International Energy Agency

Energy Performance Certification of Buildings

A policy tool to improve energy efficiency

Policy Pathway

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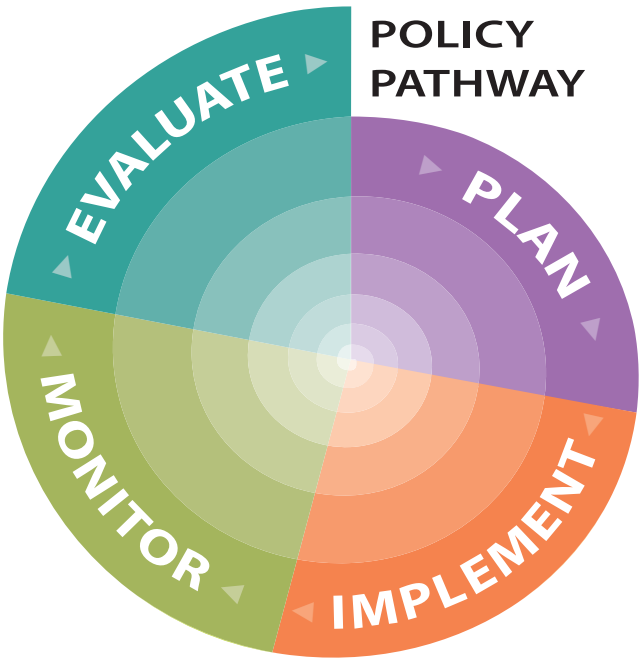
The IEA Policy Pathway series

Policy Pathway publications provide details on how to implement specific recommendations drawn from the IEA's 25 Energy Efficiency Policy Recommendations. Based on direct experience, published research, expert workshops and best-practice country case studies, the series aims to provide guidance to all countries on the essential steps and milestones in implementing specific energy efficiency policies.



The Policy Pathways series is designed for policy makers at all levels of government and other relevant stakeholders who seek practical ways to develop, support, monitor or modify energy efficiency policies in their home country and abroad. The Pathways can also provide insight into the types of policies best adapted to the specific policy context(s) of different countries, so that each country derives the maximum benefit from energy efficiency improvements.

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The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy.

The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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Executive summary

Buildings currently account for 40% of energy use in most countries, putting them among the largest end-use sectors. The International Energy Agency (IEA) has identified the building sector as one of the most cost-effective sectors for reducing energy consumption, with estimated possible energy savings of 1 509 million tonnes of oil equivalent (Mtoe) by 2050. Moreover, by reducing overall energy demand, improving energy efficiency in buildings can significantly reduce carbon dioxide (CO_2) emissions from the building sector, translating to possible mitigation of 12.6 gigatonnes (Gt) of CO_2 emissions by 2050 (IEA, 2010).

The Policy Pathway series aims to guide policy makers and relevant stakeholders on the essential steps in implementing policies that reflect the **IEA 25 Energy Efficiency Recommendations**. This specific pathway focuses on best practice in implementing building energy certification programmes.

Energy performance certification is a key policy instrument that can assist governments in reducing energy consumption in buildings. It provides decision makers in the buildings industry and the property marketplace with objective information on a given building, either in relation to achieving a specified level of energy performance or in comparison to other similar buildings. As such, certification can help governments achieve national energy targets and enhance environmental, social and economic sustainability in the building sector. Often, certification is most successful when complemented with other initiatives that support energy efficiency.

Direct benefits associated with building certification schemes include: energy and CO_2 emissions reductions and broader environmental benefits; increased public awareness of energy and environmental issues; lower costs for users; and improved data on buildings, which can be used for future policy development to further improve energy efficiency in the building stock.

Certification can be applied to both new and existing buildings. Certification schemes can be mandatory, such as the European Union Energy Performance of Buildings Directive (European EPBD), or voluntary, such as Energy Smart or ENERGY STAR. The certificates usually take one of two forms: a positive label demonstrates whether a building meets a specified standard (such as the Passive House Standard); a comparative label allows comparison with other buildings (such as the HERS Index and many European certification schemes). Comparative certification of existing buildings often includes advice on how to improve energy efficiency to obtain a better energy rating.

Delivery of a robust, accurate and cost-efficient certification scheme depends on many supporting mechanisms including: validated assessment procedures; training for assessors; quality assurance procedures; and technology and administration systems to co-ordinate and maintain these functions.

The introduction and recent amendments to the European EPBD demonstrate growing recognition among the policy community of the importance of energy efficiency in the building sector. It also provides a wealth of experience to draw from in European countries that have implemented, or are striving to implement, mandatory buildings energy certification. This pathway provides case studies and expert comments to demonstrate how two countries (Ireland and Portugal) have successfully implemented energy certification schemes and highlights lessons learned from the long-running Danish certification scheme.

This policy pathway couples the EPBD experience with that of other countries (including Australia, Singapore and the United States) that have implemented voluntary energy and environmental building certification schemes to map key elements and milestones (*i.e.* the pathway) in developing certification schemes.

Governments should, as stated in the IEA 25 recommendations, implement robust and ambitious energy performance schemes for buildings as a mean of improving energy efficiency and realising cost-effect energy savings.

This publication proposes a pathway comprising the following four stages and ten critical elements that support the development and implementation of energy certification schemes for buildings:

- **Plan:** define the terms of reference for the energy performance certification scheme, and develop an appropriate policy framework and action plan; engage multiple actors, allocate sufficient resources and communicate often with all stakeholders.
- **Implement:** provide for training and support to ensure well-qualified building assessors; raise awareness of the scheme in industry and among the public; ensure efficient operation of systems for central collection, review and dissemination of data.
- **Monitor:** establish quality control mechanisms to monitor performance of the certification scheme and of the assessors (and provide support for assessors); communicate results and outcomes openly to relevant stakeholders.
- **Evaluate:** analyse whether the certification scheme is achieving established goals and adjust scheme or systems as needed to increase impact; consider expanding the scheme to include environmental issues and assess its effectiveness in relation to supporting (and being supported by) other policy measures.

A key lesson from all implementing countries is the need to ensure that energy certification schemes are adaptable enough to evolve with expected and unanticipated developments in the future. The policy pathway action checklist (Table ES1) outlines the four main stages and ten critical steps for countries embarking on the energy certification for buildings process. Choosing the pathway carefully and being realistic about timescales are critical to the successful implementation and future development of a robust and sustainable buildings certification scheme.

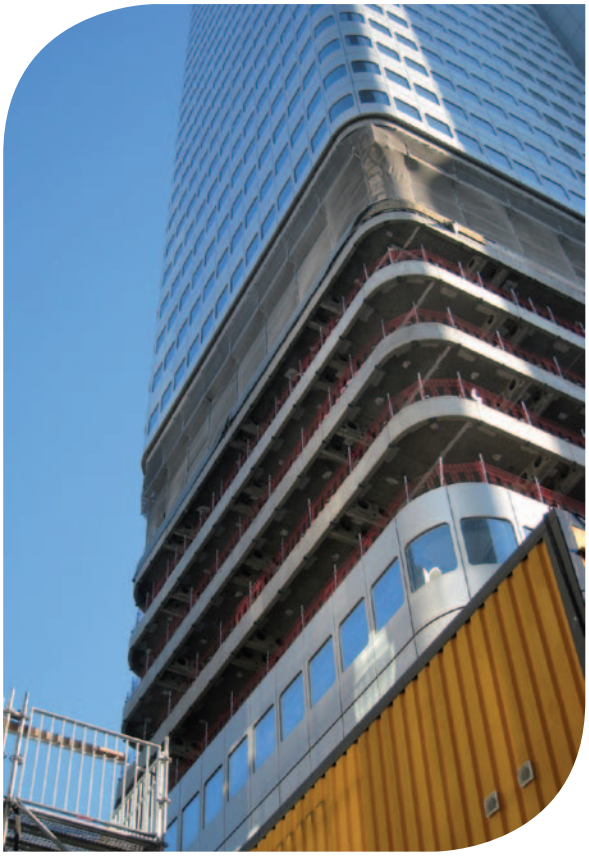
Table ES1 Policy pathway action checklist for energy performance certification of buildings

		DONE
PLAN	1 Define the terms of reference	○
	2 Establish the policy framework and action plan	○
	3 Secure the necessary resources	○
IMPLEMENT	4 Provide for training	○
	5 Raise awareness	○
	6 Collect, review and disseminate data	○
MONITOR	7 Assess quality and compliance	○
	8 Communicate the results openly	○
EVALUATE	9 Evaluate the scheme continuously	○
	10 Adapt the scheme as needed	○

Introduction

The building sector can play a critical role in achieving the transition to a low-carbon economy. At the UN Framework Convention on Climate Change (Copenhagen, December 2009), more than 100 countries associated themselves with the Copenhagen Accords, which set the objective of holding "the increase in global temperature below two degrees Celsius". This implies reducing global CO_2 emissions by 50% by 2050. According to the *World Energy Outlook 2009* (IEA, 2009) energy efficiency in end use needs to deliver 52% of the reduction in the short to medium term – and buildings must deliver a large part of this reduction.

Energy certification of buildings is a key policy instrument for reducing the energy consumption and improving the energy performance of new and existing buildings.



This policy pathway documents the elements, steps and milestones (*i.e.* the pathway) necessary to successfully implement energy certification of buildings. Its aim is to help countries implement effective programmes within the context of their national policy frameworks by offering advice and opportunities to benefit from the experience of others.

While the focus, methodology, application, output and impact of certification may differ for new and for existing buildings, both require robust, transparent procedures that are accurate, reproducible and cost-effective:

- **For new buildings**, energy certification can demonstrate compliance with national building energy regulations and provide an incentive for achieving a better standard compared with buildings of the same type.
- **For existing buildings**, energy certification attests to the energy performance of the building, and provides information that may increase demand for more efficient buildings, thereby helping to improve the energy efficiency of the building stock in the country.

Providing owners and occupiers with a certificate of the building's energy efficiency performance is increasingly viewed as a means of transforming real estate markets. If prospective purchasers and tenants come to regard an energy certificate as important to their decision making, building owners will have greater incentive to improve the energy efficiency of buildings.

What is energy performance certification of buildings?

Energy performance certification provides a means of rating individual buildings – whether they be residential, commercial or public – on how efficient (or inefficient) they are in relation to the amount of energy needed to provide users with expected degrees of comfort and functionality. The degree of efficiency depends on many factors including: local climate; the design of the building; construction methods and materials; systems installed to provide heating, ventilation, air condition or hot sanitary water; and the appliances and equipment needed to support the functions of the building and its users.

Clearly, certification is a complex procedure, requiring in-depth knowledge of building components. It also reflects increasing recognition of the need to think of buildings as "integrated systems", rather than simply the sum of their parts.

Energy certification of buildings typically involves three main steps:

- The **assessment of the energy performance** of a building by a competent assessor using a nominated methodology.
- The **issuance of a certificate** rating the building's energy performance which includes, in some cases, information on possible improvements likely to yield energy savings.
- The **communication of this information** to stakeholders through publication of the certificate.

Certification is often used in connection with the completion of new buildings as a means of demonstrating compliance with building codes. In the case of existing buildings, certification is used to compare similar buildings and to assess the degree to which an older building falls short of codes that have been introduced since the time of its construction. As much of the existing building stock was built before energy efficiency became a focus of government policy, certification of existing buildings can do more than provide ratings: it can identify measures to improve energy performance (Arkesteijn and van Dijk, 2010).

Energy performance certificates are valuable to all stakeholders in the building sector. They provide a mechanism by which prospective buyers and tenants can compare the energy efficiency of different buildings or the energy rating across a range of similar buildings. Certification also compares existing buildings to recent building codes, providing a way to compare existing and new buildings. In this regard, certificates are often considered a valuable piece of information at the time consumers are making decisions on property purchases or rentals for either new or existing buildings. But certificates can also be valuable to sellers and property owners: buyers/renters might be attracted by the opportunity to save on energy bills by purchasing or renting a more efficient building. Or, they may opt to purchase/rent a less expensive building, knowing in advance that it is less efficient but can be improved through upgrades identified on the certificate.

Energy performance assessment

In order to prepare an energy certificate, it is first necessary to undertake an energy performance assessment of the building's characteristics and systems. This is carried out by a qualified assessor who collects information on the building's characteristics and components, as well as its energy systems and energy consumption. An assessment generally includes, as a minimum, an analysis of:

- The form, area and other details of the building.
- The thermal, solar and daylight properties of the building envelope and its air permeability.
- Space heating installation and hot water supply, including their efficiency, responsiveness and controls.
- Ventilation, air-conditioning systems and controls, and fixed lighting.
- Fuel and renewable energy sources.

Other elements, such as lighting systems and installed equipment and appliances, may also be included in the assessment (Arkesteijn and van Dijk, 2010).

This information is input into an authorised calculation model that assesses the building's energy consumption under local climatic conditions. The energy assessor submits the assessment and results to a centralised system, which completes an automatic check of the assessment outputs and provides the certificate (either electronically or in paper form). If the system is administered by government agencies or local authorities, it typically includes a quality check. With this approach, the certificate is issued by a centralised administration system that can attest to the effectiveness of the certification scheme. This helps to build stakeholder confidence and enhances the reputation of the certificate.

An energy performance calculation method is central to certification. Common standards have been developed to support harmonisation in Europe (through the European Committee for Standardisation [CEN]) and in North America through the Residential Energy Services Network (RESNET) programme. These programmes also reflect international standards contained in the International Energy Conservation Code (IECC), those of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and those developed by the International Organisation for Standardisation (ISO). All of these standardisation efforts seek to provide guidance on comparability and transparency of certification schemes.

Assessment methodologies generally use software tools to calculate energy performance and ratings, which will often be based on annual energy use in specific terms, such as the number of kilowatt hours used per square metre ($kWh/m^2/year$) or the British thermal units used per square foot ($BTU/ft^2/$ year). They may also measure related CO_2 emissions, measured in kilograms of CO_2 per square metre ($kgCO_2/m^2/year$). Software tools may be developed as part of a national scheme (*e.g.* as has been done in Ireland and Portugal) or may be developed commercially (*e.g.* RESNET in the United States). Such software ensures the quality of the certification as it facilitates standardised calculations, allows internal checking mechanisms to minimise input or registration errors, and reduces time inputting repetitive data (through the use of default values or by storing information on typical building components and systems). A comprehensive software system can also help provide recommendations for upgrading the building to improve efficiency (Maldonado *et al.*, 2008).

Issuance of building certificates

Building certificates may be issued for new and existing buildings. The timing of issuance is important because it can determine the effectiveness of the certification and its potential to have a positive impact on the building's energy performance level.

Another factor that influences the impact of certification is whether the scheme is voluntary or mandatory. Voluntary certification is often considered a type of "positive branding" for builders that are keen to "advertise" the high level of energy performance their buildings achieve. But as builders achieving lower performance buildings will not "opt in", voluntary schemes tend to identify only the most efficient buildings. In contrast, mandatory schemes applied to a maximum number of buildings help to identify the most inefficient buildings – and often provide advice on how to improve energy ratings.

In this regard, mandatory schemes will have the largest impact on the building sector and deliver the largest energy savings and CO_2 reductions. The drawback is that, being much more complex, mandatory schemes are usually more costly to implement and operate.

Certification of new buildings

Many countries require building certificates at the time of construction as a means of ensuring compliance with building codes and standards, and to promote more energy efficient buildings than basic codes or standards. Examples such as the BCA Green Mark (Singapore) and ENERGY STAR (United States), illustrate energy rating schemes that document higher performance buildings (Box 1).

Box 1

Certificates highlight buildings that surpass minimum standards

Energy stars are used in labelling scheme to illustrate the energy efficiency of homes in Australia and of all buildings in China. The rating is straightforward: more stars mean greater efficiency.

Building codes in Australia are set by the regional governments, but these governments agreed to a national minimum standard of at least five stars for all new buildings. In 2010, the governments adopted a six-star building rating as the new standard. Buildings with energy performance levels that surpass minimum building code requirements can obtain more than six stars. In this way, the stars were used to drive energy efficiency in the development of building requirements. Australian energy stars in building certification are similar to the energy labelling of windows or appliances, which makes the scheme easily identifiable to consumers.

In China, a new star system is being developed primarily for public buildings; one star will show compliance with the existing building code, but up to five stars can be awarded to buildings that exceed the energy performance required in the standard building code.

Both of these star systems can be used to strengthen future building codes.

Sources: Department of Climate Change and Energy Efficiency, Australia; Chinese Academy of Building Research.

Designing for energy efficiency – at the earliest possible stage of the design process – is the most cost-effective means of improving energy performance in buildings. Energy performance certification at this early stage can enable early detection of non-compliance with national building regulations and encourage the achievement of higher standards while such changes are least expensive. Once construction is complete, energy certification can be used to verify final compliance with building codes and standards, and record accurate energy performance as constructed. The possibility of directly affecting energy efficiency is reduced at the completion stage, and improvements could become quite costly to implement. However, knowledge of post-construction certification has an indirect impact in that it forces consideration of energy efficiency issues in the upstream design stage.

