Communities and Local Government

The Government's methodology for the production of Operational Ratings, Display Energy Certificates and Advisory Reports

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Department for Communities and Local Government

Communities and Local Government
Eland House
Bressenden Place
London
SW1E 5DU
Telephone: 020 7944 4400
Website: www.communities.gov.uk

Communities and Local Government Publications
PO Box 236
Wetherby
West Yorkshire
LS23 7NB
Tel: 0300 123 1124
Fax: 0300 123 1125
Email: communities@capita.co.uk
Online via the Communities and Local Government website: www.communities.gov.uk

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Summary

This manual describes the Government's Operational Rating Methodology for assessing the operational performance of buildings. The indicators of operational performance are annual carbon dioxide emission per unit of area of the building caused by its consumption of energy, compared to a value that would be considered typical for the particular type of building.

The operational rating is a numeric indicator of the amount of energy consumed during the occupation of the building over a period of 12 months, based on meter readings.

This guide describes the scope and requirements of the Regulations applying to large public buildings and provides detailed guidance on how these are applied. While this guidance aims to explain how the requirements will work in practice, any interpretation of the Regulations is offered only as a guide, as the Department cannot provide legal advice and only the courts can provide an authoritative interpretation of the law. Therefore, it is important to read and understand the Regulations as well. In cases of doubt independent legal advice should be sought.

Section 1

Introduction

The various types of energy consumption from occupying a building must be brought together on a common basis so that the performance of one building can be compared with that of another. The UK has decided that the common unit should be carbon dioxide (CO_2) emissions, since this is a key driver for energy policy.

An operational rating (OR) is a measure of the annual (CO_2) emission per unit of area of the building caused by its consumption of energy, compared to a value that would be considered typical for the particular type of building.

OR = (Building CO_2 emissions/Building area) x (100/Typical CO_2 emissions per unit area)

The OR is related to a label, which the Government has determined is displayed on an "A to G" scale in a similar manner to many household appliances, as this is a format readily accessible and understood by the public.

To enable the performance of one building to be compared with another, the calculation has several factors which can be adjusted. Each building will be categorised and this determines which benchmark the building will be compared with. The benchmarks represent building use of a typical building of that type, under a number of standardised conditions for temperature, occupancy and proportion of non-electrical energy used. Under certain circumstances, these benchmarks may be adjusted according to location, occupancy and the ratio of non-electrical energy used. Certain buildings have activities which span more than one of the building categories. In these cases it is possible to develop a bespoke composite benchmark which will be relevant to that specific building and the activities it houses.

This document provides details of the Government's methodology to calculate operational ratings, produce display energy certificates and advisory reports. This guidance should be read in conjunction with the Government's non-technical guidance on Operational Ratings titled "Improving the energy efficiency of our buildings. A guide to display energy certificates and advisory reports for public buildings" ISBN 978-1-8511-2981-2 and can be obtained from www.communities.gov.uk/epbd

Frequently Asked Questions (FAQs) on operational ratings, display energy certificates and advisory reports are available at www.communities.gov.uk/epbd

Section 2

Scope

This guidance describes the Government's methodology for the production of Operational Ratings, Display Energy Certificates and Advisory Reports. The methodology is only applicable to buildings that are not dwellings.

For a building to fall within the requirement for a DEC it must:

- have a roof and walls

and

- use energy to condition the indoor climate. This is the case where the building has any of the following fixed services: heating, mechanical ventilation or air-conditioning.

A building can either be:

- the whole of a building

or

- part of a building, where the part is designed or altered to be used separately[1].

Regulation 49(1) of Statutory Instrument 2007 No. 991 binds the Crown. Therefore the requirements to display a DEC and possess or control an advisory report apply to the Crown where it is an occupier of the building.

[1] A part of a building designed or altered to be used separately is where the accommodation is suitable for separate occupation. This could be indicated by the accommodation having its own access, separate provision of heating and ventilation or shared heating and ventilation but with separate energy metering and the ability by the occupier to independently control those services. The part could be deemed to be separate even if some facilities (ie kitchen and toilet facilities) were shared.

Section 3

Conventions for Operational Ratings

3.1 Basis for the calculation

A Display Energy Certificate (DEC) is required to display the Operational Rating (OR) of a building. An "operational rating" is "a numeric indicator of the amount of energy consumed during the occupation of the building over a period of 12 months calculated according to the methodology within this document.

It is intended that the energy consumed is based on a meter reading. The Operational Rating is derived by comparing the energy consumption of the building with the benchmark energy consumption of other buildings representative of its type. In its very simplest form the OR would be expressed as the total annual energy used by the building divided by the area of the building, compared to the energy use per unit area of building typical of its type.

Buildings often use more than one form of energy but simply adding together annual consumptions of, for example, gas and electricity is unhelpful in any accounting as the forms of energy represent different primary energies, different costs, and give rise to different carbon emissions. So that uses of different forms of energy can be added together and compared on a common basis, the UK has decided that the common unit should be carbon dioxide (CO_2) emissions, since this is the most important driver for energy policy. A cost-based rating would be unsuitable because energy supply prices for non-domestic consumers are highly variable and so meaningful comparisons based on cost would be difficult to achieve. The OR is then a measure of the annual (CO_2) emission per unit of area of the building caused by its consumption of energy, compared to a value that would be considered typical for the particular type of building:

OR = (Building CO_2 emissions/Building area) x (100/Typical CO_2 emissions per unit area)

A building with performance equal to one typical of its type would therefore have an Operational Rating of 100. A building that resulted in zero CO2 emissions would have an OR of zero, and a building that resulted in twice the typical CO2 emissions would have an OR of 200. If the building is a net energy generator, it would still be given an Operational Rating of zero – it is not possible to achieve a rating less than zero.

Within this simple description, though, each of the terms used requires further clarification so that buildings can be compared on an even basis.

3.2 Defining the building

This methodology applies to buildings, or parts of buildings designed, or altered, to be used separately. In an ideal situation each building has its own energy meters or, where only part of a building is occupied by the authority that needs to display a DEC, that part is metered separately.

Where there is a group of buildings on a site that is metered only at site level, then each building should normally be assessed individually. The energy used by each building is determined from the site energy consumption on a simple area weighted basis. The process of disaggregating the energy on an area weighted basis means that the OR for each building will be the same and equivalent to the value that would have been obtained if a site based calculation had been carried out.

3.2.1 Building area

The building area measurement specified in the legislation is the Total Usable Floor Area (TUFA). This is the same as the Gross Internal Area (GIA) in common use in commercial property surveying, and for which measurement conventions are based on the RICS Code of Measuring Practice[2] and defined in the Building Regulations.

The Building Regulations Approved Document L2A (2006) defines TUFA as the *"total area of all enclosed spaces measured to the internal face of the external walls, that is to say it is the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS. In this convention*:

a *the area of sloping surfaces such as staircases, galleries, raked auditoria, and tiered terraces should be taken as their area on plan; and*

b *areas that are not enclosed such as open floors, covered ways and balconies are excluded."*

Some building sectors commonly use alternative measures of area, notably Net Lettable Area (NLA) for the commercial office sector, and Sales Floor Area (SFA) for retail premises. Where these are the only measurements available for these building types, then the calculation may use standard, conservative, conversion factors to obtain GIA from NLA or SFA. These conversion factors, and the building categories for which they may be applied, are defined in the benchmark information described later. The information is made available to energy assessors through the software via the Central Information Point (CIP) file available to all accredited energy assessors (see section 3.11 below). The only alternative to using these defined conversion factors would be to measure and provide the GIA directly.

[2] Guidance Note: Code of Measuring Practice. 6th edition. 2007. RICS

Alternative normalising metrics, such as the number of hotel beds, could be used as part of a non-regulatory, sector specific, initiative. However, these cannot be used on a legal DEC nor can they be displayed in a way that might cause any confusion with an "official" DEC.

3.2.2 Accessible unconditioned areas

Within the Total Usable Floor Area, some covered areas may be untreated (neither heated, cooled nor ventilated), and are termed accessible unconditioned areas (for example attics and basements). Although the calculation of the OR is not adjusted to take any account of these areas, and they do not appear on the DEC, these areas (measured in terms of GIA) are recorded as part of the data entered into the calculation procedure. Each accessible unconditioned area is recorded together with a description of the purpose of the area, so that these can be included in the output data file and be available for subsequent analysis.

Note that where a benchmark is available for the accessible unconditioned space, then a composite benchmark approach should be adopted.

3.3 Determining energy consumption and carbon emissions

The ultimate aim is that all energy flows into the building will be metered. However, at least initially, it will be permitted to use energy consumption estimates provided by the utility companies. During the initial period such estimates may also be needed where the only measurements available are for periods that do not correspond to those needed to meet the requirements of calculating the OR. These requirements are discussed further in the following paragraphs.

It is necessary for 95 per cent or more of the energy consumption of the building to be metered or estimated within acceptable limits. Where insufficient metered or estimated energy consumption information is available to carry out the OR calculation, then a default value of 200 is given to the OR. This indicates a CO_2 emissions rate of double the amount typical for the type of building, and is associated with a grade G (worst performer) label. Other comparative indicators are also set at double the typical value.

Throughout the calculation procedures and in the storage of results, energy consumptions that are the result of actual measurements are 'flagged' with the letter "A", and those that are estimates provided by utility companies are flagged "E". These flags are not displayed on the DEC. However, the Technical Information section of the DEC indicates whether the assessment has been based on "actual" or "estimated" energy data.

3.3.1 The assessment period

The Assessment Period is the one-year period (365 days) over which the energies used in the calculation of the OR are considered to have been used, and is aligned with the measurement period of the main heating fuel used in the building. If the main heating fuel is measured over a period of exactly one year (365 days), then the Assessment Period

is identical to that measurement period. Otherwise either the start date of the assessment period is taken as the start date of the measurement period of the main heating fuel, or the end date taken as the end date of that measurement period.

3.3.2 Separable energy uses

The aim of the OR is to compare the annual energy consumption of the building with that of a building typical of its type. In some cases, though, the building may include activities that consume energy and which are not considered typical of that building type. Including these activities could reduce the validity of the comparison, and so it may be reasonable to subtract these ***separable*** energy uses in certain circumstances.

In order to be able to isolate and remove the annual separable energy consumption from the total, any separable energy uses must be separately metered. This is to ensure that the adjustment is based on robust evidence and will also encourage the installation of sub-meters. The separable energy Measurement Period must be within the range 365 +/- 7days, and the measurement period must be aligned to begin within +/- 31 days of the beginning, or end within +/- 31 days of the end, of the assessment period. Otherwise, the separable energy use will not be accommodated and discounted in the calculation.

The measured separable energy use energy demand will not be recorded on the DEC certificate, but will be shown on the more comprehensive Technical Table. This will show both the demand and the area occupied by each separable energy use that has been deducted from the building totals before calculating the OR. These might be used later to develop or refine further benchmarks.

The facility to deduct a separable energy use and its area from the OR assessment is an option available to the energy assessor. However, to prevent unjustified claims, the separable energy use must be one that is included on a list of allowable adjustments for the particular building type selected. Allowed separable uses are included as part of the benchmark information described later. No other energy uses may be separated for the assessment.

The energy assessor might alternatively deal with the space separately, using the same method as the remainder of the building, as the subject of a composite rating, as indicated later.

