The CEN Standards and the Implementation of the EPBD:

A Personal Perspective from the UK

ROGER HITCHIN
email: roger.hitchin@hotmail.com

Introduction

This article illustrates how the implementation of the EPBD in the UK has interacted with the CEN EPBD-related standards. The focus is on the UK story, but the some of the opinions and perspectives reflect discussions with technical advisors and civil servants in other countries. I was quite close to some of the decisions and the reasoning behind them but more distant from others. So, some of the views expressed are inferences, sometimes from 15 or so years ago. It is a personal perspective and in no way an official one: interpretations, including misunderstandings and errors are mine.

In the beginning ....

The EPBD was approved at the end of 2002 and entered into force early in 2003, by which time EU Member States needed to enact laws and regulations and develop administrative procedures. In some circumstances this could be delayed until early in 2006.

Some of the requirements of the Directive overlap with or can be implemented through pre-existing national procedures and regulations and procedures, and the Directive allows Member States flexibility in their compliance routes. Regulatory energy performance requirements were more highly developed on some countries than others. Where they existed, they were almost exclusively in the form of minimum performance requirements for specific elements of buildings, rather than the whole-building approach required by the Directive. The performance data for these elements was generally available from manufacturers or could be readily calculated. Calculations of expected annual energy consumption were used during the design of some buildings but were rarely applied to individual existing buildings (there was an informative system of "good practice" benchmarks for measured consumption in some countries).

In 2004 the European Commission gave CEN a "mandate" (M/343) [1] to produce standards to support the Directive. The basic scope of the Mandate was for a methodology for the calculation of the energy performance of buildings, methods of assessment for certifying buildings, and guidelines for methods of inspecting boilers and heating and air-conditioning systems. This resulted in the publication of EBPD-related CEN standards in 2007 and 2008.

The sequence of events, timing and scope were challenging for a several reasons:

- The purpose of the standards is not stated but must be inferred: who is expected to use them? Why are formal standards the appropriate vehicle? Would some other form of good practice guidance be more useful?

- A key element of the EPBD is a system of Energy Performance Certificates (EPCs), based on calculated or measured annual consumption, and required whenever a building is constructed, let or sold - with a maximum certificate life of 10 years. Given the relative numbers of building that are built, let or sold, EPCs will overwhelmingly be applied to existing buildings. For these buildings, information about their structure, the thermal properties of the materials used, and the dimensions is much more difficult to determine than for new buildings or the

new elements in refurbished buildings. Any practicable building energy rating system requires trades-off between competing practical constraints such as data quality, and required consistency, precision and cost of implementation. The greater uncertainty of the available data for existing buildings means that the balance is likely to differ from that for new buildings. For existing buildings, the calculation element of the methodology is arguably one of its less challenging or critical components.

- The timescale to produce the standards was very demanding. The development of international standards is inherently time-consuming, and the standards were, in fact, developed remarkably rapidly. However, this timescale meant that there was no time (or resource) to test different options or explore the practical implications of decision. Since the coming-into-force date for the Directive preceded the mandate, any learning from experience could not be reflected but would have to be implemented later. Few of the standards-writers were directly involved in the national implementation of the Directive, so the opportunity for informal feedback was limited.

In 2005 the Commission launched a new instrument, the EPBD Concerted Action, with the objective of promoting dialogue and an exchange of knowledge and best practice between all 28 Member States and Norway. In order that the exchanges could be frank and open, the discussions were not in the public domain, although quite detailed overview reports were published.

In the UK ...

Traditionally UK Building Regulations were concerned with health and safety rather than energy efficiency and were set locally. The first set of national building standards was introduced in 1965 but minimum insulation levels were not introduced until 1976. The required levels of insulation were subsequently increased and other requirements including air leakage testing were introduced, but there was no requirement to calculate energy consumption.

