

# BUILDINGS ENERGY CONSERVATION: EUROPEAN COUNTRIES' EXPERIENCE

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## ABSTRACT

As presented by the Energy Green Paper "A European Strategy for a sustainable, competitive and Secure Energy" (1), Europe has entered a new energy era. Global demand is increasing within a framework of high and unstable prices. Emissions of greenhouse gases are rising and it is clear that the European Union and the rest of the world have not reacted quickly enough to increase the use of low-carbon energy technologies or to improve energy efficiency. EU greenhouse gas emissions will exceed the 1990 level by 2% in 2010 and 5% in 2030 according to PRIMES model. EU dependence on imported energy will increase from the current 50% to 65% by 2030.

In this domain, the building sector plays a key role. Consuming more than 40% of the final energy use and producing close to one third of the total emissions of greenhouse gas, the building sector plays a key role in any energy or environmental policy in Europe.

The basic elements of a sustainable policy in this sector clearly needs to:

- Reduce the overall energy demand of buildings,
- Increase the energy efficiency of the building sector,
- Increase the use of renewable energy.

The present paper will detail the Energy Performance of Building Directive (2) launched in 2002 and various actions taken in Europe in order to enhance these policies.

## KEYWORDS

Energy policy, Europe, Building, Energy efficiency

## INTRODUCTION

Historically, energy policy has always played a huge role in the construction of Europe; in 1952, with the Coal and Steel Treaty and 1957 with the Euratom treaty, the founding Members States saw the need for a common approach to energy.

To day, energy market and geopolitical considerations have changed significantly. But the need for action in the energy domain is stronger than ever. Energy is essential for Europe to function. But the days of cheap energy for Europe seem to be over. The challenge of climate changes, increasing import dependence and higher energy prices are faced by all EU members. Moreover, the interdependence of EU Member States in energy as in many other areas, is increasing; a power failure in one country has immediate effects in others.

Europe as well as developed country in general, needs to act now, to deliver sustainable, secure, and competitive energy. In doing so, Europe returns to its roots.

In the building sector, this need of a coherent approach is mandatory to succeed. This is the main reason why EC has launched a certain number of measures in order to improve the overall energy efficiency of the building sector, to reduce the use of primary energy in this sector and increase the use

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of renewable energies.

After a brief presentation of the weight of building sector in Europe, this paper will describe the more important element of European Energy policy in this particular sector.

## ENERGY SHARE AND SUSTAINABILITY IN EUROPE

In Europe, energy accounts for 80% of all greenhouse gas (GHG) emission; it is a root of climate change and of many pollutions. In this domain, the weight of the building sector is high, As indicated on figure 1, the final energy use of the building sector, if we integrate the transformation losses of energy is about 41% of the total energy use in Europe.

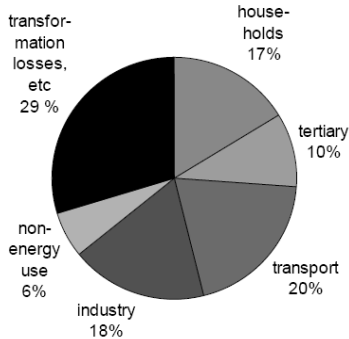
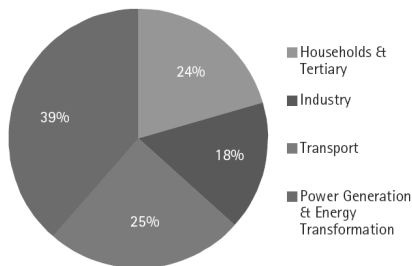


Figure 1: Overall raw energy demand (EU25-2005)

As indicated on figure 2, 24% of CO<sub>2</sub> emissions are directly linked to the building sector.



\*Source: Eurostat

Figure 2: Distribution of CO<sub>2</sub> emissions (2002)

The European Union is a region of over 460 millions inhabitants, Europeans occupy and use a wide array of building types with an equally wide range of thermal qualities and each year the building stock increases significantly. The Member States have all publicly stated their priority to energy efficiency,

and building sector represents the largest share of energy demand.

From all indicators, there is a high cost effective potential for energy savings in buildings. The Council resolution of 7 December 1998 on energy efficiency stated that meeting the indicative target of a 1% improvement in energy intensity above the current trend would result in avoiding 55Mtoe in buildings. This represents about 20% of the Kyoto Protocol target. Most recent analysis is provided in the original proposal prepared by EC before launching the recent Directive on the Energy Performance of Buildings. The global potential of energy savings in the building sector was estimated about 22% of present consumption that can be realized by 2010.

