Implementation of EPBD Article 7.3 in Germany and the UK: Comparison of Methodologies and Procedures

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Abstract

EPBD Article 7.3 states that "Member States shall take measures to ensure that for buildings with a total useful floor area over 1,000 m^2 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.". Both Germany and the UK have published their legislation to implement this requirement. This paper compares and contrasts the approaches in each country. It covers:

- the methodology;
- the content of the energy certificates to be displayed by public buildings;
- the Advisory Report (giving the recommended energy improvement measures);
- the training and accreditation requirements for assessors.

Except in Scotland, the UK is using two complementary procedures for quantifying the energy efficiency of a non-residential building:

1. Energy performance certificates (EPCs) which reflect the intrinsic efficiency of a building assuming standard use (the Asset Rating). EPCs are the responsibility of the owner, are based on calculation for heating, hot water, cooling, ventilation and lighting only, and will be required when a building is constructed, sold or let, i.e. as a part of a property transaction.
2. Display Energy Certificates (DECs) which are based on the actual total amount of energy used by a building over a year (the Measured or 'Operational' Rating), and compared with an appropriate benchmark. DECs are required to fulfil EPBD Article 7.3 and must be displayed prominently by all 'Public Buildings' over 1,000m^2 from 1st October 2008.

Germany is using the same principles for energy certification of non-residential buildings. However, in contrast to the UK, the building owner is allowed to choose whether the certificate on public display is based on the asset rating or the operational rating.

Background

The provenance of operational ratings can be traced back in many respects to UK government-funded studies in which the UK authors participated at the end of the 1980s. One of these studies involved helping nine sets of industry-leading design teams and their clients to produce exemplar low energy non-residential building designs. Another collated the results of examining the energy performance in use of about 100 office buildings in some detail, 15 of which were published as energy efficiency case studies. These data, together with a much larger set of background statistics, formed the backbone for the UK's seminal document on operational ratings, Energy Consumption Guide 19, Econ 19 (latest edition Action Energy (2003)).

The design studies employed the latest dynamic simulation models to predict annual energy use. Their conclusions exposed in stark relief a huge gulf between the predictions of building energy use by computer software and the observed outcomes in terms of measured energy use. As a consequence the UK government and a respected industry Journal eventually funded a seven year (1995 – 2002) series of post occupancy studies called Probe (BR&I 2001) which investigated and published in some detail the actual performance-in-use of twenty buildings that had been featured in the Journal at the time of their completion (often for their innovative design and low energy aspirations). Probe was lauded by the industry for drawing its attention to the massive credibility gaps which could occur between design intent and achieved performance, even for these leading buildings.

At this time, the UK authors also helped to produce and test TM22 (CIBSE, 1999), another key element of operational rating methodology. It is based on a 'tree-diagram' approach to energy assessment and reporting which both creates an end use breakdown of actual energy use and allows benchmarking at many levels, from the installed capacity of equipment, through systems energy use up to the whole building. The tree diagram methodology underpinned Econ 19, from which TM22 was a natural progression.

In April 2001 the EC published its draft proposals for the Energy Performance of Buildings Directive (EPBD). At that time, most policy makers and practitioners assumed that energy certificates would be based on so-called asset ratings, a calculated energy performance assuming a standard use, familiar to the designers of new buildings and employed for Building Regulation compliance. The authors saw things differently and launched independently two EC-funded projects to demonstrate the overwhelming benefits of allowing energy certificates to be based also on operational ratings. One of these projects was Europrosper (Cohen, 2004) which aimed to roll out the Econ 19/TM 22 and Probe methodologies for building operational performance assessment to practitioners at a European level. The other was GreenEffect (Therburg, 2005) which aimed to develop robust methodologies for operational ratings in buildings which employ renewable energy sources and high efficiency energy conversion technologies such as heat pumps, CHP and absorption chillers.

Europrosper paved the way for the implementation of building energy certificates based on operational ratings, illustrating a tailored benchmark approach for office buildings based on a tree-diagram model of energy end use but backwardly compatible with the fixed benchmarks in Econ 19. After informal collaboration between Europrosper and GreenEffect, the UK and German authors joined forces in EPLabel (Cohen, 2007), another EC funded project, with the aim of extending methodologies developed for office buildings to six major public building sectors (public administration offices, schools, higher education, sports centres, health and hotels). Both Europrosper and EPLabel informed the development of the EPBD CEN Standards relating to Operational Ratings through detailed contributions to CEN TC89 WG4 which authored the applicable Standards (CEN, 2007).

From this background, the authors have been deeply involved in influencing the legislation for implementing EPBD Article 7.3 in their respective countries. The UK authors were commissioned in July 2006 to suggest a strategy for implementing Operational Ratings in England and Wales. This encompassed the approach developed by EPLabel for mixed-use buildings and a procedure known as a Landlord Energy Statement (LES) for dealing with multi-tenanted buildings, and which is being taken forward for offices by the British Property Federation which represents major UK landlords and their managing agents (BPF, 2007); and is now spreading to other sectors. These methods can be combined to deal with multi-building campuses where some (or all) buildings are not sub-metered. The strategy was completed in September 2006 and informed the UK government's implementation plans for EPBD Article 7.3. The details were developed by technical experts, taking into account the views of government lawyers on how the legislation should be interpreted for the UK context and of the public authorities whose buildings have to display DECs, and became law on 29th March 2007 (Statutory Instrument No. 991, 2007). At the time of completing this paper (February 2008) a few critical aspects remain to be finalised in government guidelines. The reader should be aware that the content of the paper is the authors' present understanding of what will transpire by 1st October 2008, when all public buildings in England and Wales will be required to display a DEC.

In Germany, a discussion about operational and asset ratings started soon after the EPBD was ratified. It initially focused on housing, with a debate between the industry, environmental NGOs and professional engineers. Operational ratings were seen by the industry as an easy, inexpensive and quick solution if with limited insight due to the vagaries created by occupants. Asset ratings were criticised as too time consuming and expensive, an "income generation" programme for engineers and architects. Eventually, at the end of 2005, the legislative process turned to non-domestic buildings. Realising that they had to create thousands of certificates for public display, the Public Authorities put pressure on the government to offer a simple certification method for non-domestic buildings based on an operational rating. A steering group was set up by the Ministry of Building to develop a draft operational rating methodology, and a draft law was published on 16 November 2006. The law was finally passed on 24 July 2007 as an amendment of the German "Energieeinsparverordnung" (EnEV).

