Implementation of the EPBD in Germany

Status in November 2010

1 > Introduction

Since the first Thermal Insulation Ordinance (Wärmeschutzverordnung) in 1977, there have been requirements concerning the energy performance of buildings in Germany. Over the last 33 years, the requirements have been continuously increasing (see Figure 1). The additional requirements of the EPBD were supplemented by the Energy Saving Ordinance 2007 (Energieeinsparverordnung). Among other things, this concerns the introduction of the holistic calculation method of DIN 18599, further improvement of the Energy Performance Certificate and a regular mandatory inspection of air conditioning units.

The last amendment of the Energy Saving Ordinance came into force in October 2009 and strengthened the level of requirements by 30% on average. Since the beginning of 2009, in addition to the requirements of the Energy Saving Ordinance, it has been compulsory nationwide to use renewable energies for heating in new buildings, according to the Renewable Energies Heat Act (Erneuerbaren-Energien-Wärmegesetz). This obligation has even been expanded to certain refurbishments of existing buildings in some federal states.

According to the Recast EPBD, the Energy Saving Ordinance will be amended again in 2012. Further steps for the introduction of standards for nearly zero energy buildings, for the implementation of an independent control system for Energy Performance Certificates, as well as for the compulsory energy performance indicator in commercial advertisements, are under consideration.

This gives an overview of the development and status of the current requirements of the German Energy Saving Ordinance. It also indicates the prospects for future implementation in Germany.

Responsibility for the implementation of the EPBD for Germany as a whole lies with the Federal Ministry of Transport, Building and Urban Development, together with the Federal Ministry of Economics and Technology. The inspection of boilers is the responsibility of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

The EPBD has been implemented primarily on the basis of the Energy Saving Act (Energieeinsparungsgesetz), which originally came into force in 1976 and which has defined since then the legal basis for requirements concerning:

- Thermal insulation of buildings
- Heating, ventilation and hot water systems, as well as billing of heating and hot water costs on the basis of individual consumption
Since 2002, detailed requirements concerning the energy performance of new and refurbished buildings have been provided by the Energy Saving Ordinance, based on the Energy Saving Act. These requirements already included almost all aspects of the EPBD annex which are relevant to Germany: since 2002, energy performance requirements were already based on the annual primary energy demand of a building, which is the result of a standardised calculation method.

**2 > Certification**

An Energy Performance Certificate has been compulsory for new buildings and major refurbishments since 2002. In subsequent years, the requirement for an Energy Performance Certificate was also gradually introduced for existing buildings, for sale, rent or public use. In Germany, the Energy Performance Certificates can be grouped into two categories, according to the type of the calculation method: certificates on the basis of calculated demand and certificates on the basis of metered consumption. Up to 2008, there was freedom of choice between the “demand” and “consumption” methods for all existing buildings. This now applies only for large residential buildings (at least 5 units), in which the individual influence on use is statistically balanced by the large number of users. It also applies for smaller residential buildings which conform at least to the first German Thermal Insulation Ordinance for thermal insulation, as well as for all non-residential buildings. For a certificate to be issued, owners of older, small residential buildings, which have not been refurbished, must have an Energy Performance Certificate based on calculated energy demand (Figure 1).

Standard forms are mandatory for Energy Performance Certificates; they consist of four pages plus an annex of at least one page, with “Recommendations for cost-effective modernisation”. The recommendations which are given depend on the individual and free opinion of the assessor. Figure 2 shows the first 3 pages of the form for non-residential buildings. A benchmark indicates the average value of the building stock, which defines the central point of the scale, according to the individual use. Page 4 explains the technical terms used in the form, in order to enable the reader to understand the data. Figure 3 shows the form for residential buildings, which has a similar layout, but contains a fixed scale of reference values.
In the Energy Saving Ordinance 2007, new forms were introduced, in order to achieve a standard layout for the certificates for new and existing buildings. The forms were modified again in the Energy Saving Ordinance 2009, so that what was now a free choice of calculation method for residential buildings, as well as the optional use of simplifications, could be indicated. A part of the form concerning the use of renewable energies or corresponding alternative measures is also new. In addition, there was a rescaling of the reference scale for buildings, with the objective of clarifying the change in the level of requirements (Figure 4).