However, from the late 1970s, computerised methods of estimating the energy costs of dwellings started to be used outside the regulatory framework. Several versions of BREDEM – the Building Research Establishment Domestic Energy Model – were developed. These were initially used to support voluntary activities comparing annual energy costs (sometimes including appliances) in new and existing housing: to assess the suitability of designs of low energy homes in a "new town"; as a voluntary energy rating system using a relative cost index scale; by the energy supply industries to promote their form of energy supply as having the lowest running costs; and in a set of Government-published running cost guides. The core calculation in these calculations was a monthly, variable base-temperature, degree day procedure, with adjustments to reflect that some parts of the building are heated to lower temperatures than others, to allow for the impact of the thermal capacity of the building and also the responsiveness of the heating system. [2] [3] A worksheet version, which can be calculated manually (but more commonly using a small computer), the Standards Assessment Method (SAP), was published in 1992 and cited in regulations in 1994. When the EPBD appeared, it was logical and low risk to use this as the calculation engine for dwellings. In 2005 a version with a simplified input but less scope to accommodate unusual types of construction (rdSAP – reduced data SAP) was introduced for use with existing dwellings.

There was no equivalent experience of calculation methods for existing non-domestic buildings and a new tool SBEM, the Simplified Building Energy Model, was developed. A number of options for the calculation engine were considered, including dynamic simulation, reduced parameter simulation and degree-day-based methods. The decision eventually taken was to base the tool on a monthly calculation procedure that was already in use in the Netherlands and was almost certain to be included in the EPBD-related CEN standards (eventually in EN 13790). An important factor in the decision was the knowledge that the methodology had already been used elsewhere and the standard was already well advanced. Eventually SAP was modified to use the same calculation procedure - although the mathematical formulations look very different, in most situations, they produce very similar results. [4] It was recognised that complex new non-domestic buildings are often designed with the aid of commercially available dynamic simulation tools and it was decided that, in principle and subject to satisfying a number of tests and conditions, their use should also be allowed.

A fundamental feature of the rating scale that makes this use of different methods possible – and has some other advantages - is the use of a "reference" building. This is a building with the same geometry, orientation

and allocation of use patterns, and exposed to the same weather as the building being rated. (The glazed areas are not identical, in order to penalise "over-glazed" buildings). The reference building has defined elemental values – U-values, system efficiencies etc. For Energy Performance Ratings these are set to represent "typical" values for the building stock, and the rating is based on the ratio of calculated carbon emissions between the actual and notional buildings. For new buildings and major refurbishments, a "notional" building is used, with elemental values are chosen to reflect cost-effective performance. These are updated periodically. Provided that the performance standard is met, the designer retains flexibility to meet specific project requirements set by the site, planning permission or the user. This approach means that the energy rating value strongly reflects the physical characteristics of the building and its technical building services, even for classes of buildings that vary substantially in size and facilities such as hotels and mixed-use buildings. It also reduces (but does not eliminate) the impact of some types of error, such as incorrect dimensions or the allocation of activities to spaces: such errors apply both to the reference and actual building. (Sensitivity of the rating to differences in climate is also reduced).

For a given building, different calculation procedures – including different dynamic simulation models - generate different estimates of annual consumption. Since any systematic differences are applied both to the actual and the notional building their impact on the rating value is reduced. (Before being accepted for use for building energy rating, calculation tools are required to demonstrate that they produce values that are consistent with those from established tools for several example buildings.) This means that there would be no great difficulty in allowing the (optional) use of the dynamic energy calculation methods from the current CEN standards alongside the established commercial tools, though the incentive to do so is not easy to see.

Initial trials of data collection procedures showed that consistency between assessors could become a very significant issue. The EPC procedure therefore includes default values that the assessor can overwrite (and may then be asked to justify) and a database for construction elements (the assessor can define additional constructions)[5] . The user interface offers drop-down menus of options wherever practical – for example, of HVAC system types – and aims to limit

the assessor choices to questions for which he or she can reasonably be expected to know the answer. There is also a structured database of standardised activities – each space in a non-domestic building has to have assigned to it a specific activity. This sets standardised operational parameters according to the activity and type of building in which the space exists (for example the periods of use of an office in a school differ from those in a commercial building).

The rating metric is based on calculated carbon emissions rather than primary energy (or price) because this is a key driver for environmental policy and is the metric in other areas of legislation: shadow prices for carbon have long been included in policy impact assessments. (Primary energy is difficult to align directly with most energy and environmental policy objectives and is defined differently and often opaquely in different countries).

Subsequently....

