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MUNICIPAL HEATING REFORM PROJECT IN UKRAINE

Assessment of International Experience on Building Labeling in the European Union and the United States

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ALLIANCE TO SAVE ENERGY
Creating an Energy-Efficient World

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Executive Summary

Ukraine's energy dependence creates an increasing need for a detailed building energy performance assessment and certification system to help market actors make better informed decisions on investments in improved energy efficiency and on purchase or lease of a building. This system would provide a uniform level of information on all new construction, and methods to assess building energy use, as well the economic, social, and environmental costs and impacts of buildings (e.g., construction costs, lifecycle cost and utility affordability, carbon footprint).

Energy certification and labeling schemes for buildings emerged in a number of countries and regions in the early 1990s as user-friendly tools for providing transparent information on building energy use, creating incentives for improving energy efficiency, and minimizing energy consumption. Despite their common purpose, the building certification and labeling regulations and their enforcement have been extremely varied. Even within the European Union (EU), the common Directives do not provide unified methodologies for implementation of the required labeling and certification of buildings. There is also a lack of standard terminology and common understanding with respect to such key terms and concepts as energy performance, energy ratings, benchmarking, and labeling. This creates confusion among stakeholders and has led to duplication of efforts in a number of countries.

This report describes the current practices in building energy performance rating and disclosure in the U.S. and certification and labeling in EU member states as part of national compliance with the European Commission's Energy Performance in Buildings Directive (EPBD). The experiences of Australia, Canada, China, Japan, North Korea, Singapore, Mexico and Brazil are also briefly summarized for reference. Based on experience with building energy rating, disclosure, certification, and labeling in the reviewed countries, it can be concluded that a strong building energy rating and certification systems should have several functions and fulfill various criteria:

- Provide a strong technical and methodological foundation for assessing building energy performance, linked to national standards and codes (or international standards, as needed);
- Employ a standard and replicable approach allowing comparison among buildings;
- Allow for in-depth technical evaluation, while also producing simple, non-technical summary information for the label to be used by non-technical consumers;
- Make the rating and certification result—the label—available publicly;
- Select the rating method—i.e., calculated (asset) or measured (operational)—based on administrative enforceability, rating quality, cost, and applicability to building types, and information needs of multiple users;
- Provide recommendations and/or requirements for improving energy efficiency in underperforming buildings;
- Integrate building certification with overall building energy efficiency policy to serve as a basis for incentives and/or penalties associated with energy performance; and
- Ensure that the certification and labeling data output is organized and available to policymakers, consumers, and industry, as well as integrated with national statistics on energy use and GHG emissions, while preserving confidentiality of individual building records.

It is noteworthy, that not all countries' certification and labeling programs contain all of the above elements. In the U.S., where the building energy rating practice is more recent than in the EU, asset rating is based on a more limited set of data inputs, and does not encompass a detailed analysis of building energy use, nor does it provide recommendations for improvement of energy use following the rating.

Because building energy performance rating, certification and labeling are components of state policy regulating building energy performance, a necessary prerequisite for designing a successful labeling initiative is the elimination of the gaps and weaknesses identified in the Ukrainian building energy codes and norms. An earlier exercise by the USAID Municipal Heating Reform Program in Ukraine has analyzed and revealed the areas in the Ukrainian building codes requiring immediate, medium-term and longer-term intervention—in the areas of both legislative and technical improvements. These include strengthening of the minimum efficiency requirements for building envelope; introduction of efficiency requirements for fenestration, lighting, and HVAC systems; and harmonization of provisions for technical inspection of building energy systems with the EU norms. It is also noteworthy that the EU EPBD certification practices have been partially tested in Ukraine through the piloting of the EU Display Campaign in Lviv, with support from the Lviv municipality. This provides a useful learning curve for application of operational rating in Ukraine's public buildings. Asset rating, which is the more appropriate tool for newly constructed and reconstructed buildings, is yet to be tested. A few jurisdictions in the United States and 17 out of reviewed 27 EU countries exercise asset rating in most or all of the building types.

In all of the EU member states, EPBD stipulates mandatory energy certification for new and reconstructed buildings; in some countries it is also mandatory for large and commercial buildings, although it remains voluntary for existing buildings. Because of Ukraine's status as an Energy Community Contracting Party, complying with the EPBD provisions is important for its transposition.[1]

This report analyzes the relevance of current Ukraine and other Commonwealth of Independent States (CIS) countries' building energy passportization for further cultivation into a certification and labeling framework. The preliminary findings indicate that the current legislative and normative basis for passportization can reformed and, if supported with upgraded building energy codes, auditing procedures, norms and standards, will provide an adequate platform for building energy labeling. The report also describes and analyzes the advantages and drawbacks of the two main approaches to building energy rating: calculated (asset) or measured (operational), with potential applicability to Ukraine based on data availability and cost considerations. While more cost-intensive, asset (calculated) rating is more appropriate for Ukraine's newly constructed and reconstructed building stock with planned gradual introduction of measured (operational) rating for other building categories.

The existing international experience with asset rating systems allows a choice of input parameters for energy performance calculation: primary energy, delivered energy, energy demand[2], or carbon dioxide emissions, with no distinct preference for either of them. For example, Portugal, Ireland and Denmark demand primary energy and CO_2 emission analysis for certification, Czech Republic focuses on delivered energy and CO_2 emissions, while Slovakia stipulates delivered and primary energy, as well as CO_2 emissions.

In addition to establishing the necessary legal and regulatory framework, effective enforcement of certification and labeling will require the provision of targeted training and the launch of an accreditation system for ensuring the quality of certification and labeling by authorized, qualified assessors. The certificates should not only rate the building energy performance, but also should provide recommendations for cost-effective or cost-optimal energy efficiency improvements and the economic forecast for their effectiveness, including payback.

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[1] For more information, see the Energy Community website at www.energy-community.org/

[2] usually expressed in kWh/m^2 per year

In most cases, the costs of certification are borne by building owners. The Government has the responsibility to ensure the enforcement of building energy performance certification and labeling through the following functions, performed by a designated government entity:

- Improvement of building energy codes, norms, and standards; building envelope thermal protection; efficiency requirements for fenestration; lighting and HVAC system elements; consideration of renewable energy sources in the building energy system; and provisions for inspection of HVAC and energy auditing regulations. All of these are prerequisites for the development of the building energy certification and labeling process;
- Selection and introduction of building energy rating system (operational or asset);
- Establishment of qualification requirements, testing procedures, and examination committee, and organization of experts' examinations;
- Issuance of certificates to authorized, accredited experts; maintenance of the registrar of certified experts; and organization of expert technical trainings and programs to strengthen their capacity in quality assurance;
- Ensuring disclosure of building energy certificates;
- Establishing and operating a monitoring system;
- Analyzing results of energy certification and communicating them to the national energy policymakers, and ensuring they are included in official statistics;
- Regular review and revision of energy rating scales and applied methodologies (asset vs operational rating; delivered vs. primary energy) depending on data availability, policy ambitions, and other factors.

Summary of International Experience in Building Energy Certification and Labeling Policy

Despite the strong global interest in demand-side energy management, efforts to date to measure building energy performance—a key prerequisite for managing energy use and improving energy efficiency (EE)—have had limited success.

Building energy labeling is a tool for assessing and rating building energy performance and communicating that information in useful ways to market actors. By providing information about the energy consumption of a building, using a commonly accepted and public ranking scale, labels enable building owners to set energy performance targets and track dynamics over time. Disclosure of energy-related building characteristic and/or actual energy performance to prospective buyers, tenants, lenders, and other market actors also helps to incorporate energy efficiency into the asset value of the building – providing an incentive for voluntary actions by building owners to improve energy efficiency. As a common benchmarking tool, labels also allow the publicizing of best practices in new construction, building rehabilitation, and thermal modernization.

Energy labeling practices were launched in numerous countries in the 1990s, and the impacts of such programs on building energy efficiency, s well as occupancy have been significant. The Institute for Market Transformation reports that properties with superior energy efficiency ratings have higher occupancy levels, lease rates, and sale prices than less efficient properties. For example, in the United States, a sample group of Energy Star-rated buildings in 2009 had 3.5 percent lower vacancy rates and 13 percent higher rental rates than the market average.[3] Individuals and businesses investing or leasing property seek energy efficiency among building properties and, through willingness-to-pay a higher price, demand that the market supplies energy efficient buildings which will help owners and occupants save on energy bills. In a saturated property market, especially in times of economic downturn, energy efficiency becomes a competitiveness advantage; hence both developers and investors should be interested in publicizing (and improving) building energy performance.

Internationally, energy rating and disclosure (in European terms, energy performance certification and labeling) have gradually received increasing acceptance and appreciation. Due to the growing public awareness of appliance and vehicle labeling, building energy labels have a greater chance of acceptance as a tool for identifying buildings with lower energy costs. This has the potential to boost the market for efficient buildings, trigger competition, and create transparent progress through benchmarking.

In many parts of the world, including the European Union (EU), some parts of the United States, Brazil, Australia, and China, certifying and labeling the energy performance of buildings is mandatory. Since buildings are estimated to account for over 40 percent of average national energy consumption, and have very high energy saving potential, the focus on building energy labeling has been growing. In 1997, Denmark became the first country to launch a building energy labeling regulation. Five years later this practice infiltrated EU legislation through the 2002 Energy Performance of Buildings Directive (EPBD), which requires building energy rating and disclosure programs in all member states. Today, building energy certification and labeling initiatives are underway in more than 50 countries, regions, and cities around the world,

[3] Background on the Economic Benefits of Building Energy Performance Benchmarking, Disclosure and Labeling. IMT and Resource Media. Available at http://www.imt.org.

including the EU, Brazil, China, and Australia, and some of the largest cities in the United States. More than 30 countries have incorporated building energy rating into their national legislation.

Building energy rating practices in the United States have evolved since 2007 at the state or city levels, and have focused primarily on commercial, non-residential, and multi-family buildings. The states of California and Washington, the cities of Austin, New York, San Francisco and Seattle, and the District of Columbia have enacted policies requiring the benchmarking and disclosure of commercial building energy performance. Other city and state initiatives are pending. The main focus in U.S. jurisdictions has been on a measured (operational) rating for new and existing homes while most commercial building energy ratings (with one exception, a new initiative in Massachusetts) use a measured (operational) energy rating approach based on the EPA ENERGY STAR Portfolio Manager tool.[4] The below list provides the range of approaches tested by various jurisdictions in the U.S. and the member states of the EU to some or other extent include:[5]

- Requiring regular building energy performance rating and disclosure;
- Requiring rating and disclosure prior to a real estate or financial transaction;
- Reporting building performance information to government;
- Making building energy performance information public on the internet;
- Ensuring tenant and lender access to building energy rating info;
- Requiring that ratings be followed by EE measures; and
- Setting minimum rating standards for government leases.

A number of software and virtual tools are available for rating buildings. These are briefly summarized below and described in more detail further in this report:

- The U.S. Environmental Protection Agency (US EPA) Energy Star for Homes label is a voluntary "endorsement" energy label rather than a comparison label that includes both a performance path (based on a HERS rating) and a prescriptive path. More than 1 million new US homes (24% of new home starts in 2010) have qualified for the Energy Star label.
- The EPA Energy Star Portfolio Manager provides operational rating tools for commercial and institutional facilities, including guides and manuals not only for the rating, but also for the subsequent energy management and building upgrade steps.
- The RESNET HERS index is a voluntary comparative energy labeling scheme established by the Residential Energy Services Network (RESNET), in which a home built to the specifications of the HERS Reference Home (based on the 2004 International Energy Conservation Code) scores a HERS Index of 100, while a net-zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home.
- The ASHRAE Advanced Building Energy Labeling (ABEL) program is based on the Building Energy Quotient (bEQ) label, together with a supporting certificate. The label is applicable to existing buildings, using the As Operated (Operational) Rating, and to new buildings using the As Designed (Asset) Rating.
- The U.S. Green Building Council (USGBC)'s Leadership in Energy and Environmental Design (LEED) system is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. LEED ratings consider various aspects of "green building" and award recognition to buildings that meet certain standards. The LEED process grants credits in several categories associated with green buildings. These differ by the type

[4] See http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

[5] Burr A., C.Majersik and N. Zigelbaum. The Future of Building Energy Rating and Disclosure Mandates: What Europe Can Learn From the United States.

of LEED certification, but generally include: sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, and innovation.

- The DOE Home Energy Score is a simplified operational energy rating that allows a homeowner to compare her or his home's energy consumption to that of other homes, using a 10 point scale (10 is the best energy performance, 1 the worst), accompanied by a list of recommended energy efficiency improvements and approximate costs and savings.

Certification Approach: Calculated (Asset) or Measured (Operational) Rating

While terminologies may vary, the approaches for evaluating and rating the efficiency of building energy performance can generally be grouped into the following two main categories:

- **ASSET RATINGS/ Calculated energy performance:** Mainly applied for new or rehabilitated buildings, where the factual energy consumption is not known and can only be projected analytically, asset rating allows the use of simulation and modeling to project energy efficiency of the building based on the characteristics of design and construction, energy audit findings, and engineering tests. While an asset rating is not validated by actual building energy use data, its advantage is that it can reflect in a replicable way the overall energy-related characteristics of the building as a physical asset, separate from the variance in performance due to occupancy schedules, occupant behavior, and the skill level and day to day practices of building operators.

- **OPERATIONAL RATINGS/Measured energy performance:** In cases where a building is occupied and utility consumption data available, the building is assessed, analyzed, and ranked based on energy use in comparable buildings. Energy management and accounting software tools can be used for this exercise. For example, the in U.S., the Environmental Protection Agency's Portfolio Manager[6] online tool allows the determination of a building's relative energy efficiency using a year's worth of energy consumption data – in some cases "normalized" for differences in weather conditions, operating hours, indoor temperature settings, number of personal computers and other "plug loads," etc.

  For example, ASHRAE documentation proposes the following formulae for the Energy Use Index (EUI), to be used in building energy performance rating within the Building Energy Quotient certification and labeling:

Asset rating Formula

$$bEQ_{Asset} = \frac{EUI_{As\text{-}built}}{EUI_{standard}} \times 100$$

Operational Rating Formula

$$bEQ_{Operationsl} = \frac{EUI_{Measured}}{EUI_{Median}} \times 100$$

Source: http://buildingeq.com

Note that these two indices, one an asset rating and the other an operational rating, are difficult to compare directly, even for the same building – since the asset rating is normalized using the EUI for the same building if built to just meet the local building energy code, while the operational rating is normalized to a median EUI for that building type in the stock of existing buildings.

[6] For more information see:
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Table 1. Energy performance certification method used) indicates the choice of the rating/assessment method in numerous countries, including the EU. As the table shows, both the choice of methodology and the strictness of the regulation often depend on the building age and type. As can be seen from the table, most countries in the EU use the calculated (asset) rating method of building energy performance, predominantly due to the limited data availability on energy end use in existing buildings as well as the stronger policy focus on newly constructed and rehabilitated/reconstructed buildings, where asset rating is the only applicable solution. Another reason that measured (operational) rating is used less often is the difficulty of standardizing or subdividing building energy end use in cases of multiple occupancy. Asset rating is more user-neutral, since certification is targeted at the building, and not the user.

One reason for using the measured (operational) rating system is that this system is less labor-intensive (and thus less costly) than calculated (asset) rating. This is because measured energy consumption can relatively easily be derived from utility bills (if available), while for asset rating complex multi-parameter calculations are necessary. Complications may arise for in the case of multi-tenant or/and multi-meter buildings, which is often the case for larger commercial or multi-family buildings.

Table 1. Energy performance certificationmethod used

Country	Asset Rating/ Calculated energy performance for all building types and ages	Operational Rating/ Measured energy performance for all building types and ages	Method and/or strictness depends on the building type and/or age
Austria	X		
Belgium			X
Bulgaria	X	X	
Cyprus	X		
Denmark	X		
Estonia			X
Finland			X
France			X
Greece			X
Hungary	X		
Ireland			X
Italy	X		
Latvia	X	X	
Lithuania	X		
Luxemburg			X
Netherlands	X		
Poland	X		
Portugal	X		
Romania	X		
Slovak Republic	X	X	
Slovenia			X
Sweden		X	
UK			X
Croatia	X		
Norway	X		
Switzerland	X	X	
USA	X	X	

Governments must consider the various pros and cons of the different types of rating schemes before choosing a rating method. The below table compares the features of both approaches to assist with the decision-making process.

