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Energy Conservation in Buildings
and Community Systems Programme



Air Infiltration and Ventilation Centre

Energy Performance Regulations:

**Which impact can be expected from
the European Energy Performance
Directive?**

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1 Introduction

In the past and still often today, building regulations and standards don't reflect the state-of-the art with respect to the performance assessment of buildings in terms of energy use and indoor climate. Because of the field of most of these regulations (transmission losses, energy demand for heating,...) and the typical used components, the assessment procedures were rather simple and not really a reflection of the physical behaviour (e.g. dynamic behaviour of buildings).

This situation is changing and this for several reasons:

- There is a clear shift from an attention for heating energy to the total energy use (heating, cooling, lighting, fans...);
- There is increased attention for thermal comfort in summer, indoor air quality and lighting;
- There is an increased availability of more complex components that often have variable characteristics (e.g. climate facades, demand controlled ventilation...);
- The new European Directive on Energy Performance will oblige all EU member states to have such assessment procedures for ALL buildings and ALL kind of components;

As a result, a whole range of needs can be identified whereby there clearly are important scientific challenges.

Energy Performance (EP) standardisation and regulation is by an increasing number of countries considered as an attractive approach for achieving a more energy efficient built environment. Several countries have already enacted such EP based regulation (the Netherlands, France, ASHRAE approach in North America...), or are preparing one (Germany, Greece, the Flemish Region...). Moreover, a European Directive on the energy performance of buildings was adopted in November 2002.

There are clearly some remarkable trends in the expression of requirements:

- In the seventies, eighties and the beginning of the nineties, many countries set up standards and regulations concerning minimum requirements regarding the thermal insulation of buildings. Often, this was combined with requirements regarding the minimum efficiency of heating systems. This approach was quite logical since many buildings were poorly insulated (due to which transmission losses represented the bulk of the heating losses) and equipped with heating systems with a poor performance;
- In the eighties, several regulations included the so-called passive solar performances of buildings (use of free solar gains in winter time) whereby minimum requirements concerning the net heating demand were imposed;

Due to the increased importance of summer comfort and cooling, the potential contribution of renewable energy sources, the relative and sometimes absolute increase in the energy use due to ventilation, there is since the beginning of the nineties a strong tendency for setting up requirements whereby attention is paid to the total energy use of buildings.

The European Energy Performance Directive (adopted in November 2002) is a major new fact since it obliges all EU member states (and also the to implement various measures in the field of the energy efficiency of buildings.

On January 4 2003, the Official Journal of the European Communities has published “DIRECTIVE 2002/91/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2002 on the energy performance of buildings”. This directive is a major legal boundary condition for future developments in Europe in the area of energy efficiency of buildings and, related to that, measures in relation to the indoor climate in buildings. Given the fact that ventilation, indoor air quality and energy are key aspects of this directive, the full text of the directive is included in this VIP as well as comments concerning ventilation and IAQ related issues.

Moreover, information of related international research projects is briefly given.

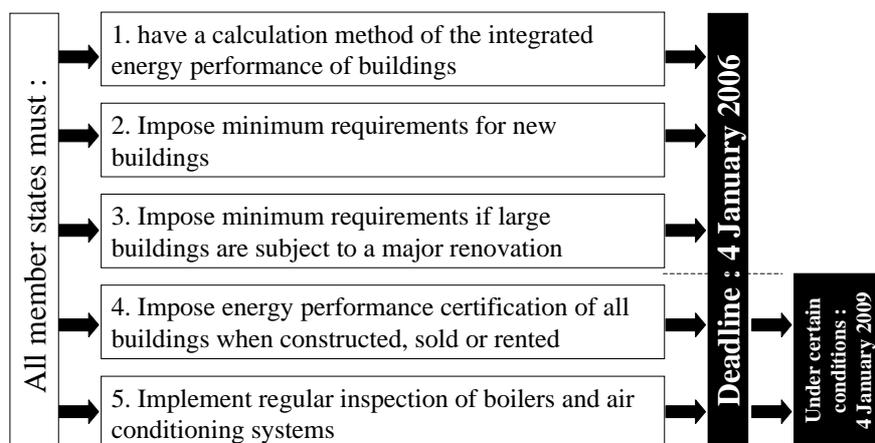
2 European energy performance Directive

Article 1: Objective

The objective of this Directive is to promote the improvement of the energy performance of buildings within the Community, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.