The display of certificates is adopted as taken directly from the directive. Mandatory forms are given in the annex of the ordinance.

Despite numerous changes to the forms, the certificates issued according to the old law, as well as the certificates from earlier programmes with different layouts (because of transitional regulations), retain their validity for 10 years -uniformly- from the date of issue.

There is a lack of knowledge about consumption for new buildings, which means that an Energy Performance Certificate can be issued exclusively on the basis of calculations (energy demand). For this reason, and in the interests of uniformity, the intention was initially to also make the specification of this basic principle mandatory for all cases of existing buildings prescribed in the EPBD. However, in Germany, there has been for many years a mandatory requirement for consumption-based billing of heating and hot water costs for all buildings with more than two units of use. Against this background, in order to limit the cost of Energy Performance Certificates for existing buildings, the use of consumption data obtained from billing information was allowed. To achieve comparability with data obtained by calculating demand, the influence of the weather during the data collection period must be corrected. Since in Germany, when measuring thermal insulation, a uniform, location-independent "reference climate" (the climate of Würzburg) has been assumed for a long time, the heating consumption data must also be standardised to this climate. This is done by forming the ratio of the relevant degree days.

**Figure 4 - Page 2 of the Energy Performance Certificate**
Method of calculation

The holistic German method of calculation is described in the standard DIN V 18599, which does not contradict the CEN standards. It is used to prove that the Energy Saving Ordinance requirements have been met, and provides the energy performance values for Energy Performance Certificates based on energy demand. The German preliminary standard DIN V 18599 is a uniform assessment method for the building envelope, the built-in lighting and the systems for heating, ventilation, cooling and hot water. The standard consists of ten sections with interfaces with one another. Formulas symbols, technical terms and indices are uniform in all sections of the standard, and are defined and used coherently for the different technical disciplines. Figure 5 shows the calculation scheme.

The basic conditions of climate and use to be applied in line with the calculations in the Energy Saving Ordinance are contained in Part 10 of DIN V 18599.

Since the Energy Saving Ordinance 2009, DIN V 18599 is also applicable to residential buildings, in parallel with the previous and simpler calculating method of preliminary standards DIN V 4701 and DIN V 4108. With the objective of limiting the work, and therefore the cost of energy reporting for existing buildings, there is the possibility of "simplified data recording". Simplifications allow the assessor to calculate with default values (e.g. historical U-Values) and to approximate the geometrical shape of the building.

Energy consumption is determined on the basis of a record of heating costs, which must normally be made as part of consumption-based billing. A condition for the use of this data in Energy Performance Certificates is that a period of at least 36 continuous months is recorded. The proportion of heat energy is weather-adjusted using climate correction factors. So far, the weather-adjustment method is not used for cooling, though cooling is included in both methods (calculation or metered energy consumption).

Comparative values must be taken from an official notification and stated as values for energy consumption characteristics of non-residential buildings (Examples in Figure 8).
Use (examples) | Comparative value according to the ordinance of 2009
---|---
| Heating and hot water | Electricity |
| final energy demand [kWh/(m² a)] |
Hotels, mid-range | 85 | 55 |
Restaurants | 205 | 95 |
Cinema | 55 | 80 |
Gyms | 120 | 35 |
Multipurpose halls | 240 | 40 |
Indoor swimming pools | 385 | 105 |
Non-food trade, small | 135 | 45 |
Food trade, small | 125 | 75 |
Department stores, shopping centres | 70 | 85 |
Hospitals, large | 175 | 80 |
Office buildings, only heated | 105 | 35 |
Office buildings, heated and ventilated | 110 | 85 |

**Quality Assurance**

The German Energy Performance Certificate system does not require issued certificates to be reported, and thus there is no central register, in order to keep the cost of issuing certificates low (Costs range between 50 € and 500 €). This unbureaucratic arrangement must also be viewed against the background that an independent control system has so far not been stipulated.