In order for an energy use to be separated from the total energy consumption, the energy use must:

- Be one of the separable energy uses listed in the appropriate table of the benchmark information
- Be applicable to the benchmark selected for the type of building being assessed, this is also indicated in appropriate tables within the benchmark information

- Comply with the criteria indicated in the benchmark information defining the separable energy use
- Have permanently metered energy use
- Have meter readings and analysis for the assessment period
- Have associated floor area measured and recorded
- Have a documented review of energy use and efficiency with improvement proposals
- Have a collated Separable Energy Record summarising all the above and signed off by the occupant's property or premises manager.

The allowed separable energy uses are:

- Regional server room
- Trading floor
- Bakery oven
- Sports flood lighting
- Furnace, heat treatment or forming process
- Blast chilling or freezing.

The Operational Rating procedure requests the energy consumption (by supply type) and the floor area of any separable energy use. Energy assessors have the option to enter this information only if they have completed a Separable Energy Record, which is signed off by the occupant's premises manager, for each separable energy use.

3.3.3 Energy measurement periods

The calculation of the OR is based on annual energy consumption, which is defined as the energy consumed over the assessment period of 365 days. This constant number of days has been selected in preference to one calendar year, remaining as 365 days rather than 366 in leap years. The ideal situation would be where all energies are metered over the same one-year period. However it is recognised that, at least during the early years of carrying out the DEC assessment, the different forms of energy consumed are likely to have been measured over different periods, and may be displaced in time from each other. Provided the differences in period length are within reasonable limits, the calculation must accommodate these by extrapolating or interpolating from shorter or longer measurement periods. Displacements in time (or lack of synchronisation) between the measurement periods of different fuels could, however, make the measurements incompatible and so displacements beyond certain limits cannot be used to produce a reliable result. In such cases, and in the initial period, the energy assessor will need to obtain estimates over a compatible period from the energy supplier.

Where actual energy measurements and utilities suppliers estimates cannot be obtained, or where the data obtained do not satisfy the duration and synchronisation limits, the DEC will show a default OR. The default OR and other energy indicators will be set at twice the energy consumption benchmark of the building type selected. By definition, this will equate to an OR of 200 and a worst ("G") label.

The method of extrapolating or interpolating energy use from measurement periods that are not exactly one year depends on the use of the energy. The main heating energy needs to be treated differently to the energies used for other purposes. Uses of energy other than for space heating are considered to be relatively constant in use throughout the year, and so correction can be applied on a pro-rata basis according to the length of the measurement period. The main heating energy is considered to be at least partially weather dependent, and so the measured energy should be corrected in proportion to the number of heating degree days in the measured and in the 'extrapolation' or 'interpolation' periods.

However, where there are metered Separable Energy Uses, any metered 'separable' use of the main heating fuel must be subtracted from the total before the degree day correction is applied. The metered separable energy use must first be adjusted to a measurement period equal to that of the main heating fuel, and this adjustment is applied on a simple pro-rata daily basis. The degree day corrected component of the main heating fuel consumption and the 'separable' use of the main heating fuel, itself re-adjusted to a 365 day period, are then added together to form the adjusted 365 day total consumption of the main heating fuel.

Where the main heating fuel is electricity, and the heating electricity is not separately metered, then a 'default' value for the proportion of the electrical consumption deemed to be used for heating is obtained using the benchmark information. This proportion is then treated as being weather dependent, and the degree day correction applied to this proportion.

For the main heating fuel only, if the measurement period does not include complete months at its beginning and end, then the number of degree days in those part-months included is obtained in simple proportion to the number of days that are included in those months. So if the measurement period begins on the 6th day of a month having 31 days, and ends on the 5th day of a month having 30 days, then the number of degree days in the month that the measurement period started would be multiplied by [(31 – 6)/31] to obtain the relevant number of degree days, and the number in the end month would be multiplied by [5/30].

Initially energy measurement periods of 365 days +/- 31 days will be accepted in the calculation, but the software that carries out the OR calculation will display a warning where the discrepancy in measurement period is between +/- 7 and +/- 31 days. The

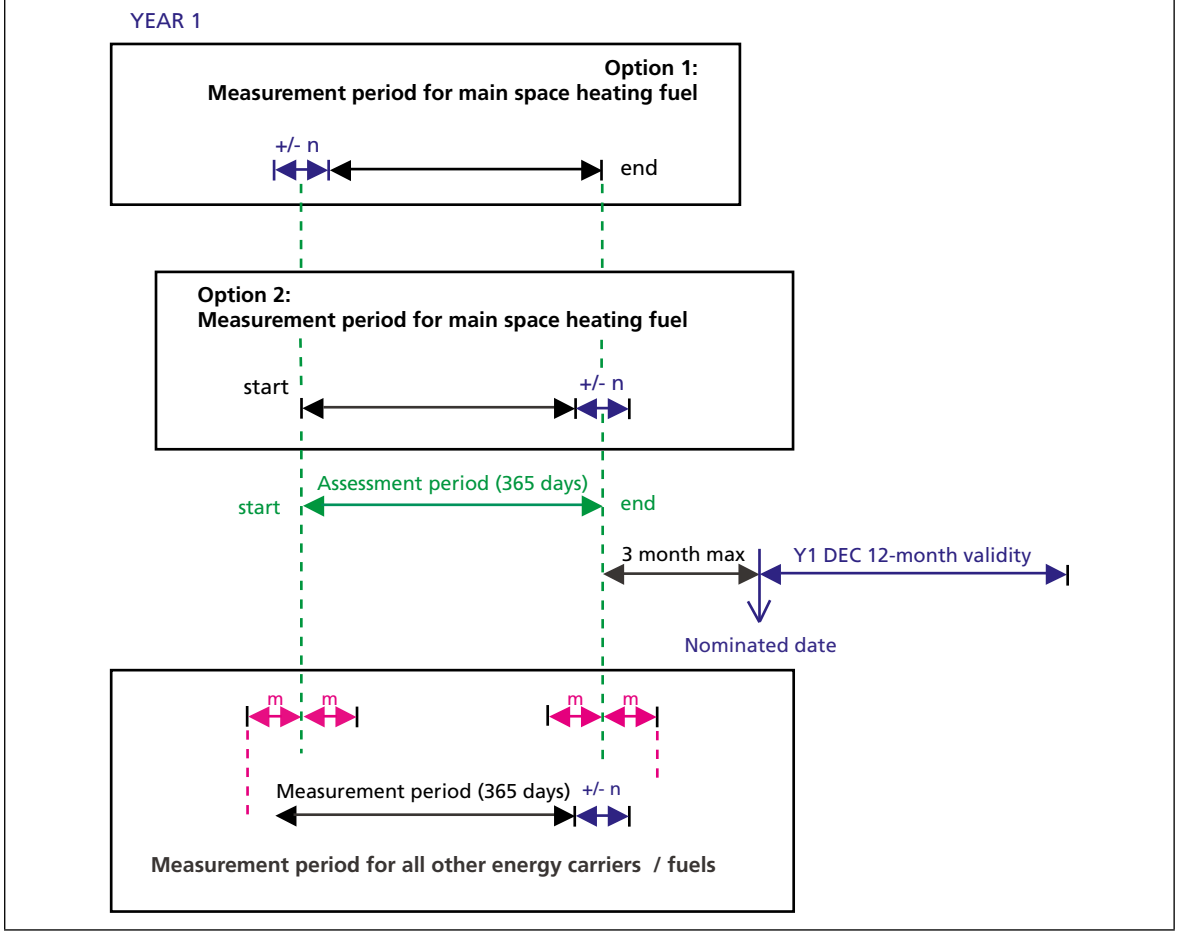
exception is where the main heating energy is electricity, where the maximum accepted discrepancy is +/- 15 days and the warning generated where the discrepancy is between +/- 7 and +/- 15 days.

Similarly, the start or end dates of the energy measurement periods of fuels other than the main heating fuel must be aligned with the start and end dates of the assessment period within +/- 31 days or these will not be accepted in the calculation. The calculation software that carries out the OR calculation will display a warning to the energy assessor where the discrepancy in alignment of the measurement periods is between +/- 7 and +/- 31 days.

Figure 3.1 below shows the principles of the allowable tolerances on energy measurement period length, the alignment of the assessment period either with the start or the end of the measurement period for the main heating fuel, and the alignment of other energy measurement periods with the assessment period. Further details are available in Appendix 2.

The energy assessor may wish to examine the start and end dates of all the measured energies, or utility estimates of energy, that are available, before setting the start or end date of the assessment period to align with the start or end date of the main heating fuel measurement period. This may help to determine whether one option is preferable to the other, as one alignment option may bring the measurements within tolerance and the other may not.

Figure 3.1: The principles of aligning measurement periods and the assessment period



3.3.4 Low and Zero Carbon (LZC) technologies

Low and Zero Carbon (LZC) technologies include On-Site Renewables (OSR) and Low Carbon (LC) technologies. LZC may be defined as technologies that supply the building with energy but that have the effect of reducing the metered energy supplied to the building from the levels that would have been needed if the building were serviced using common standard methods. LZC technologies therefore include plant such as bio-fuel boilers and heat pumps.

If there is on-site generation of electricity from a renewable energy source or from CHP, this would be reflected in a reduced grid mains electricity demand (and with CHP, an increased fossil fuel demand). Similarly solar thermal heating would normally lead to a lower fossil fuel demand. Consequently, meter readings are not adjusted. However it would be good practice to meter the outputs of all low and zero carbon sources in the building so that the efficiency of the building itself can be assessed as part of the non-regulatory assessment framework.

Where the energy production from an OSR or LC source is metered, then the energy produced by each may be acknowledged on the DEC and in the more comprehensive Technical Table.

To be included and acknowledged on the DEC, each OSR or LC output energy measurement period must be within the range 365 +/- 15 days, and the measurement period must be aligned to begin within +/-31 days of the beginning, or end within +/- 31 days of the end, of the assessment period. The software that carries out the OR calculation will display a warning where the discrepancy in measurement period is between +/- 7 and +/- 31 days.

3.3.5 Energy exports

The intention is that energies are measured nett of any energy exports. Often, where energy may flow either to or from the building, meters will be nett measurement types. In these cases the energy exported from the building will automatically be subtracted from the energy imported, and the meter reading provides the nett energy consumption (energy imported) of the building.

Where imported and exported energies are metered separately, then ideally the import and export meters should be read at the same time, so that the nett energy imported can be found simply by subtracting the exported energy from the imported energy.

Where imported and exported energies are metered separately, but not over the same periods, then limits must be put on the discrepancy between the two measuring periods, and on their alignment with the Assessment Period. Acceptable limits on the exported energy measurement period are:

- Measurement period length of 365 +/- 15 days
- Start date of the measurement period within +/- 31 days of the start date of the Assessment Period
- End date of the measurement period within +/- 31 days of the end date of the Assessment Period.

Where exported energy is not metered, or is metered over periods that are outside these acceptable tolerances for period length and alignment with the Assessment Period, then the exported energy cannot be taken into account in the calculations for the OR. Estimates are not acceptable.

Provided that the exported energy measurement periods are within acceptable tolerances, the exported energy is subtracted from the imported energy, of the same fuel, before any other adjustments are applied to the measured nett imported energy.

3.3.6 Carbon dioxide conversion factors

Buildings cause the emission of carbon dioxide (CO_2) as a result of their consumption of energy in all its various forms. The factors of interest are therefore the annual energy consumptions of each form of energy, and the CO_2 conversion factor associated with each.