Despite the additional costs associated with a two-step process, certification should optimally be applied both at the design stage (to influence construction) and upon completion (to increase compliance and record actual performance). Some countries (*e.g.* Denmark and Portugal) have implemented schemes that combine self-assessment by the owner/architects at the project phase with independent assessment(s) following construction. Other countries (such as Sweden) require re-assessments of actual consumption after two years.

European certificates – in compliance with the European EPBD requirement to certify new buildings – are designed to illustrate performance that surpasses building codes and standards. The building rating includes A, A1 and A2 (or A+ and A++) to indicate buildings that exceed the minimum energy standard in building codes.

Certification of existing buildings

Energy certification can also be applied to existing buildings. This is a significant tool for improving the overall efficiency of the entire building stock. As buildings have long life spans, turnover is low and it will take a long time before new building codes, policies and certification schemes for new buildings have any significant impact on the building stock as a whole. For existing buildings, certification and particularly the advice on options to improve energy performance help to raise awareness of energy efficiency opportunities when renovating and/or refurbishing. This is, after design, the most cost-effective time to implement energy efficiency upgrades.

Box 2

The special case of multi-dwelling buildings

In multi-dwelling buildings, energy performance implies two aspects: the building as a whole and each individual apartment/unit must be assessed to calculate energy consumption and payment of costs. Yet both consumption and costs of individual units depend on the building design, the energy supply system and the cost-sharing system. Units adjacent to the roof and gables will have higher energy losses than units in the centre of the building, and may have higher energy costs. In some cases, however, energy costs are shared equally by all occupants regardless of the actual gains or losses of the individual unit.

Often, decisions for energy improvements require unanimous agreement by all stakeholders in the building. In such cases, decisions can best be influenced by a single certificate for the whole building, and a vendor or landlord will tend to provide only one certificate for the whole building to the prospective buyer or tenant. However, an individual renter would be more interested in the implications for his/her individual apartment, and energy certification of individual units would have greater impact on the decision to rent or buy. For these reasons, certification of multi-unit buildings should include information on both the entire building and on individual apartments/units.

Energy certificates for existing buildings are often required for the sale or lease of buildings or apartments, most commonly when a contract for a sale or letting agreement is completed. However, a certificate provided by a vendor or landlord much earlier on, at the advertising stage, has greater visibility and impact, and can significantly influence the sale price or purchase decision. The recent recast of the European EPBD stipulates, for example, that certificates must be delivered at the time of advertising the building. Multi-dwelling buildings require different treatment to single dwelling buildings (Box 2).

Asset versus operational rating

In general, two types of rating are used for building certification: **asset rating** is based on data derived from building inspection or drawings and building specifications; **an operational rating** uses metered data of actual energy consumption. Asset ratings are seen to be most appropriate for new buildings and buildings in which there is frequent change of users, as the rating is independent of users and can be assessed before occupation. An operational rating is more effective for buildings that have less frequent user turnover, and for large and complex buildings.

Ratings can be calculated on the basis of on-site energy use, primary energy consumption or related CO_2 emissions. Energy scales based on primary energy have the advantage of being a sound basis for the evaluation of cost and CO_2 emissions. Rating systems for buildings can have a different focus for new, existing, residential or non-residential buildings.

Almost all countries in the European Union have implemented an asset rating (based on calculated energy) for new and small, existing non-public buildings. Most countries have chosen operational rating for large and complex non-residential buildings, and for the regular rating of public buildings.

As buildings and users change over time, most certification schemes have a limited timeframe for the certificate's validity. In Europe, according to the EPBD, the certificate can be valid for a maximum of ten years if no significant changes occur within that period. Some countries have opted for shorter periods, typically between five and ten years.

Communicating through energy performance labels

Energy certificates display the calculated outputs of the energy assessment, thereby providing key information for all stakeholders for a given building. Certificates need a simple, straightforward layout to ensure clarity, ease of use and comparability for all users; indeed, they must be understood by experts and by non-technical building owners, buyers and tenants. The certification should nonetheless provide sufficient detail from the energy assessment and appropriate information upgrading for owners and building managers. Many certificates provide a block of essential information that includes building size and energy consumption to facilitate quick comparison of certificates.

Certificates generally provide information in one of two forms. A **comparative label** provides information on this particular building's ranking compared with similar buildings. A **positive** or **endorsement label** distinguishes a certified building that fulfils a specific standard (*e.g.* ENERGY STAR and Passive house) from non-certified buildings.

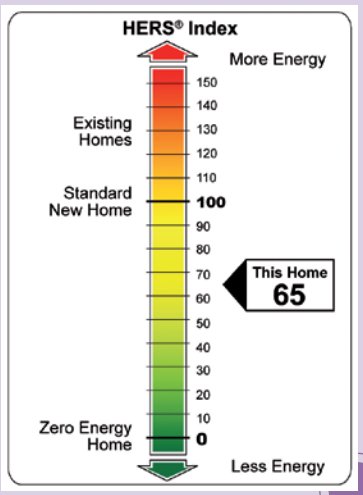
Certificates for buildings can be strengthened by incorporating other and perhaps government-endorsed regulatory schemes or by referring to well-known standards. For example, the comparative A to G labelling, often associated with white goods and products, is also used for buildings in Europe while Australia uses energy stars for buildings and for building components and appliances. In the United States, the Home Energy Rating System (HERS) index uses a comparative label, with the 2006 IECC as the basis for the scale (Box 3).

The actual scale for comparative certification should reflect the desired outcome. A linear scale that reflects national building standards as a "C" grade offers plenty of scope to improve the score for both new and existing buildings (O'Rourke, 2010). However, many countries in Europe have increased the scale to include A1, A2 or A+, A++ or A- since the previous "A" boundary was found to be too limiting to reflect very efficient new buildings.

Box 3

Comparative labelling: The US RESNET scheme

The HERS index is a voluntary certification scheme developed by RESNET. Buildings are rated based on their actual energy performance calculated by the complex RESNET certification standards. The scheme uses a comparative label on which buildings conforming to the 2006 IECC are rated 100 on the scale, while 0 represents the energy performance of a zero-energy building. Buildings that are 20% better than the 2006 IECC are rated as HERS 80. At present, most existing buildings score over 100, as typically they use more energy than new buildings. Although the HERS index is a voluntary scheme, some states (such as California) have made HERS certification mandatory.



HERS index from United States

Source: RESNET.

Positive or endorsement labelling involves issuing certificates to buildings that have met a specified standard, generally above the minimum requirement of building standards and codes. This certification usually helps inform the market about this relatively better energy performance (see examples in Box 4).

Box 4

Positive labelling: Energy Smart, BCA Green Mark and ENERGY STAR

In Singapore, a certification scheme called Energy Smart is used to rate the energy performance of commercial buildings. This system was developed for offices, hotels and shopping malls. By the use of Energy Smart, the owner of a building can assess the efficiency of the building with general industry standards and with other offices, hotels or shopping malls. Only 25% of the best buildings in each category are awarded a smart label, and each year, an award is given to the most energy-smart building. This is a voluntary positive labelling scheme: the benefit is the label itself and it can be used in the branding of companies.
The certification is undertaken with an Energy Smart Tool developed by the Energy Sustainability Unit (ESU) at the National University of Singapore and the National Environment Agency of Singapore.

Another positive label in Singapore is BCA Green Mark, which was developed by the Building and Construction Authority (BCA) and is supported by the National Environment Agency. This positive label can be applied to both residential and commercial buildings, with a special version for existing buildings. The main criteria of BCA Green Mark include energy and water use, indoor air quality and other types of environmental impacts.

Singapore Energy Smart Standards and BCA Green Mark scheme

An additional example of a positive energy label is the ENERGY STAR scheme developed by the United States Department of Energy (DOE). This is awarded to new buildings with energy performance at least 15% better than the 2006 IEEC code (equivalent to 85 on the HERS index). Although the use of ENERGY STAR is voluntary and has been declining, it has been connected with subsidies and tax exemptions, and has played an important role in transforming energy markets towards higher energy efficiency in the United States.

ENERGY STAR for Buildings (United States)

Sources: Singapore Building and Construction Authority – BCA (BCA Green Mark) and Centre for Total Building Performance, Singapore; and US Department of Energy (US DOE).

Energy certificates can provide a range of information on the building's energy performance along with the rating itself, including recommendations to improve energy efficiency (Box 5). This can be an important source of advice to building owners regarding cost, payback periods and benefits of upgrading the building to achieve a better rating. This can include measures to upgrade the building envelope elements, and enhance the efficiency of space and water heating, ventilation, lighting and air-conditioning systems and controls.

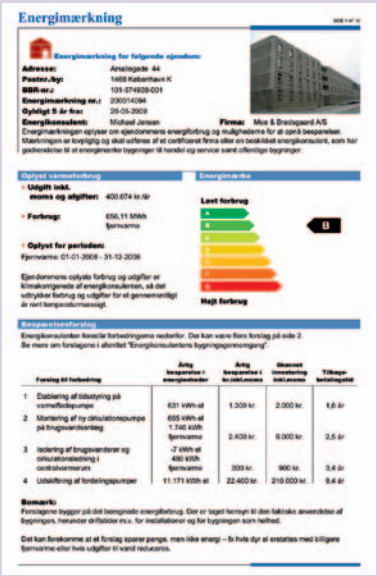
Normally it is not mandatory to implement the recommended measures. This is a key challenge associated with certification as there is no guarantee that building owners will act on the information provided on energy consumption and possible improvements. Supporting initiatives or incentives may be offered to prompt action.

Mandatory implementation can increase the impact of certification considerably, but may be difficult to implement for budgetary or political reasons; it could, for example, be seen as public/government interference in private ownership. Even so, some countries stipulate that these measures must be implemented within specific timescales, particularly in the case of public buildings (Papadopoulou *et al.*, 2009).

Box 5

Information on building upgrade

It is increasingly apparent that it is the advice on energy efficiency improvements, rather than a rating, that mobilises the market to deliver energy savings measures and to achieve reductions in the building sector carbon emissions (ECEEE, 2009). The specificity of the information provided is important in determining whether the building owners implement the advice. The more specific the recommendation, the larger the impact – but the costs of the advice may be higher. If, for example, the recommendations are automatically generated by the assessment software, costs are reduced, but such recommendations would be less specific and accurate for the building, which weakens the impact of the advice. More specific advice provided by a building professional is more expensive but is more likely to provide appropriate cost-optimal solutions and relevant details to motivate the building owner to undertake the upgrading measures.



Danish energy label for buildings including advice on improvements

Source: Danish Energy Agency.

Why is energy certification of buildings important?

Improving energy efficiency in buildings is one of the most cost-effective ways across all sectors to reduce energy consumption and hence greenhouse gas emissions. Energy certification increases awareness of energy consumption and enables consumers to compare buildings, thereby providing builders with an incentive to improve energy efficiency in buildings. In many cases, certification and implementation of the identified savings do not present any net, long-term economic cost to the owner, as the savings outweigh the costs of the investments. A key challenge, however, is that consumers tend to focus on short-term costs rather than long-term value (*i.e.* focus is on the incremental capital costs), and do not seize opportunities to improve efficiency that might require a pay-back time that exceeds what they would perceive as a good return on their investment.

Thus, certification is an important policy intervention that can help raise awareness of energy consumption and also address the market failures that cause sub-optimal uptake of energy efficiency in buildings. Certification and complementary measures can address these issues.

While certification schemes can be expensive to establish and administer, the decision on whether to proceed with a certification scheme should be based on sound analysis of the costs versus the benefits in terms of reduced CO_2 emissions, reduction in fuel poverty, increased comfort and health, etc. Certification schemes should be designed so that the benefits clearly outweigh the costs. As demonstrated in the annexed case studies on Ireland and Portugal, cost-effective and innovative certification schemes can be developed.

Raising awareness of energy consumption

Higher visibility of building energy efficiency brought about by certification can have an impact on market trends. Experience from the United States shows that energy efficient commercial buildings often command higher prices when sold or let, if this information is communicated with a certificate such as ENERGY STAR. By contrast, it has been more difficult to document the direct impact of certification in the residential sector. Other experiences show that individual building owners or renters might have a larger need for incentives to act on certification than professional owners of buildings (landlords).

Certification helps landlords and building users to become more aware of the impact of building performance on running costs and comfort and the necessity to rationalise energy usage in buildings. Within the construction industry there has been a shift towards more energy efficient design, better construction practices, increased integration of energy efficient components, and renewable technologies (Papadopoulou *et al.*, 2009). Certification of new buildings can support this process by raising awareness of the energy implications of building design or to ensure compliance with building codes.

This is important, as many cost-effective energy efficiency opportunities are available at the time of design and construction.

Buildings certification also leads to increased awareness of energy performance in buildings among the public. Under the European EPBD scheme, large buildings occupied by public authorities and institutions providing public services must display in a prominent place operational energy use on the building certificate to promote public awareness of energy efficiency (Olloqui, 2008).

Addressing market failures

As a policy instrument, energy certification addresses two critical market failures in the building sector**: incomplete information** and **the split-incentive problem**. Incomplete information refers to the situation in which insufficient, inaccurate or untrustworthy information leads building owners and users to under-invest in energy efficiency. Energy certification schemes help to increase the awareness of energy efficiency opportunities by providing building owners, purchasers and tenants with relevant information at a time when investment decisions are being made. This information can include estimates of the costs and benefits of energy efficiency investments in the property.

Split incentives occur when market actors have different goals or incentives, which may lead to less investment in energy efficiency than could otherwise have been made (IEA, 2007).

A classic example is the landlord/tenant problem, where the landlord provides the tenant with a building or apartment, but the tenant is responsible for paying the energy bills. In this case, landlords and tenants face different goals: the landlord typically wants to minimise the capital cost of the building (with little regard for energy efficiency), and the tenant wants to maximise the building's energy efficiency to save on energy costs.

Split incentives also occur in the property ownership market, where many homeowners and businesses have limited incentive to invest in efficiency measures because they do not expect to stay in their building long enough to realise the payback from investments in energy efficiency. Energy certification of buildings can help to address the split-incentive problem by encouraging builders and building owners to consider energy efficient solutions, even though they would not otherwise gain by doing so.

Box 6 The European Union takes action on energy performance

On 16 December 2002, the European Union adopted the Energy Performance of Buildings Directive (EPBD), which sets four key energy efficiency requirements for buildings, in an attempt to establish a truly integrated approach:

- *A common methodology for calculating the integrated energy performance of buildings.*
- *Minimum standards on the energy performance of new buildings and large existing buildings that are subject to major renovation.*
- *Systems for the energy certification of new and existing buildings and, for public buildings, prominent display of this certification and other relevant information. Certificates must be less than five years old.*
- *Regular inspection of boilers and central air-conditioning systems in buildings and in addition an assessment of heating installations in which the boilers are more than 15 years old.*

*Member states were given three years (to 2006) to transpose these requirements into national legislation, but were allowed three additional years (to 2009) if they demonstrated a lack of qualified experts. According to the directive, energy performance certificates must be made available when buildings are constructed, sold or rented out (*i.e. *when potential buyers or tenants need to make informed decisions). Large public buildings must be certified regularly at least once every 10 years. The directive specifically mentions rented buildings with the aim of ensuring that the owner, who does not normally pay the charges for energy expenditure, should take the necessary action.*

A recent recast (adopted on 19 May 2010) broadened the scope of the directive by demanding, for example, that all existing buildings undergoing major renovation should meet certain energy efficiency criteria (the original directive set this demand only for buildings larger than 1 000 m^2). It also stipulates that certification must be based on life-cycle analyses. The recast calls on the public sector to be a leading example in investing in energy efficiency in buildings: it states that, by 2018, all new public buildings must be near zero energy and all existing public buildings over 500 m^2 must be certified and display certificates (from 2015 this demand will cover all public buildings of more than 250 m^2). Member states must ensure all new buildings are close to zero energy in 2020, and must launch new financing schemes to overcome investment barriers.

Both the original directive and the recast aim to overcome some of the market barriers and failures for energy efficiency by ensuring that decision makers have access to information and by providing incentives to improve energy efficiency in both new and existing buildings. The recast demands that certificates be shown at the time of advertising a building for sale or rental, rather than at the time of signing a purchase or lease agreement, as was previously stipulated. The impact of certification is supported by other legislation, and certification helps to ensure higher compliance with building regulations for new buildings.