The methodology for operational ratings in the UK (ex Scotland)

Defining the building needing a DEC

The 'building' boundary and the requirement for a DEC are determined by the space let or owned by the occupier and whether the occupier is a public authority or an institution providing a public service (see Figure 1). A building with multiple occupiers may need several DECs: each is considered separately. The space of each occupier may be defined as a single building type or a mix of several building types: if mixed-use, the area of each building type must be measured separately in order to calculate an area weighted composite benchmark for the total space.

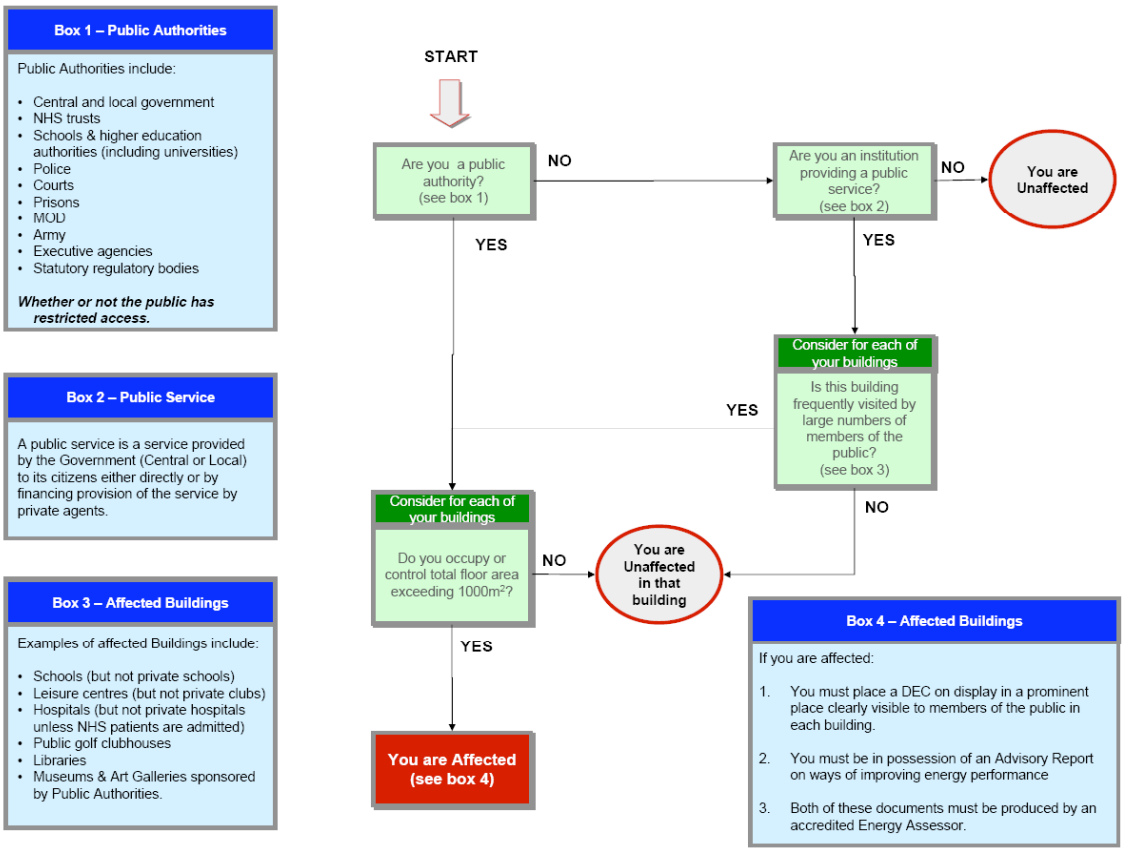


Figure 1 Flow chart defining the buildings requiring DECs in England and Wales

For multi-building sites, the requirement is for any building over 1,000m^2 to display a DEC. Individual buildings with dedicated sub-metering and an applicable benchmark category are given a specific DEC. The total residual energy and total residual composite benchmark are allocated to all the other buildings on the site pro rata each building's area, taking into account data from sub-meters where available. In the absence of any sub-meters, these other buildings will display a DEC calculated on a pro rata basis i.e. they will all receive the same rating, but the total carbon footprint will be different.

Certificate content and layout

An example of a DEC is shown in Figure 2. It provides four main results:

1. The headline energy performance indicators which comprise a class, i.e. a letter from A to G, as commonly used for other energy labels, and an index, to provide greater resolution, defined as the percentage of the actual CO_2 emissions resulting from energy supplied to the building compared with the benchmark emissions typical for the building type being assessed (per m^2 per year). The A to G scale is simple and linear, so that a typical building, with an index of 100, lies at the D/E boundary. The index is called the operational rating, even though CEN Standard prEN 15603 ascribes this term to the absolute total emissions per year which are the subject of the next point.
2. The total carbon footprint of the building in tonnes of CO_2 per year, for the last three years, showing separately the contributions from electricity (green tariffs are ignored), and fuel and heat. The CO_2 saved by the use of renewable energy sources (RES), either on site e.g. PV or

through delivered energy e.g. biomass, is shown below the axis. In accordance with CEN Standard prEN 15603, the CO_2 saved by RES is calculated by working out the emissions from the extra conventional energy that would have been required were the RES not present.

3. The index or (as defined for the UK) the "operational rating" for the last three years.
4. Technical information which allows technically aware people to understand the energy story behind the rating based on CO_2 emissions. It includes the kWh/m^2/year of electricity and fuel and heat and the energy supplied by RES.

A DEC is valid for a period of 12 months from its nominated date, which is a date expiring not later than three months after the period over which the rating displayed on the certificate has been calculated. This allows a short period for the data for the chosen 12 month period to be collected and analysed, submitted to the accrediting body and the certificate issued.