Standard values of CO_2 conversion factor are needed for each form of energy used in buildings, and these have been determined for most fuels by government. It should be noted that these values are not the same as those used in calculating the carbon performance of new buildings to demonstrate compliance with Building Regulations. The CO_2 conversion factors used in demonstrating compliance are forward looking, representing the likely situation over the life of a new building, but the CO_2 conversion factors used for DEC are intended be representative of the period for which the OR is to be calculated.

The CO_2 conversion factors are therefore one of a number of resources held and maintained by government in a Central Information Point (CIP) file available for access by all accredited energy assessors.

Where fuel consumption is measured in terms of mass or volume (eg for solid and liquid fuels) rather than in energy terms (eg kWh), the energy content of the measured fuel consumption should be derived using the Gross Calorific Value[3] of the fuel under normal conditions. The energy content of the fuel consumed over the assessment period may then be converted to CO_2 emissions by using the conversion factors specified.

[3] "The calorific value of a fuel is the quantity of heat produced by its combustion - at constant pressure and under conditions known as "normal" of temperature and pressure (ie to 0°C and under a pressure of 1,013 mbar). The combustion of a fuel product generates water vapor. Certain techniques are used to recover the quantity of heat contained in this water vapor by condensing it. The Higher Calorific Value (or Gross Calorific Value - GCV) supposes that the water of combustion is entirely condensed and that the heat contained in the water vapor is recovered. The Lower Calorific Value (or Net Calorific Value - NCV) supposes that the products of combustion contains the water vapor. The heat contained in the water vapor is not recovered." Source: http://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html

3.4 Typical carbon emissions (benchmarks)

Building performance can only usefully be compared with other buildings that carry out the same or similar functions. It is not helpful to compare, for example, an office with a hospital, and so different performance benchmarks are required for each type of building function.

The Chartered Institution of Building Services Engineers (CIBSE) have prepared operational benchmarks for 29 main categories of building, and have listed together the different types of building and use that would be included within each of the general category descriptions. These benchmarks are expressed in terms of energy density (kWh/m^2/yr), and are expressed separately as the electrical and non-electrical (fossil-thermal) components of the benchmark. Representative emissions densities (kgCO_2/m^2/yr) are also indicated, using representative CO_2 emission factors, for information only and not for use in the calculation procedure.

The benchmarks have been prepared to represent building use under a number of standardised conditions:

- The weather year is standardised at 2021degree days per year, to the base 15.5°C
- A defined occupancy period is noted for each category individually
- A standard proportion of the non-electrical energy density benchmark that is considered to be related to the heating demand is noted for each building category individually.

The purpose of these factors is explained in the following sections as they may form part of the procedure of adjusting the benchmarks to better represent the characteristics of a building being assessed, where the energy assessor believes that the basic benchmark should be adjusted to the location and use of that building.

3.4.1 Adjusting the benchmark for location (weather region)

The category benchmark is always adjusted according to the 'history' of temperature in the building location, for the one-year assessment period over which the OR is to be calculated. The adjustment is based on the number of monthly degree days over the 12-month assessment period for the region in which the building is located. The adjustments are for heating degree days only, and no adjustment for cooling degree days is undertaken. The monthly degree day information is obtained from the Central Information Point, using the postcode of the building to determine the weather region appropriate for the building.

Where the assessment period does not include complete months at its beginning and end, then the number of degree days in those part-months included are obtained in simple proportion to the number of days that are included in those months. So if the assessment period begins on the 6th day of a month having 31 days, and ends on the 5th day of a

month having 30 days, then the number of degree days in the month that the assessment period started would be multiplied by [(31 – 6) / 31] to obtain the relevant number of degree days, and the number in the end month multiplied by [5 / 30].

For a building category with an 'Electrical' energy density benchmark of "E" (kWh/m^2/yr) and a 'Non-electrical' energy density benchmark of "N" (kWh/m^2/yr), the CO_2 density benchmark "C" ($kgCO_2/m^2/yr$) is found using standard CO_2 intensity factors obtained from the Central Information Point for electricity (CE, $kgCO_2$/kWh) and for gas (CG, $kgCO_2$/kWh) (representing the Non-electrical consumption) as:

$$C = (CE \times E) + (CG \times N) \qquad (kgCO_2/m^2/yr)$$

Only that part of the energy density benchmark that is related to heating demand is adjusted for number of degree days so in a simple case where, for example:

Standard degree days for the category is	S (dd)
Degree days in the assessment period, for the specific location, is	L (dd)
Electrical energy density benchmark is	E (kWh/m^2/yr)
Non-electrical energy density benchmark is	N (kWh/m^2/yr)
Proportion of Non-electrical benchmark related to heating is	P (%)

Then the degree day adjusted thermal density benchmark (N_{dd}) is:

$$N_{dd} = [N \times (1 – P/100)] + [(N \times P/100) \times (L/S)] \qquad (kWh/m^2/yr)$$

and the resulting 'dd corrected' CO_2 density benchmark becomes

$$C_{dd} = (CE \times E) + (CG \times [N_{dd}]) \qquad (kgCO_2/m^2/yr)$$

3.4.2 Adjusting the benchmark for longer hours of occupancy

Where the energy assessor can demonstrate that the building is occupied for significantly longer periods than the standard hours quoted for in the benchmark category, and where the benchmark information includes a numerical factor allowing correction for extended hours of use to be made, then the degree day corrected benchmark may be adjusted for the extended occupancy. Suitable forms of evidence to support the extended occupancy hours claim are detailed below and in paragraph 4.1.7. Where relevant, the benchmark information includes separate correction factors for occupancy period for the electrical and the non-electrical energy density benchmarks. The benchmark information contains:

- Benchmark (standard) hours per year (SH)
- Maximum allowed hours per year (MH)
- Percentage increase in electrical benchmark at maximum allowed hours per year (PE)
- Percentage increase in fossil-thermal benchmark at maximum allowed hours per year (PN)

Where, for example, it can be shown that a the actual use of a building is "AH" hours per year, then new degree day and occupancy (dd&occ) corrected electrical (Edd&occ) and non-electrical (Ndd&occ) energy densities may be calculated as:

$$E_{dd\&occ} = E \times (1 + [\,(AH - SH)/(MH - SH)\,] \times (PE/100)) \qquad (kWh/m^2/yr)$$

and

$$N_{dd\&occ} = N_{dd} \times (1 + [\,(AH - SH)/(MH - SH)\,] \times (PN/100)) \qquad (kWh/m^2/yr)$$

and the resulting "dd&occ" corrected CO_2 density benchmark becomes

$$C_{dd\&occ} = (CE \times E_{dd\&occ}) + (CG \times [N_{dd}\&occ\,]) \qquad (kgCO_2/m^2/yr)$$

To obtain the annual occupancy hours the energy assessor must use the appropriate occupancy measurement systems as indicated for each benchmark category in the benchmark information. The two systems of defining annual occupancy hours are:

- The number of hours per year that the number of recorded occupants exceeds 25 per cent of the nominal maximum occupancy, or
- The number of hours per year that the premises are fully open to the public according to published opening hours.

The energy assessor must obtain attendance records, survey results or published opening hours and calculate the annual occupancy hours. This information is to be collated into an Annual Occupancy Hours Record and signed off by the occupants' premises manager before the energy assessor uses the occupancy data in the Operational Rating calculation procedure.

Where different parts of the building (falling within the same benchmark category) have different occupancies the lowest occupancy must be used, unless an assessment of occupancy in each part is made and the occupancies combined using the percentages of overall floor areas, ie using an area-weighted average.

Where occupancy adjustment is required in a multi-use building assessment, that is, one employing more than one benchmark category in a composite benchmarking procedure (see paragraph 3.4.3 below), the Annual Occupancy Hours must be calculated as above for each category for which an occupancy adjustment is relevant.

3.4.3 Mixed-use assessment: composite benchmarks

A composite benchmark may be needed where the activities in the space assessed span more than one building category with a separate benchmark, for example an office with an integral leisure centre.

Where the energy for each activity is separately metered, and each activity area exceeds 1,000m^2, a separate DEC for each area may be produced. Where the activity areas do not exceed 1,000m^2, separate display energy certificates may be produced on a voluntary basis. Alternatively, and in all instances where the energy for each activity is not separately metered, an overall DEC should be produced. This DEC will use a composite benchmark based on an area-weighted average of the benchmarks of each building category.

Where this composite benchmark approach is used, the energy assessor should choose which activity area, hence which building category, will be described as the Main Benchmark Category. This will be the largest area where the main heating fuel is used.

Where the areas, [a], [b], ….. [n] are associated with:

$EC_{dd\&occ}[a]$ = DD & Occ Corrected Electricity CO_2 Density for area [a]
$NC_{dd\&occ}[a]$ = DD & Occ Corrected Non-Electrical CO_2 Density for area [a]
$C_{dd\&occ}[a]$ = DD & Occ Corrected CO_2 Density for area [a]
A[a] = Floor area of area [a]
Etc…for [a], [b], ….. [n]

then the Composite CO2 Benchmark Electricity (CBE) is given by:

$$CBE = ((EC_{dd\&occ}[a] \times A[a]) + (EC_{dd\&occ}[b] \times A[b]) + \ldots + (CE_{dd\&occ}[n] \times A[n])) / (A[a] + A[b] + \ldots + A[n])$$

the Composite CO_2 Benchmark Non-Electrical (CBNE) is given by:

$$CBNE = ((NC_{dd\&occ}[a] \times A[a]) + (NC_{dd\&occ}[b] \times A[b]) + \ldots + (NC_{dd\&occ}[n] \times A[n])) / (A[a] + A[b] + \ldots + A[n])$$

and the overall Composite CO_2 Benchmark (CB) is given by:

$$CB = ((C_{dd\&occ}[a] \times A[a]) + (C_{dd\&occ}[b] \times A[b]) + .. + (C_{dd\&occ}[n] \times A[n])) / (A[a] + A[b] + \ldots + A[n])$$

The Government's software allows up to five separate benchmarks to be used to calculate a composite benchmark. Where building uses span more than five benchmark categories, the energy assessor may use a Government-approved proprietary software that allows more than five benchmarks to be combined. Alternatively, the energy assessor may review the benchmarks, and aggregate the areas of those building activities that have similar benchmarks. When aggregating areas that have different benchmarks, the lowest benchmarks should be selected to calculate the OR.

3.5 Electrical and non-electrical energy ratios

The more comprehensive Technical Table provides additional details of the assessment. This includes a comparison between the relevant actual consumptions of electricity and non-electrical energy over the assessment period and the degree day and occupancy corrected electricity and non-electrical energy densities $E_{dd\&occ}$ and $N_{dd\&occ}$. These are expressed as the electrical (ER) and non-electrical (NR) ratios, as:

ER = Relevant electrical consumption/$E_{dd\&occ}$

and

NR = Relevant non-electrical consumption/$N_{dd\&occ}$

These factors are useful to energy assessors as they may indicate where to focus resources in identifying potential reasons for poor performance.

3.6 The Operational Rating

The Operational Rating (OR) is calculated as the relevant total carbon dioxide emissions of the building over the assessment period divided by the degree day and occupancy corrected CO_2 density benchmark $C_{dd\&occ}$. To avoid fractions, the result of the comparison is expressed as a percentage, rounded to the nearest whole number.

