

Energy Performance of Buildings Directive

The Buildings Energy Performance Directive¹ (EPBD) was approved on 16 December 2002 and brought into force on 4 January 2003.

The principal objective of the Directive is to promote the improvement of the energy performance of buildings within the EU through cost-effective measures. There are four main aspects to the EPBD.

- 1) Establishment of a calculation methodology: Member States must implement a methodology for the calculation of the energy performance of buildings, taking account of all factors that influence energy use;
- 2) Minimum energy performance requirements: there must be regulations that set minimum energy performance requirements for new buildings and for large existing buildings when they are refurbished;
- 3) Energy performance certificate: there must be an energy performance certificate made available whenever buildings are constructed, sold or rented out;
- 4) Inspections of boilers and air-conditioning: there must be regulations to require inspections of boilers and heating systems (or an alternative system of providing advice as discussed below), and inspection of air conditioning systems.

Calculation methodology

The specification of a calculation methodology is central to the Directive as it impinges on the requirements both for building regulations and for energy performance certificates. The Directive does not specify a detailed calculation methodology, leaving it up to Member States to define the details, but it does clarify that the methodology is one that embraces the overall energy performance of the building, inclusive of its services. Specifically it says that the methodology shall include at least the following aspects:

- (a) thermal characteristics of the building (shell and internal partitions, etc.) which 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;
- (f) position and orientation of buildings, including outdoor climate;
- (g) passive solar systems and solar protection;
- (h) natural ventilation;

¹ Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings

(i) indoor climatic conditions, including the designed indoor climate.

In addition the methodology needs to take account of active solar systems and other heating and electricity systems based on renewable energy sources, electricity produced by CHP, district or block heating and cooling systems, and natural lighting.

In the UK a system incorporating most of the above has been in place for some years now for dwellings: this is the Government's Standard Assessment Procedure for Energy Rating of Dwellings, or SAP. SAP was reviewed and extended so as ensure compliance with the Directive and to enable its use for regulations and energy performance certificates, leading to the current version known as SAP 2005 (www.bre.co.uk/sap2005). Although the basic model is unchanged the revision has been quite extensive at the detailed level, ranging from a more complete treatment of fabric heat loss to the addition or enhancement of low and zero carbon technologies (LZCT) such as micro-CHP, heat pumps, solar collectors, photovoltaics and biomass boilers. SAP covers dwellings with a total floor area up to 450 m².

For non-domestic buildings and larger dwellings, a new methodology has been developed, known as the Simplified Building Energy Model, or SBEM (www.ncm.bre.co.uk). This is a similar model to SAP, based primarily on draft European standards that are presently being written to support the EPBD. It accommodates a wide range of building types, ranging from offices and retail units through to schools, hospitals, hotels, warehouses and airport terminals, amongst many others. Buildings can be sub-divided into zones with different activities, e.g. for an office building this includes cellular office, open-plan office, meeting room, reception, plant room, corridors, etc. This allows appropriate internal conditions (including temperature and air change rate) and internal heat gains to be set appropriate within each zone for the purposes of the calculation. As well as specifying details of the fabric construction, the model incorporates a variety of building services for heating, air-conditioning, ventilation and lighting, and can also take into account LZCT such as solar panels, photovoltaics, wind generators and CHP. It will also be possible to use other detailed simulation tools that have been approved by ODPM, particularly for cases involving innovative features that may not be adequately modelled in SBEM.

Part L of the Building Regulations

The EPBD instructs Member States to take measures to ensure that minimum energy performance requirements are set. It does not specify what the performance standards should be, nor how they should be arrived at: that is for determination by each Member State. However, it applies to all buildings, both new and existing, although the different performance levels can be set for new and existing buildings. The performance requirements are to be based on the calculation methodology and are to be reviewed at least every five years.

The Building and Approved Inspectors (Amendment) Regulations 2006 amended the Building Regulations in England and Wales with effect from 6 April 2006.² There is a set of new Approved Documents: L1A for new dwellings, L1B for work in existing dwellings (including extensions), L2A for new non-domestic buildings and L2B for work in existing non-domestic buildings (www.odpm.gov.uk). For new buildings (of all types) the new regulations implement the calculation methodology as a central part of demonstrating compliance. Essentially it has to be demonstrated that the annual CO₂ emissions from the proposed building will not exceed a target level that is established by reference to the calculated emissions from a notional gas-heated building of the same size and shape as the proposed building. The notional building complies precisely with the minimum requirements of the

² Similar provisions are expected for Northern Ireland from November 2006 and for Scotland from May 2007.

2002 Part L regulations and, to establish the target emissions, an improvement factor is applied, i.e. as well implementing the EPBD the new regulations also raise the performance standards³.

For dwellings the improvement factor is 20%, for naturally ventilated non-domestic buildings 15% and for mechanically ventilated and air-conditioned non-domestic buildings 20%. For non-domestic buildings there is an additional "LZC benchmark" of 10%, so that the overall improvement required is 23.5% for naturally ventilated buildings and 28% for mechanically ventilated and air-conditioned buildings. The LZC benchmark is an indicative level of provision for low and zero carbon energy sources, an aspect particularly encouraged by the Directive which requires that consideration be given to low and zero carbon energy supply systems before construction starts. Incorporation of LZCT is not, however, compulsory for compliance with Part L, provided that a lesser provision is compensated by other energy efficiency measures.

