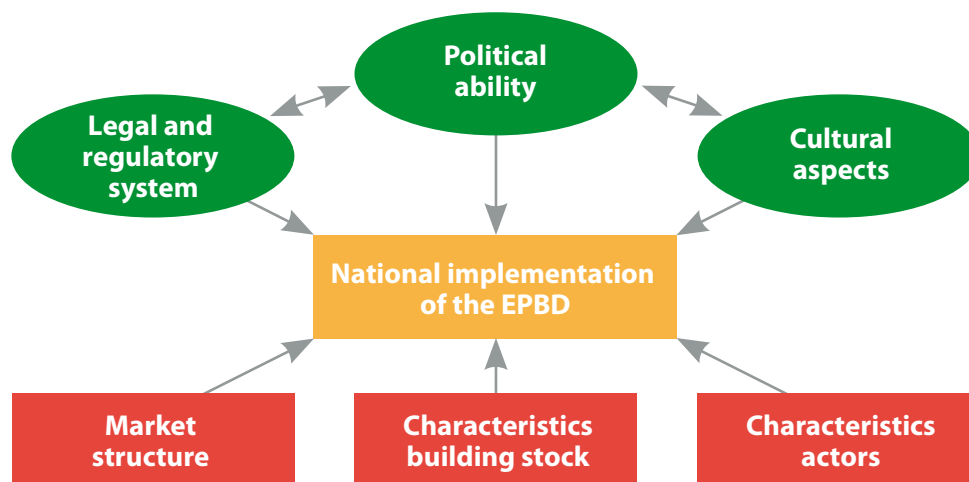


Figure 1 – Influencing factors on national implementation of the EPBD

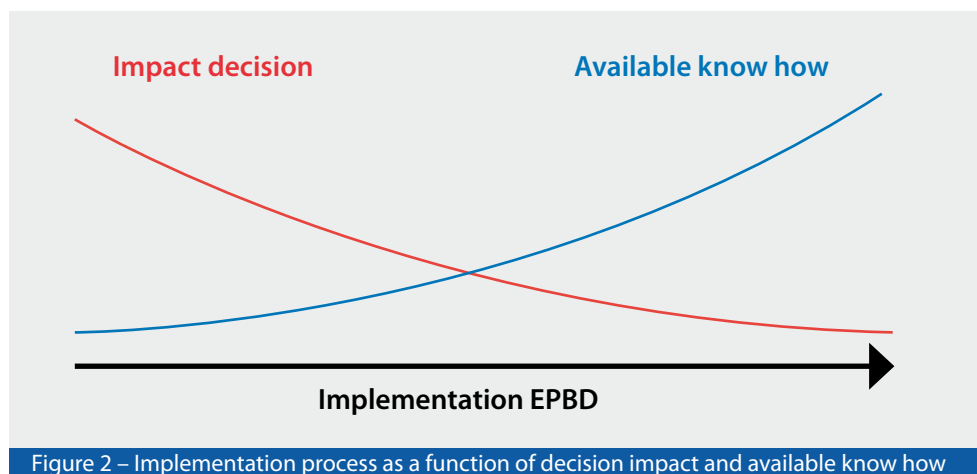
¹ Source: Bart Poel Consultancy BV; Velp, the Netherlands, 2010.

The design of the national implementation of the EPBD is a complex and challenging task that requires a lot of know-how, experience and skills in several sectors of society.

The task of shaping the implementation of EPBD has a multidisciplinary character which is not only related to technical issues but also to process matters and political and social-economic aspects. Effective implementation of the EPBD is therefore 'context-related'.

The national situation of a Member State often plays a key role in the choices made with regard to the implementation of specific components, since they have to be embedded in the country's or the region's specific practice. This results in many differences in country-specific implementation of the EPBD requirements. Besides the differences obtained due to the varying national situations among Member States, there are also differences in the interpretation of the EPBD made by Member States. The latter arises from the lack of clarity on certain elements in the EPBD, such as the definition of 'major renovation'.

The choices that have to be made in this kind of complex implementation process represent the classic dilemma of a design task, as indicated in figure 2.



In a complex process such as EPBD implementation, Member States often start with little knowledge and experience regarding relevant aspects of the implementation process. During this phase of limited knowledge, decisions of high-level impact are made (see diagram above). In terms of risk management, it is thus important to follow an implementation strategy that lowers the risk of poor decisions, while at the same time mobilising all available knowledge to support decision-making. This is the typical dilemma that occurs in the first design stage.

The standard approach to solving this dilemma is to include flexibility in the choices made and to put extra effort into acquiring knowledge by, for instance, sharing experience with other countries or including lessons learned from similar fields of application. In the first stage, it can also be advantageous to make 'adaptable' risky decisions which can be then adjusted as experience becomes more readily available over time. The latter can apply, for instance, to the design of the scheme and the assessment approach for EPC scheme.

Trade-offs in the design of the assessment process

In order to design an effective assessment approach, it is important to consider the issues of reproducibility, accuracy, level of expertise and costs. These elements are explained below.

Reproducibility is defined as the ability of the results of a building assessment to be accurately reproduced by more than one individual building expert. *Acceptable reproducibility* refers to the level of reproducibility for which the deviation between assessments of a particular building made by two or more experts using the same methodology is relatively small. For instance, in the context of label classes, a deviation of one label class is generally acceptable while a deviation of two or more label classes may undermine the credibility of the certificate and hence may be regarded as unacceptable. If the scale is divided into many classes and the acceptable deviation is assumed to be one class at most, a high reproducibility should be obtained for the label to be credible and acceptable. Figure 3 demonstrates this mechanism.

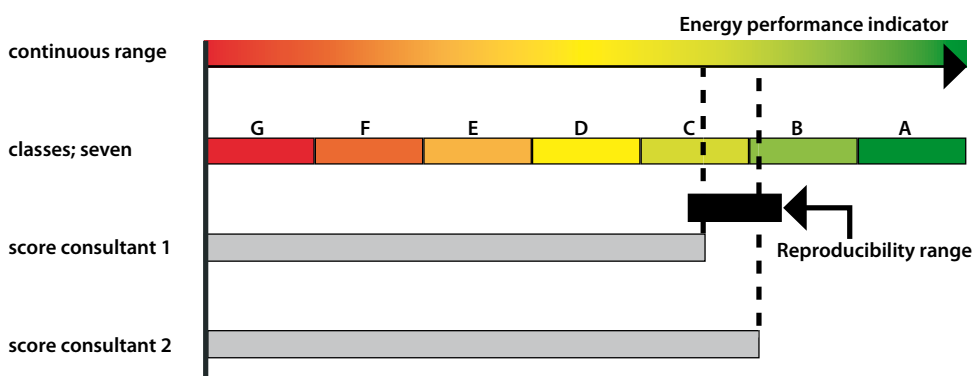


Figure 3 – Reproducibility mechanism

The *accuracy of the methodology*, which refers to the deviation between the calculated and the actual value, is mainly associated with the accuracy level of three parts of the assessment procedure. The first part is the calculation method for which inaccuracy levels typically correspond to a $\pm 10\%$ variation with respect

to the actual value, assuming that a reliable calculation method has been considered.

Secondly, inaccuracies may arise from the use of default input values to represent reality. Input parameters, such as the level of the efficiency of a boiler, g-value or the solar gain factor of transparent building parts or the surface area-to-volume ratio of the building, are required in order to proceed with the calculation method. These parameters can be either measured or predetermined (default values). Typically, a small number of well-defined default values used in the calculation will lead to a deviation of about $\pm 5\%$ in the resulting calculated values compared to the actual building¹.

Lastly, the deviation may originate from inaccuracies that are related to the data acquisition made by the expert (i.e. inaccuracies associated with human error). In the case of a calculated rating with a full range of input data to establish by measurement/assessment (surface areas, U-values, system characteristics, etc.) the derived data can differ by $\pm 30\%$ from the actual building, due to the errors introduced by the expert. This is the main source of inaccuracies, leading to a total of $\pm 45\%$ deviation in the calculated outcome of the energy performance of a building compared to the actual building. In reality, there will be compensating errors which will yield an overall inaccuracy level of about $\pm 20\%$. Figure 4 visualises this effect. Typically, the $\pm 30\%$ deviation in data acquisition is one of the main determining factors responsible for a 'poor' reproducibility, which can be in conflict with the chosen label class scale and the acceptability of the label class outcome.

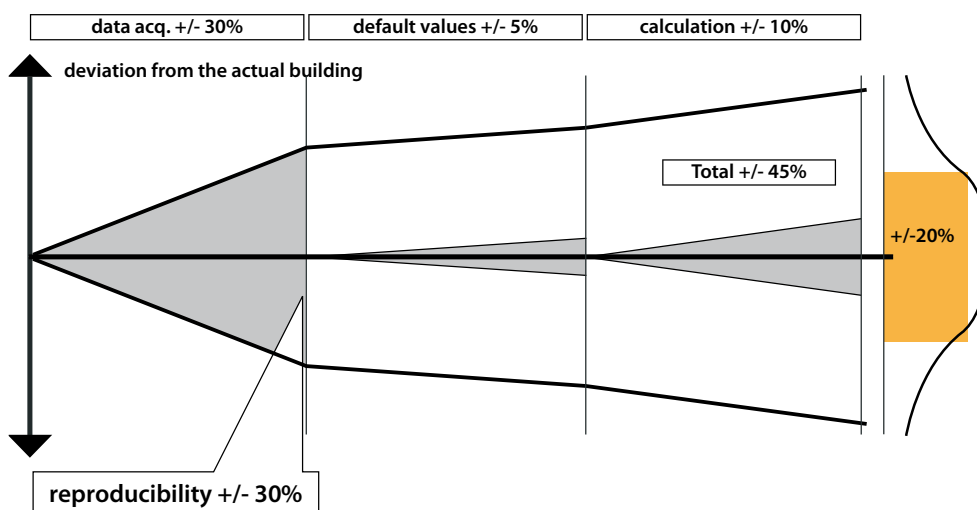


Fig. 4 – Deviation resulting from the accuracy level of the three-part assessment procedure

From the above, it is clear that the assessment process can be improved in terms of its reproducibility by simplifying the data acquisition and subsequently increasing the number of default values required for the calculation. If this approach is adopted (illustrated in figure 5), the deviation introduced by the default values in the procedure now becomes $\pm 15\%$ (as opposed to $\pm 5\%$ from the previous approach). In other words, the inaccuracy increases due to the introduction of more default values. This effect is due to the fact that default values may not always reflect the actual (real) value of a parameter. Nevertheless, the human error (from the measured values) is limited in the second approach as the deviation due to data acquisition reduces from $\pm 30\%$ to $\pm 10\%$ (see the values for the data acq. in figure 4 and 5). The second approach has therefore a much better overall performance than the previous approach. Namely, the overall inaccuracy of the second approach compared to first one is reduced from $\pm 20\%$ to $\pm 15\%$, with the reproducibility improved from $\pm 30\%$ to $\pm 10\%$ deviation from the actual building.

The method described above illustrates the importance of having the right balance between default values and data acquisition by assessor on the accuracy and reproducibility of the chosen assessment process.

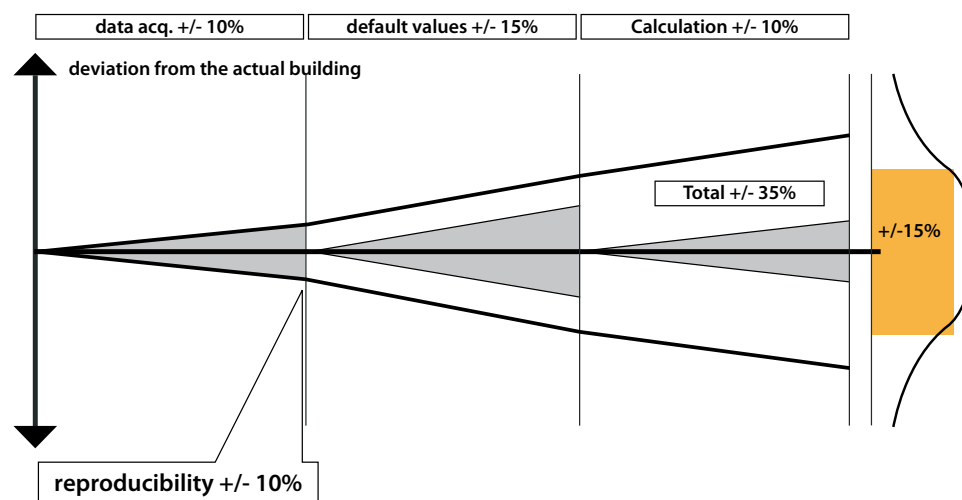


Figure 5 – Deviation resulting from the revised approach

The additional advantages of the second approach (i.e. the approach which requires a more simplified data acquisition) include a lower level of expertise, less time and effort from the assessors, thus resulting in lower costs for the assessment. This trade-off mechanism, illustrated in this case by the example of the design of the assessment approach, indicates the complex choices to be made in the implementation process. Nevertheless, the examples given here are based on real



and sound experiences in practice². It shows the importance of a multidisciplinary development of the methodology. For example, physicists developing a calculation method with accompanying default values will not necessarily take into account these trade-offs as they are beyond their knowledge and scope. From this viewpoint, it is very important to involve important multidisciplinary stakeholders in the implementation process and learn from available experiences from relevant aspects in EPBD and EPC implementation on a national and international scale.

EXPERIENCE SO FAR WITH EPBD IMPLEMENTATION

All Member States have by now progressed with the 2002 EPBD implementation to a reasonable level since its enforcement date. The legal implementation has been largely completed and the practical implementation is typically at an advanced stage. There are however many differences in the level of implementation among Member States.

In addition, the first substantial experiences of EPBD implementation are now available³. This information is however often fragmented and non-exhaustive. Sound comparative conclusions regarding the status of all relevant aspects of EPBD implementation are therefore difficult to make.

The Energy Performance Certificates have the potential to become a reliable source of information about the energy performance of the building stock in Member States. There is a legitimate wish to disseminate this information at EU level by making some simple comparisons of the implemented methods, requirements and indicators. This approach could help policy-makers realise how much work still has to be done. For example, it would be useful to see whether the energy performance indicator refers to:

- ▶ Primary or final energy;
- ▶ Energy needs or energy consumption and;
- ▶ Whether the energy end-user should be taken into consideration.

For the future development of the whole scheme it would be helpful to have a common understanding about methodology as well as about the key indicators displayed on the EPC.

In this study, focus is given to experiences drawn from a number of aspects of the implemented EPC schemes. Following the analysis of the information on each research topic, a number of concise findings were deduced for each topic⁴.

² For instance, within the Intelligent Energy Europe project EPA-NR (Energy Performance Assessment in Non-Residential buildings) and in the development of the Dutch design of the assessment approach for the EPC scheme.

³ For instance, through exchange within international networks such as the Concerted Action evaluating research regarding the implementation of the EPBD, European Projects (like ASIEPI), and research results of private parties such as stakeholders in the EPBD field (like the Royal Institute of Chartered Surveyors).

⁴ For detailed information on the research results for the specific themes and specific information per Member State, please see also the analysis in Chapter 3 and the overview of information by Member State in Chapter 4.



Implementation approach of the EPBD and EPCs

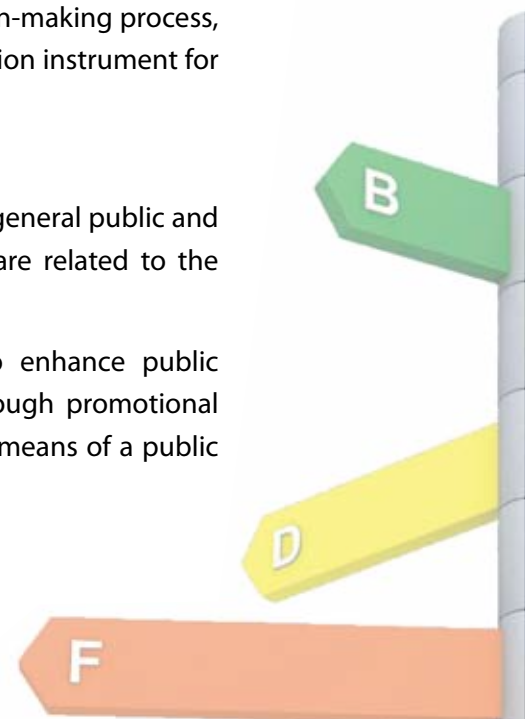
- ▶ The approach adopted for the implementation varies due to the lack of knowledge and experience as well as due to the differences between national and regional levels of responsibility;
- ▶ The national context imposes limitations on the implementation choices that arise. Member States often try to find a way to fit the implementation of new Directives into an existing national system, which can limit the degree of freedom in the implementation options;
- ▶ Member States often struggle with the development of a system and methodology for the energy assessment and certification of buildings.

Key usage indicators for EPCs

- ▶ There is limited knowledge with respect to the characteristics of the building stock across Member States. This undermines our understanding of the actual energy performance of a country's existing building stock and therefore the true energy-saving potential. EPCs are potentially a very useful instrument to gain this kind of knowledge and awareness;
- ▶ At this stage, it is often very difficult to evaluate and monitor EPC-related information and the different ways in which EPCs are used. This is due to the fact that the majority of Member States do not have a central database system for EPCs issued. The creation of a potential EPC database will enable the collection of data with respect to the number of certificates issued, the average energy performance level and the recommended measures. Moreover, monitoring the ways in which EPCs are used can help us understand the real reasons why EPCs are requested in transactions. For instance, when a building is sold, it can help us understand whether the EPC was a selection criterion for the buyer in his decision-making process, or an obligation that needed to be fulfilled, or a promotion instrument for energy saving measures.