The directive forms part of the European Community initiatives on climate change, recognising that the Community can have little influence on energy supply but can influence energy demand. One possible solution is to reduce energy consumption by improving energy efficiency. The recast specifically notes that more energy efficient buildings provide better living conditions and saves money for all citizens. It estimates the additional savings from the recast of 60 Mtoe to 80 Mtoe in 2020, or a 5% to 6% reduction in EU energy consumption (equal to the current consumption of Belgium and Romania) and 5% less CO_2 emissions.

The official names of these directives are:

- *Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.*
- *Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, (recast).*

Using complementary measures to increase impact

Analysis of existing schemes demonstrates the need for supporting measures to ensure that certification achieves its intended impact: it is often the case that simply providing information is not enough to prompt action.

The impact of energy performance certification of buildings can be increased when the scheme is part of a set of complementary measures, including energy requirements in building codes and financial incentives. For example, coupling certification with building codes, and including calculations that show potential energy saving when codes are exceeded, can provide builders with the incentive to incorporate energy efficiency measures into the design of new buildings or retrofit proposals for existing buildings. This can lead to embedding energy efficiency in project planning and realise energy savings at the most cost-effective times in the building cycle. In some cases, additional financial incentives may be needed to encourage the desired action. In a similar manner, certification can be used to identify the most cost-effective measures to implement under an incentive, thereby reinforcing and complementing incentive policies.

With a view to increasing the impact of the directive and of building certification, the recent recast of the EPBD requires that member states consider effective information actions, as well as financing and other instruments. Financial incentives would help to maximise the market follow through, notably by encouraging building owners to undertake energy efficiency retrofitting recommended in conjunction with energy performance certification (Box 7).

Some countries have already put in place such incentives. Ireland has a national grant scheme for energy retrofit and provides an additional certificate after the measure is completed. Other countries have made certification mandatory in order to obtain subsidies or tax exemption for energy saving measures.

Box 7

Examples of complementary policies to building energy certification

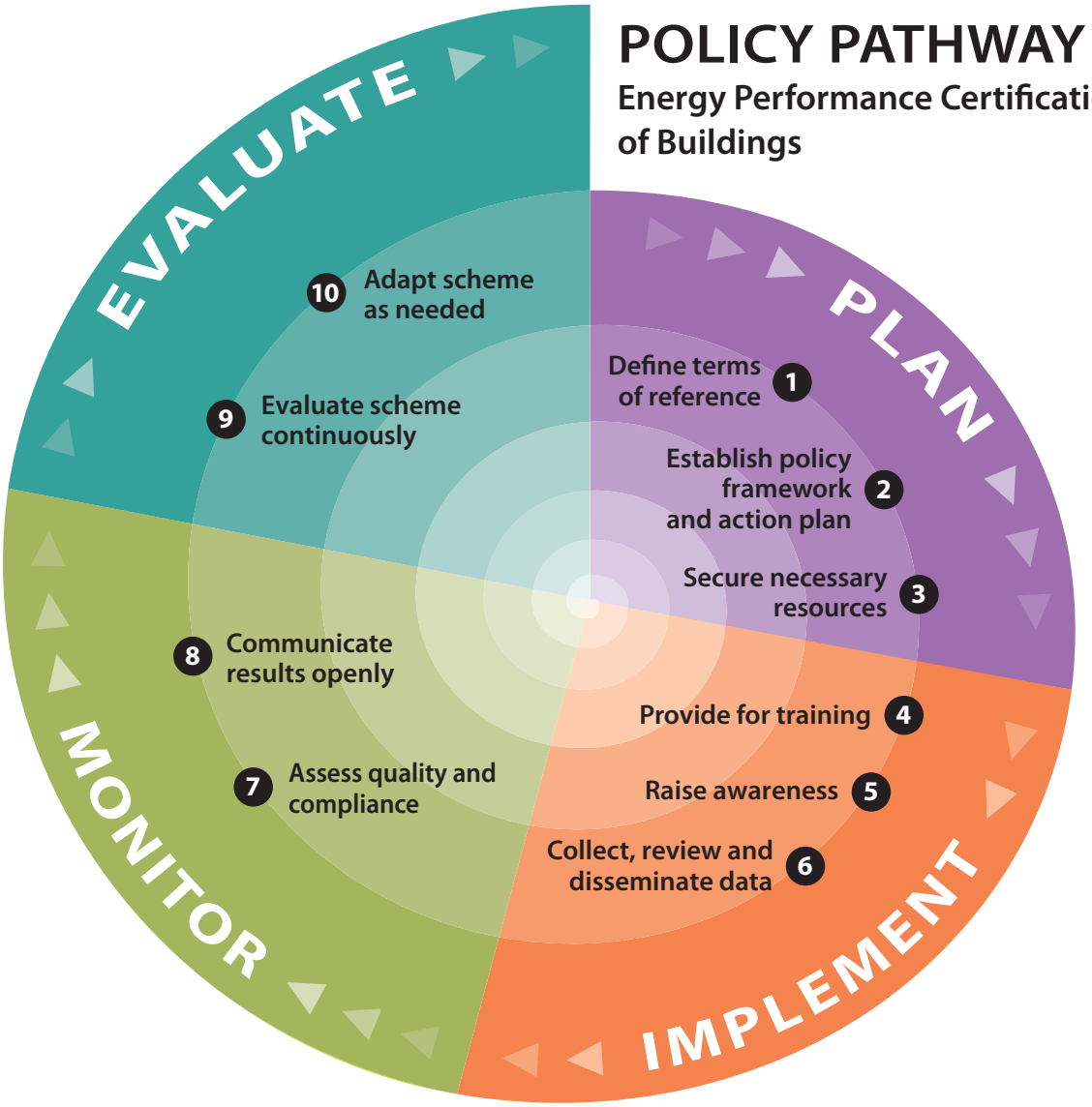
Research shows that supporting initiatives may be necessary to ensure the effectiveness of building energy certification schemes. A 2008 study (Hansen, 2008) that evaluated the Danish energy labelling scheme for existing single-family homes found that labelling alone did not necessarily lead to significantly lower energy consumption. The study evaluated building energy certificates under the previous Danish system, which was replaced by a new system in 2006, and further instruments to improve energy efficiency in existing buildings have since been implemented. "One of the lessons learned from our Danish study is that energy certification does not deliver alone, but that such systems need to be supported by other measures in order to become efficient", says Peter Bach from the Danish Energy Authority.

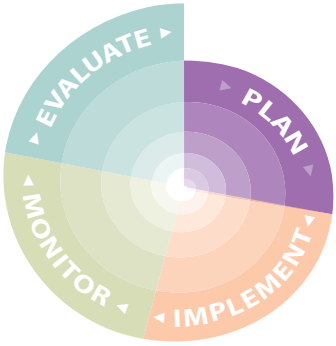
Similarly, a recent survey in the United Kingdom found that some home buyers do carry out improvements to their home within months of buying, and the measures undertaken do seem to be influenced by the certificate recommendations. The survey revealed that 32% of home buyers had undertaken some of the upgrading recommendations on the certificate, and a further 9% intended to implement some of the recommendations in the near future (NES, 2009). While this is positive, it leaves 60% of cases in which no measures were taken, indicating that many individuals did not respond to available information – and suggesting the need for complementary measures to spur action.

How to deliver effective energy certification: The policy pathway

The pathway to energy certification of buildings involves four stages – Plan, Implement, Monitor and Evaluate – under which fall ten critical steps. The approach outlined below is based on country experiences, and follows the decisions that paved the way for successful and cost-effective implementation. To date, most countries have opted to implement voluntary rather than mandatory building certification schemes. However, energy certification of buildings became mandatory in Europe in 2006 under the Energy Performance in Buildings Directive (EPBD), which aims to help improve energy performance and reduce associated CO_2 emissions.

The EPBD also requires all European member states to develop methodologies for energy certification for all buildings when sold or let (EU, 2002). Ireland and Portugal (see case studies) have fully implemented the requirements of the EPBD, both in spirit and in law, and are currently issuing energy performance certificates for new and existing buildings. These two countries are excellent examples of high-quality certification schemes that both provide an energy performance rating and contribute to increased awareness of low-energy building. These countries are using the certification scheme to transform the energy performance of their respective building stocks.





PLAN

1 *Define the terms of reference*

The manner in which a certification scheme is set up – together with the pathway necessary for its achievement – depends on its overall objectives. Defining the terms of reference, at the national level, will determine the implementation process and successful delivery. Well-defined schemes are not only easier to implement and control (Poel, 2009), but are more cost-effective. Experience from around the world illustrates the extent to which it is critical to properly define the certification scheme at the planning stage.

Define the objectives

Buildings certification can be used to compare the energy performance of similar buildings (at the time of sale, for instance) and to persuade owners or users to improve the building's energy consumption (by providing advice). It can also illustrate compliance with building codes and standards, or encourage energy efficient practices beyond the minimum standards. Ultimately, certification can help countries to achieve their energy and emission reduction goals. The objective(s) of the certification scheme will determine the assessment methods needed.

Determine the scope

Buildings differ greatly in design, construction and use, and they react differently to changed conditions. New buildings are not always similar to existing buildings and time of construction can have major impact on energy use, possible savings and need for energy management.

Certification must take into consideration the differences between new and existing buildings, between commercial, residential and public buildings, and between small and large buildings. Certification is a highly case-specific process, dependent upon the type of building, the individual circumstances of each building, and the building's ownership.

Certification of **new buildings** may help achieve greater compliance with strict building codes and standards, and can be used to promote higher performance than minimum standards. Certification of **existing buildings** may lead to improved energy efficiency of the building, if appropriate information on upgrading is given. Energy certification schemes can even facilitate comparison between new and existing buildings, which could also encourage greater energy efficiency in existing buildings.

Commercial buildings are diverse in their function, working patterns and equipment. This influences both energy consumption and the certification process. Public buildings are rarely sold on the open market, but can be required to display their certified energy consumption, making it possible for citizens to review and request greater energy efficiency from their public buildings. The European EPBD includes such requirements (Box 8).

Box 8

EPBD puts certificates in the public eye

The European EPBD includes a requirement to display an energy performance certificate in public buildings larger than 1 000 m^2 and stipulates that the certificate cannot be older than ten years. This is a means of ensuring that public buildings are assessed regularly. Some countries have chosen to extend the regulation to include public buildings less than 1 000 m^2 and commercial buildings, or to make the certificate valid for less than ten years. Denmark, for example, has made five-year certification mandatory for all buildings (public, commercial and residential) greater than 1 000 m^2.

Multi-dwelling buildings need careful consideration: the position of the individual unit (different floors with differing orientation and exposure) influences the unit's energy performance. Furthermore, energy costs for the occupant will depend on whether the energy supply is paid directly by the individual or the building syndicate as a whole. It must be decided whether certificates are issued to entire multi-dwelling buildings or to the individual units, or to both. This decision depends on who is meant to be influenced by certification – the landlord or tenant – and the manner in which the building's heat is distributed, and paid for, communally or individually.

Single-family houses generally are easier to certify from a technical point of view, but the costs of certification can be substantial in small buildings in comparison to possible energy savings or other results from the certification scheme and this is of particular concern for individual home owners. Efficient organisation and clever use of existing information (for example, creating a database that contains basic information on typical constructions and energy efficiency solutions, or providing access to registers on actual energy use from utility data) are essential to success in certification of private individual buildings.

Determine the method of assessment

An operational rating (also known as metered energy consumption) is appropriate for existing buildings that are large and complex, including both public and commercial buildings, in which change of users is infrequent and user behaviour is therefore quite stable. Operational rating is relatively simple, as it relies primarily on consumption data acquired from utilities. The main advantage of operational rating is that the certificate can document how efficiency upgrades or measures that influence user behaviour change the building's energy consumption patterns.

Metered consumption is, however, only reliable following about two years of building occupation when the building fabric, systems and users have acclimatised. These factors make it difficult to use metered consumption to rate new buildings (Box 9).

An asset rating (also known as a calculated energy rating) is appropriate for new buildings, for which metered data do not exist. Asset rating calculates energy use in relation to the characteristics and systems of the building itself, and is thus more useful than metered energy consumption in buildings that have frequent user changes (that also lead to frequent changes in energy patterns). An asset rating can be more useful for potential buyers and tenants of small buildings because they may have quite different needs and habits than the previous occupants; it is more useful for them to know about the building than about the past occupants.

Conservation of electricity in commercial buildings, particularly in relation to lighting, air cooling and ventilation, becomes more important as buildings become more energy efficient and the use of heating is reduced. (This is true even in cold climates.) Internal heat gains from electrical use for appliances and equipment influence cooling needs, particularly in warm climates, and should be included in the assessment for certification.

In very low-energy buildings, it also becomes more important to address the impact of appliances and other energy-using equipment, and to take a holistic approach when looking at energy use. Behavioural effects of building users can be significant and must also be addressed.

Decide whether to include other environmental issues

Some building certification schemes have extended their scope beyond energy performance to include assessment of a building's environmental values, measuring aspects such as the use of sustainable materials and components, land use, water use and waste handling.

Box 9

Operational vs. asset ratings in Denmark and across Europe

When implementing the European EPBD, Denmark took a decision to use asset rating (or calculated data) for all building types, both new and existing. For large and complex buildings, the government later switched to operational ratings because the costs to establish asset certification were seen to be too high relative to the benefits, particularly for those buildings that required regular certification.

Most European countries have chosen to use metered consumption in large public and commercial buildings when implementing the EPBD, but have applied asset (calculated) ratings for small, individually owned buildings and for all new buildings.

A key challenge in this regard is developing calculation methods that appropriately measure very different criteria, some of which are quantifiable (such as use of energy, land or water) and others that are more qualitative in nature (the types of materials used for the building construction and the processes used to produce them). Ideally, the calculation method would transform all aspects into metrics to derive a rating of the total performance of the building, which could then be compared against other buildings.

Environmental assessment as part of a building certification scheme offers substantial benefits in terms of reflecting the total impact of a building on the environment, which can increase the profile and impact of the certification scheme. However, it is much more difficult and costly to carry out, and often adds a degree of complexity to decision making.

Environmental assessment can be a particularly good choice for large and complex buildings that have a significant impact on the surrounding environment; but it is likely to prove too complicated and expensive for smaller buildings.

If governments wish to pursue these schemes, the choice of issues to be addressed should be taken early in the process and should reflect the overall aims, bearing in mind the necessary links to national environmental policy objectives and local issues.

Key steps: define terms of reference of certification scheme

- Define objectives in relation to targets and local requirements, existing codes and standards.
- Determine the scope in terms of type of buildings, and number of new and existing buildings.
- Determine the appropriate method of assessment depending upon scope, targets and approach.
- Decide whether to include other environmental issues.

2 *Establish the policy framework and action plan*

Once the certification scheme's terms of reference are defined, the next tasks are to establish an appropriate policy framework and an action plan for delivery. Establishing a certification scheme can take a long time, and it will succeed or fail depending on the approach taken in its early implementation. Effective co-ordination between relevant governmental bodies and main actors is essential, as is clear responsibility of assignments and allowing sufficient time for completion of tasks. A clear strategy for the full implementation should be developed at an early stage. An implementation group of high-level representatives from policy-relevant ministries and from major stakeholders should be established to develop an action plan, oversee the process and facilitate smooth collaboration during the entire implementation process.
Such groups were convened in Ireland and Portugal, and were considered essential to successfully implementing the certification scheme.

Decide if the scheme will be voluntary or mandatory

The choice of whether to pursue a voluntary or mandatory approach will strongly influence all other aspects of a certification scheme – and thus must be taken very early in the planning stage. The decision should reflect the country's policy framework and the expected outcome of the scheme, including careful assessment of whether the country can support the additional costs of a mandatory scheme in order to achieve higher impact. Voluntary schemes will require established standards and clear procedures, whereas a mandatory scheme might require new legislation, amendments to building regulations and a well-developed delivery system. In either case, planning ahead is crucial as the credibility will be easily lost if the scheme lacks secure foundations.

Mandatory schemes can be set up to include all buildings while voluntary certification schemes tend to include only buildings that have high energy performance ratings. Unless required to do so, owners of poorly performing buildings rarely want to display a negative label that could affect the sale or rental value.

By contrast, mandatory schemes that cover all buildings allow potential buyers, renters and users to compare ratings on a larger number of similar buildings and identify those with poor performance. This approach has a much greater potential to influence market prices. Many such schemes include advice on energy efficiency improvements, which makes the certificate even more valuable to potential buyers, renters or users. A key benefit of mandatory schemes is that they eliminate the possibility of "hiding" poor performing buildings and actually help to identify those buildings that have the greatest potential for energy saving. Mandatory schemes will have higher implementation and operational costs, but also much higher capacity to identify larger savings potentials and make a significant contribution to national energy and emission reduction goals.