As for the enforcement of the regulation in general, the federal states are also responsible for controlling the issuing of Energy Performance Certificates. This task is generally delegated to the local building control authorities. This legal situation enables the responsible agencies to impose fines in the case of breaches of the regulations, such as incorrect issuing of certificates, refusal to issue or submit a certificate, or deliberately include incorrect information in energy certificates.

The voluntary quality seal of the German Energy Agency (dena) labels particularly quality-tested energy certificates. In a corresponding list, prospective landlords or building owners can find specially qualified and entitled assessors registered in the dena database. The contents of quality assurance are: particularly stringent approval requirements for assessors and mandatory standards for the issuing of certificates, such as an obligatory on-site appointment, personal explanations and additional information concerning refurbishment. Every certificate is electronically checked for plausibility before it can be issued. In a further stage, random sample checks are made by independent experts and, if there are major errors in individual cases, these are examined by subsequent on-site inspection (Figure 10).

In contrast to other member states, in Germany there is no official software for energy certificates. Developers are acting free on the market. The quality of software, i.e. the right transfer of the technical rules into the software, is an important step regarding the quality of the results. Since there is also great interest by private sector software suppliers in guaranteeing the quality of their products, the great majority have joined together since April 2009. to form a "Quality community 18599". The quality community is organised as an association and contributes to further improvements in the products and greater clarity for the users.
3 > Inspections

In Germany, regular inspection of boilers has been mandatory for many years, and in fact to a much greater extent and at shorter intervals than those provided for in the EPBD. The requirements are mainly included in the Emission-Act. Energy aspects of limiting flue-gas losses are also covered. If a boiler does not comply with the prescribed requirements, it must be replaced. The inspections are carried out by the local master chimney sweeper on behalf of the competent authorities. The chimney sweeper keeps a register of all the boilers in the region. The operator of the boiler has to pay a fee, which is officially fixed according to the amount of work (e.g.: gas boiler with a rated output of 24 kW, about 25 € per year).

Thus, thousands of boilers have to be modernised every year, which results in a reduction of the average age of the boiler stock in Germany (see Figure 13). Furthermore, boilers installed before 1978, which do not comply with the status of low temperature boilers, have generally to be shut down. In many cases, the deadline for this has already expired.

Against this background, Germany has chosen "Option b" ‒ because the additional introduction of a one-off inspection of heating systems was not considered reasonable by the Federal Government. Among other actions, the German Energy Agency conducts a campaign in order to inform citizens about possible improvements to heating systems. There are also promotional programmes, as well as information campaigns by third parties (Figure 12).

Maintenance became mandatory for air conditioners. In Germany, there is also the consideration to include in this maintenance the testing of the required properties of energy-related components by the maintenance-technician. Every air conditioning unit with a thermal output of more than 12 kW also has to undergo an inspection by a specialist engineer every 10 years. In particular, the engineer has to inspect the appliance to check whether it meets the individual demand and whether its technical condition requires modernisation. He has to provide recommendations according to the EPBD for the improvement of efficiency.
In Germany, a system for authorising the issuing of energy certificates, which does not require any additional bureaucracy, was introduced with the Energy Saving Ordinance 2007. Authorisation to issue certificates is based on the qualification of the persons concerned. For new buildings, the assessors’ requirements are defined by regional law. Those intending to issue energy certificates for existing buildings must identify their personal qualifications and check whether they meet the conditions set in the Energy Saving Ordinance. There is no official approval certification. A person who issues an energy certificate and who is not entitled to do this, breaches the regulations and can be punished by a fine in theory. In Germany, due to the large number of certificates required, there is a need to make the circle of certificate assessors as wide as possible.

The qualifications required for certificate assessors are described comprehensively and conclusively in the Energy Saving Ordinance. Certificates may be issued by:

- **for all buildings:** architects and engineers of building-related disciplines and by other engineers and natural scientists with a building-related field of study, who have learned about energy efficient building either during their study or during a further vocational training, according to the Annex 11 of the Energy Saving Ordinance, or who have related professional experience of at least two years; by persons who are authorised to make energy calculations for new buildings, according to the building codes of the relevant federal state - in each case within the limits of their respective authority.

- **only for residential buildings:** master craftsmen or persons of equal qualification of crafts related to building and building appliances (including chimney sweepers), who have successfully attended further vocational training, according to the Annex 11 of the Energy Saving Ordinance.

