

## Dwelling Energy Assessment Procedure (DEAP)

# DEAP Manual

Version 4.2.3

Ireland's official method for calculating and rating the energy performance of dwellings

May 2022



## DEAP Manual

### Version 4.2.3

This document describes DEAP, Version 4.2.3, dated May 2022. This version will be applicable to Building Energy Ratings for new and existing dwellings from May 2022.

Building designers, energy rating assessors and other users should ensure they are using the latest version of this document and accompanying software. Updates will be published on the SEAI website <https://www.seai.ie/energy-in-business/ber-assessor-support/deap/>.

## Change Log

Section	Change
Introduction; Calculation procedures and conventions; Section 1 - Dimensions Section 3 - Heat losses Section 0 – Energy for cooling Appendices C; G; P; S	Additions for space cooling system entry

### Sustainable Energy Authority of Ireland

SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

SEAI is funded by the Government of Ireland through the Department of Environment, Climate and Communications.

### Acknowledgements

DEAP is the outcome of a development study completed for SEAI by a project team from the UCD Energy Research Group, National Energy Services Ltd., Rickaby Thompson Associates Ltd. and Emerald Energy.

Much of the calculation procedure in DEAP, the accompanying tabulated data and the documentation in this manual is drawn or adapted from the UK Standard Assessment Procedure ([SAP](#)) for energy rating of dwellings.

Reproduction of the contents is permissible provided the source is acknowledged

## Contents

Change log.....	2
Summary.....	11
Introduction.....	13
Scope of the Dwelling Energy Assessment Procedure (DEAP).....	15
General principles .....	18
Calculation procedures and conventions .....	26
1. Dwelling dimensions .....	29
2. Ventilation rate.....	39
2.1 Chimneys and flues.....	40
2.2 Intermittent fans and passive vents .....	42
2.3 Air leakage pressurisation test .....	42
2.4 Draught lobby.....	43
2.5 Sheltered sides .....	44
2.6 Mechanical ventilation .....	45
3. Heat losses .....	49
3.1 U-values of opaque elements .....	50
3.2 Window U-values .....	52
3.3 U-values of elements adjacent to an unheated space .....	55
3.3.1 Garages .....	56
3.3.2 Stairwells and access corridors in flats.....	56
3.3.3 Conservatories.....	56
3.3.4 Other large, glazed areas .....	60
3.3.5 Room in roof.....	60
3.4 Thermal bridging.....	61
3.5 Dwellings that are part of larger premises.....	61
3.6 Curtain walling.....	61
3.7 Including glass block walls in DEAP .....	62
3.8 Perspex or plastic roofs.....	62
4. Domestic hot water .....	64
4.1 Hot water distribution losses.....	66
4.2 Hot water storage losses.....	66
4.3 Primary circuit losses.....	68
4.4 Solar water heating.....	68
4.5 Group/community heating and district heating schemes .....	68
4.6 Hot water backup.....	70
5. Lighting and internal heat gains.....	72
6. Solar heat gains.....	73
6.1 Solar gains for glazed openings.....	73

- 6.2 Openings for which solar gain is included ..... 74
- 6.3 More than one glazing type..... 74
- 7. Mean internal temperature and dwelling thermal mass ..... 75
  - 7.1 Heating schedule..... 75
  - 7.2 Living area fraction ..... 75
  - 7.3 Internal heat capacity..... 75
  - 7.4 Mean internal temperature with ideal heating system ..... 77
- 8. Space heat use..... 78
- 9. Space heating requirements ..... 79
  - 9.1 Heating systems..... 79
  - 9.2 Heating system efficiency ..... 80
    - 9.2.1 Heating systems based on a gas or oil boiler ..... 80
    - 9.2.2 Heating systems based on a gas or oil range cooker boiler..... 80
    - 9.2.3 Heating systems based on a solid fuel boiler..... 80
    - 9.2.4 Room heaters..... 81
    - 9.2.5 Direct acting electric boilers..... 82
    - 9.2.6 Heat pumps ..... 82
    - 9.2.7 Other heating systems ..... 82
    - 9.2.8 Efficiency adjustment factor..... 82
  - 9.3 Heating controls ..... 83
    - 9.3.1 Room thermostat ..... 83
    - 9.3.2 Time switch..... 83
    - 9.3.3 Programmer ..... 83
    - 9.3.4 Programmable room thermostat..... 83
    - 9.3.5 Delayed start thermostat..... 83
    - 9.3.6 Thermostatic radiator valve (TRV)..... 83
    - 9.3.7 Cylinder thermostat..... 84
    - 9.3.8 Flow switch..... 85
    - 9.3.9 Boiler interlock..... 85
    - 9.3.10 Bypass..... 85
    - 9.3.11 Boiler energy manager ..... 87
    - 9.3.12 Time and temperature zone controls ..... 87
    - 9.3.13 Weather compensator ..... 87
    - 9.3.14 Load compensator ..... 88
    - 9.3.15 Controls for electric storage heaters ..... 88
    - 9.3.16 Appliance thermostats on room heaters ..... 88
    - 9.3.17 Enhanced user interfaces ..... 88
- 10. Total energy use ..... 89
  - 10.1 Energy use ..... 89
  - 10.2 Fuel factors ..... 89

