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Survey on energy certificates in buildings

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Project co-ordination: ESTIF

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1 INTRODUCTION

The Energy Performance Building Directive (EPBD) entered into force in 2006. This Directive allows for:

- The implementation of calculation methods (*standards*) of energy performance of buildings
- The implementation of thermal regulations for new buildings revisable every 5 years.
- The application of thermal regulations to major renovations of buildings greater than 1000 m^2
- The obligatory supply of energy performance certificates during sales and rentals and the display of such certificates in public buildings
- An obligation of regular inspection of the boilers and air conditioning systems.

This report evaluates the situation on the implementation of this Directive in the member States by particularly considering the problem of the integration of renewable energy into the improvement of the energy performance of buildings.

2 EUROPEAN PROJECTS CONCURRENT TO THE IMPLEMENTATION OF THE EPBD

In order to facilitate the practical implementation of the EPBD in the member States, the European Commission subsidised research and demonstration projects in the framework of the SAVE program. Among these projects, one particularly notes the following projects:

➢ **AUDITAC**

This project aims at the development of the market for auditing methods in air conditioning.

Its objectives are:

- To increase the inspections of air conditioning systems.
- To carry out a sufficient and varied number of inspection demonstrations and methodologies.
- To promote examples of good practices and good procedures in the audits and to obtain significant results in them.

➢ **BUDI**

This project is a pilot action for the development and implementation of energy performance certificates.

Its objectives are:

- To create regional information and competence centres that will diffuse their practical experience.
- To implement actions for two important target groups: public buildings and residential buildings.
- To make target groups for wider execution by the information of energy certificates, tools and advice.
- To implement training for independent experts in order to assure a sufficient number of qualified experts (*one training conference per country*).
- To develop guides, for the execution of procedures with the quality assurance guarantee, and, in addition, accreditation plans.
- To supply the acquired results and experiences to the principal interested players in the other regions in Europe.

- **EEBD** (Electronic Energy Building Directive)

Its principal objective is to develop on the Web a dynamic professional training tool. The training tool concerns the building designers, the project owners and the line personnel with the appropriate means to obtain the technical competence that will allow them to better understand and use the DEPB and the appropriate national regulations, so as to design, maintain and use the buildings with greater energy efficiency.

- **ENPER-EXIST**

This project aims at applying the EPBD in order to improve the conditions of energy use in existing buildings.

Its objectives are:

- To evaluate the technical work already carried out on existing buildings. Actions have been launched by the CEN, but are principally aimed at new buildings. On another hand, different certification procedure projects are done in Europe, but they are not coordinated.
- To analyse the regulatory brakes and levers, economic and organizational, to the implementation of the DEPB in the different member countries.
- To access better knowledge of the actions already carried out on European buildings.
- To define the tracks for future actions concerning the existing buildings.

- **EPA-NR**

This projects aims at the energy performance for the existing buildings in the non-residential sector.

Its objectives are:

- To supply a support platform in order to organize the EPBD implementation process for existing buildings of the non-residential sector in the context of efficiency and profitability.
- To define an energy performance certificate specifically for the existing buildings in the non-residential sector.
- To develop tools in the form of checklists, inspection methodologies and a program for energy calculation.
- To pilot projects that test the methods and the tools.
- To create recommendations of the regulatory nature that can be used at all the levels of government of the different member countries.

- **EPLabel**

This project aims at supplying the energy certificates in the public buildings of the different member countries with a framework of harmonization.

Its objectives are:

- To extend the method elaborated for the energy certification of existing office buildings developed in the Europrosper project of non-residential buildings that could appear under the designation of public buildings: postsecondary training, schools, sporting equipment, hospitals and other public health buildings, hotels and restaurants.
- To make the methodology applicable and available to all the member countries.
- To be able to supply training programs and a convivial website that makes it possible to easily and effectively use the method.
- To propose computer databases that help with a "learning by doing" process so that the information collected by using the homologation system can make an improvement in the energy performance of public buildings possible, by using optimised techniques and levels of reference.

- **E-TOOL**

This projects aims at developing a computer tool for the improvement of the energy performance in the existing buildings.

Its objectives are:

- To draw up an inventory and analyse the energy consumption of the different categories of existing buildings (*age, type, etc.*) in order to make the comparison between the current consumption and that calculated possible.
- To make guides for the measurements of energy efficiency including the cost estimations for the different categories of existing buildings.
- To calculate the impact on the building's energy performance of the modifications made, for the different categories of buildings.

- **IMPACT**

This project aims at optimising the evaluation and energy certification methods of buildings by tests.

Its objectives are:

- To carry out practical tests on the energy performance certification with 6 pilot regions.
- To do experience exchanges and to analyse the success factors.
- To state the recommendations in order to improve the evaluation tools and methods and energy certification, the training of experts and communication.
- To rely on 6 countries for the implementation of the execution process of the PEB Directive.
- To distribute the results of the projects on a national and European scale.

