Dwelling Energy Assessment Procedure (DEAP)

VERSION 3.2.1

Irish official method for calculating and rating the energy performance of dwellings

This document describes DEAP 2012, Version 3.2.1, dated June 2012. This version is applicable to new and existing dwellings.

Building designers, energy rating Assessors and other users should ensure that they are using the latest version of this document and accompanying software. Updates will be published on the SEAI website www.seai.ie/ber .

Contents

Summary

The Dwelling Energy Assessment Procedure (DEAP) is the Irish official procedure for calculating and assessing the energy required for space heating, ventilation, water heating and lighting, less savings from energy generation technologies. DEAP calculates the annual delivered energy consumption, primary energy consumption and carbon dioxide emission for standardised occupancy.

The DEAP software contains equations or algorithms representing the relationships between the factors contributing to the annual energy performance of the dwelling. The software is accompanied by a series of reference data tables. The DEAP calculation is also available as a Microsoft Excel workbook on www.seai.ie/ber.

DEAP is compliant with the methodology framework in the EU Energy Performance of Buildings Directive (EPBD). The DEAP calculation framework is based on IS EN 13790, and draws heavily on the calculation procedures and tabulated data of the Standard Assessment Procedure (SAP) for energy rating of dwellings in the UK.

DEAP is used to demonstrate compliance with the EPBD in Ireland including elements of the Irish Building Regulations Part L 2005, 2008 and 2011 for new dwellings. For Building Regulations 2005 TGD L, the DEAP software calculates the Carbon Dioxide Emission Rate (CDER) of the dwelling, and the corresponding Maximum Permitted Carbon Dioxide Emission Rate (MPCDER), expressed in units of kg CO_2 per square metre per annum. This provision applies to new dwellings built between 1st July 2006 and 1st July 2008 subject to transitional arrangements cited in Building Regulations 2005 TGD L.

DEAP compares the dwelling's Energy Performance Coefficient (EPC) and Carbon Performance Coefficient (CPC) to the Maximum Permitted Energy Performance Coefficient (MPEPC) and Maximum Permitted Carbon Performance Coefficient (MPCPC) for Building Regulations 2008 and 2011 TGD L. DEAP also determines if the Building Regulations 2008 and 2011 TGD L renewables requirement is satisfied. Building Regulations 2008 TGD L applies to new dwellings from 1st July 2008 and Building Regulations 2011 TGD L applies to new dwellings from 1st December 2011.

DEAP confirms that the fabric heat loss is limited as defined in the 2005, 2008 and 2011 Building Regulations TGD L. DEAP checks that the building air permeability is limited as defined in the Building Regulations 2008 and 2011 TGD L documents. DEAP flags the lack of an air permeability test as a non-compliance where a test result is not specified. The permeability test result specified in DEAP should follow the guidance and sampling regimes outlined in the applicable TGD L documents.

The Building Regulations TGD L documents provide guidance on the applicability of each TGD L edition to dwellings based on dwelling age, date of planning permission and construction. An existing dwelling is a dwelling which was previously sold and/or occupied. DEAP does not perform conformance checking for Building Regulations for existing dwellings. Dwellings which have not previously been sold or occupied are specified as new dwellings in DEAP.

The DEAP methodology and software are used to generate "Building Energy Rating" (BER) labels and BER Advisory Reports as required under the EPBD. This provision applies to new dwellings from 1st January 2007 and to existing dwellings for sale or rent from 1st January 2009. The format and content of such BER labels and Advisory Reports are detailed on www.seai.ie/ber .

Introduction

The Dwelling Energy Assessment Procedure (DEAP) is the Irish official method for calculating the energy performance of dwellings. The factors that contribute to annual energy usage and associated CO_2 emissions for the provision of space heating, water heating, ventilation and lighting in DEAP include:

- Size, geometry and exposure
- Construction materials
- Thermal insulation properties of the building fabric elements
- Dwelling ventilation characteristics and ventilation equipment
- Heating system(s) efficiency, responsiveness and control characteristics
- Solar gains through glazed openings
- Thermal storage (mass) capacity of the dwelling
- Fuels used to provide space and water heating, ventilation and lighting
- Renewable and alternative energy generation technologies

The BER Assessor should consider all aspects of the dwelling fabric and systems to reduce energy consumption and improve the BER result. The calculation uses standard assumptions regarding occupancy, levels and durations of heating, usage of domestic electrical appliances, etc. It is thus independent of the individual characteristics of the household occupying the dwelling when the rating is calculated, for example:
- Household size and composition
- Individual heating patterns and temperatures
- Ownership and efficiency of particular domestic electrical appliances

The procedure calculates and aggregates the monthly space heating energy balance for the October to May inclusive heating season. DEAP then calculates the hot water energy demand based on dwelling size and accounts for heating system control, responsiveness and efficiency characteristics, fuel type and calculated lighting energy (electricity) requirement to determine the overall results.

A given dwelling specification will yield the same result in all parts of Ireland in respect of Building Regulations compliance and BER i.e. independent of dwelling location. DEAP is based on the European Standard IS EN 13790: 2004 and draws heavily on the UK's Standard Assessment Procedure (SAP) 2005-2009.

Guidance in the DEAP manual must be followed by BER Assessors when completing assessments. All BER Assessors must be fully familiar with the DEAP manual and the DEAP survey guide as published under www.seai.ie/DEAP Frequently asked questions are covered under the BER FAQ: www.seai.ie/berfaq along with regular updates and examples provided in Domestic BER Technical Bulletins under http://www.seai.ie/Your_Building/BER/Technical_Bulletins . The Building Regulations Part L (current or previous) can be found under http://www.environ.ie/en/TGD/ .

Scope of the Dwelling Energy Assessment Procedure (DEAP)

The procedure is applicable to self-contained dwellings. For dwellings in the form of flats, apartments, maisonettes etc. DEAP applies to the individual dwelling unit and does not include common areas such as access corridors.

Where a dwelling contains or has attached a room or space that is intended or used for commercial purposes (e.g. as an office, shop, consulting room, surgery, workshop), such a room or space should be treated as part of the dwelling if the commercial part could revert to domestic use on a change of ownership or occupancy. This applies where there is direct access between the commercial space and the living accommodation, both are contained within the same thermal envelope and the living accommodation occupies a substantial proportion of the whole dwelling unit.

If a self-contained dwelling is part of a building and the remainder of the building is not expected to revert to domestic use, the dwelling is assessed by DEAP and the remainder by the Non-domestic Energy Assessment Procedure (NEAP).

General Principles

Input precision and rounding

Data should be entered as accurately as possible, although it is unnecessary to go beyond 3 significant figures (and some product data may only be available to lesser precision). In some cases there are a limited number of data entry options available. Unless otherwise stated in SEAI guidance, the most prevalent option should be chosen. As an example, where a dwelling has 100m^2 solid ground floor and 75m^2 suspended ground floor, "No" is selected under the entry "is there a suspended wooden ground floor?"

Input data on dwelling or component characteristics

BER Assessors are required to adhere to the BER Assessor's Code of Practice as published on www.seai.ie/ber when publishing BER assessments on the National Administration System (NAS). Reference data tables are provided for use when specific product or system performance information is not available. Specific performance information, as outlined below, should be used in preference to data from the tables particularly for new dwellings. BER Assessors are encouraged to choose non-default values provided adequate evidence for these values is available as defaults are generally conservative.

While there are a number of readily available sources for performance data entered into DEAP (such as HARP, Irish Agrement Board (IAB), British Board of Agrement (BBA)), Assessors may occasionally need to use other sources to substantiate DEAP data entries.

Accredited or certified data

The following should be borne in mind regarding use of product test data:
- Test certificates must clearly relate to the actual product in question;
- Installation instructions in the test certificate on which the stated performance depends must be adhered to;
- Test certificates must be in English or be accompanied by a certified English translation. The translation can be from the accredited test house or from a professional translator listed by the Irish Translators and Interpreters Association or international equivalent;
- The relevant test performance standard must be stated on the test certificate;
- The test laboratory must be accredited. This may be demonstrated as follows:
  - The governing accreditation body for the test laboratory can be found under http://www.european-accreditation.org/ . This governing body may list the test laboratory as accredited;
  - The accredited laboratory may be found under http://ec.europa.eu/enterprise/newapproach/nando/ ;
- Performance data on "CE marked" literature is acceptable provided that the literature refers to the relevant test performance standard.

In cases where there is any doubt, the test certificate should be sent to the BER helpdesk for clarification. The BER Assessor's Code of Practice details the type of data which must be collected and retained for BER assessments.

U-values – walls, floors, roofs

U-values should be calculated on the basis of the actual construction for new and existing dwellings.

Thermal bridging - linear thermal transmittance (Ψ-values)

There are three options for determining the effect of thermal bridging:
a) A global factor is multiplied by the total exposed surface area, as described in Appendix K.
b) On the basis of the length of each junction and the default Ψ-values referenced in TGD L 2011 Appendix D and Ψ-values from Acceptable Construction Details (Introduction Document) Appendices.
c) On the basis of the length of each junction and user-supplied Ψ-values as described in Appendix K. It is not necessary to supply Ψ-value for each junction type – values referenced in TGD L 2011 Appendix D and from Acceptable Construction Details (Introduction Document) Appendices can be mixed with user-supplied values.

Window data
Window U-values and g-values (total solar energy transmittance) should be obtained from certified data or calculated to standards outlined in Section 3. Both U-values and g-values are needed when supplying non default data. For light transmittance, only the values in Table 6b are to be used. Normally the frame factors (representing the glazed fraction of the window) in Table 6c are used. However, manufacturer's values are permitted provided they are representative of the actual windows.

Internal heat capacity
Internal heat capacity of the dwelling is estimated on the basis of the extent of "thermally massive" construction relative to total floor area. Thermal mass categories should be determined in accordance with Table 11.

Boiler efficiency – gas and oil
Boiler efficiency can be from the Home-Heating Appliance Register of Performance (HARP) database (preferably) or from certified data given in the terms stated in paragraph D3 of Appendix D. The Seasonal Efficiency of Domestic Boilers UK (SEDBUK) Database, 2005 version, may also be used. Default values from Table 4b must be used if data is not available from these sources. The HARP database can be found under www.seai.ie/harp or accessed via the 'Energy Requirements' tab in DEAP.

Boiler efficiency – solid fuel
Boiler efficiency should be taken from the HARP database (preferably) or certified data. Default values from Table 4a may also be used as specified in Appendix D and Appendix J.

Heat pump efficiency
Heat pump efficiency should be taken from the HARP database (preferably), or from a certified data. Default values from Table 4a may also be used. Appendix G provides further detail on specification of heat pumps.

Efficiency of gas/oil/solid fuel fires and room heaters
Efficiency should be taken from the HARP database or accredited data as specified in Appendix E (gas, oil and solid fuel). Default values from Table 4a may also be used.

Standing loss – cylinders, thermal stores and CPSUs (includes both gas and electric CPSUs)
The manufacturer's declared loss, obtained in accordance with an applicable Irish or British Standard, expressed in kWh/day can be used instead of the calculated storage loss factor.

Air leakage - pressure test (also called permeability test) result
Air leakage pressure test results can be used instead of the default air infiltration calculation. An air permeability design value may be used for dwellings not yet built (Provisional Building Energy Rating), subject to verification when the dwelling is built. Further guidance is available on www.seai.ie/ber.

Solar collector performance
The zero-loss collector efficiency and the collector's linear heat loss coefficient can be used if obtained from the HARP database or test results as outlined in Appendix H. Defaults are also available in Appendix H.

Specific fan power
Specific fan power for the following mechanical ventilation systems:
- positive input ventilation from outside (not loft)
- mechanical extract
- balanced
may be used in place of the default values in Table 4g, subject to the guidance in Section 2.6.

Existing dwellings
Default values may be used when assessing existing dwellings subject to the guidance in Appendix S. Non default values should be used when sufficient substantiating evidence is available.

Dwelling surveys
BER Assessors are required to complete a site survey in accordance with the DEAP survey guide for "Existing" and "New-Final" BERs. A BER Assessor is required to visit the dwelling to collect the data for the assessment and may also review plans and specifications for new or existing buildings. Plans and specifications are particularly useful in providing supplementary information not available from the site survey.

Asset rating
The energy performance of buildings is typically expressed as an asset rating, based on calculated energy use under standardised occupancy conditions or an operational rating, based on metered energy. DEAP uses the building fabric and heating system details to calculate the dwelling energy use and is therefore an asset rating. DEAP assumes the dwelling is used by standard, notional or typical occupants and is not affected by the current occupants e.g. the heating system operating hours and temperature set points are fixed.

Dwelling type
The dwelling forms or types identified in DEAP are:
- Ground-floor apartment
- Mid-floor apartment
- Top-floor apartment
- End of Terrace house
- Mid- terrace house
- Semi-detached house
- Detached house
- Maisonette
- Basement apartment

The classification of a house as detached, semi-detached or terraced depends on how it adjoins the neighbouring buildings. A side is considered attached if more than half of its area adjoins a heated space. Otherwise it is not attached for the purposes of identifying dwelling type.

A maisonette is an apartment with its own external main entrance at ground level. It may or may not have more than one storey.

Purpose of rating
DEAP allows the BER Assessor, with guidance from the client, to record the reason why the BER assessment is carried out. The options under this "Purpose of Rating" category are:
- New dwelling for owner occupation
- Sale
- Private letting
- Social housing letting
- Grant Support
- Other (a brief description of Purpose of Rating should be entered in this case).

Calculation Procedures and Conventions

DEAP consists of a series of tabs or modules with equations or algorithms representing the relationships between the factors contributing to the dwelling's energy performance. Reference data tables accompany the DEAP software. The BER Assessor should proceed sequentially through the individual tabs as follows, leading ultimately to the display of results in the 'Results' tab:

Tab	Main user entry actions	Visible calculated outcome
Start	Administrative details of the dwelling and BER assessment including electricity Meter Point Reference Number (MPRN), new/existing dwelling, TGD L version, construction date and dwelling type	As entered
Property and assessor details	Details of property, client and Assessor	As entered
Dimensions	Principal dimensions, room in roof details (for existing dwellings), area of living room and number of storeys	Total floor area, dwelling volume and living area fraction. The total energy usage is divided by the dwelling floor area to determine the Building Energy Rating.
Ventilation	Structural and other ventilation characteristics	Ventilation heat loss (components and total), electricity for fans, heat gain from fans. Air permeability compliance check with Building Regulations 2008 and 2011 TGD L requirements.
Building elements: Floors Walls Roofs Doors	Heat loss building element dimensions and U-values. Default U-values may be used for existing dwellings. When calculating a U-value for a new or existing dwelling roof, wall or floor in DEAP, Assessors should use the "Description" entry for that element in DEAP to briefly describe how the U-value was obtained. The components of the building elements should be listed in the description (insulation type and thickness, plasterboard, blocks etc).	Total Area*U-value for each element type
Building elements: Windows	Window and glazed door dimensions, orientations, U-values and shading characteristics. Defaults may be used for new or existing dwellings.	Glazed area, heat loss, effective area for solar gain, glazing ratio for daylight gain, summer heat gain
Building elements: Heat loss results	Thermal bridging factor	Fabric heat loss, total heat loss coefficient and heat loss parameter for dwelling. Compliance check with Building Regulations fabric insulation requirements (for Building Regulations 2005 - 2011 TGD L as appropriate for the dwelling)
Water heating	Water heating system characteristics, including supplementary electrical water heating and solar water heating	Hot water heating demand, solar hot water pump consumption, primary circuit loss, internal heat gains from hot water
Lighting and internal gains	Proportion of fixed lighting outlets that are low energy	Annual energy use for lighting, internal seasonal heat gains from lighting and heat gains
Net space heat demand	Thermal mass category	Mean internal temperature, annual 'useful' space heat demand from monthly calculations allowing for intermittency, solar

Tab	Main user entry actions	Visible calculated outcome
		and internal heat gain utilisation
Distribution system losses and gains	Heating system control category, responsiveness category, heat emission characteristics, pumps and fans	Annual space heat demand allowing for control, responsiveness, heat emission and equipment heat gain characteristics
Energy requirements: Individual heating system	Individual heating systems: Space and water heating appliance efficiency and fuel characteristics. Combined heat and power plant characteristics.	Annual fuel consumption for space and water heating, CO_2 emissions
Energy requirements: Group heating	Community/ group heating schemes: Space and water heating appliance efficiency and fuel characteristics. Combined heat and power plant characteristics.	Annual fuel consumption for space and water heating, CO_2 emissions.
Summer internal temperature (optional)	Effective air change rate of dwelling	Threshold internal temperature
Results	None	Annual delivered energy, primary energy, CO_2 emissions, comparison with reference dwelling, compliance check with Building Regulations for energy, CO_2 emissions and renewables conformance requirements where appropriate for Building Regulations 2005 - 2011 TGD L.

1   Dwelling dimensions

[Tabs: 'Dimensions', 'Building Elements']

The dwelling boundary or thermal envelope consists of all building elements separating the dwelling from the external environment, adjacent buildings and unheated spaces. Except where otherwise indicated, linear measurements for the calculation of wall, roof and floor areas and dwelling volume should be taken between the finished internal faces of the external building elements. Space occupied by internal elements (internal partition walls or intermediate floors) is considered to be part of the total dwelling volume. Measurements for the calculation of the areas of external door, window and rooflight openings should be taken between internal faces of cills, lintels and reveals. "Volume" means the total volume enclosed by all enclosing elements and includes the volume of non-usable spaces such as ducts, stairwells and floor voids in intermediate floors.

Dimensions refer to the inner surfaces of the elements bounding the dwelling. Thus floor dimensions are obtained by measuring between the inner surfaces of the external or party walls, disregarding the presence of any internal walls.

Storey height is the total height between the ceiling surface of a given storey and the ceiling surface of the storey below. For a single storey dwelling (including single storey apartments), or the lowest floor of a dwelling with more than one storey, the measurement should be from floor surface up to ceiling surface. In cases where the storey height varies in a single floor, the area weighted average storey height should be used.

Floor area should be measured as the actual floor area, i.e. if the height of a room extends to two storeys or more only the actual accessible floor area should be entered. However, as an exception to this rule in the case of stairs, the floor area should be measured as if there were no stairs but a floor in their place at each level.[1]

In general, rooms and other spaces, such as built-in cupboards, should be included in the calculation of the floor area where these are directly accessible from the occupied area of the dwelling. However unheated spaces clearly divided from the dwelling should not be included.

The floor area of mezzanines or balconies in the dwelling should be counted under the dimensions section in DEAP. The storey height of the floor below the mezzanine has height to the ceiling surface below the mezzanine.

Further guidance on floor area and unheated space identification as follows:

Porches:
- *should be included* if heated by fixed heating devices;
- *should be included* if there is direct access to the dwelling but no separating door, whether heated or not;
- *should not be included* if unheated and there is a separating door to the dwelling. In this context 'porch' means an addition protruding entirely from the line of the external wall of the dwelling; an entrance lobby that is within such line *should be included*.

Entrance lobby protrudes from the line of external wall of dwelling:	Entrance lobby heated by a fixed heating device:	Entrance lobby separated from the dwelling by a door:	Include entrance lobby in dwelling floor area?
NO	n/a	n/a	**YES**
YES	YES	n/a	**YES**
YES	n/a	NO	**YES**
YES	NO	YES	**NO**

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[1] Chimney breasts should also be included when measuring floor area as stated by the Department of Environment, Community and Local Government in the Floor Area Compliance Certificate Explanatory Memorandum

Conservatories:
- *should not be included* if separated from the dwelling according to the definition in Section 3.3.3;
- *should be included* as part of the dwelling if they are not separated.

Store rooms and utility rooms:
- *should be included* if directly accessible from the occupied area of the dwelling, whether heated or not;
- *should not be included* if unheated and accessible only via a separate external door. Stores accessible by a separate external door should be included if heated by fixed heaters.

Basements:
- *should be included* only if consisting of heated and habitable rooms. Habitable rooms are defined in <u>Appendix A</u>. The floor and walls of heated basements are counted as heat loss surfaces as per IS EN ISO 13370. The floor above unheated basements is counted as a heat loss element. The unheated basement itself is not counted as part of the dwelling.

Garages:
- *should be included* if heating is provided within the garage from the main central heating system;
- *should not be included* where the garage is thermally separated from the dwelling and is not heated by the central heating system. Thermal separation of the unheated garage is detailed as follows:
    - If the wall between the dwelling and the unheated garage is well insulated or the external garage wall is poorly insulated, then the garage is unlikely to reach similar temperatures to the dwelling and is therefore thermally separated. This garage is not included as part of the dwelling.
    - If the unheated garage is likely to reach the same or similar temperatures as the dwelling then the garage should be included as it is not thermally separated. This occurs when there is little or no insulation between the dwelling and garage and the garage external wall is insulated and has similar U-values to the other external walls of the dwelling.

Attics:
- *should be included* if they are habitable rooms, accessed by a fixed staircase;
- roof spaces (even if within the insulated envelope, i.e. where the roof insulation is provided at rafter level) *should not be included* unless they are habitable rooms accessed by a fixed staircase.

A habitable attic generally meets the following criteria:
- Part of the attic should be at least 2 m in height.
- The room should be "finished". A finished room typically has finished internal surfaces (walls and ceiling are papered and/or plastered and flooring rather than having exposed joists and rafters).
- Attic Room has lighting and possibly a window/rooflight.
- Structural timbers not preventing free movement.
- Water cistern not present in the attic room.

In cases where an attic meets most of these criteria and is clearly and effectively employed as a habitable area by the occupants then it may be considered as habitable for the purposes of DEAP assessments. For example, a 1.95m high attic with bedrooms, finished surfaces, lighting, windows, no water cistern and no obstructive structural timbers is considered habitable. Habitable attics, accessed by a fixed staircase, are included as a separate storey under "dimensions" in DEAP.

Where an attic's floor area is not included as part of the dwelling floor area:
- The attic floor space is not included in the floor area if the attic is open to the storey below i.e. with no door or partition wall around the attic stairs landing. In this case, the attic height is regarded as open to the storey below. Therefore the storey below is treated as having a vaulted ceiling and it is considered to extend into the attic roof. This results in a higher average storey height.
- The storey height of the storey below is not considered to extend into the attic where the attic is clearly separate from the storey below e.g. by a partition ceiling and closable attic hatch.

When porches or garages are not included in floor area, the door and part of the wall between the dwelling and these structures are adjacent to an unheated space and their U-values should be calculated accordingly (see Section 3.3).

In buildings incorporating flats, where corridors and stairwells are heated, walls between the flat and heated corridors/stairwells should be treated as non-heat loss walls (i.e. assuming the same temperature on either side of the walls). Otherwise these walls are treated as elements adjacent to an unheated space and their U-values should be calculated accordingly (see Section 3.3).

No special treatment is required where a central heating boiler is located in an unheated garage (i.e. the floor area should be the same as if the boiler were in the kitchen or a utility room).

Staircase leading to a single dwelling:
Where there is a staircase between a single dwelling (such as an apartment) and an external door:
- The staircase is excluded and is treated as a heated or unheated space adjoining the dwelling where there is an internal door between the staircase and the dwelling.
- The staircase is included where there is no door between the staircase and the dwelling (the staircase is open to the dwelling). This is counted as an extra storey.

Pitched roofs
There are three main types of pitched roof construction:
1. pitched roof with insulation at ceiling level, insulated between (and perhaps also above) joists, shown in a) below. The flat ceiling area and ceiling U-value are entered in calculating the heat loss for the roof in the DEAP Building Elements section in this case;

2. pitched roof insulated at rafter level (no insulation at ceiling level), insulated between and/or above rafters ("warm roof"), with a non-ventilated loft space but with a ventilated space between the insulation and the roof covering, shown in b) below. The flat ceiling area and ceiling U-value are entered in the DEAP Building Elements section as the heat loss roof (accounting for the insulation at rafter level as per BRE 443[8]) ;

3. pitched roof insulated either at ceiling level or at rafter level, with roof space converted into habitable space, shown respectively in c) and d) below. Section 3.3.5 provides guidance on derivation of the heat loss area and U-values of the room in roof.
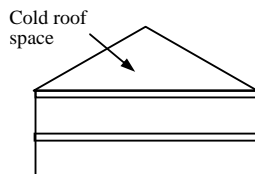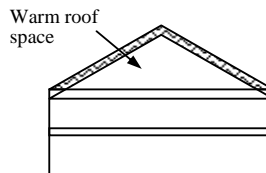
a) Insulation at ceiling level   b) Insulation at rafter level

In the cases of a) and b) the roof space should **not** be entered as a separate storey.
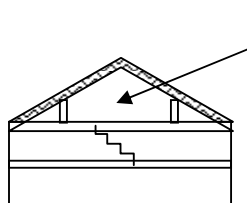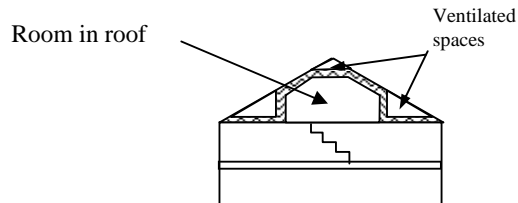
c) Room in roof built into a   d) Room in roof built into a
    pitched roof insulated at rafter level   pitched roof insulated at ceiling level

In the cases of c) and d) the floor area of the roof space that is converted into habitable space should be entered as a separate storey.

Living Area
The living area is the largest public room (irrespective of usage by occupants), added to all rooms not separated from that room, and including cupboards directly accessed from that room. Living area does not extend over more than one storey even when stairs enter the living area directly. Kitchens (including rooms like kitchen diners) are not considered public rooms on their own. The kitchen should be included when calculating the living room area if there is no door separating between the room identified as the largest public room and the kitchen. Doors or partitions between rooms should be solid and easily closable i.e. curtains are not considered as a partition. Partitions should be clearly identifiable when dwelling plans are being used.

The following tables summarise the method used to determine the living area:

(a) Where the kitchen (or kitchen/diner) is not open to another public room:

Dwelling contains a Kitchen (or Kitchen/Diner)	Dwelling contains other Public Room(s)	**Living Area specified in DEAP**
√	√	Other separate public room with largest floor area
√	X	Kitchen - as there is no public room

(b) Where the kitchen (or kitchen/diner) is open to a public room and there is a separate public room in the house

Situation	**Living Area**
Public area of kitchen >= Area of largest other separate public room	Combined kitchen/diner/public room
Public area of kitchen < Area of largest other separate public room	Other separate public room

In (b), "Public area of kitchen" = Area of Combined Room – (Area of Kitchen/diner). This is the public room area adjoining the kitchen/diner.

Diagram for case (a)   Diagram for case (b)
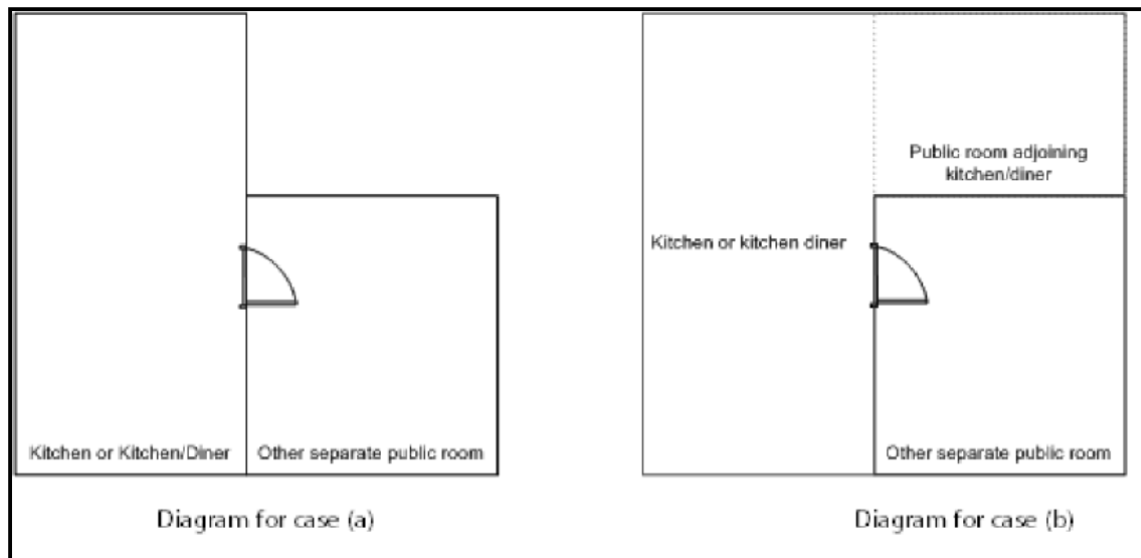
In (b), it may not always be obvious where the kitchen/dining area ends and the public room begins. Often the boundary is marked by a change of floor surface from tiles or linoleum in the kitchen/diner to carpet or wooden flooring in the public room. Alternatively, a change in room-width or style may indicate the change in room function. The Assessor should choose the most pessimistic option when measuring the public room section floor

area of a combined kitchen/diner/public room if the boundary between public room and kitchen/diner is unclear or ambiguous.

2   Ventilation rate

['Ventilation' tab]

The ventilation air change rate is the rate that air enters or leaves a building, expressed as air changes per hour (ac/h).

DEAP requires an estimate of the air change rate to calculate the **ventilation heat loss rate** (expressed in W/K) and its effect on the overall heating requirement. The ventilation rate depends on factors including permeability of materials and inadvertent gaps and openings in the structure. These factors contribute to background air infiltration or leakage characteristics and ventilation features intentionally specified and provided in the dwelling.

The air infiltration rate can be assessed either from a permeability test (also called an air leakage pressure test: Section 2.3) or, in the absence of a pressure test, using the "structural air tightness" section of DEAP. Pressurisation tests are completed with all designed ventilation openings, flues, fans etc. sealed up and inoperative. This component of overall air change rate represents only background dwelling air leakage.

DEAP uses the numbers of chimneys, extract fans, open flues, passive vents and flueless combustion room heaters to determine the contribution to overall air change rate from individual ventilation features ("openings", including fans) intentionally provided in the dwelling. The contribution of designed ventilation features is given in Table 2.1 below.

Table 2.1 Ventilation rates

Item	Ventilation rate m³/hour
Chimney	40
Open flue	20
Fan (intermittent)	10
Passive vent	10
Flueless fixed combustion room heaters[1]	40

The effect of sheltered sides on ventilation rates is addressed in Section 2.5.

The overall ventilation air change rate is adjusted to reflect the type of ventilation provision:
- Natural ventilation
- Positive input ventilation from loft
- Positive input ventilation from outside
- Whole-house extract ventilation
- Balanced whole-house mechanical ventilation, no heat recovery
- Balanced whole-house mechanical ventilation with heat recovery

Part F of the Irish Building Regulations details the ventilation requirements for dwelling design and construction.

2.1   Chimneys and flues

Ventilation rates for chimneys and flues should be entered only when they are unrestricted and suitable for use. A restricted chimney is treated as permanently blocked. Permanent restrictions include brickwork, plasterwork or timber panelling fixed in place. Temporary restrictions are ignored.
The specified ventilation rate for chimneys, flues and flueless appliances includes an allowance for the associated permanent vent for air supply, so this vent should not be entered separately.

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[1] Note that for flueless combustion devices such as flueless gas fires, for health and safety reasons, it is required that both a high level and low level permanent vent are installed to ensure the supply of oxygen for combustion and to dispose of the resultant fumes and water vapour. The 40m³/hr in Table 2.1 includes an allowance for these permanent vents.

A chimney is defined as a vertical duct for combustion gases of diameter 200 mm or more (or a rectangular duct of equivalent size). Vertical ducts with diameter less than 200 mm should be counted as flues. The following are also counted as flues:

- a chimney for solid fuel appliances with controlled flow of the air supply;
- a chimney with open fireplace and an air supply ducted from outside to a point adjacent to the fireplace;
- a flexible flue liner sealed into a chimney;
- a chimney fitted with a damper;
- a chimney fitted with an open-flue gas fire where the flue products outlet is sealed to the chimney;
- a blocked up fireplace fitted with ventilators (if ventilator area does not exceed 30,000 mm^2)
- Open fireplace fitted with an enclosure or door to control air flow from the room to the fireplace with minimum open area below the equivalent of a circle of diameter 200mm. Efficiency for this appliance is that of an open fireplace from Table 4a.

Ventilation rates should be entered only for open flues and should not be included for room-sealed (e.g. balanced flue) boilers or room heaters. A room heater is considered to be room sealed if it does not have any air exchange with the room.

2.2   Intermittent Fans and passive vents

Extract fans typically exhaust air from the kitchen, bathroom via cooker hoods and other independent extractor fans. Extract fans should be included in the 'number of intermittent fans' category. Those that form part of a whole-dwelling mechanical ventilation system are treated separately (see Section 2.6) and are not included here.

Passive stack ventilators, an alternative to extract fans, are included under 'intermittent fans and passive vents' in the ventilation tab. Such systems typically comprise extract grilles connected to ridge terminals by ducts and should be supplied with air bricks or trickle vents for balancing air ingress. The number of extract grilles in the dwelling should be entered in DEAP.

Trickle vents or air bricks alone do not count as passive or background vents and should not be included provided the cumulative minimum open area per room is less than 3500 mm^2. If the controllable vents in a room can be closed to less than 3500mm^2 (total) they should not be included as passive or permanent vents. These controllable vents may be manually or automatically controlled.

Permanent vents (including non controllable trickle vents or background ventilation) of cumulative open area in a room of 3500 mm^2 or greater should be counted as passive vents. Permanent vents of smaller cumulative area in a room should not be included in the calculation. For permanent vents associated with chimneys/flues, see Section 2.1 above. Permanently blocked vents should be ignored.

Examples:
- One vent in a room of minimum open area 3400mm^2 is not included
- Two vents in the same room with combined minimum open area of 5000mm^2 are counted as a single vent in DEAP.

2.3   Air leakage pressurisation test

A pressurisation test (also called a permeability test) is completed by installing a fan in the principal entrance doorway, sealing all fans, flues, chimneys, vents etc. and determining the air flow rate required to maintain an excess pressure of 50 Pascals (Pa) above outdoor air pressure. The pressurisation test should be completed in accordance with IS EN 13829 by an individual or organisation competent to do so (NSAI or INAB accreditation for example). The air permeability measured in this way, q_{50}, expressed in cubic metres per hour per square metre of envelope area is divided by 20 for use in the DEAP software (to give an estimate of the air change rate per hour (ac/h) at typical pressure differences under real operating conditions). In this case the structural infiltration cells of the ventilation tab (structure type, suspended wooden ground floor, draught-stripping of

windows, doors and attic hatches[1]) are not used. Section 1.5.4 of Building Regulations 2008 and 2011 TGD L and www.seai.ie/ber provide further detail on air permeability pressure testing.

The result of a pressurisation test remains valid provided dwelling envelope changes (such as area changes or replacement of exposed elements) have not occurred since the test was performed.

Where the pressurisation test is not carried out, the ground floor must be specified as solid, suspended (unsealed) or suspended (sealed). A suspended wooden ground floor is considered sealed if all joints in the floor (at the edges and the floor itself) are draught sealed using membranes or adhesives.

In the case of a carpet on a suspended ground floor, while the carpet itself is unlikely to be airtight, a carpet underlay may or may not be airtight depending on whether it is proven to extend to the edges of the floor and the material in the underlay is airtight. When in doubt, it should be assumed that the suspended ground floor is unsealed.

Air vents under the level of the suspended ground floor should not be included in "intermittent fans and passive vents" in the Ventilation tab. The effect of these vents is already accounted for as part of the structural air-tightness section.

The suspended wooden ground floor entry does not apply to dwellings such as mid-floor or top floor apartments as these do not have a ground floor.

2.4 Draught lobby

A draught lobby is an arrangement of two doors that forms an airlock on the main entrance to the dwelling, sized such that a person with a push-chair or similar is able to close the outer door before opening the inner door. To be specified as a draught lobby in a house in DEAP, the enclosed space must satisfy all of the following criteria:

- It is located at the main entrance of the dwelling (i.e. the front door);
- It is at least 2 m^2 in floor area;
- It has a minimum depth of 1.2m and a minimum width of 1.2m;
- It opens via a single door into a circulation area (such as a hall, corridor or staircase);
- The space is separated from the remainder of the dwelling by a single inner door, although it may also have access to a cloakroom along with the single door to the circulation space;
- It may be heated or unheated.

An unheated draught lobby in the form of an external porch should not be counted as part of the floor area of the dwelling as described in Section 1, although it may still be counted as a draught lobby in the ventilation section. However, the door between the dwelling and the porch is an element adjacent to an unheated space and its U-value should be calculated accordingly (see Section 3.3).

Apartments with access via an enclosed stairwell or corridor should be classified as having a draught lobby.

2.5 Sheltered Sides

A side of a building is sheltered if there are adjacent buildings or hedges/trees obstructing the wind on that side of the building. This applies at the time of the assessment (or the expected time of dwelling completion for provisional assessments). A side should be considered sheltered if all the following apply:

- the obstacle providing the shelter is at least as high as the ceiling of the uppermost storey of the dwelling;

- the distance between the obstacle and the dwelling is less than five times the height of the obstacle;

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[1] The "Percentage of windows and doors draughtstripped" is used to estimate air infiltration through gaps between the openable part of a door or window and the surrounding frame. In practice, it is unnecessary to measure the perimeter or area of each openable section when determining the percentage draught stripping. The Assessor may identify the number of openings with draught stripping and divide this by the total number of openings in the dwelling. Openings include openable windows, doors and attic hatches between the dwelling and unheated spaces or open air.

- the width of the obstacle (or the combined width of several obstacles) subtends an angle of at least 60° within the central 90° when viewed from the middle of the wall of the dwelling that faces the obstacle - see Figure 2.1. Where the obstacle is very close to or adjoining the dwelling side (for example, an adjoining unheated outhouse), the object should be the same height as the dwelling and at least half the width of that dwelling side. Where there is more than one obstacle providing shelter on a single side, their width can be combined to subtend the aforementioned 60°angle.
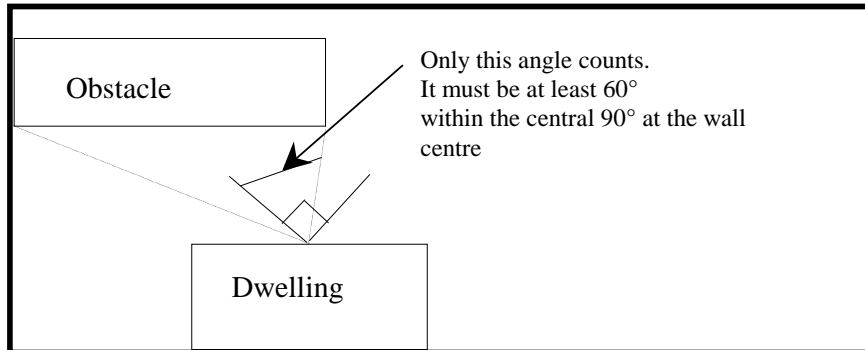
Figure 2.1   Shelter angle

Two partially sheltered sides should be counted as one sheltered side. Architectural planting does not count as shelter unless it actually exists (even though shown as mature trees on drawings).

Any party wall should be counted as a sheltered side once it meets the criteria above.