In the case of a composite benchmark assessment, the relevant total carbon dioxide emissions of the building over the assessment period are divided by the overall Composite CO2 Benchmark (CB).

3.7 The DEC 'Label'

The DEC is required to display the performance of the building as a label, which the Government has determined will be displayed on an "A to G" scale in a similar manner to many household appliances, as this is a format readily accessible to the public.

The A to G banding of the Operational Rating is determined as:

Operational Rating	"A to G" label
0 to 25	A
26 to 50	B
51 to 75	C
76 to 100	D
101 to 125	E
126 to 150	F
More than 150	G

3.8 CO_2 shown as "renewable" on the DEC

The DEC includes a CO_2 histogram which shows CO_2 under three headings: "heating", "electricity" and "renewable". This section defines what the CO_2 marked "renewable" means and how it is derived. Details of the CO_2 contributions marked "heating" and "electricity" are provided in section 3.9

On-Site Renewables (OSR) include technologies that generate heat or electricity from ambient sources and have zero (or near zero) CO_2 emissions. The energy they deliver reduces CO_2 emissions from the building. Such OSR include solar thermal, geothermal, photovoltaic and wind energy. Low Carbon (LC) technologies release less CO_2 emissions than conventional systems. They may replace or supplement plant that would have been included in a conventional servicing strategy. LC technologies include bio-fuel boilers, Combined Heat and Power (CHP) and heat pumps.[4]

The CO_2 marked "renewable" is shown "below the zero line" on the histogram and shows:

- For OSR, the actual CO_2 savings
- For LC, the CO_2 emissions that would have been emitted if a conventional system had been used, for example a gas boiler.

Where both OSR and LC technologies are present on site, the CO_2 marked "renewable" aggregates the contributions from all technologies.

[4] Further guidance on OSR and LC technologies is available from the Planning Portal "Low or Zero Carbon Energy Sources: Strategic Guide".

Where the energy output by an OSR/LC is specifically measured, within the limits to the measurement period length and alignment specified in section 3.3.5, then its CO_2 contribution are calculated as follows.

Where the output of the OSR/LC is electricity, then the CO_2 contribution is calculated as the electricity supplied in the 365 day period, multiplied by the CO_2 conversion factor for electricity obtained from the CIP. This calculation is also used to calculate the CO_2 contribution from a metered supply of electricity from an on-site CHP installation. That is:

CO_2 contribution = 365 day electricity supplied x CO_2 conversion factor (electricity)

Where the energy output of the OSR/LC is thermal (heating) energy, the CO_2 contribution is calculated as the CO_2 emissions that would have been produced by a boiler operating at a seasonal efficiency of 0.80[5] to provide the same thermal energy. The CO_2 contribution by the OSR is:

CO_2 contribution = (365 day heat energy/0.80) x CO_2 conversion factor (main heating fuel)

However, where the building is heated using a heat pump, the CO_2 conversion factor for natural gas should always be used, even though gas may not be the main heating fuel.

Where the LC output is cooling energy, the CO_2 contribution is calculated as the CO_2 emissions that would have been produced by a conventional electrically driven cooling plant operating at a seasonal efficiency of 2.25[6] to provide the same cooling energy. The CO_2 contribution by the OSR is:

CO_2 contribution = (365 day cooling energy/2.25) x CO_2 conversion factor (electricity)

3.9 Total CO_2 emissions

The DEC will display a histogram showing the Total CO_2 emissions that the building emits, in tonnes per year of CO_2. This is the entire CO_2 emissions of the building assessed and includes any emissions due to separable energy uses that may have been deducted from the total (to obtain the "relevant CO_2 emissions") in calculating the Operational Rating.

The Total CO_2 emissions histogram indicates for the current assessment year, and for the two preceding assessment periods:

- As a positive contribution to the total, the annual CO_2 emissions due to the consumption of grid supplied electricity
- As a positive contribution to the total, the annual CO_2 emissions due to the

[5] 0.80 is the minimum value for replacement boilers as defined in the Government's Non-domestic Heating, Ventilation and Air-Conditioning compliance guide.

[6] 2.25 is the minimum energy efficiency ratio for an air cooled vapour compression chiller as defined in the Government's Non-domestic Heating, Ventilation and Air-Conditioning compliance guide.

consumption of all other forms of delivered energy. For convenience this is termed 'heating' although it includes delivered fuels that are used for any purpose, together with any delivered heating and cooling energies from, for example, district heating or cooling systems. It also includes contributions from electricity used for heating

- As a total, and shown as a negative quantity, the annual CO_2 contributions from on-site renewable energy sources and LC technologies as defined in section 3.8
- The month and year of the Nominated Date (see Section 2) of each assessment shown.

3.10 The Technical Tables

The DEC displays brief Technical Information containing basic details from the assessment. It includes:

- An indication of whether the energy consumptions used in the assessment were based on actual readings or were based on estimates from the energy suppliers
- The main heating fuel type
- The main form of building environment (for example naturally ventilated or air conditioned)
- The Total Useful Floor Area (m^2)
- The current Asset Rating (where available).

and in tabular form:

- The annual energy use of the building, in kWh/m^2/year, for electrical energy and for heating (other uses of fuel and heat) energy
- The typical (benchmark) building energy use for comparison, in kWh/m^2/year, for electrical energy and for heating (other uses of fuel and heat) energy
- The percentage of electrical and of heating (fuel and heat) energy obtained from "renewables" (taken as LZC ie OSR and LC) sources.

The calculation procedure that generates the OR and the data to be displayed on the DEC also provides a comprehensive Technical Table. This is not part of the DEC and is not subject to any display or lodgement requirements. It is information that is intended for building occupiers and others interested in details of the energy performance of the building The Technical Table displays information used in the OR calculation including:

ANNUAL ENERGY USE, CO_2 EMISSIONS, AND PERFORMANCE INDICATORS:

- Totals of "fuel and heat" and of electrical energy used in the assessment period (kWh), and the resulting CO_2 emissions (tonnes CO_2)
- The "fuel and heat" and electrical energy use attributed to each Separable energy use (kWh), and the resulting CO_2 emissions (tonnes CO_2)

- Calculated "fuel and heat", electrical and CO_2 performance indicators (kWh/m^2) and ($kgCO_2/m^2$) respectively
- Reference corrected "fuel and heat", electrical and CO_2 performance benchmarks (kWh/m^2) and ($kgCO_2/m^2$)
- Benchmark ratios for "fuel and heat", and electrical energy performance
- Benchmark ratio for CO_2 performance (the calculated Operational rating)
- The Operational Rating Grade.

DISPLACED ENERGY:

- The "Fossil fuel energy displaced" by the use of renewables, in kWh and as a percentage of the total "fuel and heat"
- The "Grid electrical energy displaced" by the use of renewables, in kWh and as a percentage of the total electricity.

BUILDING TYPES:

- The major building category and area (m^2)
- Other Benchmark categories used (up to five accommodated in the Government software) and associated areas (m^2)
- Total Useful Floor Area (TUFA) (m^2)
- Total accessible unconditioned area (m^2)
- Name and area (m^2) of each Separable energy use
- Total area for DEC assessment (TADA) (m^2).

In these descriptions, it should be noted that:

- Fuel and heat includes imported combustion fuels (eg fossil) and heating and cooling from community systems, nett of exports
- Electricity includes electricity used for all purposes, including heating, cooling, small power, etc., nett of exports
- Where applicable, the "total energy use in the year concerned" includes "fuel and heat" and "electricity" generated from LZC (ie OSR and LC) energy sources
- TADA is the area used in the OR calculations and the technical table calculations; it includes accessible unconditioned spaces, but excludes separable energy use areas
- TUFA determines whether the building exceeds the 1,000 m^2 threshold for a DEC being needed, and is the area shown on the DEC
- Only separable energy uses applicable to the building benchmark type may be deducted providing suitable evidence is available

- The benchmark categories used to generate a composite DEC (as defined in paragraph 3.4.3 above) are shown in the technical table. Building types classed under the same benchmark category are not shown
- Benchmarks are corrected for weather and hours of occupancy during the assessment period.

A template of the full Technical Table is provided for information in Appendix 1.

3.11 Central source of approved information

A number of the factors needed to support the calculation of the Operational Rating must be standardised so that all energy assessors make use of the same approved data, and that these data are kept up to date. The Government makes these available through a Central Information Point (CIP) file. Access is restricted to accredited energy assessors who should download the necessary data to enable the OR software to calculate the OR, and provide the information to produce the DEC and the advisory report. The contents of the CIP are updated every month and include:

- The Approved Benchmark Information, providing the electricity and non-electrical energy densities (benchmarks), the reference degree days and approved conversion and adjustment factors for the building categories, and a tabulation showing how indicative building types are 'allocated' to the building benchmark categories. Indicative carbon dioxide benchmarks are also provided, for information only, using representative carbon conversion factors although these are not to be used in the calculation process
- The approved monthly degree day information for the weather regions of the UK. Data for the three year period up to the most recent month are accessible directly, with records maintained for a ten year period for quality assurance purposes
- A table allowing the appropriate weather region to be obtained from the postcode of the building's location
- A list of approved accreditation schemes.

3.12 Implementation software

The Government has made available on its website:

- The specification for software to carry out the calculation of the Operational Rating and information for the DEC and full Technical Table, and
- The Government's free software developed to implement that specification.

Section 4

Collecting data for the Operational Rating

4.1 The data required

The energy assessor needs to gather data and supporting evidence under the following headings:

- Building category
- Location (post code, building name, address)
- UPRN Unique Property Reference Number
- Energy consumption (meter readings or suppliers estimates) and measurement period
- Total Useful Floor Area of the building (and how it has been obtained) or other allowed area metric
- Separable energy uses if any
- Recorded hours of occupancy.

4.1.1 Building category

The building needs to be placed in one of the 29 benchmarking categories. A description of the categories is provided by the software. It describes each category together with the types of buildings that fall within that category. Further guidance on the benchmarking categories will be available from the Chartered Institution of Building Services Engineers (CIBSE) at www.cibse.org

4.1.2 Location

The post code is required to allow the Operational Rating calculation software to adjust the benchmarks for the effects of local weather.

4.1.3 UPRN

The Unique Property Reference Number (UPRN) is required to define the "building" being assessed eg floors 1 and 2 of a part occupied building. The energy assessor will be required to obtain the UPRN from the Government's central register at www.ndepcregister.com

Energy assessors will use the DEC or the advisory report unique Report Reference Number (RRN) to check and retrieve previous certificates, recommendation or advisory reports. This enables the energy assessor to include any Asset Rating or Operational Ratings from the preceding years in the display energy certificate being produced. Previous recommendation and advisory reports will inform the generation of the new advisory report.

4.1.4 Energy consumption and measurement period

The energy assessor will need to gather data on the 'annual' consumption of each fuel, electric, fossil, biofuel, district heating, etc. and also details of the measurement period for each. This data may need adjusting, according to the provisions of section 3.3.3.

After first renewal of a DEC and in subsequent years, the certificate must display the OR for the previous two years, as long as the building has not undergone a change of use or occupier during that time, in which case previous ORs are no longer relevant or required. The previous OR data will be held on the central register.

If heating or cooling is supplied from district heating or cooling then the annual readings of the relevant meters should be used. These will have to be supplemented by a statement from the system operator of the carbon burden of the energy supplies ie kg of carbon per kWh of delivered energy. Similarly, if bulk fuels like oil, LPG (Liquefied Petroleum Gas), coal or biomass are used, consumption will have to be estimated from delivery notes and stock measurements.