Some countries have, however, successfully implemented voluntary schemes that use a positive certification to identify low-energy standards. Strong examples include the passive house (first implemented in Germany and Austria but spreading widely in recent years), Minergie in Switzerland, ENERGY STAR in the United States, and Super E in Canada. Positive certification benefits the owner/landlord by providing a marketing tool that may command a higher sale value or rental income on the building, and also the buyer/tenant by ensuring that they obtain the level of performance for which they paid. If building owners are given other incentives to provide certification, voluntary certification schemes can achieve significant uptake in the market. Mandatory schemes are less necessary for positive certification, as only well-performing buildings will be certified in any case.

Establish a comprehensive action plan

As a certification scheme involves many tasks and many actors, it is vital to determine who will do what – and within what time frame. A detailed action plan should be published at an early stage, and circulated for consultation with all stakeholders, including the construction industry and real estate sectors.

Early buy-in from these players will help to overcome perceived obstacles and lead to higher rates of participants completing their assigned tasks. Once agreed upon, the action plan should be adopted and applied as closely as possible.

In Ireland, the action plan was central to the successful implementation of buildings certification, as it set out key tasks and dealt with issues such as legal transposition, institutional arrangements, technical systems development, training and accreditation, tasks and time frames, consultation, and promotion and information campaigns. The action plan was agreed upon early in the process and implemented in a strict manner. All stakeholders were aware of the programme objectives and the time frame for delivery of each. A joint working group, comprised of senior officials, was established to oversee the implementation and work closely with important stakeholders.

In Portugal, where the certification scheme is seen to be expensive, it was important to achieve significant results in order for the scheme to be deemed successful within the building sector. Those developing the scheme agreed that targets should be ambitious, either in terms of the number of certificates issued or the projected impact on market prices and estimated energy savings. A strong target attracts attention and is easier to promote. The Portuguese experience shows that these targets should be promoted through the media, the internet, seminars and workshops to make industry and the public aware of the benefits of such high expectations (Maldonado, 2010).

Key steps: establish policy framework and action plan for delivery

- Decide if the scheme will be voluntary or mandatory.
- Develop a comprehensive action plan and establish an implementation group.
- Involve all stakeholders at an early stage.
- Set a realistic time frame for implementation.
- Adopt the action plan and stick to it.

3 *Secure the necessary resources*

Several types of resources are needed to ensure effective implementation of certification schemes including technological and administrative, institutional, financial and human. It is crucial to plan and allocate all the resources needed up front, otherwise there can be significant delays and complications during implementation. Some countries in Europe underestimated both the time and resources needed to establish a national certification scheme for buildings. This led to significant delays in implementing the EPBD, for which some countries incurred European Union infringement procedures.

Technological and administrative capacity should be developed to match the many tasks associated with certification including the development of calculation methodologies, software tools, assessment procedures and a comprehensive administration system (Box 10). It is vitally important to develop, from the start, a comprehensive administrative system with integrated data collection capabilities rather than trying to "fix" a poorly integrated system at later stages. Effective methodologies and software are essential first steps, as many subsequent elements will depend on their development, such as training material and delivery, software guidance and quality assurance systems.

As a starting point, it may be useful to undertake a study to assess the appropriateness of existing methodologies and software, or to consider adopting/adapting methodologies and systems that are already in place in other countries.

Existing **institutional** arrangements and systems are often fragmented; appropriate platforms need to be identified. It is critical to assign programme responsibility within the public sector and allocate financial and human resources at an early stage of development. In Ireland, significant effort to secure such resources was required early on, but was soon seen to be beneficial to the effectiveness of implementation (O'Rourke, 2010).

Consultation with stakeholders is needed in making decisions regarding the assessment methodology, software, design of energy rating and need for training. Consultation should include, at minimum, those who will be the potential users of the system, training providers and industry. All elements of the system should be thoroughly tested to validate the assessment software, the mechanisms for uploading assessments to system and the process of providing certificates. Although it takes time, such testing is crucial when first developing a certification scheme as avoiding difficulties will pay off in the long run. By contrast, if the scheme encounters administrative or institutional problems at an early stage, it is very difficult to regain credibility among stakeholders.

Financial resources for the energy certification scheme should be established at the planning stage. In reality, significant financial resources are needed to develop and administer the scheme, train the assessors, establish support systems and ensure quality by testing all aspects of the scheme in advance of its launch. Insufficient funds can have damaging effects on the impact and credibility of the scheme.

Box 10

Elements of an integrated technological and administrative system

Development of calculation methodologies and software

- *Calculation methodologies may be developed specifically to suit the national context, but existing international standards, methodologies and software in other countries may be more easily adapted (under licence) to suit national requirements.*
- *Methodologies and units applied must be appropriate to the type, age, use and context of certification, and must allow direct comparison of similar buildings on a national basis.*
- *Software tools are key to overcoming many calculation and quality issues, and should be addressed at any early stage to ensure development.*
- *In mandatory schemes, it may be that the government defines specifications for methodologies, but the private sector will develop software.*
- *Outputs should clearly reflect actual energy use, in both asset and operational ratings.*
- *Methodologies and software should be validated and tested before dissemination to the market.*
- *Realistic time frames should be set for software development and testing.*
- *Software should be user friendly and simplify the calculation process for assessors.*
- *Software should automatically check for compliance with regulations, and for completeness of data entry and typical errors.*
- *Recommendations for upgrading should be appropriate and achievable and their cost effectiveness should be checked by the software tool.*

Energy certificate design

- *Certificate format and content require careful consideration; they should provide clear and comparative information for consumers.*
- *Rating scales should allow for quick comparison of performance levels between similar buildings, and should be based on realistic benchmarks (reflecting building standards and building stock).*
- *Rating scales should be detailed, yet flexible enough to make it possible to rate future buildings that perform better and demonstrate improvements in existing buildings.*
- *If possible, certificates for buildings can benefit from other labelling/certification schemes in the country; such "brand extension" can help consumers to understand key messages.*

Delivery of an integrated administrative system

An integrated administrative system is essential for ongoing success and should:

- *Provide access to a "one-stop-shop" for building industry, assessors and users on all matters related to certification and energy efficiency of buildings.*
- *Provide a monitoring procedure for energy assessments and certification, as well as an auditing procedure for training providers, training assessment and assessors.*
- *Make certificates available on a user-friendly interface and include electronic communication with automated data entry wherever possible.*
- *Control the output of certificates and upgrading recommendations.*
- *Include a national database to store energy benchmarks and building information.*
- *Establish links with existing databases and facilitate the development of harmonised indicators and collection of information.*
- *Have the capacity to evaluate all aspects of the certification process to highlight potential improvements for the future.*

Box 11 *Link national and international institutions*

Considering the significant work involved in establishing effective institutional arrangements for energy performance certification, governments would do well to investigate the past experience of other countries that have implemented schemes and to incorporate existing standards to the greatest extent possible.

For example, the RESNET/HERS certification scheme implemented in the United States and the Green Building Councils have used considerable existing resources to develop standards for building certifications. In the United States and Canada, such developments have been undertaken in conjunction with standards developed by the International Energy Conservation Code (IEEC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This work provides the framework for calculation methods in the RESNET and ENERGY STAR certification schemes.

Ireland has been able to establish a certification scheme that is cost neutral for the government: all of the necessary revenue is raised through assessor registration fees and certificate charges. For such a scheme to work, the budget needed must be carefully estimated in advance and should include provisions for raising revenues from within the scheme.

Acquiring the necessary **human resources** may take time and should be started early. The expertise of those undertaking building assessments is critical to achieve a robust and respected certification scheme. To implement an energy certification scheme, a country needs assessors with relevant technical experience. Most countries have a shortage of assessors and need to initiate further training. This initial lack of expertise in the market is one of the most likely factors in certification implementation delays.

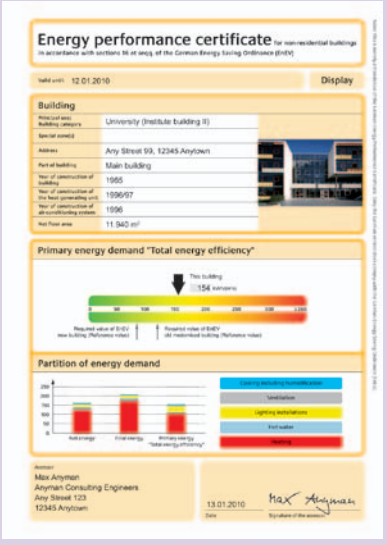
It is essential to undertake a review of existing construction profession capacities and capabilities, undergraduate educational programmes and continuing professional development programmes in order to understand what training is necessary to provide the market with properly qualified assessors.

Key steps: secure necessary resources for development and implementation

- Develop a comprehensive administrative system with integrated data collection capabilities.
- Assess institutional capacity.
- Allocate financial and human resources.
- Test systems and processes in advance of launch.

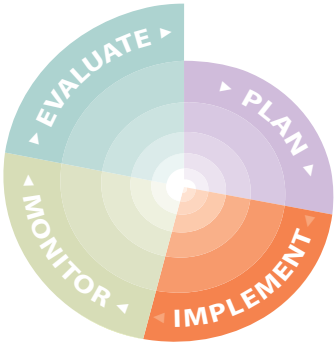
Box 12 *Test certificates to ensure reader comprehension*

Germany undertook a large field test involving certification of many buildings and by different types of experts to assess the skills of assessors, the process of delivering a certificate and the certificate's design. The field test was made at an early stage of implementation and had a large impact on the development of the certification requirements in Germany. It also increased the awareness of costs and the involvement of different stakeholders. This led to a certificate design that is significantly different from most other European countries, which have followed more closely the existing labelling of appliances.



German Energy Certificate

Source: DENA, Deutsche Energie Agentur.



IMPLEMENT

4 *Provide for training*

Availability of expertise directly affects the standards of assessment and the quality of the building rating programme. The extent of training resources required may be dictated by the number of assessors needed to deliver energy certification to the market – and by the availability of qualified experts and developed training material. Significant work is required to develop training materials, deliver the training, and establish an examination and appeals process. If training modules can be defined and delivered within existing training or undergraduate programmes early in the process, this may help to ensure the availability of highly skilled assessors by the time the scheme is scheduled to become operational. It also has the advantage of utilising existing training accreditation and professional trainers, and may allow for adaptation of existing training material.

To ensure the quality control of assessment and certification processes in Portugal and Denmark, only individuals with professional building qualifications can be trained and registered as assessors. In Portugal, engineers or architects need a minimum of five years experience.

In voluntary schemes such as RESNET, Passive House or Green Buildings Certification, assessors must go for training and pay for it as well as part of the overall costs of these systems. Assessors are part of the development and expansion of these schemes. However, if the structure is based on mandatory rules or is supported strongly by authorities such as Green Build in Singapore, more careful planning and incentives for assessors might be needed.

Box 13

Assessors need early training – and ongoing support

Training, qualification and accreditation

- *Trainers, trainees and training programmes should be accredited by a central body that regularly carries out quality assurance procedures.*
- *Trainers need to be trained in the specifics of the software as accuracy of data input is essential for consistency.*
- *Training courses should allow individuals to train to a level that reflects their existing qualifications and skills.*
- *Trained assessors should complete an examination of their knowledge and skills, prior to registration; only the best should be registered.*
- *Assessments should only be carried out by trained, accredited and registered assessors; poor quality assessments should lead to sanctions or the termination of accreditation.*
- *Disciplinary processes and procedures for complaints and appeals should be developed and enacted in a transparent manner.*

Development of assessment procedures and support mechanisms

- *Handbooks should be developed to provide guidance for undertaking assessments and surveying buildings, and should be made available in an easy-to-understand format for both assessors and the public.*
- *Initial training and continuing professional development should be available at reaonsable cost to encourage assessors to keep skills at optimum level.*
- *A Code of Practice should be agreed with and signed by all assessors.*

One lesson learned is that it takes time to train a sufficient number of assessors. If this stage is begun after all the legal and technical aspects are developed, much time may be lost or there may be insufficient assessors when the scheme starts, or they may not be of the quality required. While it may be difficult to develop training material and begin training programmes before legislation, calculation methodologies and software are fully developed, such time lags must be taken into account in the planning. Some countries have overcome this challenge by starting the scheme stepwise, thereby reducing the number of assessors needed at the starting point.

Key steps: provide for training and support

- Develop a training strategy at the earliest possible stage.
- Assess capabilities of existing professionals, and of existing training accreditation systems and programmes.
- Demand high pre-qualification standards for assessors and establish an appeal system.
- Retain control of training modules and materials, and of examination and registration processes.
- Ensure sufficient assessors are trained before launching the certification scheme.

5 *Raise awareness*

Stakeholders associated with the building sector – including design, construction, real estate, legal, financial and property management professionals, as well as those involved in the sale and rental of new and existing buildings – should be targeted with tailored advice and technical information on how the certification scheme will impact on their particular profession. The target audience and the manner in which information is delivered will depend on the type of certification scheme.

Wider promotion and information campaigns should be launched to introduce and highlight the benefits of building certification to the public. Building buyers and users in Portugal, for example, became familiar with the campaign slogan *Let's save energy to save Portugal*, which was promoted on national television and in the press. It is wise to continue information activities after initial implementation as first-time buyers and tenants enter the market continuously. Information should be disseminated through easily accessible sources such as citizens' advice, local authorities, real estate offices and websites.

Easy access to up-to-date information is an important aspect of keeping industry and the public informed.

Key steps: raise awareness among industry and the public

- Ensure that all stakeholders have access to relevant information.
- Develop ongoing information campaigns that target the general public.

6 *Collect, review and disseminate data*

Developing a comprehensive administrative system with integrated data collection capabilities is essential to the successful monitoring of the certification process and the achievement of an energy efficient building stock on a national basis. Information collected through certification schemes can be used directly to design, monitor and improve both certification and other initiatives for energy efficiency in buildings. Reliable information on national building stock performance should be used for developing evidence-based energy and construction policies (such as building regulations and codes), funding support mechanisms and public awareness programmes.

Disseminating information about innovative components and systems can assist in promoting such systems, overcoming market barriers such as lack of information and increasing the integration of renewable energy technologies into buildings. The dissemination should be targeted to different audiences and should provide all stakeholders with relevant information.

It is wise to review the objectives set at the start of the certification development process to ascertain if the requested and stored data will achieve the aims of the scheme. This may impact on the process and tools developed, so it is essential to review regularly and holistically. Such data can be used to redefine the level of energy classes and scales, and to develop general information on energy improvement measures.

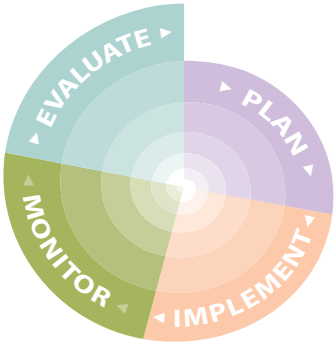
Key steps: collect data centrally, review and disseminate

- Collect data centrally in a comprehensive administrative system.
- Use the data to monitor and review the certification process.
- Review data and use to foster greater overall energy efficiency.

Box 14

Denmark's integrated data collection system

In Denmark, a form of energy or heating certification has been in place since the 1980s. Since 1997, energy certification has been mandatory for smaller buildings and apartments at the time of sale, and at regular intervals for large buildings. A key feature of the Danish scheme is that all results and data from the certificates are reported to a central register. This information has been used to assess the saving potentials and to develop policy actions for energy efficiency in the entire building stock. In-depth studies undertaken (in 2004 and 2009) by the Danish Building Research Institute and Copenhagen Technical University show the feasibility of substantial energy savings. They estimate that a 30% potential energy savings in existing buildings could be realised over the next 15 years. Many smaller studies have also used this data resource.



MONITOR

7 *Assess quality and compliance*

Assessors must be able to provide high-quality service, which is central to the reputation and effectiveness of the scheme, and certificates must be reliable and consistent to retain public confidence. Quality control is key to the ongoing success of a certification scheme; thus, it is vital to establish a comprehensive quality assurance system and related disciplinary procedures before building assessments begin.

The overall approach to quality assurance will include many facets such as training and national examinations, validation of certificates and auditing processes. The balance between assessor compliance and the necessity for disciplinary action may be directly linked to the expertise of assessors, the quality of their training and the examination process. A centralised administration system can accommodate an auditing system to monitor operational compliance by assessors and ensure the accuracy of certificates. It can identify technical, procedural or system faults, so that identified errors can be rectified and avoided in the future. Countries that have developed centralised data management systems have found them to be invaluable in supporting and controlling these activities (Flood, 2008).

Other approaches may be added as required. A serious breach of the Code of Practice, for instance, may lead to immediate termination of registration. The development of a complaints and appeals process will also be necessary for assessors subject to disciplinary action.

The need for an audit system is clear, but it is also true that good assessors need good support. In the case of Ireland, this was achieved through a help desk, regular bulletins and workshops. This not only provides support for the assessors, but also highlights necessary refinements of the assessment scheme for its developers.