➢ **STABLE**

This project aims at promoting the energy certification of buildings by making the market attractive to the project owners.

Its objectives are:

- To make the energy certification market attractive by the development and distribution of criteria for the client, by quality recommendations to directors of the program and by assuring a link between high energy performance and financial incentives.
- To increase the conscience and interest of European project owners by proposing a targeted information campaign.
- To implement accreditation procedures of experts specifying the qualification level of the experts for the audit.
- To diffuse good energy certification and energy audit practices of buildings between the different member states.

➢ **TOWARDS CLASS A**

The municipal buildings are taken as a reference example.

Its objectives are:

- To prolong the energy display of municipal buildings (*in terms of CO_2 emissions and consumption*) in more than 500 communities across Europe.
- To initiate and stimulate the certification process of buildings in the municipalities.
- To encourage the municipalities to position the performance of their buildings in Class A in order to become exemplary, demonstration operations.
- To make the existence of these exemplary operations and the reasons for their performance known.
- To show the processes that make a building an exemplary achievement, by motivating the municipalities and making gradual improvement towards certification possible.
- To stimulate communication by campaigns on the local level towards the general public starting from exemplary operations and demonstration of the municipalities.

➢ **ESAM**

This projects aims at implementing tools making it possible to elaborate a strategic patrimonial plan among the local authority housing managers in Europe.

Its objectives are:

- To define and plan long-term patrimonial strategies in order to reach the energy performance requirements of the EPBD. In the absence of financial resources, these requirements must be integrated in the existing maintenance operations and the renovation strategies by the local authority housing decision makers.
- To evaluate the energy situation of an asset and to define what solutions would allow the greatest level of energy savings.
- To put into application effective cooperation with the inhabitants, the energy suppliers and the public services of energy management in the local authority housing. The cooperation can supply a great savings in terms of energy costs and consumption.

- **RESHAPE**

This projects aims at the adaptation and implementation of the DEPD in local authority housing.

Its objectives are:

- To accelerate the taking into account of the EPBD by the professional players of local authority housing in Europe.
- To overcome the technical barriers for the renovation of local authority housing by supplying practical tools based on the opportunity of energy performance certification.
- To increase the conscience and change the attitude of the local authority housing players towards renovation solutions.

- **EPBD CA**

Its objectives are:

- To discuss and prepare a structure for the energy certification of buildings in order to maximise the convergences and reduce the range of different options chosen by the member states.
- To discuss and prepare a common base for the development of inspection methodologies of boilers and air conditioning equipment.
- To discuss and prepare adequate implementation solutions of the accreditation of experts in the subject of energy audit and inspection in the member states.
- To discuss the execution criteria of common methods for the calculation of the energy performance of buildings.

3 INVENTORY OF CALCULATION METHODS OF ENERGY PERFORMANCE CERTIFICATES OF BUILDINGS IN EUROPE

While waiting for the creation of an official calculation tool of the energy performance of buildings common to all the member states, there exists, in most of these countries, calculation methods on a national scale. We have inventoried a certain number of them:

<u>In France</u>

There exists the 3CL (*Calculation of Conventional Consumption of Housing*) developed by the Tribu Energie consulting company. It concerns a method that has been developed for the display of expenses linked to the energy consumption in housing.