Public acceptance and usability

- ▶ The public acceptance and usability of the EPCs by the general public and the professional market is an important issue. These are related to the quality and the cost of the assessment;
- ▶ Some countries are explicitly searching for ways to enhance public acceptance and usability of the EPC (for instance through promotional campaigns and a specific certificate design or even by means of a public



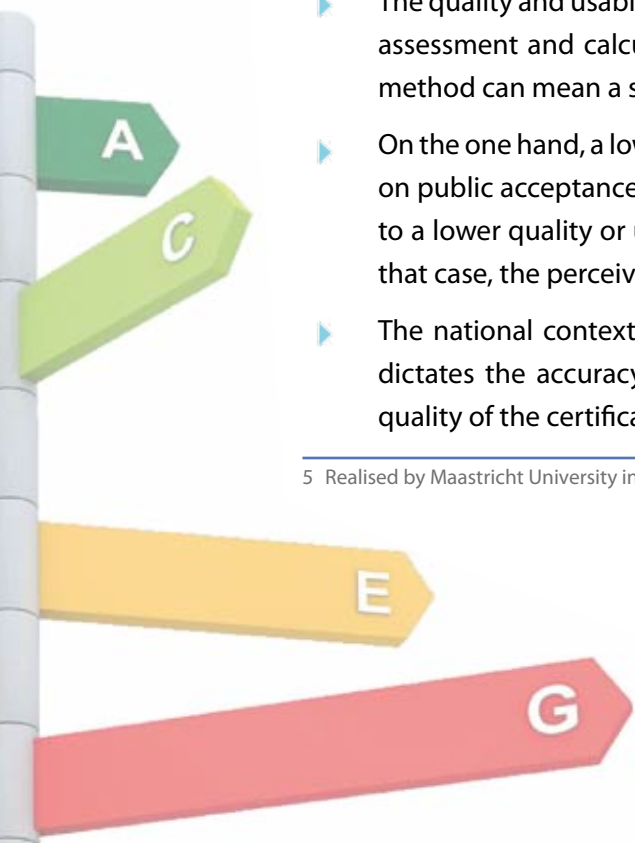
round of consultations as Ireland started in the first phases of EPBD implementation). Other countries pay little attention to this;

- ▶ Public acceptance and usability is often related to the choices which have been made in the development of the entire Energy Performance Certification scheme, for instance with regard to:
 - ▶▶ The design of the certificate, since the content and presentation of the information on the certificate is an important issue for the usability of the EPCs in the different target groups (professionals and building owners);
 - ▶▶ The choice of the assessment method, since there are different options for developing the assessment scheme which correspond to different EPC quality levels (for instance with respect to the choice of a calculated rating or a measured rating system and a basic assessment system using default values or an intensive assessment system with detailed building inspections);
 - ▶▶ Public attention and promotion, since the level of public attention to and promotion of EPCs is an important factor in raising public awareness (both professional and private target groups) regarding EPCs;
 - ▶▶ Enforcement, since the level of enforcement is a determining factor in the compliance rate.
- ▶ It is also relevant to note that EPCs can have an impact on the real estate value. A recent study undertaken by RICS⁵ shows that the existence of an energy performance certificate can impact the value with about 2.5%.

Costs of the certificates

- ▶ The quality and usability of the EPCs are often directly related to the chosen assessment and calculation method chosen. A lower quality or a simpler method can mean a substantial reduction in costs;
- ▶ On the one hand, a lower price for the certificate could have a positive effect on public acceptance, on the other hand, when the lower costs are related to a lower quality or usability it can also have a negative effect because in that case, the perceived value is less;
- ▶ The national context and interpretation of the purpose of the certificate dictates the accuracy and reproducibility needed and thus the required quality of the certificate, and therefore implicitly the level of costs.

⁵ Realised by Maastricht University in June 2010. See also www.rics.org/research

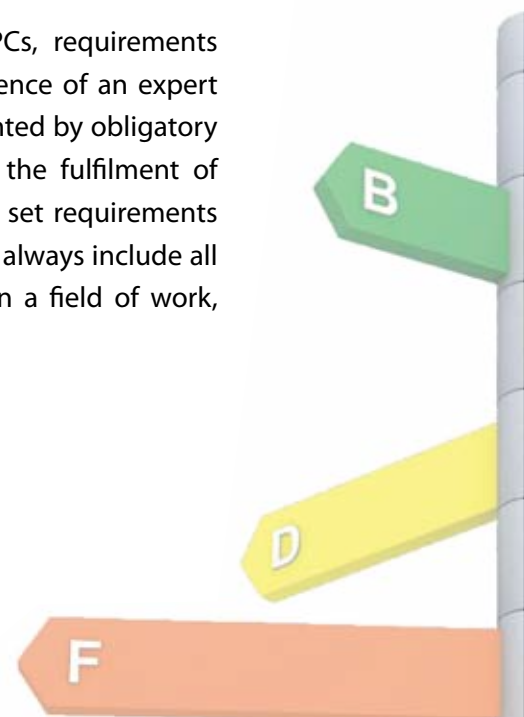


Administration, promotion, compliance

- ▶ There are differences in the level of attention given to EPCs among different Member States;
- ▶ Awareness of the importance of the Energy Performance of buildings and the EPC scheme within the general public and professional stakeholders is important for successful compliance;
- ▶ Some Member States have specific promotion and communication programs organised by the state or the regions, in other Member States the government pays little attention to communication. Other parties such as energy agencies sometimes take over that role;
- ▶ Not all countries have a sound registration system for EPCs (database at national or regional level which can be used for monitoring, evaluation, quality control and enforcement);
- ▶ In many countries, a sound communication and enforcement system still needs to be developed more consistently, which probably has an effect on the compliance rate. Low levels of communication often mean low levels of awareness, which can lead to less compliance. A strict enforcement system often leads to more compliance, especially in combination with a sound communication system from the government, which creates awareness and can provide 'status' to the EPC obligation.

Quality control

- ▶ The infrastructure for performing quality control on issued EPCs is very important. National or regional databases can be very useful in this respect. Even with sample checks it is difficult to perform without the registration infrastructure in place due to the lack of a good overview of issued EPCs;
- ▶ Concerning the authorisation of experts to issue EPCs, requirements have to be set regarding the qualifications and experience of an expert within a relevant field of work, which can be supplemented by obligatory or voluntary training courses and an exam to prove the fulfilment of these requirements. All Member States evaluated have set requirements regarding authorisation, but these requirements do not always include all three authorisation criteria (qualifications/experience in a field of work, training course and exam) in a consistent way.



The implementation hindrances addressed above should not necessarily be considered as failures or weaknesses. These frictions are inherent in a complex process such as the implementation of the EPBD and they will continue in the context of the recast Directive. They should not be taken negatively but should be considered as a learning experience which is a natural part of the process of reaching effective implementation. They should therefore be dealt with by further adaptation and refinement of the implementation approach.

POLICY ADVICE

A number of focus points for implementing EPCs are presented below. Recommendations and best practice are given for each focus point. In the end of the chapter, a checklist of issues in the EPC implementation process is presented as a general 'guide for implementation'.

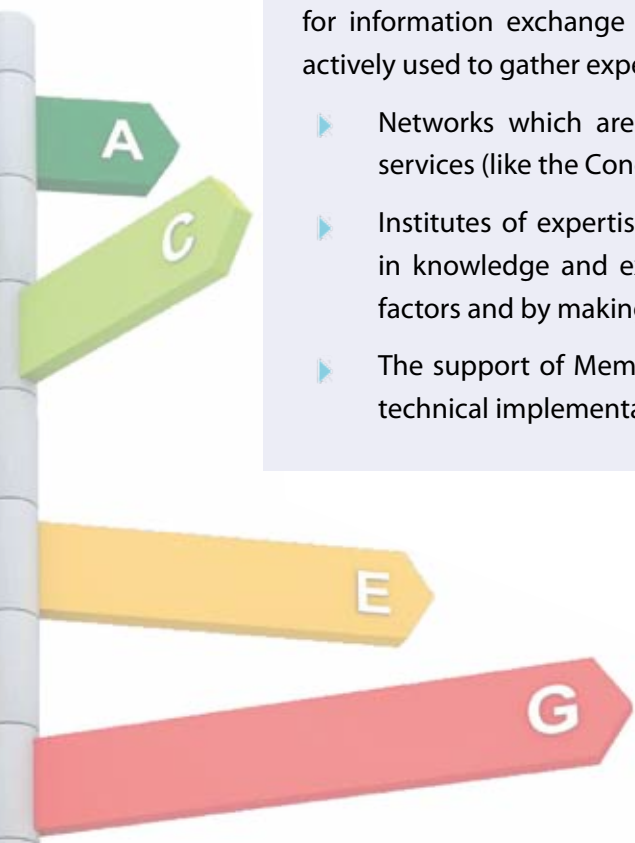
FOCUS POINT 1: EXCHANGE OF EXPERIENCE AND KNOWLEDGE DEVELOPMENT

The development of knowledge and experience from EPBD implementation (also applicable to the 'recast' EPBD in the future) can be stimulated in a number of ways.

Recommendations:

At national level, it will be particularly beneficial if all kinds of expertise, exchange and multidisciplinary cooperation are made available in all sectors of the society (public servants and officials, policy-makers, scientists and stakeholders such as energy experts and professionals within the building sector, etc.). At international level, information exchange between different countries is key for building the necessary level of knowledge. There are a number of important media available for information exchange aimed at different target groups. These should be actively used to gather experience, such as:

- ▶ Networks which are particularly relevant for policy-makers and public services (like the Concerted Actions);
- ▶ Institutes of expertise and European projects, which can play a key role in knowledge and experience exchange by eliminating country-specific factors and by making it applicable to a large international target group;
- ▶ The support of Member States with CEN standards that can assist in the technical implementation process;



- ▶ Seminars and congresses for professionals in the building sector and industry, in which technical solutions, materials and instruments can be discussed and best practices can be presented.

With regard to the international exchange of experience, it is important to abstract from the context of a particular country's national situation to transpose the experience to another national context (i.e. remove the aspects which are specific only to one country). It is also necessary to be able to precisely estimate the usefulness of the experience on relevant aspects for a specific country. It will seldom be the case that the experience in one country is directly applicable to another.

It is often very difficult for active players at national level (e.g. policy-makers, assessors, etc.) to abstract the experience from a specific national situation. International organisations or institutes are likely to have the competence to evaluate the effectiveness of solutions in one specific context and their transferability to other countries. They can therefore play a vital role in knowledge transfer and make a valuable contribution to international exchange and the facilitation of knowledge building.

FOCUS POINT 2: LEGISLATIVE LEVELS

Friction at different levels of responsibility between national and regional governments may yield complications in the legislative process. The area of 'Energy Performance of buildings' cannot be addressed separately as the interaction with other legislation is inevitable. It therefore needs to be considered in an integral manner.

Recommendations:

- ▶ It would be useful if national obligations are established, with regional translation/application when necessary (because of regional orientation in specific countries);
- ▶ Member States with a strong regional structure may develop the EPBD implementation accordingly by paying specific attention to the division of responsibilities and tasks between the national and regional governments, and the development of the approach with regard to the instrumentation, communication and enforcement in each region.



Best practice example:

The regional implementation of the EPBD in Austria may be regarded as an example to follow. It is streamlined by a national guideline (OIB-Richtlinië) to help the regions with the implementation of the major aspects of the EPBD. At the same time, it gives a level of flexibility to each region if this is considered necessary.

FOCUS POINT 3: DESIGN OF THE EPC SCHEME

Recommendations:

- ▶ The multidisciplinary character of the task of EPBD implementation should be addressed whereby stakeholders from different sectors should be determined and involved in an effective way;
- ▶ Implementation should be integrated in everyday practice and in the legal structures within a Member State.

Best practice examples:

In the Netherlands, many aspects concerning the implementation of the EPCs are regularly discussed in working groups composed of different relevant stakeholders in the field (such as energy consultants, accreditation agencies, normalisation institutes and software developers). In Portugal, the energy agency ADENE has played a key role in the successful implementation of the EPC scheme by actively getting relevant stakeholders involved in the process.

FOCUS POINT 4: FIT IN WITH EVERYDAY PRACTICE

Recommendations:

- ▶ In order to integrate energy saving in everyday practice, the processes of building management should be clear so that energy measures can be included in maintenance and renovation activities. This will provide synergy and reduce cost. If such a fit can be realised, improved energy efficiency can be stimulated more easily. Transparency, usability and accuracy are essential aspects of a method to make it applicable in practice.

Best practice examples:

This integration issue is strongly addressed by the EU projects EPA-ED, EPA-NR and EPI-CREM⁶.

⁶ EPA-ED is a project on the methodology for assessing the energy performance of existing dwellings at European level (More info at: www.epa-ed.org/). EPA-NR is a project on the method and tools for the Energy Performance Assessment of existing non-residential buildings (More info at: www.epa-nr.org/). EPI-CREM is a project on the energy performance Integration in corporate and public real estate management (More info at: www.epi-crem.org/)

FOCUS POINT 5: KNOWLEDGE REGARDING THE CHARACTERISTICS OF THE BUILDING STOCK

Recommendation:

- ▶ The development of a good registration system suitable for monitoring and evaluation in order to gain knowledge about the characteristics of the building stock and learn about the necessary adaptations of the system.

Best practice examples:

Registration systems as set up in Denmark, Belgium-Flanders, Ireland, Portugal and the Netherlands.

FOCUS POINT 6: LEVEL OF ATTENTION OF EPCS BY GOVERNMENT

Sense of urgency in communication/importance attached to EPCs by the government.

Recommendations:

- ▶ Raise awareness by promotion and communication, consistently in time and across different governmental bodies;
- ▶ If EPCs are valued by the government, awareness is raised in communication and the regulations are enforced, compliance will be high.

Best practice examples:

Belgium-Flanders: EPC is valued by the government. Denmark: years of consistent communication by the government that energy performance is important. Austria: effective regional and local communication to reach the public concerning energy efficiency.

FOCUS POINT 7: QUALITY ASSURANCE WILL GENERATE CONFIDENCE IN THE MARKET AND STIMULATE ENERGY SAVING

Recommendations:

- ▶ Set up a sound system of registration and quality control;
- ▶ The implementation process and EPC scheme should be monitored and evaluated so that adaptation is possible when necessary. A central registration of EPCs is an advantage for setting up a sound evaluation system;



- ▶ Accreditation of experts is important for quality assurance.

Best practice examples: sound systems have been created in several countries, such as Belgium-Flanders, Denmark, the Netherlands, Ireland.

FOCUS POINT 8: COMPLIANCE AND ENFORCEMENT

Recommendation:

- ▶ In the event of failure to comply with the specific legal obligations, a sound enforcement system is required which will impose penalties in the form of:
 - ▶▶ Obstruction of the process (in the case of new buildings or major renovations this can mean withholding a building permit or a permit for use. For existing buildings this can mean an obstruction to the transaction process, although this is more complicated from a legal viewpoint); or
 - ▶▶ Fines.

Best practice examples:

Sound systems are created in several countries, such as Belgium-Flanders, Portugal, Ireland.

This chapter concludes with “Points of attention for the implementation of the EPC scheme” on the following page. In this checklist several points of attention regarding the EPC implementation process are presented concerning the following aspects:

- ▶ Choice of method;
- ▶ Design of the EPC;
- ▶ Quality assurance;
- ▶ Registration;
- ▶ Communication;
- ▶ Enforcement.

Throughout the report more detailed information concerning these themes can be found.

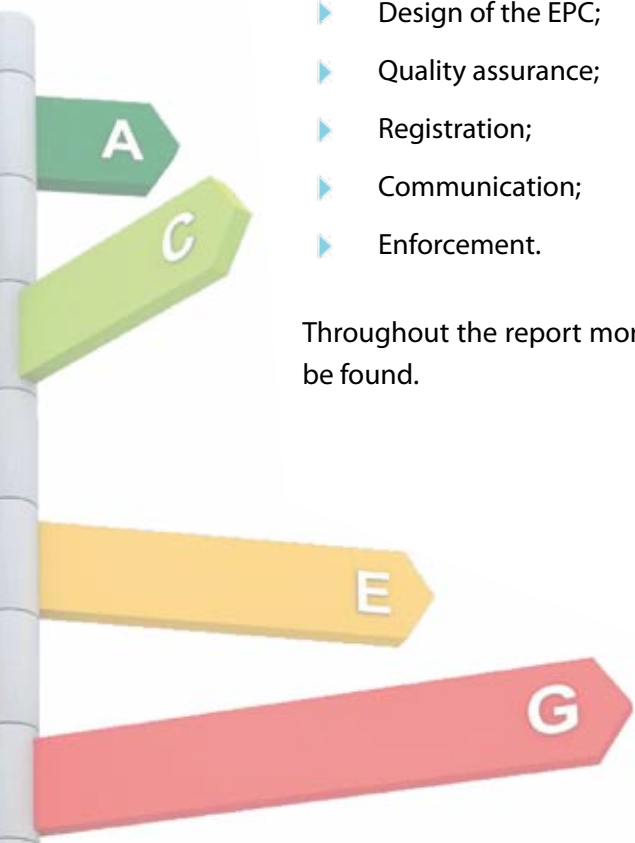


TABLE 1: POINTS OF ATTENTION FOR THE IMPLEMENTATION OF THE EPC SCHEME	
Choice of method	<ul style="list-style-type: none"> • Measured or calculated rating • Basic assessment or detailed assessment of a building • Quality of assessment method (choices with regard to the level of accuracy and reproducibility) • Software development by the state, or by market parties (possibly with requirements for the design or the calculation core which are set by the state, quality of the software should be guaranteed)
Design of the EPC	<ul style="list-style-type: none"> • Content and presentation of the information on the EPC • Label classes representation, scale • Performance indicator for energy use • Recommendations for energy saving measures (nature and quality of the recommendations)
Quality assurance	<ul style="list-style-type: none"> • Education level of assessors and level of experience; training program set up by the government or setting general requirements for education level • Accreditation/certification of experts • Registration of experts • Independency of experts • Quality control of issued certificates by control body and/or government or for instance energy agency (for example by sample control) • Audit/performance check for registered assessors • Registration of certificates: data storage by individual experts or central registration
Registration of EPCs	<ul style="list-style-type: none"> • In regional or national database • Important for quality assurance of issued EPCs • Important for making monitoring and evaluation possible • Very useful in enforcement system
Communication	<ul style="list-style-type: none"> • Sound communication and promotion campaign (specified for different target groups/stakeholders) specifically concerning EPCs raises awareness • Alignment with other communication initiatives on energy efficiency and environment can also be helpful • Knowledge centre for professionals, communication specifically directed to the professional stakeholder group • Communication specifically to the end-user group (consumers, building owners) • Dedicated state website with information (national/regional) • Promotional material like brochures, TV/Radio commercials, media attention, information leaflets, posters, public campaign etc. • Role of energy agencies
Enforcement	<ul style="list-style-type: none"> • Penalties for experts when issuing incorrect EPCs (fines or losing accreditation/registration) • Balance between penalties and chance of being caught • Penalties: obstruction of process (building/use permit, transaction process) and/or fines • Points of action in the process to link penalties to • Enforcement linked to the EPC registration system/database



3

ANALYSIS BY RESEARCH THEME

In this chapter the research results are discussed by theme. Together with the overview of the implementation per Member State in Chapter 4, this provides the basis for the conclusions of policy paper.