Box 15

Ireland's auditing system

In Ireland, the programme auditing process involves three types of control audits:

1. ***Weekly data review audits:*** *high volume, desk-based audits on single building energy rating assessments highlighting inaccuracies or unusual patterns will lead to either a notification to the assessor or a more detailed review.*
2. ***Desk review audits:*** *medium volume, desk-based audits undertaken by a specialist who carries out a forensic review of assessments may lead to an assessor notification or to a further documentation and practice audit.*
3. ***Documentation and practice audit:*** *low volume, intensive audits carried out by assessor appointed by SEAI (Sustainable Energy Authority of Ireland) may include a practice or site assessment visit and could lead to disciplinary action in the form of penalty points, fines and eventual termination of registration as assessor from the system.*

The budget for these activities can be derived from the revenue paid by assessors whenever a new assessment is logged into the administration system.

Key steps:
assess quality and compliance

- Develop an overall quality assurance approach to include training and national examinations, validation of certificates and auditing processes.
- Establish a comprehensive quality assurance system including complaint and appeal procedures.
- Develop an initial auditing system within the centralised administration system.
- Train specialists to undertake desk reviews and practice audits.
- Provide support for assessors.

8 *Communicate the results openly*

Communicating the results of the certification scheme is vital to raise awareness of the benefits of certification and to retain the confidence of the building industry and the public.

Quantifying tangible improvements, in terms of energy savings, encourages all stakeholders to continue improving the process of building certification. Providing owners and stakeholders with information on cost savings, required investments and feasibility establishes a better foundation for decision making, and can thus help to increase the impact of these measures. While good results can motivate and encourage greater participation, a weak link in the process is very visible and can undermine stakeholder confidence. Communicating both positive and negative results is vital to enhancing the scheme.

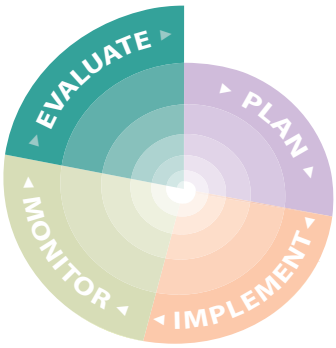
Certification that includes advice on possible improvements of existing buildings is an important means of overcoming insufficient information barriers. But it is often necessary to use other means to support the realisation of such proposals. This might include economic incentives, but also more targeted information and advice on co-ordination. Experience in the United States shows that assessors and contractors might have a different perception on what is needed in order to upgrade buildings. Such a lack of coherence can significantly reduce the uptake of energy efficiency measures. Information for both assessors and contractors can be a way to overcome such differences.

Errors in auditing should be addressed immediately and communicated openly. Information on existing procedures to ensure (and improve) the quality of the certification scheme should be included. Experience from Denmark, which has had different certification schemes in place since the 1980s, is a case in point. The Danish media highlighted discrepancies in assessments undertaken by three assessors on the same building. This rather embarrassing finding led the government to identify the need for clear procedures, robust assessment and open communication on quality control.

Revised procedures and new schemes in Denmark have been based on these principles. Retaining public confidence is vital to ongoing success of certification. Providing information in user-friendly language (avoiding acronyms, technical data and jargon) through the media and online will support informed and fair negotiations among all stakeholders in the building sector.

Key steps: communicate results openly

- Communicate both positive and negative results to retain confidence in the certification scheme.
- Translate energy savings into cost savings so that stakeholders can readily understand the benefits.
- Communicate openly any errors or weaknesses uncovered through auditing.



EVALUATE

9 *Evaluate the scheme continuously*

Once a building certification is successfully implemented, countries can turn their attention to maximising its benefits and improving the scheme. Regular evaluations should assess if certification schemes are effective according to their objectives and scope. There is in particular a need to continuously check the quality of building assessment by assessors and the compliance with the demands in the certification process. If the level of quality is not acceptable or weaknesses in the scheme are identified, the certification scheme should be modified to improve performance.

In many countries, many buildings do not comply with national building regulations (Eurima, 2005). In such cases, there is a risk that energy certification schemes will be used to make false claims of compliance. This raises a particular need for regular monitoring to ensure and improve levels of compliance, as large economic interests might be involved. Certification systems that aim to monitor compliance with building codes therefore call for enhanced control and interest.

To realise its full potential, a certification scheme must be able to adapt to changes in policy and legislation. Achieving zero-carbon or carbon-neutral buildings within the next 10 to 15 years (targets set in the recast EPBD and the 2030 goals in the United States) will require significant changes in the way buildings are designed, regulated, constructed and evaluated. To meet such ambitious standards in a cost-optimal manner, there is a strong need for innovation in building construction, technologies and energy supply systems. This highlights the inevitability that energy certification schemes for buildings will have to adapt to changing circumstances.

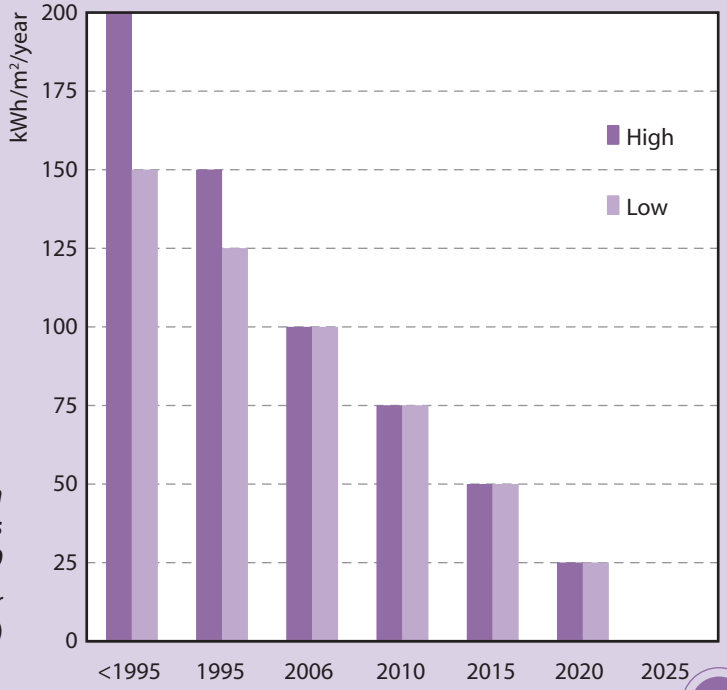
They should include appropriate mechanisms to integrate innovation into current energy performance calculation methodologies, provide an accurate assessment of their performance, ensure that calculated savings can be achieved in practice, and provide an accurate energy certificate (Spiekman, 2010).

Current energy performance calculation methodologies employ simple, easy-to-use tools that are cost effective and consistent. However, new calculation methodologies will have to be developed to integrate stricter building standards, and to allow for more complex and innovative solutions. Holistic energy performance will be of increasing importance in future certification schemes, and will need to include appliances and lighting, life-cycle environmental and cost analysis, indoor environmental quality and other environmental issues.

Box 16 ***Certifying beyond building regulations***

Many countries have already developed frameworks to achieve future building targets and have set intermediate targets as milestones for delivery. Denmark is among the countries pursuing very low-energy building; as such, it had strict energy requirements and a certification scheme in place since 1997, before the EPBD was implemented. Operational energy certification linked to the granting of a building use permit has kept energy use constant over the years despite an ever-growing building stock (Thomsen, 2009).

Irrespective of the EPBD requirements, increasingly low-energy buildings that go beyond building regulation standards are being certified. The Danish Parliament has set even lower energy targets for 2010, 2015 with a target of a 75% reduction of 2008 building energy standards by 2020 (Aggerholm, 2008).



Proposed energy consumption in new buildings in Denmark in 2020

(Maximum energy consumption for heating, cooling and ventilation)

Source: Thomsen.

Key steps:
evaluate the scheme continuously

- Undertake continuous evaluation to ensure high quality and compliance with national buildings regulations.
- Maximise the benefits through revisions of the scheme.
- Adapt calculation methodologies to integrate stricter building standards.

10 *Adapt the scheme as needed*

This policy pathway has focused on the energy performance and evaluation of buildings. But many environmental issues related to the building sector could also be assessed such as land and water use, sustainable materials, waste handling, ecology, re-use of material, etc. Use of both life-cycle and broader environmental assessments of buildings has been growing steadily, and various environmental assessment systems for buildings are now in use worldwide. Many certification schemes are based on on-site use of energy and on local units of measurement.

This has the advantage of being easily recognisable for building owners and users as it reflects the way energy bills are paid (in kWh, gas use or district heating units, for instance). The quantification of energy use by energy source or environmental impact in CO_2 emissions, however, is more targeted to the larger environmental impacts, and is more relevant to governments and wider energy reduction goals. Use of source or final energy use will often make the assessment more complex but can be used to direct efforts toward the largest possible impact in terms of achieving policy goals.

The most well-known and applied whole building qualitative assessment schemes include: Leadership in Energy and Environmental Design (LEED) in the United States; Building Research Establishment Environmental Assessment Method (BREEAM) in the United Kingdom; GBTool in Canada; Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan; and the National Australian Built Environment Rating System (NABERS) in Australia. Many have been adapted for use in other countries. They were conceived as voluntary in their application, but they have furthered the promotion of environmental building performance. Increasingly, government bodies are using the systems as a basis for specifying minimum environmental performance for their buildings.

Box 17

Environmental assessment with LEED and BREEAM

Both LEED, certified by the United States Green Building Council (USGBC), and BREEAM, certified by the Building Research Establishment in the United Kingdom, are voluntary systems providing comparative certifications that are widely applied and certified. The assessment methods are similar but differ in their measurement scales and some of the identified criteria. BREEAM criteria include energy, transport, pollution, materials, water, land use and ecology, health and well-being. LEED criteria include sustainable sites, water efficiency, energy, materials and resources, indoor environmental quality, and process and design innovation. Both assessment methods include some form of evaluation of energy consumption, indoor environmental quality, land use, water management and use of materials in their assessment (Hourigan, 2009). While there is ongoing discussion about the proper application of the systems, the certification is seen as a valuable marketing tool for building clients and a motivator for building occupants to conserve resources.

Most of the larger countries worldwide have set up Green Building Councils to lead green building certification. The national green building councils have founded a World Green Buildings Council (WGBC) in order to compare experiences and learn from each other.

Including a life-cycle assessment of energy use and relevant costing in certification methodologies could greatly enhance the value of the certificate. Some such schemes also include calculations of energy use in construction (and eventual demolition) as a means of reflecting all energy use over a building's life cycle. This makes it possible to relate increased or decreased energy use in construction and demolition with changes in consumption during the building's operational phase.

Other life-cycle assessments try to profile the environmental performance of materials and components. This approach, defined by William McDonough as "cradle to cradle", considers energy use through all phases of production, operation, maintenance, deconstruction and re-use. It also aims to estimate a wide range of impacts including the full effects on energy, water and land use, global warming and ozone depletion potential, toxic emissions (to air, land and water), and the impact on human health. This process of calculating all emissions or environmental impacts over the lifetime of a building is often referred to as determining its "carbon footprint" or "environmental footprint". Such approaches increase the possibility to make optimal ecologic choices, but also increase complexity and costs of the certification.

Current widely used life-cycle assessment methods include Building for Economic and Environmental Sustainability (BEES), developed by the United States government, and Athena Impact Estimator for Buildings developed by the Athena Institute. European systems include EcoScan, developed by TNO Built Environment and Geosciences, SIMAPRO, developed by Pre Consultants in the Netherlands, and GaBi, developed by PE International University of Stuttgart. Environmental issues or life-cycle assessments will, however, increase the costs for certification. This is a particular concern for smaller buildings for which the marginal cost increase could make the certification scheme uneconomic.

Energy consumption during operation of a building is a substantial element of both environmental assessments and life-cycle analysis. Currently, the impact of operational energy far outweighs the impact of the other assessment criteria for energy use in conventional buildings. However, as buildings become more energy efficient, other assessment criteria become significant and the benefits of combined certification become more evident. As certification becomes more complex and the focus on energy reduced, it could provide greater environmental and health benefits (Healy, 2004). It would also appeal to a broader audience and become a more important marketing tool.

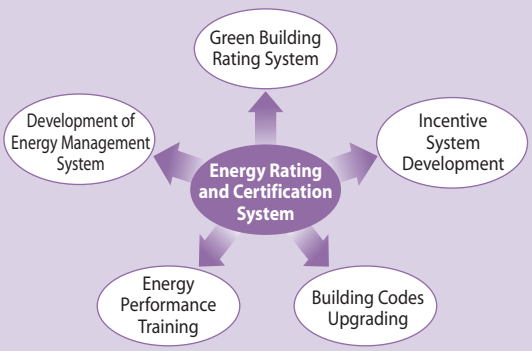
Key steps: consider inclusion of life-cycle and environmental analysis

- Link the certification scheme to other energy efficiency policies for buildings.
- Consider implementing life-cycle assessments to determine the full impact on energy use or on emissions (carbon footprint).
- Assess the possibility to include other environmental impacts on energy, water and land use, global warming and ozone depletion, toxic emissions (to air, land and water), and impact on human health (environmental footprint).
- Utilise whole energy performance or environmental building performance schemes to feed into larger policy goals.

Box 18

Green buildings in Singapore

In Singapore, a green building master plan, developed by the Building and Construction Authority (BCA), aims to bring 80% of the buildings in Singapore up to the Green Buildings Mark standard by 2030. This would lead to large energy savings and provide a great improvement in the city's environment (the local climate is highly influenced by energy use in this dense city). Strong private leadership and national support (which includes subsidies for buildings and high standards for public buildings) are important drivers for green buildings and energy efficiency in Singapore.



Energy certification feeds into Singapore's Green Building Rating and policy making

Source: Centre for Total Building Performance, Singapore.

Conclusions and considerations

The potential for energy savings in buildings is immense. As highlighted in the IEA *25 Energy Efficiency Recommendations*, effective building energy certification schemes can help to unlock this potential and contribute to the goal of meeting future environmental challenges (IEA 2008). In this sense, building energy certification is a key policy tool that can provide empowering information – which is complementary to regulatory and financial initiatives – to decision makers. It can help governments to pro-actively achieve national energy targets by creating environmental, social and economic sustainability in the building sector.

When embarking on the implementation of a certification scheme, governments should start by reviewing the existing and widespread experience with energy certification of buildings worldwide. Delivering a robust, accurate and low-cost certification scheme depends on many supporting mechanisms, from assessor training and validated evaluation procedures, tools and support, to quality assurance procedures and administration systems. This requires co-ordination and maintenance for successful and cost-effective implementation. Centralised computerised data management systems can be invaluable in supporting and controlling all these activities.

Energy certification schemes for buildings must be adaptable to the future – particularly to the innovative building technologies that are expected to come into the market. A range of issues will need to be addressed for existing buildings in the near future such as: developing building energy regulations for existing buildings; providing cost-optimal energy efficiency measures linked to general maintenance and retrofit; defining requirements for systems performance; integrating renewable energy technologies; reducing user electrical energy; and developing appropriate calculation methodologies to assess life-time energy and comfort costs and benefits. In this way, updated certification schemes can positively influence the energy performance of a country's entire building stock.

Countries that have begun to implement whole building, qualitative assessment systems that examine the larger environmental impacts of buildings are front-runners in the aim to achieve the larger policy goals of improved energy performance and reduced CO_2 emissions.

Building energy certification schemes have existed in some countries for as long as 30 years; the lessons learned during implementation and modification of those programmes should prove invaluable to programme managers now beginning the process or wanting to improve existing schemes. In addition to highlighting the benefits of building energy certification programmes and facilitating the transfer of knowledge among countries, this policy pathway serves a practical purpose by providing a list of ten critical elements and 38 steps that support implementation or improvement of building energy certification schemes.

Table 1 The policy pathway for energy performance certification of buildings

Four phases	Ten critical elements	Thirty-eight steps
PLAN	1 **Define the terms of reference**	• Define objectives in relation to targets, local requirements, and existing codes and standards. • Determine the scope in terms of type of buildings, and number of new and existing buildings. • Determine the appropriate method of assessment depending upon scope, targets and approach. • Decide whether to include other environmental issues.
	2 **Establish policy framework and action plan**	• Determine if scheme will be voluntary or mandatory. • Develop a comprehensive action plan and establish an implementation group. • Involve all stakeholders at an early stage. • Set a realistic time frame for implementation. • Adopt the action plan and stick to it.
	3 **Secure the necessary resources**	• Develop a comprehensive administrative system with integrated data collection capabilities. • Assess institutional capacity. • Allocate financial and human resources. • Test systems and processes in advance of launch.
IMPLEMENT	4 **Provide for training**	• Develop a training strategy at the earliest possible stage. • Assess capabilities of existing professionals, and of existing training accreditation systems and programmes. • Demand high pre-qualification standards for assessors and establish an appeal system. • Retain control of training modules and materials, and of examination and registration processes. • Ensure sufficient assessors are trained before launching the certification scheme.
	5 **Raise awareness**	• Ensure all stakeholders have access to relevant information. • Develop ongoing information campaigns that target the general public.
	6 **Collect, review and disseminate data**	• Collect data centrally in a comprehensive administrative system. • Use the data to monitor and review the certification process. • Review data and use to foster greater overall energy efficiency.