Table 2. Comparative Analysis of Operational and Asset Rating Approaches

Comparison Categories	**Operational Rating "Measured" or "In Operation"**	**Asset Rating "Calculated" or "As Designed/As Built"**
Objective	To improve operations	To value property
Base for Rating	Rating is based on measured energy usage, adjusted for weather and other factors	Rates the building, not the occupancy and operation.
Verification Requirement	No inherent requirement for field verification	Field verification is a requirement
Approach & Methodology	Ratings sometimes adjusted based on levels of service	Focus is on the physical building characteristics - the "bricks & mortar" - plus permanent energy systems Rating is derived from a model-based estimate of energy usage Differences in operational behavior are ignored
Application	Good for use in existing building energy efficiency incentive programs Good for managing building portfolios over time	Good for valuing building performance within a financial transaction Can provide a basis for energy efficiency code compliance and beyond code new construction incentive programs
Examples	U.S. EPA's ENERGY STAR® Portfolio Manager	RESNET and California Energy Commission (CEC) Home Energy Rating Systems

Since building energy use statistics are fragmented in Ukraine, and it is common for new rating and labeling policies to focus first on new and reconstructed buildings, calculated/asset rating is recommended for the first phase of Ukraine's building energy certification framework. Gradually, as the policy penetration rate is expanded, Ukraine may follow the example of other countries in the region and differentiate the rating method by building type (e.g., measured for existing buildings, and calculated for newly constructed buildings).

For example, Denmark decided to use asset rating (or calculated data) for all new and existing building types. Later, however, Denmark switched to operational rating for large and complex buildings, because the costs to establish asset certification were seen to be too high relative to the benefits for these buildings, particularly for those that required regular certification. The other EU countries predominantly use operational (measured) rating for large public and commercial buildings and apply asset (calculated) ratings for small, individually owned buildings and for all new buildings—for both cost and convenience considerations.

To establish an effective building energy certification scheme for Ukraine, political decisions must be made on the following key parameters:

- Energy rating method (asset/calculated or operational/measured), assigned by building types;
- Method/requirements for adjustment/verification of measured data, if operational energy rating is selected;
- Calculation methodology (and software tools, if relevant);
- Procedures and rules for energy auditing and certification of buildings, and developing the linkage between the efficiency requirements of the building energy codes and building energy rating scheme;
- Training requirements for certification experts and energy auditors; and

- Identification of certified qualified experts for conducting building energy rating/certification.

Aside from the above technical regulatory requirements, establishing and effectively enforcing a building energy certification and labeling framework requires a number of promotional activities which will help raise the acceptance and transparency of the process:

- Communication and promotion;
- Establishing a quality assurance, control and registration system;
- Enforcement and sanctioning;
- Data collection, database management, monitoring and progress reporting procedures;
- Linkage and monitoring with respect to national and international policy goals;
- Financial issues such as budget and cost of individual certificates/labels; and
- Mitigating and managing the administrative burdens.

The Building Performance Institute Europe (BPIE) provided the following practical recommendations for helping improve the effectiveness of energy performance certification:[7]

- Design the scheme to involve multidisciplinary stakeholders and pay attention to the exchange of experience and knowledge development;
- Pay close attention to the responsibilities at different legislative levels in the implementation process; and
- Make the implementation approach fit with everyday practice.

In addition to incorporating experience from the U.S., EU, Australia, and a number of other countries, the design of a building energy rating and certification system for Ukraine must also take into account the country's existing legal and regulatory framework on building energy passportization, linked to the current building energy codes. While many of the technical standards and norms need to be strengthened or developed anew, the Energy Passport was first developed as a tool for demonstrating compliance with Ukraine's thermal-performance codes, similar to the related practices in other CIS countries, and provides information about energy efficiency of the building (in many aspects following EU requirements for certification of buildings). The Energy Passport also includes a set of energy classes (from "A" through "F"); new or reconstructed buildings are expected to rate a class of C or above. The Energy Passport is now used in Russia, Kazakhstan and Kyrgyzstan as well, as part of their analogous codes. In all of these countries, a building designer enters design data into required fields of the Energy Passport form, which can be on paper or in an electronic spreadsheet. Approved calculation methodologies are used to turn input data into an estimate of whole-building energy consumption. This estimate is then compared with code-stipulated target levels; if the calculated consumption level is below the target, then the building complies with the code.

Beyond code compliance at the design stage, Energy Passports can also be used to record energy consumption during building operation. Ideally, measured consumption data can be compared with design data, to indicate whether the building is operating as designed and whether maintenance or other action is required. Design data, operating data, or both together, can be used as a basis for a building energy rating and label, with associated incentives or penalties. Applied widely, they could form a practical basis for national systems of energy and greenhouse gas (GHG) accounting for the building sector. However, the calculation methodology and A–F class ranking do not correspond to the European norms. The certification and labeling procedures for Ukraine will require development of a methodology and adequate norms, as well

[7] BPIE. Energy Performance Certificates across Europe: From design to implementation. 2010

as strengthening of the building energy codes, as recommended by the Municipal Heating Reform Project in Ukraine.

These additional dimensions of the Energy Passport have not yet been realized in practice, and therefore the system is used only for code compliance based on design. Notably, moreover, Energy Passports, as currently used in Russia and Central Asia, address only thermal performance, including the building envelope and the overall efficiency of heat delivery, but not other end uses (e.g., lighting and ventilation, application of solar water heaters and heat pumps). Despite the limitations of Energy Passports in practice so far, they are a logical starting point for a certification system in Ukraine, especially because they are already a part of the thermal-performance ДБН-s[8] mentioned above. The challenge is to expand the functions of the Energy Passport to be consistent with international best practices in both certification and integrated building design.

Energy Performance Certification (Certificate and Label Design)

Energy certificate/label design, format, and content should be developed such that the label provides clear information to the users, while allowing a clear basis for comparison with other buildings. The rating scheme defines the scale and the rating step. Rating scales should be detailed, yet flexible enough to make it possible to rate future buildings that perform better and to demonstrate improvements in existing buildings. International experience should not be copied blindly; however, a given region's successful certification and labeling scheme can be used as a foundation and to help consumers understand the label and the information it provides.
There is a wide variety of existing building energy labels.[9] Most of the labels have similar content, although some contain more information than others on the state of efficiency in building energy use. The minimum required information presented in most certificates and labels rates/benchmarks the building's specific energy need; more informative labels also indicate the environmental impact of the building energy use. Energy certificates also can contain information on primary energy and CO_2 emissions.

All European and most U.S. labels use two main types of graphic schemes to illustrate the energy rating: stepped (also benchmarked A, B, C, etc. as shown on the right in Figure 1) or continuous colored band strips (on the left in Figure 1). The physical units used in different countries for assessing and benchmarking energy performance of buildings vary, but the most common is kWh/m^2 per annum (See Table 3. Information Presented on Energy Performance Certificates in Selected EU Countries).

[8] Construction norms in Ukrainian

[9] A collection of building label images throughout the world can be found at http://www.buildingrating.org/content/energy-label-gallery.

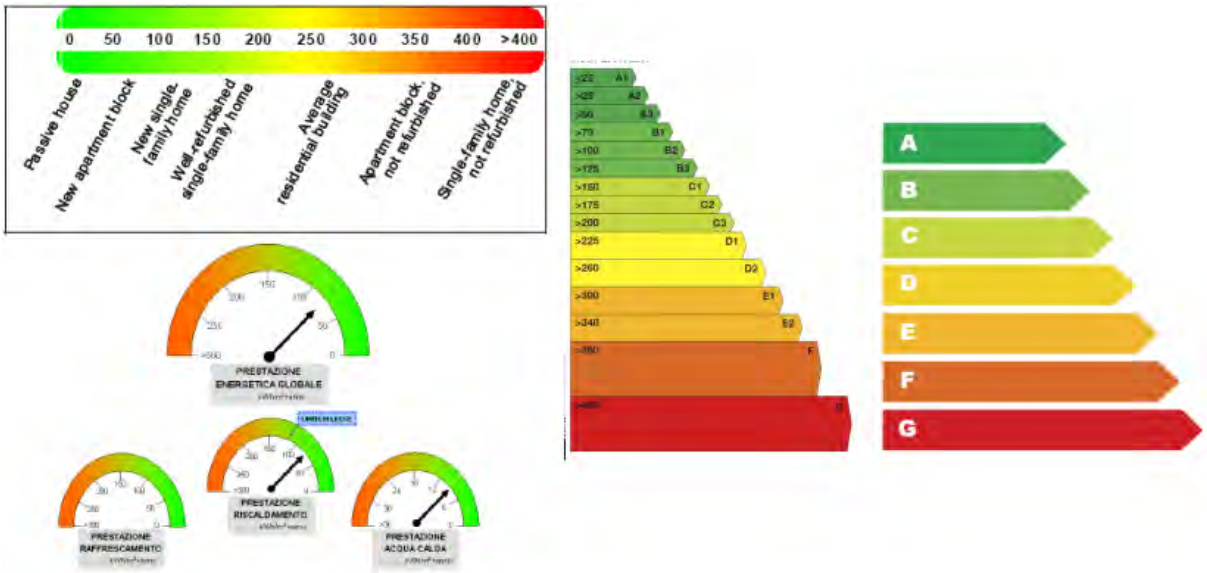

Figure 1. Examples of rating types

Poor energy performance is usually indicated with dark red, while good energy performance is shown as green, promoting an association with green buildings. The date of issue must be indicated on the certificate, since the certification must be regularly renewed (usually every five years).

For many countries in the European Union, as part of the EPBD, the certification of new buildings offers the potential to be recognized for reaching efficiency levels above the building code. On a scale of A to G, classes such as A, B, or A+ and A++ are used to indicate that these buildings are built better than standard. Some countries have used a large part of the scale or even the whole scale to show the difference in new buildings, using all the letters from A to G to classify new buildings, whereas the existing buildings are off the scale (less efficient than class G).

In Australia, different numbers of stars, up to a maximum of five, are used to show the efficiency of buildings. With the increase in energy efficiency requirements over time, the minimum requirements in the state of Victoria are equivalent to five stars—an indication of the importance of a flexible and evolving rating system.

In the U.S., a label called ENERGY STAR is displayed on homes that use 15% less energy than the requirements in efficiency standards for new homes as defined in IECC 2004.

To be effective, a building energy certification system must include at least the energy performance indicator, information on projected or actual energy costs, and a label. Other types of information can include:

1. administrative data such as building address, date, certifier name, etc. to identify a building and a certifier,
2. energy variables to be controlled and inspected by competent bodies, and
3. information gathered by the energy agencies to populate their building database (e.g., building type, total area, conditioned area, HVAC system type, energy sources).

Table 3. Information Presented on Energy Performance Certificates in Selected EU Countries

Information on the Certificate	Austria	Belgium	Czech Rep	Denmark	France	Germany	Hungary	Nether-lands	Poland	Portugal	Spain

Labeling Classes	'A++' to 'G'	'A' to 'G'	A' to 'G'	'A' to 'I'	Res: 'A'to'G'; non-res: 'A' to 'I'	No (sliding indicator, no classification)	A+' to 'G'	'A++' to 'G'	No (sliding indicator, no classi-fication)	A+' to 'G'	A' to 'G'
Performance Indicator	kWh/ m2a	kWh/ m2a	GJ/ year	Not spec if.	kWh/ m2a	kWh/ m2a	Not spec if.	Energy index	Not specif.	kWh/ m2a	Not specif.
Label present situation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Label after measures	No	No	Yes	Yes	No, but calculated rating after EE	No	Not spec if.	No	Not specif.	Yes	Not specif.
Recommendations	No	Yes	Yes	Yes	Yes: For calculated rating with a cost and payback For measured rating - only indicated	Yes	Not spec if.	Yes	Yes	Yes	Not specif.

The energy performance certificate (not the label) also contains information on the assessor's recommended energy efficiency improvements, which should bring the building's energy performance to cost-effective or, if the norms state, cost-optimal; the energy efficiency solutions can only be ignored if a substantial justification is provided on their unacceptability for rational reasons. In the EU, depending on the country, the certificate may also specify the economic performance of the suggested measures (e.g., years of payback).

Minimum Requirements

One of the key regulatory provisions for energy performance certification and labeling is the establishment of technical standards or other minimum efficiency requirements, against which building energy rating will assess and benchmark the certified building.

There is no need for a separate set of standards and benchmarks for energy labeling. The energy efficiency requirements included in buildings codes are usually the minimum requirements, for which the building energy performance assessment screens. The result of this assessment is documented in the certification process and published in the label.

If the building industry is familiar with the general requirements in the building codes, integrating efficiency requirements can efficiently inform industry actors of energy conservation measures.

In the U.S., the building energy rating process addresses many of the same efficiency requirements fixed in the standards and building codes, specifically:

- Heating & Cooling (Air-source Heat Pumps, Boilers, Central AC, Ceiling Fans, Furnaces, Geothermal Heat Pumps, Home Sealing and Insulation, Light Commercial, Programmable Thermostats, Room AC, Ventilating Fans, etc.), and
- Home Envelope (Home Sealing (Insulation and Air Sealing), Roof Products, Windows, Doors, & Skylights).

Nonetheless, since there still is no federal mandatory rating policy, no standardized approach exists for building benchmarking against minimum requirements. The standards and codes provide a reference point for the new construction.[10]

Energy efficiency requirements included in building codes are often brief, while specific standards are typically longer and more comprehensive. Some countries mix both approaches by referring to standards within codes and regulations. For example, in Germany, general building regulations refer to many specific national standards. In many other countries, specific guidelines to describe calculation rules and their use accompany building codes such that the general rules appear in the building code, while standards contain specific details. Many jurisdictions refer to national or international (e.g., European Committee for Standardization (CEN) or International Organization for Standardization (ISO)) standards.

The Directive 2006/32/EC on energy end-use efficiency and energy services (ESD) categorizes the building energy performance certification equivalent to an energy audit. Hence, an energy audit conducted in compliance with all requirements of the ESD is sufficient for compliance with certification requirements and can serve as a basis for labeling.

The following standards are assigned to provide the technical basis for EPBD Implementation within the European Union:[11]

- EN 15217 - Methods of assessment for energy certification of buildings, guidelines for certification schemes
  - As different forms of energy can be delivered to a building (e.g., district heating, gas, electricity, wood), the indicator will be a weighted sum of these delivered energies. Depending of the weight chosen, the indicator can represent either (i) Primary energy; (ii) Delivered Energy; (iii) CO_2 emissions; or (iv) Total energy cost.
- EN 15603 - Overall energy use, primary energy and CO_2 emissions: (for certificate and/or member state authorities)
  - Assessment of energy use and definition of ratings - Total Building Energy Demand, for heating cooling, hot water and lighting, including system losses and auxiliary energy, identified by energy carrier; procedures for (i) Asset Rating or (ii) Operational Rating.
- EN 15316 - Methods for calculation of heating system energy requirements and system efficiencies (13 parts)
- EN ISO 13790 - Calculation of energy use for space heating and cooling: the calculation of the energy demand of the building for heating and cooling (taking account of all losses and gains)

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[10] In the US the model energy code for residential buildings is the International Energy Conservation Code (IECC at iccsafe.org) while for non-residential buildings it is ASHRAE Standard 90.1(techstreet.com) The status of actual energy codes adopted in each state or local jurisdiction is on the BCAP OCEAN website (bcap-ocean.org).

[11] Overview of CENs available at http://www.iee-cense.eu/upload/sites/iee-cense/external%20website/announcements/workshop%20brussels%2029%20june/sc-n013%20brussels%2029%20june%20workshop%20presentation%20jh.pdf

- EN 15243 - Performance requirements for dynamic calculation of room temperatures and of load and energy for buildings with room conditioning systems (including solar shading, passive cooling, position and orientation)
- EN 15378 - Methods for Boiler Inspections
- EN 15240 - Methods for Air-conditioning Inspections
- EN 15239 - Methods for Inspection of Ventilation Systems

The CENs 15217 and 15603, along with Article 7 of EPBD, provide the normative foundation for certification. [12]

The European approach is to set a minimum energy rating for new/major renovated buildings and minimum energy performance requirements for building elements that form part of the building envelope.