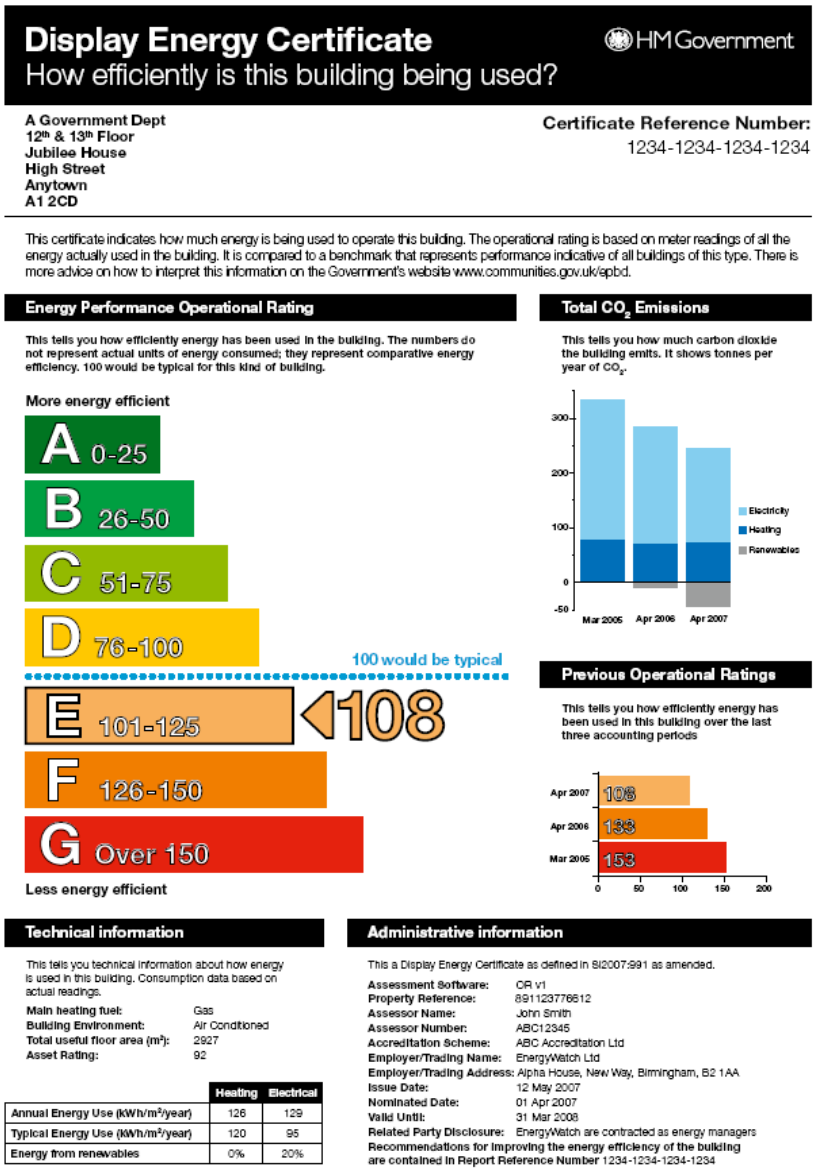


Figure 2 Building energy certificate to be displayed by public buildings in England and Wales

Defining the floor area used for the DEC assessment

The 1,000m^2 threshold determining whether a DEC is required is based on gross internal area, as defined by RICS. This is also called the Total Useful Floor Area (TUFA). The total area for the DEC Assessment (TADA) is defined as the TUFA less the area of any special energy uses. The total accessible unconditioned area, e.g. unheated attics or basements, must also be measured but is not deducted from TUFA in the calculation of energy performance; the benchmarks allow for a default amount of unconditioned area.

Defining the energy used by the "site"
It is required to identify all energy supplies used by the site e.g. electricity, gas, oil, PV, etc. and have metered values for their use over a 365 day assessment period which must start or end with a date for which there is a meter reading for the main heating fuel. At present it is rare to have meter readings 365 days apart for all energy supplies, so the measurement period for each supply can be 365 ± 31 days and the calculation methodology extrapolates or interpolates to 365 days, using degree days for the main heating fuel and on a linear basis for all other energy supplies. A synchronicity requirement means that the start and the end dates of the measurement period for each energy supply must be within ± 31 days of the start and the end dates of the assessment period (see Figure 3).

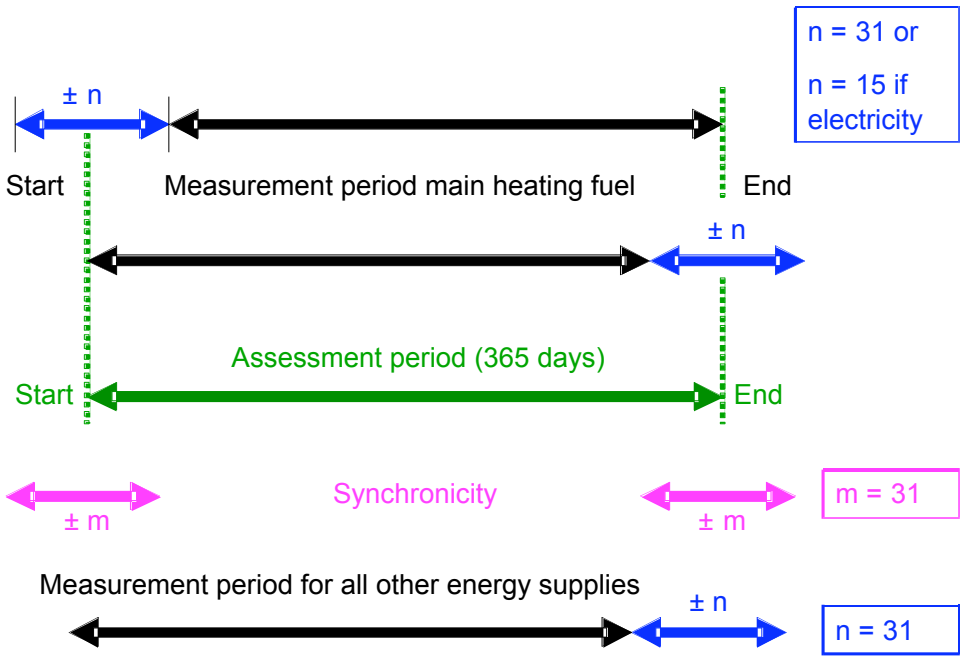


Figure 3 Tolerances for the start and end dates of energy supply measurement periods

Energy supplies are categorised as
- metered electricity
- metered fuel or heat e.g. mains gas or district heating
- bulk deliveries e.g. oil, lpg, coal

For metered energy supplies, it is desirable (but not mandatory) to calculate use over the measurement period from meter readings at the start and the end of the period. For bulk deliveries, use over the measurement period is found from stock levels at the start and the end combined with the sum of all deliveries in-between. The CO_2 intensities of energy supplies are taken as national default values, except for district heating (see below).

Landlord's energy statement (LES)
In a multi-tenanted building, there is a statutory duty on the landlord to collaborate in providing information to each occupier requiring a DEC. The LES is an industry-standard method of doing this, reporting to each tenant their share of the energy used and CO_2 produced by the landlord's services. The method of allocation will vary with the building concerned: some use a simple pro rata basis by area; others also adjust this in relation to each tenant's hours of occupancy (either actual or as in their tenancy agreement); while others make use of metering. In order to prepare its DEC, a tenant will need to combine the energy reported in the LES with any energy it procures directly.