Four phases	Ten critical elements	Thirty-eight steps
MONITOR	7 **Assess quality and compliance**	• Develop an overall quality assurance approach to include training and national examinations, validation of certificates and auditing processes. • Establish a comprehensive quality assurance system including complaint and appeal procedures. • Develop an initial auditing system within the centralised administration system. • Train specialists to undertake desk reviews and practice audits. • Provide support for assessors.
	8 **Communicate the results openly**	• Communicate both positive and negative results to retain confidence in the certification scheme. • Translate energy savings into cost savings so that stakeholders can readily understand the benefits. • Communicate openly any weaknesses or errors uncovered through auditing.
EVALUATE	9 **Evaluate the scheme continuously**	• Undertake continuous evaluation to ensure high quality and compliance with national buildings regulations. • Maximise the benefits through revisions of the scheme. • Adapt calculation methodologies to integrate stricter building standards.
	10 **Adapt the scheme as needed**	• Link the certification scheme to other energy efficiency policies for buildings. • Consider implementing life-cycle assessments to determine the full impact on energy use or emissions (carbon footprint). • Assess the possibility to include other environmental effects on energy, water and land use, global warming and ozone depletion, toxic emissions (to air, land and water), and the impact on human health (environmental footprint). • Utilise whole energy performance or environmental building performance schemes to feed into larger policy goals.

Annexes

The two case studies illustrate the use of the four phases and ten critical elements of the policy pathway for energy performance certification of buildings.

Both are recent examples of wide-scale mandatory certification schemes, implemented according to the European Directive on Energy Performance of Buildings (European EPBD) and adapted to their national contexts. Both case studies are widely acknowledged as exemplar programmes with respect to the implementation of the European EPBD.

Case study 1: Ireland

The Irish energy certification scheme for buildings is a national implementation of the European Directive on Energy Performance of Buildings (European EPBD).

The European EPBD was transposed into Irish legislation mainly through the Building Control Bill 2005 and the Statutory Instrument SI No. 666 of 2006 European Communities (Energy Performance of Buildings) Regulations 2006. The Building Regulations (Amendment) of 2005, 2007 and 2008 to amend Building Regulation Part L – Conservation of fuel and Energy gave legal effect to specific Articles.

The legal transposition of the European EPBD in Ireland is the responsibility of the Department of the Environment, Heritage and Local Government (DEHLG), while the Department of Communications, Energy and Natural Resources (DCENR) is responsible for energy policy. The Sustainable Energy Authority of Ireland (SEAI) – Ireland's national energy authority – was appointed as the Issuing Authority for building energy-rating certificates. The Department of Education and Science (DES) and the National Qualifications Authority of Ireland (NQAI) are responsible for maintaining the quality of assessor training.

PLAN

Many decisions on objectives, scope, focus, outcomes and expectations for the building certification scheme were taken at a European level regarding the development and adoption of the European EPBD. Ireland decided to pursue a full and ambitious implementation of the European EPBD. A very central element to the implementation was the Action Plan, which was developed by a joint working group established very early in the process.

Key principles

A joint working group was established in 2003 to oversee and plan the implementation of the European EPBD in Ireland. It comprised senior officials drawn from DEHLG, DCENR and SEAI which facilitated a smooth pathway between policy makers and the development of a framework that, following consultation with industry, was guided by four key principles: practicality, clarity, consistency and cost efficiency. This proved to be essential for the implementation of a robust, reliable and secure certification scheme.

Timescale for implementation

Article 15(1) of the European EPBD stated that the Directive should be legally transposed and generally given practical effect by 4 January 2006. As Ireland did not have a tradition in energy certification or inspection regimes in place, it took the option of an additional three-year period ending 4 January 2009 to give practical effect to the provision of building energy ratings, measures to improve efficiency of boilers and heating installations, and inspection of air-conditioning systems.

A key underlying factor in establishing official methodologies to calculate energy performance was the development of CEN technical standards to support European EPBD implementation. Ireland had a basis for the development of a national methodology for individual dwellings, but not for non-residential buildings. Therefore, existing CEN standards were used where appropriate. However, the complexity of this development resulted in final versions not being available until early 2006. Ireland proceeded to develop the residential methodology, and upgrade and extend energy requirements for non-residential buildings in the meantime.

Training and accreditation were required for a large number of assessors (possibly as many as 2 000 were first envisaged for residential buildings alone).

This was a considerable task as it had to be preceded by a range of technical developments that would impact on the content of training. These content considerations included: developing and adopting calculation methodologies for new and existing buildings; developing and adopting a building energy rating system (including certification and recommendations for cost-effective improvement works); developing software and hardware systems to assist assessors in deriving certificates and recommendations; and developing a central database capable of handling certificates and generating national building energy use data.

These factors led to a phased implementation of the European EPBD in Ireland between 2006 and 2009 as set out below (SEAI, 2005):

	Date
Minimum energy performance requirements came into force	
New residential	*July 2006*
New non-residential	*July 2008*
Energy certification for buildings came into force	
New residential	*January 2007*
New non-residential	*July 2008*
Existing buildings offered for sale or rent	*January 2009*
Display certificates in public buildings over 1 000m²	*January 2009*
Feasibility assessment of alternative energy systems	*January 2007*
Energy efficiency of boilers and heating systems	*January 2008*
Inspection of air-conditioning systems	*January 2008*

Support studies

A large number of support studies, focusing on best practice and options for delivery, were commissioned by SEAI to support the development of methodologies and the mechanisms for delivery of an integrated system. These included investigations of the Denmark and Netherlands systems in force at the time, and were important towards scoping and planning the resourcing, technical and administrative systems necessary for implementation.

Development of national administration system and database

SEAI, in the early stages of developing a national energy certification programme, took an integrated approach for implementation in Ireland. The National Administration System (NAS) – maintained on the SEAI website – encompasses all of the following:

- Information for the building owner and user.
- Building energy assessment calculation procedures and software.
- Registry of assessments, certificates and advisory reports.
- Registry of assessor training providers.
- Registry of assessors.
- Examination booking.
- Quality assurance procedures.
- Help desk.
- Administration and finance system.

The system enables statistical analysis of energy use and the development of benchmarks for existing buildings. It also facilitates quality control audits of certificates and assessors.

A key consideration was that the administration of the scheme should be cost neutral. Revenue is raised from assessor registration fees and a charge for each certificate, which supports the system development, its maintenance, quality assurance procedures and communications and promotion (ECEEE, 2009).

IMPLEMENT

The implementation of energy certification of buildings in Ireland followed the policy pathway presented herewith very closely.

Development of calculation methodologies, software and certificate

In the development of the calculation methodologies and certificates, SEAI was aware of the necessity to balance the issues of practicality, cost, clarity and consistency. It was accepted that the more complex the procedure and the larger the inputs, the greater the possibility of errors.

This was particularly important in Ireland, as Irish designers self-certify the compliance of their completed buildings with the Building Regulations, on the basis of their qualifications. Buildings, and in particular dwellings, will be assessed by the designer at an early stage in the design process to check compliance (using the assessment procedure as a design tool) or to assure clients of their low- energy design, and then by a trained assessor following completion to provide a building energy rating.

National calculation methodologies

Residential buildings: The national calculation methodology for new residential buildings, called the Dwelling Energy Assessment Procedure (DEAP), is a simplified asset-based, monthly calculation procedure based on CEN standards. DEAP version 3.0.1 generates a building energy rating for new and existing dwellings and demonstrates compliance with specific aspects of energy regulation for new buildings. The procedure calculates annual values of delivered energy consumption, primary energy consumption, CO_2 emissions and costs, both totals and per square metre of total floor area of the dwelling, based on building geometry and the energy required for space and water heating, ventilation and lighting, less savings from energy generation technologies, for standardised occupancy.

Simple, non- residential buildings: The Non-Domestic Energy Assessment Procedure (NEAP) generates a building energy asset rating for new and existing non-domestic buildings and demonstrates compliance with specific aspects of building regulation for new buildings. NEAP allows the calculation to be carried out, depending on the complexity of the building, by the official simplified asset-based calculation procedure, the Simplified Building Energy Model (SBEM), which is based on CEN standards and has been developed by Building Research Etablishment on behalf of the United Kingdom Department of Communities and Local Government, or by approved dynamic simulation software packages developed, maintained and promoted by commercial providers. SBEM, accompanied by a basic user interface, iSBEM, calculates monthly energy use and CO_2 emissions based on building geometry, construction, use and HVAC, and lighting equipment.

Complex, non-residential buildings: Dynamic Simulation Modelling (DSM) packages are applied to provide a building energy asset rating for complex buildings. In order to model the dynamic response of the building to parameters such as external environment, internal gains, and possibly the dynamic interactions of the building services, an approved DSM software must be capable of using the environmental conditions set by the Chartered Institution of Building Service Engineers (CIBSE), and have the capability to calculate a building energy rating.

Large, existing, public buildings: ORCalc Software is used to calculate the operational rating of a building from annual utility consumption and produce a Display Energy Certificate required for public buildings over 1 000 m^2 and an advisory report.

Certification

Following an assessment with the appropriate software, the assessment is uploaded to the NAS. The NAS runs administrative and technical checks against each submission and notes if the submission warrants further consideration, checking it prior to publication or rejection. A rejected submission must be corrected and resubmitted, or be examined by a building energy certification administrator.

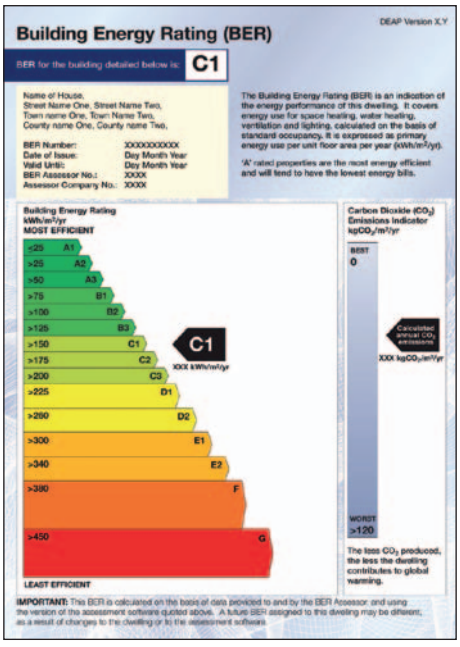
The approved energy certificate is published to be available for viewing on the National Public Register, where it can be copied or saved as a PDF file (Figure A1). It provides the following information:

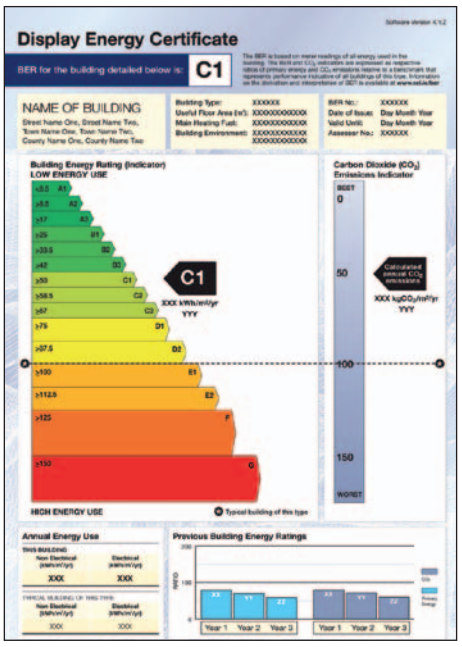
- Address of building.
- Building energy rating for the building (*e.g.* B1 and illustrated on a scale from most efficient A1 to least efficient G in kWh/m^2/yr).
- CO_2 emissions for the building (*e.g.* 18 kgCO_2/m^2/yr illustrated on a scale from best to worst).
- Date of issue and validation period.
- Software (including version reference) used to assess and rate the building.
- Address and official BER number unique to the building.
- Assessor registration number.
- Assessor company registration number.

A Display Certificate for large public buildings shows the same information for an operational rating, where the actual energy consumed in the building is compared with a benchmark for buildings of the same type.

The NAS also generates advisory reports: the system uses the rating data to automatically generate standard operational and upgrade advice relevant to the building. The advisory report can be reviewed and amended in advance of final publication. The certificate can be accessed by inserting a unique reference number or an electricity Meter Point Reference Number (MPNR) for the property.

Figure A1 Building Energy Rating certificates (BER) and Display Energy Certificates (DEC)





Source: SEAI.

Training and accreditation of trainers and assessors

Training is provided by a variety of training providers, third level institutions or private training organisations; presently there are 14 providers. Trainers and their training packages must be certified to a standard agreed by the National Qualifications of Ireland (NQAI) and meet the "Specification for Assessor Training Programme for Building Energy Rating (BER) for Dwellings" (SEAI, 2008).

Assessors are registered on the SEAI NAS and are qualified for residential buildings or three levels of complexity of non-residential buildings, according to their qualifications.

To register with the SEAI NAS as an assessor for residential buildings, an applicant must have had the relevant pre-qualification of a NQAI Level 6 Award; be certified as having successfully completed an assessors training course; passed the SEAI assessor examination; accepted the Code of Practice; and submitted relevant documentation and a registration fee. Registration is annual.

Assessors for non-residential buildings are those registered with SEAI who have registered for a specific level with pre-qualification for the level in which they intend to operate, accepted the Code of Practice and submitted relevant documentation and a registration fee. The levels are as follows:

- **Level 3:** for new and existing non-residential buildings, with frequently occurring characteristics, using the Simplified Building Energy Model (SBEM). These are buildings that have simple heating systems (Boiler Systems <100 kW), simple natural ventilation, small comfort cooling systems (up to 12 kW), and typical fabric and lighting systems as defined in the approved methodology.
- **Level 4:** for new and existing non-residential buildings using the Simplified Building Energy Model (SBEM).
- **Level 5:** for new and existing non-residential buildings requiring the use of a Dynamic Simulation Model (DSM).

Assessors for large public buildings are those registered with SEAI who have the relevant pre-qualification of a NQAI Level 7 Award, attended a workshop on the assessment of large public buildings, accepted the Code of Practice, and submitted relevant documentation and a registration fee. They may be employees of the public body or external consultants.

Only assessments on the SEAI register of assessments are deemed to be valid. BER assessments can only be lodged by an SEAI registered assessor. The BER Assessor will not operate outside of the areas for which she/he is registered.

There is no cap on the number of BER assessors who can operate in Ireland. The SEAI status report for March 2010 stated that there are 2 317 registered assessors for all dwellings and 434 registered assessors for all non-residential buildings.

Consultation, promotion and information campaign

The requirements of the European EPBD and the implementation process have been the subject of an extensive consultation process since 2004 whereby SEAI personnel have led or participated in over 210 events attended by over 24 000 people. SEAI has also run an advertising campaign that targeted the design and construction industry, the legal profession and the general public, both in print and electronic media. SEAI has developed a dedicated area on their website that provides information and guidance for trainers, assessors and building owners, available at: *www.seai.ie*.

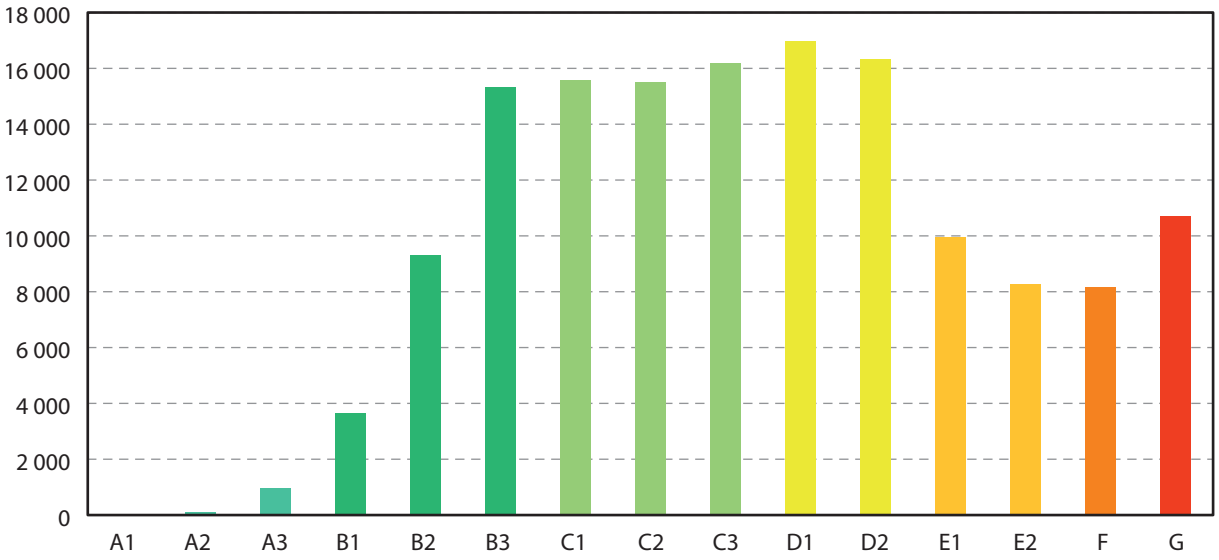
MONITOR

The system for certification of new residential buildings has been running since 2007, but the certification of existing buildings has only been running since 2009. The experience with monitoring is still limited as the scheme is recently implemented.