2.6   Mechanical ventilation

Balanced whole house mechanical ventilation is a fan driven ventilation system providing fresh air to the rooms and extracting exhaust air from the dwelling. The system may or may not be fitted with a heat recovery unit. The DEAP calculation in such cases is based on a minimum dwelling ventilation rate of 0.5 air changes per hour or larger depending on the infiltration rate and the mechanical system.

For dwellings with heat recovery from exhaust to inlet air, the heat loss by mechanical ventilation is reduced by the factor η_v where $\eta_v = 0.66$ is the default efficiency assumed for the heat recovery system. The default Specific Fan Power (SFP) is assumed to be 2W/[L/s]. Alternatively values based on tests may be used subject to conditions for acceptance of test data. The mechanical ventilation test values are listed on http://www.sap-appendixq.org.uk.

The testing methodology for inclusion of MVHR devices on SAP Appendix Q invokes BS EN 13141-6 (definition of duct configurations) and BS EN 13141-7 (testing of heat recovery devices) and therefore is an approved and suitable method for Irish use. The methodology determines the unit performance (both in terms of SFP and heat recovery efficiency) for a number of predefined configurations, specifically the number of wet areas in the dwelling where humid air is extracted.

The BER Assessor should detail the ducting type and general configuration of the ventilation system when a non default value is entered for SFP and/or ventilation system efficiency. The type of ducting may be flexible ducting, rigid ducting or both. The configuration should include the number of rooms where the ventilation system is extracting air (for example kitchen + 3 wet rooms).

Positive input ventilation is a fan driven ventilation system providing ventilation to the dwelling typically from the loft space. The DEAP calculation procedure for systems using the loft to pre-heat the ventilation includes 20 m³/h ventilation rate. The energy used by the fan counterbalances the effect of using slightly warmer air from the loft space compared with outside air. Some positive input ventilation systems supply the air directly from the outside and the procedure for these systems is the same as for mechanical extract ventilation.

Mechanical extract ventilation (MEV) refers to a fan driven ventilation system extracting air from the dwelling. The mechanical ventilation system fans do not provide fresh air. The DEAP calculation is based on a throughput of 0.5 air changes per hour through the mechanical system, plus infiltration. Mechanical extract ventilation is available in continuously running centralised systems or in continuously running decentralised systems.

The calculation requires information on specific fan power (SFP) of mechanical ventilation fans. Default data are provided in Table 4g. Alternatively, values based on tests may be used subject to conditions for acceptance of test data for specific fan power. SFP should account for any transformers. The test values used in DEAP are obtained for a list of MEV on http://www.sap-appendixq.org.uk. The Assessor must specify the number of wet rooms where the unit extracts exhaust air.

Two systems are used in the same dwelling:
a) If the two systems are identical, use the data for the system corresponding to half the actual number of wet rooms. If there is an odd number of actual wet rooms, round upwards (e.g. for Kitchen+6 wet rooms use data for Kitchen+3 wet rooms).
b) If the systems are different, use an average for the two systems, weighted according to the number of wet rooms served by each system.
c) If either of the systems are not listed on the SAP Appendix Q website the default data applies.

3   Heat losses

['Building Elements' tab]

As indicated in Section 1, the areas of building elements are based on the internal dimensions of surfaces bounding the dwelling.

Window and door area refers to the total area of the openings (windows, doors, rooflights), including frames. Wall area is the net area of walls after subtracting the area of windows and doors. Roof area is also net of any rooflights or windows set in the roof. Losses or gains through party walls and floors to spaces in other dwellings or premises that are normally expected to be heated are assumed to be zero.

The BER Assessor should allow for elements of differing U-value (e.g. some windows single glazed and some double glazed, masonry main wall and timber framed wall in an extension, main roof pitched and extension roof flat).

DEAP allows for the selection and entry of default U-values for all heat loss element types for existing dwellings. This is detailed in Appendix S.

On the 'Windows' tab under 'Building Elements' the following data is required for each window:
- The orientation selected from several orientation options: North, North East/ North West, East/West, South East/ South West, South and Horizontal.
- The area of glazing including the window glazing and frame.
- For heat loss purposes: The relevant U-value (including glazing and frame) and frame factors. These can be defaulted for new or existing dwellings based on window description and frame type.
- For solar heat gain purposes: The relevant shading, frame, window type and transmission characteristics.
- When non default U-values are chosen for the windows (glazing plus frame combined) then non default solar transmittance must also be used. <u>Non default data must be supported by acceptable certified documentation.</u>
- For summertime overheating calculation purposes (optional): The relevant shading factors for blinds/ curtains and overhangs.

DEAP calculates the overall heat loss rate for glazing (W/K), the effective collecting area on each orientation for solar gain purposes (m^2), a glazing ratio to floor area for daylighting purposes, and a solar gain rate (W/m^2) for summer period overheating calculation purposes.

For doors, walls, roofs and floors, the following data is required:
- The area and U-value of each externally exposed/semi-exposed (heat losing) element of the dwelling.
- A description of the element based on "dropdown" menus helps identify default U-values for the element for existing dwellings. This entry helps determine if the element meets Building Regulation U-value requirements for new dwellings.

A thermal bridging factor is entered in the 'Heat Loss Results' tab under 'Building Elements'. The default value of 0.15 W/m^2K must be chosen unless contrary evidence is available as defined in Appendix K.

The 'Heat Loss Results' tab calculates the overall heat loss rate, or heat loss coefficient (W/K) for the dwelling, composed of fabric (including glazing) heat losses and ventilation heat losses (from the 'Ventilation' tab). The ratio of heat loss coefficient to total floor area is calculated, and termed the heat loss parameter ($W/K\ m^2$).

3.1   U-values of opaque elements

The U-values should be calculated for the floor, walls and roof when construction details are known. This requirement always applies for new dwellings assessed using information gathered on site and building plans and specifications. Information on the use of default U-values for existing dwellings is in Appendix S. Alternatively, use of non default values may be used for existing dwellings where sufficient evidence is available as outlined in Appendix S and the DEAP survey guide.

U-values for walls and roofs containing repeating thermal bridges, such as timber joists between insulation, etc, should be calculated using methods based on the upper and lower resistance of elements, given in IS EN ISO 6946.

IS EN ISO 6946 gives the calculation for components and elements consisting of thermally homogenous layers (including air layers) and is based on the design thermal conductivity or design thermal resistances of materials and products used. The standard also gives an approximate method for inhomogeneous layers, except cases where an insulating layer is bridged by metal.

Thermal conductivity values for common building materials can be obtained from Table 12a of the DEAP manual, Building Regulations 2011 TGD L (Table A1), ISO EN 10456 or the CIBSE Guide, Section A3[6]. For specific insulation products, data should be obtained from accredited test data. Note that Table 12b may be used for insulation products' conductivity for design purposes (such as provisional ratings) and for existing dwelling assessments where no further information is available. Insulation thermal conductivities from Table 12b may not be used for final BER assessments for new dwellings.

When using certified data to determine thermal properties of building elements, acceptable data is available on Agrement Certificates from the Irish Agrement Board (IAB) and British Board of Agrement (BBA) websites. Certified data from other sources can also be used, bearing the following text in mind (taken from Building Regulations 2011 TGD L): "For thermally homogeneous materials, declared and design values should be determined in accordance with I.S. EN ISO 10456: 2007. Design values for masonry materials should be determined in accordance with I.S. EN 1745: 2002. For insulation materials, values determined in accordance with the appropriate harmonised European standard should be used." U-value calculations should only use certified data as described here.

Where insulation thickness varies across a building element, the insulation thickness used should be the average insulation thickness (weighted by area). In the case of roofs where the attic hatch is part of the roof heat loss area, the attic hatch insulation thickness is also accounted for in this calculation. In some cases, the attic hatch should be considered to be a heat loss door rather than part of the heat loss roof area, particularly when it is used to access a floored attic acting as an unheated storage area.

U-values for ground floors and basements should be calculated using the procedure described in IS EN ISO 13370, or in the CIBSE Guide, Section A3. Further detail is available in BRE 443 [8] and TGD L Appendix A.

Software packages to perform U-value calculations for different building elements in accordance with the relevant standards above are readily available. Details, such as element thicknesses, thermal conductivities and resistances, used in carrying out U-value calculations must be retained in the BER assessment records by the BER Assessor.

3.2   Window U-values

The U-value for a window should be for the whole window opening including the window frame.

Measurements of thermal transmittance for doors and windows should be made according to IS EN ISO 12567-1. Alternatively, U-values of windows and doors may be calculated using IS EN ISO 10077-1 or IS EN ISO 10077-2. A BER Assessor may perform these calculations bearing in mind that standards must be adhered to and that all non default data used in calculations must be obtained from accredited sources such as the NSAI Window Energy Performance certification scheme. BRE 443 also provides guidance on evaluation of opaque door U-values using IS EN ISO 6946.

Appendix S8 details use of defaults for windows for new and existing dwellings in the absence of data based on the standards outlined above. Tables 6a and S9 provide values that can be used in the absence of test data or calculated values. A value should be selected from these tables corresponding most closely to the description of the actual window; interpolation should not be used in these tables.

Where certified window data is not available, then defaults can be selected depending on the dwelling type:

New Dwelling-Provisional or New Dwelling-Final:
The default window U-value should be taken from Table 6a and the solar transmittance from Table 6b when data based on the standards is not available for both U-value and solar transmittance. For new dwellings specifications or plans detailing the relevant parameters for lookup in Table 6a and 6b are usually available. However, in exceptional circumstances (such as plans/specifications not available for the new dwelling) the Assessor can use Table S9 as an alternative to Table 6a/6b for new dwellings.

Existing Dwellings:
The Assessor has two options for existing dwellings when selecting windows defaults:
- U-value is taken from Table 6a and the solar transmittance taken from Table 6b; or
- U-value and solar transmittance taken from Table S9.

Within the DEAP software, the entered U-value is adjusted to account for the assumed use of curtains using the formula:

$$U_{w,effective} = \frac{1}{\frac{1}{U_w} + 0.04}$$

where U_w is window U-value calculated or measured without curtains.

Rooflights are treated as roof windows. Table 1b and Table 6 give further detail on the treatment of roof windows.

If the standard sized window (1.48 high * 1.23 wide) is used to establish the U-value using one of the standards above by testing or calculation as appropriate, then that U-value can be used for a window of the same type with different dimensions. If calculation or test outputs from the above standards are not based on the standard sized windows (1.48 high * 1.23 wide), then the windows in the tests or calculations must match the size of those in the actual dwelling. This is stated in Section 11 of BRE 443.

3.3   U-values of elements adjacent to an unheated space

The procedure for treatment of U-values of elements adjacent to unheated space is described in IS EN ISO 6946 and IS EN ISO 13789. The following procedure may be used for typical structures (no measurements are needed of the construction providing an unheated space, just select the appropriate R_u from Tables A3, A4 and A5 of Building Regulations 2011 TGD L).

$$U = \frac{1}{\frac{1}{U_o} + R_u}$$

where: U   = resultant U-value of the element adjacent to unheated space, W/m²K;
         U_o = U-value of the element between heated and unheated spaces calculated as if there were no unheated space adjacent to the element, W/m²K;
         R_u = effective thermal resistance of unheated space.

R_u for typical unheated structures (including garages, access corridors to flats and rooms in roof), having elements in a new dwelling with typical U-values, are given in Building Regulations 2011 TGD L Appendix A. These can be used when the precise details on the structure providing an unheated space are not available, or not crucial.

The effect of unheated spaces, however, need not be included if the area of the element covered by the unheated space is small (i.e. less than 10% of the total exposed area of all external walls if the unheated space abuts a wall, or 10% of the total area of all heat-loss floors if the unheated space is below a floor). Consequently a door in an element abutting an unheated space would not need to have its U-value changed

(unless it is part of a very small flat where the U-value of the door might make a significant contribution to the result). Alternatively, the U-values for semi-exposed doors in Table 6a may be used.

Appendix S details specification of R_u for existing dwellings where default U-values are being used.

3.3.1   Garages

The U-value of elements between the dwelling and a garage should be adjusted using R_u from Table A3 of Building Regulations TGD L 2011.

3.3.2   Stairwells and access corridors in flats

Stairwells and access corridors, regardless of whether they are heated or unheated, are not included in the DEAP calculation. To calculate the heat loss to unheated stairwells and access corridors the U-value of walls between the dwelling and the unheated space should be modified using the data for R_u as shown in Table A4 in Building Regulations 2011 TGD L.

Table A4 of Building Regulations 2011 TGD L refers to corridors and stairwells. The Ru values specified for access corridors apply to unheated spaces in which each dwelling is approached via a common horizontal internal access or circulation space which may include a common entrance hall. The corridor does not form an open space between more than one storey. The Ru values for stairwells apply to common enclosed areas open between more than one storey such as a stairwell or lift shaft.

3.3.3   Conservatories

A conservatory is defined as an extension attached to a dwelling where not less than three-quarters of the roof area and one half of the external wall area are made of materials that allow light transmission. An attached conservatory should generally be treated as an integral part of the dwelling. In particular, for new dwellings where Building Regulations 2008 or 2011 TGD L apply, an attached conservatory is always considered as an integral part of the habitable area of the dwelling. In all other cases (i.e. existing dwellings or dwellings where Building Regulations 2008 and 2011 TGD L do not apply), an attached conservatory may be treated as an unheated space if it is thermally separated from the main dwelling. To be considered thermally separated, it must fulfill both of the following:

i)   The walls, floors, windows and doors between it and the main dwelling must have U-values not more than 10% greater than corresponding exposed elements. For example, the U-value for a window between the heated and unheated space must not be more than 10% greater than exposed glazing elsewhere in the dwelling.

ii)   It must be unheated or, if provided with a heating facility, must have provision for automatic temperature and on-off control independent of the heating provision in the main dwelling. Guidance on Ru value of elements between thermally separated conservatory and the heated dwelling is given in Building Regulations 2011 TGD L Table A5. The following table summarises how condition (ii) for thermal separation of a conservatory from the dwelling can be met:

Situation	Automatic, independent temperature control	Automatic, independent on/off control	Meets Condition 3.3.3 (ii)Thermal Separation
Conservatory, no fixed heating	n/a	n/a	Yes
Conservatory with fixed heating (from main heating system). No radiator valve.	No	No	No
Conservatory with fixed heating (from main heating system). Radiator valve only.	No	No	No
Conservatory with fixed heating (from main heating system). TRV only.	No	No	No
Conservatory with fixed heating (from main heating system).	Yes	No	No

Room thermostat only.			
Conservatory with fixed heating (from main heating system). Own zone (time and temperature control using time control and room thermostat).	Yes	Yes	Yes
Conservatory with fixed standalone heating system without time switch and room thermostat.	No	No	No
Conservatory with fixed standalone heating system with time switch and room thermostat.	Yes	Yes	Yes

The following examples relate to inclusion of conservatories in dwelling floor area:

- New dwelling constructed to Building Regulations 2008 TGD L including conservatory in original construction: the conservatory is included in new dwelling BER assessment floor area.

- New or existing dwelling constructed to any edition of the Building Regulations TGD L prior to 2008 including conservatory in original construction: the conservatory may or may not be included in the new dwelling BER assessment floor area subject to the rules on thermal separation above.

- Existing dwelling built to Building Regulations 2008 TGD L with a conservatory at time of original construction: this conservatory is always included, on the basis that it was part of the original dwelling constructed to Building Regulations TGD L 2008.

- Existing dwelling built to Building Regulations 2008 TGD L without a conservatory. A conservatory was added after original construction: the conservatory may or may not be included in the dwelling BER assessment floor area subject to it being thermally separated as described above.

The U-value and solar transmittance of windows between the dwelling and an excluded thermally separated conservatory should be treated as if the conservatory is not present. However, other opaque elements (such as walls) between the dwelling and excluded conservatory should have an R_u value applied as outlined above.

Windows between the dwelling and excluded unheated spaces other than conservatories (e.g. window between the dwelling and a thermally separated excluded garage) should be entered under "walls" rather than "windows" as the light and solar transmittance is low through these windows.

3.3.4   Other large glazed areas

Any structure attached to a dwelling that is not a thermally separated conservatory according to the definitions in Section 3.3.3 should be treated as an integral part of the dwelling. The glazed parts of the structure should be input as if they were any other glazed component (both in the heat loss calculation, and in the solar gain calculation according to orientation).

3.3.5   Room in roof

For room-in-roof construction where the insulation follows the shape of the room, the U-value of the wall of the room-in-roof construction adjacent to the unheated space as shown in Figure 3.1 is calculated using the procedure described in paragraph 3.3 applying thermal resistance R_u from Table 3.1. The same applies to the ceiling of the room below.

U-value calculated as for a normal roof

Elements adjacent to an unheated space
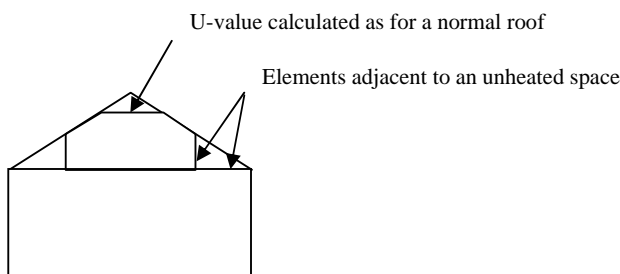
Figure 3.1 Room in roof

Table 3.1 R_u for room in roof adjacent to unheated loft space

Area (Figure 3.1)	Element between dwelling and unheated loft space	R_u for elements
Room in roof built into a pitched roof insulated at ceiling level	insulated wall of room in roof	0.50
	or insulated ceiling of room below	0.50

If the insulation follows the slope of the roof, the U-value should be calculated in the plane of the slope.

This method applies to new dwellings and existing dwellings. An optional approximate procedure may be used for a room-in-roof in existing dwellings and outlined in Appendix S.

3.3.6   Other cases

In other cases R_u can be disregarded or may be calculated using the following formula as detailed in BRE 443:

$$R_u = \frac{A_i}{\sum (A_e \times U_e) + 0.33nV}$$

A_i; A_e = respective areas of internal and external elements (m²), excluding any ground floor
U_e = U-values of external elements (W/m²K)
V = volume of unheated space (m³)
n =   air change rate of unheated space (ach)

3.4   Thermal bridging

The DEAP calculation includes thermal bridging, at junctions between elements and around openings. If linear thermal transmittance (Ψ) values are available for these junctions, they can be multiplied by the length of the junction concerned, and the total added to the transmission heat transfer coefficient. The calculation includes an allowance based on the total exposed surface area if specific Ψ- values for thermal bridges are not known. Further details are in Appendix K.

3.5   Dwellings that are part of larger premises

In the case of a dwelling that is part of a larger building where the remainder of the building is used for non-domestic purposes, the elements between the dwelling and the remainder of the building are considered:

a)   to have zero heat loss if the spaces adjacent to the dwelling are normally heated to similar levels to the dwelling (i.e. heated to a similar pattern and to similar temperatures). In this context, adjoining premises should be heated to 18⁰C or more for at least 7 of the 8 hours per day coincident with the dwelling's heating schedule outlined in Section 7.1. The adjoining premises should maintain this pattern for at least the 8 months of the heating season (seven days a week) outlined in Section 8. Otherwise option (c) below would be considered, or

b)   as heat loss elements to an unheated space if the spaces are unheated, heated only infrequently or heated only to a low level, or

c)   as if they were external elements but with their U-value halved if the spaces are heated to a different pattern to that dwelling (e.g. commercial premises). Section S6.5 of the DEAP manual applies a default U-value of 1.0W/m²K for existing dwellings in the absence of supporting information for a non-default U-value.

Where the BER Assessor is unable to determine the nature of the neighbouring premises, then conservative assumptions should be made. For example, if it is unclear whether a neighbouring heated premises is commercial or residential, it should be assumed to be commercial.

3.6   **Curtain Walling**

Curtain walling is used sometimes for apartments and requires a special procedure to get the heat loss and the solar gains correct simultaneously.

The U-value of curtain walling is that for the whole façade, i.e. an average value including mullions, transoms, glazing and spandrel panels. Calculations should be done by:

a)   entering the façade U-value for the wall U-value, applied to the opaque area;
b)   entering the façade U-value for the window U-value, applied to the glazed area;
c)   assigning a frame factor of 1.0 to the windows.

The façade U-value includes all effects of thermal bridging within the façade. It is therefore permissible to calculate the thermal bridging heat loss with the lengths of window surrounds set to zero. All other junctions are included as normal (as described in Appendix K).

Guidance in relation to rainscreen cladding and their effect on U-values is given in BRE 443 Section 4.

3.7   **Including glass block walls in DEAP**

A wall consisting of "glass blocks" can sometimes be used in a dwelling in place of a normal wall or window. The thermal conductivity of glass, 1.05W/mK taken from CIBSE Guide A, may be used in place of certified thermal conductivity for the glass in a glass block wall. After the glass thickness is measured, the U-value can then be determined.

The glass block wall may be entered as a window or a wall in DEAP. If there is a certified solar transmittance value and U-value available for the glass blocks, then it may be entered as a window in DEAP. In the case where there is no certified U-value and solar transmittance data, the glass block wall should be entered as a wall - thick glass will absorb more light than thin glass, so the values in Table 6b of the DEAP manual should not be used.

In the absence of other information, the thermal bridging effect of the adhesive between the glass blocks may be ignored as the adhesive can be assumed to have a similar thermal conductivity to that of the glass blocks.

4   Domestic hot water

['Water Heating' tab]

The demand for domestic hot water (DHW), derived from the dwelling floor area, is calculated taking account of heating, storage and distribution losses. Consequent heat gains from storage cylinders (within the heated space) and distribution pipe work is estimated and used in the calculation of space heating requirements.

A distinction is made between instantaneous water heating and water heating that relies on hot water storage in a cylinder, tank or thermal store. 'Primary' and 'cylinder' losses are not used for instantaneous heaters.

4.1   Hot Water Distribution Losses

'Single-point' heaters, located at the point of use and serving only one outlet, do not have distribution losses. Gas multipoint water heaters and instantaneous combi boilers are also instantaneous types but, as they normally serve several outlets, they are assumed to have distribution losses.

4.2   Hot Water Storage Losses

Stored hot water systems can be served by supplementary electric water heating or obtain heat from a boiler, room heater, solar heater or heat pump through a primary circuit. In either case, water storage losses are incurred to an extent that depends on how well the water storage is insulated. These losses apply for the following categories of heating equipment:
*   hot water cylinders;
*   the store volume of storage combination boilers (where boiler efficiency is derived from test data);
*   thermal stores;
*   combined primary storage units (CPSUs);
*   group heating schemes.

Water storage losses are set to zero for instantaneous combi boilers and instantaneous water heaters. Heat gains are allocated to the dwelling from the hot water storage in cases where the cylinder is within the heated dwelling space.

For cylinders the preferred way of establishing cylinder losses is from measured data according to BS 1566 or IS EN 12897. Cylinder standing losses may also be stated on an Irish Agrement Certificate or equivalent.

For thermal stores and CPSUs (including electric CPSUs) the preferred way of establishing heat losses is from measured data on the thermal store or CPSU concerned.

If measured data is not available, a default value is used; this is calculated on the 'Water Heating' tab based on insulation type and thickness and cylinder volume.

In all cases, the loss rate is to be multiplied by a temperature factor from Table 2. This factor accounts for the average temperature of the cylinder or thermal store under typical operating conditions, compared to its temperature under test. Hot water storage volume is determined using the guidance in Table 2a.

For combi boilers the storage loss factor is zero if the efficiency is taken from Table 4b. The loss is included for a storage combination boiler if its heating efficiency is based on certified data or is obtained from the Home-Heating Appliance Register of Performance (the HARP database), using the calculated hot water storage loss factor and volume on the 'Water Heating' tab and the temperature factor from Table 2. The insulation thickness and volume should be provided by the manufacturer or obtained from HARP.

4.3   Primary Circuit Losses

For boiler (or heat pump) systems with separate hot water storage, primary losses are incurred in transferring heat from the boiler to the storage; values for primary losses are obtained from Table 3. For combi boilers the additional losses in Table 3a are included to allow for the draw-off of water until an adequate temperature at

the taps is attained. The data in Table 3a are provisional pending the availability of test results based on relevant EN standards (currently under development on the basis of EU Commission Mandate 324 to CEN). The efficiency for both space and water heating is reduced by 5% if a gas or oil boiler is not interlocked for both space and water heating (see Section 9.3.9).

4.4   **Solar Water Heating**

A solar water collector coupled with solar water storage reduces the fuel needed for DHW (see Appendix H). The solar water storage can heat the lower part of a multi heat source cylinder or as a separate solar cylinder. **Solar water heating cannot provide all of the hot water or space heating requirements and a main water and space heating fuel type must be specified at all times**.

The DEAP software displays a figure for "Solar Fraction" indicating the proportion of the solar hot water yield relative to the total dwelling hot water demand. If this figure is greater than 60% for a solar water heating system, it is likely that the system is oversized and the system design may need to be reconsidered. In the case of solar space and water heating systems, solar fraction may exceed 60%.

System designers should refer to the document SR 50-2:2010: Code of practice for building services – Part 2: Solar Panels (to be published by NSAI).

4.5   **Group Heating (also called community or district heating)**

Where hot water is provided from a group heating scheme:
a)   If there is a hot water cylinder within the dwelling, its size and the appropriate loss factor should be used.

b)   If the DHW is provided from the group scheme via a plate heat exchanger use the volume and insulation of the heat exchanger (rounded upwards to the nearest litre); if there are plate heat exchangers for both space and water heating use the volume of both added together.

c)   Section H2 outlines treatment of group DHW solar heating schemes. Where solar water heating is provided from a larger shared solar water heating system the total area of the solar panels is divided amongst the dwellings served by the solar water heating system proportionate to the total floor area of each dwelling.

d)   If none of the above applies the calculation should assume that the dwelling has a cylinder of 110 litres and loss factor of 0.0152 kWh/litre/day. Primary circuit loss for insulated pipework and cylinder thermostat should be included (Table 3).

4.6   **Hot Water Backup**

The system specified as the primary water heater should be that intended to heat the bulk of the hot water during the course of the year. For example, supplementary electric water heating should be disregarded if provided only for backup where the principal water heating system is from a central heating boiler, as should other devices intended for or capable of heating only limited amounts of hot water.

Supplementary electric water heating may be specified during the summer months where operation of the main water heating system results in provision of space heating. The secondary water heating fuel type is set to "electricity". Section 10.3.3 provides further detail on electric water heating supplementing solid fuel boilers.

Where a dwelling has no water heating system present, direct electric water heating is assumed to meet the hot water demand. In this case supplementary electric water heating is not specified as the main water heating is an electrical heat source. If there is no cylinder present then hot water storage losses are not specified.

Systems where the boiler can supply domestic hot water (DHW) independent of space heating should **not** have "supplementary electric water heating during summer" specified. These systems include the following (note that any switches or valves must be accessible by the home owner and may or may not be located on the boiler control panel):

1. Full time and temperature control for DHW separate from space heating;
2. Separate zoned time control (DHW separate from space heating) with no temperature control;
3. A "summer/winter switch" that either controls a motorized valve or a separate pump for the hot water only to be separated from the space heating;
4. Boiler with a time clock and a switch to turn off the heating of the space and not of the DHW;
5. Boiler with just a time clock and a manual pipe valve to turn off the heating to the space;
6. Room thermostats capable of turning off all space heating without affecting water heating.

The following systems should have supplementary electric water heating during summer specified as the water heating and space heating functions are not independent:

1. Individual radiator shut off valves as the only means of switching off space heating;
2. Solid fuel stove with back boiler, or other solid fuel back boiler appliance located in the heated dwelling, providing space heating and main hot water source from the back boiler;
3. Boiler with just a single time clock and none of the switches or valves outlined above.

Where there is a heat pump with an immersion, then "supplementary electric water heating in summer" is set to "no" and the secondary water heating fuel type is set to "none". The efficiency of the main water heater is determined using equation G1 in Appendix G.

5   Lighting and internal heat gains

['Lighting and Internal Gains' tab]

Internal gains from appliances, cooking and from the dwelling occupants (metabolic gains) are calculated based on the total floor area. Water heating gains as outlined in the previous section are also calculated.

Lighting electricity consumption is calculated on the 'Lighting and Internal Gains' tab as described in Appendix L. Savings due to low energy lights (defined in Appendix L) are calculated. Heat gains from lighting are calculated and added to the other gains. Heat loss to the cold water network is calculated based on total floor area, and subtracted from the above gains. Gains from ventilation system fans are also included. No useful gains are assumed from individual extractor fans. Gains from heating system fans and pumps are accounted for later, in the heating system part of the procedure ('Distribution System Losses and Gains' tab).

6   Solar heat gains

['Building Elements' (Windows) tab and 'Net Space Heat Demand' tab]

6.1   Solar gains for glazed openings

Solar gains and heat use are calculated on a monthly basis. The average daily heat gain through windows and glazed doors is calculated for each month from

$$G_{solar} = 0.9 \times A_w \times S \times g_\perp \times FF \times Z$$

where:
- G_{solar} is the average solar gain in kWh/m^2 day for the orientation of a glazed opening
- 0.9 is a factor representing the ratio of typical average transmittance to that at normal incidence
- A_w is the area of an opening (a window or a glazed door), m^2
- S is the solar radiation on a surface of relevant orientation, from Table 1b, kWh/m^2 day
- $g_\perp$ is the total solar energy transmittance factor of the glazing at normal incidence as entered in the DEAP software (see Table 6b)
- FF is the frame factor for windows and doors (fraction of opening that is glazed) (see Table 6c)
- Z is the solar access factor from Table 6d.

This algorithm incorporates solar incidence data on differently oriented surfaces, based on Met Eireann long term average records for Dublin Airport.

In the case of 'arrow slit' windows where the width of opening at the external side of the wall is substantially less than the width of the window, this should be taken into account by multiplying the frame factor by the ratio of the opening width at the external surface of the wall to the width of the window.

Solar gains should be calculated separately for each orientation and for rooflights, and then totalled for use in the calculation. East/West orientation of windows may be assumed if the actual orientation is not known. The solar access factor describes the extent that radiation is prevented from entering the building by nearby obstacles. The over-shading categories are dependent on how much the view of the sky through the glazing is blocked. The categories are defined in Table 6d as a percentage of sky obscured by obstacles (the 'average' category applies in many cases, and can be used for DEAP calculations if the over-shading is not known).

6.2   Openings for which solar gain is included

Openings should be classified as windows, glazed doors or solid doors according to the percentage of glazed area (the percentage of total area of opening that is glass, i.e. excluding framing, mullions, transoms, solid panels etc.). For DEAP calculations the following definitions apply:

Category	Description	Glazing area	Solar gain included
1	Solid door	< 30 %	No (entered under "Doors" in DEAP)
2	Glazed door	30% - 60%	No (entered under "Doors" in DEAP)
3	Window	> 60 %	Yes (entered under "Windows" in DEAP)
4	Roof Window	All Cases	Yes (entered under "Windows" in DEAP)

Doors with large glazed areas, generally more than 60% as per the table above, should be treated as windows. No allowance should be made for solar gain via doors in categories 1 and 2 even though they have some glazing. French windows often have a high percentage of frame relative to glazing (around 50%) and are classified as glazed doors.

6.3   More than one glazing type

Where a dwelling has more than one type of glazing (e.g. some double glazing and some single glazing) the gains should be calculated separately for each glazing type.

7   Mean internal temperature and dwelling thermal mass

['Net Space Heat Demand' tab]

7.1   Heating schedule

The heating hours and required internal temperatures in DEAP are based on the requirements of a typical household. The schedule is as follows.
        Weekdays: 07.00 to 09.00 and 17.00 to 23.00
        Weekends: 07.00 to 09.00 and 17.00 to 23.00

This standardised schedule represents a total heating period of 56 hours per week.
The required (set-point) internal temperatures during heating periods are:
        Living area: 21°C
        Rest of dwelling: 18°C

During heating hours, the required mean internal temperature of the dwelling is calculated as the average of the set-point temperatures in the living area and in the rest of the dwelling, weighted by floor area.

7.2   **Living area fraction**

The **living area fraction** is the floor area of the living area divided by the total floor area of the dwelling and is defined in Section 1.

7.3   **Internal heat capacity**

DEAP includes a calculation based on IS EN 13790: 2004 to assess a dwelling's capacity to store heat within its structure, represented by internal heat capacity. Internal heat capacity will tend to have two opposing effects in relation to space heat demand on the 'Net Space Heat Demand' tab:

- Disadvantageous: Under normal intermittent heating conditions, a higher internal heat capacity ("heavier") structure will tend, in heating up and cooling down, to respond more slowly than a lighter structure and hence will maintain a higher internal temperature during "heating off" periods. This will result in a higher daily mean internal temperature in the dwelling and, since gross daily demand for heat is reflected in the difference (temperature "lift") between internal and external temperature, will increase the gross demand for space heating.

- Advantageous: A higher internal heat capacity offers a higher potential to store heat from free heat sources (internal gains and solar gains). Such free heat is irregular in its pattern of availability, and thus not necessarily useful in contributing to the scheduled heating requirements of the dwelling. By storing a higher proportion of such irregularly received heat, a higher internal heat capacity structure allows that heat to be retained and released at times when it can make a useful contribution to the scheduled heating needs. This is reflected in the DEAP procedure in the form of a higher "utilisation factor" being applied to the free heat gains.

Whether or not the net effect of internal heat capacity is beneficial thus depends on the relative extent of these two effects (see Section 8).

The position of insulation affects the internal heat capacity of a construction. If a masonry component is insulated internally, the masonry will not contribute internal heat capacity, but if insulated externally, it will. The internal heat capacity of a building element (wall, roof, floor, internal partition, etc.) is determined primarily by the properties of the layers adjacent to the living space. Thermal capacity deep within an element (e.g. 10 cm or more) contributes little to heat storage under a typical daily internal temperature cycle.

The index of internal heat capacity required is the **thermal mass category** of the dwelling. The **five options are**: low, medium-low, medium, medium-high or high. The category is determined using the following procedure:

(1) First, each opaque element type of the dwelling (walls, ceilings, floors, both external/ exposed and internal) should be classed as either 'thermally light' or 'thermally massive', by selecting the class of the construction in Table 11a most closely matching the construction in question.
(2) The ratio of total area of thermally massive elements to total floor area, 'AmAf', is then determined; for example, if a bungalow has a concrete floor (with insulation below the slab) and all other elements are 'thermally light', the ratio is '1'. Where internal elements (e.g., intermediate floors or internal partitions) are thermally massive on both sides, both sides should be included.
(3) The thermal mass category of the dwelling is then obtained by locating the 'AmAf' ratio in Table 11 that is closest to the calculated one.

Further notes on the procedure:
-   Thermally massive wall or roof areas should not include window and door areas as these are thermally light.
-   If, from the guidance given in Table 11a, an element appears borderline between thermally light and thermally massive, it may be assumed that half its area is light and half massive.

As an alternative way of determining whether an element is thermally light or massive, the internal heat capacity of the element may be calculated as described in EN ISO 13786:1999 using a time period of 24 hours

and with surface resistances included. A result of 38 kJ/m^2 K or greater is considered 'thermally massive', and a lower result 'thermally light'."

7.4   **Mean internal temperature with ideal heating system**

The mean internal temperature of the dwelling during periods when heating is required is calculated as a floor-area-weighted average of set-point temperatures in the living area and the rest of the dwelling. The effect of intermittent heating on the mean internal temperature is calculated using the dwelling's internal heat capacity. In the 'Net Space Heat Demand' tab, a notional "ideal" heating system is first assumed, i.e. provides just enough heat to precisely maintain required temperatures during heating hours. An ideal heating system has perfect control and responsiveness, and infinite heat output capacity. The mean internal temperature is calculated for each month, taking account of monthly mean external temperatures. The effects of imperfect control and heating system responsiveness are subsequently dealt with on the 'Distribution System Losses and Gains' tab as described in Section 9.

8   Space heat use

['Net Space Heat Demand' tab]

The space heat use is defined in IS EN 13790 as the heat delivered to the heated space by an ideal heating system to maintain the set-point temperature during a given period of time. The DEAP calculation of space heat use is done on a **monthly** basis based on the procedure described in IS EN 13790. A single-zone calculation is used, using a single average value of mean internal temperature as described in Section 7.

For each month:
- The average rate of heat loss (W) is calculated by multiplying the dwelling's heat loss coefficient (W/K) by the mean internal-external temperature difference.
- The average continuous level of useful heat gains (W) is determined as follows. The solar gains are added to the internal gains to give total heat gains. A utilisation factor is then applied to the gains, in order to include only the proportion of gains that contribute to meeting required internal temperatures. The utilisation factor calculation allows for the dwelling's internal heat capacity.
- Useful gains are then subtracted from heat loss to give the average <u>net</u> rate of heat use (W) for the month, required to be supplied from the dwelling's designated heating system. This is converted to quantity of heat use (kWh) for the month.

The utilisation factor calculation does not reflect the responsiveness of the heating system. A slow-response heating system can significantly reduce the usefulness of fluctuating heat gains.

In DEAP, the heating season is defined as running from October to May inclusive. The **annual space heat use** is the sum of monthly values for these eight months.

9   Space heating requirements

['Distribution System Losses and Gains' and 'Energy Requirements' tabs]

The annual energy required from the actual (as distinct from notional "ideal") heating system for space heating purposes is calculated, taking account not only of annual space heat use as described in Section 8, but also imperfect control and responsiveness of the heating system, and additional heat loss associated with under floor heating where applicable. This is termed the **annual space heating requirement** in the 'Distribution System Losses and Gains' tab.

The benefit of heat gains associated with electricity consumption by heating system pumps and fans is also included, applying an average utilisation factor as determined from the 'Net Space Heat Demand' tab.

The quantity of fuel or electric energy required to meet the annual space heating requirement is calculated, using the **seasonal efficiency** of the space heating system/s in the dwelling, obtained from the Home-Heating Appliance Register of Performance (HARP) database or from Table 4a or 4b. A similar calculation is carried out in respect of hot water heating, applying results carried forward from the 'Water Heating' tab.

These calculations are completed on the 'Energy Requirements' tab (Individual) in the case of dwellings served by individual heating systems, or on the 'Energy Requirements' tab (Group) in the case of dwellings served by group or group heating schemes.

All heat sources using combustion must have the **gross seasonal efficiency** specified. The conversion from "net efficiency" to "gross efficiency" is specified in the relevant appendices.

The calorific value of a fuel is the heat released when one kilogram of the fuel is burnt completely in excess air, under specified conditions, and the combustion products cooled back down to the initial (room) temperature. If the water vapour in the combustion products remains as vapour, the heat released is the "net calorific value", but if it is condensed to liquid water, releasing its latent heat of vaporisation, the total heat released is the "gross calorific value".

9.1   Heating systems

It is assumed that the dwelling has heating systems capable of heating the entire dwelling. Calculations are on the basis of a **main** heating system and **secondary** heaters as described in Appendix A; this Appendix also covers whether secondary heating is to be specified or not. The apportionment of heat supplied from the main and secondary systems is given in Table 7, Appendices A, F and N.

Direct acting electric heaters should be selected for new dwellings with no heating system specified.

For group/community heating schemes and combined heat and power, see Appendix C. A heating system supplying more than one dwelling should be regarded as a group scheme. This includes schemes for blocks of flats in addition to extended district schemes.

For an electric combined primary storage unit (CPSU), see Appendix F. For heat pumps, see Appendix G.