Energy statement from district heating supplier
Where a building uses district heating, an occupier will normally have meter readings from the supplier. However, to meet the DEC requirement, the district heating supplier will also need to state the associated emissions (e.g. in kg CO_2/kWh of the heat supplied).

Benchmarks

The benchmarks for "typical" annual energy use have been defined as separate kWh/m^2/year values for electricity and heating fuel for a list of about 240 different building types in the UK. Following a review of existing data, many of these building types have been given the same benchmark values, giving currently a total of only 29 separate benchmark 'categories', into one of which each building type is allocated. Thus, for example, a crown court, a conference centre and a public sector or commercial office have all been placed in the general office benchmark category.

The benchmarks include an allowance for space heating based on a year with 2,021 degree days to base 15.5/15.5ºC - the average of the eighteen degree-day regions in England, Wales and Northern Ireland, and it is specified what proportion of each benchmark value is climate related. Usually the adjustment is applied to the fossil fuel/heat benchmark, unless the building is an all-electric category. The benchmark for a specific building will be corrected for the degree days over the assessment period in the region where the building is located (determined by its post code), taking account of the climate dependency of each benchmark.

Each benchmark value is associated with a standard hours of occupancy per year (e.g. 2,040 hours for offices). Optionally, the benchmarks can be adjusted to take account of the actual hours of occupancy, but only where suitable valid evidence is available, e.g. the published opening hours of a library. The increased benchmark is obtained by entering the actual occupancy hours per year, separately for each building type forming part of the site being assessed, and with a requirement that extended occupancy is only applicable for times when the occupancy level is at least 25% of the nominal maximum occupancy. Each building type has a maximum extended occupancy (e.g. 8,760 hours for offices, 5,355 hours for a sports centre). The percentage increase in the benchmark allowance between the standard hours and the maximum occupancy hours is defined separately for each benchmark category and differs for the heating and the electricity benchmarks.

The standard values for annual electricity and fossil fuel use for each benchmark category are shown in Figure 4, here converted to common units of kgCO_2/m^2/year. The values take into account existing statistics but are also informed by a tree diagram energy end use model (see Figure 5) for an iconic example of each building category. As described in a later section, the data for each certificate will be lodged in a central database the analysis of which should in due course allow better benchmarks to be produced for a wider set of building types.

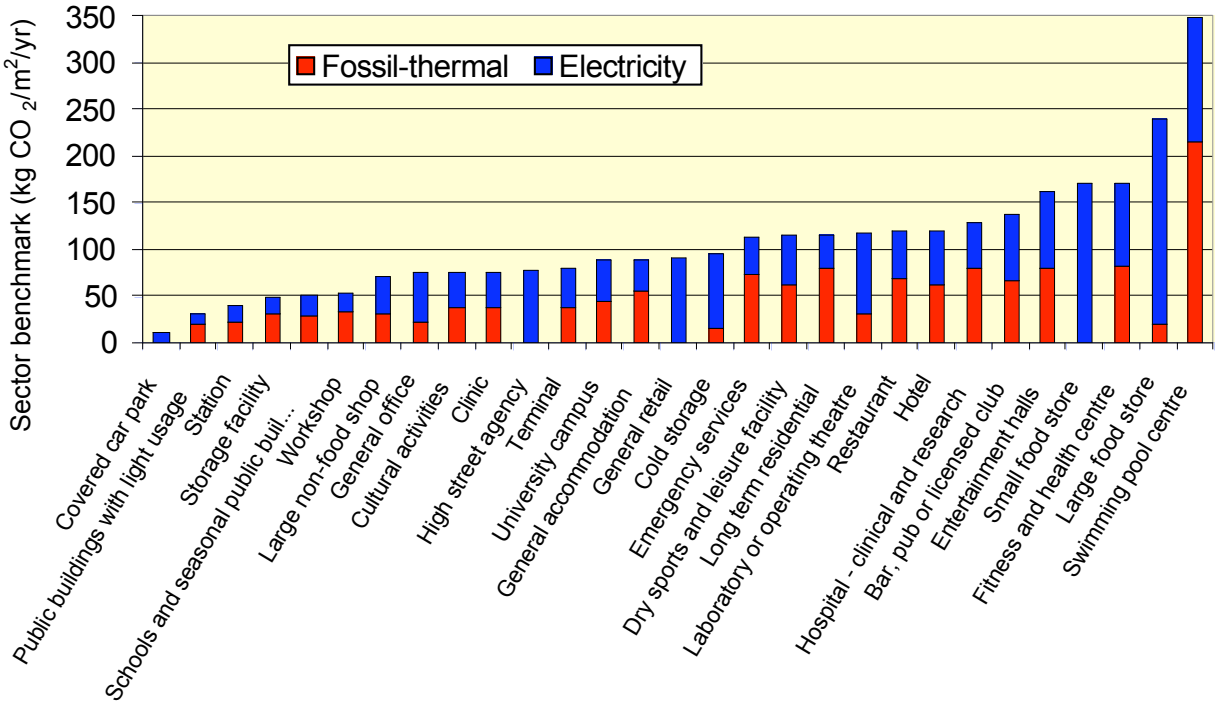


Figure 4 Standard values for each benchmark category, converted to kgCO_2/m^2/year