Member States had discussed difficulties with the "usability" of the initial standards within their national implementations at Concerted Action meetings. When the original version of the EPBD was replaced by a "recast" version in 2010, a new mandate to CEN was issued[6], to update and improve the standards. In addition, a Liaison Committee was established between CEN and the EPB Committee (representing the Member States) with the objective of better matching Member States' needs with the new standards.

The changes to the standards responded to some of these issues, notably by the separation of statements of methodology from explanatory text – albeit at the cost of there being more documents. The Liaison Committee had also investigated Member States' objectives for desired consistency, accuracy, time required and other aspects of Energy Performance Ratings. These factors largely depend on user interfaces, inspection procedures and the use of default values rather than to the issues explicitly stated in the Mandate – though the complexity of calculation methods does have a bearing. (The calculation standards introduced explicit equations for hourly-time step dynamic simulation calculations although this was not an explicit request.) [7]

Separately, the Commission contracted consultants to independently address the usability of the standards by applying them to example cases. This study "highlighted some weaknesses in the draft set of standards, and it seems that the complexity of the standards is overwhelming in some cases"…[8]. This complexity was partly due to their use of a "one-size-fits-all" approach which was considered to impose a detailed methodology even for relatively simple situations. It was noted that "the use of a reference building in the calculation can reduce the significance of systematic errors." This somewhat contradicts the emphasis on absolute – rather than relative – rating scales in the revised version of the EPBD which was adopted in 2018.

In the future ...?

The EPBD-related CEN standards undoubtedly contain information that has helped Member States to develop their implementation processes. As with other countries, the UK made use of some elements of the standards, and of standards that were not developed specifically for the EPBD.

Given the flexibility allowed to Member States for implementation of the EPBD and the shortage of practical (or even research) experience with some of the directive's instruments, it would be very difficult for any set of guidance documents to adequately cover the whole procedure for producing Energy Performance Certificates nor to mandate specific methods. Formal standards additionally have constraints on their structure, language and scope and it would be unreasonable to expect them to cover all aspects of Member States' implementation needs.

A standard is defined as "…an agreed way of doing something.… [which is] the distilled wisdom of people with expertise in their subject matter and who know the needs of the organizations they represent…."[9]. It is not unreasonable to expect them to reflect the practical constraints surrounding their application. The timing of the first Mandate and the lack of practical experience at that time would have made this difficult, but Member States' were nevertheless having to develop procedures and a greater involvement by them in the development of the standards might have avoided some of the later complaints about their usability.

In 2017, the standards were described by the Commission as providing a "toolbox for better implementation" [10] (though this concept does not appear explicitly in the Mandates). This description reflects the way that the standards have been used by many

Member States, though a better analogy might be a set of pre-defined components. They do not (and probably could not) provide a complete set of components (or tools), a blueprint for the finished product, or detailed instructions for use.

By now Member States have well-established building performance rating systems in place, with the organisational and physical infrastructure necessary to support them. Any significant change of procedure will have consequences and costs, not least because the 10-year life of Energy Performance Certificates means that substantial changes could undermine comparability between older and newer certificates. But other procedural changes could be introduced with limited impact on the rating values. The important issues now are less about calculation methodologies and definitions but more about usability and impact. It seems likely that useful ideas for such improvements will most reliably come from practical feedback from different national implementations and will probably address issues that are not (and probably could not be) effectively addressed by standards. Some starting points were suggested by the consultants who considered usability in the context of example cases. They pointed out that some of the input data has little impact on the final building rating and its accuracy is therefore relatively unimportant and suggested that sensitivity calculations be carried out to identify which information could be omitted (or fixed) in which circumstances. (Some Member States have now initiated such studies). They also suggested that simpler calculation procedures were likely to be acceptable for some types of building.

There is a need for a continuing process of exchange and review of the experience of different MS (and of potential MS). For example, while the EPBD allows the use of measured energy consumptions for rating purposes (and this approach is used to some extent), the resulting ratings are fundamentally different in nature to those based on calculations. There is general acceptance that the two approaches are complimentary, but still uncertainty about how best to extract value from their joint use. The Concerted Action format has proved to be a workable means of providing such communication but might usefully be more focused on "lessons learnt" and outstanding issues and complemented by additional independent studies. ■

References

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