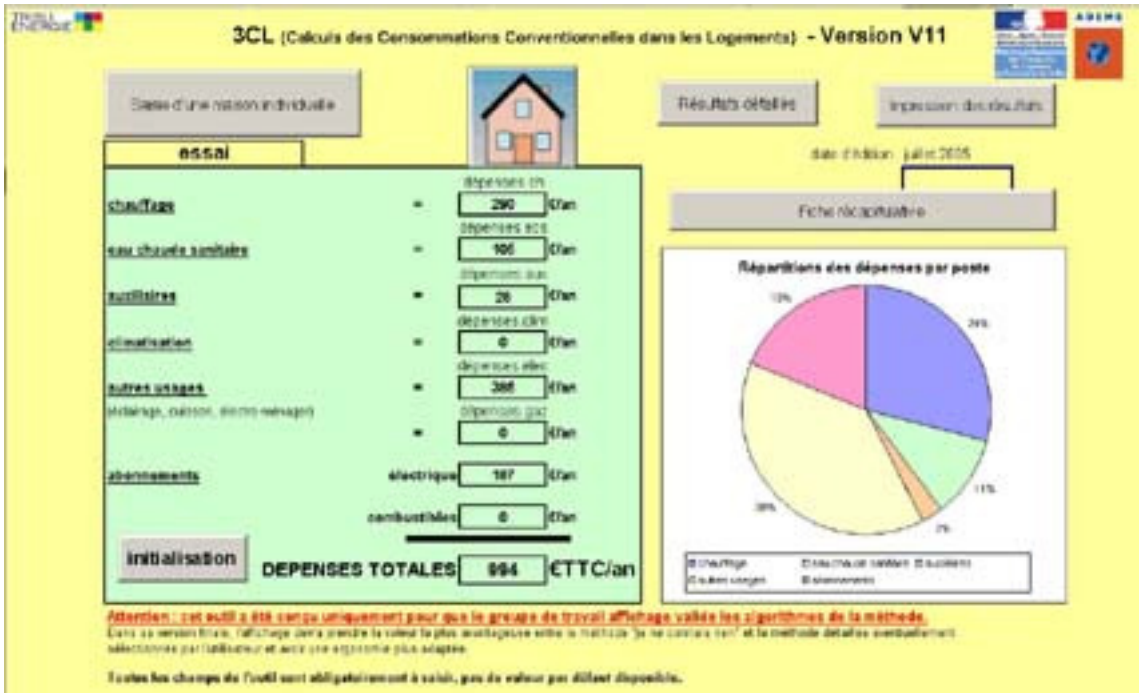


Figure 1 - 3CL calculation method

The latest version of the method is V15-IC. The software publishers are currently programming the algorithms of this method in order to develop operational software. Among them, one can cite:

IMM'PACT (ITGA) software: http://www.itga.fr/polluants-du-batiment/logiciels/immpact.php

Perrenoud software: http://www.logicielsperrenoud.com/

BBS slama: http://www.bbs-slama.com/

DTIMMO software: http://www.dtimmo.fr, etc.

The integration of renewable energy in this method is only limited to solar hot water for domestic hot water needs.

<u>In Belgium</u>

Three calculation procedures are principally available in Belgium:

- The EPW technique applies to new buildings in the Flemish region,
- The EPU technique that is applied to new schools and offices in the Flemish region,
- The PAE (*Procedure of Energetic Advice*) that was the subject of an adaptation in order to be applicable to the certification of existing buildings.

The comparison that has been done between the two applicable procedures on residential buildings highlights significant differences in the energy consumption calculated for a single building. These differences are principally due to conventional values that can be corrected. One has been able to observe similar results with other existing methodologies available in other countries.

The EPW procedure makes it possible to take into account the distribution of a solar thermal heating system. The necessary data takes up the surface of the collector, its angle, its orientation and its shadowing. It also makes it possible to determine the production of electricity by a system of photovoltaics.

A version of the software is available on www.energiesparen.be

Figure 2 – EPB software, Version 1.1

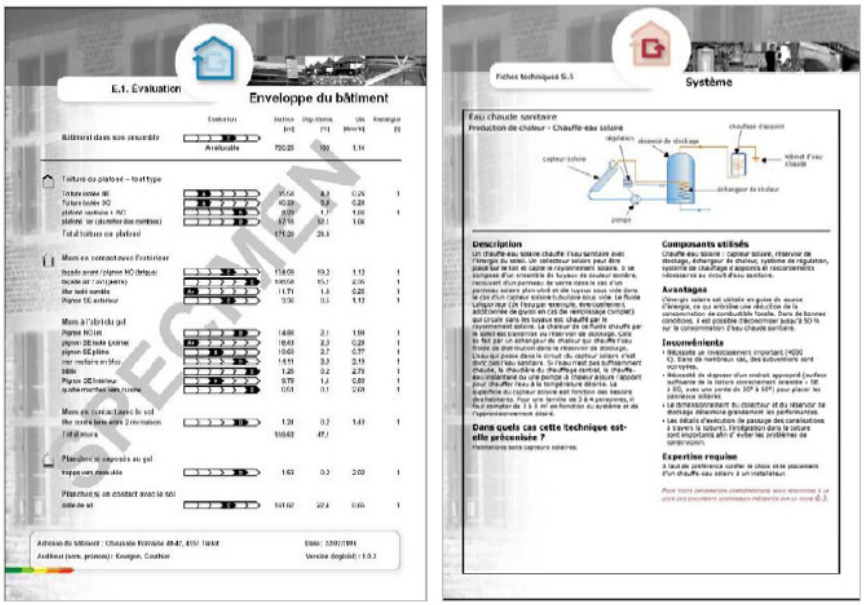
The official certificates that will be valid in Belgium are not yet officially available.

A provisional version of the certificate for buildings in the Flemish region obtained from the PAE software is presented in figure 3:

Example of certificate from the EPW

Figure 3 - Example of certificate with EPW

The energy advice (*Figure 4*) contains the description of the state of the building at the moment of the audit as well as the recommendations and technical documents showing how they can be applied. This document strongly recommends the installation of solar water heaters for the production of domestic hot water.



Example of documents included into the energy advice
Left – evaluation of the building shell – Right example of technical documentation - recommendation

Figure 4 - Document of energy advice (recommendations)

In Spain

For the calculation of the energy certificate of buildings in Spain, two tools have been used:

- The first is the European calculation tool EPA-NR (*for tertiary buildings*) and EPA-ED (*for residential buildings*),
- The second tool is the LIDER-CALENER-VYP software. It can be used for the totality of residential buildings and also sometimes for small and medium tertiary buildings.