9.2   Heating system efficiency

9.2.1   Heating systems based on a gas or oil boiler

Boiler efficiency (%) may be obtained from:
a)   The HARP database;
b)   Certified data from an accredited laboratory;
c)   Table 4b.

The preferred source of boiler efficiency is the Home-Heating Appliance Register of Performance (HARP) database. If a new boiler is not included in the HARP database, data certified as explained in paragraph D3 of Appendix D should be used. If there is no entry in the database and certified data is not available, an indicative gross seasonal efficiency should be taken from Table 4b.
The HARP database is updated monthly and may be viewed on the website **www.seai.ie/harp**.

Where it is not clear if the installed boiler is the same as the boiler listed on HARP (for example the full name is not visible on the boiler on site), then a HARP entry can be used if one of the following is available and clearly equates the boiler in the dwelling to a HARP entry:
  - Boiler installation manuals or instruction manuals for the dwelling's boiler;

  - Statement on printed letterhead (in softcopy or hardcopy) from one of:

      o   boiler manufacturer;

      o   boiler supplier;

      o   boiler service engineer or maintenance firm.

This approach can also be applied to other appliance types.

9.2.2   Heating systems based on a gas or oil range cooker boiler

For definitions see paragraph B4 of Appendix B. Boiler efficiency may be obtained from:
a)   The HARP database;
b)   Certified data from an accredited laboratory;
c)   Table 4b.

For twin burner models the preferred source of boiler gross seasonal efficiency and case heat emission is the HARP database. If a new range cooker boiler is not included in the HARP database, certified data as explained in paragraph D6 of Appendix D may be used. If there is no entry in the database or certified data is not available or the model is not of the twin burner type, an indicative gross seasonal efficiency should be taken from Table 4b.

9.2.3   Heating systems based on a solid fuel boiler

This guidance applies to independent solid fuel boilers, open fires with a back boiler and room heaters with a boiler.

Boiler efficiency may be obtained from:
a)   The HARP database;
b)   Certified data from an accredited laboratory;
c)   Table 4a.

The preferred source of boiler efficiency is the HARP database. If a new boiler is not included in the database, certified data should be used if available. Appendix J defines how the gross seasonal efficiency for calculations is determined from test data. If there is no entry in the HARP database and certified data is not available an indicative gross seasonal efficiency should be taken from Table 4a.

Solid fuel boiler efficiencies for open fires and closed room heaters with boilers are the sum of the heat to water and heat directly to the room. It is the user's/ designer's/ Assessor's responsibility to ensure that the ratio of these figures is appropriate to the dwelling. These systems are assigned a lower responsiveness to allow for limitations on the controllability of heat output to the room.

9.2.4   Room heaters

Where available, data from the HARP database or certified data values should be used for the gross efficiency of gas, oil or solid fuel room heaters, certified as explained in Appendix E. If not using certified data or data from HARP, room heater gross efficiency should be taken from Table 4a.

Gas fires
The following notes provide guidance for identifying the appropriate entry from the room heater section of Table 4a, for gas fires already installed in a dwelling. (They are not intended to classify gas fires for testing purposes.)

Gas fires can be "open" or "closed" fronted. Open fronted means the fuel bed and combustion gases are not "sealed" from the room where the gas fire is fitted. Such a fire may or may not have a glass panel in front of the fuel bed, but the glass panel is not sealed to the front of the fire. Closed fronted means the fuel bed and combustion gases are "sealed" (generally with a glass panel sealed to the front of the fire) from the room where the gas fire is fitted.

Fuel effect gas fires can be "live fuel effect" (LFE), "inset live fuel effect" (ILFE) or "decorative fuel effect" (DFE). The products of combustion from a DFE pass unrestricted from the fire-bed to the chimney or flue; for the LFE/ILFE the products of combustion are restricted before passing into the chimney or flue. For further clarification of LFE/ILFE/DFE see clauses 3.1.2, 3.1.3 and 3.1.4 and Figure 1 of BS 7977-1:2002.

Room heaters with boilers
Gas, oil and solid fuel room heaters may have a boiler providing either domestic hot water only or both space heating and domestic hot water.

For gas back boilers, separate efficiencies apply to the boiler and to the associated room heater. This means that:
- if the back boiler provides space heating, it should be defined as the main heating system, and the gas fire should be indicated as the secondary heater subject to guidance under Appendix A;
- if the back boiler provides domestic hot water only, the boiler gross efficiency is used for water heating and the gas fire efficiency for space heating (gas fire as main or as secondary heater).

For oil and solid fuel room heaters with boilers, the gross efficiency is an overall value (i.e. sum of heat to water and heat to room).
- if the boiler provides space heating, the combination of boiler and room heater should be defined as the main heating system where the criteria in Appendix A are met (it could also be the secondary heater);
- if the boiler provides domestic hot water (with or without space heating), the overall efficiency should be used as the efficiency both for water heating and for the room heater (room heater as main or as secondary heater).

9.2.5   Direct Acting Electric Boilers

A direct-acting electric boiler (also known as an electric flow boiler) heats water for space heating radiators as it circulates. Heat control options are identical to other radiator systems. Water heating is usually by an electric immersion. The cylinder can be within the boiler casing or it may be a separate cylinder. The treatment in DEAP is the same for both of these cases.

9.2.6   Heat Pumps

Heat pump efficiency may be obtained from:
a)   The HARP database;
b)   Certified data from an accredited laboratory;
c)   Table 4a.

Calculation of heat pump Coefficient of Performance when certified data is used is detailed on www.seai.ie/ber and Appendix G.

9.2.7   Other heating systems

For other systems the seasonal efficiency is taken from Table 4a. For systems not covered by the table guidance should be sought from SEAI.
In cases where the burner unit is replaced a non-default efficiency value from HARP, SEDBUK (2005) or certified test data is not to be used. Default efficiency should be selected from Table 4a or Table 4b in the DEAP Manual. The original boiler age and the replacement burner fuel type should be used.

9.2.8   Efficiency adjustment factor

It may be necessary to apply an adjustment to the space and/or water heating efficiency. Provision for such adjustment is made in the 'Energy Requirements' tab, applying the data provided in Table 4c. Examples of factors addressed by Table 4c include condensing boilers with under floor heating, heating controls (e.g. the absence of a boiler interlock), and factors affecting the supply temperature of heat pumps.

9.3   Heating controls

The influence of the heating system controls is represented in the 'Distribution System Losses and Gains' tab with reference to Table 4e. The following are descriptions of the types of controls mentioned in Table 4e.

9.3.1   Room thermostat

A room thermostat senses the indoor air temperature and switches on or off the space heating. A single target temperature may be set by the user.

9.3.2   Time switch

A switch operated by a clock to control either space heating or hot water, but not both. The user chooses one or more "on" periods, usually in a daily or weekly cycle.

9.3.3   Programmer

Two switches operated by a clock to control both space heating and hot water. The user chooses one or more "on" periods, usually in a daily or weekly cycle. A mini-programmer allows space heating and hot water to be on together, or hot water alone, but not heating alone. A standard programmer uses the same time settings for space heating and hot water. A full programmer allows the time settings for space heating and hot water to be fully independent.

A programmer may be specified in the following cases:
- Where the main space heating system also heats water (such as a boiler heating radiators and hot water cylinder coil) and there is time control of main space and water heating. This can be combined time control of space and water heating or separate time control thereof.

- Where the main space heating system does not heat water (such as a boiler heating radiators only) and there is time control of main space heating.

9.3.4   Programmable room thermostat

A combined time switch and room thermostat allowing user defined occupancy periods with different target temperatures for space heating, usually in a daily or weekly cycle.

9.3.5   Delayed start thermostat

A device or feature within a device, to delay the chosen starting time for space heating according to the temperature measured inside or outside the building.

9.3.6   Thermostatic radiator valve (TRV)

A radiator valve with an air temperature sensor used to control the heat output from the radiator by adjusting water flow. As shown in Table 4e, a programmer and TRVs are generally required to affect the calculated energy use. At least 50% of the dwelling's radiators should have TRVs to select this option in DEAP.

9.3.7   Cylinder thermostat

A cylinder thermostat measures the temperature of the hot water cylinder and switch on and off the water heating. A single target temperature may be set by the user. A TRV on the cylinder or a thermostat on the cylinder pipework will not achieve this level of control and are not considered to act as a cylinder thermostat.

9.3.8   Flow switch

A flow switch detects when there is no water flow because the TRVs on all radiators are closed.

9.3.9   Boiler interlock

This is not a physical device but an arrangement of the system controls ensuring that the boiler does not fire when there is no demand for heat. Boiler interlock can be achieved by correct wiring interconnections between the room thermostat, cylinder thermostat, and motorised valve(s). It may also be achieved by a suitable boiler energy manager. Boiler interlock can be achieved for combi boilers by fitting a room thermostat.

In systems without an interlock the oil or gas boiler cycles even though no water circulates through the main radiators or to the hot water cylinder. Boiler cycling reduces operating efficiency and Table 4c specifies that a gross seasonal efficiency reduction of 5% should be made for such oil or gas fuelled systems. Interlocked systems are systems where both the space and water heating are interlocked and a reduction is not applied to system efficiency.

A cylinder thermostat normally shuts down the primary circuit pump when the hot water temperature set point is reached. The cylinder thermostat itself may not switch off the boiler; this is only done if the pump and boiler are interlocked and so the presence of a cylinder thermostat does not in itself signify the presence of an interlock for water heating. If there is no cylinder thermostat, however, there can be no interlock since the system does not know when the demand temperature is reached. A boiler system with no cylinder thermostat must therefore be considered as having no interlock.

A boiler system with no connected room thermostat - (or a device equivalent in this context, such as a flow switch or boiler energy manager) - even if there is a cylinder thermostat – is generally considered as having no interlock.

For solid fuel boilers and dry core electric boilers the boiler interlock question is not relevant and the efficiency values in Table 4a allow for normal operation of these appliances. For such systems there is no efficiency reduction for the absence of interlock.

Note: TRVs alone do not perform the boiler interlock function and require the addition of a separate room thermostat in one room.

9.3.10 Bypass

A fixed bypass is a piping arrangement that maintains minimum flow rate through the boiler by ensuring that one radiator stays open or by adding a short pipe with a valve between the flow and return pipe. A radiator without a TRV or hand valve is a common form of fixed bypass. Alternatively, a short pipe with a fixed position valve between the flow and return pipe can be used. An automatic bypass valve controls the water flow in response to the water pressure difference, typically by spring loading, so that the bypass operates only to the extent needed to maintain a minimum flow rate through the system.

The control type 'TRVs + programmer' is a non-interlocked system in the absence of other arrangements to provide the interlock function.

9.3.11 Boiler energy manager

Typically a device intended to improve boiler control using features such as weather compensation, load compensation, start control, night setback, frost protection, anti-cycling control and hot water over-ride. It is equivalent to a hard-wired interlock, weather compensation or load compensation.

9.3.12 Time and temperature zone controls

In order to specify time and temperature zone control it must be possible to program the *heating times* of at least two space heating zones independently in addition to independent temperature controls. It is not necessary for these zones to correspond exactly with the zone division that defines the living area fraction (Section 7.2).

In the case of wet systems separate plumbing circuits are required, either with its own programmer, or separate channels in the same programmer. By contrast, TRVs provide only independent temperature control.

Time and temperature zone control can be specified for electric systems, including under floor heating, by providing separate temperature and time controls for different rooms.

9.3.13 Weather compensator

A device or feature which adjusts the temperature of the water circulating through the heating system according to the temperature measured outside the building.

9.3.14 Load compensator

A device or feature which adjusts the temperature of the water circulating through the heating system according to the temperature measured inside the building.

9.3.15 Controls for electric storage heaters

There are three types of control that can be used with electric storage heaters - manual charge control, automatic charge control and CELECT-type control. Automatic charge control uses internal thermostat(s) or an external temperature sensor to control the charging of the heaters. Availability of electricity to the heaters may be controlled by the electricity supplier on the basis of daily weather predictions. A CELECT-type controller has electronic sensors throughout the dwelling linked to a central control device monitoring the

individual room sensors and optimising the charging of all the storage heaters individually (and may select direct acting heaters in preference to storage heaters).

10   Total energy use

['Energy Requirements' and 'Results' tab]

10.1   Energy use

The annual fuel or electricity consumption, under the standard patterns of occupancy and usage is calculated for the following items or functions:

- main space heating system;
- secondary space heating;
- domestic hot water heating;
- supplementary electric water heating;
- electricity for pumps and fans (including mechanical ventilation if present);
- electricity for lighting;
- energy produced or saved from renewable and energy saving technologies.

10.2   Fuel factors

Primary energy factors and CO_2 emission factors associated with different fuels are calculated using the data given in Table 8. Other primary energy or CO_2 factors must <u>not</u> be used for the purpose of this calculation.

Since fuels have to relate to realistic heating systems it is important that practical combinations of fuel types are used.
The primary energy and CO_2 emission factors in Table 8 account for energy used and emissions released at the dwelling, and also take some account of energy used and emissions released in bringing the fuel or other energy carrier to the dwelling. For example, in the case of electricity they account for energy losses and emissions at power stations. The primary energy and CO_2 emissions factors for electricity are updated in DEAP as new National Energy Balance Figures are published.

10.3   Main heating system fuel types

The choice of fuel type from Table 8 should be appropriate for the particular heating system, whether main or secondary. Specifying the main heating fuel is usually straightforward but the following points should be borne in mind.

10.3.1   Gas systems

The choices are mains gas, bulk LPG and bottled gas. Bottled gas is normally used only with gas room heaters. In dwellings where the main heating system uses mains gas or bulk LPG, any gas-fired secondary system should use the same fuel as the main system.

10.3.2   Electric systems

A single electricity fuel type, specified in Table 8, is used for all electricity fuelled heating systems. See Table 10a for proportions of electricity used at the on-peak and off-peak rates. This may be used in conjunction with latest fuel costs available on www.seai.ie/statistics to determine expected dwelling heating system running costs but is not required when producing a BER assessment.

Integrated storage/direct systems comprise:
a) electric storage heaters with reduced storage capacity but incorporating a direct-acting radiant heater, designed to provide about 80% of the heat output from storage and about 20% from direct-acting;
b) underfloor heating designed to meet about 80% of the heating needs at off-peak times and about 20% at on-peak times. This heating can be controlled by a "low (off-peak) tariff control" which optimises the timing and extent of the off-peak charge according to outside temperature and the quantity of stored

heat. Low tariff control optimises the storage of heat in the floor during the off-peak period, and is modelled by a higher system responsiveness.

A secondary system is always to be specified when the main system is electric storage heating or off-peak electric underfloor heating.

10.3.3   Solid fuel systems

Solid fuel appliances can be fuelled by coal, anthracite, manufactured solid fuel, peat or wood. Some models, referred to as 'multi-fuel', are capable of using more than one fuel type. The flue ventilation loss (see Section 2) does not apply to room sealed pellet boilers and stoves.

For solid fuel boilers and heaters representing the main heating system, the fuel type should be chosen as follows, proceeding from points 1 towards 4 until a choice is made.

1. If the heating appliance is designed to burn only a wood fuel, i.e. its design is such as to prohibit the use of any other fuel type, then the appropriate wood fuel type should be selected. Otherwise a wood fuel should not be selected. This can be demonstrated by one of the following:
    *   Documentation showing that the product warranty is void if the product is used with any fuel type other than wood fuels ;
    *   Listing of the product under http://www.hetas.co.uk/ showing that the appliance burns wood fuels only.
    Where there is any doubt about fuel type selection wood fuels should not be selected as the fuel type for the purposes of demonstrating TGD L compliance.
2. If the appliance is designed to burn a particular coal-based or peat-based fuel type, then that should be chosen as the fuel.
3. If the appliance can burn more than one fuel type (open fires and many closed roomheaters and range/ cooker boilers are in this category), the most likely non-wood fuel type should be selected based on (a) the appliance design, and (b) the dwelling location (taking account of smoke control areas and fuels common in the area).
4. If the fuel type is still unresolved, "multi-fuel" should be selected.

The following table summarises the information above:

Scenario	Wood (logs, pellets, chips)	Manufactured smokeless fuel	One of house coal; sod peat; peat briquettes or anthracite	Solid multi-fuel
Appliance can only burn wood fuels	☒	X	X	X
Appliance can only burn a particular coal or peat based product	X	☒(select fuel type as appropriate)	☒(select fuel type as appropriate)	X
Appliance can burn multiple solid fuels but a particular non-wood fuel is the most commonly available or applicable fuel in the area	X	☒ (Select manufactured smokeless fuel when dwelling is in "smoke control area" and the appliance can burn multiple fuels)	☒ (Select one of these fuels when dwelling is in non "smoke control area" and that fuel is clearly the most commonly available fuel in the area)	X
All other scenarios	X	X	X	☒

Independent boilers that provide domestic hot water usually do so throughout the year. With open fire back boilers or closed roomheaters with boilers, an alternative system (such as an electric immersion) may be provided for heating water in the summer. DEAP assumes that a fraction 0.33 of the annual water heating is provided by the supplementary electric water heating. Supplementary electric water heating should be specified where the main water heater is incapable of providing water heating without space heating as detailed in Section 4.6.

Smoke control areas (also called coal restricted areas) can be identified using the facility under http://maps.epa.ie or following guidance on the Department of Environment, Community and Local Government website . Individual Local Authorities may have further details. Outside Smoke Control Areas

any fuel can be used subject to the manufacturer's instructions for the appliance concerned. Within Smoke Control Areas guidance under
 http://www.irishstatutebook.ie/2000/en/si/0278.html should be followed.

The fuel chosen based on the above guidance will not always be the same as the fuel specified in accredited test data or the HARP listing for the appliance. The following guidance applies when using test data:
- If the appliance fuel type in DEAP matches the test data fuel type then the gross efficiency is used if it is shown on the test certificate or on HARP. HARP always lists gross seasonal efficiencies.
- If the appliance fuel type in DEAP matches the test certificate fuel type but the test certificate only shows the net efficiency then the net/gross conversion described in Appendix E must be applied (see Table E4).
- If the appliance fuel type in DEAP is solid multifuel then the Assessor should consider the average efficiency from available solid fuel test data. This may be a single efficiency for a single available test fuel type or multiple efficiencies for multiple fuel types. The data could be from HARP or from other accredited sources. If the test data specifies gross efficiencies, such as on HARP, then the average of these can be used in DEAP. If the test data efficiencies are net, then these are averaged and the solid fuel net/gross conversion of 0.94 described in Appendix E must be applied.

10.4   Secondary heating system fuel types

Secondary heating systems are taken from the room heaters section of the HARP database or Table 4a and the fuel options will in practice be determined by the fuel used for the main heating system. For solid fuel heaters, the fuel type should be selected in the manner described in Section 10.3.3 above for main fuel types.

10.5   Water heating fuel types

Water heating may be provided by the main heating system or may be supplied using an independent water heating system.

10.6   Electricity for pumps and fans

In relation to heating and ventilation equipment fired on oil, gas, solid fuel or renewable energy, an allowance is made for energy consumption in the form of electricity used. This applies to any of the following items:
- central heating pump for individual heating systems. This is the pump from the heat source (such as a boiler or heat pump) to the space heat emitters (such as radiators or underfloor heating). Efficiency data for central heating pump power can be obtained from pump energy labels as detailed in DEAP Table 4f;
- boiler with fan assisted flue in individual heating systems (fuel and flue pump for oil boilers);
- warm air heating system fans (warm air ducted to rooms rather than via a wet heating system). Note that the presence of "fan-coil" radiators, where an electric fan draws heat from the radiator to the room, should be recorded as a "warm air heating system" in the DEAP distribution system losses and gains tab;
- whole house mechanical ventilation;
- keep-hot facility (electric) for gas combi boilers;
- Solar water heating pump;
- Group heating electrical pump energy as detailed in Section C1.1.

The standard tariff is the on-peak rate unless the heating and/or hot water uses an off-peak tariff. Note that the allowance in this section for fan assisted flues only applies for boilers - fan assisted flues for gas fires should not be counted. Data are given in Table 4f.

10.7   Electricity for lighting

The electricity used for lighting is calculated in the 'Lighting and Internal Gains' tab according to the procedure in Appendix L. The calculation allows for low-energy lighting provided by fixed outlets (both dedicated fittings and compact fluorescent lamps) on the basis of the proportion of the fixed outlets that have low-energy fittings (as defined in Appendix L). The tariff applicable to lighting is the on-peak rate.

10.8   **Group heating**

A dwelling heated by a group heating scheme can have a number of energy sources as outlined in the following sections.

10.8.1   Heating System 1/2/3

DEAP allows for three different heat sources to contribute to main space and water heating. Each source requires that the following be specified by the BER Assessor:

- Fuel type of each heating system being used;
- Seasonal efficiency of each heating system being used. Gross seasonal efficiencies are used for boilers;
- Proportion of group heating provided by each of the three heating systems being used. This figure should be taken from plant design or from operational records.

10.8.2   Group solar space and water heating

DEAP allows for solar heating to contribute to the main space and water heating of the dwelling. If this type of system is present, the proportion of group heating provided by the solar space and water heating system should be specified. This proportion is calculated using the method detailed on www.seai.ie/ber .

10.8.3   Secondary heating

A dwelling where heating is available from a group heating scheme can also have its own secondary space heating system. The proportion of heat from secondary heating is determined using Table 7. The secondary heating system efficiency is calculated using Table 4a, Table 4b, HARP or certified data.

10.8.4   CHP and waste heat from power stations

A dwelling where heating is available from a group heating scheme can take some main space heating and main water heating from a CHP plant or from heat recovered from power stations. The proportion of heat supplied in this case should be taken from plant design figures or from operational records. Further detail is available under Appendix C and Appendix N.

Note that DEAP also caters for CHP plant installed as part of an individual heating system, although this type of system is uncommon. In such cases the relevant method is detailed under Appendix N.

10.8.5   Solar water heating

If a dwelling where water heating is available from a group heating scheme obtains some of its hot water from a solar heating system then this is entered in the 'Water Heating' tab as detailed in Section 4. This also applies to solar water heating systems shared amongst a number of dwellings.

10.9   **Renewable and energy saving technologies**

The "energy produced or saved" section allows for the benefits of newer energy-saving technologies that are not included in the published DEAP software (including photovoltaics, wind energy, solar space heating amongst others). Heat pumps, biomass, heat recovery ventilation and solar water heating are all accounted for elsewhere in DEAP and are not to be included in this section.

The energy produced (and consumed) by the technology is entered as delivered energy. The associated primary energy factor and CO_2 emissions are taken from Table 8. Further guidance is taken in Appendix M and Appendix Q.

Section 13.2 provides details on use of the energy produced or saved section to contribute towards the renewable energy requirement of Building Regulations 2008 and 2011 TGD L.

11   Energy, emissions and costs

['Energy Requirements' and 'Results' tab]

DEAP enables users to calculate the following results, both total and per m^2 of total floor area. All of these relate to the assumed standard occupancy; the energy consumption patterns of real occupants vary widely.

Delivered energy, in kWh/year: This corresponds to the energy consumption that normally appears on the energy bills for the assumed standardised occupancy and end-uses considered.

Primary energy, in kWh/year: This includes delivered energy, plus an allowance for the energy "overhead" incurred in extracting, processing and transporting a fuel or other energy carrier to the dwelling. The generation efficiency of power stations is included.

Carbon dioxide emissions, in kg CO_2 per year: Emissions are calculated on the basis of primary energy consumption, e.g. emissions at power stations associated with the dwelling's electricity use are included.

Costs: Current fuel costs may be calculated using the delivered energy for each fuel type in the 'energy requirements' tab along with up to date domestic fuel cost under www.seai.ie/statistics . Table 10a and Table10b may be used in calculating on peak and off peak electricity fractions. Note that energy cost calculation is not part of the DEAP methodology.

12   Building energy rating

['Results' tab]

The procedure and software may be used to generate "Building Energy Rating" (BER) labels and BER Advisory Reports as required under the EPBD. This provision applies to new dwellings from 1st January 2007 and to existing dwellings from 1st January 2009. The format and content of the BER label is detailed on www.seai.ie/ber.

The energy rating ranges from G (largest primary energy usage) to an A1 rating (lowest primary energy usage). It is critical to note that multiple factors including dwelling dimensions, orientation, ventilation, dwelling fabric, water heating, lighting, space heating, heating controls and fuel type influence the building energy rating and must all be considered when determining the actual rating and where potential improvements could be made.

13   Building regulations

['Results' tab]

DEAP allows the BER Assessor to demonstrate a new dwelling's conformance to certain sections of Building Regulations 2005 - 2011 TGD L. This Part L conformance checking does not apply to existing dwellings.

13.1   Building Regulations 2005 TGD L conformance demonstration

DEAP performs the following checks for new dwellings where Building Regulations 2005 TGD L applies:
* Building Regulations 2005 TGD L specifies that the DEAP methodology is used to show that the Carbon Dioxide Emission Rating (CDER) of the dwelling being assessed does not exceed that of a Reference dwelling for which the corresponding Maximum Permitted Carbon Dioxide Emission Rate (MPCDER) is also calculated, both being expressed in units of kg CO_2 per square metre per annum. The Reference dwelling is specified in Appendix C of Building Regulations 2005 TGD L.
* The 'overall heat loss method' or 'elemental heat loss method', as defined in Section 1.2 of Building Regulations 2005 TGD L, should be satisfied.

13.2   Building Regulations 2008 and 2011 TGD L conformance demonstration

DEAP performs the following checks for new dwellings where Building Regulations 2008 and 2011 TGD L apply:
* The calculated primary energy usage of the proposed dwelling is divided by that of a reference dwelling, the result being called the Energy Performance Coefficient (EPC). DEAP compares the EPC

to the Maximum Permitted Energy Performance Coefficient (MPEPC). The reference dwelling for this calculation is detailed in Appendix C of Building Regulations 2008 and 2011 TGD L. The MPEPC is defined in Section 1.1.2 of Building Regulations 2008 and 2011 TGD L.

- The calculated CO_2 emission rate is divided by that of a reference dwelling, the result being called the Carbon Performance Coefficient (CPC). DEAP compares the CPC to the Maximum Permitted Carbon Performance Coefficient (MPCPC). The reference dwelling for this calculation is detailed in Appendix C of Building Regulations 2008 and 2011 TGD L. The MPCPC is defined in Section 1.1.2 of Building Regulations 2008 and 2011 TGD L.

- The new dwelling must use a minimum level of renewable technologies (such as solar thermal systems, heat pumps, CHP, wood fuels and other small scale renewable systems). The amount of heat and/or electricity to be generated by these systems is defined in Section 1.2 of Building Regulations 2008 and 2011 TGD L. DEAP allows the renewables requirement to be met using either an individual or group heating system. The energy contribution from renewables can also be specified using the 'Energy produced or Saved' section of the 'Energy Requirements' tab. In this case the energy source must be specified as being a renewable technology (electrical or thermal energy) or a non renewable technology. The 'energy produced or saved' section should not contain renewable or energy saving technologies already accounted for elsewhere in DEAP (such as heat pumps, biomass, solar water heating, CHP and heat recovery).

- The exposed elements of the dwelling fabric are required to meet the constraints detailed in Section 1.3 of Building Regulations 2008 and 2011 TGD L. An average U-value must be met for each type of element. DEAP also checks that no individual section of an element exceeds the maximum U-value for that type of element.

    As per Building Regulations 2008 and 2011 TGD Section 1.3.1.2, the wall between a dwelling and an unheated unventilated space may not need to meet the U-value requirement for external walls. Please refer to the TGD L 2008 and 2011 for further guidance. DEAP allows the BER Assessor to exclude these walls from fabric U-value compliance checking under these circumstances. These walls are still considered to be heat loss walls, and, as per Section 3.3, an R_U value should be applied to this semi-exposed heat loss wall by the BER Assessor.

If an Assessor is asked by a client to carry out a BER on a new dwelling where TGD L 2002 or earlier applies, the Assessor should notify the client that DEAP is not designed to carry out compliance checking to these earlier regulations. However, DEAP TGD L 2005 fabric insulation compliance checking can be used for Elemental Heat Loss and Overall Heat Loss method for TGD L 2002. TGD L 2002 and TGD L 2005 fabric insulation requirements are the same.

Compliance checking using the Heat Energy Rating method should be calculated as per Section 1.4 of TGD L 2002, although the Assessor does not have a role in carrying out the Heat Energy Rating.

The BER Assessor should also ensure that the client is made aware of the applicable TGD L detail on:
- Thermal bridging;
- Air Infiltration;
- Heating Controls;
- Insulation of Hot Water Storage Vessels, Pipes and Ducts.

References

Main references

IS EN ISO 13790:2004: Thermal performance of buildings – calculation of energy use for space heating.

UK Standard Assessment Procedure (SAP), published on behalf of DEFRA by BRE (http://www.bre.co.uk/).

2005 - 2011 Building Regulations, Technical Guidance Document L, Conservation of Fuel and Energy (http://www.environ.ie/en/TGD/)

Action Plan for Implementation of the EU Energy Performance of Buildings Directive in Ireland (www.epbd.ie (Key documents)).

Limiting Thermal Bridging and Air Infiltration. Acceptable Construction Details (http://www.environ.ie/en/TGD/)

Other references

1.   Anderson BR, Clark AJ, Baldwin R and Milbank NO, *BREDEM The BRE Domestic Energy Model - background, philosophy and description.* BRE Report: BR 66, BRE, Garston, 1985.

2.   Henderson G and Shorrock LD, *BREDEM - BRE Domestic Energy Model - testing the predictions of a two zone model*, Building Services Engineering Research & Technology, 7(2) 1986, pp 87-91.

3.   Shorrock LD and Anderson BR, *A guide to the development of BREDEM.* BRE Information Paper IP 4/95, BRE, Garston, 1995.

4.   Anderson BR, Chapman PF, Cutland NG, Dickson CM, Henderson G, Henderson JH, Iles PJ, Kosmina L and Shorrock LD, *BREDEM-12 Model description – 2001 update.* BRE, Garston, 2001.

5.   Anderson BR, *Energy assessment for dwellings using* BREDEM *worksheets,* BRE Information Paper IP 13/88, BRE, Garston, 1988.

6.   *CIBSE Guide A3*, The Chartered Institution of Building Services Engineers (CIBSE), London, 1999.

7.   *Basements for dwellings*. Approved Document, British Cement Association, BCA, Crowthorne, 1997. ISBN 0-7210-1508-5.

8.   Anderson BR, *BRE 443: Conventions for Calculating U values*. BRE Scotland. 2006 Edition

List of relevant standards

Reference	Title	Content
IS EN ISO 6946	Building components and building elements - Thermal resistance and thermal transmittance - Calculation method	Calculation of U-values for walls and roofs.
IS EN ISO 10077-1	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance. Part 1: General	U-values for windows and doors
IS EN ISO 10077-2	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance. Part 2: Numerical method for frames	U-values for window frames
ISO EN 10456	Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared design thermal values.	List of thermal conductivity values
IS EN ISO 12567	Thermal performance of windows and doors- Determination of thermal transmittance by hot box method	U-value measurement for windows and doors
IS EN ISO 13370	Thermal performance of buildings - Heat transfer via the ground - Calculation methods	U-values for floors
IS EN 13786	Thermal performance of building components – dynamic thermal characteristics - Calculation methods	Thermal admittances
IS EN ISO 13789	Thermal performance of buildings - transmission heat loss coefficient - Calculation method	Heat loss rate from whole building
IS EN ISO 13790	Thermal performance of buildings - Calculation of energy use for space heating and cooling	Annual heating and cooling energy use for a building
IS EN 13829	Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method	Permeability testing method
IS EN 613:2001	Independent gas-fired convection heaters	Gas fired room heater testing
I.S. EN 13278:2003	Open fronted gas-fired independent space heaters	Gas fired room heater testing
IS EN 1266:2002	Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases	Gas fired room heater testing
BS 7977-1:2002	Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors	Gas fired room heater testing
BS 7977-2:2003	Specification for safety and rational use of energy of gas domestic appliances. Part 2: Combined appliances: Gas fire/back boiler	Gas fired room heater testing
OFS A102:1999	Oil fired room heaters with atomising or vaporising burners with or without boilers, heat output up to 25 kW	Oil fired room heater testing
IS EN 12975-2	Thermal solar systems and components – Solar collectors – Part 2: Test methods	Solar panel parameter testing
BS EN 13141-6	Ventilation for buildings. Performance testing of components/products for residential ventilation. Exhaust ventilation system packages used in a single dwelling	Definition of mechanical ventilation duct configuration
BS EN 13141-7	Ventilation for buildings - Performance testing of components/products for residential ventilation. Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings, 2004	Mechanical ventilation heat recovery testing
BS 1566	Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods	Cylinder losses

IS EN 12897	Water Supply - Specification for Indirectly Heater Unvented (Closed) Storage Water Heaters	Cylinder losses
IS EN 13240:2001	Roomheaters fired by solid fuel. Requirements and test methods	Solid fuel room heater testing
IS EN 13229:2001	Inset appliances including open fires fired by solid fuels. Requirements and test methods	Solid fuel room heater testing
IS EN 14785:2006	Residential space heating appliances fired by wood pellets. Requirements and test methods	Wood pellet appliance testing
IS EN 303-5:1999	Heating boilers. Heating boilers with forced draught burners. Heating boilers for solid fuels, hand and automatically fired, nominal heat output of up to 300 kW. Terminology, requirements, testing and marking	Solid fuel boiler testing
IS EN 14511-2:200	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling. Test conditions	Heat pump testing
IS EN 255-2:1997	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode. Testing and requirements for marking for space heating units (withdrawn), 1997	Heat pump testing
IS EN 255-3: 1997	Air Conditioners, Liquid Chilling Packages and Heat Pumps with Electrically Driven Compressors - Heating Mode - Testing and Requirements for Marking for Sanitary Hot Water Units	Heat pump testing (water heating)
IS EN 61215	Terrestrial Photovoltaic (PV) modules with Crystalline Solar Cells – Design Qualification and Type Approval	Photovoltaic testing
BS EN 61646	Thin-film terrestrial photovoltaic (PV) modules – Design Qualification and Type Approval	Photovoltaic testing
IS EN 410 : 1998	Glass in Building – Determination of Luminous and Solar Characteristics of Glazing	Glazing solar transmittance

Note that some of the standards listed above may not necessarily be shown on test certificates but are cross referenced by other standards shown on the test certificates. For example a test cert for window thermal performance may list EN 14351-1 rather than EN10077-2. As EN14351-1 references the relevant standards for window U-value and solar transmittance such as EN410 and EN10077-2, it may be used for the purposes of BER assessments provided the test certificate is produced by a body with the required accreditation as outlined in the "General Principles" Section of the DEAP manual.

Appendix A: Primary and secondary heating systems

A1   General principles

The primary or main heating system heats the largest proportion of the dwelling. This proportion is calculated using a count of the habitable rooms (see A3.2). It is not usually based on individual room heaters (although it can be), and often provides hot water as well as space heating. Main heating systems are categorised on the basis of generic types in Tables 4a and 4b. Occasionally there may be two central heating systems, for example two separate boilers used to heat different parts of the property. In this case the calculation should be undertaken using the system that heats the largest part of the property.

In DEAP a main space heating and main water heating system (and associated fuel for each) must be specified at all times. For example, it may not be assumed that solar water heating is the main water heater in DEAP.

The secondary heating system is based upon a room heater. Secondary heating system efficiencies are taken from the HARP database, certified test data to the relevant standards or room heaters section of Table 4a.

A secondary heating system is to be specified if:

a)   the main system is not sufficient in itself to heat the dwelling to the temperatures used in DEAP

or

b)   fixed secondary heaters are present (e.g. a gas fire, a chimney and hearth capable of supporting an open fire or a solid fuel stove, storage or fixed direct acting electric heaters).

In case a), assume direct-acting electric heaters if no actual secondary heaters are present. A secondary system is always specified when the main system is electric storage heaters or off-peak electric underfloor heating. If none of the above conditions apply, secondary heating (or backup heating system) is not specified, i.e. in the software the secondary fraction is set to zero.

Portable heaters are not counted in DEAP assessments. These are characterised as:
- completely free standing and self supporting on feet, legs or base on the floor, i.e. not wall mounted or specifically designed for a fireplace, and in the case of gas or oil heaters containing a built-in fuel store;
and
- readily and easily transferred and relocated from one room to another, in the case of an electric heater having a lead and a plug.

Fixed electric bathroom heaters are not to be counted as secondary heaters for the purposes of DEAP assessments. Also, towel rails (both electric or from a wet heating system) should be ignored for the purposes of DEAP assessments.

Occasionally, there may be a chimney present as defined in Section 2, but the open fire is not counted as a heat source in DEAP (for example, there is another secondary heat source which takes precedence). In this case the chimney must still be counted in the DEAP ventilation section.

DEAP is based on the characteristics of the dwelling and the systems installed and **not on the heating practices of the occupying household**. That does not preclude further estimates of energy consumption being made to take account of actual usage. Such estimates are not part of DEAP but could form the basis of advice given to the occupying household on how to make best use of the systems at their disposal.

Table 7 gives the fraction of the heating that is assumed to be supplied by the secondary system. The treatment of secondary systems is not affected by any control options for the secondary system.

If two systems are present and it is not clear which is the main or secondary system the system which is cheapest to use (see A2) should be taken as the primary, and if there is still doubt, i.e. if they are both equally cheap to use, select the system that heats the living room. The other system can still be input as a secondary system but should be entered as a room heater so that its efficiency closely reflects (but does not exceed) that of the actual system (as defined by Table 4a) where using Table 4a defaults.

If two types of secondary heater are present, that which heats the greater number of rooms should be specified as the secondary system (and the other secondary heaters ignored). If that condition does not resolve the choice, the system which is the cheapest to run should be specified.

A2   Procedure for determining the heating systems

(1) Identify the main heating system. If there is a central system that provides both space and water heating and it is capable of heating at least 30% of the dwelling, select that system as the main heating system. If there is no system that provides both space and water heating, then select the system that has the capability of heating the greatest number of habitable rooms.

(2) Select the system that is cheapest to run if there is still doubt about the main system. This can be determined by entering each system in DEAP and multiply the resulting delivered energy by the cost per kWh for the fuel type of that heating system. The up to date fuel cost per kWh can be based on domestic fuel costs from www.seai.ie/statistics or from fuel bills for the dwelling.

A3   Dwellings with inadequate heating systems

A3.1   New dwellings

The DEAP methodology assumes that a good standard of heating will be achieved throughout the dwelling. For dwellings in which the heating system is not capable of providing the standard, it should be assumed that the additional heating is provided by electric heaters, using the fraction given in Table 7 (but see also A3.3). For new dwellings that have no heating system specified, it should be assumed that all heat will be provided by electric heaters using electricity at the standard domestic tariff.

A3.2   Existing dwellings

Some existing dwellings have heaters only in a limited number of rooms. In these cases the usual basis of calculation, that the dwelling is fully heated, still applies. Rooms without heaters are assumed to be heated by electric room heaters. The choice between primary and secondary heating is decided as follows:

(1)   Count the number of habitable rooms including any living room, sitting room, dining room, bedroom, study and similar; and also a non-separated conservatory. A kitchen/diner having a discrete seating area also counts as a habitable room. Excluded from the room count are rooms used solely as a kitchen, utility room, bathroom, cloakroom, en-suite accommodation and similar; any hallway, stairs or landing; and also any room not having a window. For open plan dwellings count all spaces thermally connected to the main living area (e.g. a living/dining room) as one room.