The last category covers a few cases which are not included in the above-mentioned provisions, in which certain experts - mainly craftsmen - are entitled by the local building codes to independently construct simple buildings. The federal states wanted to use this amendment in order to avoid differences between certificates for new and existing buildings.

**National information and communication campaigns**

Information campaigns and specialist handbooks play an essential role in the German implementation strategy. In this case, the offers are adapted to the different levels of knowledge and needs of the interested groups (tradesmen, building owners and tenants, as well as engineers and planners). The acceptance of and familiarity with the Energy Performance Certificates should be further encouraged, especially for building owners and tenants. Planners and tradesmen receive practical tips for how to include the Energy Saving Ordinance and the official announcement in their everyday routine. With regard to the Energy Saving Ordinance 2009, many guidelines have been revised and adapted to the current situation. Such information is published mostly free of charge for citizens.

A large advertising campaign for the CO\textsubscript{2} building refurbishment programme was initiated in 2007 (Figure 16).
6 National incentives and subsidies

The CO₂ building refurbishment programme of the KfW Bankengruppe [German Development Loan Bank] is part of the German climate protection programme and of the Federal Government’s programme for growth and employment. It is intended to promote measures for saving energy and reducing CO₂ emissions in residential buildings by financing corresponding measures, both at low interest rates and in the long term. Particularly efficient new buildings and refurbishment measures in existing buildings are both eligible. In this case, the interest rate is reduced by means of the use of Federal Government funding in the first 10 years of the life of the loan. There can be additional support in the form of a repayment subsidy. Alternatively, an application can be submitted for an investment subsidy for refurbishments.

The support is graduated according to the level of energy refurbishment achieved in the KfW’s "Energy efficient refurbishment" and "Energy efficient building" programmes. The energy performance standard is ranked in relation to the requirements for new buildings included in the current Energy Saving Ordinance (Figure 18). A refurbished building which requires, for instance, 115% of the primary energy of a comparable new building — therefore only 15% more — is assigned to the promotion standard "KfW efficient building 115". On proof of compliance with the programme requirements for the erection or refurbishment as a KfW efficient building, the following compensation credit subsidies (when a low-interest rate loan is taken up) or, alternatively, investment subsidies can be granted.

A basic condition for granting these subsidies is that all measures are undertaken exclusively by specialised contractors. All costs caused directly by the energy saving measures are eligible investment costs. These also include consultancy and planning costs, as well as the necessary ancillary work related to the project’s completion. Professional monitoring of the building work by experts during the refurbishment is also eligible, to the extent of 50% of the costs (up to 2,000 € per project).
The applicant must submit a confirmation from an approved energy consultant or an approved expert that this refurbishment measure will serve the above named purposes, and after this has been done, this person must confirm that the measures have been carried out according to plan.

The funding volume of the CO2 programme amounted to a record value of 2,000 M€ in 2009. Because of strong demand and the high utilisation of funds available in the budget, it has not been possible to support individual measures in existing buildings since September 2010. The funding programme for efficient new buildings and comprehensive refurbishments to efficiency standards continues to operate. The promotional quota is set at 950 M€ for 2011.

### 7 > Impact of the EPBD at national level

The first version of the EPBD in 2002 had scarcely any effect in Germany, since the obligation for national requirements for the energy efficiency of buildings was already more than met in advance by independent national activities. From today’s perspective, the new version of the EBPD gives further impetus for the updating of the Energy Saving Ordinance, in addition to the national integrated energy and climate programme (IEKP), and the energy concept of the Federal Government. This means that the debate about further steps to make the Energy Saving Ordinance more stringent when it is updated will now be conducted in relation to the EPBD requirement of “Nearly zero energy building by 2020”. With this clear target in view, national acceptance of more stringent requirements in future ordinances is rising, in preparation for the standard for nearly zero energy buildings.