This Directive lays down requirements as regards:

- (a) the general framework for a methodology of calculation of the integrated energy performance of buildings;
- (b) the application of minimum requirements on the energy performance of new buildings;
- (c) the application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation;
- (d) energy certification of buildings; and regular inspection of boilers and of air-conditioning systems in buildings and in addition an assessment of the heating installation in which the boilers are more than 15 years old



Article 2: Definitions

For the purpose of this Directive, the following definitions shall apply:

1. **'building'**: a roofed construction having walls, for which energy is used to condition the indoor climate; a building may refer to the building as a whole or parts thereof that have been designed or altered to be used separately;
2. **'energy performance of a building'**: the amount of energy actually consumed or estimated to meet the different needs associated with a standardised use of the building, which may include, *inter alia*, heating, hot water heating, cooling, ventilation and lighting. This amount shall be reflected in one or more numeric indicators which have been calculated, taking into account insulation, technical and installation characteristics, design and positioning in relation to climatic aspects, solar exposure and influence of neighbouring structures, own-energy generation and other factors, including indoor climate, that influence the energy demand;
3. **'energy performance certificate of a building'**: a certificate recognised by the Member State or a legal person designated by it, which includes the energy performance of a building calculated according to a methodology based on the general framework set out in the Annex;
4. **'CHP'** (combined heat and power): the simultaneous conversion of primary fuels into mechanical or electrical and thermal energy, meeting certain quality criteria of energy efficiency;
5. **'air-conditioning system'**: a combination of all components required to provide a form of air treatment in which temperature is controlled or can be lowered, possibly in combination with the control of ventilation, humidity and air cleanliness;
6. **'boiler'**: the combined boiler body and burner-unit designed to transmit to water the heat released from combustion;
7. **'effective rated output'** (expressed in kW): the maximum calorific output specified and guaranteed by the manufacturer as being deliverable during

continuous operation while complying with the useful efficiency indicated by the manufacturer;

8. **'heat pump'**: a device or installation that extracts heat at low temperature from air, water or earth and supplies the heat to the building.

Article 3: Adoption of a methodology

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 CO₂ emission indicator.

Article 4: Setting of energy performance requirements

1. 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.

In this article, particular attention is given to indoor climate conditions with as an example 'to avoid possible negative effects such as inadequate ventilation.'

2. The energy performance requirements shall be applied in accordance with Articles 5 and 6.
3. Member States may decide not to set or apply the requirements referred to in paragraph 1 for the following categories of buildings:
 - buildings and monuments officially protected as part of a designated environment or because of their special architectural or historic merit, where compliance with the requirements would unacceptably alter their character or appearance,
 - buildings used as places of worship and for religious activities,
 - temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand and non-residential agricultural buildings which are in use by a sector covered by a national sectoral agreement on energy performance,
 - residential buildings which are intended to be used less than four months of the year,
 - stand-alone buildings with a total useful floor area of less than 50 m².

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.

This article is very clear: energy performance requirements must be imposed for all buildings (see definition of building in §2) whereby the calculation method must meet the requirements as given in annex.

For new buildings with a total useful floor area over 1 000 m², 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 m² 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.

Article 7: Energy performance certificate

1. 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.

A certificate will be obligatory for all buildings when constructed, sold or rented. As described in the annex, indoor climate and ventilation related parameters have to be included. Ideally, such certificates should also correctly assess innovative technologies as demand controlled ventilation, hybrid ventilation...

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, or
- on the assessment of another representative apartment in the same block.

Member States may exclude the categories referred to in Article 4(3) from the application of this paragraph.

2. 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 must include reference values and this probably means also information on ventilation related aspects.

The certificate shall be accompanied by recommendations for the cost-effective improvement of the energy performance.

Recommendations concerning ventilation can be part of the certificate.

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.

3. Member States shall take measures to ensure that for buildings with a total useful floor area over 1 000 m² 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, where appropriate, other relevant climatic factors may also be clearly displayed.

Article 8 : Inspection of boilers

With regard to reducing energy consumption and limiting carbon dioxide emissions, Member States shall either:

- (a) Lay down the necessary measures to establish a regular inspection of boilers fired by non-renewable liquid or solid fuel of an effective rated output of 20 kW to 100 kW. Such inspection may also be applied to boilers using other fuels.