(2) If 25% or less of the habitable rooms are actually heated, and are heated by a fuel other than electricity, the (assumed) electric system is the primary and the other fuel is the secondary. A heated room means one with a heat emitter in the room.

(3) If the number of habitable rooms actually heated is more than 25% but not exceeding 50%, and there is one type of heater installed, this heating system is the primary and the (assumed) electric heaters are the secondary. Where there is more than one type of heater installed in this case, Sections A1 and A2 apply when identifying the primary and secondary space heating systems.

(4) If more than 50% of the habitable rooms are heated, the rules from Section A1 and A2 apply in identifying the primary and secondary space heating systems. In this case, the dwelling is considered to be adequately heated.

Examples. A house with 6 habitable rooms with one gas fire would be treated as being electrically heated with a gas secondary heater (1 room out of 6). If there were two gas fires (2 rooms out of 6), the gas fires are the primary heating and electricity the secondary. If there were 4 habitable rooms, and one gas fire (1 out of 4), the primary heating would be electric and the gas fire the secondary.

A3.3   Highly insulated inadequately heated small dwellings

In the case of highly insulated small dwellings, item (2) in A3.2 may not be realistic, for example a 3 kW gas fire could suffice to provide most of the heating needs. Accordingly, if the design heat loss (DHL) is less than 3 kW, the heating in the main room is the primary system in this case. Dwelling heat loss is defined in Section A3.5.

A3.4   Broken heating systems

DEAP assumes that the installed heating systems are operational and takes no account of whether they are working or not. However, in the case where the main heating unit (e.g. boiler) is missing and thus the dwelling has no installed primary heating system, the rules in A3.2 should be followed.

The DEAP methodology assumes that the installed heating systems are properly installed and serviced. When designing and installing heating systems the following documents should be read (both to be published by NSAI):
SR 50:2010
- Code of practice for building services - Part 1: Domestic plumbing and heating
- Code of practice for building services – Part 2: Solar Panels

A3.5   Estimating the required boiler size

DEAP should not to be used to size the heating system (this is usually up to the system designer or heating system supplier/installer). The following method can be used to estimate the required heat system power output. Note that sizing the heating system is not the responsibility of SEAI and is entirely a matter for the client and the Assessor or system designer.

Maximum recommended dwelling heating load: Expressed in kW.
For dwelling heat load, the maximum space heat demand is calculated by multiplying the heat loss coefficient by the desired maximum temperature differential ΔT (usually -1 to 21°C). The heat loss coefficient is the heat loss in W/K of the dwelling when accounting for fabric and ventilation losses. The heat loss coefficient is called the "Total Heat Loss" in the DEAP software building elements tab and includes heat lost through the dwelling fabric and ventilation heat loss.

2 to 4 kW should be added to the space heating demand for water heating depending on occupancy or floor area.

The total space and water heating requirement should be multiplied by 1.1 to allow for distribution losses giving the following maximum recommended dwelling heating load:

Dwelling space and water heat requirement (W)
                = dwelling space heat loss + dwelling DHW requirement

                = Total Heat Loss*22 *1.1   + 4000*1.1

Appendix B: Gas and oil boiler systems, boilers with a thermal store, and range cooker boilers

B1 Boilers in the database

The Home-Heating Appliance Register of Performance (HARP database) (see Section 9.2.1) contains, in addition to efficiency, all the boiler parameters relevant to DEAP calculations.

B2 Gas and oil boiler systems in Table 4b

General definitions of the various modern boiler types are given in Appendix D. Table 4b gives gross seasonal efficiency values for use when the HARP value is not available. The following provides guidance for the categories in Table 2 and Table 4a/4b.

B2.1   Combination boilers

Table 4b does not distinguish between the sub-types of combination boiler, and the values given for 'combi' apply to all sub-types (on/off or modulating, instantaneous or storage).

For definitions of storage combination boilers see D1.10 to D1.12 in Appendix D.

A <u>combination boiler</u> with an internal hot water store may be either:

- primary   a primary water store contains mainly water common with the space heating circuit.

- secondary   a secondary water store contains mainly water directly usable as domestic hot water.

Primary storage combi boiler   Secondary storage combi boiler
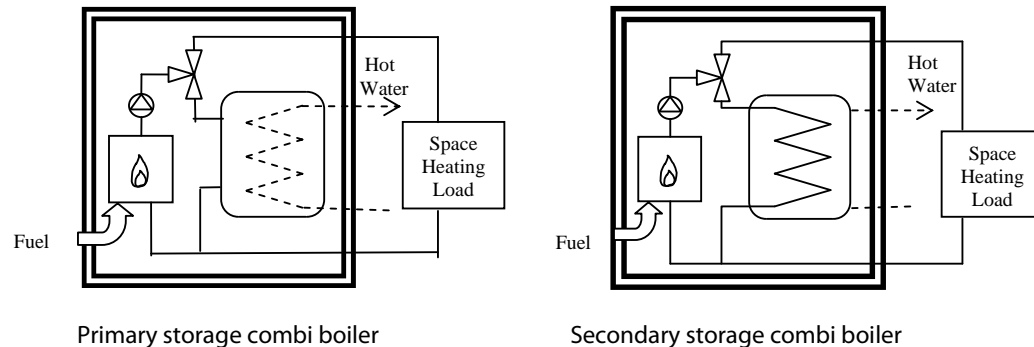
Figure B1 Primary and secondary storage combi boilers

The main difference between a combined primary storage unit CPSU (see Section B2.5) and a storage combination boiler with a larger primary store is that in a CPSU the feed to the space heating circuit is taken from the store, while in a storage combi with a larger primary store, the store does not feed the space heating circuit.

B2.2   Boilers 1998 or later

If the ignition type is not known, a boiler with a fan-assisted flue may be assumed to have automatic ignition, and one with an open flue to have a permanent pilot light.

B2.3   Boilers with fan-assisted flue

'Low thermal capacity' means a boiler either having a copper heat exchanger or having an internal water content not exceeding 5 litres. If the position is uncertain the category of 'high thermal capacity' should be used.

B2.4   Boiler selected by date

The date refers to the year of manufacture of the boiler. If this is uncertain the older category should be used.

B2.5   Combined Primary Storage Unit (CPSU)

A CPSU is defined in D 1.13. The store must be at least 70 litres - if the store is less than 70 litres, the appliance should be treated as a storage combination boiler. A schematic illustration of a CPSU is shown in Figure B2.

Note: If the store is a different appliance from the boiler (ie contained within a separate overall casing) the system should be treated as a boiler with a thermal store as described in B3.
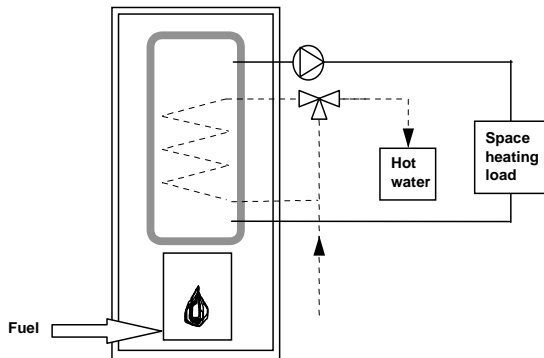
Figure B2 Combined primary storage unit (CPSU)

B3   Boilers with a thermal store

All systems described in this section have hot water stores as a separate appliance from the boiler.

B3.1   Integrated thermal store

An integrated thermal store is designed to store primary hot water directly for space heating and indirectly for domestic hot water. The heated primary water is circulated to the space heating (e.g. radiators). The domestic hot water is heated instantaneously by transferring the heat from the stored primary water to the domestic hot water flowing through the heat exchanger. A schematic illustration of an integrated thermal store is shown in Figure B3.

For an appliance to qualify as an integrated thermal store, at least 70 litres of the store volume must be available to act as a buffer to the space heating demand.
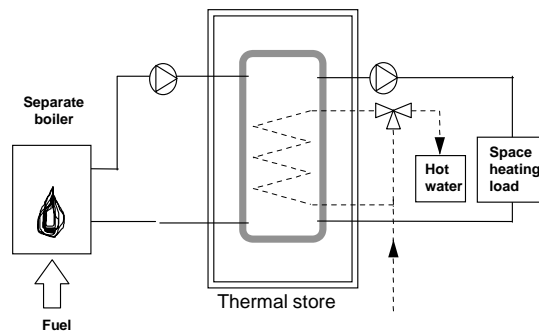
Figure B3 Integrated thermal store

B3.2   Hot water only thermal store

A hot water only thermal store is designed to provide domestic hot water only and is heated by a boiler. The domestic hot water is heated by transferring the heat from the primary stored water to the domestic hot

water flowing through the heat exchanger, the space heating demand being met directly by the boiler. A schematic illustration of a hot water only thermal store is shown in Figure B4.
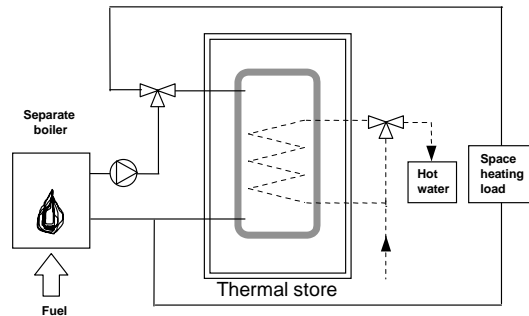
Figure B4 Hot water only thermal store

B4   Range cookers (oil, gas, LPG and solid fuel)

Range cookers are flued cooking appliances predominantly constructed of cast iron designed to provide some heat from their case into the space where they are located. There are three types:

B4.1   Range cooker with boiler for space heating

This type provides an independent water heating function for space heating in addition to the cooking function. There are two design variations:

(i)   **Twin burner range cooker/boiler –** an appliance with two independently controlled burners, one for the cooking function, one for the water heating function for space heating (using radiators for example),

(ii)   **Single burner range cooker/boiler –** an appliance with a single burner that provides a cooking function and a water heating function for space heating (using radiators for example).

For the twin burner type, the gross seasonal efficiency can be can be from the HARP database, certified data or Table 4a/4b, as explained in Section 9.2.2 and 9.2.3.

For the single burner type, the gross seasonal efficiency should be obtained from Table 4a/4b.

B4.2   Single burner range cooker/water heater

Some ranges provide a cooking function and some or all domestic hot water without providing space heating. Such a range can only be specified as a water heater if the water heating function can be provided independently from the cooking function. The efficiency is taken from Table 4a. If it is unclear whether cooking and water heating are independent, the range should not be included.

B4.3   Single burner dry heat range cooker

This type is an appliance with a single burner that provides a cooking function. It is not included in DEAP calculations.

Appendix C: Group heating schemes

C1   Group heating where heat is produced by centralised unit by dedicated plant

In group schemes, also known as community or district schemes, heat produced centrally serves a number of dwellings or communal areas.

CHP (Combined heat and Power) is defined as the simultaneous generation of heat and electrical power in a single process.

There are a number of ways of producing heat for group heating by a dedicated plant:

- heat produced by boilers only (Figure C1);
- heat produced by a combination of boilers and CHP units (Figure C2);
- other permutations of heating systems outlined in Sections C3 and C4.
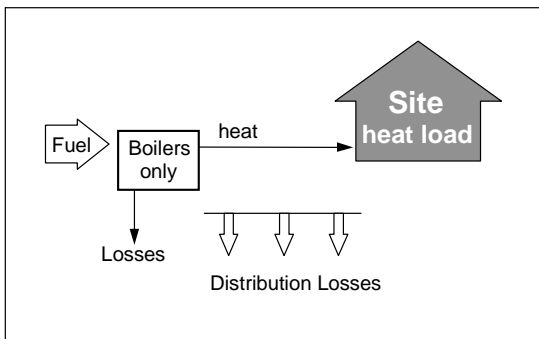
Figure C1 Group heating with heat supplied by boilers only
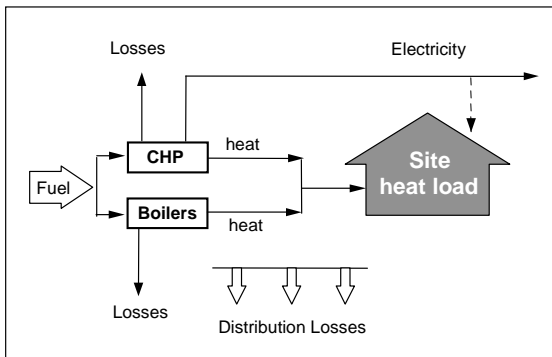
Figure C2   Group heating with heat supplied by a combination of boilers and CHP

For group heating with CHP Schemes, the CHP unit is the primary heat source, and back-up boilers of conventional design are used when the heat output of the CHP plant is insufficient to meet the instantaneous demand. The proportion of heat from CHP and from boilers varies between installations.

The proportions of heat from the CHP and from conventional boilers, and the heat and electrical efficiencies of the CHP for the calculation of CO_2 emissions, should be estimated, either on the basis of operational records or in the case of a new scheme on the basis of its design specification. Heat efficiency is defined as the annual useful heat supplied from a CHP scheme divided by the total annual fuel input (based on Gross Calorific Value). The electrical power efficiency is the total annual power output divided by the total annual fuel input (based on Gross Calorific Value).
The heat efficiency of the CHP should be based on the useful heat supplied by the CHP to the group heating, excluding any dumped heat (see Figure C3).
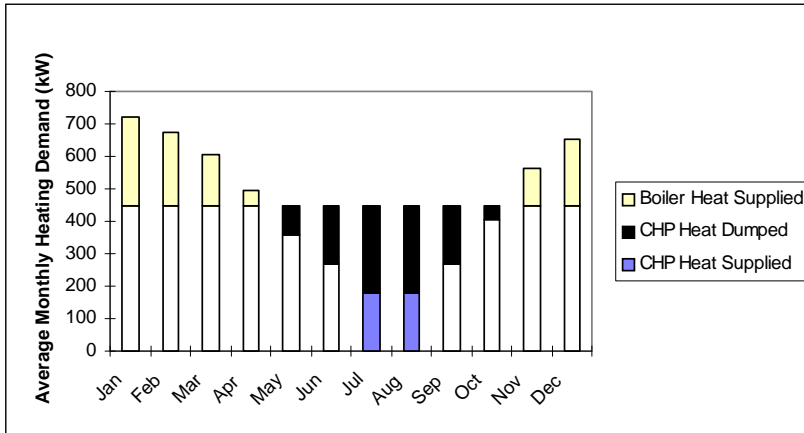
Figure C3 An example of a heat profile chart

The energy required for space and water heating is calculated using the 'Energy Requirements' (Group) tab, designed for calculating energy usage when space and water heating is provided by group heating (with or without CHP). The CO_2 emission and primary energy factors for group heating are taken from Table 8. These relate to delivered heat, e.g. the emission factor is given in units of kilograms of CO_2 emitted at the generating plant per kWh of heat delivered to the dwelling.

For group boilers, a default figure for the gross seasonal efficiency is given in Table 4a but, if known, the actual gross seasonal efficiency of the boilers should be used instead. For CHP plant, the efficiency is specified as the heat efficiency and the electrical efficiency; these may be determined from the overall efficiency and the heat-to-power ratio if these are the figures available. Default CHP efficiencies are provided in Appendix N where test data is not available.

DEAP assumes that dwellings with main space heating based on group heating schemes obtain their entire hot water requirement from the group heating scheme. The entry for "supplementary water heating used in summer" in DEAP should be set to "No" where the dwelling's main heating system is a group heating scheme.

Note: In the case of group heating with CHP, both heat and electricity are produced and the CO_2 emissions associated with the fuel burnt have to be apportioned to the two forms of energy. In the DEAP calculation the emissions saved by the CHP in displacing electricity from the national grid are subtracted from the total emissions associated with the group heating plant, and the remaining emissions are assigned fully to the heat produced.

C1.1 Heat distribution
(Source: SAP 2009)

Distribution loss
Heat loss in the distribution network is allowed for by increasing the heat to be supplied by the group heating scheme by a 'distribution loss factor'. The distribution loss factor is taken from Table 9 if any of the following conditions are met:

1) The only dwellings connected to any part of the heat network are apartments, or
2) The total trench length of the network is no longer than 100 metres, or
3) The linear heat density is not less than 2 MWh/year per metre of network.

If conditions 1) or 2) are not satisfied then the linear heat density of the network should be sought from the scheme manager (or designer in the case of a new scheme) to determine whether condition 3) is satisfied. Linear heat density is defined as the total heat delivered to all premises connected to the distribution network in MWh/year divided by the total length of the whole distribution network ("trench length") in metres. Where the linear heat density is less than 2 MWh/m/year or is unknown, methods that may be employed by the scheme manager or designer to determine the distribution loss factor are:

(a) if the scheme has full heat metering at all connections to the distribution network, then the total heat supplied to the network from the energy source(s) divided by the sum of the heat delivered from all the network connections (either to whole buildings or individual apartments), measured over a one year period (the same period for both), or

(b) by the formula

$$1+ \text{linear loss} \times \text{total length of pipework} \div (\text{total heat supplied} \times 114)$$

where:

- 'linear loss' is the average heat loss per metre run of pipework in W/m, calculated in accordance with ISO 12241, equations (8) and (9);
- 'total length of pipework' is the length of the distribution system pipes for the whole scheme in metres;
- 'total heat supplied' is the heat supplied from the energy centre(s) to the distribution network over a whole year, in MWh/year;
- 114 converts MWh/year to W.

If the distribution loss factor cannot be calculated from scheme data using the methods above, a value of 1.5 should be used.

Electrical Energy for pumping
Energy associated with the electricity used for pumping water through the distribution system is allowed for by the DEAP software. DEAP adds electrical energy equal to 1% of the thermal energy required for space and water heating.

C2 Group heating schemes that recover waste heat from power stations

This includes waste heat from power stations rated at more than 10 MW electrical output and with a power efficiency greater than 35%. Otherwise the system should be considered as CHP.

For group schemes that recover heat from power stations, the waste heat is the primary heat source, and secondary boilers of conventional design are used when the available waste heat is insufficient to meet the instantaneous demand. The proportions of heat from the power station and from the conventional boilers should be estimated, either on the basis of operational records or in the case of a new scheme on the basis of its design specification.

The emission and primary energy factors are taken from Table 8.

Note: 0.018 kg CO_2/kWh in Table 8 reflects emissions associated with the electricity used for pumping the water from the power station to the dwelling.

C3 Permutations of heat generators

Possible systems for group heating schemes include:

1. A single boiler or set of boilers all using the same fuel. Multiple boilers are specified using "Heating system 1/2/3" in the DEAP software.

2. Up to three boilers or three sets of boilers, using three different fuels such as mains gas and biomass. Multiple boilers are specified using "Heating system 1/2/3" in the DEAP software.

3. CHP plant and boiler(s), calculations according to Section C1.

4. Utilisation of waste heat from a power station topped up by boilers, calculations according to Section C2.

5. Geothermal heat topped up by boilers. The calculation is the same as that described in C2 for waste heat from power stations. This type of heat is from deep within the Earth and is not to be confused with ground source heat as used by standard heat pumps.

6. Heat pumps providing space and water heating in a group heating scheme should have the efficiency adjustment factor for high temperature heat pump applications from Table 4c applied to the heat pump efficiency before entry to the group heating section in DEAP. Separate efficiency adjustment factors may be applied in cases where the space and water heating circuits are clearly separate and the space heating circuit only uses low temperature emitters. The percentage of heat for space heating and that for water heating can be determined based on space and water heat delivered to the dwelling. The water heating efficiency and associated percentage of heat for water heating from the heat pump can then be entered separately from the space heating efficiency and percentage of heat for space heating.

In the group heating section , the "percentage of heat" entry for heating systems 1/2/3 is the percentage of heat the dwelling receives from the group heating scheme boilers and is not reduced when CHP or secondary individual heating are present. This percentage of heat column only represents group heating appliances providing heat only and not electricity. Therefore it does not include the portion of heat from CHP plant (which also generates electricity) or secondary heating (which is not part of the group heating scheme).

C4 Group scheme providing DHW only

Some group schemes provide DHW only, with the space heating provided by heaters in each dwelling. In this case the specification and calculation of space heating is the same as for a dwelling not connected to a group scheme. This includes a main heating system and secondary heaters.
A DHW-only group scheme can be:
- from group boilers;
- from a group heat pump;
- from a group CHP
- solar water heating in a group scheme is detailed in Section H2

Data required are:
- fuel used by group scheme
- efficiency of group boilers, heat pump or CHP (entered as the individual system water heating efficiency)
- if CHP, the heat-to-power ratio
- heat distribution characteristics for the distribution loss factor (Table 9) as the water heating efficiency adjustment factor
- hot water storage following guidance from Section 4.5

The efficiency adjustment factor, Table 4c (3), is not applicable.

Appendix D: Method of determining gross seasonal efficiency values for gas and oil boilers

This Appendix sets out, the method to be used to determine the gross seasonal efficiency of domestic boilers in Ireland for inclusion in the HARP database, for particular gas and oil boilers when test data have been obtained to establish conformity with Council Directive 92/42/EEC[*].

Manufacturers' declarations of gross seasonal efficiency values so calculated should be accompanied by the form of words in D3, and DEAP Assessors should look for the same form of words in order to ascertain that the efficiency value referred to is appropriate for DEAP calculations. The SEDBUK (2005) efficiency for SAP calculations in the UK is equally acceptable.

Range cooker boilers with twin burners are covered by D5 and D6.

D1   Definitions

D1.1   Boiler

A gas or liquid fuelled appliance designed to provide hot water for space heating. It may be designed to provide domestic hot water as well.

D1.2   Condensing boiler

A boiler designed to make use of the latent heat released by the condensation of water vapour in the combustion flue products. The boiler must allow the condensate to leave the heat exchanger in liquid form by way of a condensate drain. 'Condensing' may only be applied to the definitions D1.3 to D1.14 inclusive. Boilers not so designed, or without the means to remove the condensate in liquid form, are called 'non-condensing'.

D1.3   Regular boiler

A boiler providing domestic hot water indirectly via a separate hot water storage cylinder which does not have the capability to provide domestic hot water directly (i.e. not a combination boiler).

D1.4   On/off regular boiler

A regular boiler without the capability to vary the fuel burning rate whilst maintaining continuous burner firing. This includes those with alternative burning rates set once only at time of installation, referred to as range rating.

D1.5   Modulating regular boiler

A regular boiler with the capability to vary the fuel burning rate whilst maintaining continuous burner firing.

D1.6   Combination boiler

A boiler with the capability to provide domestic hot water directly, in some cases containing an internal hot water store.

D1.7   Instantaneous combination boiler

A combination boiler without an internal hot water store, or with an internal hot water store of capacity less than 15 litres.

D1.8   On/off instantaneous combination boiler

An instantaneous combination boiler that only has a single fuel burning rate for space heating. This includes appliances with alternative burning rates set once only at time of installation, referred to as range rating.

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[*] Council Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels. Official Journal of the European Communities No L/167/17. 21 May 1992, p. 92

D1.9   Modulating instantaneous combination boiler

An <u>instantaneous combination boiler</u> with the capability to vary the fuel burning rate whilst maintaining continuous burner firing.

D1.10   Storage combination boiler

A <u>combination boiler</u> with an internal hot water store of capacity at least 15 litres but less than 70 litres,
OR
a <u>combination boiler</u> with an internal hot water store of capacity at least 70 litres, where the space heating circuit supply is not taken directly from the store. If the store is at least 70 litres and the space heating circuit supply is taken directly from the store, treat as a CPSU (D1.13 or D1.14).

D1.11   On/off storage combination boiler

A <u>storage combination boiler</u> that only has a single fuel burning rate for space heating. This includes appliances with alternative burning rates set once only at time of installation, referred to as range rating.

D1.12   Modulating storage combination boiler

A <u>storage combination boiler</u> with the capability to vary the fuel burning rate whilst maintaining continuous burner firing.

D1.13   On/off combined primary storage unit (CPSU)

A single appliance designed to provide both space heating and domestic hot water with a burner that heats a thermal store containing mainly primary water which is common with the space heating circuit. The store must have a capacity of at least 70 litres and the feed to the space heating circuit must be taken directly from the store. The appliance does not have the capability to vary the fuel burning rate whilst maintaining continuous burner firing. This includes units with alternative burning rates set once only at time of installation, referred to as range rating.

D1.14   Modulating combined primary storage unit (CPSU)

A single appliance designed to provide both space heating and domestic hot water, where a burner heats a thermal store containing mainly primary water which is in common with the space heating circuit. The store must have a capacity of at least 70 litres and the space heating circuit supply must be taken directly from the store. The appliance has the capability to vary the fuel burning rate whilst maintaining continuous burner firing.

D1.15   Low temperature boiler

A <u>non-condensing boiler</u> designed as a low temperature boiler and tested as a low temperature boiler as prescribed by the Boiler Efficiency Directive (ie; the part load test was carried out at average boiler temperature of 40°C).

D1.16   Keep-hot facility

A facility within an <u>instantaneous combination boiler</u> whereby water within the boiler may be kept hot while there is no demand. The water is kept hot either (i) solely by burning fuel, or (ii) by electricity, or (iii) both by burning fuel and by electricity, though not necessarily simultaneously.

D2   Method for calculating the gross seasonal efficiency of domestic boilers in Ireland

The method of calculation is applicable only to boilers where the full load and the 30% part load efficiency values, obtained by the methods deemed to satisfy Council Directive 92/42/EEC, are available. These are net efficiency values. It is essential that both test results are available and that the tests are appropriate to the type of boiler as defined in Council Directive, otherwise the calculation cannot proceed.

In the calculation method the data are first converted to gross efficiency under test conditions, and then converted to a seasonal efficiency value that applies under typical conditions of use in a dwelling, allowing for standing losses.

In this Appendix, efficiencies are expressed in percent. Intermediate calculations should be done to at least four places of decimals of a percentage, and the final result rounded to one decimal place.

The procedure to be adopted in calculating the gross seasonal efficiency is as follows:

1. Determine fuel for boiler type.
The fuel for boiler type must be one of natural gas, LPG (butane or propane), or oil (kerosene or gas oil or biodiesel). The HARP gross seasonal efficiency cannot be calculated for other fuels for these appliances.

2. Obtain test data.
Retrieve the *full-load net efficiency* and *30% part-load net efficiency* test results. Tests must have been carried out using the same fuel as the fuel for boiler type, except as provided in D4.

3. Reduce to maximum net efficiency values.
Table D2.1 gives the maximum values of net efficiency for each fuel that may be used for the purposes of DEAP. Reduce any greater test value to the appropriate value given in Table D2.1.

Table D2.1 : Maximum net efficiency values (in %)

Condensing boilers		Non-condensing boilers	
Full load	30% part load	Full load	30% part load
101.0	107.0	92.0	91.0

4. Convert the full and 30% part load efficiencies from net values to gross.
Use the following equation with the appropriate factor from Table D2.2.

$$E_{gross} = f \times E_{net}$$

Table D2.2 : Efficiency conversion factors

Fuel	Net-to-gross conversion factor, f
Natural gas	0.901
LPG (propane or butane)	0.921
Oil (kerosene or gas oil or other biofuel)	0.937

5. Categorise the boiler.

a)   Select the appropriate category for the boiler according to the definitions given in D1.

b)   If a gas or LPG boiler, determine whether it has a permanent pilot light:

if it has a permanent pilot light, set p = 1
if not, set p = 0.

c)   In the case of a storage combination boiler (either on/off or modulating) determine from the test report whether the losses from the store were included in the values reported (this depends on whether the store was connected to the boiler during the tests):
if the store loss is included, set b = 1
if not, set b = 0.

d)   In the case of a storage combination boiler or a CPSU, obtain the store volume, V_{cs}, in litres from the specification of the device and the standby loss factor, L, using the following equation:

if t < 10 mm : L = 0.0945 − 0.0055t

if t $\geq$ 10 mm : L = 0.394/t
where t is the thickness of the insulation of the store in mm.

6. Calculate gross seasonal efficiency
a) Use the boiler category and other characteristics as defined in D1 (non-condensing or condensing; gas or LPG or oil; on/off or modulating) to look up the appropriate HARP equation number in Table D2.3. If no equation number is given the calculation cannot proceed. Otherwise, select the appropriate equation from Table D2.4 or Table D2.5.

b) Substitute the gross full and part load efficiencies (found in step 4) and p, b, V and L (found in step 5). Round the result to one decimal place; ie, to nearest 0.1%. Note the result as [x] for the purpose of the declaration in D3.

Table D2.3 : Boiler category table

HARP Equation numbers for different boiler types	non-condensing (see D1.2)				low-temperature (see D1.15)	condensing (see D1.2)			
	Gas or LPG		Oil			Gas or LPG		Oil	
	on/off (see D1.4, D1.8, D1.11, D1.13)	modulating (see D1.5, D1.9, D1.12, D1.14)	on/off (see D1.4, D1.8, D1.11)	modulating (see D1.5, D1.9, D1.12)		on/off (see D1.4, D1.8, D1.11, D1.13)	modulating (see D1.5, D1.9, D1.12, D1.14)	on/off (see D1.4, D1.8, D1.11)	modulating (see D1.5, D1.9, D1.12)
regular boiler (see D1.4, D1.5)	101	102	201	X	X	101	102	201	X
instantaneous combi boiler (see D1.7, D1.8, D1.9)	103	104	202	X	X	103	104	202	X
storage combi boiler (see D1.10, D1.11, D1.12)	105	106	203	X	X	105	106	203	X
combined primary storage unit (see D1.13, D1.14)	107	107	X	X	X	107	107	X	X

Table D2.4 : Gross seasonal efficiency, _E_, for natural gas and LPG boilers

Gas or LPG boiler type	Eq. No.	Equation
D1.4 : On/off regular	101	$E = 0.5(E_{full} + E_{part}) - 2.5 - 4p$
D1.5 : Modulating regular	102	$E = 0.5(E_{full} + E_{part}) - 2.0 - 4p$
D1.8 : On/off instantaneous combination	103	$E = 0.5(E_{full} + E_{part}) - 2.8 - 4p$
D1.9 : Modulating instantaneous combination	104	$E = 0.5(E_{full} + E_{part}) - 2.1 - 4p$
D1.11 : On/off storage combination	105	$E = 0.5(E_{full} + E_{part}) - 2.8 + (0.209 \times b \times L \times V_{cs}) - 4p$
D1.12 : Modulating storage combination	106	$E = 0.5(E_{full} + E_{part}) - 1.7 + (0.209 \times b \times L \times V_{cs}) - 4p$
D1.13 : On/ off combined primary storage unit (condensing and non-condensing) D1.14 : Modulating combined primary storage unit (condensing and non-condensing)	107	$E = 0.5(E_{full} + E_{part}) - (0.539 \times L \times V_{cs}) - 4p$

Table D2.5 : Gross seasonal efficiency, _E_, for oil boilers

Oil boiler type	Eq. No.	Equation
D1.3 : Regular	201	$E = 0.5(E_{full} + E_{part})$
D1.7 : Instantaneous combination	202	$E = 0.5(E_{full} + E_{part}) - 2.8$
D1.10 : Storage combination	203	$E = 0.5(E_{full} + E_{part}) - 2.8 + (0.209 \times b \times L \times V_{cs})$

D3   Declaring values of gross seasonal efficiency

Manufacturers wishing to declare their products' seasonal efficiencies for the specific purposes of calculating DEAP ratings can do so provided that:

a) they use the HARP calculation procedure given in D2 above; and

b)   the necessary boiler test data and the calculations are certified by a Notified Body accredited for the testing of boilers by an EU national accreditation service. The Notified Body must certify that: 'the full load and part load efficiency test results detailed in [*insert reference to report on the efficiency tests*] have been obtained by methods deemed to satisfy the Boiler Efficiency Directive'.

Where a manufacturer declares the HARP gross seasonal efficiency, it shall be expressed as:

> "Gross seasonal Efficiency (HARP) = [x]%
> The value is used in the Irish Government's Dwelling Energy Assessment
> Procedure (DEAP) for energy rating of dwellings. The test data was certified
> by [*insert name and/or identification of Notified Body*]."

Data for several products may be presented in tabulated form, in which case the second paragraph of the declaration should be incorporated as a note to the table.

D4   HARP gross seasonal efficiency for LPG boilers tested with natural gas

If the fuel for boiler type is LPG but the fuel used to obtain efficiency test results is natural gas then gross seasonal efficiency may be calculated subject to certain conditions using the procedure given below. The value of gross seasonal efficiency will be lower than if the fuel used to obtain the test results had been LPG.

1. Note the restrictions set out at the start of D2, still apply.

2. Any differences between the boiler fuelled by natural gas (used to obtain full-load and 30% part-load efficiency test results) and the boiler fuelled by LPG (seasonal gross efficiency required) must be minor. Examples of minor differences are a change of gas injector or adjustment by a single screw on the gas valve.

3. Determine the net heat input on a net calorific value basis for both the natural gas boiler and the LPG boiler. The LPG figure must lie within ± 5% of the natural gas figure.

4. Determine by measurement the percentage dry CO_2 by volume at the maximum heat input for both the natural gas boiler and the LPG boiler. From the results calculate the excess air fractions for both boilers. The calculated excess air fraction for the LPG boiler must not exceed that for the natural gas boiler by more than 5% (of the natural gas excess air fraction).

5. Retrieve the *full-load net efficiency* and *30% part-load net efficiency* test results. If the boiler is a condensing boiler then deduct 2.2 percentage points from the *30% part-load net efficiency* test result.

6. Follow the calculation procedure in D2 from step 3 onwards, taking the fuel for boiler type as LPG.

D5   Gross Seasonal Efficiency and Case Emission value of non-condensing twin-burner range cooker boiler

1. The method of calculation of the Seasonal Efficiency is applicable only to cooker boilers where the full load and the 30% part load efficiency values for the boiler function, obtained by the methods deemed to satisfy Council Directive 92/42/EEC, are available.
   Note: A non-condensing range cooker boiler without the capability to provide domestic hot water directly (i.e. is not a combination boiler) may nevertheless provide domestic hot water indirectly via a separate hot water storage cylinder exactly matches the definition D1.3 for a Regular Boiler. Consequently the methods deemed to

satisfy 92/42/EEC for a Regular Boiler will equally satisfy this requirement for the equivalent type of range cooker boiler.

Efficiencies relate to heat transferred to water and are calculated with the cooker burner turned off,

When undertaking the efficiency test, record
- input power (net) at full load conditions, $\Phi_{input,net}$, in kW.
- heat transfer to the water under full load conditions, Φ_{water}, in kW
- flue loss (net) under full load conditions, $\Phi_{flue,net}$, in kW according to the method given in I.S. EN 304 or other method assured by the independent test laboratory as providing comparable results for the product under test.
  Note: Independent test laboratory is qualified in D6 b).

2. Calculate the gross seasonal efficiency according to D2 using the appropriate equation for a regular boiler.

3. Calculate the case heat emission at full load from

$$\Phi_{case} = \Phi_{input,net} - \Phi_{water} - \Phi_{flue,net}$$

   where Φ_{water} is the heat transferred to water under full load conditions;
            $\Phi_{flue,net}$ is the flue gas loss measured according to I.S. EN 304.

4. If Φ_{case} exceeds either of $0.05 \times \Phi_{water}$ or 1 kW, reduce Φ_{case} to $0.05 \times \Phi_{water}$ or 1 kW (whichever is the smaller).

5. Provide the values of Φ_{case} and Φ_{water} in kW as part of the test report.

D6   Declaring gross seasonal efficiency and heat emission from the case for twin-burner range cooker boilers

Manufacturers wishing to declare their products' gross seasonal efficiencies and case emission values for the specific purposes of calculating DEAP ratings can do so provided that:

   a)   They use the calculation procedure given in D5 above; and

   b)   The necessary boiler test data and calculations are certified by an independent Test Laboratory notified under the Council Directive 92/42/EEC on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels (known as a "Notified Body").

Where a manufacturer declares the seasonal efficiency and the case emission value, it shall be expressed as:
   Gross Seasonal Efficiency (HARP) = [x]%
   Case heat emission at full load = [y] kW
   Heat transfer to water at full load = [z] kW
   The values are used in the Irish Government's Dwelling Energy Assessment Procedure (DEAP) for the energy rating of dwellings.   The test data was certified by [*insert name and/or identification of Notified Body*].

Data for several products may be presented in tabulated form where the last paragraph of the declaration should be incorporated as a note to the table.

Appendix E: Gross seasonal efficiency for gas, oil or solid fuel room heaters

This Appendix sets out the method to be used to determine the gross seasonal efficiency for gas, oil or solid fuel room heaters. Declared seasonal efficiencies acceptable for UK SAP calculations are also acceptable for DEAP calculations provided suitable substantiating evidence (such as a test certificate) is supplied. BER Assessors are encouraged to source efficiency data for these room heaters from the HARP database.

E1   Efficiency determination

Only test results obtained by one of the recognised methods given in Table E1, Table E2 and Table E3 may be used to establish a seasonal efficiency for DEAP calculations. The methods give comparable results.

Table E1: Recognised efficiency test methods for gas heaters

IS EN 613:2001	Independent gas-fired convection heaters
IS EN 13278:2003	Open-fronted gas-fired independent space heaters
IS EN 1266:2002	Independent gas-fired convecti on heaters incorporating a fan to assist transportation of combustion air and/or flue gases
BS 7977-1:2002	Specification for safety and rational use of energy of gas domestic appliances. Part 1: Radiant/Convectors
BS 7977-2:2003	Specification for safety and rational use of energy of gas domestic appliances. Part 2: Combined appliances: Gas fire/back boiler

Table E2: Recognised efficiency test method for oil heaters

OFS A102:1999	Oil fired room heaters with atomising or vaporising burners with or without boilers, heat output up to 25 kW

Table E3: Recognised efficiency test method for solid fuel room heaters

IS EN 13240:2001	Roomheaters fired by solid fuel. Requirements and test methods
IS EN 13229:2001	Inset appliances including open fires fired by solid fuels. Requirements and test methods
IS EN 14785:2006	Inset appliances Residential space heating appliances fired by wood pellets. Requirements and test methods

Efficiency test results are normally calculated using the net calorific value of fuel. Before a declaration can be made, conversion to gross must be carried out by multiplying the efficiency by the appropriate conversion factor given in Table E4 if test results are not based on the Gross Calorific Values of the relevant fuel.

Table E4: Efficiency conversion factors

Fuel	Net-to-gross conversion factor
Natural gas	0.901
LPG (propane or butane)	0.921
Oil (kerosene or gas oil or other biofuels)	0.937
Wood fuels	0.91
Solid multi-fuel	0.94

E2   Declaring the efficiency of gas, oil room and solid fuel room heaters

Manufacturers' declarations so calculated should be accompanied by the following form of words and should be accompanied by the associated test certificates from an accredited laboratory.

> "The gross seasonal efficiency of this appliance has been measured as specified in [*insert appropriate entry from Table E1 or Table E2 or Table E3*] and the result is *[x]%*. The gross calorific value of the fuel has been used for this efficiency calculation. The test data was certified by [*insert name and/or identification of Notified Body*]. The efficiency value may be used in the Irish Government's Dwelling Energy Assessment Procedure (DEAP) for energy rating of dwellings."

Where net efficiencies are identified from test data, they must be converted to gross efficiencies before use in DEAP assessments.