Because the target is expressed in terms of CO₂ emissions, the choice of fuel is significant as different fuels give rise to different CO₂ emissions for a given quantity of heat produced. Natural gas has the lowest emissions of the possible fossil fuels, and the use of other fossil fuels would require additional measures to limit the emissions to the target level. This is expected particularly to encourage the adoption of LZCT for buildings located off the mains gas grid, whether through the use of renewable fuels such as biomass (which are assigned very low CO₂ emissions for the purposes of the calculations), or by measures to reduce the building's net demand for fuel by the utilisation of solar energy etc.

Although whole-building compliance routes have been available in previous Approved Documents (the Carbon Index Method for dwellings and the Carbon Emissions Calculation Method for other buildings), in practice the large majority of buildings have hitherto been assessed for compliance on an elemental basis, whereby each aspect of performance (fabric insulation, heating efficiency, etc) was considered separately. While limitations on these aspects remain, the new requirement to calculate the CO₂ emissions will amount to a major change in the way buildings are assessed for the purposes of Part L.

For extensions to dwellings and change of use creating a new dwelling, the compliance route is primarily an elemental one (with higher standards than before) although with an option of using an overall CO₂ target. For non-domestic buildings, large extensions and change of use are treated as for a new building, i.e. via the overall emissions. Small extensions to non-domestic buildings of up to 100 m² floor area can be treated on an elemental basis.

Energy Performance Certificate

The EPBD requires that an energy performance certificate is provided whenever a building is constructed, sold or rented out. The energy performance is calculated using the methodology discussed earlier and the certification is to be carried out "in an independent manner by qualified and/or accredited experts". This aspect of the EPBD is not being implemented immediately – the Directive permits a delay in implementation up to 4 January 2009 at the latest if there is a lack of qualified and/or accredited experts. However, preparations have begun on the development of suitable accreditation schemes covering domestic and non-domestic buildings respectively. The government has not yet announced

³ The Approved Documents also specify minimum performance levels for individual aspects of the building design, including fabric insulation, air tightness, heating system efficiency, air handling plant, lighting, limitation of solar gain in summer, commissioning and provision of information. These requirements apply in addition to attaining the overall CO₂ emission target.

a timetable for the introduction of energy performance certificates⁴ and it is likely to be phased in between now and January 2009 applying to different sectors (housing, other buildings; new construction, property sales, rentals) as from different operative dates.

The energy performance certificate is expected to classify buildings on a banded scale from A (best) to G (worst), similar to what is already familiar in the white goods market, based on annual CO₂ emissions per unit floor area. The overall scale needs to cover a wide range of emissions, to allow for buildings that by the adoption of LZCT are carbon-neutral (or even better) over the year as a whole, through to the poorest buildings in the existing stock. This means the A-G bands will provide a broad indicator of energy performance of the building and they will be complemented by a numeric indicator that provides more discrimination. The numeric indicator is expected to be the SAP rating for dwellings and the annual CO₂ emission figure expressed in kg/m² for other buildings.

An important aspect of energy performance certificates is that they are to be accompanied by recommendations for cost-effective improvements to the building. Such improvements might range from insulation measures for the building fabric through improvements to heating systems and controls to other services such as lighting. To facilitate the calculation of energy performance and the assessment of improvement measures for existing buildings, inference rules will be available to assist the specification of data needed for the calculations, for example U-values of construction elements (representing insulation quality) based on construction type and age, and typical efficiency values for existing heating plant. For dwellings this has been included as part of the definition of SAP 2005 and similar data are incorporated into SBEM for other building types.

In addition to the above buildings with a total useful floor area over 1000 m², either occupied by a public authority or by institutions providing public services to a large number of people, will need to display in a prominent place, clearly visible to the public, a current energy certificate.

The government is expected to announce its proposals for energy performance certificates later this year.

Boiler and air-conditioning inspections

The EPBD makes provisions for the inspection of boilers and air conditioning plant.

It gives two options for boilers. The first requires a regular inspection of boilers with rated output of 20-100 kW, and for boilers over 100 kW an inspection every two years (or four years if gas-fired). For boilers over 20 kW and older than 15 years, there must be a one-off inspection of the entire heating system, including an assessment of boiler efficiency and size compared with the heating requirements. Advice must be given on replacement of boilers, modifications to the system and alternative solutions.

The second option, which the UK is most likely to opt for, requires the Government to ensure there is adequate advice on boiler replacement and other modifications to heating systems so as to improve overall energy efficiency.

Air conditioning systems over 12 kW output will need to have regular inspections, including an assessment of efficiency and sizing of plant compared with the cooling requirements of the building. The 12 kW threshold applies to the total air conditioning plant supplying the premises concerned rather than to individual chillers. The inspections, which could become

⁴ It has been announced that Home Information Packs for private house sales, of which energy certification will be a part, will be introduced on 1 June 2007.

part of regular maintenance, will be based on observations of the condition of the plant and provisions for its control, rather than quantitative measurements. The key outcome of an inspection will be a report giving appropriate advice for the operation of the plant, the air distribution system, etc.

A ministerial statement on the implementation of the provisions for boilers and air conditioning is expected soon.

Conclusions

The Energy Performance of Buildings Directive has far-reaching implications for the owners, operators and developers of all buildings in the UK (both domestic and non-domestic). Already it has substantially influenced the new Part L Building Regulations, which are set out in terms limiting the overall CO₂ emissions of new buildings. The most visible impact will be energy performance certificates, which will need to be prepared when buildings are constructed, sold or rented to a new tenant. It will also impact on those responsible for maintaining heating and cooling plant, through the need for regular inspections.

Brian Anderson, BRE
April 2006