## **POLICY DEVELOPMENT RELATED TO BUILDINGS ENERGY EFFICIENCY**

The role of EU in terms of energy efficiency policies and programs has evolved since the first oil crisis, in part because EU has evolved politically and institutionally. Going back to the 1970s, there were a number of directives (for example on appliance labeling) that were poorly implemented by Member States. There was a major change in 1989 with the creation of the THERMIE program. THERMIE's goal was to promote energy technologies and it has become to be part of Community Research program. The original SAVE program which is till today the Community's program for energy efficiency, was approved only in 1991. Energy efficiency policies and programs at the Community level have significantly evolved over recent years. In 1998, a Communication on Energy Efficiency (3) set out the broad perspective of a European energy efficiency strategy. An Action Plan followed the Communication in 2000. The action plan stated that if energy intensity of final consumption can be improved by an additional 1% per year above the baseline expectations, then two thirds of the available cost-effective saving potential would be achieved by 2010. If achieved, this would contribute to 40% of the EC commitment to meeting Kyoto protocol target. The 2000 European Climate Change Program identified the most environmentally and cost effective measures to help EU meet Kyoto Protocol, obligations giving considerable emphasis on energy. Most recently the Energy Intelligent Europe (EIE) program was approved in 2003. The EIE has SAVE as a sub program in it. The EU is also involved in technology development through the successive Framework Program (6<sup>th</sup> and now 7<sup>th</sup>) which cover all EU funded research. Energy efficiency is funded through one of the priority areas of sustainable development, global change and ecosystems. During the last two years, this strategic plan for energy efficiency and sustainability has been reinforced and new Green Paper on Energy Efficiency (5) has been issued as well as two strategic papers: one on Strategic Energy Technology Plan (6), the other on "an Energy Policy for Europe (7). It is important to review these main actions and to see their implication for buildings.

### **Legislation actions for buildings**

There is a growing body of legal obligations on Member States that directly relate to buildings energy efficiency. Directives cover

- Appliances labeling for a wide range of products,
- Appliance efficiency standards,
- Boiler efficiency,
- Measures to limit CO2 emissions by improving energy efficiency,
- Energy performance of buildings.

In the present paper we will focus on the three last categories and detail more specifically the Energy Performance of Buildings Directive which is the real core of this policy.

## **THE ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE: (EPBD)**

For significant energy efficiency improvements in the building sector, the focus has been on the Directive on Energy Performance of Buildings. It covers the major end-uses of energy in buildings: space heating and cooling, water heating in residential buildings, space heating and cooling, lighting

and water heating in other buildings as well. As shown on the two diagrams from the original proposal of the directive (2) it represents 89% of total energy use in residential buildings and 79% for other buildings.

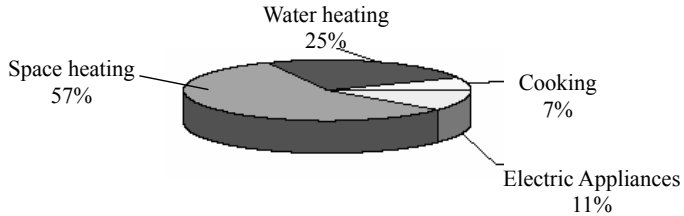


Figure 3: Energy share in EU residential buildings (2001)

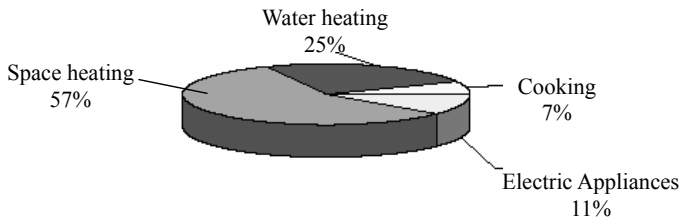


Figure 4: Energy share in EU tertiary buildings (2001)

This directive is focusing on 5 main items:

- Common methodology,
- Setting of minimum energy performance requirements,
- The energy performance certificate,
- Inspection of boilers and air conditioning systems,
- Requirements for experts and inspectors.

#### **Adoption of a common methodology:**

This theme deals with **article 3** of the directive on the Adoption of a methodology. The EPBD provides the general framework for the calculation procedures. "Member States shall apply a methodology, at national or regional level, of calculation of the energy performance of buildings on the basis of the general framework set out in the Annex. Parts 1 and 2 of this framework shall be adapted to technical progress in accordance with the procedure referred to in Article 14(2), taking into account standards or norms applied in Member State legislation. This methodology shall be set at national or regional level. The energy performance of a building shall be expressed in a transparent manner and may include a CO<sub>2</sub> emission indicator."