In principle, an accurate meter reading of fuel and electricity consumption should be taken annually. If the meter reading, or other means of measurement, has to be a few days sooner or later than the selected date, adjustments to give the consumption over a 365-day period are made automatically by the software, see section 3.3.3.

The energy assessor will need to record the dates the readings were taken and enter them into the software. The tolerances allowed on the measurement dates are defined in Appendix 2. The software will give a warning when the date is out of tolerance and default to an OR of 200, ie a worst G rating, if the measurement periods are outside the tolerances allowed.

Recording energy used for separable energy uses is covered in section 4.1.6.

4.1.5 Building area

The Operational Rating is based on Gross Internal Area (GIA) or Total Useful Floor Area (TUFA), but other measures of area are allowed as listed in table 4.1.5. The energy assessor will need to enter which measure of area is being used into the software and calculate the area from plans or by measurement. Where no plans exist the energy assessor should produce a sketch of the building outline and mark all relevant dimensions on it. Where external dimensions are used it will be necessary to allow for the wall thickness when calculating the GIA or one of the allowed alternatives. All calculations should be shown on the plan or sketch.

See section 3.2.1 for the full definition of Total Usable Floor Area (TUFA). Other definitions of floor area are often used to normalise energy demand: eg net internal floor area (ie that which is occupied as working space) or treated floor area (ie gross internal area less unheated spaces). These alternative floor areas should NOT be used as the basis for the energy rating. However, such metrics can be used as a way of determining TUFA where so approved in the methodology. For example, for rented offices, net lettable area is the norm, and this can be used in conjunction with a conservative ratio of net to gross area to deliver the required value of TUFA. In this context, conservative means a value which is the maximum likely value of the ratio of the net to gross areas, thereby delivering the smallest TUFA (and hence the most pessimistic operational rating). The allowed ratios are listed in the table below.

Table 4.1.5

Category	Name	Brief Description	Approved alternate floor area	Default multiplier applied to alternate area to obtain TUFA
1	General office	General office and commercial working areas	Net lettable area (NLA) measured as RICS	1.25
3	General retail	General street retail and services	Sales Floor Area (SFA)	1.80
4	Large non-food shop	Retail warehouse or other large non-food store	Sales Floor Area (SFA)	1.80
5	Small food store	Small food store	Sales Floor Area (SFA)	1.35
6	Large food store	Supermarket or other large food store	Sales Floor Area (SFA)	2.00

4.1.6 Separable energy uses

Separating out certain energy uses is an optional part of the Operational Rating calculation procedure where specific conditions are met. It increases the relevance of the main energy rating if a building has certain specified 'process' energy uses which are not currently included in the benchmark typical building.

Separable energy uses are energy uses within a building's overall metered energy consumption which may be reported separately from the main energy rating of the building, along with their associated floor area.

This part of the procedure is simply omitted if the building has no metered separable energy use, and all the building's energy is then counted in the main assessment. If there are unmetered separable energy uses, this provides an incentive to meter them for future assessments.

See section 3.3.2 for allowed separable energy uses and criteria.

No other energy uses may be separated from a building's assessment. The energy assessor will also need to confirm that the separable energy use has been assessed for efficiency in the past two years. If all these conditions are fulfilled the metered energy used by the separable energy use can be deducted form the total measures consumption. This is done automatically in the software.

The Operational Rating software requests the energy consumption (by supply type) and floor area of any separable energy use. Energy assessors may only enter this information if they have completed a Separable Energy Record which is signed off by the occupant's premises manager. Accreditation schemes will give particular attention to the application of this procedure to operational ratings, to ensure that accredited energy assessors are implementing the calculation procedures appropriately.

In cases where the separable energy use is intermittent or seasonal the energy assessor will need to give special consideration to how the measurement period is entered into the software. Ideally the meter readings for the separable energy use should coincide with the main readings.

As the separable energy consumption is deducted from the total consumption for the building so must the area of the building occupied by the separable use be deducted from the TUFA. The energy assessor will need to obtain this area by measurement or from plans. Where the separable use is outside, such as sports flood lighting, the area to be deducted will be zero.

4.1.7 Occupancy adjustment

Occupancy adjustment is an optional part of the Operational Rating procedure which can increase the relevance of an Operational Rating in buildings whose occupancy differs from the benchmark occupancy value. In those circumstances where occupancy adjustments are allowed, the listed energy consumption benchmarks are altered according to the actual occupancy of the building. The calculation procedure is detailed in paragraph 3.4.2

Where there is robust documentary evidence of the occupancy of the building, based on attendance records, survey results or published opening hours, the Operational Rating may be modified by adjusting the listed energy consumption benchmarks according to the actual occupancy of a building.

If suitable documented evidence of occupancy is not available, or where actual occupancy is the same as the benchmark occupancy, then the adjustment is omitted and the normal unadjusted energy benchmarks are used. If occupancy is high but undocumented this provides an incentive to obtain the occupancy data for future assessments.

Suitable evidence is detailed in paragraph 3.4.2 and includes a valid assessment and record of the occupancy of the building. Each benchmark category is associated with a reference occupancy. Where appropriate, the software adjusts the benchmark according to the occupancy data provided by the energy assessor.

Accreditation Schemes are required to ensure that adjustments to the calculations, including occupancy adjustments, are adequately implemented by their energy assessors.

4.2 Gathering data

To produce a DEC for a building the energy assessor will need gather all the information required for input to the approved software. These data will come from a number of sources and may be of variable quality.

4.2.1 Application to groups of buildings on a site

Each qualifying building must display its own DEC. For many campus style facilities, metering is at the site level rather than at the individual building level. In such cases it is reasonable for display energy certificates to be based on the metered site energy demands, but with the consumption disaggregated into the demands for each building on an area-weighted basis.

Over time, metering provision should improve as the requirements of Building Regulations Part L recommend additional metering to be installed in both new buildings and existing buildings that are being refurbished. This will allow DECs that are specific to each individual building to be produced.

The process of disaggregating the energy on an area-weighted basis means that the OR for each building will be the same and equivalent to the value that would have been obtained if a site-based calculation had been carried out.

On some sites, individual buildings may have dedicated metering, and in such a situation, building specific DECs should be produced wherever possible, ie where

a) The individual building(s) have dedicated metering for most (at least 95%) of fuels used in the building; AND

b) There is an appropriate benchmark for that category of building; AND

c) The individual building(s) falls within the public display requirement.

For the remaining buildings on the site, DECs should be based on the whole site consumption, excluding those buildings that are separately assessed, using an area-weighted distribution of energy consumption. The benchmark should be based on the site benchmark, but adjusted by the emissions associated with the benchmarks for the buildings that have been separately assessed.

For example, if a theatre block at a teaching hospital had its own gas and electricity metering, it would be impractical to produce a DEC for the theatre block, since we don't have benchmark data for theatre blocks, but we do for the site, ie a teaching hospital. However, if the separately metered building was an administration building (ie essentially an office), it could be benchmarked independently, and the revised site benchmark BMR for the remaining buildings would be

$$BM_R = \frac{(A_{site} * BM_{site} - A_{office} * BM_{office})}{(A_{site} - A_{office})}$$

When the DEC is updated each year, the procedure described above should be revisited from scratch rather than continuing with the status quo. This means that in the example quoted, if benchmark data had become available for operating theatres in the period since the previous DEC was produced, the theatre block would be treated separately from the rest of the site.

In the context of a site, a specific advisory report should be prepared for each qualifying building (a site-wide advisory report is not permitted). This will ensure that the recommendations contained in the advisory report are relevant to the specific circumstances of the building under consideration. Where existing energy reports are available and deemed "valid" by the energy assessor, then the free text entry can be used to log the recommendations that have already been made. See section 6 of this guide for further details on advisory report generation.

Note: the requirement for a DEC only applies to buildings over 1,000m^2. Consequently, if the total area of the buildings on a site exceeds 1,000m^2, but this comprises several individual buildings, none of which is greater than 1,000m^2, there is no requirement for any DEC. If one or more buildings exceed 1,000m^2, there is a requirement for a DEC for each such building.

Further information can be obtained from the Government's non-technical guidance *Improving the energy efficiency of our buildings. A guide to display energy certificates and advisory reports for public buildings* available at www.communities.gov.uk/epbd .

4.2.2 Building category

The energy assessor must select the relevant benchmark category(ies) applicable to the building uses. Category options are provided by the software.

4.2.3 Composite Benchmarks

Where a building has a mix of uses that would place parts of the building in different benchmark categories, it is possible to construct a composite benchmark. For example, in a school with a swimming pool, that part of the school excluding the swimming pool would be assigned the benchmark for schools and seasonal public buildings. The swimming pool would be assigned the benchmark for a swimming pool. The composite benchmark is the area weighted average of the two category benchmarks ie:

Composite BM = [(school BM x area of school without pool) + (pool BM x area of pool centre)]/(Area of school without pool + area of pool centre)

4.2.4 Recording energy consumptions

METERED ENERGY USE

Ideally the energy assessor will have access to meter readings and the dates on which the readings were taken. The energy assessor will select readings with start and end dates which as near as possible cover 365 days, and calculate the consumption from the difference between readings. The consumption and dates are entered into the software, which will adjust the consumption to 365 days. If the measurement period is outside the tolerances detailed in Appendix 2 the software will default to an OR of 200 ie a worst G rating.

The primary source of energy consumption data will be utility bills. These may include estimates, which may be used if there is no other source of accurate readings. When estimates are used, energy assessors must specify that the data entered in the software is estimated. It will be made clear on the DEC that the Operational Rating was produced using estimates. There should not be any reason to use estimated readings after the first year, as the requirement for readings will by then be fully understood.

Only estimates from utilities suppliers may be used to calculate the operational rating. Other bespoke estimates, whether derived by the accredited energy assessor or other experts, are not allowed.

DISTRICT HEATING AND COOLING

Where heating or cooling energy is supplied from district heating or district cooling, the suppliers of these services are required to calculate, from their own energy records, a CO_2 content per kWh of energy supplied.

Calculations should take account of the annual average performance of the whole system (including all heat/cool/power generating plant, any heat recovery, rejection, or dumping and the distribution circuits). The assessment of CO_2 content per kWh should be accompanied by a report signed by a suitably qualified person, detailing how the emission factors have been derived.

The energy assessor will need a copy of this report together with the start and end dates for the measurement period and the kWh of energy delivered.

NON-METERED ENERGY CONSUMPTIONS

Solid fuels and in some cases liquid fuels will not be metered. The energy assessor will need to obtain records of deliveries and a statement of the stock level at the start and end of the measurement period. The energy assessor will need to obtain a signed statement by a responsible person that the stock level was measured and details of the method used. The applicable tolerances are defined in Appendix 2. The energy assessor will convert the fuel consumption in kg or litres to kWh and enter this figure together with the start and end dates of the measurement period.

Where fuel consumption is measured in terms of mass or volume (eg for solid and liquid fuels) rather than in energy terms (eg kWh), the energy content of the measured fuel consumption should be derived using the gross calorific value of the fuel under normal conditions (see further details in section 3.3.6). The energy content of the fuel consumed over the assessment period may then be converted to CO_2 emissions by using the conversion factors specified in the guidance (and available from the Central Information Point).