Appendix F: Electric CPSUs

An electric CPSU is a central heating system providing space and domestic water heating. A thermal store containing primary water is heated mainly during off-peak times to approximately 75°C in summer and between 85 and 95°C in winter. The space heating circuit operates in the same way as a wet central heating system, with controls appropriate for "wet" systems. For domestic hot water, secondary water flows directly from the cold mains into a heat exchanger, where it is heated by the hot water in the store before being delivered to the taps.

Determining fuel costs (external to DEAP): The CPSU volume should be sufficiently large to meet most of the space and water heating demand during on-peak times from heat stored during off-peak times, otherwise the on-peak fraction will be high. For a 10-hour off-peak tariff providing 3 off-peak periods per day, available in some other countries, a volume of at least about 270 litres may be appropriate. For the night-rate tariff available in Ireland, providing one off-peak period each night, a larger volume would be appropriate.

The heat losses from the CPSU are calculated, as for other hot water storage vessels, on the 'Water heating' tab, using data from Table 2.

Appendix G: Heat pumps

A heat pump transfers heat energy from a low temperature source and upgrades it to a higher temperature where it can be usefully employed for heating. There are a number of heat pump techniques by which this can be achieved. The ratio of heat energy released to the energy consumed can be significantly greater than one. Heat pump systems operate most efficiently when the source temperature is as high as possible and the heat distribution temperature is as low as possible.

Heat pump systems are categorised by the low temperature heat source used (e.g. air, water, ground) and the seasonal performance factors (SPF) given in Table 4a under "Efficiency" are the default values for systems using that source. This is a simplified approach especially for ground source heat pumps where energy may be collected from the ground in a variety of ways, e.g. using surface water from lakes or ponds, using ground water from wells, using fluid (either refrigerant or a water/antifreeze mixture) circulated in closed pipe loops buried horizontally in shallow trenches or vertically in boreholes.

Values from the HARP database should be used where available. If there is no SPF for the dwelling's heat pump listed on HARP, then certified data from an accredited laboratory can be used to calculate the SPF. The calculation method requires test certificates from IS EN14511-2, IS EN 255-2 or EN 15879. Full details of this calculation method as applicable to several types of heat pump are available in the HARP Heat Pump Database Submission Notes (Section 1.2).

For Air to Water, Brine to Water and Water to Water heat pumps where test data to IS EN 14511-2 is available, then COPs measured at the test points detailed in the following table are averaged to obtain the SPF for the purposes of DEAP. For example, an Air to Water unit will use COPs averaged from A7/W45; A7/W35; A2/W35.

System type	Temperature Range	Outdoor heat exchanger		Indoor heat exchanger	
		Inlet dry bulb temp (°C)	Inlet wet bulb temp (°C)	Inlet temp (°C)	Outlet temp (°C)
Air to Water	7 – 45	7	6	40	45
	7 – 35	7	6	30	35
	2 – 35	2	1		35
Water to Water	10 – 45	10	7	40	45
	10 – 35	10	7	30	35
Brine to Water	0 – 45	0	-3	40	45
	0 – 35	0	-3	30	35
	5 – 35	5			35

Heat pumps can also be used in group schemes as detailed in Appendix C.

G1   Domestic hot water (DHW)

G1.1   DHW heated by heat pump with immersion heater

Test results produced according to IS EN 14511-2 or using Table 4a heat pump efficiencies
The heat pump is expected to raise the water temperature to a maximum of about 40°C when tested to IS EN 14511-2 (or IS EN 255-2), and an immersion heater may be used to raise the water temperature to the required delivery temperature. For the purpose of the DEAP calculation it is assumed that 50% of domestic hot water heating is by the heat pump and 50% by the immersion heater in this scenario.

The average efficiency for water heating, to be entered to the "Efficiency of main water heater" input cell of the "Energy Requirements" (Individual) tab, is:

$$\frac{100}{[50 \div SPF] + 0.50} \qquad \text{(G1(a))}$$

where SPF is the seasonal performance factor for the heat pump, stated as a percentage and determined from one of the methods outlined above. The SPF is an overall figure, taking account of all the energy required to operate the heat pump, including primary circulation pumps and an auxiliary heater if present. In the case of a ground or water source heat pump the fraction of electricity at the on-peak rate is given in Table 10a with the remainder charged at the off-peak rate.

Test results produced according to IS EN 255-3
IS EN 255-3 tests heat pumps for water heating to 50ºC and an immersion heater may be used to raise the water temperature to the required delivery temperature. For the purpose of the DEAP calculation it is assumed that 75% of domestic hot water heating is by the heat pump and 25% by the immersion heater in this scenario.

The average efficiency for water heating, to be entered to the "Efficiency of main water heater" input cell of the "Energy Requirements" (Individual) tab when test results to IS EN 255-3 are available, is:

$$\frac{100}{[75 \div SPF] + 0.25} \qquad \text{(G1(b))}$$

where SPF is the seasonal performance factor for the heat pump taken from the IS EN 255-3 test, stated as a percentage.

Where the heat pump and immersion are providing hot water, the option "Is supplementary electric water heating used in summer?" is set to "No" as the immersion is incorporated in the average main water heating efficiency from equation (G1a and G1b).

G1.2   DHW heated by heat pump without immersion heater

Where the heat pump does not have an integral immersion and is designed to heat water to appropriate DHW temperatures, the SPF of the heat pump for water heating is to be multiplied by one of the factors given in Table 4c depending on the standard used to test the heat pump and derive the SPF. Where the heat pump has an integral immersion or the heat pump is not designed to reach appropriate temperatures for water heating, G1.1 is followed.

G1.3   DHW heated by immersion only

Where an immersion heater is used for heating all hot water, then the main water heater is specified as an immersion as per Table 4a.

G2 Space heating requirement

G2.1   Space heating from ground or water source heat pump

A ground source heat pump system (when the main heating system) may consist of either a ground source heat pump sized to meet all space heating requirements, or a combination of a ground source heat pump and a direct acting electric heater (auxiliary heater). A ground source heat pump system with an auxiliary heater to help meet the maximum demands has a lower SPF than one without an auxiliary heater.   Use the appropriate SPF given in Table 4a under "Efficiency" where data from HARP or certified data from an accredited laboratory is unavailable.

For ground and water source heat pumps using an off-peak tariff, the fraction of the electricity used for space heating at the on-peak rate is given in Table 10a with the remainder charged at off-peak rate.

If the heat pump supplies heat to standard radiators (regardless of whether there is underfloor heating present or not) the heat pump efficiency for space heating is to be multiplied by the appropriate factor given in Table 4c (this also applies to air source heat pumps). A heat pump supplying heat to fan coil radiators or radiators specifically designed to run at a lower temperature than standard radiators has a higher efficiency adjustment factor than standard radiators. Note that towel rails are ignored for the purposes of DEAP assessments.

G2.2   Direct acting air source heat pump

A heat pump using ambient air as the source is subject to frost build up on the external coil and is very likely to have an integral electric heater to provide space heating while the external coil is being defrosted. The use of this heater is allowed for in the SPF. Air source heat pumps use standard electricity tariff.

Air conditioning heat pumps can be also used to heat air rather than wet heating systems. These systems typically source their heat from external air and do not provide DHW. Treatment of exhaust air heat pumps in DEAP is outlined on www.seai.ie/ber.

G2.3   Heating controls

Control options for heat pumps are given in Group 2 of Table 4e. Note that a bypass arrangement is usually necessary with TRVs to ensure sufficient circulating thermal mass while the heat pump is operating. Zoning arrangements or TRVs may not be appropriate for small domestic installations for this reason.

Appendix H: Solar water heating

The working principle of solar hot water systems is shown in Figure H1. Examples of arrangements are given in Figure H2. These do not show all possible arrangements and the procedures in this appendix are applicable to any arrangements that follow the same principles.
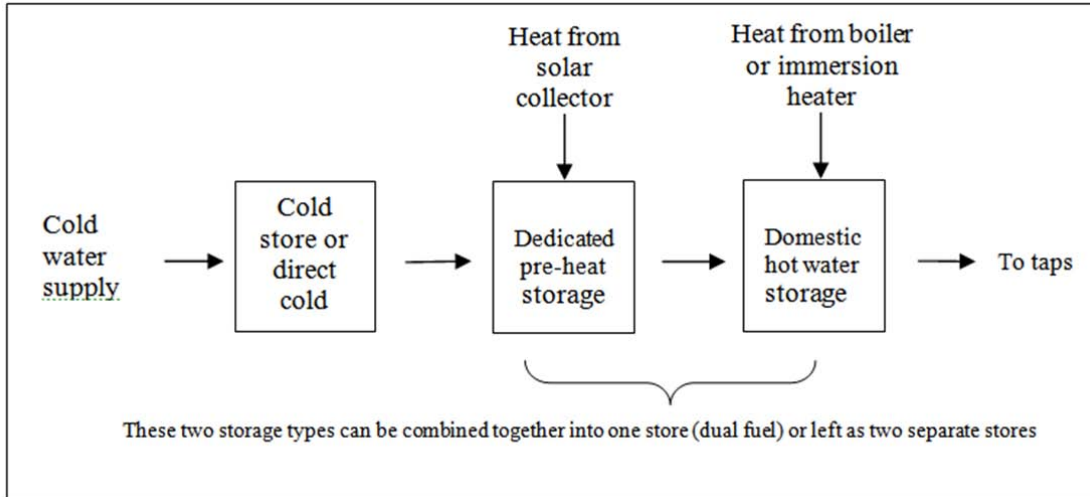
Figure H1: Working principle of solar water heating.

V_s (indicated by the dashed line) is the dedicated solar storage volume. See text below concerning the effective solar volume. V_d is the daily hot water demand.

a) With separate solar cylinder

b) With a twin-coil cylinder[1]

c) Combi boiler

d) Direct system
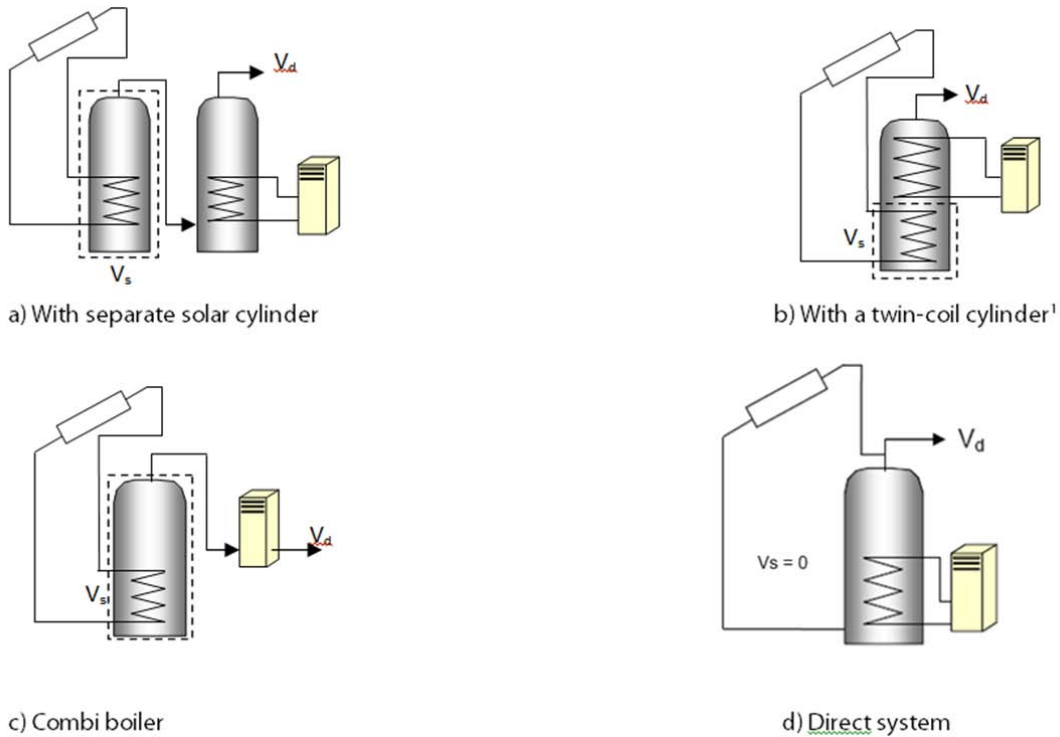
Figure H2: Schematic examples of arrangements for solar pre-heating

Water from the cold supply is either fed (directly or via a cold feed cistern) to the preheat zone where it is heated by solar energy. Then the water passes to the domestic hot storage (separate hot water cylinder or upper part of combined cylinder) which is heated to the required temperature by a boiler or an electric immersion.

There are three main types of solar collector:
- unglazed: the overall performance of unglazed collectors is limited by high thermal losses;
- glazed flat plate: a flat plate absorber (which often has a selective coating) is fixed in a frame between a single or double layer of glass and an insulation panel at the back;
- evacuated tube: an absorber with a selective coating is enclosed in a sealed glass vacuum tube.

The performance of a solar collector is represented by its zero-loss efficiency (proportion of incident solar radiation absorbed in the absence of thermal loss) and its heat loss coefficient (heat loss from collector to the environment per unit area and unit temperature difference).

The solar contribution to domestic hot water is given by

$$Q_s = S \times Z_{panel} \times A_{ap} \times \eta_0 \times UF \times f(a_1/\eta_0) \times f(V_{eff}/V_d) \qquad \text{(H1)}$$

where
Q_s = solar input, kWh/year
S = total solar radiation on collector, kWh/m^2/year
Z_{panel} = overshading factor for the solar panel
A_{ap} = aperture area of collector, m^2
η_0 = zero-loss collector efficiency
UF = utilisation factor
a_1 = linear heat loss coefficient of collector, W/m^{2}K
$f(a_1/\eta_0)$ = collector performance factor = (see H10 below)
V_{eff} = effective solar volume, litres
V_d = daily hot water demand, litres
$f(V_{eff}/V_d)$ = solar storage volume factor = $1.0 + 0.2 \ln(V_{eff}/V_d)$

The collector's gross area is the projected area of complete collector (excluding any integral means of mounting and pipework). The aperture area is the opening that admits solar radiation.

Solar panel performance can be taken from one of three sources:
a)   The HARP database
b)   Certified data for the collector concerned according to IS EN 12975-2, *Thermal solar systems and components – Solar collectors – Part 2: Test methods*. The aperture area, and the performance characteristics η_0 and a_1 related to aperture area, are obtained from the test certificate.
c)   Table H1

The effective solar volume is:
- in the case of a separate pre-heat tank (such as arrangements (a) or (c) in Figure H2), the volume of the pre-heat tank;
- in the case of a combined cylinder (such as arrangement (b) in Figure H2), the volume of the dedicated solar storage plus 0.3 times the volume of the remainder of the cylinder. Source: CIBSE Solar Heating Design and Installation Guide;
- in the case of a thermal store (hot-water-only or integrated as defined in Appendix B) where the solar coil is within the thermal store, the volume of the dedicated thermal storage.
- in the case of a direct system (such as arrangement (d) in Figure H2), 0.3 times the volume of the cylinder. Arrangement (d) is entered as a combined cylinder in DEAP with no dedicated solar storage.

DEAP requires the dedicated solar storage value which may be calculated by the following means:
(i)   Derived from indication of heating coil locations on a cylinder datasheet. The datasheet may contain a diagram of the cylinder showing the location of the internal cylinder coils or location of upper and lower coil connections to the cylinder. The dedicated solar storage applies to the volume of storage

below the coil lying directly above the solar heated coil. If for example, the combined cylinder is 300L and the connections of the upper coil are halfway down the cylinder side, then the dedicated solar storage can be assumed to be 150L.

(ii)   It may also be possible to determine the location of the coil connections on site. The dedicated solar storage is the cylinder volume lying below the coil directly above the solar coil.

(iii)   The cylinder documentation/datasheet may state the volume dedicated to solar storage along with relevant standards for storage volume specification. This is acceptable, but the Assessor should cross check that the stated dedicated solar storage volume does not include sections of the cylinder heated by coils above the solar heated coil.

(iv)   Where the dedicated solar volume is not known, then, as per DEAP Table S11, the dedicated solar volume can be assumed to be one third of the total cylinder volume.

Note: The overall performance of solar water systems depends on how the hot water system is used, e.g. daily draw-off patterns and the use of other water heating devices such as a boiler or an immersion. The procedure described here is not suitable for detailed design in a particular case. It is intended to give a representative value of the solar contribution to domestic water heating over a range of users.

H1 Calculation of solar input for solar water heating (SAP 2005 - 2008)

Aperture area of solar collector, m^2 ☐ (H1)
  If only the gross area can be established reliably, multiply it by ratio in Table H1

Zero-loss collector efficiency, η_0, from test certificate or Table H1   ☐ (H2)

Collector heat loss coefficient, a_1, from test certificate or Table H1   ☐ (H3)

Collector performance ratio a_1/η_0 (H3) ÷ (H2)=   ☐ (H4)

Annual solar radiation per m^2 from Table H2   ☐ (H5)

Overshading factor from Table H3   ☐ (H6)

Solar energy available   (H1) × (H2) × (H5) × (H6) =   ☐ (H7)

Solar-to-load ratio   (H7) ÷ [EnerUsage + DistLoss] =   ☐ (H8)

Utilisation factor   if (H8) > 0, $1 - \exp[-1/(H8)]$, otherwise enter "0" in box (H9)   ☐ (H9)
  if the cylinder is heated by a boiler and there is no cylinderstat, reduce the utilisation factor by 10%

Collector performance factor   If (H4) < 20 $0.87 - 0.034 \times (H4) + 0.0006 \times (H4)^2$=   ☐ (H10)
         else $0.604 - .0087 \times (H4)$=

Dedicated solar storage volume, V_s, litres   ☐ (H11)
  volume of pre-heat store, or dedicated solar volume of a combined cylinder

If combined cylinder, total volume of cylinder, litres   ☐ (H12)

Effective solar volume, V_{eff} ☐ (H13)
  if separate pre-heat solar storage or a thermal store, (H13) = (H11)
  if combined cylinder, (H13) = (H11) + 0.3 × [(H12) – (H11)]

Daily hot water demand, V_d, (litres)   ☐ (H14)

Volume ratio V_{eff}/V_d (H13) ÷ (H14) =   ☐ (H15)

Solar storage volume factor $f(V_{eff}/V_d)$ $1 + 0.2 \times \ln(H15)$ =   ☐ (H16)

Solar DHW input Q_s (H7) × (H9) × (H10) × (H16) =   ☐ (H17)

Note: 'HwReqt' and 'Distloss' are values in the main 'Water Heating' tab. HwReqt is the 'Hot water energy requirement' and DistLoss is the 'Distribution loss'.

If separate figures for solar input are required for the heating season (8 months) and summer (4 months) take 50% of Q_s as applying during the heating season and 50% during the summer.

Table H1 : Default collector parameters

Collector type	η_0	a_1 (W/m²K)	Ratio of aperture area to gross area
Evacuated tube	0.6	3	0.72
Flat plate, glazed	0.75	6	0.90
Unglazed	0.9	20	1.00

Table H2 : Annual solar radiation, kWh/m²

Tilt of collector	Orientation of collector				
	South	SE/SW	E/W	NE/NW	North
Horizontal	963				
15°	1036	1005	929	848	813
30°	1074	1021	886	736	676
45°	1072	1005	837	644	556
60°	1027	956	778	574	463
75°	942	879	708	515	416
Vertical	822	773	628	461	380

Where solar collectors have multiple tilts and orientations, the annual solar radiation should be calculated from Table H2 based on an area weighted average of solar collector area. If the collectors are all of the same orientation and tilt, then an annual solar radiation figure from Table H2 must be selected without interpolation. The values in Table H2 are not specific to the installed solar collector type. Table H2 is based on solar radiation figures from national climate data.

Table H3 : Overshading factor

Overshading	% of sky blocked by obstacles.	Overshading factor
Heavy	> 80%	0.5
Significant	> 60% - 80%	0.65
Modest	20% - 60%	0.8
None or very little	< 20%	1.0
Notes:		
Overshading must be assessed separately for solar panels, taking account of the tilt of the collector. Usually there is less overshading of a solar collector compared to overshading of windows for solar gain (Table 6d)		
The overshading factor for the installed solar collectors must be chosen from this table.		

H2 Group Solar DHW

Where solar panels are used in a group heating system, the total collector area and the total dedicated solar store volume should be divided between the dwellings in proportion to the total floor area of the dwellings (these can be rounded to the nearest 0.01 m² and 1 litre).

Example: A block of 24 flats, eight with floor area of 50 m² and 16 with floor area of 60 m². Total aperture area of solar panels is 40 m² and the total solar storage volume is 1000 litres. The small flats are each assigned 1.47 m² and 37 litres, and the larger flats 1.76 m² and 44 litres. The Assessor should keep a record of the relevant group heating system details used in carrying out this calculation (total floor area, number of dwellings, etc).

The calculation is done as described in H1 for single systems, with the above parameters and the orientation, pitch and overshading of the panels set at values representative of the whole installation. Usually the solar store is separate and the arrangement is equivalent to that of diagram a) in Figure H2.

The solar storage in this case is not entered as a heat loss cylinder under "Storage Losses" on the 'Water Heating' tab. The "Storage Losses" entry is only for cylinders heated by heat sources other than solar heating.

A separate procedure for solar space and water heating is detailed in Appendix Q.

Appendix J: Gross seasonal efficiency for solid fuel boilers from test data

This Appendix specifies how to obtain a gross seasonal efficiency from test data on a solid fuel boiler that is provided in the Home-Heating Appliance Register of Performance (HARP). A HARP database record for a solid fuel boiler includes:
- DEAP gross seasonal efficiency, %
- Fuel input, heat to water and heat to room from test at full load, kW (based on gross calorific values)
- Fuel input, heat to water and heat to room from test at part load, kW (based on gross calorific values)

In the case where HARP data is not available, then accredited certified boiler data to IS EN 303-5 can be used. **All efficiencies must be based on gross rather than net values.** To convert from net to gross efficiency, multiply the net efficiency by the appropriate factor in Table E4. HARP data does not require this conversion as all efficiencies and values on HARP are based on gross calorific values.

Where test data or HARP data is not available for solid fuel appliances, then default data may be taken from Table 4a.

J1   DEAP gross seasonal efficiency is given

If the overall DEAP gross seasonal efficiency is given in HARP, that value is used for both space and water heating, and the other data is disregarded. If the overall efficiency is available from a test certificate, that may also be used, provided it is converted to gross efficiency as outlined above.

J2   DEAP gross seasonal efficiency is not given

If the DEAP gross seasonal efficiency is not available, the appropriate efficiency for use in the calculations is obtained as follows :

J2.1   Part load data is available

The efficiency at full load is obtained from:

$$E_{full} = 100 \times \frac{(\text{heat to water at full load}) + (\text{heat to room at full load})}{\text{fuel input at full load}} \qquad (J1)$$

and the efficiency at part load from:

$$E_{part} = 100 \times \frac{(\text{heat to water at part load}) + (\text{heat to room at part load})}{\text{fuel input at part load}} \qquad (J2)$$

If the boiler is outside the boundary of the dwelling as defined in Section 1, "Dwelling dimensions", the heat to room is omitted from (J1) and (J2).

All efficiencies must be gross rather than net values. Fuel inputs must be based on gross calorific values.
The gross seasonal efficiency is then:
Gross seasonal efficiency = 0.5 * (E_{full} + E_{part})   (J3)

J2.2   Part load data is not available

If the data for the part load test is blank, part load efficiency is taken as 95% of full load efficiency, so that:
Gross seasonal efficiency = 0.975 E_{full} (J4)

J2.3   Rounding

The seasonal efficiency should be rounded to one decimal place before using it in calculations.

J3   Heating type and responsiveness

The heating type and responsiveness is that for the applicable type of appliance given in Table 4a.

Appendix K: Thermal bridging

Thermal bridges that occur at junctions between building elements are included in the calculation of transmission heat losses. Building Regulations 2011 TGD L Appendix D should be read for further information.

The linear thermal transmittance, Ψ describes the heat loss associated with a thermal bridge. This is the rate of heat flow per degree per unit length of bridge that is not accounted for in the U-values of the plane building elements containing the thermal bridge.

The transmission heat loss coefficient associated with non-repeating thermal bridges is calculated as:

$$H_{TB} = \sum (L \times \Psi)$$

where L is the length of the thermal bridge where Ψ applies.

If details of the thermal bridges are not known, use

$$H_{TB} = y \sum A_{exp}$$

where A_{exp} is the total area of exposed elements, m^2.

A default value of y = 0.15 W/m²K applies for all dwellings except the following:

1) **y = 0.08 W/m²K:** for new dwellings whose details conform with "Limiting Thermal Bridging and Air Infiltration – Acceptable Construction Details" (www.environ.ie) as referenced in Building Regulations 2008 and 2011 TGD L. This requires that the relevant drawings be signed off by the developer, builder, site engineer or architect. The BER Assessor must retain the relevant drawings, such as those from the Acceptable Construction Details and associated sign off in support of thermal bridging factor entered.

2) **y = 0.11 W/m²K:** Only applies to new dwellings where Building Regulations 2005 TGD L applies. This value may be used when sign-off by the developer, builder, site engineer or architect indicates that all details in the dwelling have been constructed in accordance with both

    i. Diagrams 3 and 4, and Sections 1.2.4 and 1.2.5 of Building Regulations 2005 TGD L

    ii. The details set out in the Homebond publication "Right on Site, Issue No. 28" or the 5th or later editions of the Homebond Manual.

3) Alternatively values of Ψ can be determined from the results of numerical modelling, or they can be derived from measurement. If the junction detail is as recommended in *Acceptable Construction Details (ACDs)*, the Ψ-value associated with that junction can be taken from TGD L 2011 Appendix D or from Introduction Document for Acceptable Construction Details or other certified Ψ values.

Again, the drawing details used must be signed by the relevant personnel mentioned above and kept on file by the BER Assessor. Once the Ψ values adhere to these requirements, then junction lengths with valid Ψ values are used to determine the thermal bridging y-factor for use in DEAP. SEAI have developed a tool to carry out this calculation as discussed on the [BER FAQ](). Ψ values must be based on the tables in TGD L Appendix D (based on the ACDs) or must be certified as per TGD L 2011 Section 1.3.3. Certification of the detail by a member of the NSAI Thermal Modellers' Certification Scheme is a means of meeting the requirements in TGD L and DEAP for calculation of Ψ values.

Appendix L: Energy for lighting

The calculation of lighting use is based on the proportion of fixed low energy lighting outlets installed, and on the contribution of daylight.

Allowing for fixed low-energy outlets
In Irish dwellings, the average annual energy consumption for lighting per unit floor area, E_B, is taken as follows if no low-energy lighting is used.

$E_B = 9.3$ kWh/m^2 year   (L1)

DEAP includes a correction factor C_1 for fixed lighting outlets with low-energy lamps:

$C_1 = 1 - 0.5 \times N_{LE}/N$ (L2)

where N_{LE} is the number of fixed low energy lighting outlets (including sockets or complete luminaires capable of taking only low-energy lamps, and also low energy lamps fitted into ordinary lighting sockets) and N is the total number of fixed lighting outlets.

Note: In Equation (L2), only fixed lighting outlets are included in N_{LE} and N. Movable lamps, which plug into a mains socket, are disregarded. The equation is based on two-thirds of the lighting energy consumption being via fixed lighting points, and each fixed low energy lighting point achieving a saving of 75% over a point with a non low energy lamp (2/3 x 3/4 = 0.5).

Daylighting
Analysis of typical house types gives the following approximate correction factor, C_2, for lighting energy use depending on the ratio of glass area to floor area, glass transmittance and light access factor.

$C_2 = 52.2\ G_L{}^2 - 9.94\ G_L + 1.433$ if $G_L \le 0.095$ (L3)
$C_2 = 0.96$ if $G_L > 0.095$ (L4)

$$G_L = \frac{\sum 0.9 \times A_w \times g_L \times FF \times Z_L}{TFA}$$ (L5)

where: FF is the frame factor from Table 6c
        A_w is the area of a window, m^2
        TFA is the total floor area, m^2
        g_L is the light transmittance factor from Table 6b
        Z_L is the light access factor from Table 6d

The summation allows for different window and rooflight types (the light access factor is different for windows and rooflights).

The annual energy used for lighting in the house, E_L, is then
        $E_L = E_B \times TFA \times C_1 \times C_2$ [kWh/year]   (L6)

where C_1 and C_2 are defined above, and TFA is the total floor area.

Gains from lighting
To calculate the heat gains due to lighting, it is assumed that 85% of the annual lighting electricity consumption occurs during the heating season (Oct – May). Of this, it is assumed that 90% contributes to internal gains, the remainder being accounted for by e.g. external lighting or lighting of unheated spaces. The average rate of heat gain from lighting is thus
        $G_L = E_L \times 0.85 \times 0.9 \times (1000 / (24 \times HsDays))$ [W]   (L7)
where HsDays is the duration of the heating season in days (243 days)

<u>Identifying low energy lights:</u>
A low energy lamp must use at least 75% less energy than a conventional incandescent lamp. Where low energy bulbs are actually fitted into ordinary lighting sockets they may be included in the low energy lighting calculation. If it is not explicit from the survey, drawings or specifications that low energy bulbs will be fitted in to ordinary lighting sockets they should not be included in the low energy calculation.

Light bulbs are labelled according to their energy efficiency through an EU scheme[1]. Bulbs are rated from 'A' to 'G' with 'A' being the most efficient and 'G' the least efficient. The energy label is displayed or attached to the packaging of an individual bulb.
In DEAP, bulbs with an A-rating are considered to be low-energy and are assumed to use 75% less energy than the equivalent incandescent bulb. Bulbs with a B-rating are considered to be reduced-energy and are assumed to use 37.5% less energy than the equivalent incandescent bulb. All other categories (C to G) are assumed to be equivalent to standard or incandescent bulbs.

The percentage of low energy lighting used in equation (L2) is calculated as follows:

$$\left(\frac{N_A + \frac{1}{2}N_B}{N} \right) * 100 \qquad\qquad\qquad \text{(L2a)}$$

where N_A is the number of A-rated bulbs, N_B is the number of B-rated bulbs and N is the total number of fixed lighting outlets or installed bulbs. The percentage of low energy lighting from L2a is entered into the DEAP software which carries out the correction described in (L2).

The energy label of the bulb should be used where available. The following default values may be used to calculate Equation (L2a) where the label is not available[2]:

Bulb Type	Assumed Energy Label
Compact Fluorescent	A
Fluorescent	A
Light-emitting Diodes	A
Other	E

<u>Example</u>
During a BER assessment of an existing dwelling an Assessor records the following lighting data:
- *4 CFL bulbs (no energy label available)*
- *2 Fluorescent bulbs (no energy label available)*
- *8 bulbs with "B" energy label available.*
- *6 Incandescent bulbs*
- *2 Standard fixed lighting outlets with no bulb installed*

22 fixed lighting outlets in total.

CFL and Fluorescents are both A-rated so,
- $N_A = 4 + 2 = 6$
- $N_B = 8$

Substituting these values into Equation (L2a), the percentage of low energy lighting is:

$$\left(\frac{6 + \frac{1}{2}*8}{22} \right) * 100 = 45\%$$

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[1] Official Journal of the European Communities, Commission Directive 98/11/EC, 27 January 1998: Energy labelling of household lamps.

[2] Lamp Guide 2009, Lighting Industry Federation, U.K. : http://www.lif.co.uk/lamp-guide/

This value is entered into the DEAP software.

Where several bulbs are controlled by a single switch, each bulb must be counted when calculating the percentage of low energy lights.

Light bulbs and light fittings outside of the dwelling should not be counted but should be counted if they are in unheated spaces of the dwelling (such as porches or garages). Portable (not fixed) lights, lights on cooker hoods and bathroom shaving mirrors should not be included in the count of lighting in the dwelling for either low energy lighting or conventional lighting.

In *partially-lit* dwellings, where fixed lighting is not present in every room, an adjustment must be made to calculate the electricity demand for lighting correctly.

To calculate the lighting demand in a partially-lit dwelling,
- the percentage of low energy fixed lighting outlets is calculated based on the actual lights installed;

- the result is multiplied by a correction factor:

    Correction Factor = Number of rooms with fixed lighting outlets / Total number of rooms

As an example, take a dwelling with 10 rooms. 6 rooms have fixed lighting, 4 rooms have no fixed lighting.
In the 6 rooms that have fixed lighting there are a total of 12 fixed outlets; 7 of these contain low energy bulbs. Percentage of low energy fixed lighting outlets in the 6 rooms with fixed lighting = (7/12) x 100 = 58.3%

This must be adjusted to account for the fact that only 6 of the 10 rooms have fixed lighting.
Percentage of low energy fixed lighting outlets = 58.3% x (6/10) = 35%.

Appendix M: Photovoltaic (PV) technology and on site wind turbines

M1 Energy from photovoltaic (PV) technology

Photovoltaic technology converts sunlight directly into electricity. It works during daylight hours but more electricity is produced when the sunshine is more intense (a sunny day) and is striking the PV modules directly. Unlike solar systems for heating water, PV technology does not produce heat. Instead, PV produces electricity as a result of interaction of sunlight with semi-conductor materials in the PV cells.

The energy produced per year depends on the installed peak power (kWp) of the PV module (the peak power corresponds to the rate of electricity generation in bright sunlight, formally defined as the output of the module under radiation of 1 kW/m^2 at 25°C). PV modules are available in a range of types and some produce more electricity per square metre than others (the range for currently available types is from about 30 to 120 watts peak per m^2), and the peak power depends on the type of module as well as its effective area. In the Irish climate, an installation with 1 kWp produces about 800 kWh of electricity per year (at favourable orientation and no overshading).

The procedure for PV is as follows.
1) Establish the installed peak power of the PV unit (kWp). This should be taken from certificates from accredited laboratories testing to one of:
   a. IS EN 61215/IEC 61215:   Terrestrial Photovoltaic (PV) modules with Crystalline Solar Cells – Design Qualification and Type Approval
   b. BS EN 61646/IEC 61646:   Thin-film terrestrial photovoltaic (PV) modules – Design Qualification and Type Approval
   If certified PV performance data is not available, assume a kWp of 0.06kWp per m^2 of PV collector.
2) The electricity produced by the PV module in kWh/year is
   $$0.80 \times kWp \times S \times Z_{PV} \qquad\qquad (M1)$$
   where S is the annual solar radiation from Table H2 (depending on orientation and pitch), and Z_{PV} is the overshading factor from Table H3. If there are two PV modules, e.g. at different tilt or orientation, apply equation (M1) to each and sum the annual electricity generation.
   In the DEAP software enter the calculated energy produced by PV in the 'Energy produced or saved' input cell in the 'Fuel Data' section of the 'Energy Requirements' tab. The delivered energy is acceptable as renewable (electrical) energy for TGD L conformance.
3) For calculation of CO_2 emissions and primary energy savings, the factors for electricity from Table 8 are used. The same factor is used for all electricity generated, whether used within the dwelling or exported.
4) The cost saving depends on whether the electricity is used directly within the dwelling or exported. Electricity used in the dwelling is valued at the unit cost for purchased electricity (usually the standard tariff, or the day rate in the case of an off-peak tariff). Electricity exported is valued at the price for electricity sold to the grid (currently 0c).
   The effective price depends on a factor β, in the range 0.0 to 1.0, and is the proportion of the generated electricity used directly within the dwelling. The value of β depends on the coincidence of electricity generation and electricity demand. At present the value of β = 0.30 should be used if performing fuel cost calculations: this will be reviewed in future if relevant data becomes available.
   All normal fuel costs should be taken from www.seai.ie/statistics .
   The fuel price is calculated as:
   β x normal electricity price + (1 - β) x exported electricity price.
5) Where the PV array is mounted on the building concerned or wholly within its curtilage, and its output is directly connected to the building's electricity supply, the output calculated by (M1) is included in DEAP under 'energy produced or saved'. In the case of a building containing more than one dwelling, e.g. a block of flats, then:
   a) if the PV output goes to particular individual flats, the annual output is credited to the flats concerned;
   b) otherwise the total electricity generated is divided amongst all the flats in the block in proportion to their floor area.

In case a) an inverter is needed for each flat with a PV electricity supply. In case b) there will usually be a single inverter for the total PV array and the electricity generated fed to the landlord supply or to the distribution system for the flats (with provision for export of electricity generated in excess of instantaneous demand).

Note that electricity supplied to common areas in a development is not considered in DEAP assessments.

M2 Micro wind turbines on the dwelling or within its curtilage[1]
The procedure given below applies to small horizontal axis wind turbines directly connected to the dwelling's power supply and within the curtilage of a dwelling. The performance of wind turbines is very sensitive to the local wind conditions. The procedure is based on typical conditions using a formula given by GreenSpec[2] and the wind speed correction factors given in MIS 3003[3]. At times of higher wind speeds the wind turbine may generate more electricity than the instantaneous electricity demand within the dwelling. Arrangements must be made for the surplus electricity to be exported to the grid via an ESB Networks provided import/export meter.

Monitored power output over a 12 month period from the installed wind turbine should be used if it is available. This data may be in the form of printouts from (or photographs of) onsite metering equipment. In keeping with the Code of Practice and DEAP Survey Guide, the Assessor must keep a record of all such data.

Otherwise, the calculation method is detailed in the following steps:
1) The output power P_{wind} of one turbine in watts at a wind speed of "s" m/s is:

$$P_{wind} = CP \times G \times IE \times A \times PA \qquad\qquad\qquad\qquad \textbf{(M2)}$$

- CP is the aerodynamic power coefficient (efficiency of the rotor to convert energy)
- A is the swept area of the blade
- PA is the power density of the wind $= 0.6125\ s^3$
- G is the efficiency of the generator
- IE is efficiency of the inverter (allowing for power drawn by the inverter)[4]

2) The annual energy in kWh/year is related to the output at average wind speed by

$$E_{wind} = N_{turbines} \times P_{wind} \times 1.9 \times 8766 \times 0.001 \qquad\qquad\qquad \textbf{(M3)}$$

- $N_{turbines}$ is the number of wind turbines
- 1.9 is a parameter representing the wind speed variation function
- 8766 is the average number of hours per year
- 0.001 converts from Wh to kWh
- If there is more than one turbine of differing hub height or blade diameter, apply equation (M3) to each and sum the annual electricity generation.

3) The product of CP, G and IE is 0.24.

4) The area A is $0.25 \times pi \times (rotor\ diameter)^2$.

5) Average annual wind speed "s", should be taken from a calibrated anemometer [5] located at the same height and position as the wind turbine. Where this wind power data is not available, then a default wind speed of 5m/s [6] may be used and adjusted as per Table M2 provided that:
- no part of the turbine blade dips below the level of the ridge of the roof if the turbine is roof mounted;
- there are no obstructions as tall or taller than the turbine hub within a radius of 10 times the hub height.

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[1] From SAP Appendix M2
[2] www.greenspec.co.uk/html/energy/windturbines.html (accessed 15th September 2011)

[3] Microgeneration Installation Standard MIS 3003, *Requirements for contractors undertaking the supply, design, installation, set to work commissioning and handover of micro and small wind turbine systems*, BRE Certification Ltd, 2007.

[4] Equation (M2) differs from that on the GreenSpec website by including IE. This is included so as to provide the system output rather than the turbine output.

[5] In accordance with MEASNET standards or similar. http://www.measnet.com/

[6] While the default average is 5m/s, actual wind speeds will clearly vary.