IMPLEMENTATION APPROACH AND USE OF EPCs

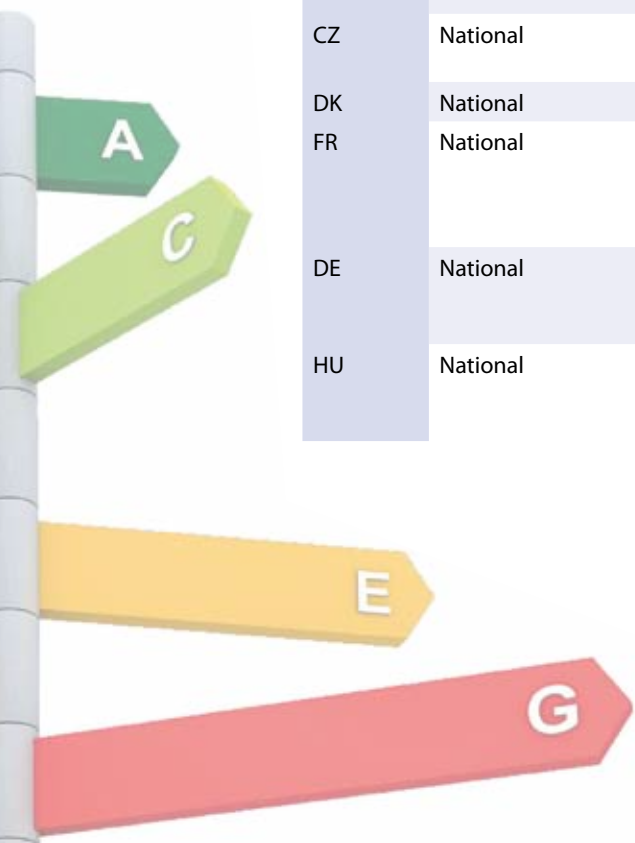
In this section the implementation approach and use of EPCs are discussed with regard to the design of the scheme, the design of the certificates and the key EPC use indicators.

■ Design of the scheme

The EPBD had to be legally implemented by 4 January 2006, with an extension period of three years (until 4 January 2009) to start the actual certification of buildings. Denmark is the only Member State that has implemented the entire EPBD in due time. In the meantime, most Member States are well on their way to full implementation and have started issuing EPCs. The table below presents an overview of the basic situation regarding the design of the EPC schemes in Member States.

TABLE 2: OVERVIEW OF THE BASIC SITUATION REGARDING THE DESIGN OF THE EPC SCHEMES IN 12 MEMBER STATES

State	Responsibility	Assessment method	EPCs issued since
AT	Partly national and regional responsibilities	Calculated rating	January 2008, January 2009 (public buildings)
BE	Regional	Combination of calculated and measured rating (public buildings)	Flanders Region: November (sale), January 2009 (rent), January 2009 (public buildings). Non-residential expected in 2011
CZ	National	Calculated rating	January 2009 (new buildings and existing renovated buildings)
DK	National	Calculated rating	2006
FR	National	Combination of calculated and measured rating	November 2006 (sale res. and non-res.), July 2007 (rent), July 2007 (new buildings), January 2008 (public buildings)
DE	National	Combination of calculated and measured rating	2002 (new buildings), July 2008 (existing buildings)
HU	National	Combination of calculated and measured rating	January 2009 (new and public buildings), January 2010 (existing buildings)



State	Responsibility	Assessment method	EPCs issued since
IE	National	Calculated rating	January 2007 (new res. buildings), July 2008 (new non-res. and public buildings), January 2009 (existing buildings)
NL	National	Calculated rating	January 2008 (sale and rent), January 2009 (public buildings, and social housing)
PL	National	Calculated rating	January 2009 (new buildings, renovations, existing buildings for sale/rent and public buildings)
PT	National	Calculated rating	July 2001 (new res and non-res buildings >1000 m ²), July 2008 (new buildings) January 2009 (existing and public buildings)
ES	Partly national and regional responsibilities	Calculated rating	2007 (new buildings), after 2010 (existing buildings)

The situation regarding EPC implementation varies between Member States. Differences occur at several levels:

Responsibility for implementation and chosen assessment method

In most Member States national authorities (ministries) are responsible for the implementation of the EPBD (and EPCs). However, in some Member States such as, for instance, Austria, Belgium and Spain, the regions are (partly) responsible.

Most Member States use calculated rating for all building types, both for new and existing building assessment. Some however use measured rating for parts of the building stock (Belgium, France, Germany and Hungary).

Building certification in practice

All Member States have introduced an Act or a Decree implementing EPCs according to the EPBD, although in some Member States parts of the Act have not yet come into force i.e. parts of the EPBD have not yet been put in practice. In Belgium, for example, the EP certification for non-residential buildings is still being implemented and this is also the case in Wallonia and the Brussels Capital Region for residential buildings.

Most Member States start by issuing EPCs for new residential buildings. Existing buildings and non-residential buildings often follow at a later stage. This can be explained by the fact that many Member States have already had some experience with energy performance requirements for new buildings in the context of the building permit procedures. For most Member States, the field of energy performance of existing buildings is new. Besides this, the assessment



of the energy performance of non-residential buildings is usually more complex than the energy performance of residential buildings.

In some Member States the Act relating to the implementation of EPCs according to the EPBD does not cover all the situations described in the EPBD. For instance, in the Czech Republic certification is only mandatory for new and existing renovated buildings larger than 1000 m² and public buildings. An EPC is not required for existing buildings when sold or rented. In the Netherlands, an exception was made for housing associations: they were given a one year delay to issue EPCs (until January 2009) if they would certify their entire building stock in one procedure. This resulted in the situation that almost the entire building stock of the Dutch Housing Associations has now been surveyed for energy performance; approximately 40% is formally certified.

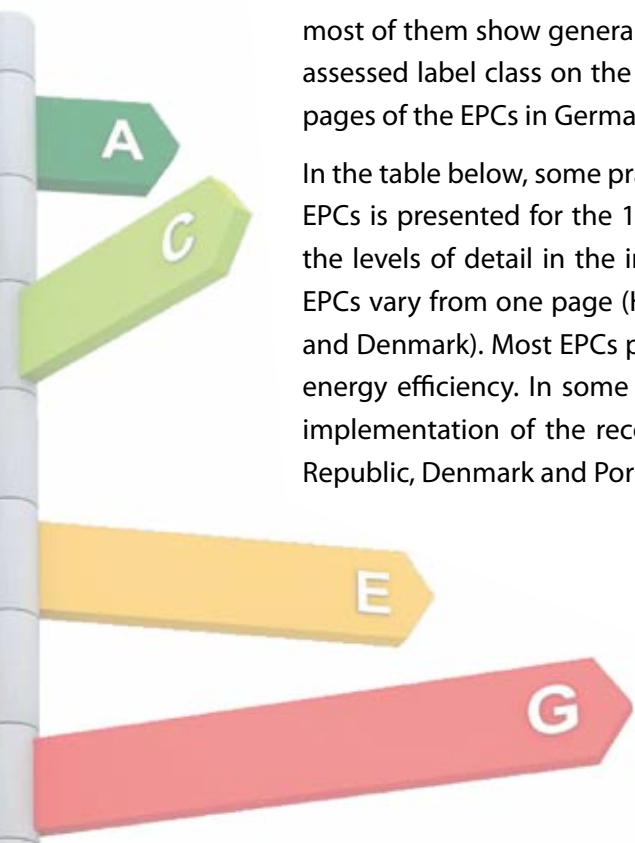
Transition, building on former experiences

In several Member States (such as Belgium, the Czech Republic, Germany, Denmark and the Netherlands) energy certification already existed in some form before the introduction of the EPBD, usually on a voluntary basis and/or related to a subsidy scheme. Those Member States could build on their previous experiences when implementing the EPBD. However, except for Denmark, these experiences did not result in a quick and smooth implementation of EPCs. For instance, in the Netherlands the implementation process was delayed for political reasons: the administrative costs of certification were to be as limited as possible. This requirement put an extra pressure on all aspects of the implementation process, ranging from the development of the method, to the quality control and the training of the assessors.

■ Design of the certificate

The EPCs in the 12 Member States demonstrate many similarities. For instance, most of them show general characteristics and a picture of the building and the assessed label class on the first page. Below you can find examples of the main pages of the EPCs in Germany, France, the UK and Belgium-Flanders.

In the table below, some practical information regarding the basic content of the EPCs is presented for the 12 Member States. There is a substantial difference in the levels of detail in the information presented on the EPCs. For instance, the EPCs vary from one page (Hungary and Ireland) to eight pages (Czech Republic and Denmark). Most EPCs provide recommendations for improving the building energy efficiency. In some countries the EPC also presents the label class after implementation of the recommended energy saving measures (e.g. the Czech Republic, Denmark and Portugal).



a.

ENERGIEAUSWEIS

für Wohngebäude
gemäß den §§ 16 ff. Energieeinsparverordnung (EnEV)

Muster Nr. 1234
Vorbehauf

Berechneter Energiebedarf des Gebäudes

Energiebedarf

Endenergiebedarf **222 kWh/(m²a)** CO₂-Emissionen¹⁾ **56** [kg/(m²a)]

Primärenergiebedarf "Gesamteffizienzfaktor" **250 kWh/(m²a)**

Endenergiebedarf

Energieträger	spezifischer Endenergiebedarf in kWh/(m ² a) für Heizung	Wärmesumme	Wärmezahl ²⁾	Gesamt in kWh/(m ² a)
Erds gas HT	177,9	40,5	0,0	218,4
Strom	0,0	0,0	3,6	3,6

Ersatzmaßnahmen³⁾

Vergleichswerte Endenergiebedarf

Erläuterungen zum Berechnungsverfahren

b.

Diagnostic de performance énergétique – logement

(6.1. neuf)

NP¹⁾: Valable jusqu'au :
Date :
Type de bâtiment : Diagnostiqueur :
Année de construction :
Surface habitable :
Adresse :
Signature :

Propriétaire :
Nom :
Adresse :
Propriété, Des installations communes (s'il y a lieu) :
Nom :
Adresse :

Consommations annuelles par énergie

	Consommations en énergie finale		Consommations en énergie primaire		Frais annuels d'énergie
	détail par énergie et par usage en kWh _{ep}	détail par usage en kWh _{ep}	détail par énergie et par usage en kWh _{ep}	détail par usage en kWh _{ep}	
Chauffage	EP _{h,ca}	EP _{h,ca}	EP _{h,ca}	EP _{h,ca}	€ TTC
Eau chaude sanitaire	EP _{h,e}	EP _{h,e}	EP _{h,e}	EP _{h,e}	€ TTC
Refroidissement	EP _{h,r}	EP _{h,r}	EP _{h,r}	EP _{h,r}	€ TTC
Production d'électricité à demeure	EP _{h,p}	EP _{h,p}	EP _{h,p}	EP _{h,p}	€ TTC
CONSUMATIONS D'ÉNERGIE POUR LES USAGES RECENSÉS	EP _{h,t}	EP _{h,t}	EP _{h,t}	EP _{h,t}	€ TTC

Consommations énergétiques
pour le chauffage, la production d'eau chaude sanitaire et le refroidissement, déduction faite de la production d'électricité à demeure

Consommation conventionnelle : kWh_{ep}/m².an

Émissions de gaz à effet de serre (GES)
pour le chauffage, la production d'eau chaude sanitaire et le refroidissement

Estimation des émissions : kg_{CO2eq}/m².an

Logement économe

Logement

Faible émission de GES

Logement

Forte émission de GES

c.

Display Energy Certificate

How efficiently is this building being used?

HM Government

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Arytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epcd.

Energy Performance Operational Rating

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO₂.

Total CO₂ Emissions

Mar 2006: 100
Apr 2006: 100
Apr 2007: 100

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

100 would be typical

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

Apr 2007: 100
Apr 2006: 100
Mar 2006: 100

Technical information

Administrative information

Assessment Software: GH 1
Property Reference: 091123776612
Assessor Name: John Smith
Assessor Number: ABC12345
Accreditation Scheme: ABC Accreditation Ltd
Employer/Trading Name: EnergyWatch Ltd
Employer/Trading Address: Alpha House, New Way, Birmingham, B2 1AA
Issue Date: 12 May 2007
Nominal Date: 01 Apr 2007
Valid Until: 31 Mar 2008
Related Party Disclosure: EnergyWatch are contracted as energy managers
Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234

d.

energiecertificaat

nieuwbouw

wooneenheid

De afgegeven waarde van de energieverbruik is gebaseerd op de berekening van de energieverbruik op basis van de gemiddelde energieverbruik van de afgegeven wooneenheid.

energieprestatie- en binnenklimaat

E 60

primair energieverbruik/m²

150 kWh/m²

verklaring van de metingen

Dit certificaat is geldig tot en met **10 juli 2016**

Draft samples of EPCs for (a) Germany (b) France (c) the UK and (d) Belgium-Flanders

TABLE 3: INFORMATION ON THE BASIC EPC CONTENT FOR THE 12 MEMBER STATES

Information on the certificate	AT	BE (Flanders)	CZ	DK	FR	DE	HU	IE	NL	PL	PT	ES
Label classes	A++ A+ A B C D E F G	No (sliding scale)	A B C D E F G	A B C D E F G	Res. Non-res A B C D E F G	No (sliding scale- indicator without classification)	A+ A B C D E F G	A1A2A3 B1B2B3 C1C2C3 D1D2 E1E2 F G	A++ A+A A B C D E F G	No (sliding scale- indicator without classification)	A+ AB B- B C D E F G	A B C D E F G
Performance indicator	kWh/m ² a	kWh/m ² a	GJ/year	No specific info	kWh/m ² a	kWh/m ² a	No specific info	kWh/m ² a and CO ₂ emission	Energy index	No specific info	kWh/m ² a	No specific info
Label present situation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Label after taking measures indicated	No	No	Yes	Yes	No, but the new indicator is calculated for each recommendation (calculated rating)	No	No specific info	No specific info	No	No specific info	Yes	No specific info
Recommendations	No	Yes	Yes	Yes	Yes, for calculated rating with a cost and payback range, for measured rating only indicated.	Yes	No specific info	No	Yes	Yes	Yes	No specific info

■ Key usage indicators for EPCs

Regarding the indication of actual use of Energy Performance Certificates in Member States, the number of EPCs issued is a useful indicator. For countries that have a (central or regional) database system in which EPCs are collected, this kind of information is more easily available than for countries that do not have a sound registration system. In such cases, only an estimation is possible. For some Member States, additional information concerning the average energy performance of buildings is available (in label class scale or as a different performance indicator).

Concerning the actual or potential energy savings made by EPCs, no specific information is currently available because such information is not specifically monitored in Member States. There is no specific information available about the effectiveness of EPCs as an instrument for energy savings.

For residential buildings, information concerning the key usage indicators is presented in the table below.

Key usage indicators: residential buildings	N° of EPCs (*1000)	Estimate of % of existing buildings which have EPC	Average energy performance rating
BE	141.3	4.10%	No specific info available
CZ	25-30 each year (= number of new buildings constructed each year, EPCs since January 2009 obligatory)	1.50%	No specific info available
DK	45-50 each year	50%	Label class D (detached houses)
FR	No specific info available	90% of social housing, 14% of private houses	Label class C: 18% Label class D: 31% Label class E: 22%
DE	No specific info available	No specific info available	Single family home: 235 kWh/m ² a Multi-family home: 211 kWh/m ² a
IE	75	No specific info available	New buildings: label class B2-B3 Existing buildings: label class D1-D2
NL	1287 (of which 83% rental homes)	18%	Label class ABC: 35% Label class CD: 50% Label class EFG: 39%



Key usage indicators: residential buildings	N° of EPCs (*1000)	Estimate of % of existing buildings which have EPC	Average energy performance rating
PL	80-100	0.75%	New buildings: 140 kWh/ m ² a
PT	100	No specific info available	Label class A+ A: 4% Label class B- B: 36% Label class C: 33% Label class D: 14% Label class EFC: 13%

For non-residential buildings, even less information is available compared to residential buildings. This can be explained by the fact that a lot of countries start their certification process with residential buildings to gain experience before issuing certificates for more complex buildings (see table below).

TABLE 5: INFORMATION ON KEY USAGE INDICATORS FOR NON-RESIDENTIAL BUILDINGS

Key usage indicators: non-residential buildings	N° of EPCs (*1000)	% of existing buildings has EPC	Average energy performance rating
BE (Flanders)	5.1	No specific information available	No specific information available
DK	15	50% of new buildings	Label class E
FR	4 (public buildings)	No specific information available	No specific information available
IE	2	No specific information available	Label class B3-C1-C2
NL	6.5	No specific information available	No specific information available
PL	Several thousands	No specific information available	No specific information available

PUBLIC ACCEPTANCE OF THE CERTIFICATES

Public acceptance of the Energy Performance Certificate in EU Member States can be defined in relation to a number of indicators, such as:

- ▶ The actual use of the certificates when a building goes up for sale or rent;
- ▶ The perception of usefulness of the EPCs in the eyes of the general public;
- ▶ Possible issues regarding the EPCs that the public opinion and/or relevant market parties reflect.

In the table below, information about public acceptance in Member States is summarised. Detailed information by Member State is provided in Chapter 4.