4.2.5 Occupiers guidance

Guidance for building occupiers on gathering the information required to prepare a DEC is at Annex A of the "A guide to display energy certificates and advisory reports for public buildings" available at www.communities.gov.uk/epbd

The guidance is intended for non-technical readers and provides information necessary to enable energy assessors to complete the assessment of the building, produce a display energy certificate and an advisory report.

Energy assessors may distribute the guidance to building occupiers ahead of a building visit to raise awareness and allow occupiers to start gathering relevant data and information.

Section 5

Producing a DEC

5.1 Energy assessors

Display energy certificates and advisory reports may only be produced by accredited energy assessors. Building occupiers must ensure they employ an energy assessor accredited to produce DECs and advisory reports as energy assessors may be accredited to produce other documents eg energy performance certificates, recommendation reports, etc. Ultimately energy assessors should not undertake work for which they are not accredited.

The energy assessor is accredited by one of the Government-approved accreditation schemes. An up-to-date list of approved accreditation schemes is available from www.communities.gov.uk/epbd

Building occupiers may either contact one of the approved accreditation schemes or go to www.ndepcregister.com to find a suitably accredited energy assessor to produce the required display energy certificate and advisory report.

5.2 Government software

The Government has produced a free-issue software package for suitably accredited energy assessors to generate display energy certificates, advisory reports, and associated data files (in XML format). This software is available either through the approved accreditation schemes, or at www.ukreg-accreditation.org

The software requires a Central Information Point (CIP) file to generate an accurate DEC and advisory report. The CIP file contains reference data for use in the operational rating calculations including monthly degree days data. Therefore the CIP file needs to be updated monthly to include the latest degree days data available. The latest update of the CIP file is available to accredited energy assessors at www.ndepcregister.com The CIP file should be downloaded and saved on the accredited energy assessor's local workstation every month.

The software checks that suitable degree days data is available from the CIP file up to the end date of the specified assessment period of the operational rating. The software does not allow completion of the operational rating calculations, DEC and advisory report generation where degree days data is not available up to the specified end date of the assessment period. In such instances, the energy assessor will either need to download the latest CIP file, or alter the end date of the assessment period.

Accreditation schemes will provide a software "key" to their accredited energy assessors. This "key" will allow accredited energy assessors to produce complete display energy certificates and advisory reports. The software may be used without the "key". In such instances the software produces DEC and advisory reports marked "draft" that are not suitable for public display or lodgement on the central register.

A software user note is included as part of the software files available for download at www.ukreg-accreditation.org The note provides guidance for software users on getting started and appropriate use of the software to produce display energy certificates and advisory reports. Software users, in particular accredited energy assessors, must ensure they are familiar with the contents of this note prior to using the software.

5.3 Proprietary software

The Government has produced software specifications detailing the processes required to produce display energy certificates and an advisory reports. These specifications are intended to allow interested software houses to produce proprietary software packages. The specifications are available from www.ukreg-accreditation.org

Software houses interested in the development of proprietary software to generate display energy certificates and/or advisory reports will need access to the CIP file to ensure their software can interact with the CIP. Software houses should contact www.ndepcregister.com to get a copy of the CIP file suitable for software development.

Software houses will also need to ensure that their software can interact with the accreditation schemes' "key" to generate complete display energy certificates and advisory reports, and should liaise with accreditation schemes directly.

Details of the Government's procedures to approve proprietary software are available from www.ukreg-accreditation.org

5.4 Lodging a DEC

Once a complete DEC and/or advisory report and their respective accompanying data files have been produced by a suitably accredited energy assessor, the energy assessor is required to submit the documents to his/her accreditation scheme. This submission process is left to the accreditation schemes' discretion, therefore may vary.

The accreditation scheme then submits the DEC and/or advisory report to the Government's central register for lodgement. In parallel, the accreditation scheme is required to undertake quality assurance checks on the documents provided by the energy assessor.

Once lodged on the central register the documents are available for retrieval by members of the public that have obtained the documents' unique reference number. The availability of the documents on the central register also provides a check for building occupiers to ensure the energy assessor has completed his/her duties.

It is left to the energy assessor's and/or accreditation schemes' discretion to elect at what point the documents generated may be provided to the building occupier.

Section 6

Procedure for producing an Advisory Report

Occupiers must possess or control a valid advisory report at all times to accompany the display energy certificate (DEC). Only when both the advisory report and the DEC are lodged will these documents become legal. However, unlike with the DEC, it is not a requirement that the advisory report itself be on public display. The reports will be of a standard format and produced using approved and accredited software.

The standard recommendations for improvement are held in the approved software and are also available through the software specifications.

There is an expectation that the energy assessor must conduct a building walk-around energy survey to inform the production of the advisory report, or possess comprehensive prior knowledge of the building so that he/she can answer basic questions about key elements of the building that affect energy performance. Where an existing recommendation report or advisory report is available, the energy assessor should establish with the building occupier the actions planned or completed in response to the existing report.

Approved software must be used to generate advisory reports. The software is a means of filtering the database of generic recommendations into a shortlist that is applicable to the building in question. Recommendations that are not applicable to the building and have not been filtered out by the software must be deleted from the shortlist by the energy assessor. To give the building occupier an indication as to which of the suggested measures are priorities and are more or less likely to affect building carbon emissions, the energy assessor should provide a broad estimate of the potential carbon impact of each measure. Carbon impact is categorised into standard bands depending on whether the measures are likely to have "high", "medium" or "low" impact on the overall building emissions. Where the energy assessor does not possess sufficient knowledge to make this judgement it may identified as "not defined".

In addition to the filtered shortlist, but not a substitute for it, the energy assessor may enter into a free text box recommendations deemed applicable to the building. These recommendations may be obtained either from a valid source such as the building's recommendations report, an energy survey report, an air-conditioning inspection report, a boiler energy efficiency inspection report, or the energy assessor's knowledge of the building. It is left to the energy assessor's discretion to decide whether the reports are valid or not.

As part of the accreditation scheme's quality assurance system, the energy assessor may be required to provide commentaries justifying the deletion of short-listed recommendations, the selection of recommendations' carbon impact levels, or the selection of any additional measures included in the final advisory report.

It must be noted that the advice provided in the Advisory Report is intended to be for information only. Recipients of the Advisory Reports are advised to seek further detailed professional advice before reaching any decision on how to improve the energy performance of the building.

6.1 Information needed to produce an Advisory Report

It is expected that an energy walk-around survey is undertaken to gather information relating to the building and its energy systems. An energy walk-around survey may not be required in instances where energy assessors have comprehensive prior knowledge of the building for example where the energy assessor is the building energy manager. The energy assessor may gather the necessary information through a competent third party with satisfactory knowledge of the building (eg the building manager). Under the latter option, energy assessors should be mindful of the need to keep a complete track record of the information provided by a third party to ensure they can discharge their responsibilities as necessary.

Regardless of the route preferred to gather the building information necessary to generate the advisory report, energy assessors are ultimately responsible for the production of the advisory report and its contents.

This section describes what information the energy assessor should possess in order to successfully produce a meaningful advisory report. Energy assessors should familiarise themselves with the advisory report generation software prior to the start of the information gathering process.

OPERATION AND MANAGEMENT

Energy assessors must seek evidence of current energy management practices. Areas of interest include the operation of the building services, the management of spaces and staff interaction, responsibility and guidance. Evidence might be obtained by speaking to site representatives with appropriate knowledge. It is necessary to establish what meters are in place and whether the metering arrangements are sufficient.

BUILDING FABRIC

The building fabric relates to the condition and thermal performance of building elements such as roofs, walls, windows, doors and floors. The energy assessor must have a basic knowledge or gather/assess evidence provided with regard to the type of construction and its condition to answer questions under this section.

CONTROL OF HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

The control of HVAC relates to the control and operation of building services used to heat, cool and ventilate the building. This includes the physical control systems in place and the way in which these controls are managed. The energy assessor should seek evidence of the current settings and management practices in place, for instance seeking evidence that control systems are regularly checked and adjusted as necessary to suit building occupancy.

HEATING SYSTEMS

Basic information about the heating systems must be obtained to proceed with this section. Evidence should be sought in respect of planned inspections and servicing regimes in place. Where available, boilers inspection reports should be reviewed. Visual inspections of the heating plant for condition, leaking, insulation, corrosion, etc. will help the energy assessor gather the information required to complete this section.

VENTILATION

The energy assessor must first establish what the building ventilation strategy is, for example: natural ventilation, mixed mode or full mechanical ventilation. The energy assessor must then gather information about the specific circumstances of the ventilation system installed, for example: whether air paths are clear of any obstruction, whether the building is adequately cooled, whether a servicing and maintenance regime is in place, etc.

AIR-CONDITIONING SYSTEMS

Information relating to the age of the air-conditioning system, its condition and the maintenance regime implemented should be established. It would be advantageous to the energy assessor to locate and utilise a valid air-conditioning inspection report if such report is available.

LIGHTING

Lighting covers both artificial and natural internal lighting and external lighting systems. The energy assessor should establish what maintenance regimes are in place and if the lighting strategy matches the current needs of the building occupiers.

DOMESTIC HOT WATER (DHW)

Basic information about the DHW system should be obtained to proceed with this section. Evidence should be sought with regard to water saving devices fitted, the condition of the DHW plant, etc.

OCCUPIER'S ENERGY CONSUMING EQUIPMENT

Information should be obtained to assess how effectively the occupier's energy consuming equipment is utilised, for example are users encouraged to switch their own equipment off, are power save settings used to reduce energy consumption, are sufficient automated controls in place, etc. The type of equipment will vary from site to site but will typically include computers, printers, faxes, portable heaters/air-conditioners, vending machines, fume cupboards, specialist process equipment, etc.

LIFTS AND ESCALATORS

Energy assessors should establish what metering is in place for lifts and escalators and if alternative methods of travelling between floors are available to the building users. Evidence should also be sought as to whether the lift and escalator systems match the current occupier's needs.

ALTERNATIVE ENERGY SOURCES

This section requires the energy assessor to make a judgment on what Low and Zero Carbon (LZC) measures may be suitable for the building. The decision to include particular measures in the advisory report should be based on knowledge of the building form, fabric, energy demands, location, etc.

POOLS

It will be necessary to establish what energy metering or sub-metering is in place for the pool complex. Issues of interest will include whether pool covers are installed, if they are utilised effectively, whether the pool hall is effectively insulated from the outdoors for example using air-locked doors, etc.

CATERING

For stand-alone restaurants and for buildings that have a commercial catering facility (not including staff kitchens), it will be necessary to review current energy management practices, energy metering and the condition, suitability and utilisation of equipment.

STEAM

The energy assessor will need to seek evidence in respect of planned inspections and servicing regimes in place for the steam plant. Every effort should be made to locate and utilise existing valid steam plant inspection reports and to visually inspect the condition of the equipment eg for leaks, insulation and corrosion.

REQUIRED INFORMATION

The more information that the energy assessor gathers about the building the more meaningful the advisory report will be. However, there are some mandatory questions that the energy assessor must answer positively in order to produce an advisory report. These questions are:

- Is there a previous Advisory Report?
- Is the building listed or of special architectural or historic interest?
- Has any proportion of the site energy consumption been discounted for separable energy uses ie regional data/server centres, pools, commercial catering etc (as allowed by the approved methodology)
- Have the HVAC control settings been checked by suitably qualified persons to match current occupancy patterns?