6) The electricity produced is entered as energy produced/saved in DEAP, with associated primary energy factor and carbon dioxide emissions factor for electricity from Table 8. This electricity produced value is entered under "Delivered Energy" and "Part L contribution" with "type" set to "Renewable Electrical".

7) For calculation of the cost savings the factor β is taken from Section M1.
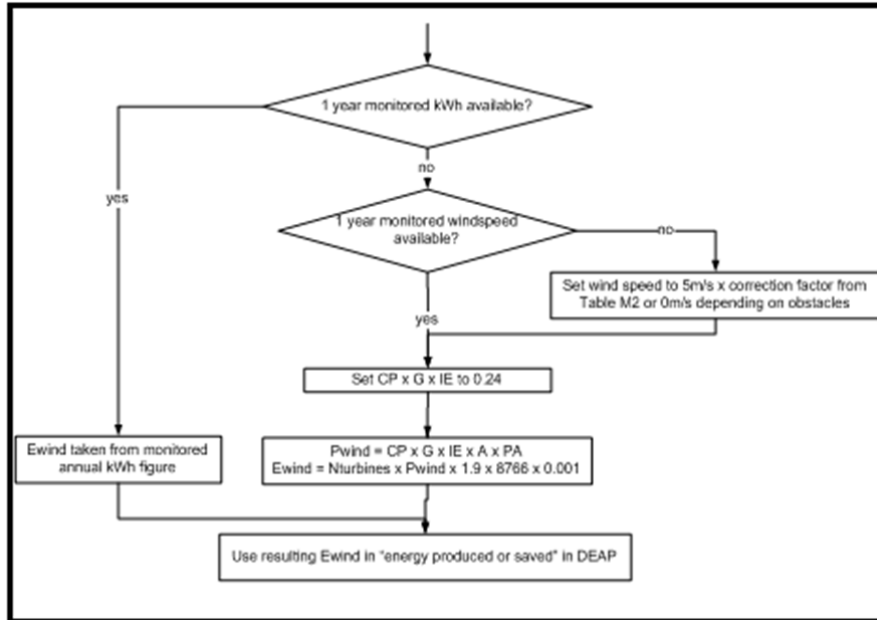
Figure M2: Calculation method summary for micro wind turbines

Table M2: Wind speed correction factors[1]

Terrain type	Height of Turbine hub above tallest nearby objects (m) *	Correction Factor
Dense urban (city centres with mostly closely spaced buildings of four storeys or higher)	10	0.56
	5	0.51
	2	0.40
	0	0.28
Low rise urban/suburban (town or village situations with other buildings well spaced)	6	0.67
	4	0.61
	2	0.53
	0	0.39
Rural (open country with occasional houses and trees)	12	1.00
	7	0.94
	2	0.86
	0	0.82
Use linear interpolation for intermediate values. For hub height higher than the maximum given for the terrain type use the highest for that terrain type (i.e. 0.56, 0.67 or 1.00). * including objects such as mature trees, landmass, building (either neighbouring buildings or actual dwelling being assessed) within a radius of 10 times the turbine hub height		

Other useful information can be found under SEAI's small scale wind energy FAQs:
http://www.seai.ie/Renewables/Microgeneration/Microgeneration_FAQ.

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[1] Factors in Table M2 derived from data in *The Designer's Guide to Wind Loading of Structures*, N.J. Cook, Butterworths, 1986

Appendix N: Micro-cogeneration (also known as micro-CHP)

N1   Overview

Micro-cogeneration from Combined Heat and Power plant provides both heat and electricity. It is assumed to be heat-led, meaning that it is allowed to operate only when there is a demand for space heating or hot water. The domestic application of micro-cogeneration is treated in conjunction with a conventional domestic heating system, such as a boiler or heat pump. It is also assumed that it is connected to the public electricity supply in such a way that surplus generated electricity is exported. For both group heating systems and individual dwellings, the fraction of heat from CHP (Main Space Heating demand + Main Water Heating demand from CHP) needs to be determined for entry into DEAP.

The performance characteristics of CHP are derived from laboratory tests in the form of thermal efficiency and electrical efficiency. Test data should be based on appropriate national or international standards and/or the CHP directive on promotion of cogeneration. Efficiency figures are based on Gross Calorific Values (GCV) of the input fuel. Where test results are not based on the GCV, conversion to gross efficiency must be carried out by multiplying the efficiency by the appropriate conversion factor given in Table E4.

The heat produced by the CHP installation and the electrical energy consumed/generated are determined by the heating system designer and are based on design for operation and heat demand during an average year. This design should reflect the appliance output rating and the expected dwelling heat demand.

DEAP calculates the electrical energy co-generated with this heat based on the thermal and electrical efficiency of the unit after the quantity of heat generated by the CHP plant is calculated. DEAP also calculates the energy savings from use of CHP for the purposes of renewables compliance checking against Building Regulations TGD L 2008 and TGD L 2011.

The electricity consumed will normally be a negative quantity, and then represents the net electricity provided by the CHP package that is available to offset electricity that would otherwise be taken from the public electricity supply grid or, to the extent that instantaneous generation exceeds instantaneous electricity demand, is exported to the grid.

If CHP details cannot be ascertained they are defaulted to the following (the percentages below are entered as a fraction in the DEAP software):
  *   fraction of heat from CHP = 0.30
  *   CHP overall efficiency = 75%
  *   heat to electrical power ratio = 2.0
  *   CHP electrical efficiency = 25%
  *   CHP thermal efficiency = 50%

N2   CHP installation in an individual heating system

The DEAP user enters the fraction of the total main space and water heat derived from CHP thermal output under the 'Energy Requirements' tab ('Space Heating') section.

DEAP calculates the total main space heating demand as the value 'Annual Space Heating Demand' shown on the 'Distribution System Losses and Gains' tab minus the 'Fraction of Heat from Secondary/Supplementary System'.

The total main water heating demand is the value 'Output from Main Water Heater' shown on the DEAP 'Water Heating' tab.

The 'Fuel Data' section of the 'Energy Requirements' tab allows the user enter the thermal efficiency (CHP Hη) and electrical efficiency (CHP Eη) for the installed CHP unit as well as the fuel used in the CHP unit.

DEAP calculates the total energy delivered to the CHP unit based on the CHP thermal output and the CHP thermal efficiency. DEAP calculates the total electrical energy generated by the CHP unit based on energy delivered to the CHP unit and the CHP electrical efficiency.

N3   CHP: calculating energy savings

DEAP calculates the energy savings attributable to the Part L (2008 and 2011) renewables requirement following the formula in TGD L 2011. The kWh/yr contributing towards the renewables compliance requirement as follows:

$$\text{Rth} = \text{CHP H} \times \left[\frac{1}{0.9} + \frac{\text{CHP E}\eta}{\text{CHP H}\eta \times 0.4} - \frac{1}{\text{CHP H}\eta} \right] \quad \text{...............(N1)}$$

- **Rth** is the energy saving contribution from the CHP system.
- **CHP H** is the useful heat output from the CHP system.
- **CHP H η** is the heat efficiency of the CHP production defined as annual useful heat output divided by the gross calorific fuel input.
- **CHP E η** is the electrical efficiency of the CHP production defined as annual electricity from cogeneration divided by the fuel input.

N4   CHP installation in a group heating system

Appendix C of the DEAP manual details how the DEAP software caters for CHP installations in a group heating system. DEAP uses equation (N1) in calculating the energy saved by the CHP installation in a group heating scheme (considered renewable for the purposes of the Building Regulations Part L renewables requirement).

The useful heat output from the CHP plant is the heat generated by the CHP plant over the year in the group heating scheme and is based on the dwelling's heat requirement from the group heating scheme (main space and water heating) and the user specified fraction of this heat derived from the CHP installation.

Appendix P: Assessment of internal temperature in summer

This Appendix provides a method for assessing the propensity of a dwelling to have high internal temperature in hot weather. It does not provide an estimate of cooling needs. The procedure is not integral to DEAP and does not affect the BER result.

The calculation is related to the factors that contribute to internal temperature: solar gain (taking account of orientation, shading and glazing transmission); ventilation (taking account of window opening in hot weather), thermal capacity and mean summer temperature for the location of the dwelling.

P1   Assessment procedure

1.   Obtain a value for the effective air change rate during hot weather. Indicative values are given in Table P1.

Table P1: Effective air change rate

Window opening	Effective air change rate in ach			
	Trickle vents only	Windows slightly open (50 mm)	Windows open half the time	Windows fully open
Single storey dwelling (bungalow, flat) Cross ventilation possible	0.1	0.8	3	6
Single storey dwelling (bungalow, flat) Cross ventilation not possible	0.1	0.5	2	4
Dwelling of two or more storeys windows open upstairs and downstairs Cross ventilation possible	0.2	1	4	8
Dwelling of two or more storeys windows open upstairs and downstairs Cross ventilation not possible	0.1	0.6	2.5	5

Cross ventilation can be assumed only if the at least half of the storeys in the dwelling have windows on opposite sides and there is a route for the ventilation air. Normally bungalows and two storey houses can be cross ventilated because internal doors can be left open. Three storey houses or other situations with two connected storeys where one is more than 4.5 m above ground level often have floors with fire doors leading onto stairs thus preventing cross ventilation. Slightly open refers to windows that can be securely locked with a gap of about 50 mm. Often this option will not give sufficient ventilation.
Windows on ground floors cannot be left open all night because of security issues. Windows on other floors can. Fully open refers to dwellings where security is not an issue (e.g. an upper floor flat) or secure night time ventilation is available (e.g. by means of grilles, shutters with vents or purpose-made ventilators). In most cases where there are ground and upper floor windows 'windows open half the time' is applicable, which refers principally to night-time ventilation (ground floor evening only, upper floors open all night).
If there is a mechanical ventilation system providing a specified air change rate, that rate can be used instead.

2.   Calculate the ventilation heat loss, H_v^{summer}, using the formula:

$$H_v^{summer} = 0.33 \times n \times V \tag{P1}$$

where:
n = air change rate during hot weather, ach
V = volume of the heated space of the dwelling, m³

3. Calculate the heat loss coefficient under summer conditions:

    $H = \text{total fabric heat loss} + H_v^{\text{summer}}$ (P2)

    The total fabric heat loss is the same as for the heating season ('Building Elements' tab).

4. Calculate the total solar gains for the summer period , $G_{\text{solar}}^{\text{summer}}$, using the solar flux for the summer period from Table 1c.

    $$G_{\text{solar}}^{\text{summer}} = \sum \left(0.9 \times A_w \times S \times g_\perp \times FF \times Z_{\text{summer}} \right)$$ (P3)

    where:
    0.9 is a factor representing the ratio of typical average transmittance to that at normal incidence
    A_w is the area of an opening (a window or a glazed door), m²
    S is the solar flux on a surface during the summer period from Table 1c, W/m²
    $g_\perp$ is the total solar energy transmittance factor of the glazing at normal incidence from Table 6b as entered in the DEAP software.
    FF is the frame factor for windows and doors (fraction of opening that is glazed) from Table 6c
    Z_{summer} is the summer solar access factor

    Solar gains should be calculated separately for each orientation and for rooflights, and totalled according to equation (P3).

    For data to calculate Z_{summer} see Section P3.

    Assume that the summer internal gains (G_i) are equal to the winter 'net internal gains' (these are calculated in the 'Internal gains' section of the DEAP software), so that the total gains are:

    $G = G_{\text{solar}}^{\text{summer}} + G_i$ (P5)

5. Calculate the temperature increment due to gains in summer, from the following, where H is the heat loss coefficient of the dwelling:

    $\text{Temperature increment} = \dfrac{G}{H}$ (P6)

6. Obtain the summer mean external temperature, T_e^{summer}, from Table P2. Alternatively, the mean for the months June – August for the dwelling location may be used if available.

Table P2: Summer mean external temperature

Region	Mean external temperature, T_e^{summer}, used for estimating mean internal temperature in summer [ºC]
Ireland	15

7. Obtain the threshold internal temperature to estimate likelihood of high internal temperature. This is the mean internal temperature during the summer period plus an increment related to the thermal mass.

    $T_{\text{threshold}} = T_e^{\text{summer}} + \dfrac{G}{H} + \Delta T_{\text{mass}}$ (P7)

    where
    $\Delta T_{\text{mass}} = 2.0 - 7 \times HCP$ if HCP < 0.28

$\Delta T_{mass} = 0$ if HCP ≥ 0.28

HCP (heat capacity parameter) is the internal heat capacity of the dwelling divided by the total floor area, as entered to the DEAP calculation software.

8. Use Table P3 to estimate tendency to high internal temperature in hot weather.

Table P3: Levels of threshold temperature corresponding to likelihood of high internal temperature during hot weather

$T_{threshold}$	Likelihood of high internal temperature during hot weather
< 20.5°C	Not significant
≥ 20.5°C and < 22.0°C	Slight
≥ 22.0°C and < 23.5°C	Medium
≥ 23.5°C	High

P2   Reporting of results

Results should include:
- details of the house design including its heat capacity parameter and specification of any overhangs, together with its orientation and the climatic region assumed;
- for one or more scenarios, the category from Table P3 for stated assumptions on occupant-determined factors (usage of blinds/curtains and window opening).

If the orientation of the dwelling is not known, the assessment should be for the orientation giving the greatest tendency to high internal temperature.

P3   Solar shading

Z_{summer} is given by

$Z_{summer} = Z_{blinds} (Z + Z_{overhangs} - 1)$ (P8)

subject to

$Z_{summer} \geq 0.1 \; Z_{blinds}$ (P9)

where

Z_{blinds} is a shading factor for blinds or curtains
Z is the solar access factor from Table 6d
$Z_{overhangs}$ is a shading factor for overhangs

Table P4 gives values for Z_{blinds}, and Tables P5 and P6 give values for $Z_{overhangs}$. If there are no overhangs, $Z_{overhangs} = 1$.

P3.1   Curtains and blinds

Unless specifically included in the design specification a default of dark coloured curtains should be assumed closed during daylight hours (f = 1). Shutters with window closed is compatible with windows open half the time in Table P1 as the latter refers to night-time and Table P4 refers to daytime.

Table P4 : Shading factors for blinds, curtains or external shutters

Blind or curtain type	Z_{blind}
Net curtain (covering whole window)	0.80
Net curtain (covering half window)	0.90
Dark-coloured curtain or roller blind (note 1)	0.85

Light-coloured curtain or roller blind (note 1)	0.60
Dark-coloured venetian blind (note 2)	0.88
Light-coloured venetian blind (note 2)	0.70
Dark-coloured external shutter, window closed (note 3)	0.24
White external shutter, window closed (note 3)	0.27
Dark-coloured external shutter, window fully open (note 3)	0.85
White external shutter, window fully open (note 3)	0.65

Notes to Table P4
1. Factor applies when fully closed. If closed only for a fraction f of the daylight hours use $f \times Z_{blind} + (1 - f)$.
2. Factor applies for venetian blind with slats at 45° against the sun. The same factor can be used if the blind is fully closed. If closed only for a fraction f of the daylight hours use $f \times Z_{blind} + (1 - f)$.
3. External shutters are not applicable to roof windows.

P3.2   Overhangs
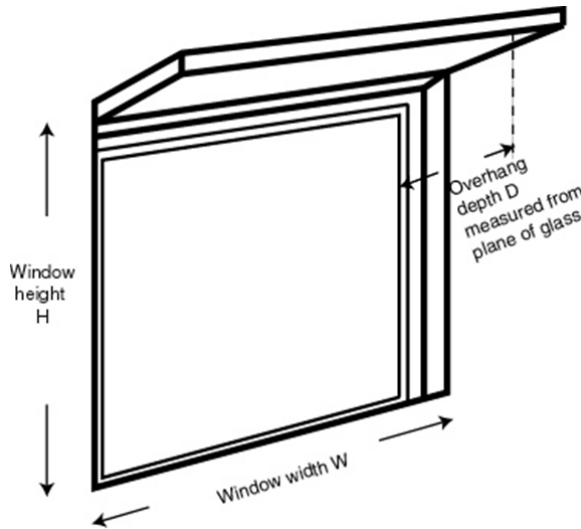
Where the overhang is at least twice as wide as the window (e.g. balconies on blocks of flats) use Table P5. In other cases use Table P6. Interpolation may be used between rows of these tables. Usually the same value of $Z_{overhangs}$ can be applied to all the windows on a given façade on the basis of an average depth-to-height ratio.

Table P5: $Z_{overhangs}$ for wide overhangs

Depth/H	Orientation of window				
	N	NE/NW	E/W	SE/SW	S
0.0	1.00	1.00	1.00	1.00	1.00
0.2	0.92	0.89	0.88	0.83	0.77
0.4	0.85	0.80	0.76	0.67	0.55
0.6	0.79	0.72	0.66	0.54	0.38
0.8	0.73	0.65	0.58	0.43	0.32
1	0.69	0.59	0.51	0.36	0.30
1.2 or more	0.66	0.55	0.46	0.31	0.29
This table is to be used where the overhang is at least twice as wide as the window					

Table P6: Z$_{overhangs}$ for normal overhangs

Depth/H	Orientation of window				
	N	NE/NW	E/W	SE/SW	S
0.0	1.00	1.00	1.00	1.00	1.00
0.2	0.94	0.91	0.89	0.84	0.79
0.4	0.90	0.85	0.79	0.72	0.64
0.6	0.88	0.81	0.72	0.62	0.53
0.8	0.86	0.79	0.66	0.55	0.50
1	0.85	0.77	0.61	0.52	0.49
1.2 or more	0.84	0.76	0.57	0.50	0.48
This table is to be used where the overhang is less than twice as wide as the window					

Appendix Q: Special features and specific data

Q1   Special features

This section provides a method to allow for the benefits of new energy-saving technologies that are not included in the DEAP software.

This method may only be used for technologies whose characteristics have been recognised as part of DEAP and described on the web page http://www.seai.ie/ber (or a web page linked to it). In general, a technology may use one form of energy to achieve savings in another form of energy.

In the DEAP software, in the 'Energy Requirements' tab, go to the 'Renewable and energy-saving technologies' sub-section, and enter the delivered energy produced or saved, and the delivered energy consumed by the technology, to the appropriate input cells. Then enter the primary and CO_2 factors for the energy produced or saved, and the energy consumed, to the appropriate input cells.

The technologies likely to be included in this section of DEAP are:
- o   Wind energy using micro-turbines (see Appendix M2);
- o   Space heating from solar thermal panels (see www.seai.ie/berfaq);
- o   Flue gas heat recovery systems (these are not the same as ventilation heat recovery systems) with efficiency data from SAP Appendix Q;
- o   Photovoltaics (See Appendix M1).

This section does not include technologies already specifically dealt with in the DEAP methodology (such as ventilation heat recovery, solar thermal for hot water, CHP, heat pumps, wood fuel boilers).

Appendix S: DEAP for existing dwellings: survey methodology and default data

S1   Introduction

The methodology in this appendix applies to existing dwellings and is not appropriate for new dwellings unless there are exceptional circumstances where dwelling plans and specifications are not available to supplement the dwelling survey. The methodology consists of a system of data collection through an on-site survey of the actual dwelling together with defaults and inference procedures, as defined by the rules given in this Appendix, to generate a complete set of input data for the DEAP calculation.

Some reductions in data requirements are specified for aspects having little effect on the rating or recommended improvement measures in order to simplify the survey process. When conducting a dwelling survey, Assessors should comply with all applicable health and safety legislation and should exercise due caution. All site surveys are expected to be non-intrusive wherever possible (for example, the Assessor is not expected to drill walls to confirm construction, or to lift carpets and floor boards to confirm floor insulation).

All default data should be overridden when relevant substantiating evidence is available (as outlined in the DEAP Survey Guide). This rule applies even when non-defaults result in higher calculated energy usage for the dwelling than would be achieved when using the available defaults listed in this Appendix. The defaults listed in this appendix are facilitated by the DEAP software for existing dwellings. The defaults are generally not applicable to new dwellings unless otherwise stated elsewhere in the DEAP manual and guidance outside of Appendix S (for example plans and specifications for the new dwelling are unavailable).

S2 Overview of the Methodology for DEAP for Existing Homes

Following the format of the DEAP software program, the methodology can be summarised accordingly:

Dimensions – All dimensional data that is needed is to be measured on site. Definitions follow Section 1.

- The floor areas entered into the DEAP software are the internal floor areas for each level of the dwelling. These areas are calculated either from internal dimensions or, alternatively, calculated and converted from external dimensions.

- Storey heights are measured on site, with any upper floors adjusted for presence of any intermediate floors.

- Living area percentage is based on internal measurements taken within the dwelling.

Ventilation – The factors effecting the ventilation losses within a dwelling (i.e. the number of chimneys, flues, air vents, extract fans, and flueless combustion roomheaters, the presence of a draught lobby, number of storeys, basic construction of the walls and the floor, the draughtproofing on the windows and doors, the presence of a mechanical ventilation system and any heat recovery component, and results of a pressurisation test) are to be identified during on-site survey.

Building Elements: The construction of the floors, roofs, walls, doors and windows of a dwelling, and any insulation, are to be identified (where practical) during the site survey.

- The areas of each building element entered are the internal areas. Appropriate default U-values are set out in tables in this appendix. Other U-values may be used where substantiating evidence is available and retained on file along with detail of the U-value calculations used.

- Single doors can be assumed to have an area of 1.85m^2 with double doors being twice that. Appropriate default U-values, and a method for calculating a door U-value, are available in Table 6a. DEAP multiplies the number of doors entered by 1.85m^2 when using the default door area in existing dwellings.

- Window areas are measured on site. Other window characteristics (i.e. the orientation, overshading, type of glazing, gap, and frame material) to be identified during site survey. Window U-values and solar transmittance are determined using the method outlined in Section 3.2.

- Thermal bridging factor will be a default value given in this appendix.

Water Heating: The storage and distribution loss characteristics of the primary water heating system, the characteristics of any hot water cylinder, and the presence of controls are to be identified during site survey. The appropriate temperature adjustment factors are selected from Table 2.

Lighting and Internal gains – The percentage of low energy lights within a dwelling is calculated from information collected through the site survey.

Net Space Demand – The living area percentage is based on internal measurements taken within the dwelling. The Thermal Mass Category of the dwelling is identified from default table in this appendix.

Distribution Losses and Gains – The presence of any space heating controls, and the nature and responsiveness of the heat emitters, and the presence of any pumps and fans, are identified during site survey. The responsiveness category, heating system control category, and temperature adjustment are selected from DEAP Tables 4a-f.

Energy Requirements – The primary and secondary heating system and / or appliances, and their system efficiencies, and any efficiency adjustment factors are identified from DEAP Tables 4a-f. The primary and the secondary heating fuel (where there is one), the primary water heating fuel, and supplementary electric water heating fuel (when appropriate) are identified through the site survey.

S3   Dwelling Type and Purpose of Rating

The dwelling type and purpose of rating fields in DEAP should not be based on defaults as they should be readily identifiable on site.

S4   Dimensions and Building Elements

In general, if one building element is thermally different from another within a dwelling, then they are to be measured so that their respective areas can be calculated, so the appropriate U-values can be assigned, and then values can be entered separately into the DEAP software. That said, building elements comprised of relatively small areas compared to the dwelling overall, and very small differences in U-values, will have a very marginal effect on the final result, and therefore can be ignored.

Many dwellings have one or more extensions of a different construction or insulation standard added to the main part of the dwelling (e.g. a cavity wall construction with an extension constructed from hollow blocks), or have parts of the original dwelling with different constructions or insulation standards although built at the same time (e.g. the front of the dwelling is constructed from stone and part of the rear is constructed from brick). In these cases, dimensions and constructional details of the main part of the dwelling and the extension are recorded separately (including year of construction), to allow the assignment of different U-values to the original and to the extension. Occasionally, there may be two or more extensions whose details need each to be recorded separately. DEAP allows the user to record the presence of an extension for existing dwelling BERs.

In addition, dwellings may comprise a different construction for some parts of the walls (for example, a timber-framed bay window or panel in an otherwise masonry construction). These are recorded as separate constructional elements.

Regardless of whether a dwelling's floor (or floors) loses heat, the floor area for each level of the dwelling is needed to calculate both the **total floor area** and the **dwelling volume**. The floor area includes the habitable dwelling and parts of the habitable dwelling accessed from within the dwelling at each level. Floor areas do not include unheated garages, coal sheds, external unheated store rooms, thermally separated conservatories or thermally separated porches (please see the Dimensions Section for fuller guidance on each of these items and their respective definitions).

The assessment of an existing dwelling is also concerned with assessing and measuring the **building elements that lose heat** from the habitable dwelling. Non-heat loss areas (e.g. party walls, a floor or a ceiling wholly above or below another apartment, or walls backing onto a heated circulation space) are ignored altogether as heat loss elements.

To simplify the measurement process:
- Individual dimensional measurements may be rounded to nearest 0.1m.
- Opaque heat loss areas may be rounded to nearest 0.5m^2. Glazed areas and doors may be rounded to 0.1m^2.
- Small bay windows, small porches, small door entrances or recesses, small chimney breasts, where they affect the total floor area by less than 10% overall, can all be ignored for the purposes of total floor area measurement. Bay windows, chimney breasts and other small areas within the living room area must be included in the living room area measurement.
- Where a specific floor, wall or roof area within a dwelling represents less than 10% of the respective total floor, wall, or roof area of the dwelling, then the differences in construction or U-value can be ignored, and the smaller area subsumed within the larger area.
- Where the differences in U-values are less than .05 W/m^{2}K then the elements can be combined, and the U-value of the larger area adopted (e.g. the difference between 0.29 and 0.25 is 0.04 and therefore whichever represents the larger area is used, whereas difference between 0.30 and 0.25 is not less than 0.05 so the areas should be entered separately with their respective values).

All heat loss areas and **all** floor areas are based on internal measurements. On-site measurements may be internal or external, provided they are converted to internal measurements when the respective heat loss areas are calculated for entry in the DEAP software.

Storey heights are entered into the DEAP software in accordance with the DEAP methodology, that is, for a one storey dwelling, the storey height is the height from the topside of the floor to the underside of the ceiling. For dwellings comprised of more than one floor, the lowest floor is calculated in the same way, that is, the lowest floor height is from the topside of the floor to the underside of the ceiling, with subsequent floor heights calculated from the underside of the ceiling below to underside of the ceiling on that level (that is, the upper floor includes the allowance for the intermediate floor). It may not be possible in an existing dwelling to measure the thickness of the intermediate floor, therefore, measure the topside of the floor to underside of the ceiling height on each level, and add 0.25m to each upper floor level to calculate the storey height to enter into the DEAP software.
Note: Do not forget to use these adjusted storey heights when calculating exposed wall areas.

S5 Age bands

A set of age bands is defined according to Table S1 for the purposes of assigning U-values and other data.

Table S1: Age bands

Age band	Years of construction
A	before 1900
B	1900-1929
C	1930-1949
D	1950-1966
E	1967-1977
F	1978-1982
G	1983-1993
H	1994-1999
I	2000-2004
J	2005 onwards (without BER certificate already)

From the mid-1970s, constructional changes caused primarily by amendments to draft or actual Building Regulations for the conservation of fuel and power have resulted in increased levels of thermal insulation. The dates in Table S1 are generally two or three years after a change in regulations based on indicative figures of likely transition periods. This allows for the dwellings to be completed after the regulations came into force.

The Building Regulations assign U-values to different building elements as outlined in the following table. This table is for reference only. Default U-values must be taken from Tables S3, S4, S5, S7, S8 and S9.

Table S2: Building Regulations summary[1]

Year of regulations	Applicable age band	U-values (W/m²K)		
		Roof	Wall	Floor
1976 (Draft)	F[2]	0.4	1.1	0.6
1981 (Draft)	G	0.4	0.6	0.6
1991	H[3]	0.35	0.55	0.45/0.6
1997	I	0.35	0.55	0.45/0.6
2002	J	0.25	0.37	0.37

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[1] U-values for overall heat loss method used where available. At all times non default U-values are used where sufficient evidence is available.

[2] Where it is clearly evident for age band F or G that the roof is uninsulated, the walls and floors are to be treated as if they were in age band E (and are also uninsulated) unless contrary evidence is available.

[3] For age bands H and I: .45 = ground floor, .6 = exposed / semi exposed floor

S6 Constructional types and U-values

U-values of construction elements are determined from the constructional type and date of construction. U-values are assessed separately for the main part of the dwelling and for any extension. Where Building Regulations are available, the associated U-value from Table S2 is used. Any other walls with insulation can have non default U-values entered.

S6.1   U-values of walls

This section details default wall U-values where there is insufficient information to enter non-default U-values. Lookup of the defaults in Tables S3 and S3a are automatically referenced by DEAP software. Values from Table S3b are entered into DEAP by the user.

Table S3: Exposed wall U-values[1]

Age Band	A	B	C	D	E	F	G	H	I	J
Wall type										
Stone	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37
225mm solid brick	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37
325mm solid brick	1.64	1.64	1.64	1.64	1.64	1.1	0.6	0.55	0.55	0.37
300mm cavity	2.1	1.78	1.78	1.78	1.78	1.1	0.6	0.55	0.55	0.37
300mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37
solid mass concrete	2.2	2.2	2.2	2.2	2.2	1.1	0.6	0.55	0.55	0.37
concrete hollow block	2.4	2.4	2.4	2.4	2.4	1.1	0.6	0.55	0.55	0.37
timber frame	2.5	1.9	1.9	1.1	1.1	1.1	0.6	0.55	0.55	0.37
Unknown	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37
425 mm Cavity Wall	1.73	1.51	1.51	1.51	1.51	1.1	0.6	0.55	0.55	0.37
425 mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37

If the dwelling is of age band F or G but the roof of the dwelling is shown to have no insulation, then the wall must be assumed to be age band E (no insulation)

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[1] These U-values may be used as a starting point for calculating U-values of similar walls with insulation provided evidence is available to substantiate the insulation levels used in any U-value calculations.

As a simple example, take a stone wall from age band B and add 50mm (d_{ins}) of insulation with thermal conductivity 0.035W/m·K (λ_{ins}). This example does not account for any extra cladding or plaster.
The resistance of the original stone wall is the inverse of the U-value of 2.1W/m²K. $R_{stonewall}$ = 0.4762m²K/W.
The resistance of the extra insulation is R_{ins} = d_{ins}/ λ_{ins} = 0.05/0.035 = 1.429m²K/W.

Total wall resistance = R_{wall} = R_{ins} + $R_{stonewall}$ = 0.4762 + 1.429 = 1.9052m²K/W.
Insulated wall U-value = U_{wall} = 1/R_{wall} = 0.525W/m²K.

In cases where an existing cavity wall has been filled with insulation, this method may be applied and requires the following information:
- the original default U-value of the wall from Table S3;
- the type and thickness of the newly added insulation preferably as identified on site and documented by the BER Assessor. Alternatively using receipts or invoices as detailed in the survey guide;
- the thermal conductivity of the new insulation material used to fill the cavity – taken from a certified data source as explained in Section 3.1 or from Table 12b.

Alternatively the U-value may be calculated in full using the thermal conductivities and thicknesses of the different layers in the wall. If the information above is unavailable, then the wall U-value should be taken from Table S3.

For semi-exposed walls the U-value for the applicable wall area is taken as that of the external walls of the dwelling adjusted as described in Section 3 using the following default values for the effective thermal resistance, R_u:

- 0.25 m²K/W if the dwelling is a house.
- 0.4 m²K/W if the dwelling is an apartment or maisonette.

When using default U-values from Table S3 for semi-exposed walls between an existing dwelling and an unheated space, the "Wall is semi-exposed" option in DEAP can be selected. DEAP then automatically applies the above Ru values to the default U-value. Alternatively, the Assessor may apply the relevant default Ru value from TGD L 2011 Appendix A.

Often, the wall between an apartment and unheated spaces (corridor, stairwell or commercial unit for example) will be uninsulated. Where this is the case, the U-values in Table S3a may be used. In these cases, the "Wall is semi-exposed" option is not selected in DEAP as the Ru value is already built into the defaults for these uninsulated walls.

Table S3a : U-values of semi-exposed uninsulated walls between apartment and unheated corridor, stairwell or commercial unit

Semi exposed wall description	U-value
Semi exposed 100mm block wall adjacent unheated circulation space	1.46
Semi exposed 215mm block wall adjacent unheated circulation space	1.13

Table S3b indicates default U-values where internal drylined insulation is retrofitted to one of the wall types in Table S3. This table assumes that the insulation added has thermal conductivity 0.038 W/m·K and the Assessor has insufficient detail on the actual thermal conductivity of the installed insulation. Table S3b applies only where the insulation is an addition to that of the original wall. Where the actual installed insulation thickness does not match one of the columns in the table below, the next lowest insulation thickness should be assumed from this table. For example, if the installed drylining insulation is 63mm thick, the column "Plasterboard + 60mm insulation" should be referenced if using Table S3b.

Table S3b: Exposed wall U-Values with typical drylining insulation upgrades

Original Wall U-Value from Table S3	Plasterboard + 0mm insulation	Plasterboard + 20mm insulation	Plasterboard + 30mm insulation	Plasterboard + 40mm insulation	Plasterboard + 50mm insulation	Plasterboard + 60mm insulation	Plasterboard + 70mm insulation
2.4	1.53	1.12	0.91	0.77	0.67	0.59	0.53
2.2	1.45	1.08	0.88	0.75	0.65	0.58	0.52
2.1	1.41	1.05	0.87	0.74	0.64	0.57	0.51
1.9	1.31	1.00	0.83	0.71	0.62	0.55	0.50
1.78	1.25	0.96	0.81	0.69	0.61	0.54	0.49
1.64	1.18	0.92	0.78	0.67	0.59	0.53	0.48
1.1	0.87	0.72	0.63	0.56	0.5	0.46	0.42
0.6	0.53	0.47	0.43	0.39	0.36	0.34	0.32
0.55	0.49	0.44	0.4	0.37	0.34	0.32	0.30
0.37	0.34	0.31	0.3	0.28	0.26	0.25	0.24

Deriving wall U-values: summary

Wall type and available data: examples	How to select the appropriate wall U-value
Full detail on all wall layers available from documentary evidence	Enter actual wall U-value based on U-value calculation into DEAP rather than using default value.
No detail available on exposed wall other than wall type and age band	Select wall type and age band in DEAP. DEAP automatically selects U-value from Table S3.
No detail available on semi-exposed stone wall other than wall type and age band	Select wall type and age band in DEAP and tick "wall is semi-exposed" in DEAP. DEAP selects U-value from Table S3 and automatically applies an Ru value.
Semi-exposed uninsulated 100mm block wall between apartment and corridor	Select wall type in DEAP. DEAP automatically selects U-value from Table S3a.
Original dwelling stone wall, age band B, retrofitted with drylining plasterboard (with 20mm insulation)	Identify U-value from Table S3 (2.1W/m²K) and identify retrofitted U-value from Table S3b. User enters resulting U-value (1.05W/m²K).

S6.2   U-values of roofs

The U-value assumed for a pitched roof with an insulated ceiling should, where possible, be based on the observed thickness of the loft insulation (mineral wool) according to Table S4.

Table S4: Roof U-values when loft insulation thickness is known (applies to ceiling insulation between joists only)[1]

Insulation thickness (mm)	Assumed roof U-value (W/m²K)
None	2.3
12	1.5
25	1.1
50	0.68
75	0.5
100	0.4
150	0.26
200	0.2
250	0.16
>= 300	0.13

If the insulation thickness is not known, the U-value should be taken from Table S5. Where there are loft areas with different insulation thicknesses, enter each of these areas as separate roofs in DEAP or base the U-values on area weighted thickness of insulation.

Table S5 : Assumed U-values when the roof insulation thickness is unknown

Age band	Assumed Roof U-value (W/m²K) (applies to all roof types).
A, B, C, D, E	2.3
F, G	0.49
H	0.40
I	0.36
J	0.25

Some of the U-values in Table S5 differ from those for roofs in Table S2. Table S5 U-values are based on insulation thicknesses stated in the regulations applicable to each age band and current U-value calculation methods.

Room in Roof:
If there is a 'room in roof' within an existing dwelling, with a total floor area of **Frr** (measured internally), then the heat loss area and U-value may be calculated as follows:
(1) Area Frr is deducted from the roof area
(2) A separate heat-loss roof area Arr is defined, where

$$Arr = Frr + 11\sqrt{Frr/1.5}$$

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[1] These U-values take account of joists. The insulation is taken as being between joists only up to 100 mm, and between and over joists for 100 mm or more. Uninsulated sheet metal roofs should be set to a U-value of 7.0 W/m²K unless another U-value can be substantiated.

Arr has a default U-value for the appropriate age band for the construction of the roof rooms (see Table S5) and is automatically calculated by the DEAP software in the building elements tab. The formula is based on a rectangular room-in-roof area of average height 2.2 m, and Arr includes the walls of the roof rooms as well as their roof. The storey height for the room-in-roof is (2.2 + 0.25) = 2.45 m. The residual roof area (area of roof less the floor area of room(s) in roof) has a default U-value according to its insulation thickness or Table S5. The default room in roof U-value is taken from Table S5.

Further detail on the room in roof approximation:
It is acceptable to use the equation for all room-in-roof shapes (for existing dwellings). The room in roof approximation should not be used for single storey apartments entirely within the roof.

To account for a room in roof for an existing dwelling:
(1) Take a room in roof with floor area Frr, where Frr is part of a ceiling of the storey below of area Crr.

(2) Determine the exposed ceiling heat loss area of the storey below (not including the room in roof area). This is entered under "roofs" in building elements with area (Crr - Frr)

(3) Frr is entered under the dimensions tab in DEAP as a room in roof floor area, along with average height of the actual room in roof.

(4) Under building elements (roofs), select "room in roof insulated on side":

a. Use the default U value listed on this tab (without using an "Ru" adjustment), or, if another U value can be used for the entire room in roof using supporting evidence use this non-default U value.

b. The automatically calculated area, Arr, includes all walls and roof sections in the room in roof. Openings should not be subtracted from Arr as it is an approximation. Windows in the room in roof must still be entered in the "windows" tab under the "building elements" section of the software.

5) Alternatively, it is acceptable to use the same method as for new dwellings (measuring the room in roof in full, including the walls and roofs separately). It is more accurate but will probably take more time. This may need to be done in an existing dwelling BER when it can be shown that only some facades of the room in roof attain a non-default U-value and the other facades are not accessible. A default U-value applies to the inaccessible facades. In this case, the U-values of the room in roof heat loss walls and roofs differ. As the approximation only allows a single U-value for all heat loss walls and roofs of the room in roof, the DEAP room in roof approximation cannot be used in this case.

(6) As mentioned above, it is acceptable to use a non-default U-value. However, bear in mind that some of the non default U values can have an Ru value applied and some cannot as it is directly on the rafter and the external roof.

Rooms not fully within the roof:
Where the upper storey included in the total floor area has walls (other than gable walls) which are exposed, this would not be a room in roof and would not use the room in roof approximation. The walls and roofs of this upper storey are entered separately in DEAP. An example of such a scenario would be a "storey and a half" dwelling.

Room in roof examples:

Room fully within the roof. Therefore the approximation formula may be used.

Insulated at ceiling level

Crr – Frr

Crr

Frr

Frr

Crr = area of downstairs ceiling
Frr = floor area of room in roof (entered under "dimensions")
Heat loss area of downstairs ceiling = Crr – Frr (entered in DEAP under "roofs")
Arr = Heat loss area of room in roof auto-calculated by DEAP (entered under "roofs")

Room fully within the roof. Therefore the approximation formula may be used.

