Better Indoor Climate With Less Energy: European Energy Performance of Building Directive (EPBD)

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Abstract: The European Commission's Action Plan on Energy Efficiency (2000) indicated the need for specific measures in the building sector. In response, the European Commission (EC) published the proposed Directive on the Energy Performance of Buildings (EPBD) in May 2001. The European Parliament and Council accepted the text, and it was published in the EU Official Journal in January 2003, at which time the Directive became a European Law. The objective of the EPBD is to promote the improvement of the energy performance of buildings, taking into account outdoor climatic and local conditions, as well as indoor climate requirements. The main objective is to achieve better indoor climate with less energy.

ANTECEDENTS

Since the last century the way of life has completely changed due to the technical and economic development. Significant signs of this process can be observed in building sector, e.g. new technologies of insulation, heating and cooling systems. However, it has led to increasing energy demand, which must be provided to ensure the required comfort level of people.

According the survey of International Energy Agency[1], 34,1% of the total primary energy required by European countries.

41% of the energy demand in the European Union was applied in the residential area against 28% industrial purpose. In the building sector 40% utilizing, mostly by heating.

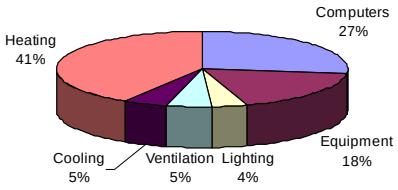

Fig. 1 Breakdown of energy use (EEBD)

Needs of primary energy had made the European countries the most energy importer since oil became the basic energy source. Therefore the European Union highly had been depended on import and got affected elementally by adverse cases such as oil crisis in 1970s as well. Nevertheless this shocking crisis had important conclusion, the EU's leadership and governments paid more attention for improving energy saving technologies and renewable energy sources. First at all they focused on the building sector partly due to the above mentioned percentages on the other hand the fact should be considered that the occupants (over 820 million people in 2002) are considerably responsible for efficient end-using.

It is also important factor that many buildings are hundreds years old, otherwise there is strong growth in new buildings. However there are many with good thermal parameters due to the improved insulation and new type of windows, large number of apartment buildings involved "affordable" flats are being build in poor quality.

On 1 May 2004, the 15 older European Union Member States were joined by 10 new Members. This makes the EU the second largest economy after

the United States. (Final energy consumption in the EU-25 increased by about 8 % in1990-2002). Unfortunately new Member States had brought numerous sub-standard buildings too.

Today, urban pollution is bringing a new chorus of calls for action, and municipal governments have become new partners in finding solutions. And the global concern about climate change has forced action, through the yet to be ratified Kyoto Protocol (1997), to reduce carbon dioxide emissions, as well as other greenhouses gases[2]. The protocol commits 38 industrialised countries to cut their emissions of greenhouse gases in 2008 - 2012 to levels that are 5.2 % below 1990 levels.

Current projections show that many Western European countries will not meet their Kyoto targets, while most Central European countries probably will. In Eastern European countries, which often have rich energy sources, the link between energy efficiency strategies and environmental issues is not a well-established policy concern as yet (OECD 2004). Considering that fossil fuels (especially gas and oil) are expected to remain the largest energy source in Europe for the next 30 years, the energy consumption and its environmental effects might be said one of the most important “emergency cases” nowadays.

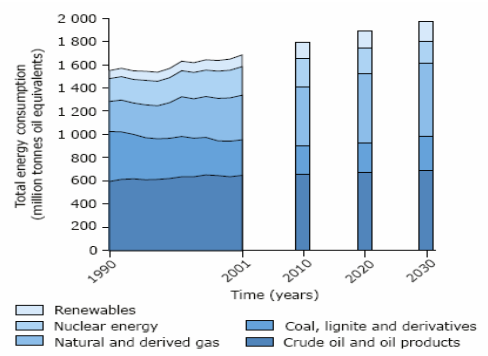

Fig.2 Total energy consumption for the enlarged European Union by fuel type[5]