When setting requirements, EU member states differentiate between new and existing buildings and between categories of buildings. The EPBD allows the exclusion of certain types of buildings, e.g., officially protected buildings, religious and worship buildings, temporary buildings, buildings in use less than 2 years, non-residential agricultural buildings with low energy demand and non-residential agricultural buildings, stand alone buildings with total floor area less than 50 m^2.

However, most of the EU countries—with the exception of Slovakia, the Czech Republic and Hungary— apply minimum requirements on all new buildings without any building area threshold. Slovakia applies a threshold of 50m^2. In Hungary, minimum requirements are applied to all new buildings, but only to major renovated buildings over 1000 m^2 (this is expected to be changed to 200 m^2).

Some countries do not define minimum requirements for major building renovations. For those that do, minimum energy performance requirements can be defined using a variety of approaches:
- minimum requirements for major renovated buildings are obligatory and are the same as for new buildings,
- minimum requirements are different than for new buildings (e.g., according to building construction year), or
- minimum requirements are same as for new buildings but must be achieved only if cost-effective.

Calculation of building energy efficiency as defined in current Ukrainian building norms (ДБН) takes into account thermal characteristics of building structures, the built area of structures, and internal volume of the air heating system (through general coefficients), air exchange rate, and internal and solar gains.

The energy performance method in the EPBD takes into account the following parameters:

- thermal characteristics of the building structures;
- heating system installation and hot water supply, including their insulation characteristics;

[12] System and building energy needs for heating, cooling, humidification, dehumidification, hot water, lighting and ventilation systems are defined by EN ISO 13790, EN 15316-1, EN 15316-2.1, EN 15243,EN 15316-3, EN 15316-4, EN 15265, EN 15193, EN 15241, EN 15232. Definitions and terminology, external climate data, indoor conditions, overheating and solar protection, thermal performance of building components, ventilation and air infiltration are prescribed predominantly in EN ISO 6946, EN ISO 13370, EN ISO 10077-1, EN 13947, EN ISO 10211, EN ISO 10077-2,EN ISO 14683, EN ISO 10456, EN 15242,EN 13779,EN 15251,EN ISO 15927, EN ISO 7345, EN ISO 9288, EN ISO 925, EN 12792.

- position and orientation of buildings, including outdoor climate;
- indoor climatic conditions, including calculation of air exchange rate;
- internal and solar gains;
- seasonal calculation for dwelling buildings and monthly method for non-dwelling buildings;
- ventilation and air-conditioning; and
- indoor lighting.

Box 1. Ukrainian Norms Framework for Building Envelope Heat Transfer Coefficient Applicable for Building Energy Rating

ДСТУ-Н Б А.2.2-5:2007 «Instructions on Development and Preparation of Energy Certificates (passport) of the Buildings at New Construction and Reconstruction" the following formula could be used:

$$H' = \frac{k_{\Sigma пр} \cdot F_{\Sigma}}{F_l} = \xi \frac{\left(\frac{F_{нп}}{R_{\Sigma прнп}} + \frac{F_{сп}}{R_{\Sigma прсп}} + \frac{F_{д}}{R_{\Sigma прд}} + \frac{F_{пк}}{R_{\Sigma прпк}} + \frac{F_{ц}}{R_{\Sigma прц}} \right)}{F_l}$$

where:

$k_{\Sigma\, пр}$ – adjusted U-value of the heat insulation envelope of the building, W/m2K

ξ – factor which counts for additional heat losses connected with envelope orientation, availability of corner rooms, cold air penetration through entrances.

$F_{нп}$, $F_{сп}$, $F_{д}$, $F_{пк}$, $F_{ц}$– area of walls, windows, doors, roof, floor slabs (or floors on the ground)
$R_{\Sigma пр\, нп}$, $R_{\Sigma пр\, сп}$, $R_{\Sigma пр\, д}$, $R_{\Sigma пр\, пк}$, $R_{\Sigma пр\, ц}$– adjusted thermal resistance of walls, windows, doors, roof, floor slabs (or floors on the ground – considering their division into zones)
F_{Σ}– total area of indoor surface of building envelope
F_l– useful area of the building (or heated area, depending on the decision of National Authority)
Such rated heat transfer coefficient (H') could be also specified in more details, giving the limits for each envelope element (walls, windows, roof, floor) or for infiltration.

Many additional norms need to be developed or upgraded in the Ukrainian regulations to provide a comprehensive technical base for building energy certification, including U-values for fenestration, HVAC system efficiency requirements, lighting appliances, and indoor air quality and comfort requirements.

The MHRP Task 4.2 team (ASE, ENSI and SRIBC) has provided recommendations with respect to the areas in which the Ukrainian norms should be strengthened, specifically revising the calculation formula in the Ukrainian methodology given in ДСТУ-Н Б А.2.2-5:2007 «Instructions on Development and Preparation of Energy Certificates (passport) of the Buildings at New Construction and Reconstruction"; introducing U-values for building fenestration, and establishing up-to-date efficiency requirements for HVAC systems, heat recovery and insulation in the В.2.5-XX-20XX «Engineering Systems of Buildings. Heating Ventilation and Air Conditioning", as well as integrating solar water heating features and applying heat pumps. (*Source: SRIBC)*

Carbon Index

The result of energy certification (the Energy Certificate) in the EU clearly displays the current energy class of the building and is in a user-friendly format that is easy for the public to understand. It displays the e-rating scale, and also provides the reference value for the given type of building, as well as the estimated CO_2 production resulting from the building's energy consumption and the primary energy scale. The Energy Certificate also includes proposed measures for improving the building's energy performance.

Ireland is one of the few countries that specifically require labels to include information on the building's carbon footprint. For both residential and non-residential buildings, Ireland's certification regulation not only regulates maximum permitted values of the Energy Performance Coefficient, but also regulates buildings using a Carbon Performance Coefficient (CPC).

The performance indicators in many countries (e.g., Slovakia, Ireland, Romania, Denmark –see Table A. 2. EPBD Key Requirements Implementation in Reviewed EU countries) are linked to either final/delivered energy or CO_2 emissions.

Many of the EU regulations include additional technical information to support energy certification and labeling programs. For example, the regulation on energy certification and inspection of boilers (defined in line with ISO EN standards) includes a CO_2 emissions coefficient, along with other physical and technical parameters (e.g., total floor area, external dimension, thermal envelope area, shape factor of building, energy carrier, energy need for heating, energy need for domestic hot water, auxiliary energy, system thermal loss, recoverable system thermal loss, delivered energy, renewable energy produced on the building site, primary energy).

Cost of the Certificate/Label

The cost of energy performance certification and labeling is one of the key factors affecting the success and acceptance of this policy tool. While the adoption of simpler methodologies can help keep program costs down, such methodologies can also result in unreliable outcomes; this can, in turn, damage confidence in and acceptance of the label. The BPIE has collected a range of estimates of the energy performance certificate costs from a number of EU member states for residential buildings; using as a reference point the average income per capita in the different countries—see **Table 4. Cost of Energy Performance Certification** .

Table 4. Cost of Energy Performance Certification

Selected EU countries with Reference to Average Income per Capita

Country	Minimum Cost (€)	Maximum cost (€)	income per capita (€)
Germany	45	500	34200
France	50	300	32800
Austria	150	180	38300
Belgium	205	245	36200
Czech Rep.	500	800	23700
Denmark	700	800	37200
Poland	50	100	15500
Portugal	224	324	21900
Netherlands	2009	2010	38600
Ireland	200	200	45100
Spain	800	800	33100
Hungary	50	50	19300

(Source: BPIE 2010)

Labeling Quality Assurance

As noted, energy performance certificates and labels trigger the real estate market and affect occupancy and sales. Hence, the quality of certification and the accuracy of information on the label have to be reliable. The quality of certification has several variables:

- Quality, transparency and effectiveness of the certification system;
- Quality of experts and training providers;
- Label design and understandability; and
- Quality of inspections of HVAC systems.

Comprehensive building energy databases can facilitate effective quality control of the issued Energy Performance Certificates (EPCs) and ensure their consistency, by providing the infrastructure to monitor the quality of work of different energy experts. In a number of countries (e.g., in Belgium-Flanders, Ireland, the Netherlands and Portugal), such databases are effectively used for quality control. In Austria, regional databases are set up to perform a basic consistency check. For comparison, in other countries experts are responsible for performing quality control of their own work, without effective external control mechanisms (Germany) or with limited external sample performance checks (e.g., France and Hungary).

While quality assurance (QA) has been a low priority for most European countries, certification quality has gradually been gaining government attention. While some countries are considering voluntary QA systems, there is general consensus on the need for mandatory QA systems for energy performance certification. In Denmark, for example, the Government delegates certification services to accredited companies holding ISO 9001 standard certificate. Consequently, the accredited companies enforce a QA procedure internally, which is inspected by the Government agency regularly. Failure to meet the QA standards can result in the loss of accreditation, mandatory additional training, further scrutiny over other certificates issued by the given expert, nullification of the certificate in question, a fine, or a mandate to issue a certificate free of charge.

Cost and Other Considerations for Quality Assurance

The cost of QA is primarily incurred by individual experts. In cases where the Government bears the QA cost, it becomes part of the general energy performance certification system cost. If an automated, electronic database of certificates exists, the QA can also be automated; if not, it can be implemented manually for all certificates or for a random sample either through desk audits or through on-site re-certification with the use of the same methodology (e.g., in Denmark).

Using accredited firms and companies for certification and labeling has the advantage of providing access to an established internal QA procedure, as well as providing the flexibility of using experts with a broad range of qualifications for the same buildings. On the other hand, company-level accreditation limits the freedom and access of the Government QA agency to make an intervention in the companies' internal affairs.

Summarizing the findings of the EPBD Concerted Action,[13] the following issues need to be discussed by Governments before setting up a QA system:

[13] EPBD Concerted Action (CA) is a joint initiative of the EU Member States and the European Commission was launched in 2005. It involves those representatives of national ministries or their affiliated institutions charged with preparing the technical, legal and administrative framework for the Energy Performance of Buildings Directive (2002/91/EC) in each country. The key aim is to enhance the sharing

- Defining the QA scheme requirements, procedures and actors;
- Defining features of a central database and rules of access;
- Developing the QA cost structure and responsibility;
- Putting in place systematic QA checks and automated routines;
- Designing a system of sanctions and fees and their application, including potentially an experimental/learning period.

These aspects of quality assurance are still under development in many countries. In the U.S., for example, the Portfolio Manager tool does not provide any data quality assurance, and the EPA requires third-party verification of benchmarking information only in conjunction with applications for the Energy Star label, which constitutes just a fraction of benchmarked buildings. Many jurisdictions are receiving benchmarking information for thousands of buildings in a relatively short timeframe and have limited budgets to conduct rigorous quality assurance measures. Requiring third-party verification of benchmarking information prior to its required disclosure is not an option for most jurisdictions without seeking legislative approval. The EPA further works to require that jurisdictions ensure the quality of benchmarking through training, audits, signatures on submitted benchmarking information, and transparency through publishing of the benchmarking information.

Training, Qualification and Accreditation of Appraising Experts

One of the keys to ensuring the good quality of a building energy performance appraisal lies with the quality of the expert and the procedures that he/she is required to follow.

The EU Directives require that each individual member state develops procedures for ensuring the independence of experts carrying out the energy performance evaluation. The experts need to be self-employed, public or commercially recruited company experts with relevant qualifications and/or accreditation. The training completion and accreditation information on these experts must be publicly available in the form of a regularly updated public registrar of experts and expert companies.

The best practices of U.S. building energy rating and disclosure programs in ensuring the quality and independence of responsible experts can be summarized as follows:

- Trainers, trainees, and training programs 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, since 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.

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of information and experiences from national adoption and implementation of this important European legislation. Official EPBD CA website: www.epbd-ca.org

- 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.

Selected U.S. accreditation schemes for building energy performance appraisal are presented in **Box 2**.

For comprehensive coverage of all energy performance assessment and certification practices, the accreditation needs to result in authorization of the tested expert for the above practices. Specifically, the following four types of authorizations are necessary for certification of buildings:

- Authorization for assessment of thermal performance of buildings
- Authorization for assessment of energy performance of heating and hot water
- Authorization for assessment of energy performance of ventilation and air-conditioning
- Authorization for assessment of energy performance of indoor lighting

Regarding the authorization of experts to issue EPCs, qualification in their work field (e.g., as an architect or engineer) is often the first standard that has to be fulfilled, often supplemented by a training course with an examination. Regional differences in requirements for experts can occur in countries, which (partly) implement the EPCs on a regional level (e.g., Germany and Spain).

Box 2. Selected U.S. Accreditation Schemes for Building Energy Performance Appraisal

The reliability of energy assessment and comparisons depends heavily on the competence of the person/group of people/organization performing the analysis. Therefore, not only should an appraiser verify the technical basis of energy performance documentation; he or she should also seek assurances about the technical credibility and responsibility of the preparer. There are three types of such assurances:
1) Assurance of technical competence in the form of a professional license or other related training or experience, including:

- ***ASHRAE Building Energy Assessment Professional (BEAP)*** certification program -- aims to certify individuals' ability to audit and analyze residential, commercial, and industrial buildings, including determining project scope, collecting data, analyzing building performance, interpreting results, evaluating alternatives, submitting recommendations for energy conservation measures, and assisting with the implementation of these recommendations. www.ashrae.org/certification/
- ***RESNET Energy Rater*** certification program includes a mandatory successful completion of the complete training by a RESNET Accredited Rater Training Provider. The expert rater must be certified by a RESNET Accredited Rating Provider.The training is conducted in accordance with a syllabus developed by RESNET. **www.resnet.us**
- ***COMNET (http://www.comnet.org/#sf) has developed standard modeling guidelines for commercial asset ratings – not sure if they're also planning to certify raters.***

2) Assurance of legal responsibility for the document contents in the form of a signed statement
3) Assurance of coverage by professional liability insurance

Reporting and Disclosure of Energy Performance Information

Collecting data on building performance can help governments:

- Establish an energy efficiency baseline for local building stocks
- Track progress and identify trends in energy efficiency over a number of years
- Establish aggregate building performance goals
- Set standards for incentives and programs related to building energy efficiency
- Design future building policy based on performance data

If building performance data is only reported to counterparties in private real estate transactions, governments may lose the ability to carry out many or all of the items listed above. The Concerted Action EPBD, in its Executive Summary Report on the Interim Conclusions of the CA EPBD (2007–2010), recommended that "every MS (or region) should collect EPC data in a central register" for many of the reasons stated above.

Many EU Member States require building owners to report building performance information to the government; however, this requirement is not part of the EPBD. In the United States, the District of Columbia, New York City, and the city of Seattle require reporting to government in conjunction with rating, while the city of Austin requires the reporting of information to a municipal utility.

Internet posting of building performance information

Rather than disclosing building performance on a physical "label," as is required for some types of buildings under the EPBD, some countries have sought disclosure beyond the point-of-transaction approach via public web sites. Denmark and Lithuania are requiring the posting of building performance information to public web sites. In the United States, the District of Columbia and New York City have both announced that they will administer public web sites containing building performance data, although neither website is operational yet. Arlington County, Virginia, is currently posting performance data for government-owned buildings to a public web site. Public web sites may have advantages over physical building energy labels; however, more research and experience are necessary before drawing conclusions. The public could have greater access to information posted on a website than within a building, bringing more positive recognition to very efficient buildings and providing a "shaming" effect on very inefficient buildings. Investors and other stakeholders in buildings or building ownership groups would also presumably have greater access to building performance information, which may help exert pressure on the owners and operators of inefficient buildings.

Disclosure of building performance information to users (tenants and lenders)

Disclosing building performance information to prospective lenders and tenants already within buildings are logical extensions of the EPBD point-of-transaction disclosure requirements at the time of sale and lease. Additionally, the result of the energy performance evaluation in form of the certificate or certification report should be made available to public authorities, as requested.

In the U.S., the states of California and Washington and the city of Seattle require disclosure to prospective lenders. The goal is to allow lenders to understand and more accurately value energy efficiency, which could lead to more favorable financing terms for efficient properties. The full range of issues associated with energy efficiency finance and appraisal is beyond the scope of this paper.