- 10.3 Main heating system fuel types ..... 89
  - 10.3.1 Gas systems..... 89
  - 10.3.2 Electric systems..... 90
  - 10.3.3 Solid fuel systems ..... 91
- 10.4 Secondary heating system fuel types ..... 93
- 10.5 Water heating fuel types..... 93
- 10.6 Electricity for pumps and fans ..... 93
- 10.7 Electricity for lighting ..... 95
- 10.8 Group/community heating and district heating schemes ..... 95
  - 10.8.1 Heating system 1/2/3/4 ..... 95
  - 10.8.2 Group solar space and water heating ..... 95
  - 10.8.3 Secondary heating..... 95
  - 10.8.4 CHP and district heating ..... 95
  - 10.8.5 Solar water heating ..... 97
- 10.9 Renewable and energy saving technologies..... 97
- 10.10 Energy for cooling..... 97
- 11. Energy, emissions and costs ..... 98
- 12. Building energy rating ..... 99
- 13. Building regulations ..... 100
  - 13.1 Building Regulations 2005 TGD L conformance demonstration..... 100
  - 13.2 Building Regulations 2008, 2011, 2019 and 2021 TGD L conformance demonstration ..... 100
- References..... 103
- List of relevant standards ..... 105
- Appendix A: Primary and secondary heating systems ..... 109
  - A1 General principles ..... 109
  - A2 Procedure for determining the heating systems..... 110
  - A3 Dwellings with inadequate heating systems ..... 110
    - A3.1 New dwellings..... 110
    - A3.2 Existing dwellings ..... 111
    - A3.3 Highly insulated inadequately heated small dwellings ..... 111
    - A3.4 Broken heating systems ..... 111
    - A3.5 Estimating the required boiler size ..... 112
- Appendix B: Gas and oil boiler systems, boilers with a thermal store, and range cooker boilers ..... 114
  - B1 Boilers in the database..... 114
  - B2 Gas and oil boiler systems in Table 4b ..... 114
    - B2.1 Combination boilers..... 114
    - B2.2 Boilers 1998 or later ..... 115
    - B2.3 Boilers with fan-assisted flue..... 115
    - B2.4 Boiler selected by date..... 115
    - B2.5 Combined primary storage unit (CPSU)..... 115