Tab.1 Estimates of total energy subsidies in 2001, EU-15, billion euros[4]

	Solid fluel	Oil and gas	Nuclear	Renewables
On-budget	>6.4	>0.2	>1.0	>0.6
Off-budget	>6.6	>8.5	>1.2	>4.7
Total	**>13.0**	**>8.7**	**>2.2**	**>5.3**

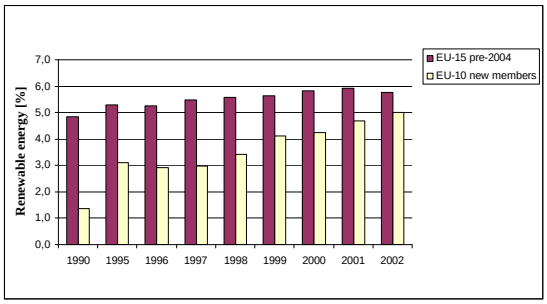

Fig.3 Share of renewable energy in total energy consumption 1990-2002[6]

DIRECTIVE 2002/91/EC

The European Commission's Action Plan on Energy Efficiency (2000) indicated the need for specific measures in the building sector. In response, the European Commission (EC) published the proposed Directive on The Energy Performance of Buildings (EPBD) in May 2001. The European Parliament and Council signed the agreed text of the Directive at Energy Council on 25 November 2002. Upon its publication in the EU Official Journal on 4 January 2003, the Directive became European Law.

The Directive could be handled as a declaration about necessity of energy savings and use of renewable energy sources. In respect of the 10 EU countries, cost-effective savings potential of around 22% of present consumption (building structure, heating, hot water supply, air conditioning, ventilation and lighting) in buildings can be realised by 2010, payback time is shorter than 8 years. (Efforts could result more than 14 billion euro savings by 2010 for the Member States.)

The Directive must be implemented by Member States no later than thirty-six months after it has come into force i.e. by 4 January 2006.

The objective of the Directive is to promote the improvement of the energy performance of buildings within the Community[3], focussing on follows:

- Calculation, monitoring and controlling of energy performance of buildings, with respect to existing (after major renovation) and new buildings.
- Energy certification.
- Regular inspection of boilers and air conditioning systems.

Main technical Articles:

- Principles how to calculate the energy consumption of buildings (Article 3)
- Performance based maximum values of energy consumption for buildings (Article 4)
- Considering more economical systems in case of new buildings; required measurements (Article 5)
- Improvement of the energy efficiency of the renovated buildings (Article 6)
- Energy performance certificate for all buildings (Article 7)
- Inspection of boilers (Article 8)
- Inspection of air conditioning systems (Article 9)

It is specially mentioned the rising number of air-conditioning systems in southern European countries. Energy demand of these appliances can generate serious problems in supply systems during the cooling season.

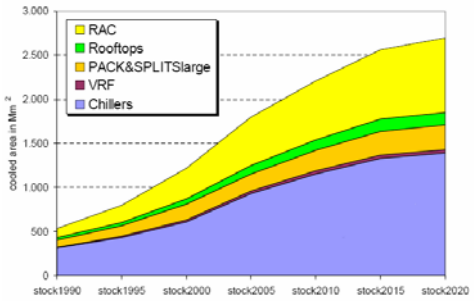

Fig.4 Cooled area in Europe (SAVE study EECCAC)

Nevertheless highlighted questions are the CO2 emission, which should be included in energy certification, and the indoor climate environment.

The occupants' part in the energy use should not be neglected. Higher comfort levels, reflected in increased demand for space heating and cooling, have also contributed to higher final energy consumption.

The Directive must be implemented by Member States no later than thirty-six months after it has come into force i.e. by 4 January 2006. There is an additional 3-year period to allow Member States to apply the provisions of Articles 7, 8 and 9 in case of lack of qualified and/or accredited experts.