Boilers of an effective rated output of more than 100 kW shall be inspected at least

every two years. For gas boilers, this period may be extended to four years.

For heating installations with boilers of an effective rated output of more than 20 kW which are older than 15 years, Member States shall lay down the necessary measures to establish a one-off inspection of the whole heating installation.

On the basis of this inspection, which shall include an assessment of the boiler efficiency and the boiler sizing compared to the heating requirements of the building, the experts shall provide advice to the users on the replacement of the boilers, other modifications to the heating system and on alternative solutions; or

- (b) Take steps to ensure the provision of advice to the users on the replacement of boilers, other modifications to the heating system and on alternative solutions which may include inspections to assess the efficiency and appropriate size of the boiler. The overall impact of this approach should be broadly equivalent to that arising from the provisions set out in (a). Member States that choose this option shall submit a report on the equivalence of their approach to the Commission every two years.

Article 9 : Inspection of air-conditioning systems

With regard to reducing energy consumption and limiting carbon dioxide emissions, Member States shall lay down the necessary measures to establish a regular inspection of air-conditioning systems of an effective rated output of more than 12 kW.

This inspection shall include an assessment of the air-conditioning efficiency and the sizing compared to the cooling requirements of the building. Appropriate advice shall be provided to the users on possible improvement or replacement of the air-conditioning system and on alternative solutions.

Advice concerning improvement or replacement of air-conditioning is required as well as on alternative solutions. This might include information on e.g. passive cooling whereby applying intensive (night) ventilation concepts.

Article 10: Independent experts

Member States shall ensure that the certification of buildings, the drafting of the accompanying recommendations and the inspection of boilers and air-conditioning systems are carried out in an independent manner by qualified and/or accredited experts, whether operating as sole traders or employed by public or private enterprise bodies.

Each member state must take the necessary measures to guarantee the required number of qualified and/or accredited experts (including their specifications). This requires very substantial resources. As an example: for Germany alone, one has to deliver in the 1st year more than 2 million certificates.

Article 11 : Review

The Commission, assisted by the Committee established by Article 14, shall evaluate this Directive in the light of experience gained during its application, and, if necessary, make proposals with respect to, inter alia:

- (a) possible complementary measures referring to the renovations in buildings with a total useful floor area less than 1.000 m²
- (b) general incentives for further energy efficiency measures in buildings.

Article 12: Information

Member States may take the necessary measures to inform the users of buildings as to the different methods and practices that serve to enhance energy performance. Upon Member States' request, the Commission shall assist Member States in staging the information campaigns concerned, which may be dealt with in Community programmes.

Article 13: Adaptation of the framework

Points 1 and 2 of the Annex shall be reviewed at regular intervals, which shall not be shorter than two years.

Any amendments necessary in order to adapt points 1 and 2 of the Annex to technical progress shall be adopted in accordance with the procedure referred to in Article 14(2).

Article 14: Committee

1. The Commission shall be assisted by a Committee.
2. Where reference is made to this paragraph, Articles 5 and 7 of Decision 1999/468/EC shall apply, having regard to the provisions of Article 8 thereof.
The period laid down in Article 5(6) of Decision 1999/468/EC shall be set at three months.
3. The Committee shall adopt its Rules of Procedure.

This Committee is assumed to play an important role in the practical implementation and updating of this directive. All member states are represented in this committee. The decisions by this committee may include ventilation related aspects.

Article 15: Transposition

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive at the latest on 4 January 2006. They shall forthwith inform the Commission thereof.

When Member States adopt these measures, they shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. Member States shall determine how such reference is to be made.

2. Member States may, because of lack of qualified and/or accredited experts, have an additional period of three years to apply fully the provisions of Articles 7, 8 and 9. When making use of this option, Member States shall notify the Commission, providing the appropriate justification together with a time schedule with respect to the further implementation of this Directive.

Article 16: Entry into force

This Directive shall enter into force on the day of its publication in the Official Journal of the European Communities.