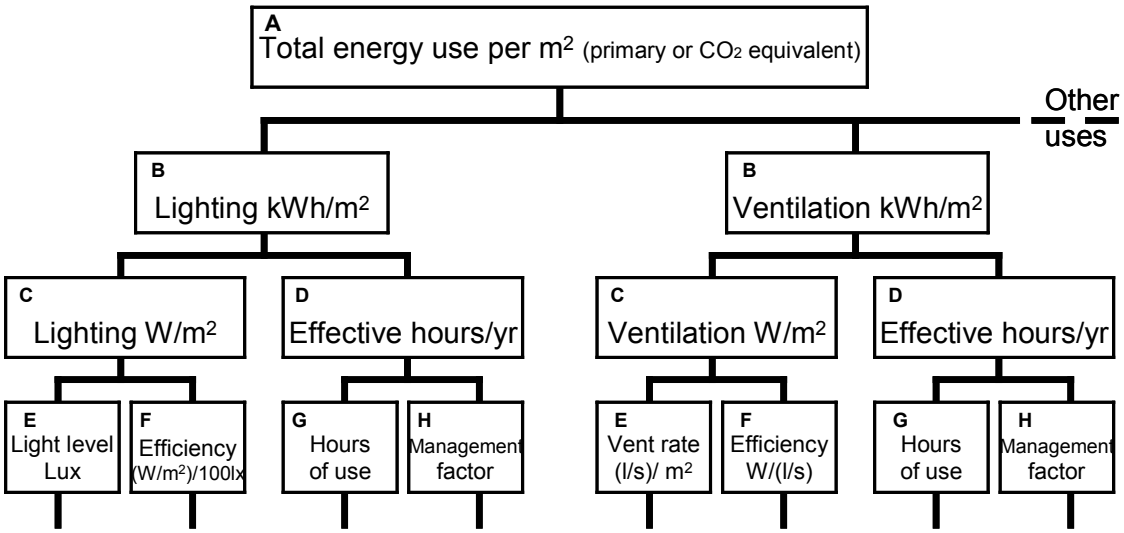


Figure 5 Tree diagram model of building energy use

A building or site comprising a mix of building types is given an area weighted composite benchmark. An example for a dry sports centre with a swimming pool and a restaurant is shown in Figure 6.

		Energy benchmarks		CO2 benchmarks (calculated from energy benchmarks)		
		Electricity Typical benchmark kWh/m2	Fossil-thermal Typical benchmark kWh/m2	Electricity Typical benchmark kgCO2/m2	Fossil-thermal Typical benchmark kgCO2/m2	Total Typical benchmark kgCO2/m2
Dry sports and leisure facility		95	330	52.3	62.7	115.0
Swimming pool centre		245	1130	134.8	214.7	349.5
Restaurant		90	370	49.5	70.3	119.8

Total for each building type

Zone category	Area (m2)	Electricity kWh	Fossil-thermal kWh	Electricity kgCO2	Fossil-thermal kgCO2	Total kgCO2
Dry sports and leisure facility	800	76,000	264,000	41,800	50,160	91,960
Swimming pool centre	500	122,500	565,000	67,375	107,350	174,725
Restaurant	200	18,000	74,000	9,900	14,060	23,960
Total	**1500**	**216,500**	**903,000**	**119,075**	**171,570**	**290,645**

Totals per m2 of whole building		Electricity kWh/m2	Fossil-thermal kWh/m2	Electricity kgCO2/m2	Fossil-thermal kgCO2/m2	Total kgCO2/m2
Dry sports and leisure facility		51	176	28	33	**61.3**
Swimming pool centre		82	377	45	72	**116.5**
Restaurant		12	49	7	9	**16.0**
Total	**1500**	**144**	**602**	**79.4**	**114.4**	**193.8**

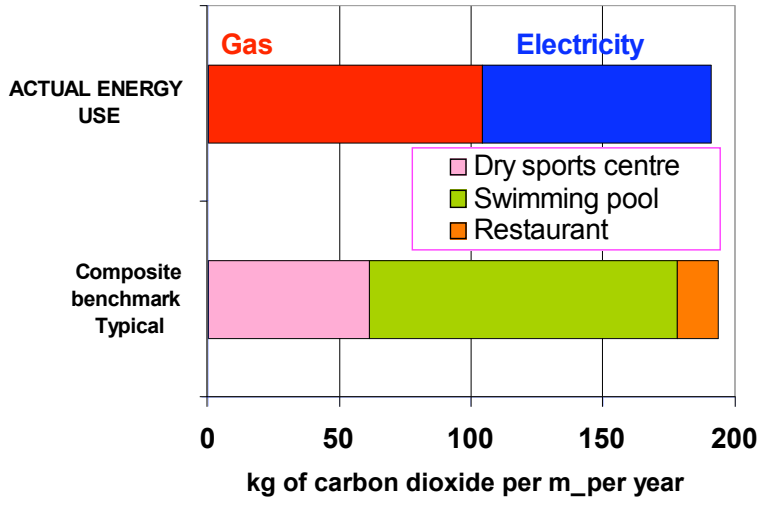


Figure 6 Illustration of a composite benchmark for a site or building with three building types

Special energy uses
Some buildings contain 'special' energy uses which are not allowed for in their benchmark – because they are either unusual or highly variable. If a special use is sub-metered over the assessment period, then its energy use and emissions can be deducted from the measured totals in the calculation of the operational rating. However, the total carbon footprint for the building still includes any special energy uses.

Technical information summary
To supplement the results shown on the DEC itself, the table below will also be produced. This provides a detailed explanation of how the calculation treats special energy uses, details of renewable energy sources as well as additional performance indicators, separately for fuel/heat and electricity.

Annual energy use, CO_2 emissions, and performance indicators (building floor area = 1,000 m^2)	Fuel and heat[1]	Electricity[2]	Units for energy data	CO2 emissions	Units for CO2 data
Total energy use in the year concerned	100,000	230,000	kWh	146.5	tonnes CO2
Special energy use deducted 1: data centre	5,000	150,000	kWh	83.5	tonnes CO2
Special energy use deducted 2	0	0	kWh	0	tonnes CO2
Calculated performance indicators	95	80	kWh/m2 pa	63	kg CO2/m2 pa
Reference performance benchmarks corrected	160	100	kWh/m2 pa	87	kg CO2/m2 pa
Benchmark ratios and Operational Rating (lower is better)	59	80	Typical = 100	72	Typical = 100
Operational Rating grade (A is best)	C	D	A to G	C	A to G
Renewables type 1: imported biomass	5,000		kWh	5%	% of total avoided
Renewables type 2: on-site PV		16,000	kWh	7%	% of total avoided

[1]Fuel and heat includes imported combustion fuels and heating and cooling from community systems, nett of exports.
[1]Delivered heat is factored by 1.25 to allow for conversion and distribution losses.
[2]Electricity includes electricity used for all purposes, including heating, cooling, small power, etc., nett of exports

Advisory reports
A simple questionnaire has been devised to identify the potential energy saving measures in each building receiving a DEC. The recommended improvement measures are then listed in an advisory report, which the law requires the building occupier to have but not to display. The measures are categorised as short, medium or long payback and high, medium or low carbon impact. Additional recommendations can be added by the assessor, and can incorporate results from a previous detailed energy survey. Ideally, the Advisory Report will also include recommendations for improving the energy efficiency of any special energy uses, or for an assessment by an expert in this area (e.g. in data processing equipment and not just air conditioning in a data centre).

Unlike a DEC which must be renewed each year, an advisory report remains valid for up to 7 years.