### Evolution of minimum standards in the Energy Saving Ordinance

Since the introduction of the EPBD, the requirements of the Energy Saving Ordinance have been tightened by 30% on average, and the expected obligation to introduce the standard for nearly zero energy buildings in 2020 further stimulates the discussion about the remaining scope for renewed and cost-effective tightening. Since the ordinance is basically subject to the need for cost effectiveness, a
scientific study of cost effectiveness precedes every tightening in the law. In Germany, the basic idea of the "cost-optimal level" has therefore been anticipated.

Figure 19 - Evolution of primary heating demand in kWh/m²a

8 > Requirements for new and existing buildings

Requirements methodology for new buildings

In the Energy Saving Ordinance 2009, the previous certification procedure for new residential buildings, which defined the required value depending on the surface area-to-volume ratio, was replaced by the new so-called reference building process. The reference building method had already been the requirements methodology for non-residential buildings. Requirements are specified by means of a reference building which coincides with the actual building in geometry, usable area of a building, orientation and basic conditions of use. In addition, a minimum requirement was also set for the energy efficiency of the building envelope. In cases of favourable heat supply, this ensures, from a primary energy viewpoint, a minimum of energy quality for the envelope. The heat transfer coefficients of the table in Figure 14 serve to calculate the threshold for primary energy demand for residential buildings, with the help of the reference building. The stated specific transmission heat loss (H′ₜ), on the other hand, must be understood as an obligatory minimum requirement, and thus it must be complied with in every case.

Conditional requirements for existing buildings

For existing buildings, conditional requirements must be complied with in defined cases either of first-time installation or of renovation of the relevant component or building compliance, whereby the requirement extends, in each case, exclusively to those parts of the building surfaces and parts of the installation that are the subject of the measure. The table in Figure 15 shows the threshold for renovated fabric elements. No requirements are imposed for external parts of the building if less than 10% of the relevant parts of the building are concerned.
<table>
<thead>
<tr>
<th>Component</th>
<th>Reference design / value</th>
<th>2nd requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>External walls, Floors</td>
<td>$U = 0.28 \text{ W/(m}^2\cdot\text{K)}$</td>
<td>Small detached residential building $H'_{\tau} = 0.40 \text{ W/(m}^2\cdot\text{K)}$</td>
</tr>
<tr>
<td>Floor, basement structural element</td>
<td>$U = 0.35 \text{ W/(m}^2\cdot\text{K)}$</td>
<td>Large detached residential building: $H'_{\tau} = 0.50 \text{ W/(m}^2\cdot\text{K)}$</td>
</tr>
<tr>
<td>Roof, upper ceiling</td>
<td>$U = 0.20 \text{ W/(m}^2\cdot\text{K)}$</td>
<td>Residential semi-detached building : $H'_{\tau} = 0.45 \text{ W/(m}^2\cdot\text{K)}$</td>
</tr>
<tr>
<td>Windows incl. French windows</td>
<td>$U = 1.3 \text{ W/(m}^2\cdot\text{K)}$</td>
<td>All others: $H'_{\tau} = 0.65 \text{ W/(m}^2\cdot\text{K)}$</td>
</tr>
<tr>
<td>(Skylight $U=1.4 \text{ W/(m}^2\cdot\text{K)}$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrance doors</td>
<td>$U = 1.8 \text{ W/(m}^2\cdot\text{K)}$</td>
<td></td>
</tr>
<tr>
<td>Boilers</td>
<td>Condensing boilers</td>
<td>Requirements for pipe insulation and control systems</td>
</tr>
<tr>
<td>Hot water</td>
<td>Central, with solar system</td>
<td>Thermal protection in summer</td>
</tr>
<tr>
<td>Cooling</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
<td>Central exhaust fan, demand-controlled</td>
<td>None</td>
</tr>
</tbody>
</table>

*Figure 14 - Example of how requirements can be met for new residential buildings*

<table>
<thead>
<tr>
<th>External structural element (examples)</th>
<th>Maximum heat transfer coefficient at normal indoor temperatures $U$ [kWh/m²*K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>External walls</td>
<td>0.24</td>
</tr>
<tr>
<td>Windows</td>
<td>1.30</td>
</tr>
<tr>
<td>Windows with special glazing</td>
<td>2.00</td>
</tr>
<tr>
<td>Glazing</td>
<td>1.10</td>
</tr>
<tr>
<td>Curtain walls</td>
<td>1.50</td>
</tr>
<tr>
<td>Curtain walls with special glazing</td>
<td>2.30</td>
</tr>
<tr>
<td>Top floor ceiling, pitched roofs</td>
<td>0.24</td>
</tr>
<tr>
<td>Flat roofs</td>
<td>0.20</td>
</tr>
<tr>
<td>Floor structures</td>
<td>0.50</td>
</tr>
</tbody>
</table>