The city of Seattle also requires disclosure to current tenants within buildings that must be benchmarked, rather than prospective tenants only. Upon receiving a full-building energy-efficiency rating, tenants may choose to evaluate their operational habits related to energy consumption in their leased space, or to pressure the building owner into improving the building's energy performance (in the case of a low rating).

Outreach

Establishing a comprehensive certification and labeling procedure is not sufficient for efficient enforcement. The training and education activities described above are also instrumental to quality assurance. In addition, one of the key elements of an effective labeling procedure is the promotion of public awareness and acceptance of the certification process and the label by the building community. An effective multi-stakeholder campaign has the potential to build strong support for the certification policy, and to accelerate penetration and quality assurance.

The outreach program needs to have a clear plan, identified relevant stakeholders and partner organizations, as well as clearly defined objectives. The education and training for appraisal experts may or may not be part of the outreach activities. Tools of an effective certification and labeling outreach campaign include a media campaign, a web-site and social media resources,

direct contact with building owners, and the seeking of feedback through surveys, as well as building partnerships with relevant stakeholder organizations for organization of trainings and education.
In the U.S., the cities of Austin, New York, and Seattle have developed outreach programs with most or all of these elements.

Negative publicity for the certification process may jeopardize the implementation of the whole policy. In Netherlands, a comparison of an audit by three different companies for the same house was publicized on national television. The three audits resulted in the issuance of three different labels with ratings of C-, E, and G. This dealt a major blow to consumer trust in the certification process and program. This trust was further damaged when the association of home owners (Vereniging Eigen Huis) published information about a block of terrace houses, in which the corner houses received the same label as the interior houses—despite the fact that they consumed considerably more energy. This negative publicity led to a situation where house brokers (who already were skeptical about the energy performance assessment and the label) actively discouraged buyers and sellers from getting an energy certificate for their house. As a result, since the launch of the energy certificate program, less than 5% of the houses being sold have certificates.[14]

It is clear that outreach, transparency, and the quality of the label are all key factors that can be promoted through such measures as the standardization of benchmarks and assessment tools.

Conclusions

Based on experience with building energy rating, disclosure, certification, and labeling in the reviewed countries, it can be concluded that building energy rating and certification systems should have several functions and fulfill various criteria:

- Provide a strong technical and methodological foundation for assessing building energy performance, linked to national standards and codes (or international standards, as needed);
- Employ a standard and replicable approach allowing comparison among buildings;
- Allow for in-depth technical evaluation, while also producing simple, non-technical summary information for the label to be used by non-technical consumers;
- Make the rating and certification result—the label—available publicly;
- Select the rating method—i.e., calculated (asset) or measured (operational)—based on administrative enforceability, rating quality, cost, and applicability to building types;
- Provide recommendations and/or requirements for improving operations in underperforming buildings;
- Integrate building certification with overall building energy efficiency policy to serve as a basis for incentives and/or penalties associated with energy performance; and

[14] In response to this situation, the Minister responsible for the certificate has taken steps to improve the calculation tool, as well as the qualifications of the experts operating it. A procedure was also created for registering complaints. However, new criticisms have already arisen that the new version of the certificate is not consumer friendly (e.g., the energy consumption is measured in Kilo joule and not m3 gas or kWh). In addition, the improved legislation still lacks provision for a penalty for not having a certificate when selling a house.

- Ensure that the certification and labeling data output is organized and available to policymakers, consumers, and industry, as well as integrated with national statistics on energy use and GHG emissions.

- Have a strong technical foundation of building energy codes, norms and standards.

An earlier exercise by the USAID Municipal Heating Reform Program in Ukraine has analyzed and revealed the gaps in the Ukrainian building codes and, among others, recommended strengthening of the minimum efficiency requirements for building envelope; introduction of efficiency requirements for fenestration, lighting, and HVAC systems; and harmonization of provisions for technical inspection of building energy systems with the EU norms. Additionally, Ukraine's experience in piloting of the EU Display Campaign for energy labeling and the existing building energy passportization framework can be used as a foundation for designing a national building energy certification and labeling. The most widely spread building energy rating method among the reviewed countries is asset rating for most or all of the building types, which is also mandatory for all new and reconstructed buildings for EU member states. Harmonization with EPBD provisions is necessary for Ukraine due to its status of an Energy Community Contracting Party.

In addition to establishing the necessary legal and regulatory framework, effective enforcement of certification and labeling requires the provision of targeted training and the launch of an accreditation system for ensuring the quality of certification and labeling by authorized, qualified assessors. In most cases, the costs of certification are borne by building owners. The Government has the responsibility to ensure the enforcement of building energy performance certification and labeling through the following functions, performed by a designated government entity:

- Improvement of building energy codes, norms, and standards; building envelope thermal protection; efficiency requirements for fenestration; lighting and HVAC system elements; consideration of renewable energy sources in the building energy system; and provisions for inspection of HVAC and energy auditing regulations. All of these are prerequisites for the building energy certification and labeling process;

- Selection and introduction of building energy rating system (operational or asset);

- Establishment of qualification requirements, testing procedures, and examination committee, and organization of experts' examinations;

- Issuance of certificates to authorized, accredited experts; maintenance of the registrar of certified experts; and organization of expert technical trainings and programs to strengthen their capacity in quality assurance;

- Ensuring disclosure of building energy certificates;

- Establishing and operating a monitoring system;

- Analyzing results of energy certification and communicating them to the national energy policymakers, and ensuring they are included in official statistics;

- Regular review and revision of energy rating scales and applied methodologies (asset vs operational rating; delivered vs. primary energy) depending on data availability, policy ambitions, and other factors.

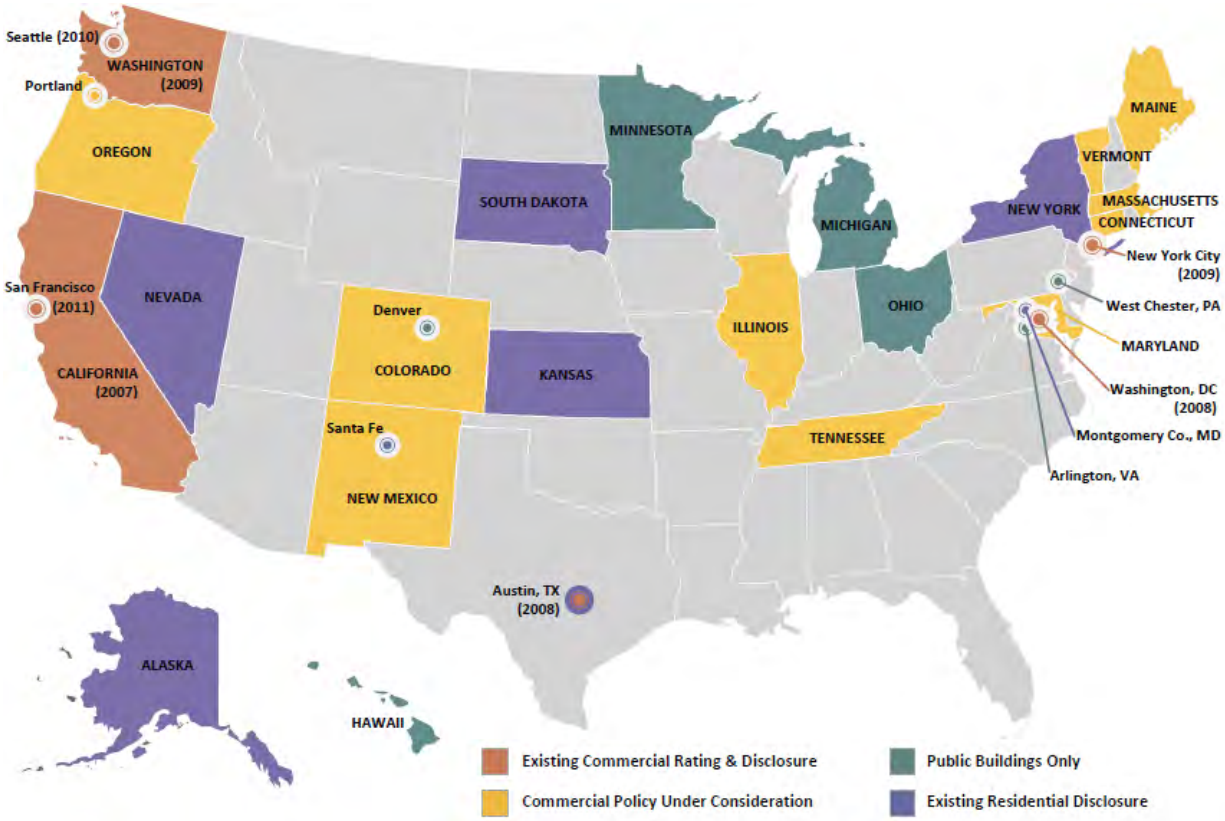
Annex. Overview of International Experience in Building Energy Certification and Labeling

U.S. Experience

Unlike the European Union, where EPBD creates the framework for mandatory country-specific policies, there is no U.S. federal policy regulating building energy performance assessment and certification (commonly referred to as "rating and disclosure" in the U.S. literature). However, there has been recent action in government agencies and the U.S. Congress on this front: Two bills were introduced in 2009 and are pending review (H.R. 2454 and S. 1462). These pending bills, if passed, will introduce voluntary building energy labeling or certification. If passed, US DOE and EPA will be required to develop the label/certificate.

In addition to these pending policy changes, there are a number of current program activities related to building energy certification and labeling. US DOE launched the National Building Rating Program in 2009, which closely follows the provisions laid forth in H.R. 2454 and S. 1462. The program is currently focused on residential buildings, with similar work on commercial buildings to follow.

The below map shows the states and cities with building energy certification and labeling initiatives underway. [15]



Source: Buildingrating.org

EPA Buildings ENERGY STAR® Certification[16]

[15] Sector-specific policy matrix are available at http://www.buildingrating.org/content/policy-graphics

[16] ENERGY STAR Portfolio Manager can be accessed via www.energystar.gov/istar/pmpam/

ENERGY STAR is a U.S. Environmental Protection Agency program that focuses on improving energy performance in buildings as a method of reducing GHG emissions.

ENERGY STAR is a technical assistance and recognition program that offers owners and managers of all buildings access to free tools and resources to help them evaluate their energy performance and reduce energy use and GHG emissions. Organizations are encouraged to begin by benchmarking the performance of their buildings using ENERGY STAR's Portfolio Manager online energy tracking tool. For certain types of buildings that perform in the top 25% compared to their peers nationwide, the ENERGY STAR label is available as an indicator of superior energy performance. Buildings carrying the ENERGY STAR label consume, on average, about 35 percent less energy than their non-ENERGY STAR counterparts. Buildings earn the ENERGY STAR by achieving a score of 75 or higher on EPA's energy performance scale and meeting relevant requirements for indoor air quality. More than 80,000 buildings have benchmarked their energy usage with ENERGY STAR, of which 63,000 buildings received an ENERGY STAR energy performance score. The ENERGY STAR Snapshot (http://www.energystar.gov/index.cfm?c=business.bus_energy_star_snapshot) provides an at-a-glance summary of the latest national ENERGY STAR metrics to help building owners see the impact of their efforts. The ENERGY STAR Snapshot is published twice a year and provides:

- Trends in energy benchmarking of commercial and industrial buildings.
- State-by-state activity along with activity for the top Designated Market Areas.
- Industrial sector participation in ENERGY STAR.
- Trends in ENERGY STAR labeled commercial and industrial facilities.
- Trends in Measuring Building Energy Performance.

Benchmarking energy use is a first step to assess energy performance and to measure ongoing progress. EPA's online tool, Portfolio Manager, is a free benchmarking tool available online that enables building owners and managers to assess and track this performance over time as well as target investments in energy efficiency. Any building's energy performance can be tracked by the owner of the data at www.energystar.gov/benchmark. State governments play an important role in the ENERGY STAR program. Many are taking important steps to protect the environment and lower energy costs and are increasingly leveraging EPA's ENERGY STAR resources to reduce energy use in their buildings.

EPA's Energy Star Portfolio Manager is the most widely used energy benchmarking tool in the United States. Cumulatively, more than 21 billion square feet of floor space has been benchmarked using Portfolio Manager since its introduction in 2000. For most commercial building types, Portfolio Manager generates an operational energy rating from "1" to "100" (100 is best) comparing the building's energy performance to that of similar buildings nationwide.

Portfolio Manager requires 12 consecutive months of utility bills and basic building and space use characteristics, such as the building's size and location, operating hours and number of occupants, to compute performance metrics. It normalizes for factors including climate, vacancy and space use.

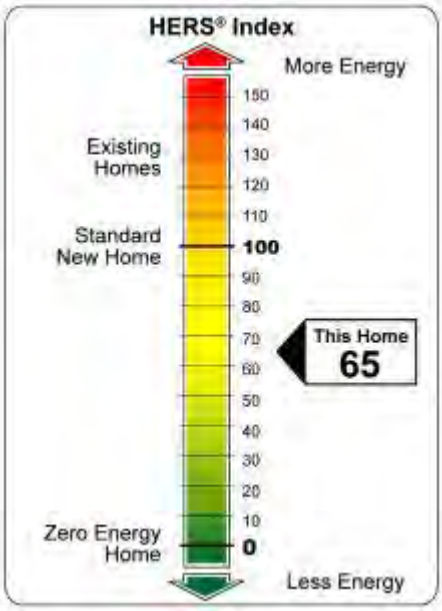
Portfolio Manager also generates a Statement of Energy Performance: a one-page summary sheet showing key input and output data, including normalized annual energy consumption and costs, associated airborne emissions, as well as the building's rating score itself.

The process consists of the following seven steps:

1. Make a commitment
2. Benchmark your building
3. Based on benchmark - set goals
4. Create action plan
5. Implement action plan
6. Evaluate progress
7. Recognize achievements

The HERS Index

The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET), in which a home built to the specifications of the HERS Reference Home (based on the 2004 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home.



Each 1-point decrease in the HERS Index corresponds to a 1% reduction in energy consumption compared to the HERS Reference Home. Thus a home with a HERS Index of 85 is 15% more energy efficient than the HERS Reference Home and a home with a HERS Index of 80 is 20% more energy efficient.

The Home Energy Rating is a recognized tool in the mortgage industry. Home energy ratings can be used in a variety of ways in the housing industry. Since a rating quantifies the energy performance of a home, the HERS Index provides an easily understandable means to compare the relative energy efficiency of different homes.[17]

The EnergySmart Home Scale (E-Scale) was developed by the U.S. Department of Energy (DOE) for the National Builders Challenge. The E-Scale is based on RESNET's HERS Index. DOE has developed an E-Scale Interactive Tool to compare estimated cost and energy savings of new and existing homes.

ASHRAE Advanced Building Energy Labeling (ABEL)

The ASHRAE Advanced Building Energy Labeling (ABEL) program is based on the Building Energy Quotient (bEQ) label, together with a supporting certificate. The label is applicable to existing buildings, using the As Operated (Operational) Rating, and to new buildings using the As Designed (Asset) Rating. The ratings are designed to support regulatory energy use disclosure requirements, and are supported by a user instruction manual and forms for use and development during the prototype phase of the program.[18]

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[17] Source : www.resnet.us

[18] More details can be found at http://buildingeq.com/files/ABELFinal.pdf

The ABEL program uses a new rating system and methodology, in which the best scores indicate net zero energy buildings. This does not correlate with the ENERGY STAR® rating and scoring, which is based on the current statistical energy use of buildings as recorded in the CBECS database, so the user cannot currently make a connection between the two systems.

While the energy ratings do not relate to each other, ASHRAE recommends that if the building has earned an ENERGY STAR rating, this additional information should be highlighted on the label. ASHRAE has also developed two Building Certificates to accompany the Building EQ label, one of which reports the EPA ENERGY STAR score as part of the documentation.