Success to date

As of end August 2010, a total of 141 900 energy ratings had been published on the NAS. These comprised 22 658 energy ratings for new dwellings; 114 445 energy ratings for existing dwellings; and 4 797 energy ratings for non-residential buildings. The distribution of energy ratings in Ireland to date, aggregated for all buildings, is shown in Figure A2.

Figure A2 Distribution of building energy ratings in Ireland to end August 2010



EVALUATE

Since the major part of the certifications – for existing buildings – has only been in place for one and a half years, no extensive evaluation of the certification scheme has been done so far. However, the frequency of certification of different types of buildings has been studied and consumer awareness and attitude surveys have shown a high level of recognition of the concept of energy certification for buildings among the general public. At a European level, the EPBD has been revised and some smaller changes in the structure's demands are foreseen, which will have to be implemented in Ireland.

Where to get more information on the Irish example?

www.myhome.ie/residential/advice/improving/building-energy-rating-ber-certificate-in-ireland-2426

www.seai.ie/Your_Building/EPBD/

www.seai.ie/Your_Building/BER/Training_Providers/BER_Training_Specification/BER_Training_Specicication.pdf

Box A1 ***Key guidance from Irish implementation*** IRELAND

What lessons did Ireland learn that would help other countries to implement successfully?

Ireland based its building energy scheme on a philosophy that certification is a positive instrument of national energy policy aimed at driving market choice and market transformation. Our aim was to achieve the objectives of the EPBD and other complementary elements (notably energy performance requirements set in building regulations). This meant putting in place strong legislative, technical, administrative and promotional systems to establish certification as an effective market stimulus to achieve energy savings. The alternative option of a simplistic approach would have led to a weak certification process that was seen as an ineffective and bureaucratic "paper exercise" that was a cost burden in the construction and property marketplace.

A key aim was to mobilise building stakeholders to make energy efficient choices based on the certification scheme being recognised as a reputable, reliable service that delivered an objective and useful outcome, in the form of the energy rating and an advisory report of recommended improvements. A certificate is meaningful only if its content is clear and its timing of delivery can impact the choices made by owners and prospective purchasers/tenants; it needs to be available in advance of a decision to purchase or rent.

This is a young market instrument, being just 20 months in full implementation for both new and existing buildings. However, it is already being used to leverage the implementation of a national programme of energy efficiency retrofit upgrading of the existing building stock. Strong recognition among the general public of building energy certification/labelling as an explicit currency can be expected to be reflected in the price or transaction speed of a building within its market segment.

What are the five key actions that delivered success?

Twelve sets of actions contributed to establishing a successful building energy certification scheme in Ireland. As these action steps are approximately sequential and strongly interconnected, it is difficult to single out five for special mention. With that caveat, the five nominated as being of perhaps the greatest significance are:

- *Establish an active co-ordinating group (from the key government departments and agencies) to plan and oversee the transposition and implementation of the EPBD.*
- *Publish an Action Plan for Implementation to provide the construction industry and stakeholders with a clear signal of strategic intent, as well as proposed tasks, decision issues and options, responsibilities and timetable. This formed a key reference for industry consultation and briefing, and helped to shape strong legislative provisions requiring certificates to be available when buildings are offered for sale or rental.*
- *Be realistic and provide sufficient resources for both the development and operational (including ongoing improvement) phases of the certification scheme.*
- *Pay attention to ensuring that the energy rating scale is properly representative across the building stock, and leaves sufficient room at the good end of the scale to motivate the industry to improve building specifications in future years*
- *Use the power of a highly automated technical and administrative system to report and support certification. On-line hosting of certification has many advantages in terms of system cost efficiency, service efficiency and quality, promotion (through a powerful, actively managed, website www.seai.ie/ber), 24/7 access, ultimate cost, database power, quality auditing, etc. This requires a significant investment in an ICT systems development project, and huge attention to detail in specifying the requirements and managing the project. It also demands a very strong software project management resource within the responsible agency, but the rewards are considerable in terms of information efficiency and power, service quality, labour cost savings and reduced administrative burden.*

Is there anything that Ireland would do differently if starting to implement now?

Ideally, we would have started developing the technical methodology and software six months earlier than we did. We learned from experience that software development projects take considerably longer to deliver (including intensive testing and debugging before release) than typically optimistic initial schedules indicate. We also learned the importance of very tight daily to weekly monitoring oversight on the quality and delivery of the technical and administrative software, since software code writers are not subject-matter experts in the field of energy in buildings. These delays created initial tensions in relation to stakeholder expectations, but this was merely a short-term transitional difficulty.

Oversight of training providers was not a formal responsibility of the energy authorities. While such activities cannot be precisely controlled, it is worth mentioning that aggressive promotion of courses by commercial training providers led to considerably more people being trained than was needed for the market. In the first year, it led to an oversupply of registered assessors and discontent regarding initial lack of business. As the scheme became rapidly adopted, this issue was considerably alleviated. Moreover, it is true that a degree of oversupply of assessors is needed to ensure healthy competition.

Likewise, a transitional difficulty (and a consequence of already established institutional responsibilities, and therefore not an option to do differently) was oversight of compliance by assessors with their service performance and conduct obligations rests with the energy authorities. Separately, oversight of compliance by building owners with their obligations rests with local authority building control offices, which are also responsible for inspecting new buildings in relation to all aspects of regulations compliance. Owing to heavy workloads in relation to other duties, there were initial delays in securing the commitment of the building control offices to enforce the obligations on building owners – and in particular on estate agents – in relation to building energy certification.

What changes, if any, would Ireland make to the software, certificates?

We would have liked to start even earlier! Training had to await software completion, which led to delivery of training within tight timeframes to ensure that adequate numbers of assessors were registered in time to meet anticipated initial demand.

The scope and design of the rating scales shown on certificates, covering both primary energy and CO_2 emissions, have worked very well; enough "headroom" was left at the better end of the scale to give credit to current building energy standards and improvements planned over the next five years. The accompanying advisory report on recommendations for improvement is auto-generated on the basis of the building characteristics input to the software by the assessor. We plan to strengthen the functionality and content of the advisory report, which will require considerable work to refine. We would have liked to have time to strengthen this element at the outset of the scheme.

Not a change, but a relevant observation: in relation to the software for the technical calculation methodology, we are already on version 3 of the software, i.e. *in a three-year period, functionally substantive improvements have been made twice to the original software. Similarly with the administrative software. The most significant strategic improvement has been to create a smooth web-based interface between the technical software and administrative system to allow export or uploading of the data files and building energy certificates. We should have been more aware of the constant need for new updates and improvements.*

Source: Kevin O'Rourke (SEAI), August 2010.

Case study 2: Portugal

The Portuguese energy certification scheme for buildings is a national implementation of the European Directive on Energy Performance of Buildings (European EPBD).

Portugal implemented certification at the same time as complementary measures such as building codes and inspection of air conditioners were introduced. Implementation of energy certification for buildings in Portugal must therefore be seen in close relation to the broader European Union directive.

PLAN

The European EPBD was transposed into Portuguese legislation in 2006 through three Decrees: Decree 78/2006 created and defined the System for Energy and Indoor Air Quality Certification (SCE). Decree 79/2006 established the amendments to Building Regulation for energy systems and HVAC in buildings (RSECE). Decree 80/2006 established the amendments to Building Regulation on the characteristics of thermal behaviour in buildings (RCCTE).

In 2007, two legislative documents were enacted: Ordinance 461/2007, which established the timescale for implementation, and Ordinance 835/2007, which defined the fee to be paid by assessors for registration and certification process. Later in 2008/9, Ordinance 10250/2008 defined the energy performance certificate model and energy ratings; and Ordinance 11020/2009 defined the simplified methodology for calculating the energy rating and certification of existing residential buildings.

Two additional legal documents adapted the national legislation of Madeira and the Azores to meet the European EPBD requirements.

The legal transposition of the European EPBD in Portugal is the responsibility of the Ministry of Economy, Innovation and Development and the Ministry for Environment and Spatial Planning. The Ministry of Public Works and Transport is responsible for Building Regulations. ADENE, the Portuguese Energy Agency was appointed as the issuing authority for building energy certification under the supervision of the Directorate General of Energy and Geology (DGEG), for issues related to the Certification and Energy Efficiency, and the Portuguese Agency of Environment (APA), for issues related to the Indoor Air Quality in Buildings.

Key principles

The key objective for implementation was to save energy while ensuring comfortable indoor conditions and acceptable indoor air quality. A system had to be developed that could support that objective and promote practical implementation of the advisory report recommendations to deliver energy savings.

A committee was set up to develop a programme for implementation involving different entities with expertise in the area, ranging from research institutes and professional associations to universities and other public institutes such as The Counsel of the Public Works and Transports (CSOP), the Architects Association (OA), the Engineers Association (OE) and the National Association of Engineering Technicians (ANET).

The management of the SCE was assigned to the Portuguese Energy Agency (ADENE), and is supervised by the Directorate General of Energy and Geology (DGEG), and the Portuguese Agency of Environment. This is documented in Decree nº 78/2006, of 4 April, Chapter II - Organization and Functioning of the SCE, Article 6º, Supervision of the SCE, and Article 7º, Management of the SCE.

Timescale for implementation

The implementation of the European EPBD in Portugal was divided into three phases from 2006 to January 2009 when full implementation was in place, to allow for a smoother adaptation of the different market agents and authorities to the new framework.

One of the national issues which influenced the development and timescale for implementation was the training of sufficient assessors to ensure that the number of professionals in the field could provide the necessary response to the market. No certification scheme had been in place before the implementation of the European EPBD, only national building codes (revised in 2006), namely the Regulation of the Characteristics of Thermal Behavior of the Buildings, approved by Decree nº 40/90. It was the first legal instrument to improve the thermal quality of the building envelope, what is referred to as the "improvement of the comfort without additional energy consumption". This was followed by the first Building Regulation for energy systems and HVAC in buildings (approved by the Decree nº 118/98).

These factors led to a phased implementation of the European EPBD in Portugal in 2006 and 2009 as set out below:

	Date
Minimum energy performance requirements came into force	
All new buildings	*July 2006*
Mandatory energy certification for buildings came into force	
Phase 1: *New residential/non-residential (floor area >1 000 m²)*	*July 2007*
Phase 2: *All new buildings (regardless of floor area)*	*July 2008*
Phase 3: *Existing buildings offered for sale or rent*	*January 2009*
Display certificates in public buildings over 1 000 m²	*January 2009*
Feasibility assessment of alternative energy systems	*January 2007*
Energy efficiency of boilers and heating systems	*January 2009*

Support studies

A research project on the Portuguese implementation of certification called "Energy Efficiency in Buildings Programme" was supported by the government. A website with results is still available at *www.p3e-portugal.com* showing the calculation methodologies.

Development of national administration system and database

ADENE developed an integrated web-based system, maintained on their website, which allows easy access for building energy assessors, owners and users. It contains the following:

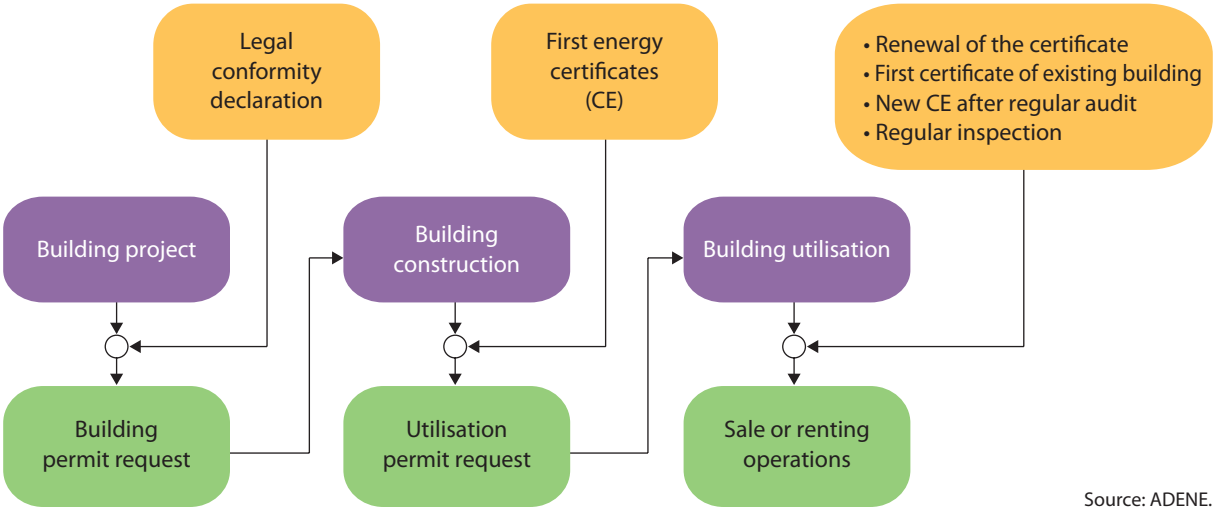
- Information for the property developer, building owner and user.
- Registry of assessments, certificates and advisory reports.
- Registry of assessors.
- Quality assurance procedures.
- Administration and finance system.

The system acts as a national database of energy use in buildings, which helps to monitor the progress of the European EPBD implementation and provides data for future possible tightening of Building Regulations. It facilitates periodic quality control checks on assessors and certificates. Assessor audits will be undertaken at least once every five years; 10% of certificates are checked.

ADENE charges a registration fee for each certificate issued which is used to support the management of the system, undertake quality control checks and promote the certification scheme (ECEEE, 2009).

Below is a simplified illustration of the process for certification of new buildings, from the point that the building is conceived up to first occupation, sale, or renting (Figure A3).

Figure A3 Diagram of the building energy rating administrative process in Portugal



Source: ADENE.

IMPLEMENT

Development of calculation methodologies, software and certificate

Energy calculation procedures are defined in the Building Regulations for residential buildings and in the HVAC regulations for non-residential buildings. Buildings are twice assessed with the calculation methodology to show compliance with Building Regulations, first when requesting a building permit and again after completion by a trained assessor following completion to provide a building energy rating. This is to ensure that buildings are fully designed in accordance with energy efficiency concepts, which are more cost effective than making changes later on.

Residential and small, non-residential buildings: For residential buildings and small, non-residential buildings, energy calculations can be done to show compliance with building regulation requirements and to provide a building energy asset rating on a spreadsheet. A software tool is used, developed by the National Institute of Engineering, Technology and Innovation (INETI, now the National Laboratory of Energy and Geology, LNEG) for the SCE system or commercial software.

For small, non-residential buildings, new and existing, with more than 25 kW of installed HVAC capacity, the calculation method considers the building envelope features, HVAC systems, ventilation, lighting, building position and orientation, including exterior conditions, passive solar systems and indoor conditions. A simplified methodology for small, non-residential buildings is available, through a programme developed by the National Institute of Engineering, Technology and Innovation (INETI, now LNEG), by hourly simulation for single zones models.

Non-residential large buildings: For large, non-residential buildings, commercial dynamic simulation modelling software tools complying with ASHRAE standard 140-2004 (*e.g.* DOE-2, ESP or Energyplus) must be used to show compliance with building regulation requirements. This is also used to calculate a building's energy asset rating by means of hourly simulations on a yearly basis. National databases of hourly annual climatic data are published for all municipalities in Portugal and must be used for demonstrating building regulation compliance (Santos *et al.,* 2008). Later, programmes TRACE 700, and HAP4.31 VisualDOE4.1 were also accredited under this standard.

Certification

Following an assessment with the appropriate software, it is uploaded to the SCE portal and certificates are issued through this web-based central registration system. This way, a national database of certified buildings is being fed with information that will be useful to monitor progress of different aspects regarding the implementation of the directive, from basic statistics, such as the number of certified buildings, to feeding studies for the future possible tightening of minimum requirements that the European EPBD demands on a periodic basis.