EPA-NR: Energy Performance Assessment of existing Non-Residential buildings

EPA-ED: Energy Performance Assessment for Existing Dwellings.

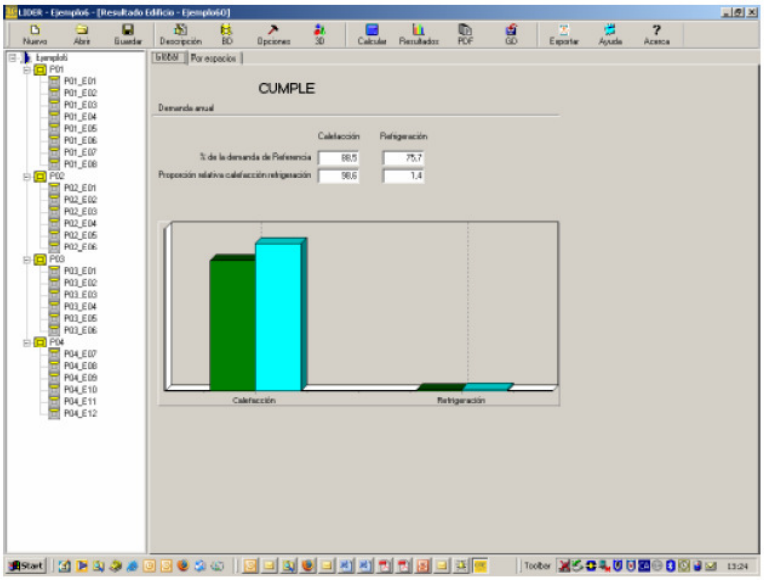
The EPA tool was chosen because it fills the principal selection criteria, including cooling, solar energy, the possibility of adding the local climate and is relatively simple to use.

This tool does not supply a certificate, but makes it possible to calculate in simple manner the final consumption of energy and the CO_2 emission rate of the building.

EPA-NR is more complicated and longer to use than the EPA-ED.

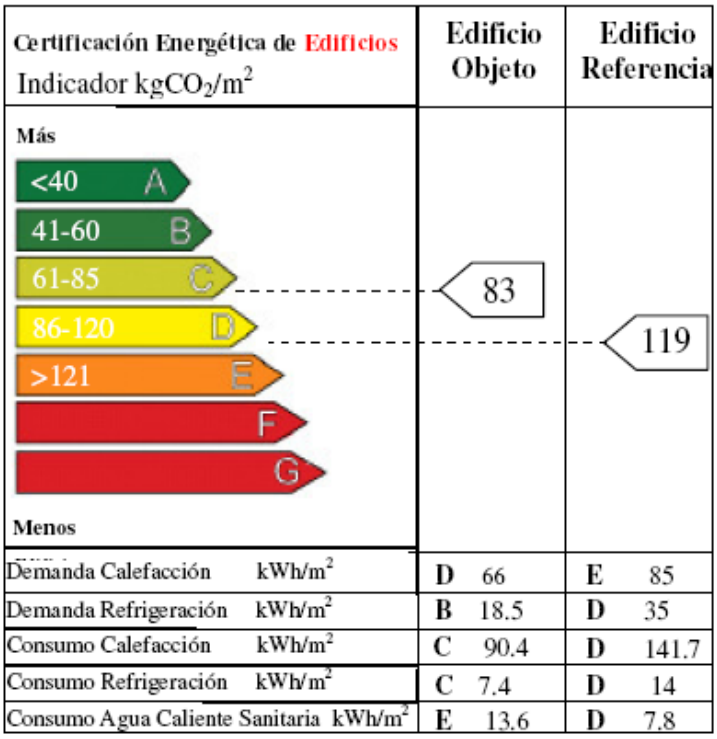
The **LIDER-CALENER-VYP** software, officially available on the market, proposes three different versions for several types of buildings. These three versions are the following:

- ✓ LIDER is now official and can be used in order to fill the conditions of the CTE, document for the limitation of the energy demand.
- ✓ CALENER VYP, which is the certification for residential buildings and small and medium tertiary buildings. This tool is developed by the University of Seville. It's an evolution of the LIDER adding the building's systems.
- ✓ CALENER, which is the certification tool used for large non-residential buildings that cannot be simulated by the CALENER-VYP tool.



screenshot of the screen available results in the LIDER tool

Figure 5 – Results in the LIDER tool



Certificación Energética de Edificios Indicador $kgCO_2/m^2$	Edificio Objeto	Edificio Referencia
Más <40 A; 41-60 B; 61-85 C; 86-120 D; >121 E; F; G Menos	83	119
Demanda Calefacción kWh/m²	D 66	E 85
Demanda Refrigeración kWh/m²	B 18.5	D 35
Consumo Calefacción kWh/m²	C 90.4	D 141.7
Consumo Refrigeración kWh/m²	C 7.4	D 14
Consumo Agua Caliente Sanitaria kWh/m²	E 13.6	D 7.8

Figure 7 : energy certification label draft from the Real Decreto of October 2005

Figure 6 – Energy certification label generated by the CALENER tool

CALENER-VYP and CALENER are not completely reliable yet and there is no technical support for the available software (*in case of problem, there is no fast way to resolve it*). The user must have a special qualification in order to use it correctly.