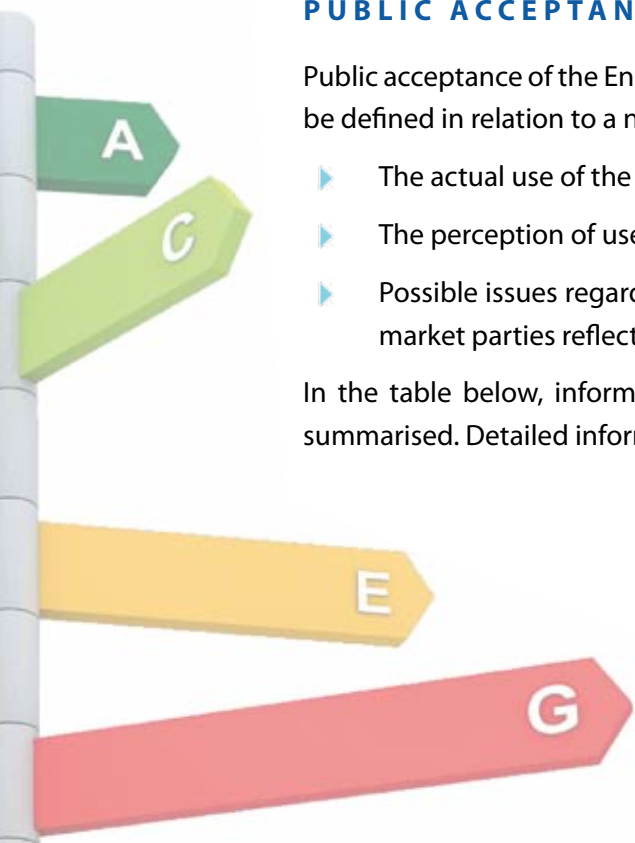


TABLE 6: INFORMATION ABOUT PUBLIC ACCEPTANCE IN THE 12 MEMBER STATES

Public acceptance	Use of certificates at sale/rent	Perception of usefulness by the public	Main “discussion points”
AT	**	*	Transparency of the certificate, not showing total energy performance, recommendations not always presented (clearly)
BE (Flanders)	****	***	Non-residential still under development
CZ	*	*	Perception of general public as a new expression of bureaucracy. Information on EPC not very useful. Only EPCs for new buildings and major renovations. Main group of existing buildings not affected.
DK	***	**	For new buildings EPCs are issued more than during transactions moments for existing buildings.
FR	**	**	Use of EPCs high in social renting market, but low in private rental market. EPC still often only regarded as an ‘informative instrument’.
DE	**	*	The quality of the cheaper version based on measured rating. Registration and practical enforcement.
HU	*	*	The costs of the certificate and mandatory character of it are a discussion point for the general public. EPCs not mandatory yet for existing buildings.
IE	****	****	Recommendations for energy saving measures not in actual EPC but in advisory report.
NL	**	**	Actual use of EPCs high for social housing, but low for private market. A public discussion on the transparency, reliability and reproducibility of the certificates led to adaptations in the scheme.
PL	**	*	The EPC provides little useful information for the building owner for improvements. In practice, EPCs are only issued at transactions when demanded by both parties.
PT	****	**	Use of EPCs is lower in the rental market than in the sale market.
ES	*	*	EPCs are only in practice for new buildings, public awareness is low.

* Improvement desirable
 ** Room for improvement

*** Good
 **** Very good



The following conclusions⁷ can be drawn:

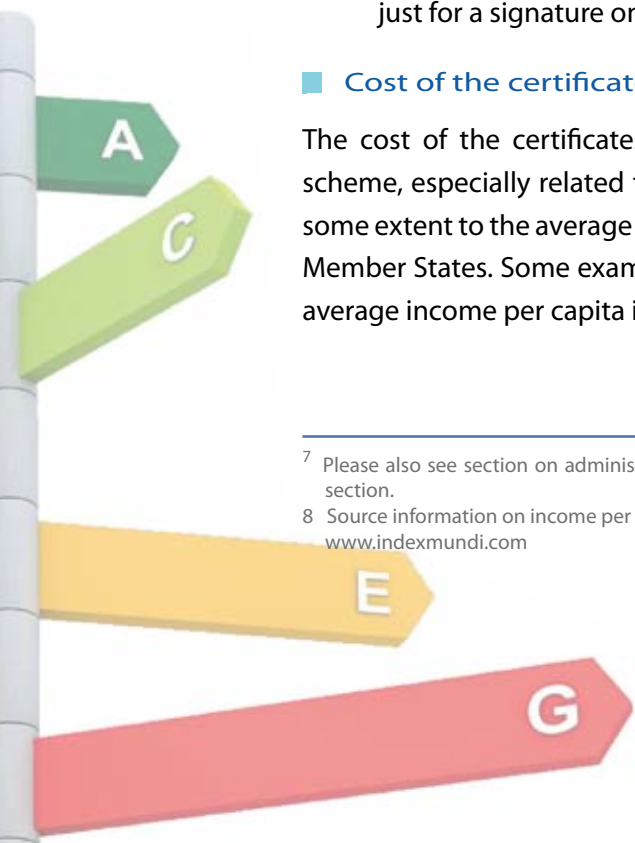
- ▶ In some countries the implementation of EPCs for existing buildings at the moment of transaction is still under development (Spain and Hungary), and therefore not yet common practice. In the Czech Republic, an EPC is not required for existing buildings at the moment of transaction (when they have not been recently renovated);
- ▶ In practice in a number of countries the EPCs are often only actually issued when specifically required in the transaction process, although they are formally mandatory according to regulation. The most important reason for this seems to be that practical enforcement is low (Poland, the Netherlands, Austria, Germany);
- ▶ In countries with a strict practical enforcement scheme with clear penalties, EPCs are more common practice at the moment of transaction (Belgium-Flanders, Portugal);
- ▶ In most countries, the EPCs are issued at the time of transaction and not at the advertising stage. It is therefore unlikely that the EPC is being used as an instrument of selection. In France the trend is beginning towards an obligation to produce an EPC at the moment of advertising;
- ▶ The transparency of the EPC scheme as well as the assessment process of a building is very important for public acceptance;
- ▶ The public needs the certificate to be reliable, with useful information so one can see the added value of the EPC as a consciousness-raising instrument for energy efficiency in buildings. It helps people to appreciate it and not regard it as another form of bureaucracy that only costs money just for a signature on a piece of paper.

■ Cost of the certificate

The cost of the certificates plays a role in the public acceptance of the EPC scheme, especially related to the perceived usefulness of the certificates and to some extent to the average income per capita. The costs vary among the different Member States. Some examples for residential buildings (with a reference of the average income per capita in the different countries⁸):

⁷ Please also see section on administration, promotion and compliance in relation to the conclusions in this section.

⁸ Source information on income per capita in Member States: Index Mundi, July 2010 www.indexmundi.com



- ▶ Germany: between €45 and €500, depending on the choice of a simple or more complicated methodology: measured rating or calculated rating (income per capita: €34,200);
- ▶ France: between €50 and €300 (income per capita: €32,800);
- ▶ Austria: for multifamily houses about €150-180 per home, for single family houses about €450 (income per capita: €38,300);
- ▶ Belgium: for an apartment starting from €205, for a dwelling starting from €245 (income per capita: €36,200);
- ▶ Czech Republic: about €500-800 (income per capita: €23,700);
- ▶ Denmark: about €700-800 (income per capita: €37,200);
- ▶ Poland: about € 50-100 (income per capita: €15,500);
- ▶ Portugal: about €224-324 (income per capita: €21,900);
- ▶ The Netherlands: about €200⁹ (income per capita: €38,600);
- ▶ Ireland: about €200 (income per capita: €45,100);
- ▶ Spain: about €800 (income per capita: €33,100);
- ▶ Hungary: about €50 (income per capita: €19,300).

These examples are visualised in the graphs below, in which the price range for a certificate for a residential building is marked against the average income per capita in the different countries.

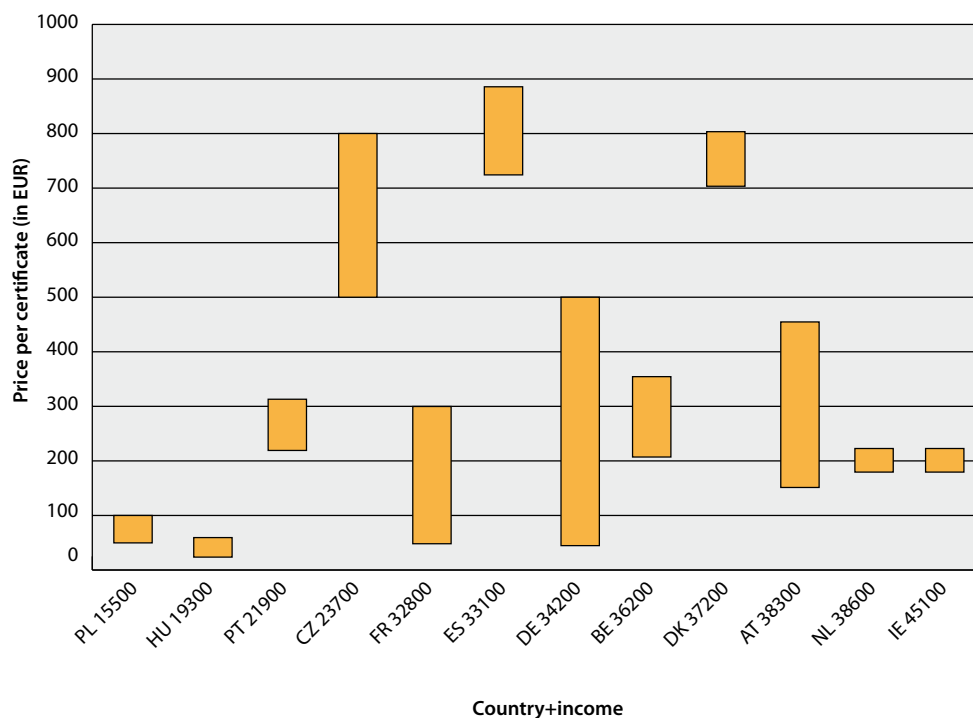


Figure 6 – Range of prices of certificates in the 12 Member States

9 Additional information: when provided in large series for social housing organisations €30 up to €50

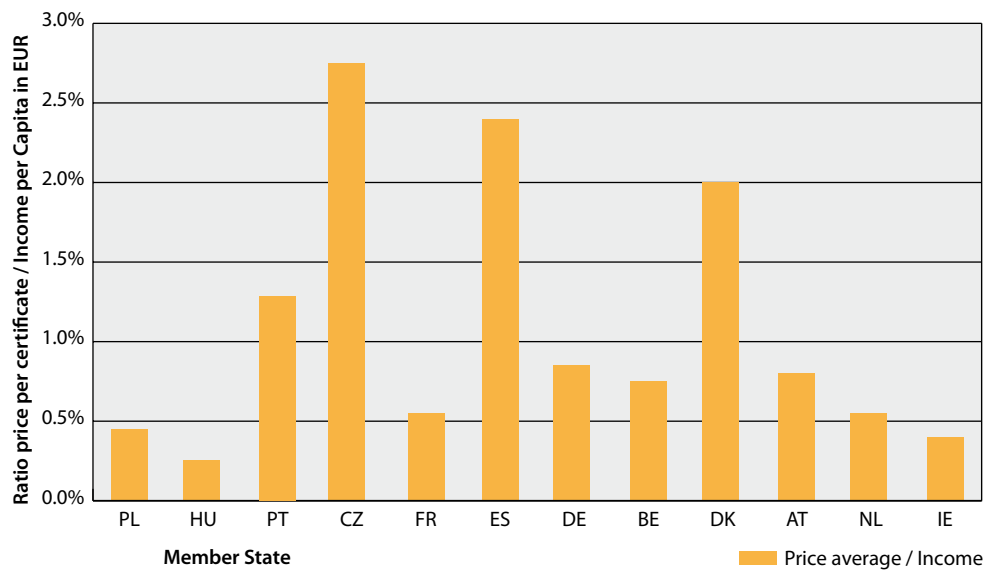


Figure 7 - Ratio of certificate price over income per capita for the 12 Member States

NB It should be noted that it is difficult to find a clear connection between the price of the certificate and the average income per capita due to a number of factors such as:

- ▶ The price range in one country can mean the difference between the cost of the certificate for a house or an apartment;
- ▶ The price-range in one country can mean the difference between a low and a high-quality certificate;
- ▶ A combination of both factors above can be possible, and such information is not always available;
- ▶ The price of a certificate can be influenced by a political choice, or can be determined by a free market system.

Overall, the costs for a residential EPC vary from about €45 to €800. The lower cost certificates (frequently based on measured rating) are often of lower quality. This is often a politically motivated choice linked to public acceptability. A low quality EPC, however, is often less valued by the public while a better quality EPC provides the building owner with more useful information. It is important to find a balance between the price and the information value that the certificate offers.

For *non-residential buildings* the cost of the certificate is often highly dependent on the size and complexity of the building, and may therefore vary considerably.



ADMINISTRATION, PROMOTION AND COMPLIANCE

Compliance with the Energy Performance Certification regulations by the general public can be stimulated by a dedicated promotional campaign to make sure all stakeholders are aware of the obligations, and by an operational system of administration and enforcement.

In the table below, the information relating to administration, promotion and compliance is summarised for the Member States. Detailed information by Member State is provided in Chapter 4.

Promotion Administration Compliance	Promotion	Administration/ registration	Compliance/ enforcement
AT	Regional promotion (***)	Regional databases (***)	No practical/ functional enforcement system (*)
BE (Flanders)	Regional promotion (***)	Regional databases (***)	Strict enforcement with penalties (***)
CZ	Low attention to promotion (*)	No database (*)	No practical / functional enforcement system (*)
DK	Promotion aimed at professionals (**)	Central database (***)	No practical/ functional enforcement system (*)
FR	Low attention to promotion, but professionals well informed (**)	No databases (*)	No practical/ functional enforcement system (*)
DE	National promotion campaign by energy agency (***)	No database (*)	No practical/ functional enforcement system (*)
HU	National promotion campaign (**)	No database (*)	No practical/ functional enforcement system (*)
IE	National promotion campaign by energy agency (***)	Central database (***)	Strict enforcement system with penalties (***)
NL	National promotion campaign (***)	Central database (***)	No practical/ functional enforcement system (*)
PL	Low attention to promotion (*)	No database (*)	No practical/ functional enforcement system (*)



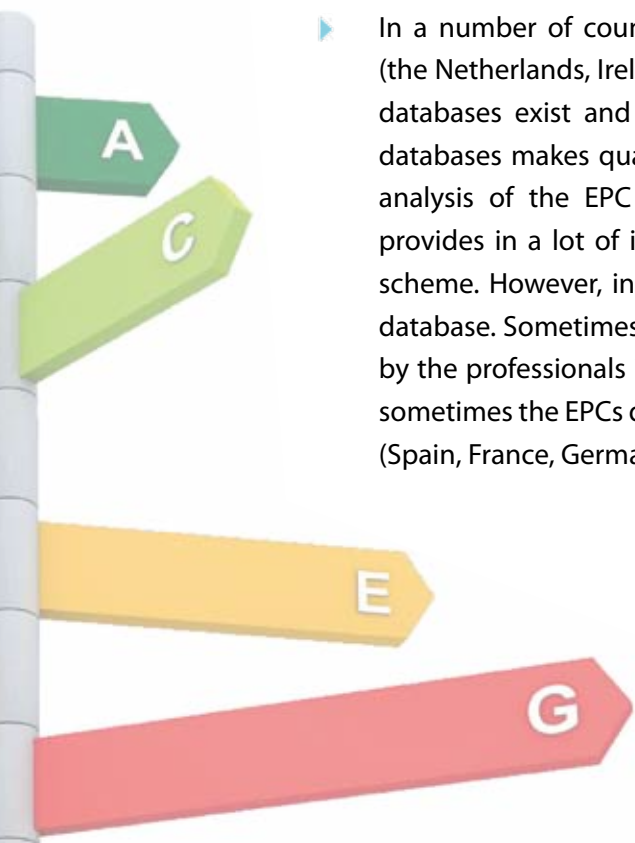


Promotion Administration Compliance	Promotion	Administration/ registration	Compliance/ enforcement
PT	Promotion by energy agency dedicated to stakeholders (***)	Central database (***)	Strict enforcement system with penalties (***)
ES	Low attention to promotion (*)	No database (*)	No practical/ functional enforcement system (*)

*	Improvement desirable
**	Room for improvement
***	Good

The following conclusions can be drawn:

- ▶ A promotional campaign leads to greater awareness among stakeholders, market players and the general public concerning the obligations for EPC requirements. In a number of countries, national or regional energy agencies play a key role in the promotion of EPCs (Denmark, Germany, Austria, Belgium, Portugal, Ireland). A lot of (state) organised promotional campaigns, which are sometimes also initiated or executed by energy agencies, use websites, TV-radio commercials, brochures, posters and other promotional material to create public awareness. In a number of campaigns the professional target groups that have to take part in the practical implementation of the EPCs are specifically addressed (the Netherlands, Portugal, Denmark, Czech Republic and Austria, via a forum). This seems to be effective. There are also a number of countries that have no state organised specific promotional campaigns related to EPCs (Spain, France, Poland);
- ▶ In a number of countries the EPCs are collected in a national database (the Netherlands, Ireland, Portugal, Denmark, Belgium). In Austria regional databases exist and are used for EPC collection. Collection in national databases makes quality control, enforcement, monitoring and statistical analysis of the EPC scheme possible. This can be very valuable, and provides in a lot of information concerning the effectiveness of the EPC scheme. However, in a lot of countries EPC information is not saved in a database. Sometimes EPCs are collected by the government concerned or by the professionals issuing them (Hungary, Poland, Czech Republic), and sometimes the EPCs do not seem to be collected/saved systematically at all (Spain, France, Germany);



- ▶ In a lot of countries the enforcement of compliance is a weak point in EPC implementation. When EPCs are (still) only mandatory in the event of new buildings/renovations, the control of compliance is fairly easy to combine with the issuing of the building permit (Spain, Hungary, Czech Republic). However, even in these cases, a practical enforcement system often still seems to be missing. In a number of countries there are in theory sanctions for non-compliance. Since an operational enforcement system is unavailable, only in the event of specific complaints will legal steps be taken (Germany, the Netherlands, Poland, Austria, Denmark). In a number of countries there is a sound system of practical enforcement (Ireland, Portugal, Belgium-Flanders). This seems to lead to higher compliance rates.

QUALITY CONTROL

The authorisation of experts and the quality control related to EPCs which are issued, are important issues which affect the successful implementation of Energy Performance Certificates schemes.

The table below, summarises the situation concerning quality control in the different Member States.