B3 Boilers with a thermal store .....	115
B3.1 Integrated thermal store .....	115
B3.2 Hot water only thermal store .....	117
B4 Range cookers (oil, gas, LPG and solid fuel).....	118
B4.1 Range cooker with boiler for space heating.....	118
B4.2 Single burner range cooker/water heater.....	118
B4.3 Single burner dry heat range cooker.....	118
Appendix C: Group (community) heating/district heating schemes .....	119
C1 Group heating where heat is produced by centralised unit by dedicated plant.....	119
C1.1 Heat distribution .....	122
C2 District heating.....	123
C3 Permutations of heat generators in group schemes .....	123
C4 Group scheme providing DHW only .....	125
C5 Group scheme providing cooling via air conditioning or heat pumps .....	125
Appendix D: Method of determining gross seasonal efficiency values for gas and oil boilers .....	126
D1 Definitions .....	126
D1.1 Boiler.....	126
D1.2 Condensing boiler.....	126
D1.3 Regular boiler.....	126
D1.4 On/off regular boiler .....	126
D1.5 Modulating regular boiler.....	126
D1.6 Combination boiler.....	127
D1.7 Instantaneous combination boiler.....	127
D1.8 On/off instantaneous combination boiler .....	127
D1.9 Modulating instantaneous combination boiler .....	127
D1.10 Storage combination boiler.....	127
D1.11 On/off storage combination boiler.....	127
D1.12 Modulating storage combination boiler .....	127
D1.13 On/off combined primary storage unit (CPSU).....	127
D1.14 Modulating combined primary storage unit (CPSU) .....	127
D1.15 Low temperature boiler.....	128
D1.16 Keep-hot facility .....	129
D2 Method for calculating the gross seasonal efficiency of domestic boilers in Ireland .....	129
D3 Declaring values of gross seasonal efficiency .....	133
D4 HARP gross seasonal efficiency for LPG boilers tested with natural gas.....	133
D5 Gross seasonal efficiency and case emission value of non-condensing twin-burner range cooker boiler.....	135
D6 Declaring gross seasonal efficiency and heat emission from the case for twin-burner range cooker boilers.....	135
Appendix E: Gross seasonal efficiency for gas, oil or solid fuel room heaters.....	138

E1 Efficiency determination .....	138
E2 Declaring the efficiency of gas, oil room and solid fuel room heaters .....	139
E3 Use of HETAS for solid fuel room heater efficiencies .....	139
Appendix F: Electric CPSUs .....	140
Appendix G: Heat pumps .....	141
G1 Introduction .....	141
G1.1 General guidance for the heat pump methodology .....	143
G1.2 Input from the designer/installer .....	146
G2 Heat pumps not compliant with Ecodesign/Energy Labelling Directives. ....	149
G2.1 Domestic hot water: Not compliant with Ecodesign/Energy Label Directive.....	151
G2.2 Space heating: Not compliant with Ecodesign/Energy Label Directive .....	154
G3 Heat pumps compliant with Ecodesign and Energy Labelling or EN16147 / EN14825 .....	154
G3.1 Space heating: Compliant with Ecodesign/Energy Label Directives or EN14825 data available. .	158
G3.2 DHW: Compliant with Ecodesign/Energy Labelling Directive or EN16147 data available.....	159
G4 Other heat pump system types.....	159
G4.1 Air to air heat pumps .....	159
G4.2 Exhaust air heat pumps (EAHP).....	161
G4.3 Double-duct heat pumps and heat recovery systems incorporating heat pump functionality	161
G4.4 'Thermodynamic' solar/heat pump systems.....	162
G4.5 Group heating using heat pumps not required to comply with Ecodesign/Energy LabellingDirectives .....	163
G4.6 Direct exchange and other types of heat pumps .....	163
G4.7 Cooling systems .....	163
Appendix H: Solar water heating .....	164
H1 Calculation of solar input for solar water heating (SAP 2005 - 2008) .....	167
H2 Group Solar DHW.....	169
Appendix I: Water efficiency calculation methodology .....	170
I: Sanitary Fitting .....	170
I.1.1: WCs .....	170
I.1.2 Bidets.....	170
I.1.3 Taps.....	170
I.1.4 Baths.....	171
I.1.5 Dishwashers.....	171
I.1.6 Washing machines .....	171
I.1.7 Showers .....	171
I.1.8 Water softeners (where present) .....	171
I.1.9 Waste disposal units (where present) .....	171
I.1.10 External taps.....	172
I.2 Rainwater .....	172
I.2.1 Greywater (in accordance with BS 8525).....	172