Insulated at rafter level

Crr

Frr

Crr = area of downstairs ceiling
Frr = floor area of room in roof (entered under "dimensions")
Heat loss area of downstairs ceiling = Crr – Frr = 0 in this case
Arr = Heat loss area of room in roof auto-calculated by DEAP (entered under "roofs")

Upper storey included in the total floor area has walls (other than gable walls) which are exposed. Room in roof approximation not applicable. The walls and roofs of this upper storey are entered separately in DEAP. An example of such a scenario would be a "storey and a half" dwelling.

S6.3 U-values of floors next to the ground

The floor U-value is calculated according to I.S. EN ISO 13370 using its area and exposed perimeter, and rounded to two decimal places. The ratio of floor perimeter to area is the P/A ratio. The following parameters are used:

For solid ground floors:
– wall thickness assumed at 300mm for U-value calculations
– soil type: default (thermal conductivity 2.0 W/m·K)
– R_{si} = 0.17 m²K/W
– R_{se} = 0.04 m²K/W
– floor type with 50mm screed
– all-over floor insulation of thickness as per Table S6 with thermal conductivity 0.035 W/m·K

For suspended floors:
– height above external ground level 0.3 m
– average wind speed at 10 m height 5 m/s
– wind shielding factor 0.05
– ventilation openings per m exposed perimeter 0.003 m²/m
– U-value of walls to underfloor space 1.5 W/m²K
– all-over floor insulation of thickness as per Table S6 with thermal conductivity 0.04 W/m·K

Note that non separated conservatory floors are to be treated as normal floors within the dwelling.

Table S6: Basis for floor U-value calculation

Age band	All-over floor insulation (for solid or suspended floors)
A, B, C, D, E	None
F or G[1]	12 mm
H or I	35 mm
J	50 mm

This table also applies to heated basements or ground floors above unheated basements.

The exposed perimeter of a ground floor is the total length of the external wall dividing the dwelling ground floor from the external environment or from an unheated adjoining space. The part of the dwelling perimeter that adjoins (e.g. by a party wall) other heated properties (residential or commercial) is not included.

For example:
- If a dwelling adjoins an unheated garage or unheated stairwell on one side, the perimeter on that side is included when determining the ground floor U-value.

- The perimeter on a side adjoining the heated space of a neighbouring house would not be included in the total exposed perimeter when determining the ground floor U-value.

- The perimeter on a side adjoining an unheated space (e.g. garage) of a neighbouring house would be included in the total exposed perimeter when determining the ground floor U-value.

S6.4 U-values of exposed and semi-exposed upper floors

To simplify data collection no distinction is made in terms of U-value between an exposed floor (to outside air below) and a semi-exposed floor (to an enclosed but unheated space below) and the U-values in Table S7 are used (based on Building Regulations Table S2).

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[1] If the dwelling is of age band F or G but the roof of the dwelling is shown to have no insulation, then all floors types must be assumed to be age band E (no insulation) where contrary evidence is not available.

Table S7 : Exposed/Semi-exposed floor U-values

Age band	U-value (W/m²K)
A to E	1.20
F, G	0.8
H, I	0.6
J	0.37

S6.5   U-value of floor above a partially heated space

The U-value of a floor above partially heated premises is taken as 1.0 W/m²K. This applies typically for a flat above non-domestic premises that are not heated to the same extent or duration as the flat.

Where an existing dwelling is above a space heated to a different pattern than that of a dwelling, then the default U-value of 1.0W/m²K from Section S6.5 of the DEAP manual applies. This is half of a typical value for an uninsulated exposed element. However, if there is enough information available (and proof thereof) to calculate the actual floor U-value, then this should be done, and the result halved as per DEAP Section 3.5(c) to attain the floor U-value.

Table S8: Summary of floor U-value defaults

Floor Type	P/A Ratio	A	B	C	D	E	F	G	H	I	J
Ground Floor – Solid	**0.1**	0.27	0.27	0.27	0.27	0.27	0.23	0.23	0.19	0.19	0.17
	0.2	0.46	0.46	0.46	0.46	0.46	0.38	0.38	0.29	0.29	0.26
	0.3	0.61	0.61	0.61	0.61	0.61	0.48	0.48	0.36	0.36	0.31
	0.4	0.73	0.73	0.73	0.73	0.73	0.57	0.57	0.41	0.41	0.34
	0.5	0.84	0.84	0.84	0.84	0.84	0.64	0.64	0.44	0.44	0.37
	0.6	0.94	0.94	0.94	0.94	0.94	0.7	0.7	0.47	0.47	0.39
	0.7	1.02	1.02	1.02	1.02	1.02	0.74	0.74	0.49	0.49	0.4
	0.8	1.1	1.1	1.1	1.1	1.1	0.79	0.79	0.51	0.51	0.42
	0.9	1.16	1.16	1.16	1.16	1.16	0.82	0.82	0.52	0.52	0.43
	1 or more	1.23	1.23	1.23	1.23	1.23	0.85	0.85	0.54	0.54	0.44
Ground Floor – Suspended	**0.1**	0.27	0.27	0.27	0.27	0.27	0.25	0.25	0.22	0.22	0.2
	0.2	0.44	0.44	0.44	0.44	0.44	0.39	0.39	0.32	0.32	0.28
	0.3	0.56	0.56	0.56	0.56	0.56	0.48	0.48	0.37	0.37	0.33
	0.4	0.65	0.65	0.65	0.65	0.65	0.55	0.55	0.42	0.42	0.36
	0.5	0.73	0.73	0.73	0.73	0.73	0.6	0.6	0.45	0.45	0.38
	0.6	0.8	0.8	0.8	0.8	0.8	0.64	0.64	0.47	0.47	0.4
	0.7	0.85	0.85	0.85	0.85	0.85	0.68	0.68	0.49	0.49	0.41
	0.8	0.9	0.9	0.9	0.9	0.9	0.71	0.71	0.50	0.50	0.42
	0.9	0.94	0.94	0.94	0.94	0.94	0.73	0.73	0.52	0.52	0.43
	1 or more	0.98	0.98	0.98	0.98	0.98	0.76	0.76	0.53	0.53	0.44
Ground Floor – Above Unheated Basement[1]	**0.1**	0.56	0.56	0.56	0.56	0.56	0.47	0.47	0.36	0.36	0.31
	0.2	0.75	0.75	0.75	0.75	0.75	0.60	0.60	0.43	0.43	0.36
	0.3	0.88	0.88	0.88	0.88	0.88	0.68	0.68	0.47	0.47	0.39
	0.4	0.98	0.98	0.98	0.98	0.98	0.73	0.73	0.50	0.50	0.41
	0.5	1.06	1.06	1.06	1.06	1.06	0.78	0.78	0.51	0.51	0.42
	0.6	1.12	1.12	1.12	1.12	1.12	0.81	0.81	0.53	0.53	0.43
	0.7	1.17	1.17	1.17	1.17	1.17	0.84	0.84	0.54	0.54	0.44
	0.8	1.21	1.21	1.21	1.21	1.21	0.86	0.86	0.55	0.55	0.44
	0.9	1.26	1.26	1.26	1.26	1.26	0.88	0.88	0.56	0.56	0.45
	1 or more	1.29	1.29	1.29	1.29	1.29	0.89	0.89	0.56	0.56	0.45

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[1] This U-value is for the ground floor between the dwelling and unheated basement. Underground open car parks would not be considered to be unheated basements. The actual basement floor is assumed to be uninsulated. Perimeter is the exposed perimeter of that ground floor and area is the area of that ground floor. Insulation thickness as outlined. Insulation thickness and conductivity as per solid floors for same age band.

Floor Type	P/A Ratio	A	B	C	D	E	F	G	H	I	J
Basement – Heated[1]	**0.1**	0.36	0.36	0.36	0.36	0.36	0.29	0.29	0.22	0.22	0.2
	0.2	0.54	0.54	0.54	0.54	0.54	0.42	0.42	0.31	0.31	0.27
	0.3	0.65	0.65	0.65	0.65	0.65	0.49	0.49	0.35	0.35	0.3
	0.4	0.73	0.73	0.73	0.73	0.73	0.54	0.54	0.38	0.38	0.32
	0.5	0.78	0.78	0.78	0.78	0.78	0.57	0.57	0.4	0.4	0.33
	0.6	0.81	0.81	0.81	0.81	0.81	0.59	0.59	0.41	0.41	0.34
	0.7	0.84	0.84	0.84	0.84	0.84	0.6	0.6	0.42	0.42	0.35
	0.8	0.86	0.86	0.86	0.86	0.86	0.62	0.62	0.42	0.42	0.35
	0.9	0.87	0.87	0.87	0.87	0.87	0.63	0.63	0.43	0.43	0.36
	1 or more	0.89	0.89	0.89	0.89	0.89	0.63	0.63	0.43	0.43	0.36
Partially Heated Below		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Exposed / Semi Exposed		1.2	1.2	1.2	1.2	1.2	0.8	0.8	0.6	0.6	0.37
Other	**No Default Data**										

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[1] This U-value applies to the heated basement walls and floor. Insulation in walls and floor assumed to be of thickness and conductivity as per solid floors. When determining default U-values for heated basements in existing dwellings the following rules apply:

a) A heated basement is considered as part of the dwelling volume in DEAP when the criteria in Section 1 (dimensions) are met. The heated basement floor and walls are considered to be heat loss elements in DEAP. The ground floor (which is also the heated basement ceiling) is an internal non-heat loss element.

For P/A ratio of the basement for default U-value calculation:
- o   Perimeter is the basement floor perimeter
- o   Area for P/A ratio calculation is the basement floor area

b) Basement heat loss area in the "floors" section of DEAP is the sum of basement floor area and basement walls exposed to ground. In a semi-detached or terraced house with a basement, it is likely that the adjoining house has a basement. Unless proven otherwise, the adjoining basement should be assumed to be unheated.

c) Basement walls above ground are to be entered separately as walls in DEAP using the default wall U-values

d) The heated basement U-value defaults apply to any basement with average depth below ground >= 1.2m

e) If average basement depth below ground < 1.2m then:
- o   the basement floor is considered to be a solid ground floor for the purposes of determining its default U-value
- o   all basement walls are entered as walls in DEAP using the default wall U-values

S6.6   Allowance for thermal bridging

The thermal bridging factor, y, is defaulted at 0.15 W/m²K.

S7 Solar gains

Solar gains are calculated as for new dwellings.

S8 Window U-values and g-values

Section 3.2 outlines when values in Table S9 should be used for U-value and solar transmittance derivation. The survey process provides information on window area, glazing type, age, frame type and orientation.

Table S9 : Window default characteristics

Glazing	Low E coating	Frame	Metal thermal break assumed	U-value (W/m²K) (based on Table 6a)	Solar transmittance (based on Table 6b)	Comment
Single	n/a	Wood/PVC	n/a	4.8	.85	
Single	n/a	Metal	4mm	5.7	.85	
Single with secondary glazing	n/a	Wood/PVC	n/a	2.4	.76	
Single with secondary glazing	n/a	Metal	4mm	2.4	.76	
Double	No	Wood/PVC	n/a	3.1	.76	Air filled 6mm gap
Double	No	Metal	4mm	3.7	.76	air filled 6mm gap
Double	Yes	Wood/PVC	n/a	2.2	.72	Air filled low E hard coat εn = .15 12mm gap
Double	Yes	Metal	4mm	2.7	.72	Air filled low E hard coat εn = .15 12mm gap

If the surveyor is unable to determine whether double glazing is "Low E" or not, it can be assumed that double glazing installed before 2004 is not Low E and then refer to the associated value in Table S9. Any other U-value and solar transmittance from Table 6a/b may be chosen subject to the guidance under Table 6a/6b provided supporting evidence is available.

Adjustments for roof windows apply as per new dwellings.

Further detail on use of Table S9:
If the Assessor chooses to use the default window U-value and solar transmittance from Table S9 then the following defaults are assumed:

Installed before 2004:
Glass is uncoated, with 6mm air filled gap. Metal framed window thermal break is 4mm for metal framed windows.

Installed during or after 2004:
Glass is hard coated with εn = 0.15. 12mm air filled gap. Metal framed window thermal break is 4mm.

The following examples show use of DEAP Manual Table S9 to determine U-value and solar transmittance defaults:

- Double glazed windows installed in 2002 with a PVC frame:
  - When using Table S9 for a 2002 window (i.e. pre 2004), always assume glass is uncoated with a 6mm air filled gap;
  - U-value = 3.1 W/m2K;
  - Solar Transmittance = 0.76.

- Double glazed windows installed in 2004 with a PVC frame:
  - When using Table S9 for a 2004 window, always assume glass is hard coated with εn = 0.15. 12mm air filled gap;
  - U-value = 2.2 W/m2K;
  - Solar Transmittance = 0.72.

When an Assessor encounters retrofitted / upgraded glass in an existing window frame, they will most likely need to resort to the default window U-values in DEAP. Non-default values are used where there is sufficiently evidenced information to carry out a calculation to EN10077-1. It is unlikely that EN10077-2 (detailed calculation) or EN12567 (measurement) would be feasible in this case.

S9 Living room area

Living room is identified as per new dwellings and is recorded during survey.

S10   Thermal mass category

Thermal mass category may be based on the following defaults. If the heat capacity is significantly different from the defaults, the category must be determined using Table 11 or Section 7.3.
It is based on internal partitions (which must be identified during site survey) as well as external elements.

Table S10: Thermal Mass Category Defaults

Mass of construction elements

Ground floor	External Walls	Separating walls	Internal Partitions	Illustrative construction	Thermal Mass Category
light	light	Light	light	suspended timber floor, timber/steel frame walls, plasterboard on timber/steel stud internal partitions	Low
light	light	Light	medium	suspended timber floor, timber/steel frame walls, masonry internal partitions with plasterboard on dabs	Low
medium	light	light	light	solid floor, timber/steel frame walls, plasterboard on timber/steel stud internal partitions	Low
light	light	medium	light	suspended timber floor, timber/steel frame walls, masonry separating walls with plasterboard on dabs, plasterboard on timber/steel stud internal partitions	Low
light	medium	medium	light	suspended timber floor, masonry external and separating walls (cavity fill or external insulation on external walls) with plasterboard on dabs, plasterboard on timber/steel stud internal partitions	Medium-Low
medium	light	medium	light	solid floor, masonry external walls (internal insulation), masonry separating walls with plasterboard on dabs, plasterboard on timber/steel stud internal partitions	Medium-Low
medium	medium	medium	light	solid floor, masonry external walls (cavity fill or external insulation) with plasterboard on dabs, masonry separating walls with plasterboard on dabs, plasterboard on timber/steel stud internal partitions	Medium-Low
medium	medium	heavy	light	solid floor, masonry external walls (cavity fill or external insulation) with plasterboard on dabs, masonry separating walls dense plaster, plasterboard on timber/steel stud internal partitions	Medium
medium	heavy	medium	light	solid floor, masonry external walls (cavity fill or external insulation) with dense plaster, masonry separating walls with plasterboard on dabs, plasterboard on timber/steel stud internal partitions	Medium
medium	light	medium	medium	solid floor, masonry external walls (internal insulation), masonry separating walls with plasterboard on dabs, masonry internal partitions with plasterboard on dabs	Medium
medium	light	heavy	light	Solid floor, masonry external walls (internal insulation), masonry separating walls dense plaster, plasterboard on timber/steel stud internal partitions	Medium
medium	heavy	heavy	light	solid floor, masonry external walls (cavity fill or external insulation) with dense plaster, masonry separating walls with dense plaster, plasterboard on timber/steel stud internal partitions	Medium
light	heavy	heavy	light	Suspended timber floor, masonry external walls (cavity fill or external insulation) with dense plaster, masonry separating walls with dense plaster, plasterboard on timber/steel stud internal partitions	Medium
medium	medium	medium	medium	solid floor, masonry external walls (cavity fill or external insulation) with plasterboard on dabs, masonry separating walls plasterboard on dabs, masonry internal partitions with plasterboard on dabs	Medium
medium	medium	heavy	heavy	solid floor, masonry external walls (cavity fill or external insulation) with plasterboard on dabs, masonry separating walls dense plaster, masonry internal walls with dense plaster	Medium-High
light	heavy	heavy	heavy	Suspended timber floor, masonry external walls (cavity fill or external insulation) with dense plaster, masonry separating walls with dense plaster, masonry internal walls with dense plaster	Medium-high
medium	heavy	heavy	heavy	solid floor, masonry external walls (cavity fill or external insulation) with dense plaster, masonry separating walls with dense plaster, masonry internal walls with dense plaster	High

S11   Space and water heating

Space and water heating systems and their controls are those defined in Table 4 and should be determined by survey. In any case where the survey is unable to determine heating system properties, pessimistic values must be used. For example if the boiler and controls cannot be accessed during survey then a non-condensing pre 1998 boiler is assumed with no thermostats, timers or zoning unless otherwise indicated by age band in Table S11.

S11.1 Hot water details and defaults

If the hot water cylinder is accessible, the storage volume should be measured using height and diameter measurements as per Table 2a. If not accessible then the following defaults apply:
- Where electric immersion with night rate electricity, assume 210L cylinder for houses and 135L for apartments.
- If heated by solid fuel boiler default at 145L.
- Otherwise, default at 110L.

Table S11 : Heating and hot water default parameters

Parameter	Value
Hot water cylinder insulation if not accessible	Age bands A to G: none Age band H: 25 mm foam (factory applied insulation) or equivalent Age bands I or J: 35 mm foam (factory applied insulation) or equivalent
Insulation of primary pipework	No
Space heating circulation pump for wet systems	Within heated space
Hot water separately timed / separate temperature control	Age bands A to I: no Age band J: yes
Boiler interlock	Assumed present if there is a room thermostat and (for stored hot water systems) a cylinder thermostat. Otherwise not present
Solar collector	If solar collectors are present, the following data can be used for any unavailable parameters: - total aperture area of all collectors = 3 m^2 - η_0 and/or a_1 from Table H1 - facing South, pitch 30°, modest overshading - combined cylinder, dedicated solar part one-third of total, or if a combi boiler the cylinder identified is a dedicated solar cylinder - pump is not solar powered
Photovoltaics	If PV collectors are present, the data for unavailable parameters are: - PV area is roof area for heat loss, times percent of roof area covered by PVs, and if pitched roof divided by cos(35°) - kWp is 0.06 x PV area. - facing South, pitch 30°, modest overshading
Group heating scheme	If details cannot be ascertained they are defaulted to: system based on mains gas-fired boiler, efficiency 80%, piping installed before 1990, pre-insulated, flat-rate charging If CHP and details cannot be ascertained they are defaulted to: fraction of heat from CHP = 0.30, CHP overall efficiency 75%, heat to power ratio = 2.0

S12   Improvement measures

The BER Advisory report is generated by the National Administration System (NAS) on assessment upload.

S13   Dwelling Survey

A separate document detailing the survey methodology is available from SEAI. This document explains how each of the following items are measured where necessary and is summarised as follows:

Table S12 : Data to be collected

Item	Data	Comment
Built form and detachment	Classification according to dwelling type in survey methodology.	
Age band	According to Section S5.	Identify age band separately for: – main property – any extension – any rooms in roof
Dimensions	–Total Floor area, average room height for each floor (incl. Room in roof) –Floor area next to ground (including heated basement floors/walls) and associated exposed perimeters. –Floor area exposed to outside air or internal unheated air and associated exposed perimeters. –Floor area above partially heated space –Exposed wall areas –Semi exposed wall areas. –External door count –Exposed window area, orientation and detail on window construction as per Section 3.2. –Roof area –Living room area counted as per new dwellings –Estimate of internal walls thermal mass categories (mostly light, mostly massive, mixed).	Measured separately for main property and any extension For rooms-in-roof, measure floor area only, inside the dwelling
Wall construction	One of types from Table S3 (also used for wall ventilation infiltration category)	Recorded separately for main dwelling and any extension.
Wall insulation for each wall	One of types from Table S3	Recorded separately for main dwelling and any extension. External, cavity or internal insulation to be indicated only if added subsequent to original construction. If it has only the insulation that was part of the original construction it is "as built".
Roof construction	One of types from Table S5	Recorded separately for main dwelling and any extension
Roof insulation (if not another dwelling above)	One of types from Table S5	Recorded separately for main dwelling and any extension
Roof insulation thickness (joists)	One of values from Table S4	For roof insulation at joist level and where can be accessed. Recorded separately for main dwelling and any extension

Item	Data	Comment
Windows	External window area, orientation and detail on window construction as per Section 3.2.	
	Percentage of opening areas that have draught stripping based on a count of openable windows, doors and attic/crawlspace hatches between the dwelling and the exterior or unheated spaces as described in Section 2.3.	
Ventilation	Openings: Count of chimneys, open flues, flueless combustion roomheaters, intermittent fans and passive vents to be done in survey	
	Identify any whole house mechanical ventilation system present as one of: –positive input ventilation from loft –positive input ventilation from outside. –whole house extract ventilation –balanced whole house ventilation without heat recovery –balanced whole house ventilation with heat recovery.	
	Identify presence of a draught lobby	
	Identify presence of sealed or unsealed suspended timber ground floor	
	Number of storeys in dwelling	
	Count of sheltered sides to be defaulted to 0 if the number of sheltered sides cannot be determined and supported.	
Low energy lights	Low energy lighting counted as per new dwellings	
Main heating system	Fuel for main heating	
	Boiler identification if possible, otherwise system according to Table 4a/4b	If boiler can be identified, its characteristics are obtained via the HARP database
	Heat emitter type, one of –radiators –underfloor – fan coil radiators –low temperature radiators –other	If underfloor, is the floor a heat loss element?
	Heating system pumps and fans (oil fuel pump, flue fans, central heating pumps). The gas boiler flue fan may be at the air intake or exhaust gas outlet of the gas boiler.	A gas boiler is likely to have a flue fan and an oil boiler is likely to have an oil fuel pump. Where an Assessor encounters a gas boiler without a flue fan or an oil boiler without a fuel pump, they should retain detail on how these items were determined to be absent from the heating system. Wet central heating systems are likely to have one or more central heating pumps.
Main heating controls	Describe in as much detail as possible: zoning, timers, thermostats, interlock, TRVs, weather and load compensation etc…	
Secondary heating system	Fuel for secondary heating, and system from room heater section of Table 4a	Use of "none" defined in Appendix A
Water heating	Either – from main heating system, or –from secondary system, or –item from hot-water-only section of Table 4a	If insufficient water heating is available in the dwelling, assume direct acting electric heating as the main water heater.

Item	Data	Comment
	Storage losses? Cylinder details as per Section S11. Cylinder thermostat and timer present?	
	Details on immersion / supplementary electric water heating	
	Distribution losses?	
Mains gas available	yes/no	
Solar water heating	Solar panel (yes/no)	
Photovoltaic array	yes/no, and if yes the % of external roof area with PVs	
Group heating scheme	If details cannot be ascertained they are defaulted to: – system based on mains gas-fired boiler, efficiency 80% – piping installed before 1990, pre-insulated – flat-rate charging If CHP and details cannot be ascertained they are defaulted to: – fraction of heat from CHP = 0.30 – CHP overall efficiency 75% – heat to power ratio = 2.0	

Appendix U: Submission of BER assessments

DEAP allows registered BER Assessors to save assessments in a single database in the DEAP software, as individual files on a computer network, or as submitted assessments to SEAI's National Administration System (NAS) for BER assessments under http://ber.seai.ie.

The assessment may be saved within an internal database while entering data in the DEAP software. The assessment can also be exported to a file on the user's computer network or uploaded directly to NAS from within DEAP. DEAP highlights any incomplete mandatory fields when a file-export is attempted. Incomplete assessments cannot be submitted to the NAS. www.seai.ie/ber details how to access, submit files to and use the NAS.

Assessments submitted to the NAS are put through validation checks to highlight any unexpected data. Assessors should correct and resubmit any assessment that contains unexpected data resulting from human error before publishing that assessment on the BER register. If the unexpected data reflects the actual dwelling being assessed, the Assessor can choose to ignore the validation notices and publish the assessment on the BER register.

A BER submission is placed in the Repair Queue on the NAS when the BER and/or MPRN number submitted is incompatible with a record already held on the NAS. Repairs can be found by clicking on the 'Repairable' tab within the NAS account. If the Assessor can identify the error, they can discard the rating in repair, and resubmit the rating after correcting it in DEAP and resubmitting the assessment to NAS. If the Assessor is unable to identify an error and the numbers are correct, they can await final determination of the status of the rating by the BER Administrator. SEAI reviews the Repair Queue on a regular basis and resolves "Repairable" assessments as part of this review. This may involve contacting the Assessor directly to help resolve the issue.

The DEAP software provides a number of lookups and webservices for the user such as:
- Address search based on MPRN Number (requires registered Assessor login);
- Validation of BER number against NAS register (requires registered Assessor login);
- BER assessment upload and download to and from NAS (requires registered Assessor login);
- DEAP manual and technical bulletin access;
- Table 2 hot water storage loss factor lookup;
- Table 4 heating system controls lookup;
- HARP database gas/oil/LPG lookup (all other products listed on HARP are available under www.seai.ie/harp).

Queries related to any aspect of the DEAP methodology, may be addressed under the DEAP Frequently Asked Questions (FAQ) or BER Technical Bulletins under www.seai.ie/ber. Any further queries should be directed to the contacts under **http://www.seai.ie/Your_Building/BER/BER_Contact_Info/** .

TABLES

Most of the following tables are sourced from the UK Standard Assessment Procedure. SAP table numbers are retained where appropriate. Not all SAP tables are used.

Some of these tables have been incorporated into the DEAP software to facilitate user input.

Table 1a: Mean external temperature [ºC]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.3	5.5	7.0	8.3	11.0	13.5	15.5	15.2	13.3	10.4	7.5	6.0

Annual mean	9.9
Heating-season mean (Oct – May)	7.6

Source: Met Eireann data

Table 1b: Monthly means of daily solar radiation on unshaded vertical and horizontal surfaces [kWh/m² day]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
North	0.27	0.51	0.91	1.36	1.89	2.12	1.94	1.57	1.06	0.61	0.33	0.20
NE/NW	0.27	0.53	1.02	1.68	2.34	2.49	2.28	1.92	1.29	0.69	0.33	0.20
E/W	0.44	0.88	1.51	2.24	2.88	2.90	2.68	2.44	1.87	1.18	0.56	0.37
SE/SW	0.94	1.53	2.05	2.60	3.02	2.88	2.74	2.69	2.35	1.84	1.19	0.87
South	1.22	1.93	2.37	2.66	2.86	2.67	2.59	2.66	2.56	2.23	1.55	1.15
Horizontal	0.64	1.31	2.31	3.58	4.77	4.86	4.52	3.96	2.81	1.64	0.84	0.50

Notes regarding window orientation:
1) Use E/W orientation when the orientation is not known.
2) For a roof window in a pitched roof with a pitch of less than 70 degrees, use the value under 'North' for orientation within 30 degrees of North and the value under 'Horizontal for all other orientations. If the pitch is 70 degrees or greater, treat it as if it is a vertical window.

Source: Calculated from Met Eireann data

Table 1c: Solar flux for summer period [W/m²]

North	78
NE/NW	93
E/W	111
SE/SW	115
South	110
Horizontal	185

Notes
1) These values are averages for Jun – Aug.
2) This table is not required for a DEAP rating calculation; it is for use in the optional assessment of internal temperature in summer (see Appendix P).

Table 2: Factors to be applied to losses for cylinders, thermal stores and CPSUs (Source SAP 2005)

Type of water storage	Temperature Factor	
	for manufacturer's declared loss	for calculated loss
Cylinder, immersion main water heater	0.60	0.60
Cylinder, indirect	0.60 [a) b)]	0.60 [a) b)]
Storage combi boiler, primary store	n/a	Store volume ≥ 115 litres: 0.82 Store volume < 115 litres: $0.82 + 0.0022 \times (115 - V)$
Storage combi boiler, secondary store	n/a	Store volume ≥ 115 litres: 0.60 Store volume < 115 litres: $0.60 + 0.0016 \times (115 - V)$
Hot water only thermal store	0.89 [c) d)]	1.08 [c) d)]
Integrated thermal store and gas-fired CPSU	0.89 [c) d)]	1.08 [c) d)]
Electric CPSU: winter operating temp. 85°C 90°C 95°C	 1.09 1.15 1.21	 1 1 1
Plate heat exchanger in a group heating system	1	1

Notes:
a)   Multiply Temperature Factor by 1.3 if a cylinder thermostat is absent.
b)   Multiply Temperature Factor by 0.9 if there is separate time control of domestic hot water (boiler systems only – includes heat pumps).
c)   Multiply Temperature Factor by 0.81 if the thermal store or CPSU has separate timer for heating the store.
d)   Multiply Temperature Factor by 1.1 if the thermal store or CPSU is not in an airing cupboard.
e)   Where it is unclear if a storage combi boiler has a primary or secondary store, assume primary store present.
Where none of the Table 2 notes apply, the temperature factor and associated multiplier default to 1.

Table 2a: Calculation of hot water storage vessel volume

Diameter (mm)	Height (mm)	Storage volume
300	1600	**96**
350	900	**72**
400	900	**96**
400	1050	**114**
450	675	**84**
450	750	**95**
450	825	**106**
450	900	**117**
450	1050	**140**
450	1200	**162**
450	1500	**206**
500	1200	**190**
500	1500	**245**
600	1200	**280**
600	1500	**360**
600	1800	**440**

Notes:

Determine the hot water storage vessel volume using one of the following steps:

a)   Measure the height and diameter of the hot water storage vessel and choose the nearest height and diameter options from Table 2a to determine the volume in litres. Insulation thickness should not be included in the height or diameter measurement when using the table above. Table 2a is based on BS1566 and applies to copper cylinders, however, these figures may also be used for other types of storage vessels for the purposes of DEAP assessments.

b)   The storage vessel diameter may be determined based on vessel circumference, dividing the circumference by π (3.14), before following step (a) above. Diameter should not include insulation thickness.

c)   Alternatively, the hot water storage vessel volume may be determined from a label on the vessel, provided the label also references a European or national standard (such as BS1566 or IS161).

d)   Where the hot water storage vessel is inaccessible, documentary evidence from the installer, developer, architect or engineer identifying the volume of the installed vessel may be used.

e)   Where none of the above options are available, the vessel volume may be assumed from the defaults in DEAP Appendix S (section S11.1).

Where multiple hot water cylinders are present in a dwelling the average insulation thickness is determined using the weighted volume of each cylinder.

Table 3: Primary circuit losses[**]

System type[+]	kWh/year
Electric immersion heater	0
Boiler with uninsulated primary pipework* and no cylinder thermostat	1220
Boiler with insulated primary pipework and no cylinder thermostat	610
Boiler with uninsulated primary pipework and with cylinder thermostat	610
Boiler with insulated primary pipework and with cylinder thermostat	360
Combi boiler	0
CPSU (including electric CPSU)	0
Boiler and thermal store within a single casing (cylinder thermostat present)	0
Separate boiler and thermal store connected by no more than 1.5 m of insulated pipework	0
Separate boiler and thermal store connected by:	
- uninsulated primary pipe work	470
- more than 1.5 m of insulated primary pipe work	280
Group heating	360

+ References to "boiler" in this table also imply other wet heating systems such as heat pumps.
 * "Primary pipework" means the pipes between a primary water heater and a hot water tank.
** When specifying that the primary pipework is insulated, bear in mind that this refers to **all** of the pipework between the primary water heater and the water storage. Where some of the pipework is not visible (if for example it runs through walls or floors), then it must be assumed to be uninsulated unless it can be proven to be insulated.

Table 3a: Additional losses for combi boilers

Combi type	kWh / year
Instantaneous, without keep-hot facility*	600 [a)]
Instantaneous, with keep-hot facility controlled by time clock	600
Instantaneous, with keep-hot facility not controlled by time clock	900

Storage combi boiler** store volume ≥ 55 litres	0
Storage combi boiler** store volume V < 55 litres	$600 - (V - 15) \times 15$ [a)]

[a)] If the hot water usage is less than 100 litres/day, multiply by (daily hot water usage) / 100

* "keep-hot facility" is defined in Appendix D, Section D1.16. The facility to keep water hot may have an on/off switch for the user, or it may be controlled by a time switch. If the store is 15 litres or more, the boiler is a storage combination boiler.
** "storage combi boilers" are defined in Appendix D, Section D1.10.

Notes:
In the case of keep-hot:
1) If the keep-hot facility is maintained hot solely by burning fuel, use an appropriate loss for combi boiler from Table 3a and proceed with the calculation as normal.
2) If the keep-hot facility is maintained by electricity, use the following approach:
   a)   enter the appropriate combi loss from Table 3a to the appropriate cell in the 'Water Heating' tab;
   b)   enter appropriate electricity consumption from Table 4f to appropriate cell in 'Water Heating' tab;;
3) In the case of an untimed electrically powered keep-hot facility where the power rating of the keep-hot heater is obtained from the HARP database, the loss should be taken as:
         Loss =8.76 x P (kWh/year)
    where P is the power rating of the heater in Watts
4) The DEAP software will add the fuel use (i.e. the ad ditional combi loss minus any associated electricity consumption) to the fuel required for water heating, and account for the electricity consumption in the 'electricity for pumps, fans etc' category on the 'Energy Requirements' tab.

Source: SAP 2005

Table 4a: Heating system seasonal efficiency (space and water)

1) The table shows space heating efficiency. The same efficiency applies for water heating when hot water is supplied from a boiler system.
2) For independent water heaters see section at end of table.
3) Boiler efficiencies are all gross seasonal efficiencies.
4) In all cases, refer to the HARP database rather than this table where HARP data is available.

Heating System	Efficiency %	Responsiveness category[1]
CENTRAL HEATING SYSTEMS WITH RADIATORS OR UNDERFLOOR HEATING		

Gas boilers and oil boilers

For efficiency, use HARP database (www.seai.ie/harp) if possible, otherwise use efficiency from Table 4b.

Use Table 4c for efficiency adjustments.

Use Table 4d for responsiveness category.

Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.

Micro-cogeneration (micro-CHP)

See Appendix N. Performance data to be obtained from HARP database (www.seai.ie/harp).

Use Table 4c for efficiency adjustments.

Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.

Solid fuel boilers

For efficiency, use HARP database if possible, otherwise use efficiency from this table. For open fires with back boilers and closed roomheaters with boilers the efficiencies are the sum of heat to water and heat to room.

Refer to Group 1 in Table 4e for control options.

Heating System	Efficiency %	Responsiveness category
Manual feed independent boiler in heated space (mineral or wood) [a]	60	2
Manual feed independent boiler in unheated space (mineral or wood) [a]	55	2
Auto (gravity) feed independent boiler in heated space [a]	65	2
Auto (gravity) feed independent boiler in unheated space [a]	60	2
Open fire with back boiler to radiators	55	3
Closed roomheater with back boiler to radiators	65	3
Wood chip/pellet independent boiler	65	2
Stove (pellet-fired) with back boiler to radiators.	65	2
Range cooker boiler (integral oven and boiler)	45	3
Range cooker boiler (independent oven and boiler)	55	3

Note:[a] Heated space means within the boundary of the dwelling as defined in Section 1, "Dwelling dimensions".

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[1] For wet heating systems in Table 4a supplying heat to underfloor heating (with pipes in concrete slab), the responsiveness category of 4 from Table 4d is specified.

Heating System	Efficiency %	Responsiveness category
Electric boilers		
Refer to Group 1 in Table 4e for control options		
Direct acting electric boiler	100	1
Electric CPSU in heated space [a)]	100	2
Dry core storage boiler in heated space [a) b)]	100	2
Dry core storage boiler in unheated space [a) b)]	85	2
Water storage boiler in heated space [a) b)]	100	2
Water storage boiler in unheated space [a) b)]	85	2

[a)] Heated space means within the boundary of the dwelling as defined in Section 1, "Dwelling dimensions".

[b)] Store within boiler capable of meeting all space heating needs

Heating System	Efficiency %	Responsiveness category
Heat pumps (see also warm air systems)		
Refer to Group 2 in Table 4e for control options		
Ground-to-water heat pump (electric)	320	From Table 4d
Ground-to-water heat pump with auxiliary heater (electric)	300	From Table 4d
Water-to-water heat pump (electric)	300	From Table 4d
Air-to-water heat pump (electric)	250	From Table 4d
Gas-fired, ground or water source	120	From Table 4d
Gas-fired, air source	110	From Table 4d

GROUP HEATING SCHEMES

If known, use manufacturer's declared certified efficiency instead of the value in this table.

Refer to Group 3 in Table 4e for control options

Check Table 4c for efficiency adjustment due to controls

Distribution loss allowed for separately (see Table 9).