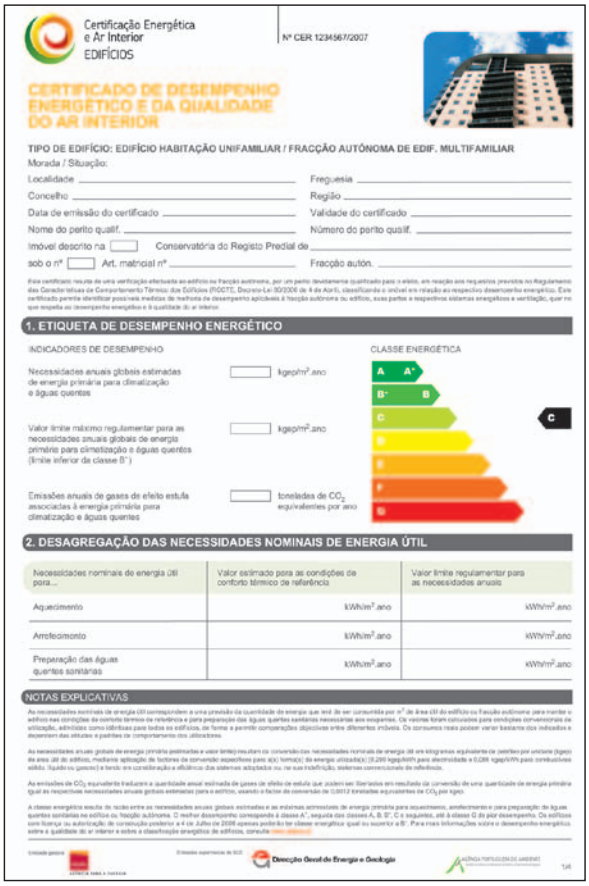
The system checks and analyses some of the information given in the certificates; samples are also checked by ADENE's staff and subcontracted entities. Currently 4% are checked, but the intention is to increase to about 10% per year. It is possible to view a building's energy performance rating, the validity of the certificate and the identification of the assessor.

Certificates display the following information:

- Address, official number and image of building.
- Building energy rating for the building (*e.g.* B- and illustrated on scale from most efficient A+ to least efficient G in kWh/m^2/yr).
- CO_2 emissions for the building (*e.g.* 18 kgCO_2/m^2/yr illustrated in four bands from best to worst).
- Indoor air quality expressed as a minimum quality required and data on concentration of pollutants in indoor air.
- Assessor registration number.
- Upgrade recommendations for new and existing estimates of cost, payback period and the impact on energy rating, if implemented, are indicated on the back of the certificate.

If the building is new, the information on the certificate related to the indoor air quality is the value of the minimum outdoor air supply (Figure A4).

Figure A4 Energy label from Portugal


Certificação Energética e Ar Interior
EDIFÍCIOS

Nº CER 1234567/2007

CERTIFICADO DE DESEMPENHO ENERGÉTICO E DA QUALIDADE DO AR INTERIOR

TIPO DE EDIFÍCIO: EDIFÍCIO HABITAÇÃO UNIFAMILIAR / FRACÇÃO AUTÓNOMA DE EDIF. MULTIFAMILIAR

Morada / Situação:

Localidade — Freguesia

Concelho — Região

Data de emissão do certificado — Validade do certificado

Nome do perito qualif. — Número do perito qualif.

Imóvel descrito na — Conservatória do Registo Predial de

sob o nº — Art. matricial nº — Fracção autón.

1. ETIQUETA DE DESEMPENHO ENERGÉTICO

INDICADORES DE DESEMPENHO

CLASSE ENERGÉTICA

Necessidades anuais globais estimadas de energia primária para climatização e águas quentes — kgep/m^2.ano

Valor limite máximo regulamentar para as necessidades anuais globais de energia primária para climatização e águas quentes (limite inferior da classe B-) — kgep/m^2.ano

Emissões anuais de gases de efeito estufa associadas à energia primária para climatização e águas quentes — toneladas de CO_2 equivalentes por ano

A A+ B- B C D E F G

2. DESAGREGAÇÃO DAS NECESSIDADES NOMINAIS DE ENERGIA ÚTIL

Necessidades nominais de energia útil para...	Valor estimado para as condições de conforto térmico de referência	Valor limite regulamentar para as necessidades anuais
Aquecimento	kWh/m^2.ano	kWh/m^2.ano
Arrefecimento	kWh/m^2.ano	kWh/m^2.ano
Preparação das águas quentes sanitárias	kWh/m^2.ano	kWh/m^2.ano

NOTAS EXPLICATIVAS

Direcção Geral de Energia e Geologia

Source: ADENE.

If it is an existing building, the information on the certificate related to the indoor air quality is the concentration of the main parameters to be analysed under IAQ audits: CO_2, carbon monoxide, formaldehyde, volatile organic compounds, particles, ozone, fungi, bacteria, radon and legionella.

In Portugal, public buildings are defined as every non-residential building, owned by private or government bodies, which means that all non-residential buildings larger than 1 000 m^2 are required to display an energy certificate based on calculated energy. This must be reviewed every six years. Indoor air quality certificates must be reviewed every two to three years, depending on the building typology.

Training and accreditation of trainers and assessors

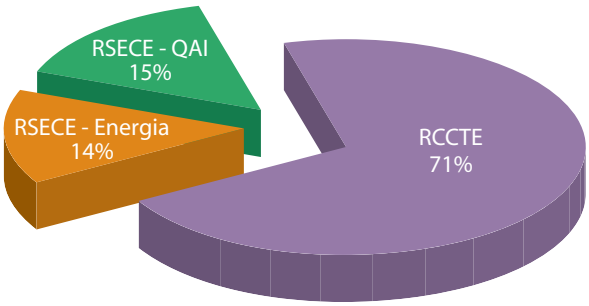
Training is given by a variety of training providers, both existing universities and approved commercial training providers. However, ADENE co-ordinates the training and is responsible for the Energy Certification module in all courses. Assessors are qualified to work within the areas of the system: RCTTE (residential and small non-residential buildings) and RSECE (large non-residential buildings). Within large non-residential buildings, an assessor may train and qualify in either RSECE-E (energy) or RSECE-QAI (indoor air quality).

To register with the SCE as an assessor for all buildings types, an applicant must have relevant pre-qualifications, such as an architect or engineer with at least five years experience, or be certified as having successfully completed an assessor's training module developed by Adene, and have passed the national assessor examination. Assessors are registered for five years; renewal is subject to continual training and good practice. The high level of expertise of the assessors is crucial to deliver appropriate recommendations for improving the energy efficiency of these buildings.

Only assessments in the register of the SCE's assessor database are deemed to be valid. Assessments can only be lodged by a registered assessor. The assessor will not operate outside of the areas for which s/he is registered. Qualified assessors work as individuals or as part of public or private organisations.

Currently there are 1 330 assessors, 71% with a qualification for RCCTE, 14% for RSECE-ENERGY and 15% for RSECE-QAI (indoor air quality). It is hoped to have trained 2 000 assessors by the end of 2010, which will be sufficient to supply market demand (Figure A5).

Figure A5 Number of assessors in Portugal



Source: ADENE.

Currently about 3 000 certificates for new buildings and 15 000 certificates for existing buildings are issued every month, covering nearly all the licensing and selling processes that are taking place.

Consultation, promotion and information campaign

The requirements of the European EPBD and the implementation process have been the subject of a national advertising campaign that targeted all sectors of the industry. The campaign slogan "Let's save energy to save Portugal" has been promoted on television, the press, information seminars, the internet and construction billboards.

ADENE has a dedicated area on their website that provides information and guidance for licensing authorities, building professionals, property owners and developers and building users. This is available at *www.adene.pt* (Santos *et al.,* 2008).

MONITOR AND EVALUATE

Success to date

Up to March 2010, approximately 248 000 certificates were issued (Figure A6). Below is an illustration of energy ratings of buildings before and after certificate recommendations (Figure A7).

No research has been carried out on the behaviour of consumers, but it has been verified that the public is receptive to energy efficiency measures.

Figure A6 Number of energy performance certificates issued up to March 2010

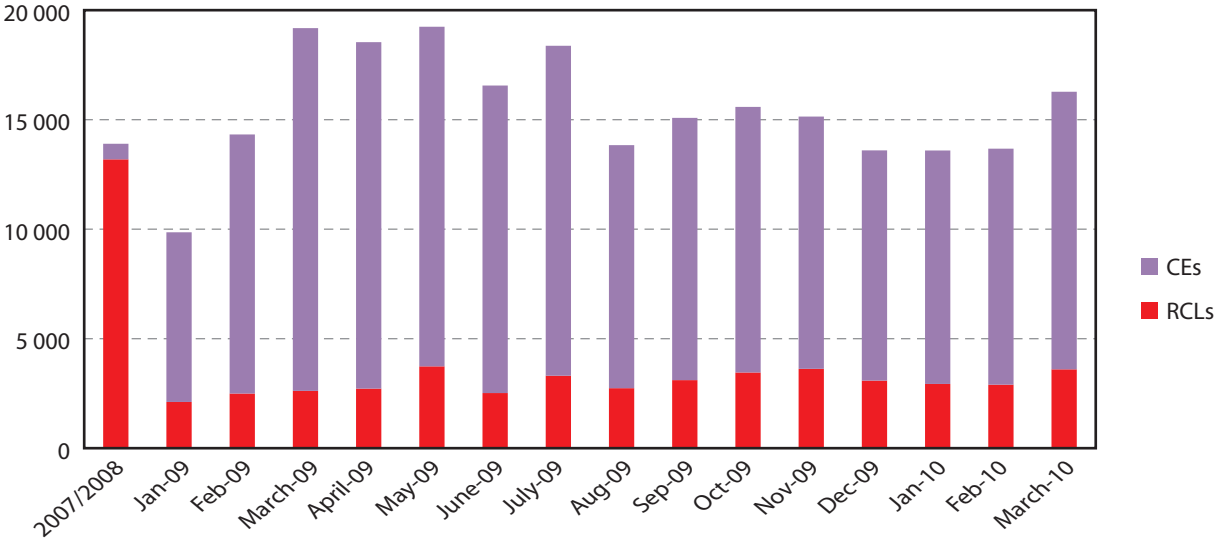
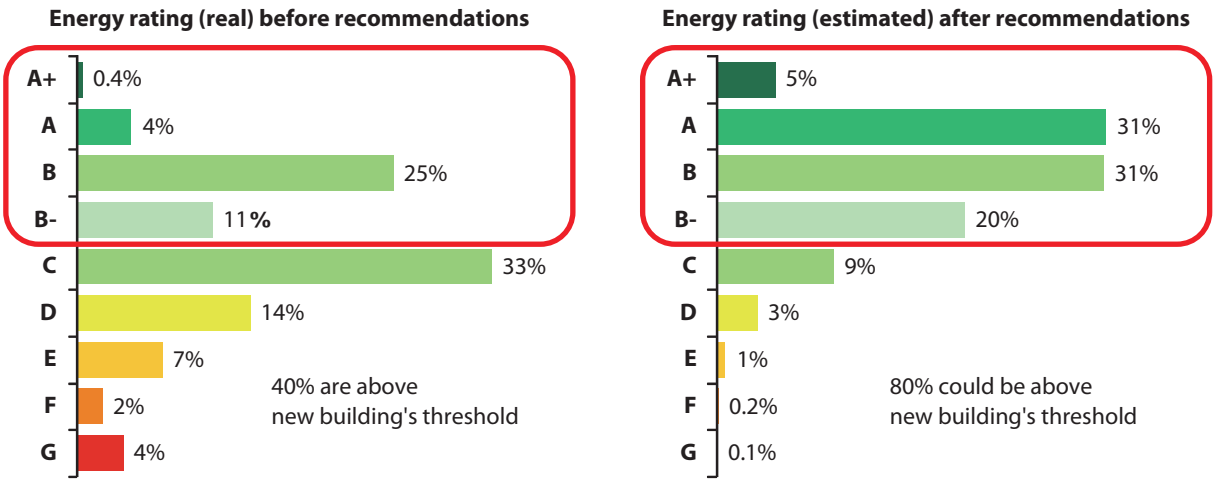


Figure A7 Energy rating of existing buildings before and after recommendations



Note: the figure indicates the share of ratings for each category. Source: ADENE.

Box A2 ***Key guidance from Portuguese implementation*** PORTUGAL

What lessons have been learned in Portugal that would assist other countries to implement successfully?

In Portugal, the system was implemented based on quality assurance, through the following:

- *High levels of training required to be a qualified expert, to ensure the quality of their certification activities in the field in the future; minimum of five years experience.*
- *Establishing a final national examination, based on two components: multiple answer tests and solving a case study, to test real life situations.*
- *Monitoring training activities (analysis on examination results) to determine assessor's strengths and weaknesses.*
- *Using FAQs as an easy way to clarify the legislation and improve the training process/material.*
- *Hiring of specialised communication companies to define and establish best practices to communicate to public and specific sector agents.*
- *Establishing close contacts with key players: municipalities (about 100 training meetings were organised for more than 1 500 municipality technicians), real estate agencies, banks, consumers associations, property owners associations and notaries [mailings]).*
- *Setting up a call centre managed by ADENE; providing end-users with information on energy performance certification issues and also supporting assessors in their work.*

What are the three key actions that delivered success in Portugal?

The three key actions are:

- *Compulsory training of assessors*
- *Mass media coverage*
- *Regular checks and supervision of the assessors.*

Is there anything that Portugal would do differently if starting to implement now?

Portugal would:

- *Design the system from the beginning to obtain information suitable for national statistics.*
- *Give more importance to the building envelope issues instead of focusing on the sanitary hot systems issues, in the energy rating calculations.*
- *Make it a mandatory requirement for qualified assessors to give more detailed recommendations regarding energy saving in the certificate. This will make it easier for building owners to act on the recommendations.*
- *Define an extra functionality at an early stage of the IT development, as it would have enhanced the usefulness of the database as a research and analysis tool.*

Any changes planned to software or certificates?

Regular improvements have been made to the software, with the intention to perfect the System for Energy and Indoor Air Quality Certification (SCE). Furthermore, the revision of the legislation will enforce the amended European EPBD to the Portuguese legislation.

Source: Paulo Santos (ADENE), June 2010.

Glossary

Action plan is a plan for implementation developed by the authority or the body responsible for implementation of a certification scheme setting the strategy for the implementation and the timescale.

Advice on improvements or **Advice on possible savings** or efficiency gains often simplified to **Advice** is a list of proposals on how to improve the energy performance of an existing or a new building.

Advisory report is a more detailed report providing advice on possible improvements in connection to the energy certification of a building. Often an advisory report is an independent report separated from the more simplified certificate.

Assessment of a building or **Assessing** in connection with energy certification of buildings is the process of collecting information on the energy performance of the building and calculating the background for rating. This can include advice on energy improvements.

Assessor is a term for the person or the team that conducts the energy certification, including the assessment of the building and the calculation of the energy performance metrics for the energy rating of the building.

Asset rating is a rating where energy performance is calculated based on a detailed registration of building parts, surfaces and the technical installations in the building.

Certificate is the output of a certification. It contains the results and key information communicated in a simplified way. It can possibly include advice on improvements. It can be presented electronically or in hard copy.

Certification or **Energy certification** is a policy instrument. Certification of a building includes the entire process of certification (the assessment), the result (the certificate) and the dissemination of this information.

Comparative certificate is a certificate including a comparison of a building with other buildings or standards. Usually a comparative label will have a scale. Comparative can also be used in connection with labels or rating.

Documentation, used in connection with certification, is a more detailed description of basic assumptions, registrations and results from the certification process.

Energy consultant or **Energy advisor** are other terms used to describe the assessor in energy certification.

Energy label is the presentation of the energy performance information. The label includes the energy rating and possibly other information on energy consumption, but, in general, does not include information or advice.

Energy performance of buildings is a term for the energy efficiency of both new and existing buildings. Energy performance can be expressed specifically (energy per unit, m^2 or square foot) or in total terms.

Energy plan for a building is a term used for proposed actions for possible saving or improvements of energy efficiency.

Energy rate of a building is the process of establishing an energy rating of a building, including comparing the energy performance with a scale or a benchmark.

Energy rating for a building is the part of the certificate which rates the energy performance of the building and illustrates this with a simplified graphic. It can either compare the energy performance with a standard or with that of other similar buildings.

Environmental certification of a building is an assessment of a building which includes consideration of wider environmental issues and results in an environmental certification of the building.

Environmental rating or **Environmental label** is a rating of the building based on environmental issues, for instance based on the CO_2 emissions related to this building.

Labelling of buildings is the process of generating an energy label for a building.

Measures or **Proposals** in connection with certification refer to the individual actions that can improve the energy efficiency of an existing or a new building.

Operational rating is a rating where the calculated energy performance is based on metered consumption, which is normalised to standard conditions.

Positive certificate is a certificate that documents compliance with minimum requirements or a specific standard. Positive certificates can also be used in connection to energy labels or ratings.

Scale is used in connection to certification to describe the different levels of a building in comparative labelling, expressed in numbers, letters or stars.

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