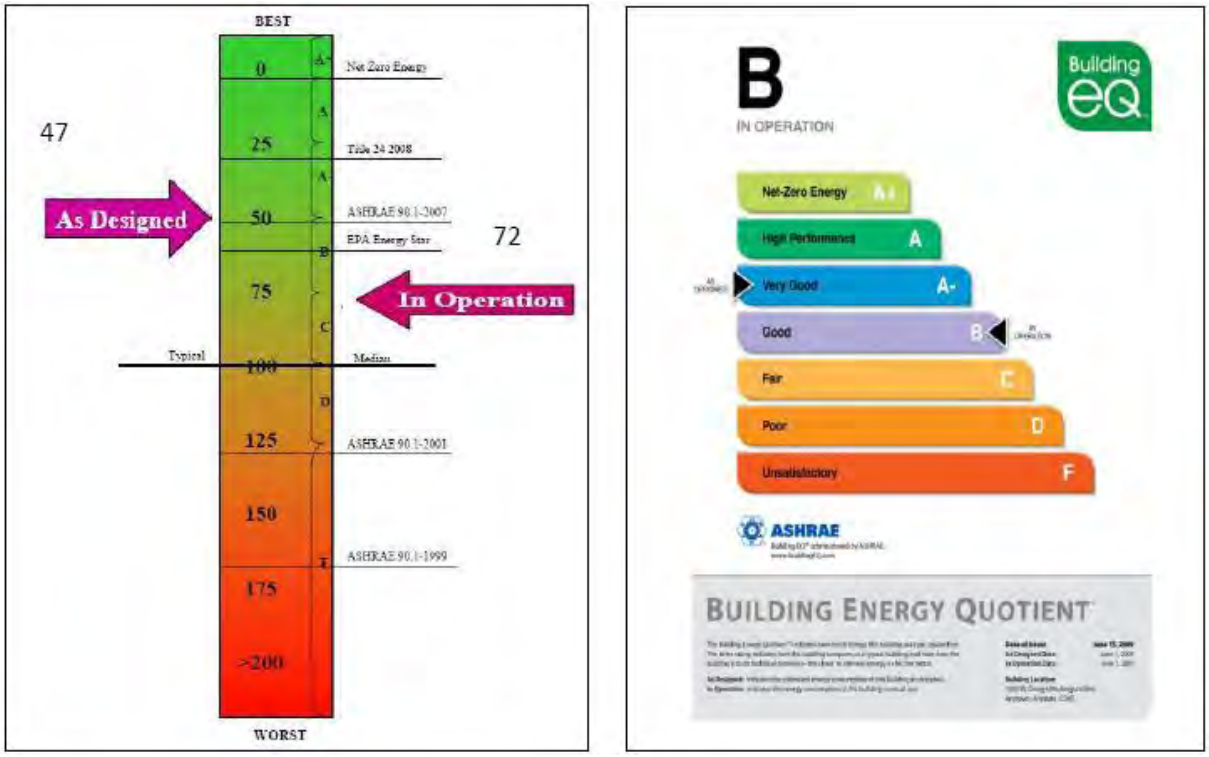

Figure I. ASHRAE bEQ Rating Scale (on the left) and proposed Building Energy Quotient Label (on the right)

Leadership in Energy and Environmental Design (LEED)

The non-profit U.S. Green Building Council (USGBC) helped develop LEED (Leadership in Energy and Environmental Design), a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. LEED is a building certification process that considers various aspects of "green building" and awards recognition to buildings that meet certain standards. Users of the LEED process earn credits in several categories associated with green buildings. These differ by the type of LEED certification, but generally include: sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, and innovation. While each category may have required prerequisites that must be met, for the bulk of the credits required for certification users can choose in which categories they wish to focus based on their own priorities. Energy efficiency may or may not be one of those priorities, depending on the user. Unlike building energy codes which often address only building energy efficiency, LEED promotes a whole building approach to sustainability by recognizing performance in five key areas of human and environmental health: (1) sustainable site development, (2) water savings, (3) energy efficiency, (4) materials selection and (5) indoor

environmental quality. The current LEED rating systems were developed for the following nine building categories:[19]

- *LEED for New Construction*: The rating system is designed to guide and distinguish high-performance commercial and institutional projects, including office buildings, high-rise residential buildings, government buildings, recreational facilities, manufacturing plants and laboratories.

- *LEED for Existing Buildings*: The rating system helps building owners and operators measure operations, improvements and maintenance on a consistent scale, with the goal of maximizing operational efficiency while minimizing environmental impacts. LEED for Existing Buildings addresses whole-building cleaning and maintenance issues (including chemical use), recycling programs, exterior maintenance programs, and systems upgrades. It can be applied both to existing buildings seeking LEED certification for the first time and to projects previously certified under LEED for New Construction, Schools, or Core & Shell.

- *LEED for Commercial Interiors*: The system is the green benchmark for the tenant improvement market. It is the recognized system for certifying high-performance green interiors that are healthy, productive places to work; are less costly to operate and maintain; and have a reduced environmental footprint. LEED for Commercial Interiors gives the power to make sustainable choices to tenants and designers, who do not always have control over whole building operations.

- *LEED for Core & Shell*: The green building rating system is geared toward designers, builders, developers and new building owners who want to address sustainable design for new core and shell construction. Core and shell covers base building elements such as structure, envelope and the HVAC system. LEED for Core & Shell is designed to be complementary to the LEED for Commercial Interiors rating system, as both rating systems establish green building criteria for developers, owners and tenants.

- *LEED for Schools*: The rating system recognizes the unique nature of the design and construction of K-12 schools. Based on the LEED for New Construction rating system, it addresses issues such as classroom acoustics, master planning, mold prevention and environmental site assessment.

- *LEED for Retail* (a pilot): The pilot recognizes the unique nature of the retail environment and addresses the different types of spaces that retailers need for their distinctive product lines.

- *LEED for Healthcare*: The green building rating system was developed to meet the unique needs of the health care market, including inpatient care facilities, licensed outpatient care facilities, and licensed long term care facilities. LEED for Healthcare may also be used for medical offices, assisted living facilities and medical education and research centers. LEED for Healthcare addresses issues such as increased sensitivity to chemicals and pollutants, traveling distances from parking facilities, and access to natural spaces.

- *LEED for Homes*: The rating system promotes the design and construction of high-performance green homes. A green home uses less energy, water and natural resources; creates less waste; and is healthier and more comfortable for the occupants. Benefits of a LEED home include lower energy and water bills; reduced greenhouse gas emissions; and

[19] Halverson MA, B Shui, M Evans. *Country Report on Building Energy Codes in the United States.* PNNL 2009.

less exposure to mold, mildew and other indoor toxins. The net cost of owning a LEED home is comparable to that of owning a conventional home.

- *LEED for Neighborhood Development* (a pilot): The rating system integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design. LEED certification provides independent, third-party verification that a development's location and design meet accepted high levels of environmentally responsible, sustainable development. LEED for Neighborhood Development is collaboration among USGBC, the Congress for the New Urbanism and the Natural Resources Defense Council.

Table A.1. below summarizes the key state, country and city initiatives in building energy rating and disclosure in the United States.

Table A. 1. The Building Energy Performance Rating Experience in the United States

State, City or County	**Building Energy Performance Rating and Disclosure Initiatives**
State Initiatives	
Massachusetts	**Zero Net Energy Buildings Pilot** To achieve zero net-energy commercial and residential construction in Massachusetts by 2030, a legislative effort is underway requiring energy performance rating and disclosure for new and existing commercial buildings by 2012, administered by the Massachusetts Department of Energy Resources (DOER). Within residential construction framework, a home energy rating pilot has been launched in western Massachusetts and a commercial building asset rating pilot in eastern Massachusetts. The home rating pilot includes energy labeling and widespread thermal imaging of homes, to help homeowners implement "deep" energy efficiency upgrades. Aside from the energy rating and labeling, the program has a job creation component: providing workforce training for clean energy jobs and testing complementary innovations. The commercial buildings component of the above pilot initiative aims to establish a sustainable asset rating program for existing commercial buildings through minimizing the cost barriers and testing best practices related to building energy asset ratings. **Building EQ Building Energy Rating Pilot** DOER is also participating in the Building EQ (bEQ) national building energy rating pilot program administered by the American Society of Heating, Refrigerating and AirConditioning Engineers (ASHRAE). DOER enlisted five buildings in the operational rating pilot phase in 2010 and enlisted one building in the asset rating pilot phase, scheduled to begin in the summer of 2011. DOER is on the ASHRAE sub-committee that is developing the program for the asset rating pilot phase.
District Of Columbia	The Clean and Affordable Energy Act of 2008, passed by the Council of the District of Columbia on July 15, 2008, requires the annual energy rating and disclosure of nonresidential buildings. DC Mayor Adrian Fenty signed the Energy Act into law on Aug. 4, 2008. Although the state of California previously mandated rating and disclosure, the DC mandate was the first in the nation to require commercial building energy performance rating at scheduled intervals (rather than at the time of a transaction) and disclosure to the general public (rather than to transaction counterparties only) via a public web site administered by the District of Columbia. The

	requirement affects nonresidential buildings greater than 50,000 square feet and is being phased in over several years. Buildings greater than 200,000 square feet must benchmark their energy performance using Portfolio Manager beginning in 2010. The size threshold decreases by 50,000 square feet each year until 2013, when all buildings greater than 50,000 square feet must benchmark annually. The disclosure of benchmarking data will be phased in similar to the rating implementation schedule beginning in 2012. Buildings owned or operated by the District of Columbia greater than 10,000 square feet in size were required to begin benchmarking their energy performance using Portfolio Manager in late 2009. The benchmarking data will be posted to the web site. Additionally, newly constructed nonresidential buildings greater than 50,000 square feet that file construction permits on or after Jan. 1, 2012 must estimate their energy performance using ENERGY STAR software and benchmark and disclose their energy performance annually after the building delivers.
California	The state of California passed Assembly Bill 1103 in 2007, requiring for the first time in the United States the rating and disclosure of nonresidential buildings. The California bill is modeled after the Energy Performance of Buildings Directive, requiring building energy rating and disclosure to transaction counterparties prior to the completion of a building sale, lease or financing arrangement. It also requires energy providers to aggregate energy data for buildings and upload it directly into Portfolio Manager upon the request of a building owner, addressing energy privacy concerns by tenants and owners of multi-tenant buildings. This tactic is also being employed by the state of Washington. Initial compliance (originally scheduled for Jan. 1, 2010) has been delayed while the California Energy Commission determines the rulemaking. The most recent draft rules call for a three-year, phased-in approach to implementation determined by building type and size. The City of San Francisco, located in northern California, may introduce legislation that would build on this legislation (AB 1103) by requiring public disclosure of energy performance data at scheduled intervals and mandatory energy audits. Those procedures were recommended to San Francisco Mayor Gavin Newsom in a report published in December 2009 by the Mayor's Task Force on Existing Commercial Buildings.
Washington	The state of Washington passed building energy rating and disclosure legislation in 2009 based on the California mandate. It requires nonresidential buildings to rate their energy performance using Portfolio Manager and disclose benchmarking data to prospective buyers, lessees and lenders prior to the closing of a transaction. The legislation, SB 5854, also requires major improvements to

	building energy codes and recommendations to the state legislature to rate the energy performance of homes. Washington Governor Chris Gregoire signed the bill into law on May 8, 2009. Nonresidential buildings greater than 50,000 square feet must rate and disclose using Portfolio Manager beginning Jan. 1, 2011, while buildings greater than 10,000 square feet must rate and disclose beginning Jan. 1, 2012. Energy providers were required beginning Jan. 1, 2010 to aggregate energy data for buildings and upload it directly into Portfolio Manager upon the request of a building owner. Public buildings are subject to more comprehensive energy requirements, including new performance standards and mandatory retrofits. The energy performance of public buildings must be rated by July 1, 2010 and reported to a state agency, which will make the benchmarking data public. A preliminary energy audit is required for buildings with poor energy performance (a Portfolio Manager score of less than 50). If cost-effective energy savings are identified by the audit, an investment-grade energy audit is required by July 1, 2013 and cost-effective efficiency measures must be implemented by 2016. Washington has also begun using building energy ratings to set minimum efficiency requirements for state leases in privately owned buildings. Starting Jan. 1, 2010, state agencies may not sign a new lease or renew space in a private building with an ENERGY STAR rating less than 75. Exceptions are allowed when a building owner agrees to undertake an energy audit and implement cost-effective upgrades within the first few years of a state lease.
City and Country Initiatives	
Austin, Texas	The Austin City Council approved the Energy Conservation Audit and Disclosure Ordinance on Nov. 6, 2008, requiring building energy rating and disclosure for nonresidential facilities and mandatory energy audits for homes and apartment complexes. Notably, some apartment complexes are also required to undergo energy retrofits. Nonresidential buildings greater than 10 years old must rate their energy performance by June 1, 2011 using Portfolio Manager or a free, online tool from Austin Energy, the municipal utility. Buildings less than 10 years old are required to rate their energy performance within 10 years of the completion of construction. Benchmarking data must be disclosed to prospective buyers prior to a sale transaction. For multifamily properties, a mandatory energy audit replaces the energy performance rating requirement. Audits for existing buildings are required by June 1, 2011. The results of the audit must be posted within the building and provided to prospective tenants and buyers. Additionally, "high energy-use" properties consuming more than 150% of the average multifamily energy use per square foot in Austin must make energy retrofits within 18 months to bring the property to within 110% of the average. The

	retrofit requirement is the first of its kind for any privately owned, nonresidential property in the United States.
New York City, New York	The New York City Council on Dec. 9, 2009 passed bill no. 476-A requiring the energy rating and disclosure of public buildings and nonresidential and residential multifamily buildings. The bill was approved along with three other bills related to building energy efficiency, requiring periodic building energy audits and retrocommissioning, lighting upgrades, sub metering of large tenant spaces and the establishment of a city building energy code. Known collectively as the Greener, Greater Buildings Plan, the four bills were supported by New York City Mayor Michael Bloomberg as a key piece of his PlaNYC initiative to reduce the city's greenhouse gas emissions by 30 percent by the year 2030. Mayor Bloomberg signed the bills into law on Dec. 28, 2009. Nonresidential and multifamily buildings greater than 50,000 square feet in size must benchmark their energy performance annually using the ENERGY STAR Portfolio Manager tool. The initial deadline to benchmark was May 1, 2011. Benchmarking data will be posted to a public web site administered by New York City beginning Sept. 1, 2012 for nonresidential buildings and beginning Sept. 1, 2013 for multifamily buildings. Buildings greater than 10,000 square feet owned or fully leased by the New York City government must benchmark their energy performance annually using Portfolio Manager beginning May 1, 2010. Benchmarking data will be posted to the web site. Buildings subject to the benchmarking law are also required to conduct building energy audits and retrocommissioning once every 10 years. Additionally, following the energy audit, city-owned buildings must implement capital improvements with a payback period of seven years or less. Denmark and Portugal have mandated a similar retrofit scheme for its public buildings based on the results of Energy Performance Certificates.
Seattle, Washington	Less than a year after the state of Washington enacted its rating and disclosure legislation, Seattle, the state's largest city, passed a city ordinance that expands significantly upon the state law. Seattle City Council Bill 116731, passed on Jan. 25, 2010, augments the state mandate in three ways: 1. Benchmarking data for nonresidential buildings must be reported annually to the city; 2. Multifamily buildings are subject to the new reporting requirements; and 3. Benchmarking data must be disclosed to current tenants in a benchmarked building upon tenant request. Nonresidential buildings have been annually reporting energy performance data to the city starting April 1, 2011 for buildings 50,000 square feet and greater, and beginning April 1, 2012 buildings 10,000 square feet and greater will report the same data. Multifamily properties with five units or more will report energy performance data to the city annually beginning April 1, 2012. Multifamily buildings are not covered in the state legislation. Although the city will begin collecting energy performance data, it does