*Figure 15 - Requirements for structural elements in case of modification in existing buildings*

As an alternative to complying with individual requirements for structural elements, a holistic assessment can also be made - analogous to the calculations for new buildings. The requirements are met if modified residential or non-residential buildings exceed the relevant requirements for similar new buildings by not more than 40%.

**Retrofitting obligations**

Apart from the conditional requirements which result from refurbishment or replacement of a structural element, the Energy Saving Ordinance also contains retrofitting obligations which must be fulfilled by the building owners in each case, before a specific time limit. All retrofitting obligations are also subject to the precondition for cost-effectiveness. According to legal requirements, these are measures with short payback periods, such as the insulation requirement which exists since 2004 for all previously non-insulated and accessible hot water distribution pipes and fittings in unheated rooms. In addition, there is a requirement for the insulation of non-insulated top floor ceilings of heated rooms,
above which there is an accessible, but non-walkable space. The obligation also applies to top floor ceilings, above which there is an attic, as from the 31st of December 2011. As an alternative, the roof located above can be insulated instead of the top floor ceiling.

Retrofitting automatically operating control devices with separate reference values for the room humidity is mandatory for larger air conditioning and ventilation systems, insofar as these systems are intended to affect the humidity of the indoor air. Because of the high primary energy expenditure in electric power generation in Germany, the Energy Saving Ordinance requires that electrical heat storage systems must gradually be taken out of operation, if the room heat of the building is generated exclusively by electrical heat storage systems. This applies to larger residential and non-residential buildings whose thermal protection does not comply with the Energy Saving Ordinance '95.

Quality assurance and ensuring implementation of the Energy Saving Ordinance

Since the Energy Saving Ordinance 2009, in order to ensure the implementation of the ordinance and the quality of execution, there has been an obligation to provide proof in the form of a contractor's declaration. This is provided by the contractor in writing and certifies that the modified or installed parts of the building or installations meet the requirements of the Energy Saving Ordinance 2009. The contractor's declaration must be given to the owner promptly after the conclusion of the work, and must be kept for at least five years by the developer or owner. Paragraph 26b, which regulates the duties of the district master chimney sweeper with regard to compliance with the regulations of the Energy Saving Ordinance, has recently been included in the Energy Saving Ordinance 2009. In the future, district master chimney sweepers throughout Germany should check whether the retrofitting obligations (replacement of old boilers, insulation of heat distribution and hot water pipes), as well as the requirements for the installation of a new heating system (night-time temperature reduction, circulating pumps with automatic electric power consumption adjustment, insulation of heat distribution and hot water pipes) are complied with. A comparable ruling has already been previously applied in 2 federal states.

9 > Conclusion and future planning

Because of the long tradition of energy saving in Germany, notable successes have been achieved in actual energy saving in the building sector (see Figure 19). Comprehensive measures contributing to reducing energy consumption and to increasing the share of renewable energies have been implemented successfully. The Energy Performance Certificate can provide initial information about the expected energy efficiency standard of a building for ambitious consumers, and can thus help to save energy in the long term. Measures are required to increase familiarity with the Energy Performance Certificate and confidence in its information. The introduction of an independent control system during the implementation of the recently issued recast of the EPBD must be viewed in this context.

Current considerations about the possible tightening of the requirements by up to 30% in the Energy Saving Ordinance 2012 had not been brought to a final conclusion. However, a step-by-step harmonisation with the future standard for nearly zero energy buildings, so that it can be established on the market by 2021, appears to be adopted in a short time. The steps by which this occurs and at which time depend directly upon the national definition of the standard for nearly zero energy buildings, and on the results of studies of the cost effectiveness of such requirement levels, which have not yet been concluded.