In order to facilitate application of article 3, a mandate has been given to the CEN committee to develop appropriate calculation procedures to support member states for the national implementation of a calculation methodology of energy performance.

#### **Setting of minimum energy performance requirements**

This topic deals with the procedures for setting up energy performance requirements in the Member States, which are covered in **articles 4, 5 & 6** of the directive. As Member States may differentiate their requirements between new and existing buildings and different building categories, the issues of this

these span a wide range of items such as: strategies on national minimum EP requirements, which building categories are considered in the different Member States, how do the requirements take into account the general indoor climate conditions, what building types are exempted from energy requirements, is the 1000 m<sup>2</sup> borderline applied in all Member States, what kind of requirements are there for major renovations, are these requirements based on benchmarks, is the rating based on measured or calculated data, how are compliance checks organized, what kind of legal sanctions are there,...

#### **Article 4: Setting of minimum energy performance requirements**

"Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings are set, based on the methodology referred to in Article 3. When setting requirements, Member States may differentiate between new and existing buildings and different categories of buildings. These requirements shall take account of general indoor climate conditions, in order to avoid possible negative effects such as inadequate ventilation, as well as local conditions and the designated function and the age of the building. These requirements shall be reviewed at regular intervals which should not be longer than five years and, if necessary, updated in order to reflect technical progress in the building sector.

#### **Article 5: New buildings**

Member States shall take the necessary measures to ensure that new buildings meet the minimum energy performance requirements referred to in Article 4.

For new buildings with a total useful floor area over 1 000 m<sup>2</sup>, Member States shall ensure that the technical, environmental and economic feasibility of alternative systems such as:

decentralised energy supply systems based on renewable energy, CHP, district or block heating or cooling, if available, heat pumps, under certain conditions, is considered and is taken into account before construction starts.

#### **Article 6: Existing buildings**

"Member States shall take the necessary measures to ensure that when buildings with a total useful floor area over 1 000 m<sup>2</sup> undergo major renovation, their energy performance is upgraded in order to meet minimum requirements in so far as this is technically, functionally and economically feasible. Member States shall derive these minimum energy performance requirements on the basis of the energy performance requirements set for buildings in accordance with Article 4. The requirements may be set either for the renovated building as a whole or for the renovated systems or components when these are part of a renovation to be carried out within a limited time period, with the abovementioned objective of improving the overall energy performance of the building."

**The Energy performance certificate** is stated in **article 7** of the directive as follow:

Member States shall ensure that, when buildings are constructed, sold or rented out, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant, as the case might be. The validity of the certificate shall not exceed 10 years.

Certification for apartments or units designed for separate use in blocks may be based:

- on a common certification of the whole building for blocks with a common heating system,
- on the assessment of another representative apartment in the same block.

Member States may exclude the categories referred to in Article 4 from the application of this paragraph.

The energy performance certificate for buildings shall include reference values such as current legal standards and benchmarks in order to make it possible for consumers to compare and assess the energy performance of the building. The certificate shall be accompanied by recommendations for the cost-effective improvement of the energy performance. The objective of the certificates shall be limited

to the provision of information and any effects of these certificates in terms of legal proceedings or otherwise shall be decided in accordance with national rules.

Member States shall take measures to ensure that for buildings with a total useful floor area over 1 000 m<sup>2</sup> occupied by public authorities and by institutions providing public services to a large number of persons and therefore frequently visited by these persons an energy certificate, not older than 10 years, is placed in a prominent place clearly visible to the public.

The range of recommended and current indoor temperatures and, when appropriate, other relevant climatic factors may also be clearly displayed.

### **Inspection of boilers and air conditioning systems**

This theme deals with **articles 8 & 9** of the directive. These articles relate to:

- the inspection of hot water boilers used for heating of buildings
- the inspection of air conditioning systems used to control air temperature inside buildings, possibly in combination with the control of building ventilation, air humidity and air cleanliness.

In its "considerations", the EPBD states that "regular maintenance of boilers and of air-conditioning systems by qualified personnel contributes to maintaining their correct adjustment in accordance with the product specification and in that way will ensure optimal performance from an environmental, safety and energy point of view".

It also asserts that "an independent assessment of the total heating installation is appropriate whenever replacement could be considered on the basis of cost-effectiveness".

### **Requirements for Experts and Inspectors**

This theme deals with **article 10** of the directive on Independent Experts. It comprises issues such as specifications and training requirements for experts and inspectors including indications on the resources needed at national level (how many experts and inspectors and level of expertise), quality assurance for experts, inspectors and certificates, criteria for accreditation, code of practice, insurance and liability...