	not plan to post the data publicly.
Arlington County, Virginia	Arlington County, Virginia, a suburb of the District of Columbia, began voluntarily posting energy data for county facilities to a public web site in 2009, providing an example for other jurisdictions. For each building, the web site reports annualized energy consumption, site and source energy intensity, greenhouse gas emissions, and Portfolio Manager benchmarking data and plans for energy efficiency improvements, where available. Arlington County does not require privately owned buildings to measure and disclose their energy performance.
Portland, Oregon	The City of Portland Office of Sustainable Development (OSD) published policy recommendations to improve the energy and environmental performance of Portland's building stock in Dec. 2008. The report was commissioned by the Portland City Council and developed through a series of public stakeholder meetings in early and mid 2008. It addressed new and existing buildings in the nonresidential and residential sectors, and included recommendations on nonresidential rating and disclosure policy and mandatory building energy improvements. Additionally, the City of Portland and Multnomah County Climate Action Plan, which was adopted by both jurisdictions in 2009, calls for the benchmarking of all nonresidential and multifamily buildings by 2012. OSD's policy recommendations, as published in 2008 in the City of Portland Proposed High Performance Green Building Policy, called for energy and water benchmarking using Portfolio Manager in nonresidential and multifamily buildings. Building owners would be required to disclose to OSD an Energy Star State Action Plan? or a similar report for each building according to the following schedule: • Jan. 1, 2011: Buildings greater than 100,000 square feet • Jan. 1, 2012: Buildings 50,000 square feet to 100,000 square feet • Jan. 1, 2013: Buildings 20,000 square feet to 49,999 square feet After the initial reporting deadline, owners would be required to submit updated benchmarking information to OSD at least once every three years. New nonresidential and multifamily construction would begin disclosing benchmarking information to OSD within three years of receiving a Certificate of Occupancy. OSD would not make benchmarking information publicly available; however, OSD would assist owners with voluntary disclosure. OSD would require verification of benchmarking information by a Professional Engineer.
San Francisco, California	The San Francisco Board of Supervisors unanimously passed the Existing Commercial Buildings Energy Performance Ordinance in Feb. 2011. The ordinance requires annual benchmarking, periodic energy audits and the public disclosure of benchmarking information for nonresidential buildings. It augments a nonresidential benchmarking and disclosure law enacted by the state legislature in 2007. The ordinance is based on proposals by the Mayor's Task Force on Existing Commercial Buildings, which

	convened in 2009 to develop and recommend actions to reduce energy consumption and carbon emissions, enhance electricity reliability and improve the competitiveness of commercial buildings in San Francisco. The Task Force included local commercial real estate owners, building operators, green building consultants, utilities and banks, and was advised by city and state policymakers. It published its findings in Dec. 2009. Policy Requirements Nonresidential Buildings: Building owners must annually benchmark nonresidential buildings of at least 10,000 square feet using Portfolio Manager and report an Annual Energy Benchmark Summary (AEBS) to the San Francisco Department of the Environment (SFDOE) and to existing tenants in the building. Initial compliance is being phased-in from 2011 to 2013 according to the following schedule: • Oct. 1, 2011: Buildings 50,000 square feet and greater • April 1, 2012: Buildings 25,000 square feet to 49,999 square feet • April 1, 2013: Buildings 10,000 square feet to 24,999 square feet Building owners must report the AEBS to SFDOE by April 1 each year following the initial compliance date. SFDOE will post benchmarking information for each building to a public web site beginning with the second AEBS submitted by an owner. The owner of a newly constructed building must report an initial AEBS within 24 months of the issuance of a Certificate of Occupancy. Owners may be exempted from compliance if a building is unoccupied for the 12-month period prior to the AEBS submittal, or if reporting or disclosing the required benchmarking information would compromise confidential business information. Public Buildings: Municipally owned buildings totaling 10,000 square feet or more must be annually benchmarked in accordance with the compliance schedule established for privately owned buildings. Benchmarking information must be posted publicly. The general manager of the San Francisco Public Utilities Commission will develop additional implementation guidance in 2011 for municipal buildings.

Sources: The Future of Building Energy Rating and Disclosure Mandates: What Europe Can Learn From the United States. IMT and NRDC; and Building Energy Transparency: A Framework for Implementing U.S. Commercial Energy rating & Disclosure Policy. IMT 2011.

European Union

The 2002 Energy Performance of Buildings Directive (EPDB)[20] calls for energy performance legislation in each of the EU's 27 Member States. Further recast in 2010, the EPBD requires development of performance and inspection standards as well as energy performance certification for commercial, residential, and government buildings. Energy ratings can be either asset or operational, must include recommendations for improved performance, and must be prominently displayed in public buildings.

The EPBD requires the EU Member States to tighten their building energy regulations and to:

- Apply minimum requirements for new and major renovated buildings,
- Implement an integrated energy performance calculation methodology,
- Introduce an energy certification scheme for the energy performance of new/major renovated buildings,
- Introduce an energy certification scheme for the energy performance of buildings when they are rented and sold, and
- Implement regular inspection of boilers and air conditioners in buildings.

A recent recast of the EPBD (adopted on 19 May 2010)[21] 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 that 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, recognizing that the Community can have little influence on energy supply but can influence energy demand. [Note that Ukraine joined the Community in December 2010.] One solution is to reduce energy consumption by improving energy efficiency. The recast specifically notes that more energy efficient buildings provide better living conditions and save money for all citizens. It estimates the additional savings from the recast of 60 Mtoe to 80 Mtoe in 2020, or a 5–6% reduction in EU energy consumption and 5% less CO_2 emissions.

EU countries started to implement the EPBD directive following different timeframes. The EPBD has been mandatory since 1996. Its adoption, however, has been somewhat slow: Although

[20] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

[21] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, (recast).

energy certification is also mandatory, by the end of 2008 only 20% of new buildings have obtained an energy certificate. The corresponding values for buildings sold and large buildings are 49% and 2.7% respectively.

This key EPBD tasks have been supported since 2005 by Concerted Action (an active forum of 29 countries with various working groups) launched by the European Commission to promote dialogue and exchange of best practices among them. In 2005, most of the countries were in planning stage of EPBD implementation, but now are well advanced.

The status of the above EPBD provisions' implementation in the reviewed EU countries is summarized below in Table A. 2. EPBD Key Requirements Implementation in Reviewed EU countries.

Aside from EPBD, which is the key legislative background to building energy rating, the EU Directive 2006/32 on energy end-use efficiency and energy services (usually referred to as the Energy Services Directive – ESD)) states in Article 13 pt. 1: "Member States shall ensure that, in so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy savings, final customers for electricity, natural gas, district heating and/or cooling and domestic hot water are provided with competitively priced individual meters that accurately reflect the final customer's actual energy consumption and that provide information on actual time of use."

In addition, the EU issued the Standard EN 16001:2009 – Energy Management systems in 2009, which is intended to contribute to the creation of a continuous improvement process that will lead to more efficient energy use. It encourages organizations to implement an energy monitoring plan as well as energy analysis.

EPBD Recast Provisions for Building Energy Certification

To summarize, in the areas related to assessing building energy performance, carrying out certification and providing energy efficiency improvement recommendations, the EPBD recast asks the Member States to comply with the following:[22]

- Aim to be "cost-optimal" over the building's life
    - But no absolute requirement for this
    - Also required for major renovations
- May be applied to whole building or to renovated part or to elements
- High efficiency alternative systems to be considered
- Required for replacement elements of envelope of existing buildings that have a significant impact on energy performance
- Required for technical building systems when replaced or upgraded
- Requirements to be set for new, replacement and upgraded systems installed in existing buildings:
    - Shall cover energy performance, installation, sizing, adjustment and control.
    - Includes (at least) heating, hot water, air-conditioning, large ventilation systems
- Commission to "lay down" a comparative methodology
    - a cost-optimal balance between investments end energy costs saved through the life-cycle of the building

[22] EPBD Recast: an overview by Roger Hitchin. BRE. Available at *www.harmonac.info*

    - use financial rather than economic calculation
    - differentiate between new and existing, and categories of buildings
- National requirements to be evaluated every five years
- Member States may set more demanding requirements
- If there are significant differences (i.e., exceeding 15%) Member States should justify them or plan steps to reduce them
- Framework to be in place by June 2011
    - Commission to adopt a voluntary common EU certification scheme for non-residential buildings by 2011
- Member States are encouraged to recognize the scheme or adapt it to national circumstances
- Public display is required for buildings that are occupied by public authorities and are frequently visited by the public over 500 m^2 (after five years 250 m^2) and other buildings over 500 m^2 which have an EPC and are frequently visited by the public such as shops, supermarkets, restaurants, theatres, banks and hotels
- These may be calculated or measured ratings
- There is no requirement to display recommendations
- Recommendations now to be included in (rather than to accompany) EPC
    - Unless there is no reasonable potential for improvement
    - Recommendations shall be technically feasible for the specific building
    - May provide estimate for range of paybacks or cost-benefit
        - Cost-effectiveness to be based in standard conditions
    - Shall provide indication of where to get more detailed information, including cost-effectiveness
- Member States should encourage public buildings to set an example by implementing recommendations
- Independent control mechanisms are to be established for certification and inspection
- Random selection of statistically significant percentage of EPCs and inspection reports is to be checked

The current status of implementation of the EPBD with respect to certification of building energy performance is summarized further in this report in Tables A.2, A.3 and A.4.

European Display® Campaign – a Voluntary Operational Rating Tool[23]

The European Display® Campaign is a voluntary scheme designed by energy experts from European towns and cities in EU. When started in 2003 it was initially aimed at encouraging local authorities to publicly display the energy and environmental performances of their public buildings using the same energy label that is used for household appliances. Since 2008 private companies are also encouraged to use Display for their corporate social responsibility (CSR) activities. As most EU Member States now have a National Certificate for their existing public buildings, Display is increasingly being used as a complementary communication tool. With its strong emphasis on local communication campaigns and large variety of communication tools, Display goes beyond the basic requirements of the EPBD.

The EU Parliament has proposed a common European certification for the energy performance of non-residential buildings. To be introduced by 2012, this voluntary scheme will be the same in all Member States and will exist alongside the national certification scheme. The Display supporters propose that it can become the common approach providing the EU with the

[23] Official campaign website can be found at http://www.display-campaign.org/

opportunity to introduce an already tried and tested voluntary common European Union certification for the energy performance of non-residential buildings.

Display was also tested in Ukraine at the initiative of the local government and the energy efficiency activists. At the beginning of 2008, based on utility consumption and other building data collected in 2007, the city of Lviv joined the Display Campaign.

An online tool provided by the Campaign, available in the majority of the official European languages, enables the city or building owner to calculate three performance indicators: primary energy consumption per square meter, CO_2 equivalent emissions per square meter, and water consumption per square meter. Depending on the building type, the calculated building performance is graded into a pan-European classification of six levels, from A (the most efficient) to G (the least efficient). The tool can then generate a poster to present the building's performance rating, which is placed in a prominent place visible to the public. The city made an effort to actively publicize this demonstration initiative. Such a scheme was also seen as a low cost yet effective way to pressure compliance with utility consumption targets. In 2009, the city was recognized as one of the most active participants of the Display Campaign amongst some 400 participating cities across Europe.

This tool is applicable when:

- Final energy consumption data can be easily obtained; and
- Operational rating certificates can be updated yearly and therefore can also act as a measure of quality of the management and be used to motivate the building caretakers and users.

The first step for all Display® Campaign participants is to collect simple baseline data and feed this into the Display® calculation tool. Data requirements include readily available information such as:

- Annual consumption for lighting and equipment in kWh
- Annual heating and hot water consumption in kWh
- Annual water consumption in m^3

Table A. 2. EPBD Key Requirements Implementation in Reviewed EU countries

Country	Energy Certification of new and major renovated buildings	Energy Certification of existing buildings	Energy label	Validity of energy certificate (years)	Minimal Energy Requirements for new /major renovated buildings	Introduction of energy Performance Indicators
Slovakia	New – Yes, all over 50m2 Major renovated – all, over 50 m2	Yes – all rented and sold buildings	Labeling of large buildings over 1000 m2	10	Minimum requirements for new buildings – class B, Minimum requirements - Requirements on U-values of building components Major renovated buildings – no requirement, the minimum values are to be implemented if cost-effective	Total delivered energy Primary energy CO2 emissions
Austria	New – all Major renovated - all	Yes – all rented / sold	Large public buildings over 1000 m2 have duty to place energy certificate at building entrance	10	New buildings – class C (í classes from A++ to G) Since 2010 class B, before 2020 class A+ Major renovated buildings – no requirement, simply rated	
Germany	New – all Major renovated - all	Yes – all for sale, rent and public use	Display of certificates is adopted as taken directly from the directive	10	**New buildings** are specified by means of reference building which coincides with actual building geometry, usable area, orientation and basic conditions of use. **Existing buildings conditional requirements** must be complied with in defined cases of first installation or renovation of relevant component or building compliance. No requirements are imposed for external parts of the buildings if less than 10% of the relevant part are concerned. Apart from the conditional requirements, there are in place also retrofitting obligations which must be fulfilled by the building owners in each case before a specific time limit.	
Portugal	New – all Major	Yes – All buildings when sold or rented	Labeling all non-residential building	10 years with	Minimum requirement for new buildings and major renovations is B- (from A+ - G scale).	Primary energy.

	renovated – All		over 1000 m2	exception of energy performance certificate for public display which is valid for 6 years	Minimum requirements - - requirements on U-values of building components	
Ireland	Building Energy Rating – all new buildings since January 2007 all new non-residential since July 2008	All – rented and sold buildings since January 2009	Display Energy Certificates over 1000 m2 since January 2009	General: 10 years Provisional certificate (for new building offered for sale or rent, issued before they are built): 2 years Display Energy certificate : 1 year	**Dwellings:** - Maximum permitted values of EPC (Energy Performance Coefficient) and CPC (Carbon Performance Coefficient) - U values - minimum requirement of 10 kWh/m2 delivered from renewable sources **Non-domestic Buildings:** - Maximum permitted values of EPC (Energy Performance Coefficient) and CPC (Carbon Performance Coefficient)	Primary Energy CO2 emissions
Denmark	Since 1997 own certification tool similar to EPBD (EPBD implemented in 2006) Threshold is	Yes – ALL at sale/rent (since july 2009)	On public buildings (public administration, institutions, companies, associations, public owned companies, companies having	5	New/renovated buildings must achieve rating B (since January 2007) New buildings: Houses, hotels: Total demand of supplied energy building to deal with heat losses, ventilation, cooling and domestic hot water must not exceed: 70 + 2200/A kWh/m2 per year	Primary energy CO2 emissions

	based on use, not on size of buildings: single family houses – at sale/renting Buildings with flats: large, regularly every 5 year – small, at sale or renting Public buildings: every 5 years, All new buildings since January 2006.		influence on decisions) No size threshold i.e. as EPBD proposes large buildings over 1000 m2.		(A=heated gross floor area) offices, schools, institutions and other buildings: 95 + 2200/A kWh/m2 per year Supplementary requirements: U-values • minimum boiler efficiency • pipe insulation • heat recovery • fan power efficiency • automatic control • low temperature heating Major renovated buildings: No minimum requirement! Rule - cost effectiveness >1.33 : value of annual saving * lifetime investment Cost efficient energy saving measures are required in case of roof, external wall renovation, Exchange of Windows, installation of new boilers, change of heat supply	
Czech Republic	New above 50 m2 – all new buildings (since 1.1.2009) Major renovated above 1000 m2	Existing rented/sold – only when they are new constructed (above 50 m2) or renovated (above 1000 m2)	Public buildings over 1000 m2 – display of EPC on visible place only in case of new construction and renovation	10	New and major renovated buildings needs to achieve rating C. Minimal U-values of building components obligatory for new and major renovated buildings.	Total annual delivered energy consumption.
Romania	Since 1st January 2011 – all new buildings and major renovated buildings	All major rented/sold (until 1st January 2011 major renovated residential buildings when sold or rented were excluded)	no evidence		New/renovated buildings must achieve rating B Minimum thermal resistance R-values Maximum thermals transmittance U-values Maximum overall thermal coefficients G-values Proof: building permit and commissioning For existing building U-max are different than for new.	Total specific energy consumption CO2 emissions

					Renovation – thermal rehabilitation – below 100 kWh/m2.year	

Table A. 3. Government Responsibilities for Accreditation, Training and Oversight of the Certification and Labeling Procedures in Selected EU Countries