In addition, the EPA-ED tool is simple to use and requires less specific training. EPA-NR is the most complicated and the longest to use.

In Germany

The DENA (Deutsche Energie-Agentur), energy agency in Germany, actively supported the German federal government in the implementation of an evaluation methodology of the certificates by associating on numerous projects destined to facilitate the progression of the directive and its introduction onto the market. The prototype of energy certification of buildings carried out by the DENA is called **ENERGIEPASS**

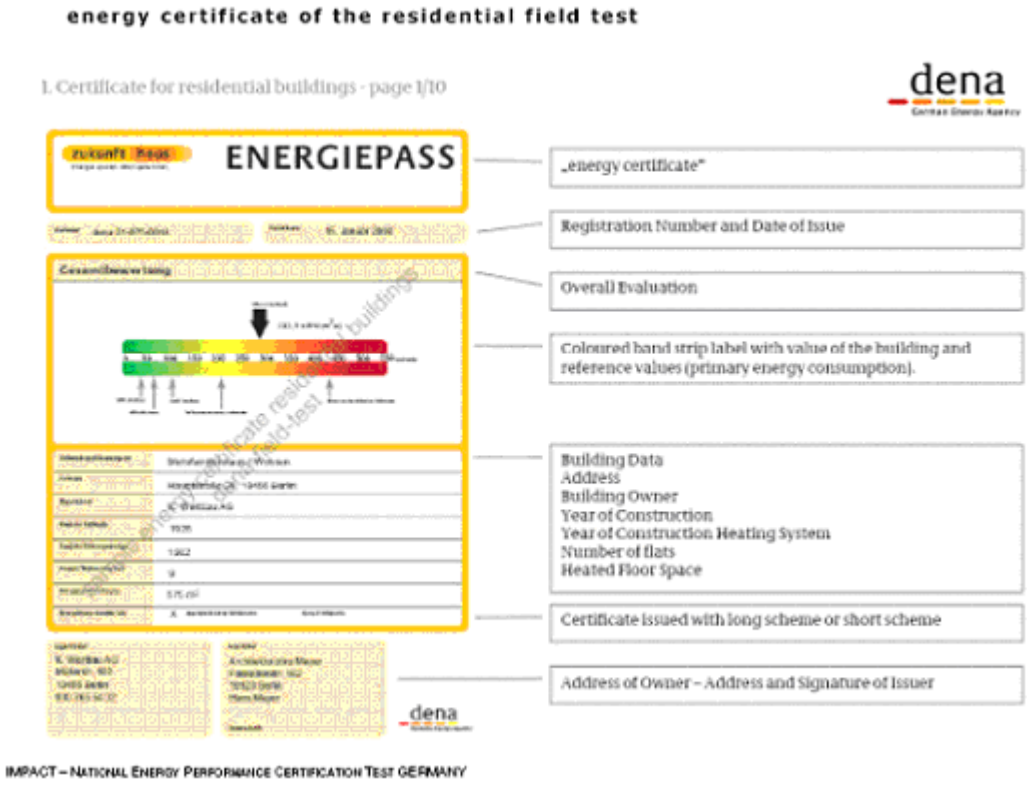


Figure 7- Prototype of the energy certificate of the DENA

The cabinet of ministers adopted the "energy certificate of buildings" in the framework of the new decree on energy saving. The Bundesrat must still approve the new decree.

The energy certificate will gather the energy indicators that already exist on household appliances. It will comprise the same type of colour scale: the buildings with low consumption will be indicated in green whereas the buildings with high consumption will approach red. With the implementation of the energy certificate, the European directive on the energy performance of buildings (EPBD) will be entirely transposed in the German law.

For the calculations making it possible to obtain these certificates, the existing procedures defined in the German and European standards are used. For residential buildings, the calculation method will remain as defined in En EV 2004 (*table*). This method will also be employed for the energy estimation of existing residential buildings.

For non-residential, new and existing buildings, the calculation method will be in accordance with the DIN V 18599 standard (*table below*)

Component parts and contents of DIN V 18599:	
DIN V 18599-1	General balancing procedures, terms and definitions, zoning and evaluation of energy sources
DIN V 18599-2	Net energy demand for heating and cooling of building zones
DIN V 18599-3	Net energy demand for air-conditioning
DIN V 18599-4	Net and final energy demand for lighting
DIN V 18599-5	Final energy demand for heating systems
DIN V 18599-6	Final energy demand for ventilation systems and air heating systems for residential buildings
DIN V 18599-7	Final energy demand of air-handling and air-conditioning systems for non-residential buildings
DIN V 18599-8	Net and final energy demand of domestic hot water systems

Table 1 – Part of the DIN V 18599-1

Currently, a certain number of software publishers are working for the complete incorporation of the DIN V 18599 standard into their tool. One is waiting for the aforementioned software to be available.