- Are the HVAC controls (including Building Energy Management Systems) operated by suitably qualified staff?
- Has a boiler plant energy performance inspection been carried out in the past 12 months?
- Is there a system in place that ensures regular (annual) expert checks are made on the heating systems for operating efficiency?
- Is there a servicing and maintenance plan in place that addresses air-conditioning energy efficiency?
- Is there a strategic plan for regularly checking that the steam boiler plant is operating efficiently?

6.2 Using the software

This section describes the approach and steps to utilise the approved advisory report generation software. The software is based on a questionnaire that is designed to receive inputs from the energy assessor about the building. Based on the information provided the software filters out recommendations from the database that are not applicable, and generates a shortlist of recommendations likely applicable to the building. The key steps of the filtering process are:

Building background information

REPORT/SURVEY TYPE

The energy assessor is asked to confirm whether an energy walk-around energy survey has been carried out.

PREVIOUS ADVISORY REPORTS

It is necessary get confirmation from the building occupier whether a valid advisory report is available. If a previous advisory report has been produced the energy assessor should check the occupier's actions, planned or completed, in response to the recommendations listed in the existing advisory report.

LISTED BUILDINGS

The energy assessor must establish whether the building is listed, or is of special interest eg architectural, historical, etc. If so, then the advisory report will include a recommendation with a link to the English Heritage website for measures specific to these type of buildings.

SEPARABLE ENERGY USE

Under certain circumstances some specific energy uses can be separated out from the operational rating calculations. If any proportion of the site energy consumption has been discounted in the calculation of the operational rating to allow for separable energy uses such as regional data centres, pools, commercial catering etc. the energy assessor should indicate here.

BUILDING FEATURES AND ENERGY SYSTEMS SELECTION

This is the first stage of the recommendations filtering process. The energy assessor should select the specific features and energy uses, for example heating, cooling, catering etc. that apply to the building. Building features and energy systems not selected at this stage will automatically be removed from the filtering process and recommendations associated with these systems will not be short-listed.

SPECIFIC QUESTIONS

For each building feature or energy system selected the energy assessor will be presented with a number of questions.

These questions either identify specific measures to be selected by the energy assessor, or require a response (usually "yes", "no", and in some instances "don't know") to eliminate recommendations that are not applicable. All questions have multiple choice answers and the energy assessor should answer the questions based on the information gathered about the building. The more questions are answered, the more useful the advisory report will be.

COMPLETING THE ASSESSMENT

When all building features and energy systems questions are complete and the energy assessor attempts to advance to the next stage, any missing information or unanswered questions are flagged up in a brief interim summary page. The energy assessor must review this summary and complete any outstanding action before proceeding to the next stage.

On successful completion of the building questionnaire stage, a shortlist of recommendations is presented to the energy assessor. Recommendations within the shortlist are ordered based on broad estimates of cost effectiveness ie quickest payback first (at the top). The shortlist is divided into three separate sections based on bands of simple payback estimates of each recommendation.

PAYBACK BANDS

Up to 30 recommendations may be selected from the database of standard measures and appear on the advisory report. In most instances many of the top 30 recommendations would be low and no cost energy efficiency measures. To cater for the potential interests of occupiers that would like to consider investing in their building to reduce carbon emissions it is important to ensure the advisory report is not dominated by these low and no cost recommendations. The advisory report therefore displays the recommendations in three bands of simple payback.

The recommendations appear in three tables:

- Short-term payback (0 to 3 years), for example building energy management measures
- Medium-term payback (3 to 7 years), for example upgrading building services
- Long-term payback (more than 7 years), for example LZC technologies.

The simple payback, which dictates the order the recommendations appear in the shortlist, is derived by dividing the "estimated capital cost to implement the measure" by the "estimated annual cost saving for the measure". Where available this information has been taken from Good Practice Guides and Carbon Trust energy survey reports. In the few instances where no payback data was available, experts have taken a conservative view as to which band the recommendation should appear in ie short-, medium, or long-term payback. The database of standard recommendations is detailed within the software specifications available at www.ukreg-accreditation.org

REMOVING UNSUITABLE RECOMMENDATIONS

The recommendations shortlist can be amended by removing unsuitable recommendations (eg impractical measures or measures already implemented). Based on knowledge and experience, energy assessors may remove recommendations they see fit. When a recommendation is removed the next recommendation automatically moves up in order.

When the energy assessor is content that the short-listed measures are suited to the building and advances to the next stage, the software will take the top 30 recommendations from the shortlist: 15 short-term payback measures, 10 medium-term payback measures, and five long-term payback measures.

CARBON IMPACT

The energy assessor should estimate the carbon impact of the selected recommendations. This is done by qualifying the estimated carbon impact of each recommendation as "high", "medium" or "low". In instances where the energy assessor is unable to estimate the potential carbon impact of a measure, it is possible to enter "not defined".

Example Carbon Impact tables

Short-term payback (0 to 3 years) – top 15 recommendations	**Carbon Impact**
1. Fit Variable Speed Drives to pumps and fans	LOW
2. xxxxxxxxxxxxxxx	LOW
3. xxxxxxxxxxxxxxx	MEDIUM
Etc	
15. Replace lighting for high efficiency alternatives	HIGH

Medium-term payback (3 to 7 years) – top 10 recommendations	**Carbon Impact**
16. xxxxxxxxxxxxxxx	MEDIUM
17. xxxxxxxxxxxxxxx	LOW
18. xxxxxxxxxxxxxxx	MEDIUM
Etc	
25. xxxxxxxxxxxxxx	HIGH

Long-term payback (more than 7 years) – top 5 recommendations	**Carbon Impact**
26. xxxxxxxxxxxxxxx	HIGH
27. xxxxxxxxxxxxxxx	HIGH
Etc	
30. xxxxxxxxxxxxxx	MEDIUM

GENERAL GUIDANCE ON CARBON IMPACT

When estimating the potential carbon impact of a recommendation consideration should be given to the implementation of the recommendation in the current building context ie what is the impact of the measure for the specific building. It is up to the energy assessor to form an opinion of how a recommendation will impact the carbon emissions from the building.

For example, in a recently constructed or refitted office building, built to recent standards, a recommendation to "Engage experts to review the building lighting strategies and propose alterations and/or upgrades to day-lighting provisions, luminaries and their control systems and develop an implementation plan" may be of "low" carbon impact as the scope of the recommendation is limited. However, in an office building that is 20+ years old with lighting installations of the same age, the carbon impact is likely to be "high".

It is also important to consider the proportion of the site and the type of energy consuming services the recommendation applies to, for example:

- Measures applicable to a large proportion of the site, or to energy intensive services that are constantly used would more likely have a "high" potential carbon impact
- Measures applicable to some but not all of the site would more likely have a "medium" potential carbon impact
- Measures applicable to only a small proportion of the site, or to energy consuming plant little used would more likely have a "low" potential carbon impact.

ADDITIONAL RECOMMENDATIONS

A separate section of the software and the advisory report is provided to allow energy assessors to add to the advisory report bespoke recommendations that are deemed suitable to the building, but were not included in the shortlist provided by the software.

These recommendations are entered as free text and may originate either from the energy assessor's previous knowledge and experience of the building, from information gathered through a competent third party (for example the building energy manager), or from an existing valid report. A valid report may include a recommendation report accompanying the building's energy performance certificate, an air-conditioning inspection report (as

defined in Part 4 of SI 2007:991), an energy survey report (for example reports sponsored by a professional body such as Carbon Trust or CIBSE), any reports produced for a specific item of plant in the building, etc. It is left to the energy assessor's discretion to form an opinion as to the validity of the information used. Full reference of the source(s) of information used must be included in the advisory report.

6.3 Changes affecting advisory reports

6.3.1 Change of occupied space

Over the seven-year validity of an existing advisory report, the occupier may increase or decrease the space it occupies, for instance to accommodate changes in activity levels, staff numbers, etc.

Where the occupied space changes within the boundaries of the building referenced in the existing advisory report, no new advisory report is required. The building and the services are the same as those considered when the existing advisory report was produced, therefore the recommendations included in the existing advisory report remain applicable to the new space.

6.3.2 Change of building services

Over the validity period of an existing advisory report, the occupied space may be refurbished. The scope of the refurbishment works may vary from minor works (eg fitting new floor covers, wall paints, etc.) to more significant works which may follow the recommendations of the advisory report (eg new lighting, heating, ventilation, air-conditioning, controls, windows, etc).

It is left to the occupier's discretion whether the scope of the refurbishment works affect the accuracy of the recommendations included in an existing advisory report. However, where significant works have been undertaken, it would be considered good practice to update the advisory report at the earliest opportunity (eg at the same time as the next DEC is produced) to ensure the advisory report is aligned with the changes to the circumstances of the building.

Appendix 1

DEC Technical table

DEC Full Technical Table

Annual energy use, CO2 emissions, and performance indicators	Fuel and heat	Electricity	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
Separable energy use deducted # 1 (if any)	5,000	150,000	kWh	83.5	tonnes CO2
Separable energy use deducted # 2 (if any)	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)	Not applicable	Not applicable	Not applicable	C	A to G

Displaced energy	Fuel and heat	Electricity	Units for energy data	%age kWh displaced	Units
Fossil Fuel Energy Displaced	5,000		kWh	5%	% of total
Grid Electrical Energy Displaced		16,000	kWh	7%	% of total

Building types	**Area (m2)**
Office	1050
Benchmark category # 2	
Benchmark category # 3	
Benchmark category # 4	
Benchmark category # 5	
Total Useful Floor Area TUFA	**1050**
Total accessible unconditioned area	100
Separable	
Data centre	50
Separable type # 2	
Separable type # 3	
Total Area for DEC Assessment TADA	**1000**

Notes

(a) "Fuel and heat" includes imported combustion fuels (e.g. fossil) and heating and cooling from community systems, nett of exports.

(b) "Electricity" includes electricity used for all purposes, including heating, cooling, small power, etc., nett of exports

(c) Where applicable, the "total energy use in the year concerned" includes "fuel and heat" and "electricity" generated from LZC energy sources.