The Process for obtaining a DEC in England and Wales

Data collection, verification and registration
A building occupier must appoint an accredited DEC energy assessor (EA) to produce an official DEC. It is permissible for the EA to be an employee or contractor of the occupier. However, all EAs must operate in an independent manner. The DEC must show any association between the EA and an occupier as a "related party disclosure". The EA is responsible for approving all the data used to produce the DEC and must obtain and retain suitable evidence to substantiate the data, sufficient to satisfy any quality control checks by the Accreditation Scheme to which they belong. The end-to-end process for producing a DEC is illustrated in Figure 7. The EA enters the data collected for a building into approved software to obtain a provisional DEC, which they submit to their Accreditation Scheme for checking. The Accreditation Scheme then lodges the DEC and advisory report on a web-based central register operated by the government. An approved DEC will then be made available to the EA, for issue to the occupier for physical display in the building.

To help to prevent an unapproved DEC being put on display, each DEC has a unique report reference number (RRN). Anyone who notes down the RRN on a DEC, can log into the Central Register and verify that the DEC is bona fide.

Accreditation schemes
The government has approved ten organisations to operate Accreditation Schemes for DECs in England & Wales. Each scheme is responsible for the accreditation of and the quality of work done by its EAs, which means, inter alia, demonstrating that their EAs are:

- Qualified and achieve appropriate levels of consistency and accuracy. It is expected that 90% of Operational Ratings will be within ± 2% of the "correct" answer (i.e. one produced by a very experienced assessor) and that 100% will be within ± 5% of the right value.
- "Fit and proper persons" who comply with an appropriate code of conduct and complaints procedure and are covered by suitable indemnity arrangements.

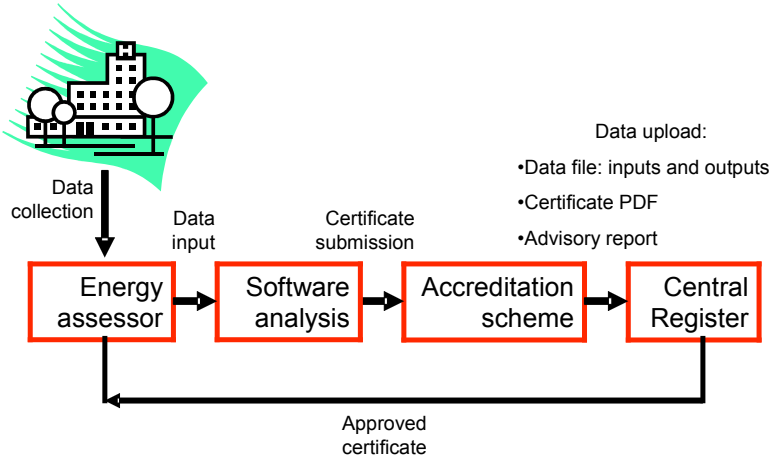


Figure 7 Process for collecting and processing the data for a DEC

The methodology for operational ratings in Germany

Operational and asset rating in Germany

In Germany, unlike in most EU countries, non-residential building owners have a free choice between asset and operational ratings (see Figure 8). Public buildings are always considered as non-residential, so a certificate on display may be based on either an operational or an asset rating.

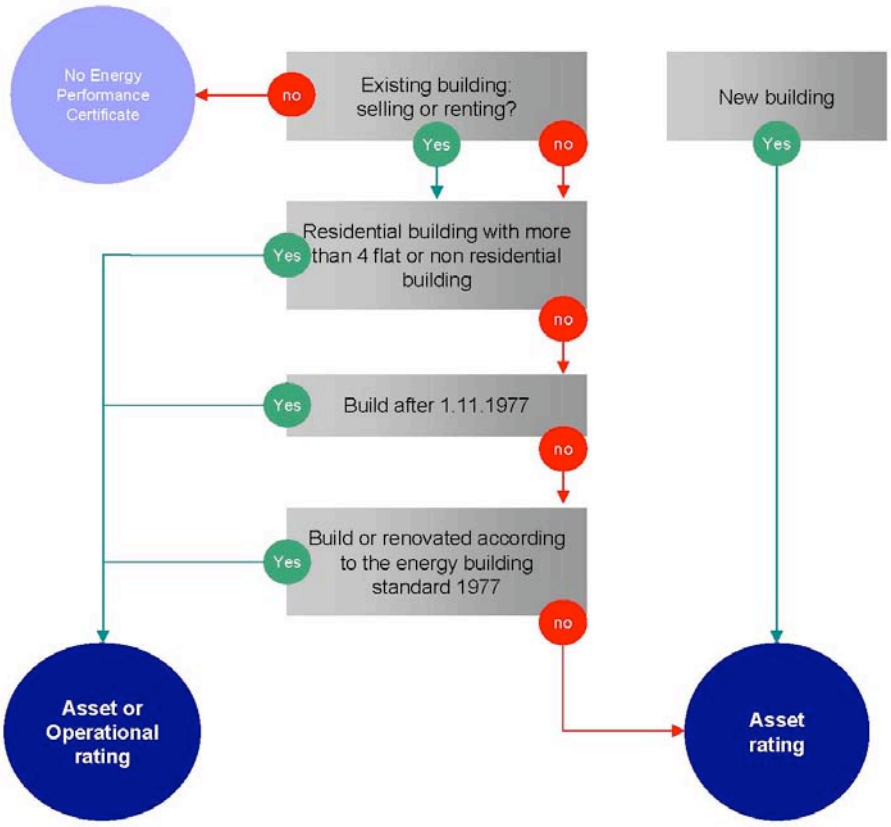


Figure 8 German decision process for whether an operational rating is allowable or not

Definition of a public building

A Public building is defined in the German legislation as follows:

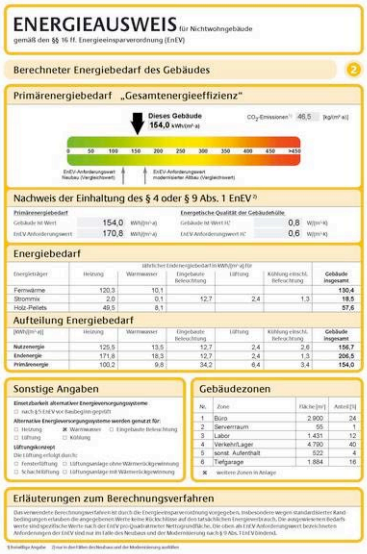
"If public authorities or other organisations deliver public services for a large number of persons and the building has an area which is larger than 1000 m², this building is considered as a public building/facility and needs a DEC on public display." There may be cases where the interpretation of this aspect of the law has still to be defined.