## **ACCOMPAGNIING MEASURES**

### **EPBD Concerted Action: ( [www.epbd-ca.org](http://www.epbd-ca.org) )**

The Concerted Action working plan is organized around a series of 8 meetings (from January 2005 to June 2007), bringing together the participants of 25 countries (23 Member States + Bulgaria and Norway - missing: Czech Republic, Luxemburg, Malta). The CA-participants are the representatives of national governmental ministries or governmental affiliated institutions that are in charge of preparing the technical, legal and administrative framework for transposing the EPBD in their own country.

Within the global objective of sharing information and experiences between countries, EPBD CA has the following specific goals :

- To discuss and to prepare a structure for the energy **certification** of buildings in order to maximize similarities and reduce the range of different options selected by the MS;
- To discuss and prepare a coherent basis for the methodologies for **inspection** of heating boilers and air-conditioning equipment;
- To discuss and prepare ways to implement adequate schemes for accrediting of energy audit and inspection **experts** in Member States;
- To discuss criteria for the implementation of common **methodologies** for calculating of the energy performance of buildings.

### **EPBD Building Platform: ( [www.buildingsplatform.eu](http://www.buildingsplatform.eu) )**

The EPBD Buildings Platform is a European Commission initiative in the framework of the Intelligent Energy - Europe (2003-2006) program, which provides information services for practitioners and

consultants, experts in energy agencies, interest groups and national policy makers in the European Member States for helping the implementation of the **EPBD**.

### **Intelligent Energy Europe:**

There are many untapped opportunities to save energy and encourage the use of renewable energy sources in Europe, but market conditions do not always help. The **Intelligent Energy - Europe programme** is the EU's tool for funding action to improve these conditions and move us towards a more energy intelligent Europe. The second Intelligent Energy – Europe programme started in early 2007 as part of a broader EU programme called **Competitiveness and Innovation**. Concerning the building domain two main programmes have to be considered : SAVE (energy efficiency and rational use of resources) and ALTENER( new and renewable resources) ; More than 50 projects have been financed since 2004 in accompanying measure of EPBD implementation.

### **Certification:**

CEN, the European standard organization has led a huge work in developing standards for different aspects as:

- energy performance,
- heating and cooling,
- lighting,
- thermal insulation,
- ventilation.

Furthermore, EU gave a specific mandate to CEN, CENELEC and ETSI for the production of standards for calculating the integrated energy performance of buildings and estimating the environmental impact, in accordance with the terms set forth in EPBD.

## **NATIONAL INITIATIVES**

As stated, EPB gives only a frame but the main initiative belongs to each Member State to adapt this frame to its particular climatic, economical, cultural or technical conditions. Thus the Member States who committed in fact when establishing the directive have a key role in its implementation. All Member States were not equally prepared and facing the huge legislative work to be done, most of them have recently asked for an extension of the implementation period initially defined until 2009. In 2007-2008, certificates will pop up for **new buildings, public buildings**, and, to a lesser extent, **existing buildings**. Because of this diversity of approaches, the complete EPBD shall not be fully in force in the whole of Europe before 2009.

However it is interesting to see how the Member States are now really involved in this energy policy. Most of them are, in parallel with the implementation of the EPBD, reviewing their own policy and are defining new initiatives in order to promote the integration of renewable energies in building, to develop specific certification for sustainable buildings, to label low energy buildings or even positive energy buildings. In the very few last years, low energy buildings or green buildings have bloomed everywhere in Europe.

Most of countries have also set a number of measures of financial incentives to support the financial cost for improving the energy efficiency of buildings. These measures cover a large scale of

- **tax allowances and exemptions** (Belgium, France, Slovenia, Czech Republic,...),
- **grants** (Austria, Belgium, Finland, France, Germany, Hungary, UK, Sweden,...)
- **or loan support** (Austria, Germany, the Netherlands, Lithuania, Spain, Slovak Republic,...).

## CONCLUSIONS

This paper has shown how Europe is developing a very strong effort in order to reduce the overall energy demand of buildings, increase the energy efficiency of the building sector, increase the use of renewable energy and reduce drastically the GHG emission.

We are still in the implementation phase of this policy and very strict evaluation of its impact is already prepared in order to propose a revision of EPBD planned for 2009 following the Energy Plan which is targeting a further 20% reduction of energy use for 2020.

With all its diversity in climates, building types, cultures and traditions, Europe could play a key role in demonstrating to the world that a very strong concerted policy combined with local and national initiatives can lead to a real improvement of the energy efficiency on the one hand but also to a real sustainable society on the other hand.

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