CALCULATION METHOD OF ENERGY PERFORMANCE OF BUILDINGS

The energy performance of buildings should be calculated on the basis of a methodology, which may be differentiated at regional level, that includes, in addition to thermal insulation other factors that play an increasingly important role such as heating and air conditioning installations, application of renewable energy sources and design of the building[3].

Each Member State has to work out its own methodology to calculate the energy performance of buildings based on the general framework. It enables each Member State to meet the Directive individual capability and circumstances (standards and norms).

Calculation methods should be prepared with respect to follows:

- Building envelope (including air tightness)
- Heating and domestic hot water
- Air conditioning installations
- Ventilation
- Lighting
- Location and orientation of the building
- Passive solar systems and solar protection
- Natural ventilation
- Design values of indoor climate

It could be carried out in three basic ways:

- Computer simulation (with accepted programs)
- Detailed calculation (by hand or computer)
- Simplified calculation (by hand or computer)

Certainly computer simulation methods ensure more parameters (changing in time) taking into consider, however these should be based on detailed calculation according the standards and norms.

At the end of calculation process energy performance of buildings could be evaluated using integrated energy performance Ep [kWh/m2a]. It is equal the total energy demand of HVAC and lighting systems of building divided by heated area.

The calculated EP value should be compared with the standard given in diagrams for different type of buildings such as:

- Residential buildings (houses, flats or other sort of accommodation)
- Office buildings
- Educational buildings
- Hospitals
- Hotels and restaurants

- Sport facilities etc.

The assumed integrated energy performance should not exceed the standard value given in diagrams separately.

Evaluation of energy performance should be applied any kind of energy consuming buildings, except for:

- officially protected buildings and monuments,
- buildings used for religious purposes,
- temporary or temporary used buildings,
- buildings with less than 50m^2 useful area.

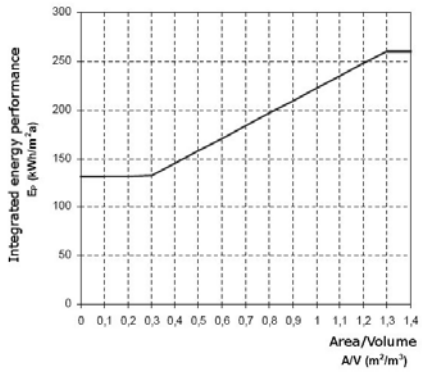

Fig.5 Integrated energy performance for offices (Hungarian calculation method)

ENERGY PERFORMANCE CERTIFICATE (ARTICLE 7)

According the regulation of the Directive certification should be carried out for:

- new buildings with a total useful area over 1000m^2,
- existing buildings undergo major (cost is higher than 25% of value of building),
- public authority buildings,
- frequently visited public buildings,

in case of selling or hire.

The Energy Performance Certificate

- shall be available when building is sold or rented,
- not older than ten years,
- shall include reference values,
- should give also advise how to improve energy efficiency,
- shall be visible in public buildings,
- indoor climate target values may be included.

The detailed form depends on the Member States. It is not specified exactly what does frequently visited or public authority buildings mean.

The form of Certification is not regulated either. Therefore are there differences between applied certification documents of Member States. Primary energy demand data (measured and/or calculated compared with reference values) might be subdivided according the installed system (heating, cooling, lighting..etc.) as well as completed by carbon dioxide emission data. Common form is to use a scale to indicate the energy demand; usually "A" is given to the most energy efficient buildings.

CONCEPT FOR STANDARDIZATION RELATED TO THE EPBD

European standards are being written by the European Committee for Standardization (CEN), which are intended to support the EPBD. CEN/BT WG 173 "Energy Performance of Buildings Project Group" was set up to co-ordinate the CEN work concerning the EPBD and EC standardisation Mandate 343.

CEN established an EPBD-Project group – the co-operating CEN committees (TC):

- TC 89 Thermal performance of buildings and building components
- TC 156 Ventilation for buildings
- TC 169 Light and lighting
- TC 228 Heating systems in buildings

TC 247 Building automation, controls and building management

In the M343-EN-2004 mandate, which asked CEN to cooperate, 31 work items are listed. These must be developed to support the Directive.