EPC and DEC in Germany

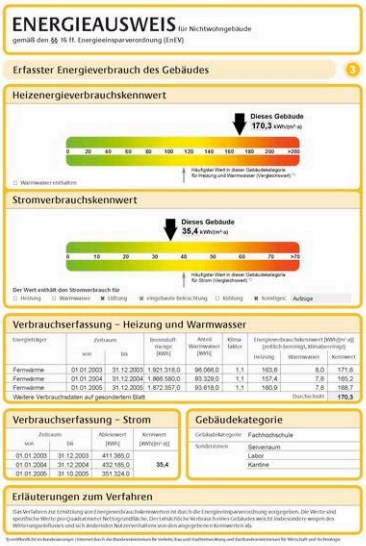
A public building will always have both an EPC, a 5 page document (see Figure 9), and a DEC, a 1 page summary displayed to the public, shown in Figure 10. The DEC is a supplement to each EPC for non-residential buildings.

EPC page 1:Cover

EPC page 2: Asset rating



EPC page 3: Operational rating



EPC page 4: Explanations

EPC page 5: Optimisation measures

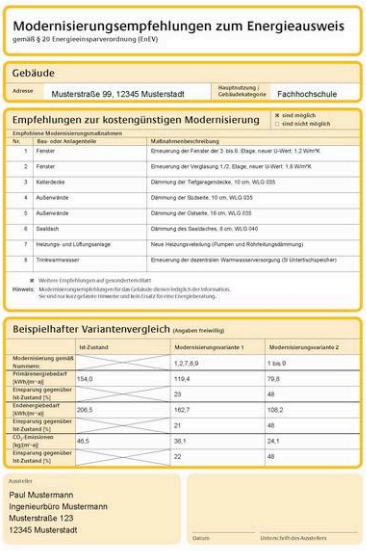


Figure 9 German Energy Performance Certificate EPC

EPC page 1: Cover sheet with general information about the building and the issuer. Additionally it shows whether the certificate is based on operational and/or asset rating and whether the data was provided by the building owner or the issuer

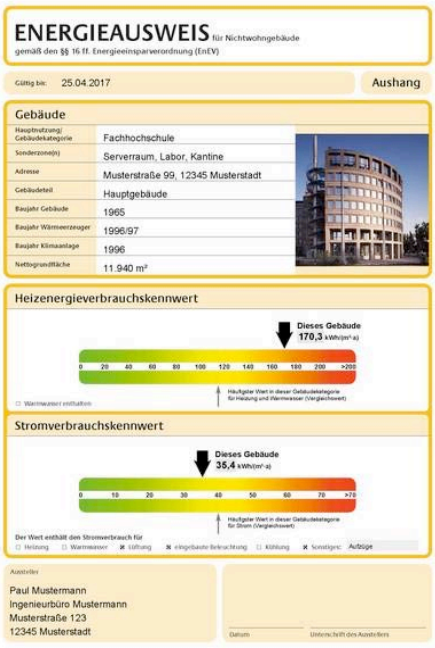
EPC page 2: Building performance based on an asset rating. The rating metric is primary energy. Additional information shows the predicted energy use for heating, lighting, ventilation, cooling and hot water. Further information is provided on the ventilation system, the use of renewables and the building zones.

EPC page 3: Building performance based on an operational rating. The rating metric is the delivered heating energy and the delivered electricity. The energy source, the energy/fuel metering and the climate correction factor are shown. Special uses may be indicated on the certificate, but are not taken into account in the performance.

EPC page 4: Explanations, mainly to assist in understanding the different energy types (primary, end and delivered energy).

EPC page 5 Advisory report

DEC asset rating
Shows information on the building, the issuer, the energy performance indicator and a breakdown into the different energy end uses.



DEC operational rating
Shows information on the building, the issuer and the energy performance indicators for fuel/heat and electricity.

Figure 10 German Energy Performance Certificate for public display (DEC)

Building definition

Unlike the UK, the German legislation always requires the energy performance certificate to be for the whole building, independent of the structure of ownership or occupiers. This can lead to a situation where one user of the building needs a certificate when the others do not. The one who needs it has to produce the certificate for the whole building - and obtain all the necessary information from the other owners or occupiers. Several practical problems can be expected from this in implementation.

Building area: definition

The building area is defined as the "net gross" floor (NGF) area. All areas which are treated thermally must be included. Non-certification of parts of buildings is possible. The following default conversion factors can be used when the net gross floor area is not available (ARGE, 2007):

				Conversion factor to		
Building categories		**Sample size**	**NGF**	**BGF**	**NF**	**HNF**
7.1	Hospitals more than 250 beds	8	1	0,865	1,70	2,41
8.5	Airport terminal	5	1	0,90	1,86	N.A
9.1	Office building heated	55	1	0,80	1,44	1,82
9.2	Office building, ventilated	60	1	0,81	1,32	1,57
9.3	Office building air conditioned	9	1	0,80	1,36	1,69

Gross Floor Area (BGF in German): this area includes external walls and unheated areas like car parking, cellars, etc.
Net Floor Area (NGF in German): this area is the BGF, less the area of external and internal walls including chimneys, etc.
"Use" area (NF in German): NGF minus corridors and functional areas (technical area)
Main use area (HNF in German): NF minus kitchens, toilets etc.

Multi-building site
In general the German legislation demands an energy certificate for each building. However, an exception is allowed if different buildings on a site are metered together and a certificate based on an operational rating is being used; then one certificate can be issued for all buildings.

Landlord's energy statement (LES)
Unlike UK, Germany doesn't have a LES. The German government regards the building as a physical and not a commercial construction. However, landlords of a multi-tenanted building may find it very difficult to produce the operational rating, because they would need to acquire the energy bills of every single one of their tenants over the past three years. In a large building complex, this might be a huge undertaking. A discussion of this issue is still ongoing and it is not yet clear if a solution will be found.

Defining the reference values (benchmarks)
The German government developed reference values for public buildings on the basis of a large database of energy use. After the first revision of this database, it became clear that further data were needed and a consortium named ARGE Benchmark was commissioned to develop reference values for privately owned buildings. Consequently, the German legislation contains two tables of reference values: one for public and one for non-public buildings (see Figure 11).