Heating System	Efficiency %	Responsiveness category
Group heating boilers (Also see Table S11 for existing buildings)	75	1

ELECTRIC STORAGE SYSTEMS

Refer to Group 4 in Table 4e for control options

Off-peak tariffs:

Heating System	Efficiency %	Responsiveness category
Old (large volume) storage heaters	100	5
Modern (slimline) storage heaters	100	4
Convector storage heaters	100	4
Fan storage heaters	100	3
Modern (slimline) storage heaters with Celect-type control	100	3
Convector storage heaters with Celect-type control	100	3
Fan storage heaters with Celect-type control	100	2
Integrated storage/direct acting heater	100	2

ELECTRIC UNDERFLOOR HEATING

Refer to Group 7 in Table 4e for control options

Off-peak tariffs:

Heating System	Efficiency %	Responsiveness category
In concrete slab (off-peak only)	100	5

Integrated (storage/direct acting)	100	4
Integrated (storage/direct acting) with low (off-peak) tariff control	100	3
Standard or off-peak tariff:		
In thin screed (45-60 mm, above insulation)	100	2
In timber floor, or immediately below floor covering	100	1

WARM AIR SYSTEMS
Refer to Group 5 in Table 4e for control options

Gas-fired warm air with fan-assisted flue

Ducted, on-off control, pre 1998	70	1
Ducted, on-off control, 1998 or later	76	1
Ducted, modulating control, pre 1998	72	1
Ducted, modulating control, 1998 or later	78	1
Roomheater, with in-floor ducts	69	1

Gas fired warm air with balanced or open flue

Ducted or stub-ducted. On-off control, pre 1998	70	1
Ducted or stub-ducted. On-off control, 1998 or later	76	1
Ducted or stub-ducted, modulating control, pre 1998	72	1
Ducted or stub-ducted, modulating control, 1998 or later	78	1
Ducted or stub-ducted with flue heat recovery	85	1
Condensing	81	1

Oil-fired warm air

Ducted output (on/off control)	70	1
Ducted output (modulating control)	72	1
Stub duct system	70	1

Electric warm air

Electricaire system	100	2

Heat pumps
Refer to Group 2 in Table 4e for control options

Ground-to-air heat pump (electric)	320	1
Ground-to-air heat pump with auxiliary heater (electric)	300	1
Water-to-air heat pump (electric)	300	1
Air-to-air heat pump (electric)	250	1
Gas-fired, ground or water source	120	1
Gas-fired, air source	110	1

ROOM HEATERS
Refer to Group 6 in Table 4e for control options
If declared efficiency is available (see Appendix E) use instead of value from table

Gas (including LPG) room heaters:

Gas fire, open flue, pre-1980 (open front)	50	1

Gas fire, open flue, 1980 or later (open fronted), sitting proud of, and sealed to, fireplace opening	63	1
Gas fire or wall heater, balanced flue	58	1
Gas fire, open flue (open fronted), sitting proud of, and sealed to, fireplace opening, with back boiler unit	63	1
Flush fitting Live Fuel Effect gas fire (open fronted), sealed to fireplace opening, with back boiler unit	40	1
Gas fire, closed front, fan assisted	72	1
Condensing gas fire	85	1
Flush fitting Live Fuel Effect gas fire (open fronted), sealed to fireplace opening	40	1
Flush fitting Live Fuel Effect gas fire (open fronted), fan assisted, sealed to fireplace opening	45	1
Decorative Fuel Effect gas fire, open to chimney	20	1
Gas fire, flueless	90	1

add additional ventilation requirements under 'Ventilation'

Oil room heaters:

Room heater, pre 2000	55	1
Room heater, 2000 or later	60	1
Room heater with boiler (no radiators), pre 2000	65	1
Room heater with boiler (no radiators), 2000 or later	70	1

Solid fuel room heaters

Open fire in grate	30	3
Open fire with back boiler (no radiators)	50	3
Closed room heater	60	3
Closed room heater with boiler (no radiators)	65	3
Stove (pellet fired) – with or without back boiler	65	2

Electric (direct acting) room heaters:

Panel, convector or radiant heaters *	100	1
Fan heaters	100	1
Portable electric heaters	100	1

*includes water or oil filled electric radiators

Other roomheaters

Bioethanol fires, flueless	90	1

OTHER SPACE HEATING SYSTEMS

Refer to Group 7 in Table 4e for control options

Electric ceiling heating	100	2

HOT-WATER-ONLY SYSTEMS

If water heating from main system, use efficiency of main system

Electric immersion (on-peak or off-peak)	100	n/a
Direct acting electric heating (specified where insufficient water heating present in dwelling)	100	n/a
Back boiler (hot water only), gas	65	n/a
From a circulator built into a gas warm air system, pre 1998	65	n/a
From a circulator built into a gas warm air system, 1998 or later	73	n/a
Single-point gas water heater (instantaneous at point of use)	70	n/a
Multi-point gas water heater (instantaneous serving several taps)	65	n/a
Electric instantaneous at point of use	100	n/a
Oil boiler/circulator for water heating only	70	n/a
Solid fuel boiler/circulator for water heating only	55	n/a
Range cooker with boiler for water heating only:		
Gas, single burner with permanent pilot	46	n/a
Gas, single burner with automatic ignition	50	n/a
Gas, twin burner with permanent pilot pre 1998	60	n/a
Gas, twin burner with automatic ignition pre 1998	65	n/a
Gas, twin burner with permanent pilot 1998 or later	65	n/a
Gas, twin burner with automatic ignition 1998 or later	70	n/a
Oil, single burner	60	n/a
Oil, twin burner pre 1998	70	n/a
Oil, twin burner 1998 or later	75	n/a
Solid fuel, integral oven and boiler	45	n/a
Solid fuel, independent oven and boiler	55	n/a
From hot-water only group scheme – boilers	75	n/a
From hot-water only group scheme – CHP	75	n/a

Table 4b: Gross seasonal efficiency for gas and oil boilers

1) This table is intended only for gas and oil boilers where the HARP efficiency is not available.
2) The table shows seasonal efficiencies for space heating. The same seasonal efficiencies should be assumed for water heating when hot water is supplied from a boiler system.
3) See Appendix B for guidance on boiler classification.
4) Apply efficiency adjustments in Table 4c if appropriate.
5) See Table 4d for responsiveness category.

Boiler	Efficiency, %
Gas boilers (including LPG) 1998 or later	
Non-condensing (including combis) with automatic ignition	73
Condensing (including combis) with automatic ignition	83
Non-condensing (including combis) with permanent pilot light	69
Condensing (including combis) with permanent pilot light	79
Back boiler to radiators (gas fire as secondary heating)	65
Gas boilers (including LPG) pre-1998, with fan-assisted flue	
Low thermal capacity	72
High or unknown thermal capacity	68
Combi	70
Condensing combi	83
Condensing	83
Gas boilers (including LPG) pre-1998, with balanced or open flue	
Wall mounted	65
Floor mounted, pre 1979	55
Floor mounted, 1979 to 1997	65
Combi	65
Back boiler to radiators (gas fire as secondary heating)	65
Combined Primary Storage Units (CPSU) (mains gas and LPG)	
With permanent pilot (non-condensing)	70
With automatic ignition (non-condensing)	74
With permanent pilot (condensing)	79
With automatic ignition (condensing)	83
Oil boilers	
Standard oil boiler pre-1985	65
Standard oil boiler 1985 to 1997	70
Standard oil boiler, 1998 or later	79
Condensing	83
Combi, pre-1998	70
Combi, 1998 or later	76
Condensing combi	81
Oil room heater + boiler, pre 2000	65
Oil room heater + boiler, 2000 or later	70
Range cooker boilers (mains gas and LPG)	
Single burner with permanent pilot	46
Single burner with automatic ignition	50
Twin burner with permanent pilot (non-condensing) pre 1998	60
Twin burner with automatic ignition (non-condensing) pre 1998	65
Twin burner with permanent pilot (non-condensing) 1998 or later	65
Twin burner with automatic ignition (non-condensing) 1998 or later	70
Range cooker boilers (oil)	
Single burner	60
Twin burner (non-condensing) pre 1998	70
Twin burner (non-condensing) 1998 or later	75

Table 4c: Efficiency adjustment factors

Heating system	Multiply efficiency by:

Gas or oil boiler systems with radiators or underfloor heating:

The adjustments are to be applied to the space and water heating gross seasonal efficiency for both the HARP value and for efficiency values from Table 4b. The term "radiators" when connected to a boiler refers to standard radiators, along with lower temperature and fan coil radiators.

(1) Efficiency adjustment due to lower temperature of distribution system:	**Mains gas**	**Oil or LPG**
Condensing boiler with load compensator [a]	1.02	1.01
Condensing boiler with weather compensator [a]	1.02	1.01
Condensing boiler with under-floor heating [a] [b]	1.03	1.02
Condensing boiler with thermal store [a]	1	1

(2) Efficiency adjustment due to control system	
No thermostatic control of room temperature [c]	0.95
No boiler interlock [c]	0.95

Group heating systems:

(3) Efficiency adjustment due to charging method	
Flat rate charging [d]	0.90

Heat pumps:

(4) Efficiency adjustment due to temperature of heat supplied	**Space**	**DHW**
Heat pump with underfloor heating or warm air heat pump	1.0	
Heat pump with standard radiators without load or weather compensation (regardless of presence of underfloor heating, fan coil or low temperature radiators) [e]	0.7	
Heat pump with standard radiators and load or weather compensation (regardless of presence of underfloor heating, fan coil or low temperature radiators) [e]	0.75	
Heat pump with fan coil or low temperature radiators (regardless of presence of underfloor heating)	0.85	
Heat pump supplying all DHW tested to IS EN 14511-2		0.7
Heat pump supplying all DHW tested to IS EN 255-3		0.75
Heat pump supplying 50% or 75% DHW (see Appendix G)		1.0

Range cooker boilers gas or oil fired:

The following adjustment is to be applied only to the space heating gross seasonal efficiency (i.e. not waterheating efficiency), and only where the efficiency is obtained from the HARP database or manufacturer's declared value. 'Φ_{case}' is the heat emission from the case of the range cooker at full load (in kW); and 'Φ_{water}' is the heat transferred to water at full load (in kW). Φ_{case} and Φ_{water} are obtained from the database record for the range cooker boiler or manufacturer's declared value.

Range cooker boiler gas or oil fired	$1 + (\Phi_{case} / \Phi_{water})$

Notes:

a) These are mutually exclusive and therefore do not accumulate; if more than one applies, the highest applicable efficiency adjustment is to be used. These do not apply if there is passive flue gas heat recovery. Weather compensators are located outside the dwelling. Load compensators are located inside.

b) Adjustment is applicable if the boiler supplies only the underfloor heating, and not if it also feeds radiators or supplies hot water. Radiator systems designed to operate at the same temperature as underfloor heating as outlined in note (e) below can also use these factors if the boiler does not supply hot water.

c)   These do not accumulate as no thermostatic control or presence of a bypass means that there is no boiler interlock. However, if the system is such that interlock is achieved using an alternative to "thermostatic control" (even if there is a bypass in the system), then both "No thermostatic control of room temperature" and "no boiler interlock" should both be set to "NO" so that DEAP will account for the presence of the interlock mechanism. The Assessor should keep a record of how the interlock's presence was determined in this scenario.

d)   'Flat rate charging' means that households pay for the heat according to a fixed monthly or annual amount, not depending on the amount of heat actually used. If the charges vary within a scheme for other reasons, for example according to dwelling size, it is still classified as flat rate.

e)   The following provides further guidance on selection of the space heating efficiency adjustment factor for heat pumps heating radiators or underfloor heating.

Underfloor heating present?	Number of fan coil rads present	Number of rads present	Assumed operating temperature	Is there load or weather compensation present?	Space heating efficiency adjustment factor for heat pumps in DEAP
Yes	0	0	Low temperature (~35°C)	Yes or no	1
Yes or no	One or more	0	Medium temperature (~40°C)	Yes or no	0.85
Yes or no	Yes or no	One or more	High temperature (>=50°C)	Yes	0.75
Yes or no	Yes or no	One or more	High temperature (>=50°C)	No	0.7

For example, where there is at least one standard radiator present with weather compensation, then, regardless of the presence of underfloor heating or fan coil heating, the system is assumed to operate at a higher temperature efficiency adjustment factor chosen in DEAP is 0.75.

Where design documentation within the dwelling specification is obtained by the BER Assessor detailing that the entire space heating emitter system is intended to run at a lower temperature than that specified above, then a higher space heating efficiency adjustment factor may be used for the heat pump, up to a maximum value of 1.0. For example, if system design documentation details that a system containing fan coil radiators and underfloor heating is designed to run at the same temperature as underfloor heating (35°C), then the efficiency adjustment factor is assumed to be 1.0 in DEAP. Likewise, if system design specification shows that a system containing standard radiators and underfloor heating is designed to run at a medium temperature (40°C), an efficiency adjustment factor of 0.85 may be used.

The guidance above is based on the premise that systems with radiators (standard or fan coil) operate at temperatures above the temperatures encountered using underfloor heating only. Lower temperatures than those specified in the table above (and therefore improved efficiency adjustment factors) may be assumed only where design specifications for the actual dwelling clearly demonstrate that the system is designed to operate at lower temperatures. In the design specifications, a heat loss calculation should be performed as detailed in "SR 50-1:2010 Code of practice for building services – Part 1: Domestic plumbing & heating" Section 7. The heat emitter should be sized for the space where it is installed, taking into consideration the flow and return temperatures of the heating system and the mean water to air temperature of the emitter. The resulting system operating temperature should be clear in the design specification if being used as evidence for DEAP assessments.

The temperatures assumed in this guidance are based on "Heating and Domestic Hot Water Systems for dwellings – Achieving compliance with Part L 2008" available on www.environ.ie.

Table 4d: Heating responsiveness category for wet systems with heat supplied to radiators or underfloor heating

Heat emitter	Responsiveness category
Systems with radiators (standard or fan coil or low temperature) :	1
Underfloor heating (wet system):	
pipes in insulated timber floor	1
pipes in screed above insulation	2
pipes in concrete slab	4

Where underfloor heating in concrete slab and radiators are both in use then responsiveness category is defined as follows:

    a)   responsiveness category is 2 if the room defined as the living area is heated using radiators
    b)   otherwise, responsiveness category is 3.

See Table 4a for electric underfloor heating responsiveness.

Table 4e: Heating system controls

1) Use Table 4a to select appropriate Group in this table.
2) 'Control category' is entered into the appropriate cell of the 'Distribution System Losses and Gains' tab.
3) The 'Temperature adjustment' modifies the temperature of the living area during heating hours, and is entered into the appropriate cell of the 'Distribution System Losses and Gains' tab.

Type of control	Control category	Temperature adjustment, °C	Reference to other possible adjustments
GROUP 1: BOILER SYSTEMS WITH RADIATORS OR UNDERFLOOR HEATING			
No time or thermostatic control of room temperature	1	+0.6	Table 4c[2]
Programmer, no room thermostat	1	+0.6	Table 4c[2]
Room thermostat only	1	0	Table 4c[2]
Programmer + room thermostat	1	0	Table 4c[2]
Programmer + at least two room thermostats	2	0	Table 4c[2]
Programmer + room thermostat + TRVs	2	0	Table 4c[2]
Programmer + TRVs (likely to include bypass)	2	0	Table 4c[2]
Programmer + TRVs + flow switch	2	0	Table 4c[2]
Programmer + TRVs + boiler energy manager	2	0	Table 4c[2]
Time and temperature zone control	3	0	Table 4c[2]
Adjustments for features of control systems:			
(applicable to any control option above and in addition to the adjustments selected above)			
Delayed start thermostat	one of the above	-0.15	n/a
Load or weather compensation	one of the above	0	Table 4c[1]
Temperature control of water heating (cylinder stat)	n/a	n/a	Tables 2 and 3
Time control of water heating (separate programming)	n/a	n/a	Table 2
Adjustments for features other than controls:			
Temperature adjustment for CPSU	n/a	-0.1	n/a

or integrated thermal stores

Underfloor heating	n/a	n/a	Table 4c[1]

GROUP 2: HEAT PUMPS WITH RADIATORS OR UNDERFLOOR HEATING

No time or thermostatic control of room temperature	1	+0.3	Table 4c[4]
Programmer, no room thermostat	1	+0.3	Table 4c[4]
Thermostat only	1	0	Table 4c[4]
Programmer + room thermostat	1	0	Table 4c[4]
Programmer + at least two room thermostats	2	0	Table 4c[4]
Programmer + room thermostat + TRVs + bypass	2	0	Table 4c[4]
Time and temperature zone control	3	0	Table 4c[4]

Adjustments for features of control systems:

(applicable to any control option above and in addition to the adjustments selected above)

Load or weather compensation	one of the above	0	Table 4c[4]
Temperature control of water heating (cylinder stat)	n/a	n/a	Tables 2 and 3
Time control of water heating (separate programming)	n/a	n/a	Table 2

GROUP 3: GROUP HEATING SCHEMES

No thermostatic control of room temperature	1	+0.6	Table 4c[3]
Programmer and roomstat	1	0	Table 4c[3]
Programmer and TRVs	2	0	Table 4c[3]
Time and temperature zone control	3	0	Table 4c[3]

(Programmer in group heating scheme may be inside dwelling or part of the group heating system)

GROUP 4: ELECTRIC STORAGE SYSTEMS

Manual charge control	3	+0.3	n/a
Automatic charge control	3	0	n/a
Celect-type controls	3	0	n/a

GROUP 5: WARM AIR SYSTEMS

No thermostatic control of room temperature	1	+0.3	n/a
Programmer, no room thermostat	1	+0.3	n/a
Room thermostat only	1	0	n/a
Programmer + room thermostat	1	0	n/a
Programmer and at least two room thermostats	2	0	n/a
Time and temperature zone control	3	0	n/a

GROUP 6: ROOM HEATER SYSTEMS

No thermostatic control	2	+0.3	n/a
Appliance thermostat	3	0	n/a
Appliance thermostat + programmer	3	0	n/a
Programmer + room thermostat	3	0	n/a
Room thermostat only	3	0	n/a

GROUP 7: OTHER SYSTEMS

No thermostatic control of room temperature	1	+0.3	n/a
Programmer, no room thermostat	1	+0.3	n/a
Room thermostat only	1	0	n/a
Programmer + room thermostat	1	0	n/a
Temperature zone control	2	0	n/a
Time and temperature zone control	3	0	n/a

Table 4f: Electricity for fans and pumps and electric keep-hot facility

Equipment	kWh/year
Heating system:	
Central heating pump (supplying hot water to radiators or underfloor system)	130 [a)]
Oil boiler [b)] – pump (supplying oil to boiler and flue fan) [c)]	100 [a)]
Gas boiler or gas fired heat pump– flue fan (if fan assisted flue)	45
Warm air heating system fans [d)]	$0.6 \times V$
Keep-hot facility of a combi boiler:	
Electricity for maintaining keep-hot facility [e)]	
- keep-hot facility, controlled by time clock	600
- keep-hot facility, not controlled by time clock [f)]	900
Ventilation system:	
Mechanical extract ventilation [g)]	$SFP \times 1.22 \times V$
Balanced whole house mechanical ventilation fans [g)]	$SFP \times 1.22 \times V$
Positive input ventilation (from loft space)	0
Positive input ventilation (from outside) [g)]	$SFP \times 1.22 \times V$
Solar water heating pump:	
Solar water heating pump, electrically powered	75
Solar water heating pump, PV powered	0

Notes:
a) Default values applied by DEAP. Multiply by a factor of 1.3 if room thermostat is absent
b) Applies to all oil boilers that provide main heating, but not if boiler provides hot water only.
c) The same motor operates both the pump and the flue fan. This is usually inside the oil boiler.
d) If the heating system is a warm air unit and there is whole house ventilation, the electricity for warm air circulation should not be included in addition to the electricity for mechanical ventilation. V is the volume of the dwelling. The electric fan on fan coil radiators is recorded in the DEAP distribution system losses and gains tab under this entry.
e) See notes to Table 3a for the definition of keep-hot facility.
f) In the case of an untimed electrically powered keep-hot facility where the power rating of the keep-hot heater is obtained from the Boiler Efficiency database, the electricity consumed for maintaining the keep-hot facility should be taken as:
      electricity consumed = 8.76 x P (kWh/year); where P is the power rating in watts
g) SFP is specific fan power in W/(litre/sec), see paragraph 2.6 and Table 4g, V is volume of the dwelling in m^3.

Note on use of non-default central heating pump electricity consumption:
For integrated central heating pumps (pump not separate from boiler), defaults are taken from Table 4f:

Boiler controlled by room thermostat   130kWh/year
Boiler not controlled by room thermostat   169kWh/year

To calculate the annual energy consumption for standalone central heating pumps (pump separate from boiler) the following method is used:

Energy Label Category[1]	Annual Electricity Consumption (kWh)	
	Boiler controlled by room thermostat	Boiler not controlled by room thermostat
A	52	67.6
B	78	101.4
C	104	135.2
Other / Don't know	130	169

The default electricity consumption value in the DEAP software for each central heating pump is 130kWh/yr where a room thermostat is installed. Where the boiler is not controlled by a room thermostat, the default electricity consumption per central heating pump is 169kWh/yr. When using the default value, the BER Assessor must specify whether or not the boiler is controlled by a room thermostat.

The user has the option of entering a non-default central heating pump electricity consumption figure in the following scenarios:
- Where there is an Energy Label for the installed pump from the European Association of Pump Manufacturers with a Label Category of A, B or C the values from the table above are chosen. For example, a central heating pump, with Energy Label Category of "C" has an annual electricity consumption of 104kWh/yr where the boiler (or heat pump) is controlled by a room thermostat.
- Where the pump power is known, the pump power is multiplied by the value selected from the table above and divided by 65. For example where the boiler (or heat pump) is not controlled by a room thermostat, a 40W pump with an "A" Energy Label Category from the European Association of Pump Manufacturers has an annual electricity consumption calculated as follows:

$$(67.6*40/65) = 41.6kWh/yr$$

Where multiple central heating pumps are installed, then the BER Assessor enters the total electricity consumption for these pumps along with the number of central heating pumps installed. When not using the default pump electricity consumption, the BER Assessor must manually account for the presence (or lack of) the room thermostat as indicated in the sample calculation shown above.

Table 4g: Specific fan power for mechanical ventilation systems

Type of mechanical ventilation system	SFP, W/(litre/sec)
Balanced whole house mechanical ventilation, with or without heat recovery	2.0
Mechanical extract ventilation, or positive input ventilation from outside	0.8

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[1] The Energy Label Category refers to the value calculated for the pump under the Energy Labelling Scheme controlled by the European Association of Pump Manufacturers as outlined at http://www.europump.org .

Table 5: Gains from fans and pumps

Function	Gains (W)
Central heating pump in heated space [a)]	10
Oil boiler pump, inside dwelling [b)]	10
Warm air or fan coil heating system fans [a) c)]	$0.06 \times V$
Balanced whole house mechanical ventilation fans	$SFP \times 0.06 \times V$

Notes:
a) Does not apply to group heating
b)   Only for boiler providing main heating. In addition to central heating pump, but not if oil pump is outside dwelling
c)   If the heating system is a warm air unit and there is whole house ventilation, the gains for warm air circulation should not be included in addition to the gains for mechanical ventilation. V is the volume of the dwelling. Source: SAP 2005. The electric fan on fan coil radiators is recorded in the DEAP distribution system losses and gains tab.

Table 6a: Default U-values (W/m²K) for windows, doors and roof windows

The values apply to the entire area of the window opening, including both frame and glass, and take account of the proportion of the area occupied by the frame and the heat conducted through it. Unless known otherwise, double and triple glazing should be taken as air-filled without low-E coating. If the U-value of the components of the window (glazed unit and frame) are known, window U-values may alternatively be taken from the tables in Annex F of I.S. EN ISO 10077-1, using the tables for 20% frame for metal-framed windows and those for 30% frame for wood or PVC-U framed windows.

When available, the manufacturer's certified U-values for windows or doors should be used in preference to the data in this table. Adjustments for roof windows should be applied to manufacturer's window U-values unless the manufacturer provides a certified U-value specifically for a roof window.

Where there is insufficient detail to determine the gas filling, gap between panes, thermal break thickness and glass coating defaults may be assumed so that a value from Table 6a may be chosen as outlined under www.seai.ie/berfaq . Table S9 outlines use of defaults for windows in existing dwellings as an alternative to use of Table 6a.

	Type of frame					
	Window with wood or PVC-U frame (use adjustment in Note 1)			Window with metal frame with 4mm thermal break (use adjustments in Note 2)		
	6 mm gap	12 mm gap	16 or more mm gap	6 mm gap	12 mm gap	16 or more mm gap
double-glazed, air filled	3.1	2.8	2.7	3.7	3.4	3.3
double-glazed, air filled (low-E, εn = 0.2, hard coat)	2.7	2.3	2.1	3.3	2.8	2.6
double-glazed, air filled (low-E, εn = 0.15, hard coat)	2.7	2.2	2.0	3.3	2.7	2.5
double-glazed, air filled (low-E, εn = 0.1, soft coat)	2.6	2.1	1.9	3.2	2.6	2.4
double-glazed, air filled (low-E, εn = 0.05, soft coat)	2.6	2.0	1.8	3.2	2.5	2.3
double-glazed, argon filled	2.9	2.7	2.6	3.5	3.3	3.2
double-glazed, argon filled (low-E, εn = 0.2, hard coat)	2.5	2.1	2.0	3.0	2.6	2.5
double-glazed, argon filled (low-E, εn = 0.15, hard coat)	2.4	2.0	1.9	3.0	2.5	2.4
double-glazed, argon filled (low-E, εn = 0.1, soft coat)	2.3	1.9	1.8	2.9	2.4	2.3
double-glazed, argon filled (low-E, εn = 0.05, soft coat)	2.3	1.8	1.7	2.8	2.2	2.1
triple glazed, air filled	2.4	2.1	2.0	2.9	2.6	2.5
triple-glazed, air filled (low-E, εn = 0.2, hard coat)	2.1	1.7	1.6	2.6	2.1	2.0
triple-glazed, air filled (low-E, εn = 0.15, hard coat)	2.1	1.7	1.6	2.5	2.1	2.0
triple-glazed, air filled (low-E, εn = 0.1, soft coat)	2.0	1.6	1.5	2.5	2.0	1.9
triple-glazed, air filled (low-E, εn = 0.05, soft coat)	1.9	1.5	1.4	2.4	1.9	1.8
triple-glazed, argon filled	2.2	2.0	1.9	2.8	2.5	2.4
triple-glazed, argon filled (low-E, εn = 0.2, hard coat)	1.9	1.6	1.5	2.3	2.0	1.9
triple-glazed, argon filled (low-E, εn = 0.15, hard coat)	1.8	1.5	1.4	2.3	1.9	1.8
triple-glazed, argon filled (low-E, εn = 0.1, soft coat)	1.8	1.5	1.4	2.2	1.9	1.8
triple-glazed, argon filled (low-E, εn = 0.05, soft coat)	1.7	1.4	1.3	2.2	1.8	1.7
Windows and doors, single glazed	4.8			5.7		
Window with secondary glazing	2.4					
Solid door (exposed)	3.0					
Solid door between house and an unheated space (semi-exposed)	1.71					
Solid door between apartment and an unheated space (semi-exposed)	1.36					
Metal uninsulated garage door	5.9					

Notes:

1) For roof windows with wooden or PVC-U frames apply the following adjustments to U-values:

Wood or PVC-U frame	U-value adjustment for roof window, W/m²K
Single glazed	+0.3
Double glazed	+0.2
Triple glazed	+0.2

2) For windows or roof windows with metal frames apply the following adjustments to U-values:

Metal frames	Adjustment to U-value, W/m²K	
	Window	**Roof window**
Metal, no thermal break	+0.3	+0.7
Metal, thermal break 4 mm	0	+0.3
Metal, thermal break 8 mm	-0.1	+0.2
Metal, thermal break 12 mm	-0.2	+0.1
Metal, thermal break 20 mm	-0.3	0
Metal, thermal break 32 mm	-0.4	-0.1

3) For half-glazed doors (approximately) the U-value of the door is the average of the appropriate window U-value and that of the non-glazed part of the door (e.g. solid wooden door [U-value of 3.0 W/m²K] half-glazed with double glazing [low-E, hard coat, argon filled, 6 mm gap, U-value of 2.5 W/m²K] has a resultant U-value of 0.5(3.0+2.5) = 2.75 W/m²K).
Source: SAP 2005

4) When the window U-value is declared using certified data rather than from Table 6a, then the Metal frame adjustment above is generally accounted for in the certified window U-value. Therefore when a non default window U-value is applied, DEAP assumes the Metal Frame adjustment to be zero. However, the roof window adjustment applies for all roof windows regardless of whether default or non-default U-values are used.

Table 6b: Transmittance factors for glazing

Type of glazing	ID	Total solar energy transmittance (for calculation of solar gains)	Light transmittance (for calculation of lighting requirement)
Single glazed	1	0.85	0.90
Double glazed (air or argon filled)	2	0.76	0.80
Double glazed (Low-E, hard-coat)	3	0.72	0.80
Double glazed (Low-E, soft-coat)	4	0.63	0.80
Window with secondary glazing	(2)	0.76	0.80
Triple glazed (air or argon filled)	5	0.68	0.70
Triple glazed (Low-E, hard-coat)	6	0.64	0.70
Triple glazed (Low-E, soft-coat)	7	0.57	0.70

Notes:

1) The values are for normal incidence of solar radiation. The transmittance values are multiplied by 0.9 (both solar and light transmittance) by DEAP.

2) When the window U-value is declared using certified data (rather than from defaults) the solar transmittance must also be obtained from certified data. Ensure that such solar transmittance values relate to the glazing, not the whole window. In cases (such as NSAI Window Energy Performance certificates or BFRC certificates) where the solar factor for the entire window is given (including frame) as g_{window}, and the solar transmittance, $g_{\perp}$, is unavailable, then solar transmittance to be entered in DEAP =

$$g_{\perp} = g_{window} \,/\, [\text{Frame Factor*0.9}].$$

3) Solar transmittance is calculated by accredited sources using IS EN 410. If $g_{\perp}$ is directly available from certified data to IS EN 410, such as on some NSAI Window Energy Performance or BFRC Certificates, this is entered in DEAP instead of "g_{window}/ [Frame Factor*0.9]" provided the certified U-value is also available. Light transmittance should always be taken from Table 6b, irrespective of the source of the U-value and solar transmittance.

Table 6c: Frame factors for windows and glazed doors

Frame type	Proportion of opening that is glazed, (FF)
Wood	0.7
Metal	0.8
Metal, thermal break	0.8
PVC-U	0.7

Note: If known, the actual frame factor can be used instead of the data in Table 6c provided that it is obtained either for the standard window configuration defined in BRE 443 or it is an area-weighted average of all windows in the dwelling. Frame factors from certified test data for windows should be used where available.

Table 6d: Solar and light access factors

Overshading	% of sky blocked by obstacles	ID	Winter solar access factor (for calculation of solar gains)	Summer solar access factor (for calculation of summer temperatures – Appendix P)	Light access factor (for calculation of lighting reqt.)
Heavy	> 80%	4	0.3	0.5	0.5
More than average	> 60% - 80%	3	0.54	0.7	0.67
Average or unknown	20% - 60%	2	0.77	0.9	0.83
Very little	<20%	1	1	1	1

Notes:
A solar access factor of 1.0 and a light access factor of 1.0 should be used for roof windows.
Source: SAP 2005

Overshading of a window is an <u>estimate</u> of the sky which is blocked when viewed outwards from the centre point of the window in question. Objects obscuring the skyline below or behind the window centre point should be ignored. Objects obscuring the skyline may be close to the window, such as balconies and window reveals, or far away from the window, such as landmasses and other buildings.

Table 7: Fraction of heat supplied by secondary heating systems

Main heating system	Secondary system	Fraction from secondary
All gas, oil, solid fuel, heat pump and group heating systems	all secondary systems	0.10
Micro-cogeneration	all secondary systems	see Appendix N
Electric storage heaters (not integrated)	all secondary systems	
- not fan-assisted		0.15
- fan-assisted		0.10
Integrated storage/direct-acting electric systems		0.10
Electric CPSU		0.10
Electric room heaters		0.20
Other electric systems		0.10

Notes
1) See also Appendix A.
2) If an off-peak tariff is present, an electric secondary heater uses the on-peak tariff.

Main source: SAP 2005

Table 8: Fuel data[1]

Fuel	Primary energy factor	Emissions kg CO_2 per kWh
Gas:		
mains gas	1.1	0.203
bulk LPG (propane or butane)	1.1	0.232
bottled LPG	1.1	0.232
Oil:		
heating oil	1.1	0.272
Biodiesel from renewable sources only [7]	1.3	0.047
Bioethanol from renewable sources only [7]	1.34	0.064
Solid fuel:[2]		
house coal	1.1	0.361
Anthracite	1.1	0.361
manufactured smokeless fuel	1.2	0.392
peat briquettes	1.1	0.377
sod peat	1.1	0.375
wood logs	1.1	0.025
wood pellets - in bags, for secondary heating	1.1	0.025
wood pellets - bulk supply, for main heating	1.1	0.025
wood chips	1.1	0.025
solid multi-fuel	1.1	0.369
electricity[3]	(8)	(8)
electricity displaced from grid	(8)[4]	(8)[4]
Group heating schemes:		
heat from boilers – gas, oil, solid fuel	as above[5]	as above[5]
heat from heat pump	as above[5]	as above[5]
heat from boilers – waste combustion	1.1	0.057
heat from boilers – biomass or biogas	1.1	0.025
waste heat from power stations	1.05	0.018
heat from CHP	as above[5]	as above[5]
electricity generated by CHP	(8)[4]	(8)[4]

Notes
1) Current domestic fuel costs per kWh are available on http://www.seai.ie/statistics . Cost calculation is not part of the BER assessment but may be done using the delivered energy values (on the 'results tab') determined during the assessment, with data from Table 8, Table 10a and Table 10b where appropriate.
2) Select the fuel for a solid fuel appliance as described in Section 10.3.3. A wood fuel should be chosen only if the appliance is designed to burn only wood, i.e. if its design is such as to prohibit the use of any other fuel type.
3) With electric off-peak tariffs, some of the consumption is at the off-peak rate and some at the on-peak rate. The on-peak percentages to be used are given in Table 10a, the remainder being provided at the off-peak rate

4) Deducted from emissions and primary energy
5) Take factor from further up the table according to fuel burnt.
6) Bulk wood pellets should be specified as fuel for a main heating system only if there is adequate provision (at least 1.5 m^3) for storage of the fuel.
7) Biodiesel or bioethanol verified as being from renewable sources only. Fuel type of biodiesel or bioethanol should not be selected if the appliance can burn any other fuel (for example kerosene mixed with biodiesel or pure kerosene). Fuel factors for biodiesel and bioethanol sourced from SAP 2009.
8) The primary energy factors and CO_2 factors are published on www.seai.ie/ber . These figures are updated as new annual National Energy Balance figures become available. The DEAP methodology cannot take account of the homeowner's choice of electricity supplier as the calculation is based on an asset rating. Changing electricity supplier does not involve any physical change to the dwelling asset.

Table 9: Distribution loss factor for group and group heating schemes

The following factors are used when one of the conditions stated in Section C1.1 in Appendix C apply. Otherwise the factor is calculated as described in section C1.1.

Heat distribution system	Factor
Mains piping system installed in 1990 or earlier, not pre-insulated medium or high temperature distribution (120-140ºC), full flow system	1.20
Pre-insulated mains piping system installed in 1990 or earlier, low temperature distribution (100ºC or below), full flow system.	1.10
Modern higher temperature system (up to 120ºC), using pre-insulated mains installed in 1991 or later, variable flow system.	1.10
Modern pre-insulated piping system operating at 100ºC or below, full control system installed in 1991 or later, variable flow system	1.05

Note: In a full flow system the hot water is pumped through the distribution pipe work at a fixed rate irrespective of the heat demand (usually there is a bypass arrangement to control the heat delivered to heat emitters). In a variable flow system the hot water pumped through the distribution pipe work varies according to the demand for heat.

Source: SAP 2009

Table 10a: On-peak fractions for systems using night-rate tariff

This table is applicable where electric space and water heating systems use electricity at both off-peak and on-peak rates. Use an electricity price for the main heating system weighted between the on-peak and off-peak unit price using the fraction from the table. Secondary heating with fraction according to Table 7 is applied as well.

Fuel costs should be taken from www.seai.ie/statistics (under fuel cost comparisons).

System	Fraction at on-peak rate
Integrated storage/direct acting systems (storage heaters and underfloor heating)	0.20
Direct-acting electric boiler	0.90
Ground/water source heat pump:	
water heating with off-peak immersion	0.17
water heating without immersion heater	0.70
space heating with on-peak auxiliary	0.80
space heating without auxiliary	0.70
Immersion water heater	Fraction from Table 10b

Table 10b: On-peak fraction for electric water heating

Instead of a table, the following equations are used to calculate the fractions of electricity required at on-peak rates for cylinders with single and with dual immersion heaters, for night-rate tariffs. The equations are valid for V between 110 and 245 litres.

Dual immersion: $[(6.8 - 0.024V)N + 14 - 0.07V]/100$

Single immersion: $[(14530 - 762N)/V - 80 + 10N]/100$

where V is the cylinder volume and N is the standardized number of occupants. (If these formulae give a value less than zero, set the on-peak fraction to zero.)

Notes:
1) Do not use this table to obtain the on-peak fraction for an electric CPSU. Use on-peak fraction given in Table 7.
2) Do not use this table for the on-peak fraction for domestic hot water heated by a heat pump. Use on-peak fraction given in Table 7.

Source: SAP 2005

Table 11: Thermal mass categories for the dwelling

| Category | AmAf ranges | | Heat capacity per unit floor area | |
| | Low | High | [MJ/m^2 K] | |
			UF	IH
Low	<0.25	0.25	0.07	0.07
Medium-low	0.26	0.75	0.14	0.09
Medium	0.76	1.50	0.20	0.11
Medium-high	1.51	2.75	0.32	0.15
High	2.76	> 2.76	0.50	0.20

AmAf = Area of thermally massive elements divided by total floor area (see Section 7.3 for further detail). As an example, any AmAf value between 0.26 and 0.75 is considered Medium-low.
UF: for calculation of utilisation factor
IH: for calculation of effect of intermittent heating

Table 11a: Thermally massive and thermally light constructions
The layers given below are those nearest the internal surface of the construction.

Thermally massive constructions:
  Dense plaster on clay brickwork or solid concrete blockwork.
  Plasterboard-on-dabs on clay brickwork or solid concrete blockwork.
  Plaster or plasterboard-on-dabs on hollow concrete blockwork.
  Concrete or screed floor, either bare, laminated, tiled, carpeted, or with wood laid directly on
   concrete/screed.
  Dense plaster on aerated concrete blockwork or aerated concrete slab.

Thermally light constructions:
  Plasterboard ceiling below joists or rafters, with insulation or air space between the joists.
  Plasterboard wall with insulation behind (timber-frame walls and masonry walls with internal insulation
   fall in this category).
  Plasterboard-on-dabs on aerated concrete blockwork or aerated concrete slab.
  Suspended timber floor.
  Windows and doors.

Table 12a: Thermal conductivity of some common building materials
Thermal conductivity values for common building materials can be obtained from Table 12a of the DEAP manual where certified data is not available.

Item	Density (kg/M3)	Thermal conductivity [λ] (W/mK)
Clay Brickwork (outer leaf)	1700	0.770
Clay Brickwork (inner leaf)	1700	0.560
Concrete block (heavyweight)	2000	1.330
Concrete block (medium weight)	1400	0.570
Concrete block (autoclaved aerated)	700	0.200
Concrete block (autoclaved aerated)	500	0.150
Cast concrete, high density	2400	2.000
Cast concrete, medium density	1800	1.150
Aerated concrete slab	500	0.160
Concrete screed	1200	0.410
Reinforced concrete (1% steel)	2300	2.300
Reinforced concrete (2% steel)	2400	2.500
Wall ties, stainless steel	7900	17.000
Wall ties, galvanised steel	7800	50.000
Mortar (protected)	1750	0.880
Mortar (exposed)	1750	0.940
External rendering (cement sand)	1800	1.000
Plaster (gypsum lightweight)	600	0.180
Plaster (gypsum)	1200	0.430
Plasterboard	900	0.250
Natural Slate	2500	2.200
Concrete tiles	2100	1.500
Clay tiles	2000	1.000
Fibre cement slates	1800	0.450
Ceramic tiles	2300	1.300
Plastic tiles	1000	0.200
Asphalt	2100	0.700
Felt bitumen layers	1100	0.230
Timber, softwood	500	0.130
Timber, hardwood	700	0.180
Wood wool slab	500	0.100
Wood-based panels (plywood, chipboard, etc.)	500	0.130
Basalt	2850	3.500
Granite	2600	2.800
Limestone (soft)	1800	1.100
Limestone (hard)	2200	1.700
Marble	2800	3.500
Sandstone	2600	2.300

Table 12b: Thermal conductivity of some common insulation materials

Thermal conductivity values for common insulation materials from this table may be used in existing and new-provisional BER assessments where certified data is not available.

Item	Density (kg/M3)	Thermal conductivity [λ] (W/mK)
Expanded polystyrene (EPS) slab (HD)	25	0.035
Expanded polystyrene (EPS) slab (SD)	15	0.038
Extruded polystyrene	30	0.029
Mineral fibre / wool quilt	12	0.044
Mineral fibre / wool batt	25	0.037
Phenolic foam (rigid)	30	0.025
Polyurethane board (unfaced)	32	0.023
Polyurethane foam	30	0.028
Polyisocyanate	45	0.030
Polyisocyanurate board	<32	0.025
Polystyrene beads	16	0.036
Cellulosic insulation	43	0.042

Sources for Table 12a and Table 12b: TGD L (2008 and 2011), CIBSE Guide A, EN 10456, CE71 (EST).