Quality control	Quality/ consistency check issued certificates	Authorisation of experts to issue EPCs
AT	Basic consistency check by means of regional databases	No obligatory training course (voluntary training possible) and exam, authorisation based on field of expertise/ qualifications within work field
BE (Flanders)	Quality control by means of regional database	Authorisation after training course with exam
CZ	Quality ensurance by Ministry, based on control of expert's work possible.	Authorisation/ registration of experts based on field of expertise and an exam
DK	The experts are responsible for a quality check of their work, the Danish Energy Agency performs sample checks	Authorisation based on fields of expertise/ qualifications within work field
FR	Experts must store the issued EPCs, the government performs sample checks on quality	Authorisation after exam (voluntary training course)
DE	The energy experts are responsible for the quality of the issued EPCs	Authorisation based on field of expertise/ qualifications within work field; which can vary by region

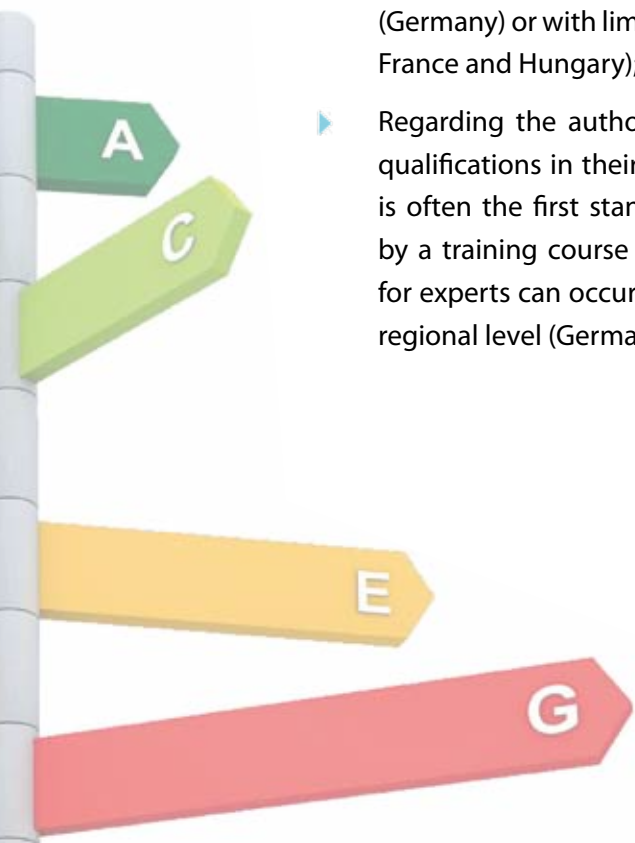




Quality control	Quality/ consistency check issued certificates	Authorisation of experts to issue EPCs
HU	Chambers of Architects and Engineers responsible for quality control, but there is no infrastructure to allow easy quality assurance	Authorisation/ registration of experts based on field of expertise and an exam after a training course
IE	Quality control by means of national database	Authorisation based on field of expertise/ qualifications within work field and a training course and exam
NL	Quality control by means of national database	Authorisation based on field of expertise/ qualifications within work field and a training course and exam
PL	No quality control yet	Authorisation based on field of expertise/ qualifications within work field and a training course and exam
PT	Quality control by means of national database	Authorisation based on field of expertise/ qualifications within work field and a training course and exam
ES	No quality control	Authorisation based on field of expertise/ qualifications within work field and a training course. Regional differences in requirements

The following conclusions can be drawn:

- ▶ Databases can help to make effective quality control of the issued EPCs easier and more consistent because they can provide the infrastructure to reach the issued EPCs and track the work of different energy experts. In a number of countries, the databases are effectively used for quality control (e.g. in Belgium-Flanders, Ireland, the Netherlands and Portugal). In Austria the regional databases are set up to perform a basic consistency check;
- ▶ In some countries the experts are basically responsible to perform quality control of their work, without effective external control mechanisms (Germany) or with limited external sample check performance (for example France and Hungary);
- ▶ Regarding the authorisation of experts to issue EPCs the expertise and qualifications in their work field (as an architect or engineer for example) is often the first standard which has to be fulfilled, often supplemented by a training course with an exam. Regional differences in requirements for experts can occur in countries which (partly) implement the EPCs on a regional level (Germany and Spain for instance).



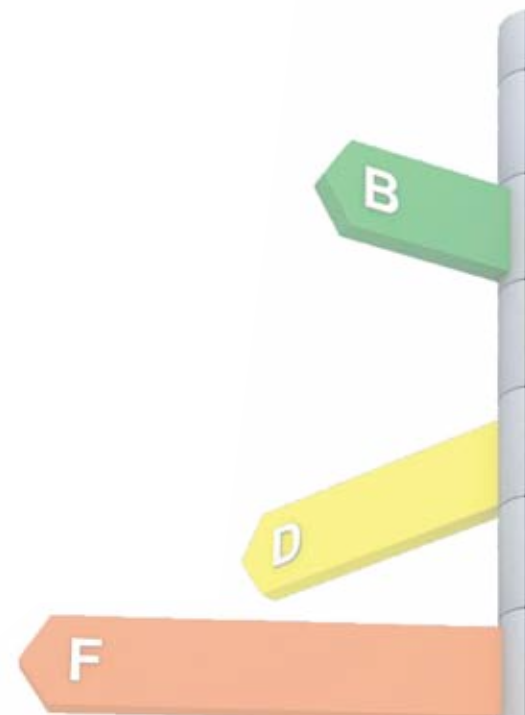
BARRIERS TO THE IMPLEMENTATION OF EPCs

Within the implementation of the Energy Performance Certificates various EU Member States have experienced specific barriers which had to be overcome, and in some cases still present a burden for future developments regarding regulation and practical implementation.

The information in this chapter and the overview by Member State in Chapter 4 indicate that a lot of different barriers have been or need to be addressed. Many of these barriers are related to country-specific circumstances such as:

- ▶ Slow administrative procedures in Spain *inter alia* due to the delegation of responsibilities from a national to a regional level, prolongs the implementation of EPC scheme;
- ▶ Commitments on payment for the Energy Performance Certificate in Hungary. In Hungary the public can, in principle, reject a regulation via a referendum. This makes it difficult to impose financial obligations, especially when people do not see the added value of the certificate;
- ▶ Some interference by market players/stakeholders with political choices of EPC implementation in the Czech Republic by raising a discussion about the values of primary energy coefficients.

In a number of the countries looked at barriers have arisen due to the reliability, transparency and usability of the EPCs for consumers and the choices that have to be made in the implementation process regarding the assessment method, administrative and enforcement system and the involvement of relevant stakeholders. Also a lack of awareness regarding the EPC obligations is an issue and can lead to a sub-optimal implementation in practice.



4



IMPLEMENTATION OF THE EPBD IN MEMBER STATES

In this chapter we provide an overview of the implementation of the EPBD, specifically regarding Energy Performance Certificates in the selected Member States. The implementation approach regarding the EPBD and EPCs will be briefly elaborated on a country by country basis, and information concerning public acceptance and the use of the certificate, quality control, promotion, administration and compliance will be presented. When applicable, specific barriers experienced or future plans for improvement of the implementation scheme are also outlined.

AUSTRIA



Implementation approach

In Austria the EPBD is implemented by the Federal Republic of Austria and the nine provinces. Each of the provinces has its own regulations and ways of practical implementation. To guide the provinces in the implementation and harmonise the way they are implemented a national guideline has been developed that provides basic calculation methods and sets energy performance requirements for buildings. The chosen methodology is based on calculated rating.

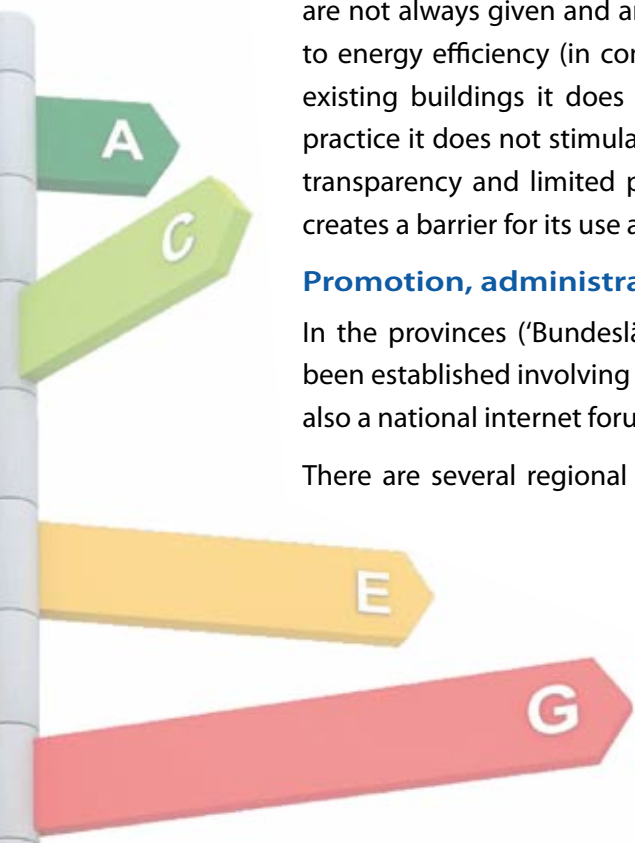
Public acceptance and use of certificates

EPCs are not regularly issued at the moment of transaction as there is no enforcement of the obligations. The EPC only shows the annual heating demand, and not the total energy performance. This is not transparent and does not give building owners very useful information. The information on the EPC is very detailed and complicated. The recommendations to improve energy efficiency are not always given and are not always clear. For new houses, the EPC can add to energy efficiency (in combination with an existing subsidy scheme), but for existing buildings it does not seem to be a very effective instrument yet. In practice it does not stimulate the taking of energy saving measures. The limited transparency and limited practical usability of the EPC for the building owner creates a barrier for its use and effects public acceptance.

Promotion, administration and compliance/enforcement

In the provinces ('Bundesländer') a lot of regional promotional activities have been established involving regional websites, brochures and campaigns. There is also a national internet forum to exchange EPC information among stakeholders.

There are several regional databases which are used for EPCs and for subsidy



schemes. There is also a national database, but it is not yet widely used. The databases perform a basic online quality check and can be used for statistical analysis.

The Austrian legislation does not provide an enforcement system with penalties. Claims can be made in case of non-compliance, which can be brought before a judge.

Quality control

The regional databases perform a basic quality check when a certificate is issued and stored in the database. The system provides a warning when the entered data seems to be incorrect or incomplete. The EPCs should be issued by an authorised expert in the field of, for instance, construction, engineering and energy. There is no obligation for these experts to take a training course or pass an exam for energy inspections. Since a lot of experts are aware of a possible lack of knowledge regarding the calculation procedures, they undertake voluntary training courses which are offered at regional level.

The software to calculate the energy performance has been developed by several market parties and institutions, based on the calculation system the government provided. Quality control for this software is not always undertaken consistently.

Barriers experienced or future plans for improvement of the implementation scheme

The transparency and usability of the software for the user are a clear point of attention with regard to the success of the energy performance certification scheme.



BELGIUM

Implementation approach

In April 2008 the decree on the energy certification of buildings (rules and rating method) was issued by the Belgian government. It applies to all regions. In Belgium the (practical) implementation of the EPBD is the responsibility of the three regions (Flanders, Wallonia and Brussels). The Flanders region is the most advanced so far in implementing the EPBD. In this region the chosen methodology is calculated rating for most buildings (except for public buildings). The other regions are still in the implementation process. The Walloon region is implementing the EPBD in phases. It is applying the calculated rating. Brussels-Capital region is most likely to choose calculated rating for the residential and the non-residential buildings. The public buildings are going to be assessed by measured energy rating.



Public acceptance and use of certificates

In Flanders, EPCs are almost always issued at the moment of transaction for houses (but are very seldom available at the moment of advertising, making it difficult for a buyer/renter to select according to energy efficiency). For non-residential buildings the implementation of EPCs is still in process.

Public acceptance is high; a large percentage of building owners (about 80%) is convinced the EPCs are a useful instrument for stimulating energy efficiency.

The Walloon region is introducing the EPC's for existing buildings (approx. 1.2 million) in phases, starting June 2010. The buildings will need to have an EPC when a sale transaction takes place.

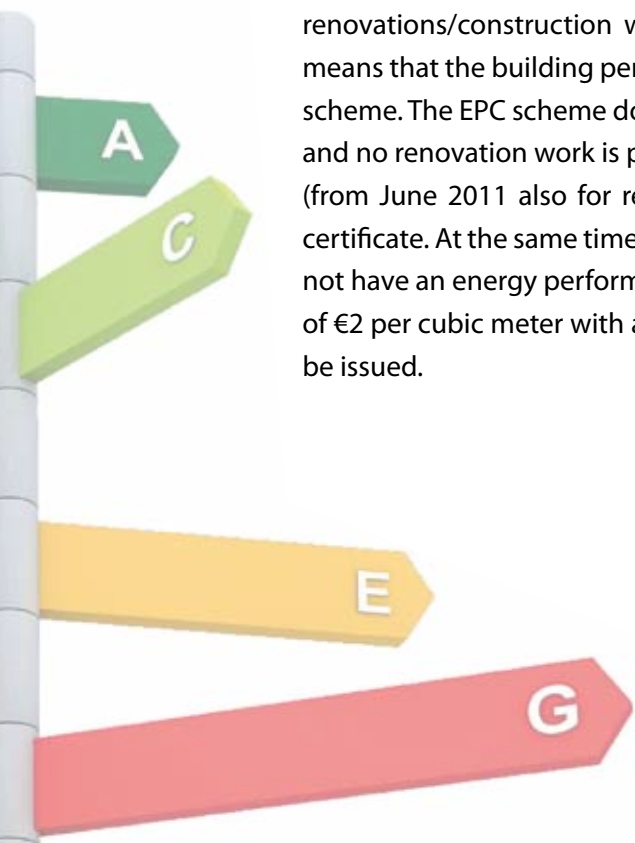
Promotion, administration and compliance/enforcement

In Flanders there is a dedicated website and a public campaign supported by flyers, brochures and seminars. Information is provided to the public concerning the EPC related to subsidies and tax benefits.

In Brussels, communication has started towards the professional target groups which will be involved in the EPC scheme (information, training, helpdesk for professionals, brochures and seminars).

In the Flanders region there is a database in which all EPCs are collected, which is also used for quality control, for the building permit process and for the automatic attribution of subsidies and discounts for energy efficient buildings. There is a strict enforcement system with financial penalties for non-compliance with EPC regulations (for building owners and energy experts).

In the Walloon region, new rules apply from 1 May 2010 for construction and major renovation (energy related). An EPC ("PEB" - a certificate showing energy performance calculations for new or renovated buildings) has to be made for renovations/construction work that is a part of building permit procedure. It means that the building permit procedure helps to ensure compliance of the EPC scheme. The EPC scheme does not apply to existing buildings when they are sold and no renovation work is performed. From 1 June 2010, no building transaction (from June 2011 also for rent) can take place without an energy performance certificate. At the same time, new enforcement measures apply: if a property does not have an energy performance certificate during a transaction procedure, fines of €2 per cubic meter with a minimum of €250 and a maximum of €25,000 could be issued.



Quality control

In Flanders the EPC database is used for quality control by the Flemish Energy Agency (VEA). The first level of quality control is with the energy expert, who is responsible for the correct description of the building and calculation of the EPC. The second level of quality control is with VEA. This means there is an administrative control of the procedures and often practical control of the EPC on site. The accreditation of energy experts is done based on a set of requirements for experts (requirements for two types of assessors: inspectors and auditors). The experts have to pass a theoretical and practical exam.

The Walloon region has approved the energy experts. Approval is given by the Energy Administration of the public services of the Walloon administration (Service public de Wallonie). An approval is valid for 3 years. To become a government approved expert one has to be: a person with qualifications in the energy audit field, have the technical knowledge and equipment to perform the audits and has to submit an approval dossier to the Energy Administration. When failures by the approved expert are noted at quality/performance checks, the energy expert has to explain this and can receive a warning, or even lose his approval temporarily or definitively.

Barriers experienced or future plans for improvement of the implementation scheme

In the future, it is planned that the functionality of the EPC database will be expanded and optimised. Harmonisation of the EPBD implementation across the three regions continues to be an issue.



CZECH REPUBLIC Implementation approach

In the Czech Republic the Ministry of Industry and Trade is responsible for the implementation of the EPBD. Energy assessment of buildings is not an entirely new thing in the Czech Republic since there has been a methodology for energy audits and certificates in place since 2001 for buildings with energy consumption higher than 1500 GJ per year.

In the Czech Republic, EPCs are only required for new buildings and in the case of major renovation (an obligation linked to the building permit). The chosen methodology is based on calculated rating, making use of reference buildings.

The choice to issue EPCs only in case of new buildings or major renovations is not fully in line with EPBD requirements, since this leaves out most existing buildings.



A large proportion of the existing buildings that are not renovated have poor energy performance, which is now not detected, and no energy saving measures are recommended.

Public acceptance and use of certificates

Only new buildings and buildings that undergo major renovation should have an EPC issued to request a building permit. In case they are sold or let afterwards the certificate should be presented at the moment of transaction. All other existing buildings do not require an EPC at a moment of transaction. In public buildings the EPC has to be displayed when they are new or recently renovated.

The information available on the EPCs is not very useful, since an EPC is only issued for new buildings or buildings that undergo major renovation (as an instrument to check compliance with energy performance requirements). These buildings are therefore always in a 'good' energy class, and it is not very useful to recommend energy saving measures. So the main target group for the recommendations (existing buildings) is not affected.

A considerable section of the general public views the EPC's as a new expression of bureaucracy.

Promotion, administration and compliance/enforcement

There is little attention given to promotion at the national level, there is no state campaign or dedicated website. Some professional stakeholders have initiated local information campaigns for the general public. Relevant state authorities that deal with the EPCs are well informed about the EPCs.

All EPCs are collected by the Ministry concerned, but there is at the moment no indication that they use a database for policy analysis or quality control.

Since EPCs are only required for new or renovated buildings, the check for compliance with the EPC obligation is done in order to receive a building permit. It is possible to be fined if the building is checked and does not comply with EP requirements.

Quality control

Energy experts need to be registered with an Energy Auditor Registration Number, and should be registered authorised experts (architects, engineers and technicians). They need to have relevant experience and pass an exam. Experts should have a liability insurance and have an independent role in the certification process.



The Ministry of Industry and Trade is responsible for the certification scheme and the quality assurance, and can control the work of experts.

Barriers experienced or future plans for improvement of the implementation scheme

Low governmental interest is a barrier for implementation, alongside the choice for a minimal implementation of EPCs (only for new and renovated buildings). The interference of market players/stakeholders with political preferences for implementation has played a role in the choice of assessment variables with regard to energy consumption.



DENMARK

Implementation approach

In Denmark the responsibility for implementing the EPBD is at a national level. Energy performance certification exists in Denmark since 1997. The calculated rating has been chosen in the new EPBD certification scheme which has been implemented since 2006. This was an adjustment to the previous scheme where the measured rating was then used for large buildings. There is still an ongoing discussion whether it should be possible to use some measured (operational) values. A revision of the scheme is expected in 2011.

Public acceptance and use of certificates

In Denmark energy performance certification was already in practice before the EPBD was implemented, so the public was already familiar with EPCs. About 50% of the new buildings have a certificate issued. For existing buildings the EPC is obligatory as a part of the mandatory paperwork at the time of sale or rent, compliance is expected to be somewhat lower than for new buildings.

A study concerning the effect of the 'old' EPCs (before the EPBD implementation) shows that there seems to be little difference in energy consumption between houses with a certificate and those without one. The effect of the 'new' EPCs is still unknown.