<u>In Denmark</u>

Denmark seized the occasion and is attempting to link the energy regulations and the rules for certification in several ways. Before a construction permit is delivered, a calculation of the energy demand must be executed. Before an official permit to occupy a new building is delivered, an energy audit must be carried out by a consultant accredited in energy in order to verify if the calculations used for the energy demand are correct.

SBi developed an electronic tool in order to calculate the energy demand in buildings (*called Be06*). In principle, it's the same method that is used for all types of buildings, but the quantity of entry data can be totally different in describing a dwelling and a large office building respectively.

As far as possible the calculation method is based on the CEN standards. With new regulations on energy, energy consumption for new buildings should always be calculated and will include the energy for heating, hot water, cooling, ventilation, the electricity used by the pumps and ventilators, and also the energy for the lighting in non-residential buildings.

The calculations take into account the techniques and systems of renewable energy (*i.e. passive solar energy, solar collectors, and photovoltaics*).

The calculation engine will be updated with the new CEN standards. The interfaces for the certification are in the process of development.

The method is simple to use, but a good manual is necessary.

In the Netherlands

The EPA-W calculation methodology, version 5.0-June 2006 (*Energy Performance Advice*) is used. The calculation procedure is described in the BRL9501 and ISSO 82 standards.

The method is improved in order to give recommendations on the measures, the cost and the returning time.

It also determines the energy consumption for the heating, domestic hot water and the electricity for the pumps and the ventilators. Renewable energies are also taken into consideration (*passive solar energy, solar collectors, photovoltaic panels, and heat pumps*).

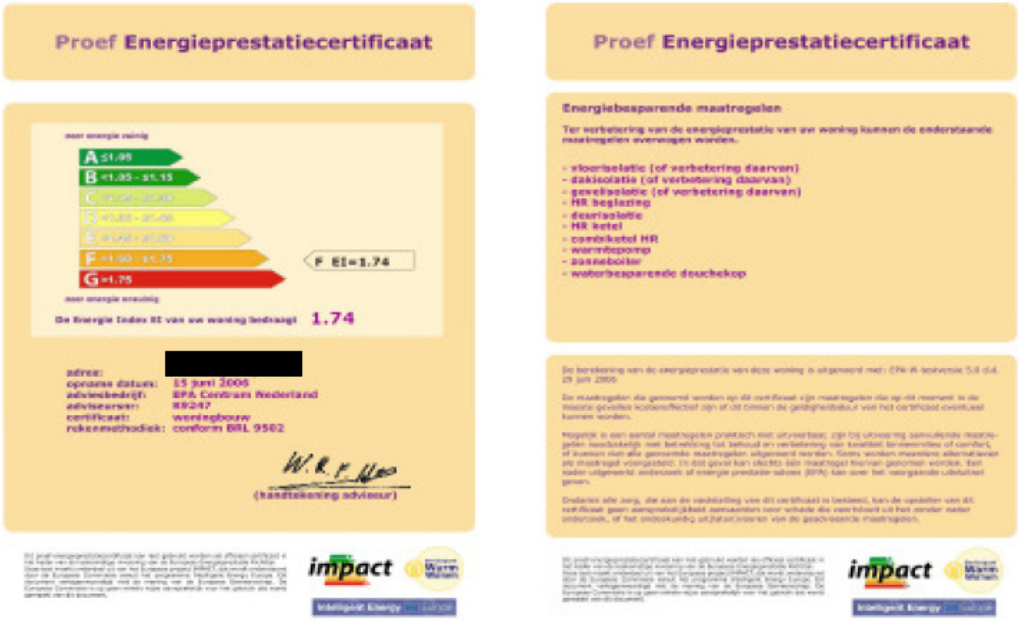


Figure 8 – Energy performance certificate in the Netherlands

In Portugal

The new building regulations in Portugal follow the requirements stated in the EPBD Directive, namely:

- *integrated energy performance of the building;*
- *minimum energy requirements for the new and for the large existing buildings;*
- *energy certification;*
- *inspection of boilers and air conditioning systems.*

Portugal set up its new building regulations according to those principles, which substitute the existing regulations since the 1990´s. The overall strategy consists of two separate regulations and a Certification procedure.

1. Regulations for buildings without heating or cooling systems (Residential or small service buildings with area under 1000 ^{m2}) - RCCTE
2. Regulations for Buildings with HVAC systems – RSECE

Detailed information on the calculation methodology adopted in the new building regulations in Portugal can be found in the legal documents:

Air Conditioning Energy Systems Regulation (RSECE) (Decreto-Lei n.º 79/2006, DR 67 SÉRIE I-A, 2006-04-04) (It imposes as mandatory priority, the consideration in both new buildings

and major renovations, with the exception of fault of technical availability demonstrated by the designer under a mandatory methodology, the usage of flat solar collector systems for hot sanitary water production (Clause 2.a, Article 32 of RSECE)).