ANNEX

General framework for the calculation of energy performance of buildings (Article 3)

1. The methodology of calculation of energy performances of buildings shall include at least the following aspects:
 - a) thermal characteristics of the building (shell and internal partitions, etc.). These characteristics may also include air-tightness;
 - b) heating installation and hot water supply, including their insulation characteristics;
 - c) air-conditioning installation;
 - d) ventilation;
 - e) built-in lighting installation (mainly the non-residential sector);
 - f) position and orientation of buildings, including outdoor climate;
 - g) passive solar systems and solar protection;
 - h) natural ventilation;
 - i) indoor climatic conditions, including the designed indoor climate.

Ventilation and IAQ related aspects are very dominant in the specifications of the calculation method: “air-tightness”, “ventilation”, “natural ventilation”, “indoor climate conditions”...

For some of the more innovative ventilation systems (e.g. demand controlled ventilation, hybrid ventilation ...) there is a large probability that the normal procedures will not allow a correct assessment of these technologies in the framework of such regulation. Alternative procedures (the so-called principle of equivalence) have to be made available.

2. The positive influence of the following aspects shall, where relevant in this calculation, be taken into account:
 - a) active solar systems and other heating and electricity systems based on renewable energy sources;
 - b) electricity produced by CHP;
 - c) district or block heating and cooling systems;

- d) natural lighting.
3. For the purpose of this calculation buildings should be adequately classified into categories such as:
 - a) single-family houses of different types;
 - b) apartment blocks;
 - c) offices;
 - d) education buildings;
 - e) hospitals;
 - f) hotels and restaurants;
 - g) sports facilities;
 - h) wholesale and retail trade services buildings;
 - i) other types of energy-consuming buildings.

3 Ventilation related aspects in energy performance regulations

In principle, an energy performance regulation can pay attention to various ventilation related aspects and therefore directly or indirectly influence the type of systems used in the market:

1. Uncontrolled air flow processes
The airtightness of the building envelope and of air distribution networks can be taken into account.
2. Regulation of air flows
An EPR can associate various performance indices to the different kinds of control strategies, e.g. manual control, timer control, demand controlled ventilation (presence detection, CO₂ control,...), hybrid ventilation,...
3. Heat recovery technologies
An EPR can take into account the impact of heat recovery systems (heat exchangers, combination with heat pumps...)
4. Fan characteristics
An EPR can take into account the fan characteristics (nominal power, control characteristics...)
5. Indoor air quality targets
The minimum ventilation requirements are from an indoor air quality point of view

not optimal values. An EPR can take into account the fact that higher air flow rates may be chosen but it can at the same time stimulate the use of more advanced technologies for such applications.

6. Intensive (night) ventilation and passive cooling

Summer comfort and limiting the use of air-conditioning is one of the key challenges for the future. Intensive (night) ventilation can be a very effective strategy for improving summer comfort and/or reducing the cooling needs. An EPR can pay attention to the benefit of intensive (night) ventilation

In several countries with an energy performance regulation, there is clear evidence that such regulations have a very substantial impact on the type of systems used in the market. Moreover, these regulations are also a major driving factor in the development of innovative systems, e.g.:

- France
Humidity controlled ventilation has taken a substantial part of the market of ventilation systems, and this mainly due to the associated energy benefit.
- Netherlands
Since the middle of the nineties, energy performance regulations are implemented.

As a result, several innovative systems have been developed of which some of these technologies are already widely used (e.g. balanced ventilation with high efficiency heat recovery, demand controlled ventilation systems)

4 Conclusions

1. Without any doubt, this new directive will in a very substantial way influence the European legal measures in terms of energy efficiency and indoor climate of buildings. The EPD is not only applicable for the present EU members but also for the 10 new associated states. Moreover, it probably will indirectly influence the regulatory measures in other countries.
2. The EPD pays explicit attention to various ventilation related aspects.
3. Experiences in countries with an EPR show that such regulations can indeed strongly influence the type of systems used in the market.
4. An EPR can be a major driving force for innovation in ventilation.

The Air Infiltration and Ventilation Centre was inaugurated through the International Energy Agency and is funded by the following seven countries: Belgium, Czech Republic, France, Greece, the Netherlands, Norway and United States of America.

The Air Infiltration and Ventilation Centre provides technical support in air infiltration and ventilation research and application. The aim is to promote the understanding of the complex behaviour of the air flow in buildings and to advance the effective application of associated energy saving measures in the design of new buildings and the improvement of the existing building stock.