One of the main tasks of CEN group was to create an umbrella document to present a clear overview of all work items, standards and their relation as well as main definitions. This paper describes the European standards (ENs) that are intended to support the EPBD by providing the calculation methods and associated material to obtain the overall energy performance of a building[7].

The calculation procedure for assessing the

overall energy performance of buildings is based on the characteristics of the building and its installed equipment, as listed in the Annex to the EPBD.

Regarding indoor environmental standards, adaptation of CEN CR 1752 Ventilation for buildings – Design Criteria for the indoor environment) has new aspects came to light. Indoor environmental categories could help the designers and owners (users) to realise energy savings by avoiding unnecessary high requirements. It is also important to highlight, which is set out in the Directive too, indoor climate environment should not be underplayed by energy savings intention.

INSPECTION STATUS IN 2005

Several surveys have been carried out in order to estimate the expected situation of the Directive in 2006. The main consequence was that most of the EU Members States probably will need the three year extension, whereas some of them will have serious difficulties with implementation.

Figure 6. Perspectives for legal approval of national schemes (EPBD CA)

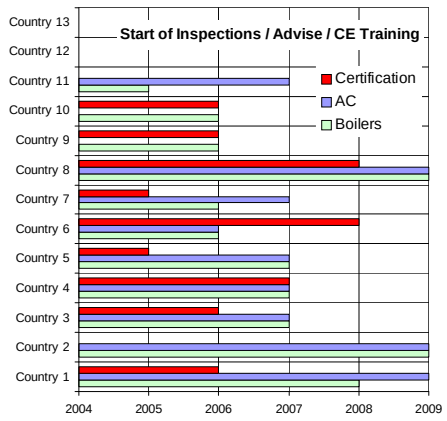

Fig.7 Start of Inspections / Advice / Training (CE) (EPBD CA)

AFTER 4TH OF JANUARY, 2006

At 4th of January, 2006 ten countries (3 full, 7 partly) were able to comply with the first provision: Germany, Italy, Portugal, Austria, Denmark, Belgium, Lithuania, Latvia, Poland, and Slovakia. However all of them required more or less extension as regards Articles 7, 8 and 9.

The 31 CEN standard connected to the Directive will be bring out continuously, up to 2008.

To support the implementation in the other Member states, it has been established several projects such as SAVE projects, Intelligent Energy Europe program and EPBD Buildings platform.

CONCLUSIONS

In the European Union, as well as in other parts of the world, energy saving projects has gained more importance. Thanks to the fact that the EU is highly depended on energy import, but also with respect to environmental reasons. Up to 2010 expected cut down of energy demand is more than 20%. In case of most of the Member States it could be realized by concerted action. The 2002/91/EC Directive on the energy performance of buildings (EPBD) composed the necessity, target and main steps of this. However the Member States should be carried out the detailed development, they are helped by several programs and projects. CEN has been also asked to support by standards the Directive.

The European Directive on the Energy Performance of Buildings poses significant challenges for most of the EU Members States. After the first deadline, 4th of January, 2006, only a few countries were able to implement the Directive, but all of them need more or less extension as regards:

- Article 7: Energy Performance certificate
- Article 8: Inspection of boilers
- Article 9: Inspection of air-conditioning systems.

In the other Member States the implementation is also in process and going to be finished after a short delay. Probably the Directive will be extend after middle of 2006 in order to realise more energy savings and less emission of carbon-dioxide and

other greenhouse gases. In this way the target of Kyoto protocol might be fulfilled as well.

REFERENCES

[1] IEA - Key World Energy Statistics2005

[2] EuroAce - Towards energy efficient buildings in Europe, Final report, 2004 with updated Annexes July 2005 [3] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings

[4] EEA Briefing No 2/2004

[5] EEA Signals 2004

[6] Eurostat – EEA state and outlook 2005

[7] CEN/BT WG 173 EPBD N 04rev Version 2, 14th July, 2004 – Umbrella document