(d) TADA is the area used in the OR calculations and the technical table calculations; it includes accessible unconditioned spaces, but excludes separable energy use areas

(e) TUFA determines whether the building exceeds the 1,000 m2 threshold for a DEC being needed, and is the area shown on the DEC

(f) Only separable energy uses applicable to the building benchmark type may be deducted providing suitable evidence is available

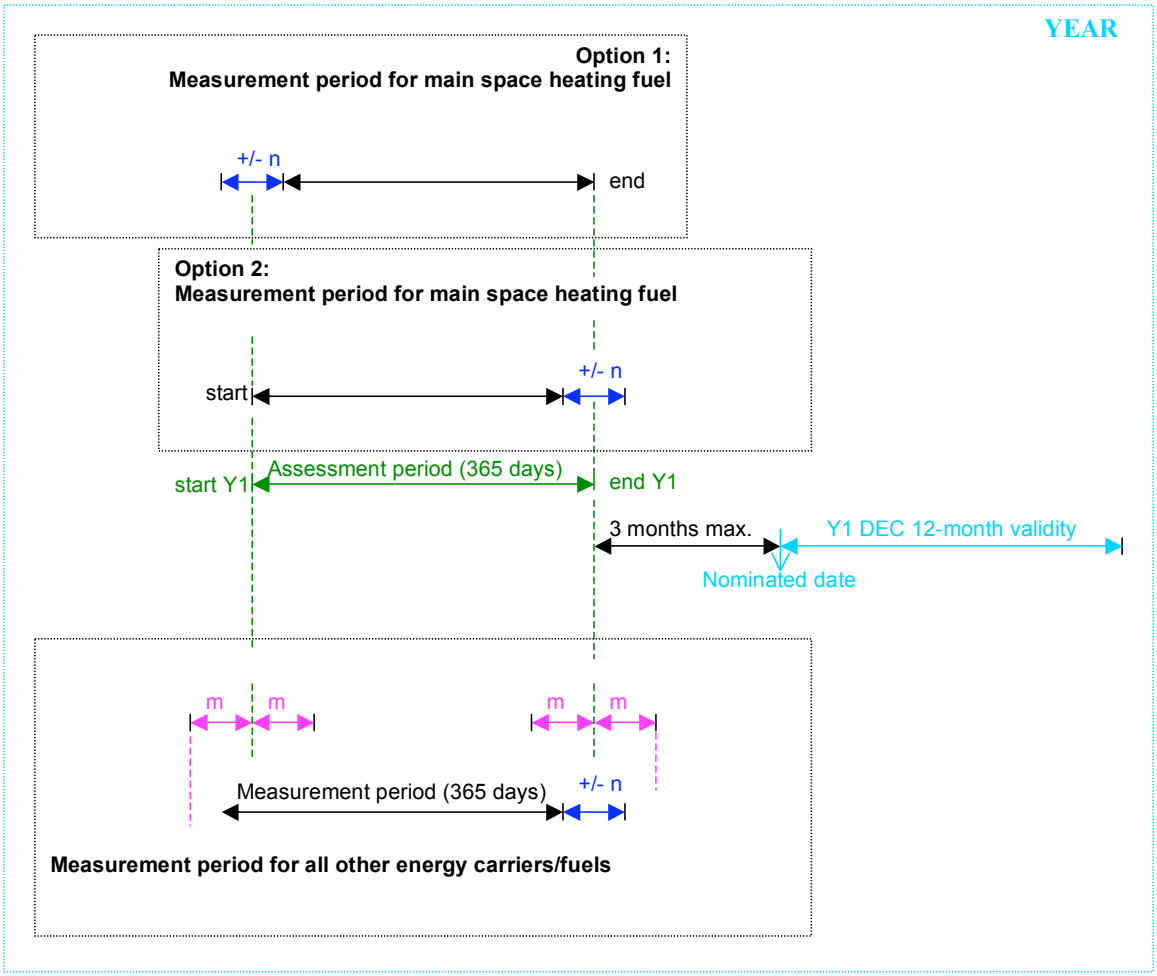
(g) Up to five benchmark categories may be shown in the technical table; some sites may have more and alternative software should be used. Building types classed under the same benchmark category are not shown.

(h) Benchmarks are corrected for weather and hours of occupancy during the assessment period

(i) "Displaced energy" is energy generated by on-site renewable (OSR) and low & zero carbon (LZC) sources, consumed by the building, nett of exports.

Appendix 2

Rules for Energy measurement periods



To give building owners some flexibility in their meter reading dates, the measurement periods for the different fuels and energy carriers (electricity, gas, oil, etc.) used by a building do not have to coincide exactly. The period for which the energy assessment applies is defined as a 365 day Assessment Period. The following rules apply.

1. Two alternative options are available to define the Assessment Period. The energy assessor may choose either option with the intent of minimising any data quality issues associated with alignment of measurement and assessment periods (see following text).
2. Option 1: The end date of the 365 day Assessment Period coincides with the end date of the measurement period for the main fuel used for space heating.

3. Option 2: The start date of the 365 day Assessment Period coincides with the start date of the measurement period for the main fuel used for space heating.

Note: coupling the assessment period to the measurement period of the main heating fuel should minimise extrapolation errors created by the dependence of heating fuel use on weather.

Measurement period duration tolerance (rules are applicable to all fuels)

4. For all fuels, energy carriers, and separable energy uses, the measurement period is the period of time elapsed between two meter readings, manual, automatic, or estimates from utilities suppliers.
5. The measurement period for the main fuel used for space heating, and for all other fuels and energy carriers, must be:
    a. 365 +/- n days where n = 31 days.
    b. Where the measurement period is outside the tolerance defined in (5.a), an estimate from utilities suppliers must be obtained and must be within the same tolerance defined in (5.a).
    c. Where no estimate is available from utilities suppliers, or the estimate is outside the tolerance defined in (5.a), a default Operational Rating of 200 (ie a G grade) is awarded. This allows the occupier to discharge its duties under the regulations, but also provides an incentive to improve metering to produce a more accurate and likely better OR.
    d. Where 7 < n < 31 days, the software generates a standard warning *"The software is extrapolating/interpolating the data provided by n days to derive energy consumption for a 365-day period"*. The warning is for the software user (generally the accredited energy assessor) and is not displayed on the DEC.
6. For buildings which use electricity for most or all of their space heating, the measurement period must be:
    a. 365 +/- n days where n = 15 days.
    b. Where the measurement period is outside the tolerance defined in (6.a), an estimate from utilities suppliers must be obtained and must be within the same tolerance defined in (6.a).
    c. Where no estimate is available from utilities suppliers, or the estimate is outside the tolerance defined in (6.a), a default Operational Rating of 200 (ie a G grade) is awarded. This allows the occupier to discharge its duties under the regulations, but also provides an incentive to improve metering to produce a more accurate and likely better OR.

d. Where 7 < n < 15 days, the software generates a standard warning *"The software is extrapolating/interpolating the data provided by n days to derive energy consumption for a 365-day period"*. The warning is for the software user (generally the accredited energy assessor) and is not displayed on the DEC.

Synchronicity of measurement periods (rules are applicable to fuels other than the main fuel used for space heating)

7. The start date of the energy measurement period for all fuels and energy carriers, other than the main fuel used for space heating, should be within +/- m days of the start day of the Assessment Period.
8. The end date of the energy measurement period for all fuels and energy carriers, other than the main fuel used for space heating, should be within +/- m days of the end day of the Assessment Period.
9. For both (7) and (8) above m = 31 days.
    a. Where the start or end dates of the measurement periods are outside the synchronicity range defined in (9) above, an estimate from utilities suppliers must be obtained and must be within the same synchronicity defined in (9).
    b. Where no estimate is available from utilities suppliers, or the estimate is outside the tolerance defined in (9), a default Operational Rating of 200 (ie a G grade) is awarded. This allows the occupier to discharge its duties under the regulations, but also provides an incentive to improve metering to produce a more accurate and likely better OR.
    c. Where 7 < m < 31 days, the software generates a standard warning *"The measurement period for [insert fuel type] is m days out of line with the 365-day assessment period"*. The warning is for the software user (generally the accredited energy assessor) and is not displayed on the DEC.

Extrapolation/interpolation rules

10. Extrapolation or interpolation of data for the main fuel used for space heating to the 365-day Assessment Period will be pro-rata the relative degree days for the Measurement Period and the Assessment Period. A 'default' value for degree day dependency of xx per cent [to be extracted from CIBSE benchmarks table] (as indicated for the specific building type) will be assumed and applied to the proportion of the fuel consumption that the benchmark suggests should be used for heating.

    The extrapolation or interpolation should be calculated on a daily basis using:

    (monthly degree days)/(number of days in the month)

11. Extrapolation or interpolation of data for all other fuels and energy carriers to the 365-day Assessment Period will be linear (ie pro-rata to the relative number of days in the respective measurement period and the Assessment Period).
12. For buildings which use electricity for most or all of their space heating, the adjustment to the 365-day assessment period will be pro-rata the relative degree days for the measurement period and the Assessment Period. A 'default' value for degree day dependency of xx per cent [to be extracted from CIBSE benchmarks table] (as indicated for the specific building type) will be assumed and applied to the proportion of the electricity consumption that the benchmark suggests should be used for heating.

    The extrapolation or interpolation should be calculated on a daily basis using:

    (monthly degree days) / (number of days in the month)

Separable energy uses

13. Some separable energy uses may be discounted from Operational Rating calculations. Allowed separable energy uses are defined for each benchmark category and building type in the CIBSE benchmarks tables. No other separable energy uses can be discounted.
14. Measurement period tolerance: the separable measurement period must be 365 days +/- n_s where n_s = 7 days. Where the measurement period is outside the allowed range, the separable energy use cannot be discounted.
15. Measurement period synchronicity: the separable measurement period must be within +/- ms of the assessment period start date and end date, where m_s = 31 days. Where the measurement period is outside the allowed range, the separable energy use cannot be discounted.

Consecutive measurement periods

16. There must be no gaps between consecutive (year-on-year) measurement periods, but overlaps of no more than 3 months are allowed to enable building occupiers to change the start date of their measurement periods.

Low and zero carbon technologies

17. The following rules apply for LZC:
    (a) Measurement period tolerance: rules 5 and 6 applies.
    (b) Synchronicity: rules 7 to 9 apply.
    (c) Overlaps: rule 16 applies.

Energy exports

18. Only metered energy exports may be taken into consideration. Energy exports that are not metered may be referenced in the advisory report free text field (eg through a recommendation such as "Add meters to measure energy exports from on-site generation"), but cannot be accounted for in the operational rating calculations.
19. It is assumed that, in most instances, either readings of energy exports meters will take place at the same time as readings of energy imports, or the results will be defined automatically by a net meter. Either way, accounting for energy exports (ie deducting energy exports from imports) should be done before assessing the tolerance or synchronicity of the fuels used by the building.
20. Where meter readings of energy exports are not aligned on meter readings of energy imports, the following rules apply:
    i. Measurement period tolerance: rules 5 and 6 applies.
    ii. Synchronicity: rules 7 to 9 apply.
    iii. Overlaps: rule 16 applies.
21. Exports outside the boundaries defined in paragraph 20 cannot be accounted for in the operational rating calculations.
22. Deducting energy exports from energy imports may only be undertaken on a same fuel basis. For example, kWh of electricity exports may be deducted from kWh of electricity imports, and so on for any other fuels imported or exported from the site.

Other issues

23. Where the energy consumption data for any fuel or energy carrier is based on:
    (a) Actual meter readings (manual or automatic), an "actual" is displayed in the Technical information section of the DEC.
    (b) The utilities suppliers' estimates, an "estimated" is displayed in the Technical information section of the DEC. Estimates by other parties (eg the accredited energy assessor) are not allowed.
24. For fuels and energy carriers that collectively account for less than 5 per cent of the total CO_2 emissions of the building, no data quality warning is provided by the software.
25. The benchmark for the main fuel used for space heating will be corrected to the regional degree days applicable to the Assessment Period selected.

    Note for software specification: this implies that any 365 day tolerance and measurement period synchronicity warning(s) need to be given after the entry of all energy data has been completed.

26. The OR input data file (to be submitted to accreditation schemes and lodged on the central register) will record the following entries, which may be used for auditing purposes.
    a. For each fuel, the raw (unadjusted) energy consumption data measured over each fuel's Measurement Period.
    b. For each fuel, the adjusted figure for the 365 day Assessment Period.
    c. The degree days adjusted benchmark for the main heating fuel used for space heating (see 25 above).
27. The above definitions apply for leap years, ie assessment and measurement periods should be extrapolated or interpolated to 365 days (not 366 days).

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