Country	**No. of authorized persons involved in Energy Certification of Buildings**	**Legal form of authorized experts**	**Institution responsible for training and experts examination**	**Institution responsible for issuing authorization to experts**	**Monitoring and operation of register, evaluation of results**	**Control over quality of energy certification**	**Penalties**
Slovakia	4	Physical persons, legal person	**Training by** Chamber of Civil Engineers	Ministry of Construction and Territorial Development	Ministry of Construction and Regional Development	State Energy Inspectorate - random under compliances	**Yes :** **Sanctions to authorized experts** when quality is unsatisfactory **Sanctions to building owner**, if they to not provide for certification
Austria	**1**	qualified experts (defined in Law) = engineering consultants, agencies with license, master builders and master carpenters, accredited experts with relevant expertise,.	**Training (not mandatory):** Lander authorities, universities, Chamber of Commerce and Civil Engineers Governments	**n/a**	Central registrar of Statistics of Austria	Some regional governments authorize for control regional energy agencies. Quality assurance system – all certificates go through quality check (compliance with methodology) and if necessary revised.	No penalties until 2010 to experts
Ireland	Assessor for dwellings – 1 Assessor for non-domestic buildings – 1 Assessor for public buildings – 1	Physical persons, legal person	Training:	National qualifications authority of Ireland	Examination	Outsourced to private company (multinational service company) – 41 test centers (16 fixed, 25 mobile)	**Yes.** **Authorized persons:** system of penalty points. **Building Owners:** when offering building for sale without valid certificate (fine up to 5000 EUR, or up to three months in prison, or both)
Netherland	1	Physical persons (individual experts) Legal person (accredited companies?)	**Training:** **secretariat for**				

Country	**No. of authorized persons involved in Energy Certification of Buildings**	**Legal form of authorized experts**	**Institution responsible for training and experts examination**	**Institution responsible for issuing authorization to experts**	**Monitoring and operation of register, evaluation of results**	**Control over quality of energy certification**	**Penalties**
		Since 2008 only accredited companies, individual max. up to 2 energy consultants : appointments are available consultants covering single and two family house with less than 500 m2. Consultants covering multifamily houses, public buildings, trade and service sector. RIBH: Technical experts – 4 types for oil and solid fuel boilers; gas boilers; oil and solid fuel heating system; gas-fired heating system	**energy certification** **Examination for: secretariat for energy certification**				
Germany	1	Physical Persons - qualified experts Authorization	Authorization is based on the qualification of the person concerned. No examination are in place for ECB	There is no official approval certification. A person, who issues an energy certificate and is not entitled to do this, can be punished by a fine for breaching the regulation.	The German Energy Performance Certificate System does not require the certificates to be reported, and thus there is no central register	The voluntary quality seal of the German Energy Agency labels particularly quality tested certificates.	For breaches of the regulations such as incorrect issuing of certificates, refusal to issue or submit certificate or deliberately include incorrect information in certificate may be imposed fines by responsible agencies. In general local building authorities act as the responsible agencies.
Portugal	**ECB** 1 Authorizati	Physical persons. They may act on freelance basis	ADENE – Portuguese Energy	ADENE – Portuguese	ADENE – Portuguese	Mandatory Quality Assurance Scheme – developed by ADENE,	**Building owners:** Owners who fail deliver the certificate to

Country	**No. of authorized persons involved in Energy Certification of Buildings**	**Legal form of authorized experts**	**Institution responsible for training and experts examination**	**Institution responsible for issuing authorization to experts**	**Monitoring and operation of register, evaluation of results**	**Control over quality of energy certification**	**Penalties**
	on is divided in three areas: - residential and small non-residential - large non-residential (one or both of following areas: Energy / Indoor Air Quality)	or be integrated in public or private organizations.	Agency	Energy Agency	Energy Agency	approved by government. Four stages 1/ training, 2/ validation of data inputs (before issuing certificate), 3/ simple quality check (performed on random sample of 2% of the certificates issued daily), 4/ detailed quality check (performed on random sample of 2% of the certificates issued monthly). Target is to extent the random sample to 8% in 2011.	buyer or tenant, or display it on public building will incur fine between 250 and 3740 EUR. **Experts:** Yes, for insufficient of quality of certificate (based on results of the detailed quality check)
Czech Republic	ECB:1	Physical person – energy auditor with registration number	Examination and accreditation of experts for ECB	Ministry of Industry and Trade	List of experts is kept by the Ministry of Industry and Trade	No central register of certificates. State Energy Inspectorate (SEI) – random sample check.	SEI can impose different penalties to: - building owner/operator/ flat owners association when not providing for ECB - legal and physical person when not providing for regular inspection of Boilers and HVAC – 8300 EUR - building owner/ constructor when not achieving compliance with minimal performance requirements 4000 EUR
Romania	1	Physical or legal entity	Obligatory training and examination: Ministry of Regional	Professional license is issued by Ministry	List of authorized experts is kept	ECB/ Central registrar of all EPC and national database must be organized by National	

Country	**No. of authorized persons involved in Energy Certification of Buildings**	**Legal form of authorized experts**	**Institution responsible for training and experts examination**	**Institution responsible for issuing authorization to experts**	**Monitoring and operation of register, evaluation of results**	**Control over quality of energy certification**	**Penalties**
			Development and Tourism Recognized courses are also organized by Technical Universities	(validity of 5 years)	by the Ministry of Regional Development and Tourism	Building Research Institute Quality of EPC – periodic control by commission established by Ministry. Once a year experts are tested through examination. No clear regulation about control yet.	

Table A. 4. Legal Enforcement Status for Certification of Energy Performance of Buildings in European Union

Country	Summary of Energy Performance Certification and Labeling Policies and Programs
	Sources: Towards an Energy Efficient European Building Stock: RICS Status Report on the Implementation of Directive 2002/91 on the Energy Performance of Buildings (EPBD) in the EU Member States; www.buildingrating.org; and www.buildup.eu
Austria	Requirements regarding the certification of buildings are part on the 'OIB-Guideline'. Detailed information can be found on www.energieausweis.at and www.energyagency.at. Certification is obligatory for new buildings with a building permit after the 'OIB-Guideline' came into force in a 'Bundesland', on 1 January 2008 at the latest. The certificate of public buildings has to be publicly displayed as of 1 January 2009, unless a 'Bundesland' introduces it earlier by regional law (building code). Existing buildings (including apartments, offices) with a building permit after 1 January 2006 must have a certificate when rented or sold as of 1 January 2008. Other existing buildings when rented or sold must have a certificate as of 1 January 2009.
Belgium	**Brussels Capital Region:** Certification for new buildings and existing buildings undergoing renovation has become mandatory as of 30 June 2008. For public buildings and other existing buildings when rented or sold, the certificate is mandatory as of the year 2009. Certificates are issued and registered by the IBGE (Brussels Institute for Environment). The government will issue a list of public authorities and institutions affected by the current regulation and will also determine the form, the content and the periodicity of the certification of public buildings. **Flemish Region:** An execution order of 2 December 2005 introduced certification for new buildings for which a building permit has been requested after 1 January 2006. Certification of public buildings over 1000m^2 that have a significant amount of through-traffic has been mandatory since 27 March 2008. It is based on operational rating and must be visibly displayed. Since 1 November 2008, a certificate (EPC) has been mandatory whenever a residential dwelling (e.g., house, apartment, studio) is put up for sale. Since 1 January 2009 this requirement has been extended to include residential dwellings put up for rent. The EPC needs to be available at the time of marketing. A mandatory EPC for nonresidential dwellings will be introduced in late 2009. An 'EPB-Declaration' must be sent electronically to the Flemish Energy Agency (VEA) database. This database and its application are the core of the control system. In case of non-compliance, administrative fines will be imposed on the owner of the building, the building constructor or the assessor. **Walloon Region:** The certificate will be mandatory for selling in January 2010 and at a later date for renting (this date must be set in an execution order). For existing non residential buildings, a common procurement contract for Brussels capital region, the Flemish region and the Walloon region has been launched to find an existing calculation method (asset rating) and software tools for non residential buildings, to adapt it to the Belgian context and then organise the training of trainers. Certification of existing non residential buildings is expected to start in 2010. The certification of public buildings should enter into force within 2010 and will be based on an operational rating as in the Flemish Region. The certificate is valid for 10 years. A handbook for assessors has been finalized available at: http://energie.wallonie.be/fr/guide-de-la-performanceenergetique-des-batiments-peb.html?IDC=6935&IDD=20571. Concerning the certification of apartments, there will be a certificate per unit. In case of a collective heating system, an audit of the heating system will be completed at the time of renting or selling the first apartment.

Table A. 4. Legal Enforcement Status for Certification of Energy Performance of Buildings in European Union

Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Bulgaria	The requirements regarding the certification of buildings have been adopted with the Ordinance for 'Energy Efficiency Certification of Buildings', in force since 1 January 2005. The energy certificate of a new construction is issued by the construction consultant before construction is started and includes the energy performance parameters corresponding to the normative and project requirements for energy efficiency of the completed construction. The energy certificate of an existing building is issued after a detailed energy efficiency audit is carried out by physical or legal entities registered in the Energy Efficiency Agency (EEA) register. The energy certificate is issued for a whole building only, not for a separate apartment. For public buildings exceeding 1000m2 certification is obligatory. The 'Energy Label' has been introduced in 2008.
Cyprus	The Energy Service of MCIT has opened the registry for Accredited Experts and set up the system for issuing official Energy Certificates from 1st of October 2009. The certificate will become mandatory from 1st of January 2010. The certification of non-residential buildings will start later in 2010 as soon as the registry for non-residential Accredited Experts opens.
Czech Republic	Certification became mandatory for new buildings, renovated existing buildings (with a floor space exceeding 1000m2) as of 1 January 2009. Energy assessment of buildings is not a new thing in the Czech Republic. Since 2001 there is a methodology for energy audits and certificates of building envelope in place. A part of the energy audit was also the energy certificate with a graphical scale, showing the thermal characteristics of the building envelope. Due to the energy auditing system a set of national requirements in terms of energy efficiency and indoor climate was adopted. The EPC implementing regulation (published in 2007) of the Act (Energy Management Act incorporating EPB Directive – published in 2006) sets the minimum requirements for the energy performance of new buildings and existing buildings under major renovation. Czech EPCs use asset ratings.
Croatia	Croatia's current EPCs are asset ratings that focus primarily on heating loads.

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Denmark	Certification is covered by Decree 1294 on the 'Energy labeling of Buildings' of 13 December 2005. Buildings need a certificate ('label'): (1) • When constructed; (2) • When sold or rented; (3) Regularly (every 5 years) when exceeding 1000m2; and (4) Regularly (every 5 years) for all public buildings (all measures identified by the certificate, having a pay-back period of less than 5 years, have to be implemented within 5 years). Existing buildings, when rented or sold, need to have a certificate which is no more than 5 years old. This also applies to the sale or renting out of individual flats in blocks of flats. Certification of apartment blocks is done on the whole building with an additional individual certificate for each unit. There are 14 different certification categories from A1 to G2. New buildings must at least achieve B1 to get a permit for use. Grade A1 and A2 are for low energy buildings (Class 1 and Class 2). The day-to-day running of the scheme is done by the FEM secretariat which is also where all certificates are lodged. The secretariat also carries out a continuous evaluation of the scheme, the quality of the certificates and the inspectors. The specific rules for inspectors can be found in the 'Handbook for Energy Consultants' available on: www.femsek.dk. It includes data for typical constructions and installations to facilitate benchmarking and uniformity of certificates. The certification fee structure provides the income to cover the operating costs of the FEM secretariat, the technical auditor and training of the inspectors. The maximum fee for a detached single-family residential building is set at 500€. The market for energy certification of larger buildings is not regulated by the Danish Energy Authority.
Estonia	Estonian EPCs are both asset and operational ratings for new and existing buildings upon sale, rent, or renovation. Certification of new buildings is mandatory with building permits requested after 1 January 2009. All other buildings, when rented or sold, must have an energy performance certificate as of 1 January 2009. For public buildings, certification is mandatory from 1 January 2009. In the majority of cases, certification will be based on actual energy consumption measurements. In case of new buildings, estimation is used.
Finland	In Finland, new and small residential buildings receive asset ratings, while existing and larger buildings receive operational ones. The Act on Building Energy Certification was approved by Parliament on 13 April 2007. According to this act, certification will become mandatory for new buildings with a building permit in 2008. Other buildings when rented or sold must have a certificate as of 1 January 2009. Energy Performance Certificates are not required for holiday homes or buildings smaller than 50 m2, industrial premises and heritage buildings. Certificates are optional for existing detached houses and residential properties consisting of no more than six homes

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
France	The implementation of the certification activity has been transposed into French legislation through the Building Code (amended by laws in 2005 and an ordinance in 2006). Certification is mandatory: • As of 1 November 2006, when residential or non-residential buildings are sold (overseas areas excluded); • As of 1 July 2007, when buildings are rented and • As of 1 July 2007 for new buildings with a building permit required. The French certification (called Diagnostic de Performance Energetique, DPE) describes the building or housing and its equipments in terms of heating, domestic hot water production, cooling, ventilation, as well as the conditions of their utilisation. It indicates, accordingly to each case, either the quantity of energy actually consumed (on the base of energy consumption data/bills) or the energy consumption estimated for a standardised utilisation of the building or housing. Two labels classify the building or housing, according to its energy performance and its greenhouse gas emission. The DPE also provides guidance and recommendations. Public buildings over 1000m^2 are required to display a certificate as of January 2008. The cost of a certificate is between 150 and 250 €, depending on the type of building and it is valid for 10 years.
Germany	German EPCs, called Energieausweiss, include both asset and operational ratings. New buildings have required certification since 2002. Deadlines for certification are (i) All residential buildings built before 1965 by July 2008; and (ii) All residential buildings built after 1965 as well as all nonresidential buildings by July 2009. In public buildings or buildings with a lot of through trade exceeding 1000m2, the certificate will need to be displayed at the building's entrance. There are two types of certificate. Until 1 October 2008 building owners were able to choose the type of certificate. **Type 1** is a cheap version (1-3 hours of work at a price of 10-150€ via the Internet or via the company that reads the heating meters) that only provides information regarding the energy use of the previous 3 years. It has no real value as it says nothing about the actual energy demand of the building itself. After 1 October 2008, this type of certificate may only be used for homes built after 1978 and more generally with all buildings comprising of five or more units regardless of the age of the building. For non-residential buildings, Type 1 certification requires between 1-5 hours and the cost is between 50-350€. Type 1 certification may not be used when applying for public funding or state subsidised grants. **Type 2** is a more expensive (100-500€) and comprehensive version that highlights the actual energy demand of the building and its components. For residential buildings there exists a simplified method based on transmission heat loss as laid down by EnEV 2002. This requires between 2-8 hours of work and the cost is between 100-500€. For non-residential buildings, demand is calculated on the basis of a methodology according to DIN V 18599. Depending on the size and type of the building, this may take between 2-30 hours and can cost between 1.000-15.000€. This type of certificate can only be issued by a skilled expert. Building owners cannot be forced to carry out the recommended improvements. Against a background of strict tenants statuary rights in Germany, building owners cannot pass on the cost of energy efficient renovation to their tenants which is a major barrier to large scale market transformation.

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Greece	The standard A-G label will be used with a subdivision into A+, A. A- to further stimulate building efficiency competition. Certification was planned to become mandatory for public buildings and other buildings when rented or sold as of 1 January 2009.
Hungary	Certification of buildings is mandatory as of 1 January 2009 for: • new buildings • state-owned public buildings with a surface area exceeding 1000m2 EPCs will be required in case of selling and renting of existing buildings as of 1 January 2012. Rules and methods of the certification were put forward in the Ministerial Decree No.176/2008. The Chamber of Hungarian Architects has already published an interactive electronic guide and the software is available free of charge (http://etk.mek.hu/).
Ireland	Energy performance certification of buildings has been required in Ireland since 2007 in compliance with EPBD. Energy certificates called 'Building Energy Rating' (BER) are needed as of 1 July 2008 for new nonresidential and public buildings. Residential existing buildings require a BER as of 1 January 2009. A BER is an objective scale of comparison for the energy performance of a building ranging from A1 to 6. An advisory report must accompany a BER certificate (tool on www.sei.ie/ber). The assessments are submitted by the assessor to the BER National Administration System. Public data are accessible on the web. As of 1 January 2009, the BER are required at the point of sale or rental for all existing buildings (residential, non-residential and public), or on completion for a new building. BER are valid for up to 10 years from the date of issue. The implementation has been based on a philosophy that certification is a positive instrument of national energy policy aimed at driving market choice (on the principle that "information is power") and market transformation. This has focused on putting strong legislative, technical administrative and promotional systems in place to establish certification as an effective market stimulus to achieve energy savings. The implementation of energy certification of buildings in Ireland followed the policy pathway presented today very closely. The development of the scheme involved planning, implementing, monitoring and evaluating phases. Planning began with a joint working group of senior government officials from different government departments and agencies in 2003 to oversee and plan the implementation of the EPBD in Ireland. By August 2010, a total of 141 900 energy ratings had been published on the integrated website, the National Administration System (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. Although full implementation of building energy certification has only been in place for just 20 months, there is already evidence of the scheme being used as a central lever to the implementation of a national program of energy efficiency retrofit upgrading of the existing building stock. It is too early to assess, but the already strong recognition among

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
	Ireland's general public of building energy certification/ labeling can be expected to be reflected in the price or transaction speed of a building within its market segment.[24]
Italy	The certification of new buildings started 30 days after publication of the new Decree on 1 February 2007. The certification will gradually become mandatory for all new buildings, when the property is sold or rented, in three steps: (1) July 2007 for buildings above 1000m2; (2) July 2008 for buildings below 1000m2 (excluding single apartments); and (3) July 2009 for all flats. Moreover, since 1 January 2007, a certificate is required in order to have access to any type of public incentive for improving energy performance like: • A 55% fiscal deduction over a period of three years for energy efficiency measures • Interventions for public building energy renovation. • The new premium rate program for photovoltaic systems. For new buildings exceeding 1000m2, the compulsory display of the certificate is required. The same obligation is extended to existing public buildings, when an energy service contract of any type is signed, starting as of 1 July 2007
Latvia	Latvian EPCs are based on a combination of asset and operational ratings. According to Building Energy Efficiency law, the energy certification process of buildings must have started on 1 January 2009. Despite intensive research, it was not possible to obtain any further information with regard to certification in Latvia.
Lithuania	Certification requirements for new buildings came into force on 1 January 2007. Certification requirements for existing buildings and refurbished existing buildings entered into force as of 1 January 2009.