Promotion, administration and compliance/enforcement

Regarding promotion, a knowledge centre for energy saving in buildings was established in 2008, providing professionals with information. This centre is financed by the Danish government (€4.3 million has been allocated for the period of 2008-2011), and partly by a public fee through the revenues from the EPC scheme.

All EPCs are collected in a central database at the Danish Energy Agency. For new



buildings an EPC is required to get a permit for use, which is not granted in case of non-compliance. For existing buildings, the EPC is obligatory at the moment of the transaction. The possibility of penalties exists in case of non-compliance. However, there is no enforcement system in practice.

Quality control

Energy consultants have to be independent and qualified as an architect, engineer or construction designer, and must have relevant experience concerning building technology and energy consulting. The individual consultants are responsible for a quality check, but are also under the surveillance of the Danish Energy Agency. Performance checks are done regularly.

Barriers experienced or future plans for improvement of the implementation scheme

The set up of an administration system to support the EPC scheme and finding the optimal way to register the data from the EPCs were barriers which had to be overcome. A logical connection between the EPC-data, the software and the database had to be found. Frequent consultation with the parties involved helped in choosing the right combination.

Political discussion is still ongoing about financial support for energy saving measures in order to improve the energy efficiency of the building stock.

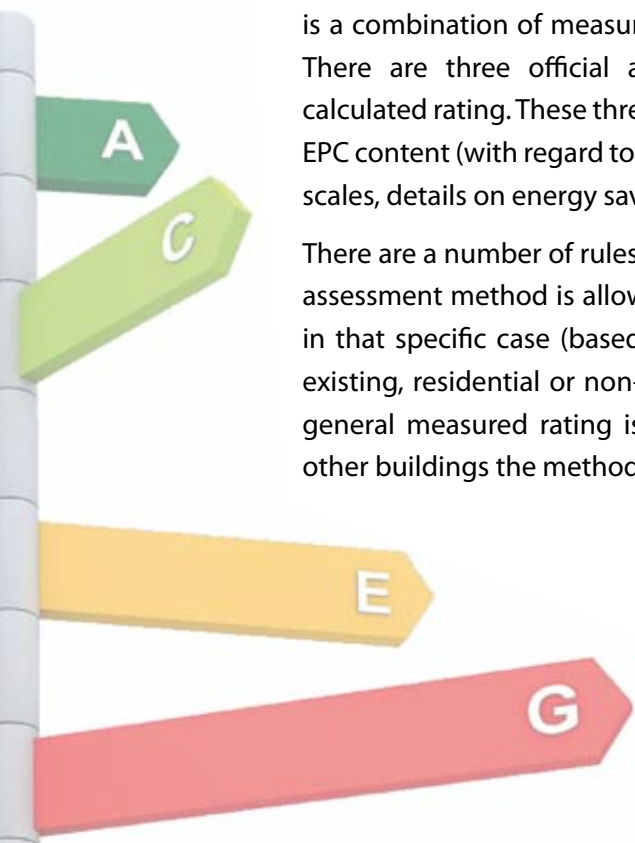
FRANCE

Implementation approach



In France the implementation of the EPBD is the responsibility of the central government. EPCs are required in France in case of sale from September 2006, for residential rental and construction as from July 2007 and for public buildings (>1000 m²) from January 2008. The chosen methodology for energy assessment is a combination of measured (operational) and calculated rating (asset rating). There are three official assessment methods, based on measured and/or calculated rating. These three assessment methods also lead to a slightly different EPC content (with regard to the presentation of results, different energy reference scales, details on energy saving recommendations).

There are a number of rules established by which a building owner can see what assessment method is allowed and if measured or calculated rating are allowed in that specific case (based on ownership of the building, sale or rent, new or existing, residential or non-residential, year of construction, heating system). In general measured rating is used for non-residential and public buildings. For other buildings the method is determined by sets of rules.



Public acceptance and use of certificates

The EPC is part of the technical building dossier that is obligatory with a transaction of privately owned buildings. The notary must check if this dossier is complete. In 2008 about 90% of the professionals like notaries and real estate agents were familiar with the Energy Performance Certificate, and about 65% of the private home owners. About 14% of the private residential buildings were certified at that time. Energy saving measures that are recommended are executed in about 24% of these cases. The EPC is not common practice in housing advertising and not a main issue in contract negotiations yet. Overall the general public finds the EPC informative, but not very effective in offering actual environmental solutions. Regarding private renting the letters and renters are less familiar with the EPCs than in the sales market. For public buildings the EPC is common practice, as about 90% have an EPC already. Public housing is included in the public building sector, which means that most social houses have an EPC.

Promotion, administration and compliance/enforcement

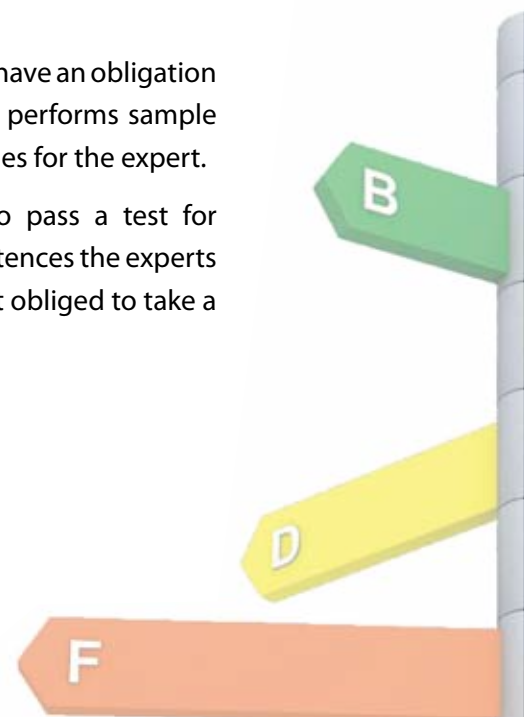
There is no specific promotional campaign for the EPCs. There are, however, some other environmental communication initiatives in which energy efficiency is also a topic. The central database for EPCs is managed by ADEME – the French environmental and energy agency. Enforcement has been planned commencing the first semester of 2011.

As from January 2011 the energy label and class have to be displayed as soon as the building is advertised for the sale or rent (newspapers, web sites, real estate agencies etc.). These new requirements result from the “Grenelle Law”. The notary publics play a role in the enforcement of the issuing of an EPC at the moment of transaction. They may not pass the transaction when the ‘technical building dossier’ (including EPC) is incomplete.

Quality control

All experts have to store the data of the EPCs they issue. Experts have an obligation to send a data on EPCs to central database. The government performs sample checks on quality. Incorrect issuing of an EPC can cause penalties for the expert.

Only qualified experts can issue a certificate. They have to pass a test for certification. The French government publicised a list of competences the experts have to fulfil. They must prove this in the exam. Experts are not obliged to take a specific training course before the exam.



Barriers experienced or future plans for improvement of the implementation scheme

The main barrier in the implementation of the EPBD has been the choice of the assessment method and the perceived accuracy. There were different opinions about the best EPC assessment method, also because of big differences between residential and non-residential buildings. The solution has been found by introducing two assessment options: calculated and measured rating, and the enlargement of the energy classes with classes H and I to mark specific non-efficient (non-residential) buildings. This way the same scale can be used for residential and non-residential buildings (with the extended scale for non-residential buildings).

The quality of the EPCs is also identified as a barrier, related to the quality of the assessors. In order to overcome this obstacle stricter requirements for assessors are being planned.

For the future, a central database and the extension of the EPC obligation to all buildings with collective heating systems (not just at the moment of transaction) and all rental contracts is planned.

GERMANY

Implementation approach

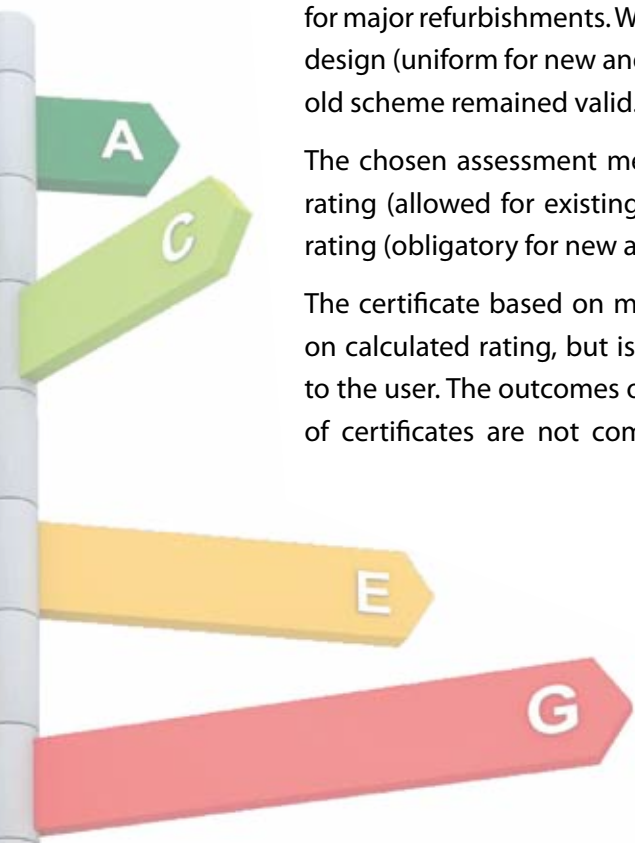


In Germany the implementation of the EPBD lies in the responsibility of three ministries: the Federal Ministry of Transport, Building and Urban Development, the Ministry of Economics and Technology and the Ministry of Environment, Natural Conservation and Nuclear Safety.

The Energy Performance Certification scheme is not new to Germany. Since 2002 energy certificates have been mandatory for new buildings and, in certain cases, for major refurbishments. With the EPBD implementation the EPCs received a new design (uniform for new and existing buildings), but certificates issued under the old scheme remained valid.

The chosen assessment methodology is based on a combination of measured rating (allowed for existing buildings built after 1978 and flats) and calculated rating (obligatory for new and renovated/extended residential buildings).

The certificate based on measured rating is cheaper than the certificate based on calculated rating, but is also of lower quality and provides little information to the user. The outcomes of both assessment methods regarding the two types of certificates are not comparable. It means for the same building, different



outcomes are likely to occur when the building is evaluated both on the basis of measured rating and calculated rating.

Public acceptance and use of certificates

As stated above, in specific situations the dwelling user/owner can choose between a low quality and cheap certificate based on measured rating, and a higher quality and more expensive certificate based on calculated energy demand. The lower quality version is often chosen at the time of transaction to comply with the law. It is not exactly known how common practice the EPCs are at the time of transaction, since registration does not exist. Recent research about the market development with regard to the use of EPCs in Germany (BMVBS, February 2010) shows that about 87% of the social housing organisations have EPCs for a large part of their building stock. With regard to private building owners and private landlords, only about 30% are estimated to have energy performance certificate issued at the time of sale or rent. The general public is often not aware of the obligation to issue an EPC, or it is not done because the renters or buyers do not ask for an EPC. In case of sale or renting out of a building, the EPC rarely plays a decisive role.

The low quality certificate has little useful information for the building owner and therefore does not stimulate energy efficiency very effectively.

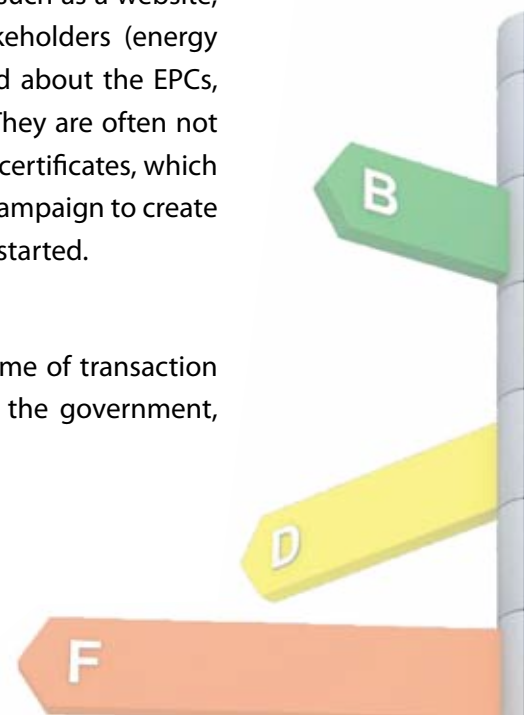
The quality of the certificate is a discussion point. The German Energy Agency DENA has started its own database with available energy experts who have the authority to issue a EPC based on the calculating rating which has DENA quality seal.

Promotion, administration and compliance/enforcement

The German Energy Agency DENA initiated a promotional campaign in 2007, with radio commercials, audio podcasts and promotional material such as a website, brochures, CD-ROM, posters etc. Although professional stakeholders (energy experts, social housing organisations) are often well informed about the EPCs, this is not yet always the case with private building owners. They are often not aware enough about the difference between the two types of certificates, which could be useful to explain more specifically in an information campaign to create more awareness now the obligation to issue EPCs has actually started.

There is no central database or registration for EPCs.

In case of the non-compliance of the EPC obligation at the time of transaction there are penalties (inter alia the possibility of fines) set by the government,



but there is no operational enforcement system. Municipalities are in principle responsible for the monitoring compliance, but in practice there is often only a check of compliance when a complaint is filed.

Quality control

The German regions set the accreditation requirements for experts, therefore the rules and qualifications may vary considerably by region. Different professionals may issue certificates, such as for instance: architects, engineers, natural scientists with building related degree and master craftsmen. There are often differences about which version a specific group of professionals are allowed to issue; the version based on calculated rating or the version based on measured rating. There is no official register of experts, but DENA has a voluntary national quality seal for experts to make it possible to monitor the quality of the certificates and the qualification of inspectors.

In some cases the building owner can provide the energy expert with building data to use for the EPC assessment. Although the energy expert is bound to check whether the received information is likely to be correct, actual quality assurance is difficult.

Barriers experienced or future plans for improvement of the implementation scheme

Some barriers experienced are: the low quality of the operational label version, some unclarity and changes in regulations, incentives not working properly and a lack of coordination and communication in the decisive process of developing the scheme. For the future an amendment of the energy performance requirements for buildings is planned. An update of the legislation is expected in 2011/2012.

HUNGARY



Implementation approach

In Hungary the implementation of the EPBD is the responsibility of the State Office of Housing and Building, the Ministry of Economy and Transport and the Ministry of local Government and Regional Development. Certification of buildings is mandatory from January 2009 for new buildings and state-owned buildings with a surface area exceeding 1000 m². EPCs will be required in the event of sale or rent of existing buildings as of January 2012, and are therefore not effective yet.

For new buildings the chosen assessment method is calculated rating, based on the average climatic data and standardised user behaviour. For public buildings



where the heated surface area is more than 2000 m² an measured rating system is suggested. A discussion is ongoing about the assessment method for existing buildings as of 2012. Because of the costs of the certificates, which will have to be paid by the public, measured rating is considered because this makes it possible to keep the costs low.

Public acceptance and use of certificates

For new buildings, compliance with the energy performance requirements is checked in order to receive a building permit. For the EPC a recalculation should be performed when the building is ready, but in practice this check is often executed very minimally and means more or less just a signature on a form.

For existing buildings, EPCs are not yet mandatory, but public acceptance is expected to have a direct connection to the costs of the certificate. The costs and mandatory character of certificates are a main point of discussion in Hungary. In Hungary it is possible that the public rejects a regulation by referendum. These issues delayed the implementation of the EPCs for existing buildings as the government wants to come up with an acceptable approach for the public to avoid rejection.

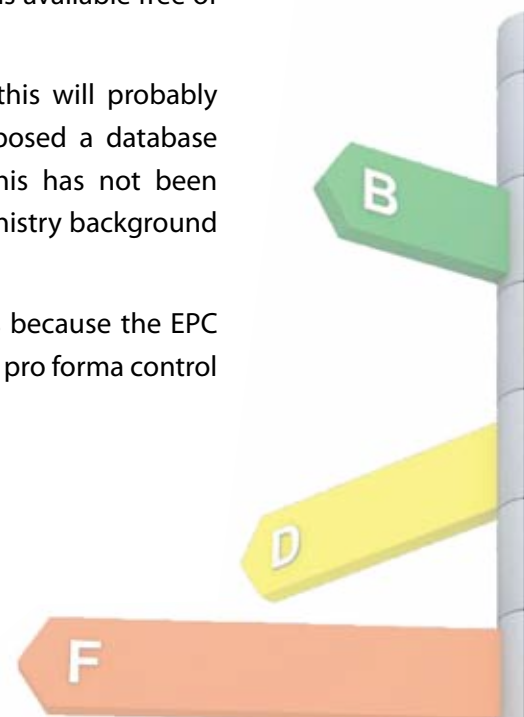
Promotion, administration and compliance/enforcement

The implementation of the EPBD received a lot of media attention and a TV campaign in 2006. At that time the regulation was still under development, which made the promotion activities somewhat less convincing. The effect of the promotion campaign is unknown.

For professional stakeholders (local authorities, assessors) practical information concerning the EPCs has been made available by the Ministries concerned by means of guidance papers and an electronic guide regarding the assessment method from the Chamber of Hungarian Architects. Software is available free of charge.

There is no registration of EPCs in a central database yet; this will probably be developed in the future. A commercial stakeholder proposed a database registration system which allows for quality control, but this has not been accepted so far. Currently EPCs are collected and held by a Ministry background institution.

There is no enforcement of compliance for existing buildings because the EPC process is still under development. For new buildings there is a pro forma control of EPCs when the building is ready.



Quality control

The Chambers of Architects and Engineers are responsible for quality control, and accredited experts. The Chambers have no infrastructure for data collection to allow easy quality assurance. The certificates are not used for policy analysis and program refinement; there is limited quality control.

The hourly rate and the hours an expert can spend on an assessment are limited by governmental order, to keep the costs of the certificate low. This makes practical quality control difficult. For new buildings, for which the EPCs are obligatory, this means that the EPC is restricted to a 'paper check' in which the calculation of the designer is checked against a statement of the contractor who carried out the work.

The Chambers of Architects and Engineers have established an examination board that issues licences to experts for energy assessments. The experts must be a member of the chambers and must have relevant diplomas with practical experience. They also have to pass an additional exam for which training courses are offered. Experts are publicly registered on the website of the Chambers of Architects and Engineers.