Thermal Performance Building Regulation (RCCTE) (Decreto-Lei n.º 80/2006, DR 67 SÉRIE I-A, 2006-04-04) (as referred above).

Calculations tools can be elaborated based on the calculation methodologies described in the official documents.

Presently, INETI, has developed one software tool for calculations according to RCCTE:
RCCTE-STE
(http://www.ineti.pt/pesquisa_geral/pesquisa_frameset.aspx?area=&textopesquisa=RCCTE&area=Geral) (18.08.2008)

For calculation of the contribution of Solar Thermal Systems in hot water preparation the software tool developed by INETI is also used – SolTerm5
(http://www.ineti.pt/pesquisa_geral/pesquisa_frameset.aspx?area=projectos&textopesquisa=solTerm&area=Geral)

An umbrella document is:
Building Certification National System on Energy and Interior Air Quality (SCE) (Decreto-Lei n.º 78/2006, DR 67 SÉRIE I-A, 2006-04-04).

This defines the national certification system for buildings. The responsible entity for this certification system is ADENE:

ADENE AGÊNCIA PARA A ENERGIA
http://www.adene.pt/ADENE.Portal

SCE (Building Certification Scheme) pages:
http://www.adene.pt/ADENE/Canais/SubPortais/SCE/Apresentacao/Apresenta%c3%a7%c3%a3o.htm (31.01.2008)

In the Madeira Autonomous Region the SCE Manager is:

Agência R AREAM *ergia e Ambiente da Região Autónoma da Madeira*
http://ww

Each certification process has a qualified expert as manager, in articulation with ADENE, under the supervision of the Portuguese Directorate-General of Energy (http://www.dgge.pt/), for energy certification and efficiency, and of the Environmental Portuguese Agency (http://www.apambiente.pt), for interior air quality.

The SCE Manager (ADENE) has permanently available information about each one of the certified buildings, with their type, localization, official registration, qualified expert, and energy classification on their website. For example: on
http://www.adene.pt/ADENE/Canais/SubPortais/SCE/EdificiosCertificados/Pesquisa/ (search page) entering with the name "Lisboa" in box for "Concelho" (Municipality), we can get 81 (2008.04.30) entries for certified buildings. One of these gives the following information:


CERTIFICAÇÃO ENERGÉTICA E AR INTERIOR EDIFÍCIOS

Nº DCR DCR0000001222815

Fechar X

DECLARAÇÃO DE CONFORMIDADE REGULAMENTAR

TIPO DE EDIFÍCIO: Pequeno Edifício de Serviços Com Sistema(s) de Climatização

Morada / Localização Passeio dos Heróis do Mar - Parque Expo Lote 5.01.03

Localidade Lisboa

Freguesia Santa Maria dos Olivais

Concelho Lisboa

Região Portugal Continental

Data de emissão do certificado 31-03-2008

Validade do certificado Não aplicável

Nome do perito qualif. Alda Maria Neto Serradeiro Cordeiro

Número do perito qualif. PQ00195

Imóvel descrito na 1 ª Conservatória do Registo Predial de Loures

sob o nº 2532 Art. matricial nº 3345

Fracção autón. Lote A - P5

1. ETIQUETA DE DESEMPENHO ENERGÉTICO

CLASSE ENERGÉTICA

A A* B- B C D E F

B

Figure 9 – Energy performance certificate in Portugal

In Austria

The Austrian Energy Agency was mainly responsible to implement the EPBD and further for the development of the calculation method. There was a long lasting struggle between the nine provinces for one single calculation method.

The result is presented in the OIB-Richtlinie 6 (OIB = Österreichisches Institut für Bautechnik, Richtlinie = guide line). This OIB-RL6 defines requirements on the energy savings and heat protection of buildings through setting requirements for heating and cooling load, thermal quality of buildings, final-energy demand, heat conducting construction components and components of energy systems. Further it defines basic set up of the energy performance certificate (=Energieausweis).

The "Leitfaden Energietechnisches Verhalten von Gebäuden" defines the calculation methods that can be used. It offers a simplified calculation method for existing buildings and provides references to standards which describe in detail how to calculate the energy performance of buildings.