[24] IEA Policy Pathway series - Fact sheet on energy performance in buildings policy pathway. OECD/IEA, © 2010

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Luxemburg	An energy performance certificate is required: • Each time a building permit is needed – both for new buildings and refurbishment/extension of existing buildings. • If an alteration of the technical installation of a building influences its energy performance. According to the Grand-Ducal Regulation (Memorial A no. 124), existing buildings, when rented, sold or refurbished, will need energy certification as of 31 December 2009. Every building owner must be in possession of an original of the certificate. When a change of ownership takes effect, the owner is required to forward the original of the certificate to the new owner immediately.Four years after the issuing of a certificate for a new or existing residential building, the building owner must ensure that the certificate is accompanied by an energy consumption indicator for heating and/or domestic hot water. In state owned residential buildings, in local authorities or associations of local authorities where the reference surface energy exceeds 1000m2 and which are frequented by a significant number of people, the certificate must be displayed at the entrance of the building. The certificate rates energy performance on a scale from 1 to 9. Three indicators are used: • Primary energy consumption • Heating consumption • CO2 emission. Data on domestic hot water production and heating systems are included, as well as suggestions for improvement measures An asset rating will be used for all new buildings and buildings over 1.000m2 that undergo major renovations. A combination of asset and operational ratings will be used for public buildings over 1000m2. EPCs are mandatory for residential buildings, when rented or sold, as of 2 January 2009, while all other buildings require one as of 1 June 2009. EPCs are valid for a number of years depending on the type of building or certificate: • For residential buildings, EPCs are valid for 10 years from the date of issue; • For public buildings, the first EPC is valid for 5 years from date of issue. Following that period, an updated EPC is required every 3 years and is to be displayed together with the original EPC for comparison
Netherlands	The guidelines for the issuing of certificate are part of the Decree 'Energy Performance of Buildings'. In the Netherlands, the certificate is called 'Energielabel' and is mandatory for all flats and houses, whether rented or sold as of 1 January 2008. The permanent certification for public buildings & housing corporations (social housing) became mandatory on 1 January 2009. The certificates are valid for ten years. A revised energy label is available as of 1 January 2010.

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Norway	Part of the European Economic Area, Norway followed the European Union's EPBD ruling requiring energy performance certificates (EPCs) for commercial, residential, and government buildings. Norwegian EPCs, which use asset ratings, must be publicly displayed in public buildings and are required at point of sale or transaction for commercial and residential buildings. A separate regulation on energy certification in force since 01 July 2010. It is based on the Norwegian Energy Act and is harmonized with the EU Directive on energy performance of buildings. Approach: The following buildings shall have an energy performance certificate (EPC): • All domestic buildings/flats with a heated floor area > 50 m2 and non domestic buildings with a heated floor area <1000 m2 shall have an EPC when: selling existing, renting out existing or commissioning new building/flat. • All non domestic buildings with a heated floor area >1000 m2 shall have an EPC. The energy performance certificate consists of an energy performance label showing energy rating (from A to G) and heat rating (from green to red). The energy rating is based on annual delivered energy per m2 and the heat rating is based on how big part of the heat need must be covered with direct electricity or fossil fuel (oil, gas). In addition, the certificate has a list of proposed measures needed to get a better energy and heat rating. Buildings > 1000 m2 must have the energy certificate label exposed in a place used by the building users. The certificate must be renewed at least after 10 years. Calculation: All calculations for the certification are done according to NS 3031 (EN 13790) by the central calculation system and database of the Norwegian Water Resources and Energy Directorate (NVE). The calculation is based on the registration input done by the building owner or a person/specialist authorized by her. The certification system has 4 levels of registration. Domestic buildings at level 1 and 2 can be registered by non skilled personnel. All non-domestic buildings must be registered by skilled personnel. 1. Simple registration. For domestic single family houses (buildings with up to 4 flats, chained houses) where no changes have been done on building envelope or heating systems since it was built. 2. Detailed registration. For domestic buildings where changes have been done, and for small and simple non domestic buildings. 3. Expert registration. For complex buildings without air conditioning and/or large glass areas. 4. Expert registration with external calculation program. For complex buildings with air conditioning and/or large glass areas where dynamic (hourly) calculation is needed. The external program must be based on methods described in NS 3031 (EN 13790) and produce a result file to be uploaded in NVE's certification system.

Table A. 4. Legal Enforcement Status for Certification of Energy Performance of Buildings in European Union

Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Poland	As mandated by the European Union's EPBD ruling, Poland theoretically requires energy performance certificates (EPCs) for commercial, residential, and government buildings at point of sale or lease (although only if requested by both parties), and for public buildings to prominently display. Polish EPCs are based on asset ratings. New buildings need to have a certificate as of 1 January 2009. Existing buildings undergoing major renovation, as well as when rented or sold, need a certificate as of 1 January 2009. Public buildings require certification as of 1 January 2009. Different types of energy performance certificates are issued for residential buildings, apartments and building parts constituting separate technical/functional areas.
Portugal	The certificate is the most visible aspect of the SCE: it classifies the buildings on an efficiency scale ranging from A+ (high efficiency) to G (poor efficiency). It is used for residential and non-residential buildings. To issue certificates, qualified experts must access and use a web based central registration system. This regularly updated national database will be used to monitor progress (basic statistics and studies for the future). The timetable to implement the SCE in various types of buildings is divided into three phases: • In the first phase, certification is only required for all new residential and nonresidential buildings with a floor area larger than 1000m2 and requesting a construction permit as of 1 July 2007 • The second phase includes all new buildings, regardless of their floor area, when a building permit is requested as of 1 July 2008 • Since January 2009, the date of full implementation, energy certification is mandatory for all buildings: new buildings, major renovations of existing buildings, public buildings and all buildings when sold or rented. Certification of new buildings started in July 2007. More than 100.000 certificates have been issued by qualified experts by the end of June 2009
Romania	According to the Law 372/2005 as amended in October 2007 and October 2008, certification is mandatory for new buildings with a building permit since 1 January 2007. Existing buildings, when rented or sold, must have a certificate as of 1 January 2010. In state owned public buildings with a surface exceeding 1000m2, the certificate must be displayed at a visible place. The EPC contains information about the energy performance of the building including its installations, as well as advice on the potential benefits resulting from an energy efficiency refurbishment. Certificates provide a mark ranging from 10 to 100, where 76 is an average value. Energy performance certificates are valid for a period of 10 years, although experts consider that this is a too long period of time.
Slovak Republic	Certification is mandatory for new buildings and major renovations of an existing building where a building permit is mandatory as well as for public buildings and buildings which are rented or sold after 1 January 2008

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Country	Summary of Energy Performance Certification and Labeling Policies and Programs
Slovenia	Certification is covered by the amended 'Energy Act' of 17 November 2006. New buildings and public buildings require an energy performance certificate as of January 2008. Large public buildings require certification as of January 2008 and these need to be displayed until December 2010 at the latest. According to the Regulation on the energy certification of buildings, asset rating certificates are necessary for new and existing residential buildings, while operational rating certificates are foreseen for all the other buildings. A central database for lodging energy certificates for sale, rental or display is being currently developed.
Spain	Provisions regarding certification of new buildings have been adopted at national level with the 'National Basis Procedure for Energy Certification'. However, regional authorities may amend these by issuing more detailed provisions. Certification for all types of new buildings has become mandatory for building permits requested since 31 October 2007. There are 2 options for the calculation of the energy demand: • A complex procedure that requires the use of the official software tool 'CALENER' (there are 2 versions: 'CALENER_VYP' for residential and small non-residential buildings and 'CALENER_GT' for larger non-residential buildings) • A simplified procedure that includes any validated procedure approved by the 'certification Commission' added to the already existing simplified methodology for residential buildings based on 12 tables for the different climate zones. For existing buildings a 'Basic Procedure' is expected to be adopted by 2010.
Sweden	Sweden does not have an 'Energy Performance Certificate' but an 'Energy Declaration' in order to avoid confusion with the electrical certification. All declarations must be sent to the 'National Board of Housing, Building and Planning' where they are lodged in a register. Declarations are mandatory for new buildings as of 1 January 2009. For public buildings and multi-family houses, declarations are mandatory as of 31 December 2008. Other buildings, when rented or sold must have a declaration as of 1 January 2009
Switzerland	In Switzerland the Minergie label, an energy performance standard using both asset and operational ratings, is voluntary but widely used.

Table A. 4. Legal Enforcement Status for Certification of Energy Performance of Buildings in European Union

Country	Summary of Energy Performance Certification and Labeling Policies and Programs
United Kingdom	**England and Wales**: An 'Energy Performance Certificate' (EPC) is required when a building is constructed, sold or rented out and must be accompanied by a report outlining ways of improving the energy efficiency of the building. It is valid for 10 years, except for sales of homes, which are subject to the Home Information Pack Regulations 2007, where a Home Information Pack (HIP) is required. In these cases an EPC must be no more than three years old when the property is first marketed. Further details can be found at: www.homeinformationpacks.gov.uk All certificates must be lodged in a central, government approved, database. Residential buildings: • The builder is required to provide an EPC on construction to Building Control using the SAP methodology • Buildings for sale or rental require an EPC on first marketing using the rdSAP methodology. Non-residential buildings: • All buildings over 50 m2 require an EPC on sale or rental at the point of first marketing • The builder is required to provide an EPC on construction to Building Control using the SBEM or DSM methodology. 'Display Energy Certificates' (DEC) are required for publicly accessible public authority occupied buildings over 1000m2 and are renewable annually. The advisory report which accompanies a DEC is renewed every seven years. **Scotland:** Certification is required under the Housing (Scotland) Act 2006 on construction, sale or rental. Energy performance certificates (EPC) are required for display in publicly accessible public authority occupied buildings over 1000m2, however these are produced using the SBEM or DSM methodology and have a life of ten years. Note: There is no central database for lodging EPC's for sale, rental or display. **Northern Ireland:** Certification follows the England and Wales model. All certificates must be lodged in a central, government approved, database

Other Countries

The building energy labeling experiences in other countries, including Australia, Canada, China, Japan, North Korea, Singapore, Mexico and Brazil are summarized in below table A.5.

Table A. 5. Other Countries' Experiences in Building Energy labeling: Australia, Canada, China, Japan, Mexico, North Korea, Singapore

Country	Legal Enforcement Status for Certification of Energy Performance of Buildings *Sources: IMT, IEA, NRDC , Buildingrating.org*
Australia	The Australian Building Greenhouse Rating (ABGR) has been used to benchmark buildings energy ratings and CO2 emissions. ABGR provides market recognition and a competitive advantage for low greenhouse emitters and energy efficient buildings. It encourages best practices in the design, operation and maintenance of commercial buildings. Administered nationally by the Department of Energy, Utilities and Sustainability (DEUS) and locally by leading state greenhouse agencies, the ABGR system rates buildings from one to five stars with five stars representing exceptional performance with current market best practice being three stars. ABGR is voluntary and can be initiated by a building owner, manager or tenant. Also, it can be used for the base building (central services), whole building or individual tenancies. The Green Star rating system, developed by the Green Building Council of Australia, is a national voluntary environmental rating system that evaluates the environmental design and construction of commercial buildings. It covers nine categories that assess the environmental impact of a project's site selection, design, construction and maintenance. These include management, indoor environmental quality, energy, transport, water, materials, land use & ecology, emissions, and innovation. Each category is divided into credits, and points are awarded in each credit for actions that demonstrate the project's attainment of the overall objectives of Green Star. All claimed credits in each category are assessed, a percentage score is calculated and Green Star environmental weighting factors are then applied. The Green Star Certified Ratings include: (i) 4 Star Green Star Certified Rating (score 45-59) signifies 'Best Practice' in environmentally sustainable design and/or construction; (ii) 5 Star Green Star Certified Rating (score 60-74) signifies 'Australian Excellence' in environmentally sustainable design and/or construction; (iii) 6 Star Green Star Certified Rating (score 75-100) signifies 'World Leadership' in environmentally sustainable design and/or construction.

Canada	Canada approved its first comprehensive law on energy efficiency, the Energy Efficiency Act, in 1992. This act gives the Government of Canada the authority to make and enforce regulations related to performance and labeling requirements for energy- consuming products (as well as doors and windows). A system for energy-performance rating and labeling, ecoENERGY for new houses was created to promote the construction and purchase of more energy-efficient houses. Based on the R-2000 Standard and training program, ecoENERGY for Houses is geared towards large-volume, mass-market builders. EcoENERGY's rating process begins by bringing an energy advisor to evaluate the house plans. The energy advisor will recommend energy-savings upgrades and discuss cost-effective options with the client. After the client has approved the costs of the upgrade work and the building has been completed, an ecoENERGY advisor (a third-party contractor) confirms that the recommended upgrades have been incorporated into the house, in addition to performing a blower door test. Once all the tests have been performed, the client receives an ecoENERGY rating label and report.[25]
China	China already has a green Building Rating System but is interested in establishing a certification or labeling system for buildings to help ensure the efficiency of new buildings and the visibility of energy efficiency in the market place. The Chinese Ministry of Housing and Urban-Rural Development (MOHURD) has issued, among others, regulations to promote building energy efficiency including the following: - "Guidance on Building Energy Efficiency Evaluations and Labeling (2006), and - Green Building Evaluation Labeling (2008)
Japan	Japan has detailed testing, rating and labeling requirements for key building components, such as windows, insulation and combustion-based equipment. These test standards and ratings are referenced in the building energy codes.
Mexico	Under Mexican law and as an element of the standards, Conae also implements a mandatory comparative labeling program for room and central air conditioners, refrigerators and/or refrigerator-freezers, clothes washers, centrifugal residential pumps, gas water heaters, commercial refrigeration, and non-residential building envelopes.

[25] For more information, please refer to www.oee.nrcan.gc.ca/corporate/eeinitiative.cfm?attr=0 and www.ecoaction.gc.ca/ECOENERGY-ECOENERGIE/index-eng.cfm

North Korea	Besides the mandatory building energy standard, the BDCES, and Energy Audit Program, South Korea has also promoted an array of voluntary programs to improve building energy efficiency, including Energy Efficiency Labeling Program for Buildings, Green Building Certification Program, Financial Incentives, and Voluntary Agreements for Existing Buildings. Newly built or renovated dwellings with more than 18 households are classified into three grades depending on the application of energy-saving features and equipment. A building which surpasses a certain performance standard is provided with a Certificate of Building Energy Efficiency, which makes the building eligible for low-interest rate construction loans. The Korean government has progressively expanded the energy efficiency labeling program by targeting office buildings in 2004 - 2010 (Y. Lee and S. Kim 2008).
Singapore	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 labeling 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.