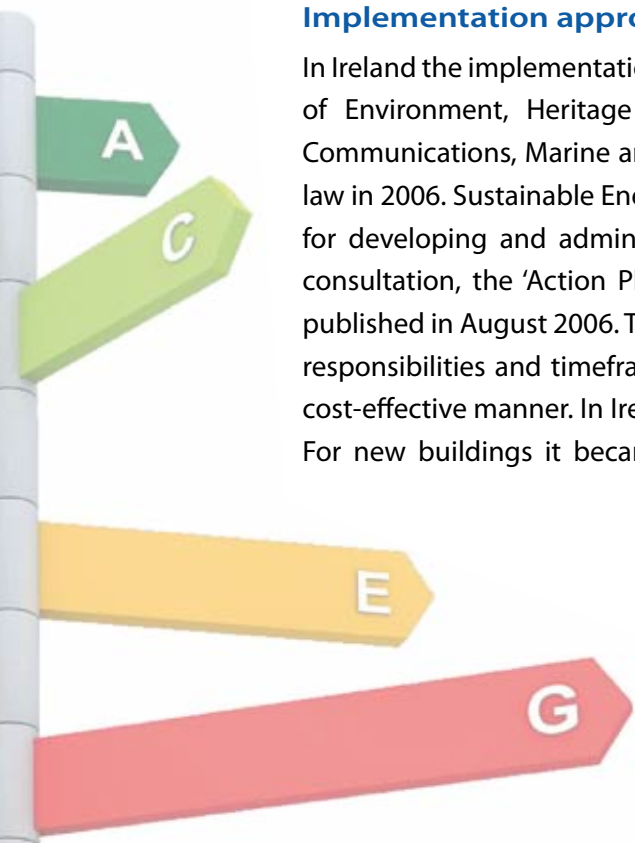
Barriers experienced or future plans for improvement of the implementation scheme

The costs of the certificate, which have to be paid by the public as the certificates are obligatory, are the most important barrier encountered. The government is trying to overcome this barrier by choosing a system with low cost certificates, and making the advice for energy saving measures optional. An update of the national regulations is planned to implement the EPBD recast.

IRELAND

Implementation approach

In Ireland the implementation of the EPBD is the responsibility of the Department of Environment, Heritage and Local Government and the Department of Communications, Marine and Natural Resources. The EPBD was adopted in Irish law in 2006. Sustainable Energy Ireland (national energy authority) is responsible for developing and administering the EPC scheme. After a process of public consultation, the 'Action Plan for Implementation of the EPBD in Ireland' was published in August 2006. This Action Plan sets the outline of the proposed tasks, responsibilities and timeframe for full EPBD implementation in a workable and cost-effective manner. In Ireland the EPC is called a Building Energy Rating (BER). For new buildings it became mandatory in January 2007, for non-residential



buildings and public buildings in January 2008 and for existing residential buildings in the event of sale or rent in January 2009. The chosen assessment method is calculated rating.

Public acceptance and use of certificates

In Ireland around 300 EPCs are issued each day. Public acceptance is influenced positively by the public consultation round. In the development of the EPC scheme Sustainable Energy Ireland paid specific attention to balancing issues like practicality, costs, clarity and consistency because this was considered vital to the market reputation and effectiveness of the scheme. This led to a scheme which:

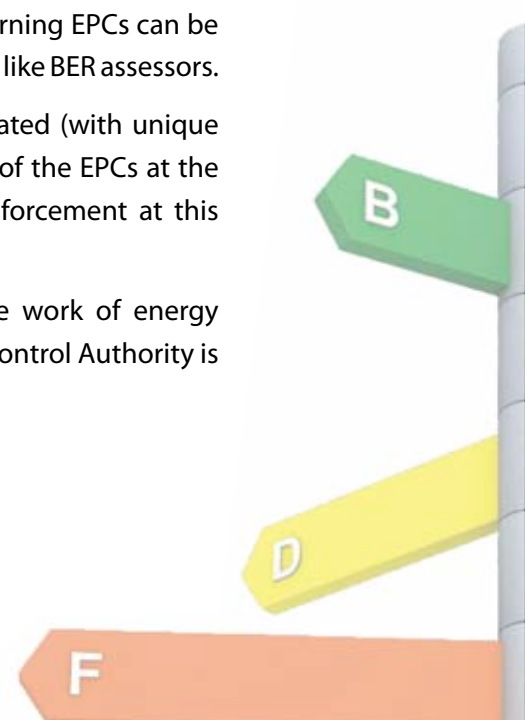
- ▶ Has a visually good and high impact certificate with energy rating which is familiar to the general public (in line with the rating for household appliances);
- ▶ Provides an advisory report which accompanies the BER, with good information on how to actually improve the building's energy performance;
- ▶ Provides a system for registering qualified and well trained building assessors;
- ▶ Provides a database for BERs and advisory reports;
- ▶ Provides a quality assurance mechanism;
- ▶ Provides an administrative system with support functions such as a help desk.

Promotion, administration and compliance/enforcement

Specific attention has been paid to promotion at the time of the public consultation for the Action Plan. There are relevant targeted campaigns aimed at key actors involved in property transactions to create awareness. On the website of Sustainable Energy Ireland (SEAI) a lot of information concerning EPCs can be found, both for home-owners and for professional stakeholders like BER assessors.

There is a national database where the issued EPCs are validated (with unique reference number). The database can be used for verification of the EPCs at the time of transaction (solicitors play a role in the practical enforcement at this point), for statistical information and for quality control.

The EPC (BER) Issuing Authority is responsible to check the work of energy assessors and can impose reasonable sanctions; the Building Control Authority is responsible to enforce compliance with building owners.



Quality control

EPCs are issued by specially trained EPC 'BER assessors', who are building professionals with relevant background, registered by Sustainable Energy Ireland. Sustainable Energy Ireland sets requirements for assessors. They have to follow initial accreditation training with examination and follow-up periodic training courses and pay a fee to be re-registered annually. Assessors have to sign a 'Code of Practice', which includes requirements to act in a professional and independent manner, to comply with the scheme rules and ensure confidentiality.

Furthermore the national database is used for practical quality control of issued certificates. Audits are taken both on a random basis and as a result of any unusual or suspect data. Every active energy assessor is on average assessed at least once a year.

THE NETHERLANDS

Implementation approach



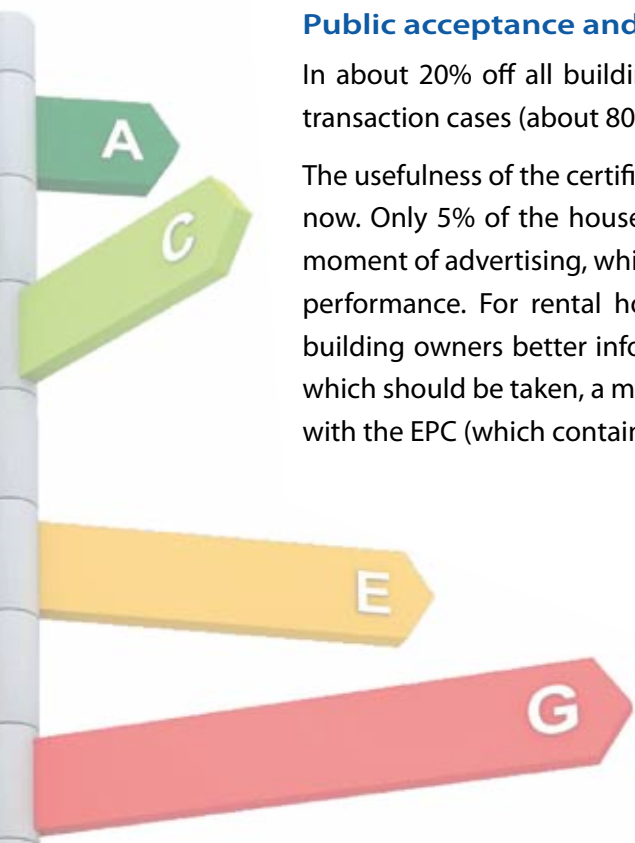
In the Netherlands the implementation of the EPBD is the responsibility of the Ministry of Housing, Spatial Planning and Environment (VROM). There was already some experience before the EPBD with a voluntary system of energy performance labelling of existing buildings. This was developed further for EPBD implementation. In December 2006 the EPBD was transposed into Dutch law. From January 2008 the EPC has been mandatory for all buildings which are sold or rented out, except for social housing (see below) and the public display of the certificate in public buildings. This obligation started January 2009.

For new buildings, the calculation of energy performance ('energy performance coefficient') that is used to receive a building permit is valid as a certificate for ten years. The chosen assessment method is calculated rating.

Public acceptance and use of certificates

In about 20% off all building transactions (sale/rent) an EPC is issued. In most transaction cases (about 80%) it concerns lease/letting transactions.

The usefulness of the certificate in the event of sale has been relatively poor until now. Only 5% of the houses that come on the market have a certificate at the moment of advertising, which makes it possible for the buyer to select on energy performance. For rental homes the usefulness is higher (see below). To give building owners better information regarding relevant energy saving measures which should be taken, a more detailed 'tailor-made' energy advice can be issued with the EPC (which contains basic improvement measures).



In the Netherlands a public discussion about the reliability and reproducibility of the EPCs started at the end of 2007. This was investigated by the government, and adjustments to the assessment method and the certificate have been made accordingly. The transparency of the assessment process and the certificate and the comprehensibility of the information on the certificate for the general public is very important for the public acceptance of the certificate.

In the Netherlands most of the certified buildings are rental homes. The Dutch government gave social housing organisations the possibility to postpone the obligation to present an EPC at the lease transaction stage for one year (January 2009 instead of January 2008, the date the obligation of certification at the time of transaction started in the Netherlands). The condition for this postponement was that they then had to issue EPCs for their entire building stock, and not just for the houses that were let at that moment. A lot of social housing organisations postponed, and found this time very useful to map the energy performance quality of their building stock, and develop energy improvement plans alongside their refurbishment plans. This way the certificate actually contributes to energy saving measures being executed in the social housing sector.

Promotion, administration and compliance/enforcement

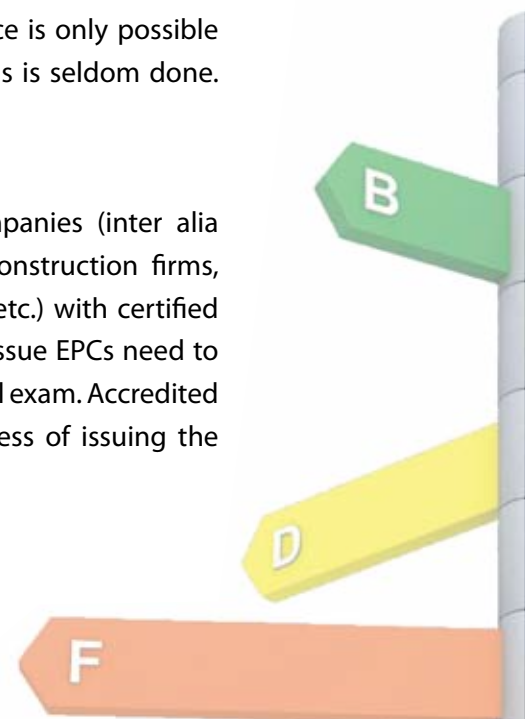
For the general public a national information campaign started in 2007/2008, this included a TV campaign, newspapers, brochures and several websites with information. For building professionals a specific campaign started in 2008. By means of these campaigns awareness has been raised to a reasonable level among a considerable portion of the general public.

There is a national database in which all EPCs are registered. The database can also be used for monitoring purposes and quality control of EPCs and the assessment process by accredited control bodies.

At the moment of transaction, the enforcement of compliance is only possible when a demand for EPC is made based on the civil code. This is seldom done. Otherwise no enforcement and no sanctions are in place.

Quality control

In the Netherlands there are a few hundred certified companies (inter alia consultancy companies in construction, building physics, construction firms, real estate agents, housing corporations, energy companies etc.) with certified experts that can issue an EPC. Advisors/energy experts who issue EPCs need to have a higher building-related education and pass an additional exam. Accredited bodies control these advisors by checking the internal process of issuing the



EPCs and checking the quality of the EPCs on a random basis by means of the database and visits on site. Energy performance inspectors need a valid NL-EPBD-certificate. The requirements that they have to meet are stipulated in a regulation.

Barriers experienced or future plans for improvement of the implementation scheme

The Dutch government has tried to keep the cost of the certificate as low as possible for a reasonable quality certificate. For this reason it was also decided to make it possible to acquire separate detailed energy saving advice alongside the certificate. This way the actual certificate could be issued more cost-effectively.

The public discussion about the reliability and reproducibility of the EPC which started end of 2007 has been a barrier to implementation. The government has initiated an investigation, adapted the EPC and assessment process according to the outcome, and worked on improving communication to the general public (on the EPC and about the EPC). For the future, the implementation of the EPBD recast is on the agenda, and it is being explored how the EPC can be a means to stimulate better energy performance improvement, for instance by making financing products available linked to the EPC and incorporating energy performance in the methodology to set the maximum rent for properties (to overcome the split-incentive problem).

P O L A N D

Implementation approach

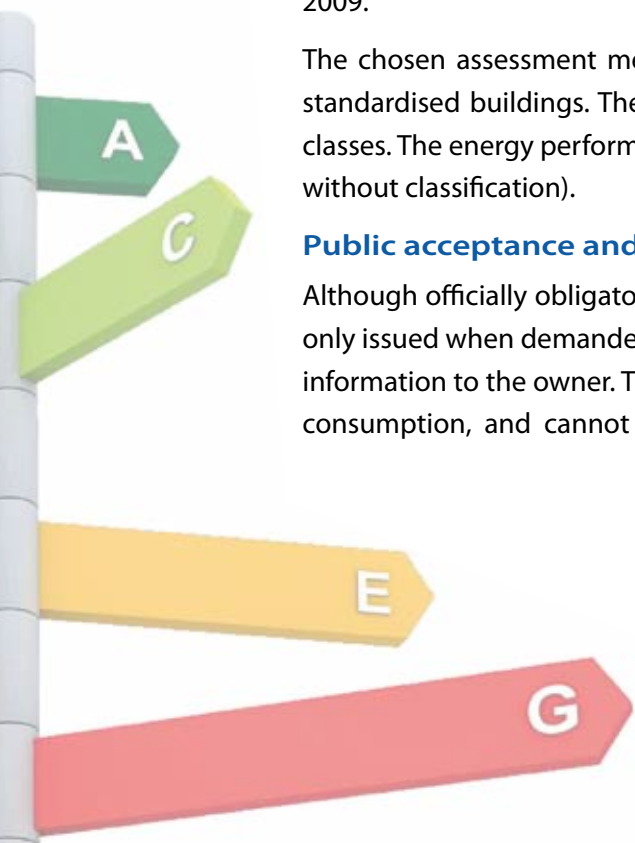


In Poland the implementation of the EPBD is the responsibility of the Ministry of Infrastructure and the Ministry of Economy. The EPBD was transposed in the Construction Act in 2007 and in three following Ministerial ordinances in 2008. The certification of new, existing buildings and public buildings started in January 2009.

The chosen assessment method is calculated rating, based on calculations for standardised buildings. The assessment procedure doesn't make use of energy classes. The energy performance results are presented on a linear scale (indicator without classification).

Public acceptance and use of certificates

Although officially obligatory at the moment of transaction, in practice EPCs are only issued when demanded by both parties. The certificate provides little useful information to the owner. The certificate does not present the end-use of energy consumption, and cannot be used to draw conclusions about the building's



energy costs. By the public it is often perceived just as a piece of paper, required by law, but not very useful.

Promotion, administration and compliance/enforcement

Until now only limited promotional activities have been set up. There has been an informational campaign within a larger educative program and some information leaflets in the period from 2005 to 2007. More promotion was planned for 2009, but was not executed yet (TV campaign, brochures, posters, conference for professionals etc.). Therefore the promotion has not been very effective so far. The only identified database in Poland is that of BuildDesk Poland.

Energy experts have to keep certificates for 10 years. In principle there should be a random quality check, but this is not in practice yet. There are no specific administrative procedures to check compliance regarding the EPC requirements. Authorities in general only check the completeness of documentation (also because of lack of expertise); there is no administrative quality check or a practical check if buildings comply with the regulations. Authorities only intervene in the event of a complaint. Enforcement thus can only be done when a complaint is made by the Chamber of Architects or Engineers, for instance related to the quality of the EPC or when an EPC is not presented as requested at a transaction process. Complainants can also go to court.

Quality control

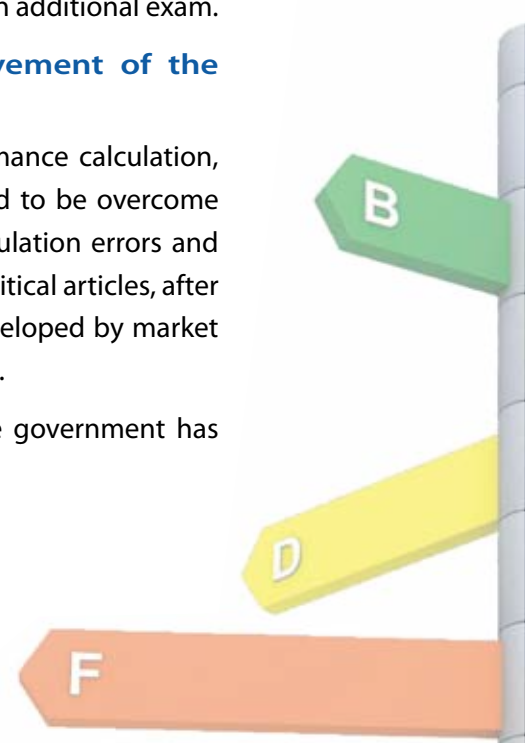
There are no quality control procedures for EPCs and energy experts, but it is noticed that this should be developed.

The training of independent energy assessors is regulated by the Construction Act and the Ordinance on the training and the examination of experts of 21 January 2008. To become a certified expert, candidates need to have a relevant higher education (architecture, construction, engineering) and pass an additional exam.

Barriers experienced or future plans for improvement of the implementation scheme

Regarding the development of a method for energy performance calculation, which has been set down in an ordinance, some barriers had to be overcome regarding the initial use of some incorrect assumptions, calculation errors and misleading methods. This led to the publication of a series of critical articles, after which the methods have been adjusted. Software can be developed by market parties, which can also lead to validation and quality problems.

The lack of promotion and information campaigns from the government has



contributed to the public regarding the EPC as just another piece of paper which is obligatory, and not as an instrument to improve energy efficiency. This situation is also encouraged by the new energy performance requirements which were introduced in Poland due to the EPBD and which are in fact less demanding than the existing requirements.

For the future, the Certifiers Association is planning to set up a quality control system regarding EPCs and the issuing experts.