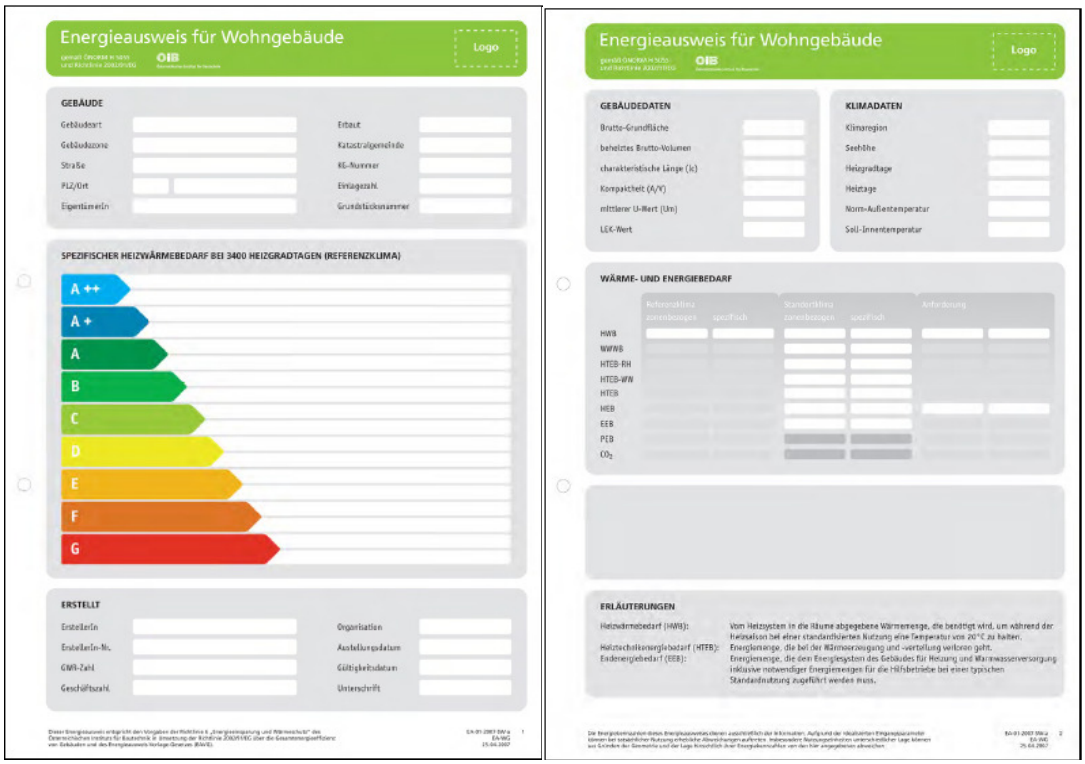


Figure 10 – Facsimile of the Energieausweis

Table of references given in the "Leitfaden Energietechnisches Verhalten von Gebäuden" (a.k.a. OIB-LF6) for calculation of the energy performance:

	Titel der ÖNORM	Nummer der ÖNORM
Nutzenergiebedarf	Heizwärme- und Kühlbedarf (HWB, KB)	ÖNORM B 8110-6
	Raumlufttechnik-Energiebdarf (RLTEB)	ÖNORM H 5057
Endenergiebedarf	Heiztechnik-Energiebedarf (HTEB)	ÖNORM H 5056
	Kühl-Energiebedarf (KEB)	ÖNORM H 5058
	Beleuchtungs-Energiebedarf (BelEB)	ÖNORM H 5059

Benefit from renewable energy systems such as solar thermal systems are calculated on a simplified method for existing buildings according to the OIB-LF6. For all other buildings these systems are calculated according to the ÖNORM H 5056, which itself provides references to EN15316-4-3, ÖNROM M 7701 or acknowledged software packages such as T-Sol, PolySun, TRNSYS.

Otherwise there exist various commercial and public available software tools to calculate partial or in total the energy performance of a building according to the OIB-LF6: www.geq.at, www.ecotech.cc, www.etu.at, ..

4 SUMMARY

Other existing methods also exist in other European countries. We have listed in the following table a summary of these methods.

Country	Are energy performance softwares or methods existing?	Are RES included in these softwares or methods?
Austria	YES	NO
Belgium	YES, one official	YES (PV&Th)
Bulgaria		
Cyprus	NO	NO
Czech Republic	Under development	NO
Denmark	YES (compulsory)	YES
Finland	YES	NO
France	YES	YES (Th)
Germany	Under development	
Greece	NO	NO
Hungary		
Ireland	NO	NO
Italy	YES	NO
Latvia	YES	NO
Netherlands	YES	YES (PV&Th)
Norway	YES	YES (PV&Th)
Poland	YES	NO
Portugal	YES	NO
Slovakia	YES	NO
Slovenia		
Spain	YES	YES (PV&Th)
Sweden	YES	NO
United Kingdom	YES	NO

Table-2 – Calculation methods of the energy performance of buildings in European countries – Summary. *Note on Portugal: Separate tool available*

Most of European countries already have softwares or methods enabling to assess the energy performance of building. If the majority of these methods, which are based on the CEN standards, are well adapted to new buildings, there are few methods adapted to existing buildings. In the majority of countries, there still doesn't exist an official method (*at the national or regional level*).

In addition, few countries have integrated renewable energies into their calculation methods. When it is done, it is generally solar hot water that is favoured and sometimes photovoltaics.