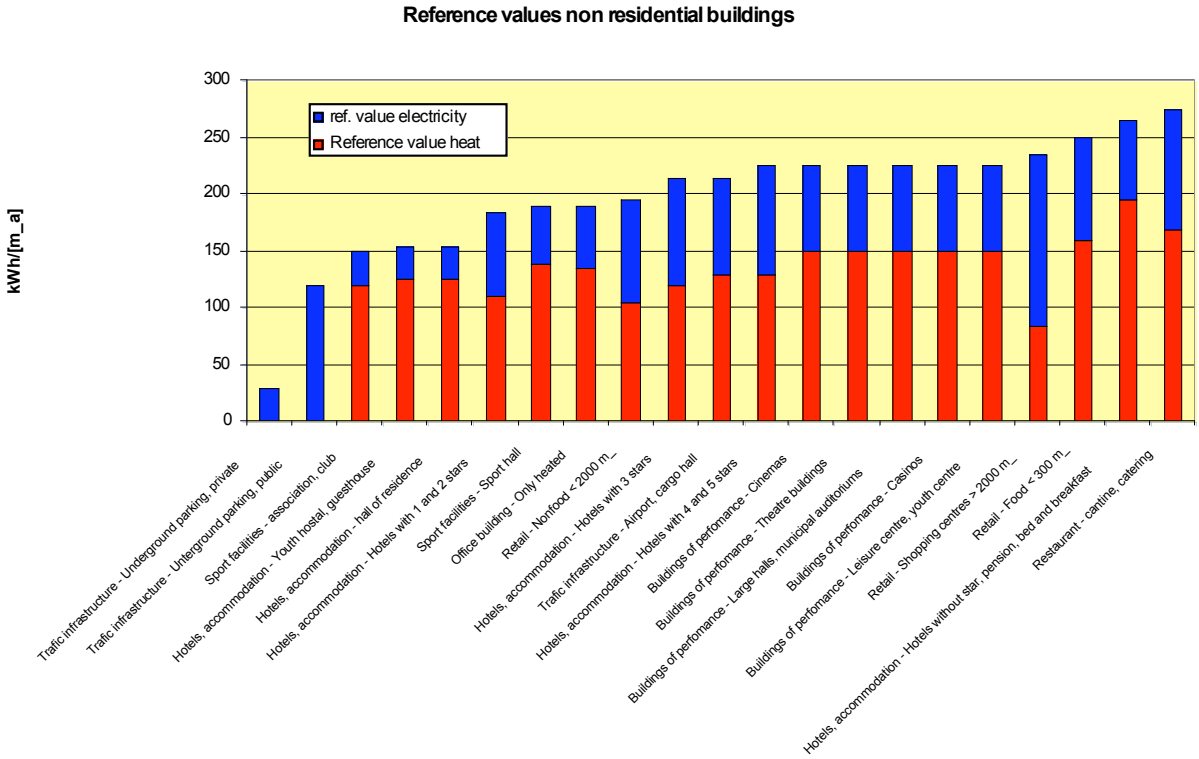


Figure 11 German reference values for non-public buildings (based on delivered kWh)

The reference values are calculated on a statistical basis. So far, no further empirical development of the reference values has been allowed, although a change in this procedure is being discussed.

Special energy use
Special energy uses can be indicated on the certificate, but not deducted from the total energy consumption.

Mixed use
If a building has more than one usage, a composite reference value is calculated, according to the area ratio of the different usages.

Adaptation to the hours of use
An adaptation to different usage times is not allowed.

Climate correction
The metered energy consumption is adjusted according to correction factors relating to the period and the region (defined by the post code). A new correction method is under development and is expected to be published in May 2008. The new climate correcting model is based on a refined set of climate data. The correcting factor can be calculated for each metering period and each location, allowing differences of altitude within one climate zone to be taken into account.

The Process for obtaining a DEC/EPC in Germany

Data collection, verification and registration
In the German legislation (ENEV) the requirements for an assessor are defined. Depending on the type of EPC, different levels of education and professional experiences are required. The building owner is allowed to collect the data and submit this to the assessor. The assessor has to verify the data, to issue the certificate and to sign it. Apart from spotting what should be obvious mistakes in the basic data, the assessor is not responsible for the quality of the data. The German legislation includes an annex where a training course is described. But this annex is voluntary.

Based on the provision of data by the owner, web based services for energy certificates are established in Germany for both asset and operational ratings of residential buildings and for operational ratings of non-residential buildings. These cost between 25 and 50 Euros. In contrast, an energy certificate for non-residential buildings based on an asset rating will take 5 to 15 days and will cost orders of magnitude more.

There is no central registration of assessors nor any central collection of the results of certificates.

Accreditation schemes
Beside the requirements on educational and professional experience, no further accreditation credentials are needed. Each assessor has to decide by self-regulation whether they are suitably qualified to issue a certificate for a specific building or not.

Conclusions

Implementation in England and Wales
The energy certificates for public buildings (DECs) are aimed both at the organisations occupying a building and at the general public. For the first time ever, the energy performance of buildings and the resultant CO_2 emissions will become visible. The DECs will identify poor buildings to be prioritised for improvement and there will be a high profile reputational pressure to implement energy saving measures - reinforced by the fact that a DEC highlights year-on-year performance.

The government policy for DECs has many synergies with forthcoming new legislation such as the EU's Energy Services Directive, a UK government initiative called the Carbon Reduction Commitment (a cap-and-trade emissions trading scheme for large non-industrial organisations) and, of course, the EC's anticipated enhancements and tightening of the EPBD.

Implementation in Germany
Energy performance certification of public buildings in Germany lives in two worlds: the operational and the asset rating. The operational rating is a simple basic certification scheme, whilst the asset rating for non domestic buildings is very complex and time consuming. Further development must be done, to simplify the asset rating on the one hand and to enhance the operational rating on the other hand. A solution for multi-tenanted rented buildings must be found too.

Key differences between the UK and German methodologies
1. Weather adjustments are made to the benchmarks in the UK whilst in Germany they are made to the actual energy use. The UK approach has the merit of reporting actual (unadulterated)

results on the certificate and is technically more rigorous because the proportion of the benchmark which is weather dependent can be specified, but it means that the benchmark for each building type will be different in different regions and will vary from year to year. The German approach has the benefits of fixed benchmarks for each building type, but suffers the vagaries of using a model to correct the metered energy for the effects of weather.

2. Special energy uses can be deducted in the UK but not in Germany.
3. The UK certificate headlines an overall rating for the building, whilst the German certificate shows only the use of electricity and fossil fuel or heat compared with benchmarks, on separate graphics.
4. For a multi-tenanted building, separate certificates are required for different tenants in the UK, whilst the landlord must produce a single certificate for the whole building in Germany.
5. The UK has a more formalised approach to the training and accreditation of the assessors permitted to produce building energy certificates.
6. The German approach does not include the central collection of energy performance data which means that, for the moment, the German government is missing the opportunity to collect the data which can support the development of benchmarks and strategic policy measures.

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