PORTUGAL

Implementation approach



In Portugal the implementation of the EPBD is the responsibility of the Ministry of Economy and the Ministry of Environment. The EPC scheme was launched in July 2007; first for new buildings, and from January 2009 also for existing buildings. The EPCs cover indoor air quality as well as energy performance. The chosen assessment method is calculated rating. The calculation procedures are defined in building regulations. A software tool (INETI) has been available since September 2006, but other tools are also allowed. Calculations have to be done based on a national database regarding regional climates. ADENE, the Portuguese Energy Agency, is the managing body for the EPBD implementation process and plays a big role in the practical implementation of the EPCs.

Public acceptance and use of certificates

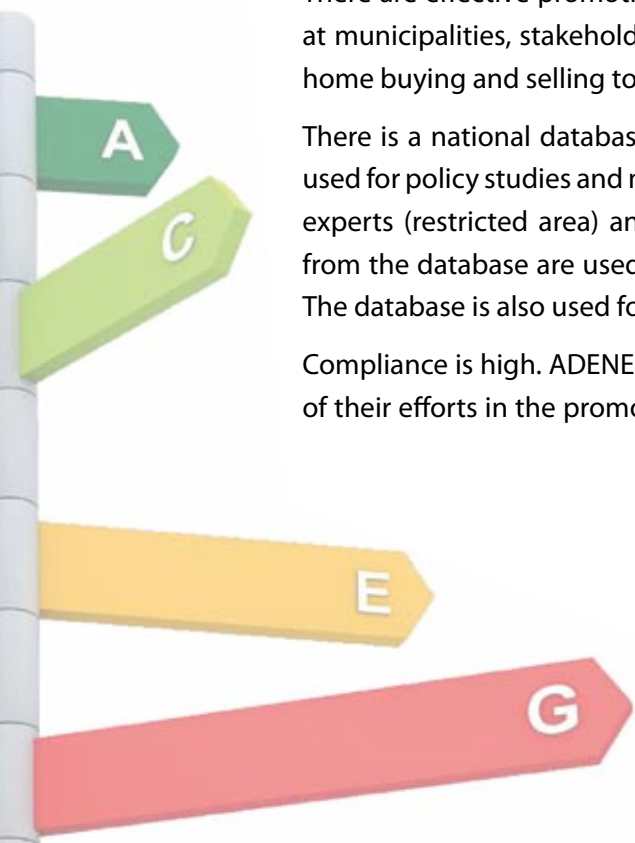
In about 90% of building completions and transactions an EPC is issued, so compliance is high. Compliance is lower in the rental market than in the sale market.

Promotion, administration and compliance/enforcement

There are effective promotional activities by the energy agency ADENE directed at municipalities, stakeholders and key market players involved in construction, home buying and selling to ensure compliance and support of the certification.

There is a national database in use for the registration of EPCs. The database is used for policy studies and monitoring and is accessible by the authorities, energy experts (restricted area) and the general public. Results for the policy analysis from the database are used to improve policy, regulations and implementation. The database is also used for random quality checks of the issued EPCs.

Compliance is high. ADENE plays a key role in the high compliance rate, because of their efforts in the promotional activities towards municipalities, stakeholders



and key market players. In case of non-compliance there is a penalty system with sanctions (fines), both for building owners and experts.

Quality control

Only qualified experts may issue certificates. They must be recognised architects or engineers with at least five years of relevant experience. Qualified experts must attend courses and pass a national exam. ADENE coordinates the training of qualified experts. The license which experts have is valid for five years and will only be renewed when they can provide proof of continued training and a lack of malpractice.

ADENE regularly performs controls to check the content of issued certificates by independent experts, for which the EPC database is also used. A parallel analysis of the certified building is performed in the control, with an onsite visit. About 4% of the EPCs are checked this way, and additional random checks are done on the content of the certificates (consistency check).

Barriers experienced or future plans for improvement of the implementation scheme

The main barrier was to convince key stakeholders of the importance of the EPC scheme. Energy Agency ADENE played a key role in overcoming this barrier, with its information/promotion campaign.



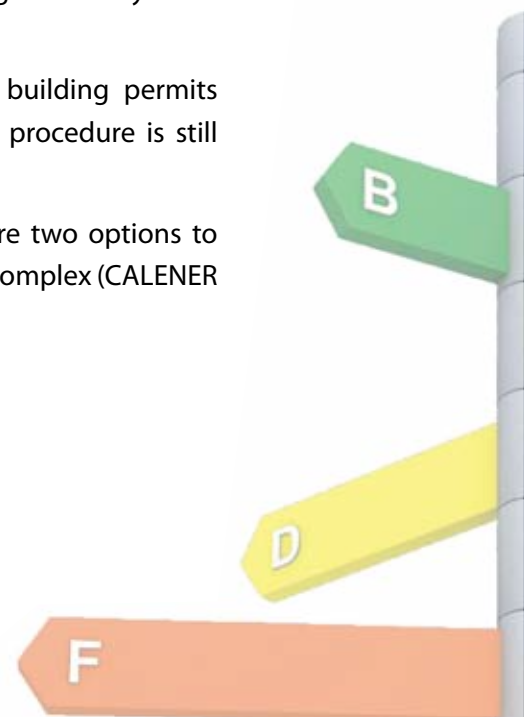
SPAIN

Implementation approach

In Spain the implementation of the EPBD at a national level is the responsibility of the Ministry of Housing and the Ministry of Industry, Tourism and Trade. The regional authorities are responsible for the practical implementation of the EPBD in their region, and may amend and complete the national regulations by more detailed provisions.

Certification of new buildings has become mandatory for building permits requested after 31 October 2007. For existing buildings, the procedure is still under development, so there is no certification yet.

The chosen assessment method is calculated rating. There are two options to calculate the energy demand of a building; a simple and more complex (CALENER software tool) calculation procedure.



Public acceptance and use of certificates

So far EPCs are only in practice for new buildings in combination with a request for a building permit. Implementation of EPCs for existing buildings is still ongoing, so there is no certification yet in the case of sale or rent. Public awareness is low.

Promotion, administration and compliance/enforcement

There is no specific national promotion for the general public regarding EPCs, therefore public awareness is low. There is limited local promotion.

There seems to be no central/regional database for issued EPCs.

For new buildings the control of compliance regarding EPCs for new buildings is the responsibility of the regional government when the building is finished. But most regions are still working on administrative procedures for registration and control and have limited manpower for actual enforcement. Non-compliance could in principle result in administrative penalties in the case of an EPC which is not applied to the actual building project, but also civil penalties are possible. The regions can state their own specific set of sanctions in case of non-compliance with the regulations.

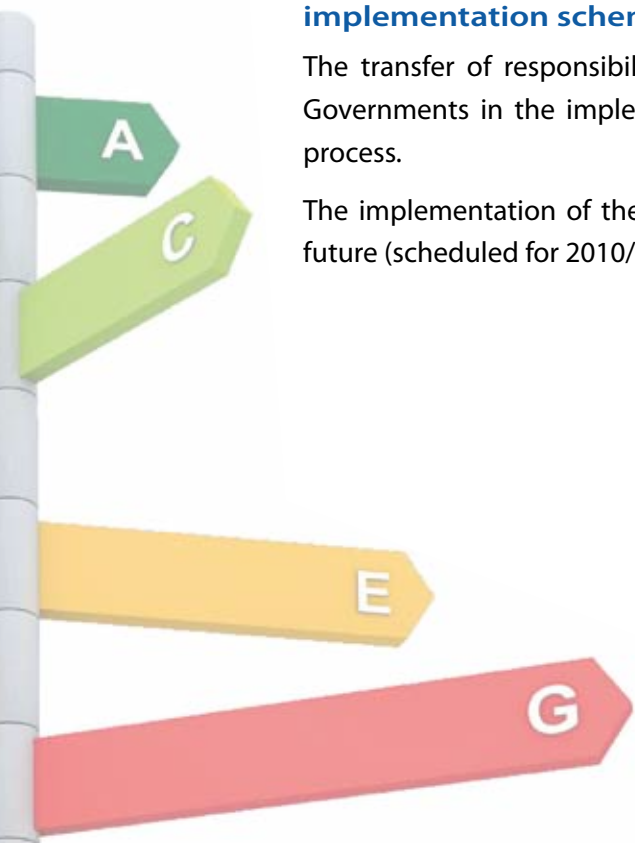
Quality control

Regarding the authorisation of experts in Spain to issue EPCs, the situation is that inspections of thermal installations have been carried out by experts periodically because of safety regulations. For the EPBD, an additional training of 2-3 days is required. Mainly architects and engineers who are qualified to design buildings and technical installations are involved in the certification process. The specific requirements for the experts depend on the respective regional authorities. In most regions quality control procedures are not established yet.

Barriers experienced or future plans for improvement of the implementation scheme

The transfer of responsibilities from the central Government to the Regional Governments in the implementation of the EPBD makes it a time consuming process.

The implementation of the EPCs for existing buildings is planned for the near future (scheduled for 2010/2011).



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RESEARCH APPROACH

The following 12 Member States have been selected for the review, taking into account their geographical spread, classification between old and new Member States and more or less successful implementation process of the EPCs.

- Austria (AT)
- Belgium (BE)
- Czech Republic (CZ)
- Denmark (DK)
- France (FR)
- Germany (DE)
- Hungary (HU)
- Ireland (IE)¹⁰
- The Netherlands (NL)
- Poland (PL)
- Portugal (PT)¹⁰
- Spain (ES)

1. The research focused on the following research topics:

- ▶ The basic implementation approach;
- ▶ Key indicators of use of the EPCs;
- ▶ Public acceptance, both regarding consumers and professional stake holders;
- ▶ Administration/registration of EPCs;
- ▶ Quality control;
- ▶ Involvement of the market;
- ▶ Promotion;
- ▶ Compliance;
- ▶ The price of the certificates;
- ▶ Barriers to the introduction of EPCs;
- ▶ Future changes planned.

2. The enquiry was supplemented with available information for the selected Member States by means of a web search, research of documents and additional personal contacts by telephone and email. The most recent publicly available sources were preferred, complemented by information from somewhat older sources when necessary and with information from contact persons and stakeholders in the EPC field within Member States.

¹⁰ The review of Ireland and Portugal has been limited to a 2009 study by eceee ('Successful EPC schemes in two Member States: An eceee case study').

3. After processing and analysing the enquiry data conclusions have been drawn. The presented overview of EPC implementation by country and the analysis of information per research theme form the basis for the policy conclusions. In the policy paper a wider outlook is given regarding EPC implementation. The fact that the national context has a large influence on the success of a certain policy was taken into account. Recommendations for success and best practices have been identified.

Availability and use of information

Finally not all research questions could be answered for each country to an equal level as some information was not available. An overview of current EPC implementation in Member States was strived for "as complete and correct as possible". Information derived from personal observation of contact persons has been used when no information was available in public sources. These additional sources have been selected carefully, based on their practical experience with the EPC scheme in the Member States concerned. The research was set up to present the available information as objectively as possible, nevertheless the chosen approach (using additional information from contact persons when necessary) implies that a minor part of the information presented in the report can have a more subjective character, representing the 'practical experience' with EPCs the contact persons (such as stakeholders in the Member States) referred to.

The information and examples of national situations in the Member States that is presented does not provide an exhaustive overview. The analysis undertaken for this study is of a qualitative nature, and does not provide information suitable for generalisation or for statistical purposes.

The goal of this study is to provide an overview of EPC implementation in the selected Member States which is helpful to define market failures and success factors. This can help Member States in the implementation process of Energy Performance Certificates by learning from the experience of other Member States. The implementation of the EPBD and EPCs in particular is highly context related. For this reason the policy paper elaborates on the actual experiences in the Member States on the one side. On the other side it defines recommendations and focus points on a higher more abstract level, with best practice examples, to make the information more applicable for a larger number of Member States.

An overview of information by Member State is presented in the main report (Chapter 4). A list of sources is provided at the end of this report.

The sources have been examined over the period of March until September 2010. Since the status of information after this period is not available, the report may not reflect some of the most recent developments in specific countries.

The ratings given in some tables referring to various activities (such as information, promotion, compliance) are based upon the available information collected and represent best estimations by the authors.

DEFINITIONS

1. **Energy Performance Certificate¹¹** or EPC means a certificate recognised by a Member State or by legal person designated by it, which indicates the energy performance of a building or building unit, calculated according to a methodology adopted in accordance with Article 3 of Directive 2010/31/EU.
2. **Energy certification¹²** refers to a number of procedures enabling to produce an energy certificate
3. **Building¹¹** means a roofed construction having walls, for which energy is used to condition the indoor climate;
4. **Energy Performance of a building¹¹** means the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting;
5. **Building unit¹¹** means a section, floor or apartment within a building which is designed or altered to be used separately;
6. **Building element¹¹** means a technical building system or an element of the building envelope;
7. **Energy class¹²** is easy to understand metric (e.g. A to G) for indicating the energy performance of a building;
8. **Energy performance requirement¹²** means minimum level of energy performance that is to be achieved to obtain a right or an advantage: e.g. right to build, lower interest rate, quality label;
9. **Calculated energy rating¹²** is energy rating based on calculations of the weighted net delivered energy used annually by a building for heating, cooling, ventilation, domestic hot water and lighting.
NOTE: National bodies can decide whether other energy uses resulting from occupants' activities such as cooking, production, laundering, computer equipment etc. are included or not. If included, standard input data needs to be provided for the various types of building and uses. Lighting is always included except (by decision of national bodies) for residential buildings;
10. **Measured energy rating¹²** means energy rating based on measured amounts of delivered and exported energy.
NOTE 1: The measured rating is the weighted sum of all energy carriers used by a building, as measured by meters or other means. It is a measure of the in-use performance of a building. This is particularly relevant to certification of actual energy performance.
NOTE 1: Also known as "operational rating".
11. **Primary energy¹¹** means energy from renewable and non-renewable sources which has not undergone any conversion or transformation process;
12. **Delivered energy¹²** refers to expressed per energy carrier, supplied to the technical building system through the system boundary, to satisfy the uses taken into account (heating, cooling, ventilation, domestic hot water, lighting, appliances etc.) or to produce electricity
NOTE 1: For active solar and wind energy systems the incident solar radiation on solar panels or on solar collectors or the kinetic energy of wind is not part of the energy balance of the building. It is decided at national level whether or not renewable energy produced on site is part of the delivered energy.
NOTE 2: Delivered energy can be calculated for defined energy uses or it can be measured.
13. **Building envelope¹³** means the integrated elements of a building which separate its interior from the outdoor environment;

11 Source: Directive 2010/31/EU of 19.05.2010 on the energy performance of buildings – recast

12 Source: CEN standard - EN 15217 "Energy performance of buildings – "Methods for expressing energy performance and for the energy certification of buildings"

13 Source: IUPAC International Union of Pure and Applied Chemistry - Compendium of Chemical Terminology 2nd Edition (1997)

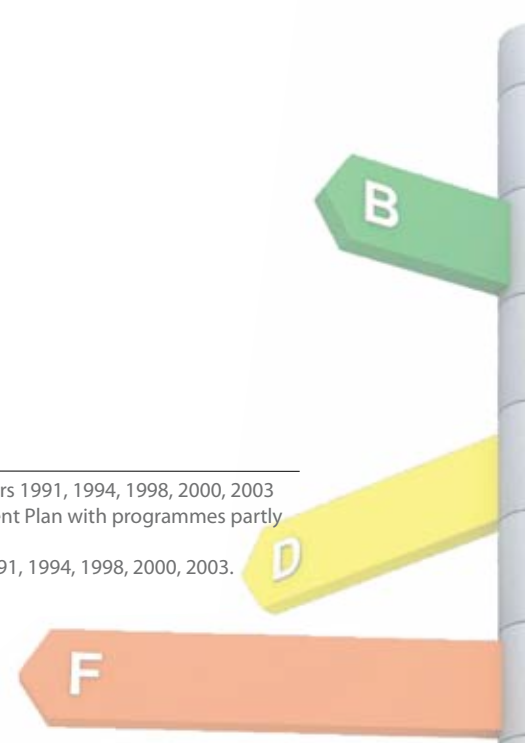
- 14 **Reproducibility**¹⁴ is the closeness of agreement between independent results obtained with the same method on identical test material but under different conditions (different operators, different apparatus, different laboratories and/or after different intervals of time). The measure of reproducibility is the standard deviation qualified with the term 'reproducibility' as reproducibility standard deviation.
- In some contexts reproducibility may be defined as the value below which the absolute difference between two single test results on identical material obtained under the above conditions may be expected to lie with a specified probability.
- Note that a complete statement of reproducibility requires specification of the experimental conditions which differ.
- 15 **U-Value**¹⁵ is the measure of the rate of heat loss through a material. Thus in all aspects of home design one should strive for the lowest U-Values possible because the lower the U-value – the less heat that is needlessly escaping. The calculation of U-values can be rather complex - it is measured as the amount of heat lost through a one square meter of the material for every degree difference in temperature either side of the material. It is indicated in units of Watts per Meter Squared per Degree Kelvin or W/m^2K .
- 16 **Thermal conductivity (specific)**¹⁶ is a measure of the ability of a substance to conduct heat, determined by the rate of heat flow normally through an area in the substance divided by the area and by minus the component of the temperature gradient in the direction of flow: measured in watts per metre per kelvin. Symbol is λ , k , sometimes shortened to conductivity.
- 17 **Surface-area-to-volume ratio**¹⁷ is the ratio of the heat-emitting envelope (A) to the heated volume (V) (the so called A/V ratio). The smaller the surface-area-to-volume ratio, the less is the specific energy required per m^3 heated room by identical conditions. The smallest surface-area-to-volume ratio has a spherical object, followed by a cube.
- Typical surface-area-to-volume ratios are:
- Detached single-family homes 0.7 to over 1.0
 - Semi-detached houses from 0.6 to 0.9
 - Townhouses from 0.4 to 0.6
 - Multi-family homes from 0.3-0.5
- The surface-area-to-volume ratio depends primary from the absolute size and secondary from the form of the building. As a rough guide, applies to build structures with a large volume.

14 Source: Collins English Dictionary – Complete and Unabridged © HarperCollins Publishers 1991, 1994, 1998, 2000, 2003

15 Source: Irish Energy Centre - Funded by the Government under the National Development Plan with programmes partly financed by the European Union.

16 Source: Collins English Dictionary - Complete unabridged © HarperCollins Publishers 1991, 1994, 1998, 2000, 2003.

17 Source: Baunetz Wissen; Das Online-Fachlexikon



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