I.2.2 Rainwater (in accordance with EN 16941:2018) .....	172
I.3 Large water consuming installations .....	172
Appendix J: Gross seasonal efficiency for solid fuel boilers from test data .....	173
J.1 DEAP gross seasonal efficiency is given.....	173
J.2 DEAP gross seasonal efficiency is not given.....	173
J2.1 Part load data is available .....	173
J2.2 Part load data is not available .....	175
J2.3 Rounding.....	175
J3 Heating type and responsiveness .....	175
Appendix K: Thermal bridging .....	176
Appendix L: Energy for lighting.....	180
Appendix M: Photovoltaic (PV) technology and on-site wind turbines .....	185
M1 Energy from photovoltaic (PV) technology .....	185
M2 Micro wind turbines on the dwelling or within its curtilage.....	186
Appendix N: Micro-cogeneration (also known as micro-CHP).....	190
N1 Overview .....	190
N2 CHP installation in an individual heating system .....	191
N3 CHP installation in a group heating system .....	191
Appendix P: Assessment of internal temperature in summer.....	192
P1 Assessment procedure.....	192
P2 Reporting of results.....	196
P3 Solar shading .....	196
P3.1 Curtains and blinds.....	196
P3.2 Overhangs.....	198
Appendix Q: Special features and specific data.....	200
Q1 Special features .....	200
Appendix S: DEAP for existing dwellings: survey methodology and default data .....	201
S1 Introduction.....	201
S2 Overview of the methodology for DEAP for existing homes.....	201
S3 Dwelling type and purpose of rating .....	205
S4 Dimensions and building elements.....	205
S5 Age bands .....	208
S6 Constructional types and U-values .....	209
S6.1 U-values of walls.....	209
S6.3 U-values of floors next to the ground .....	218
S6.4 U-values of exposed and semi-exposed upper floors.....	219
S6.5 U-value of floor above a partially heated space .....	219
S6.6 Allowance for thermal bridging .....	221
S7 Solar gains.....	222
S8 Window U-values and g-values.....	222

S9 Living room area .....224

S10 Thermal mass category for existing dwellings .....224

S11 Space and water heating .....225

    S11.1 Hot water details and defaults .....225

S12 Improvement measures.....227

S13 Dwelling survey.....228

Appendix U: Submission of BER assessments.....234

TABLES.....236

## Summary

The Dwelling Energy Assessment Procedure (DEAP) is the Irish official procedure for calculating and assessing the energy required for space heating, space cooling, ventilation, water heating and lighting, less savings from energy generation technologies. DEAP calculates the annual delivered energy consumption, primary energy consumption and carbon dioxide emissions 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 <https://www.seai.ie/energy-in-business/ber-assessor-support/deap/><sup>1</sup>.

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.

Annex I of the Energy Performance of Buildings Directive 2010/31/EU (**EPBD**) as amended by Directive 2018/844/EU (EPBD) outlines requirements for determining energy performance of buildings and methodologies. In Ireland, the national calculation methodology required by the EPBD is described in the annexes of the overarching standards namely I.S. EN ISO 52000-1:2017, I.S. EN ISO 52003-1:2017, I.S. EN ISO 52010-1:2017, I.S. EN ISO 52016-1:2017, and I.S. EN ISO 52018-1:2017 and are available from [NSAI](#) (National Standards Authority of Ireland). As outlined in the standards, the completed annexes are available [here](#).

The DEAP methodology and software is used to demonstrate compliance with the EPBD (recast) in Ireland including elements of the Irish Building Regulations Part L 2005, 2008, 2011, 2019 and 2021 for new dwellings and for generating Building Energy Rating (BER) labels and BER advisory reports. This provision applies to new dwellings and dwellings for sale or rent. S.I.243 of 2012 details the Irish legislative requirements for BER, including scenarios where an energy rating is required and scenarios where buildings are exempted.

For Building Regulations 2005 Technical Guidance Document (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<sub>2</sub> per square metre per annum. This provision applies to new dwellings built between 1 July 2006 and 1 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, 2011, 2019 and 2021 TGD L. DEAP also determines if the Building Regulations 2008, 2011, 2019 and 2021 TGD L renewables requirement is satisfied. Building Regulations 2008 TGD L applies to new dwellings from 1 July 2008 and Building

---

<sup>1</sup> The Excel version of DEAP gives full detail on the DEAP calculation equations. Most of these equations are not replicated in this document.

Regulations 2011 TGD L applies to new dwellings from 1 December 2011. Building regulations 2019 TGD L applies to new dwellings from 1 November 2019 and Building regulations 2021 TGD L applies to new dwellings from 27 July 2021. These dates are all subject to transitional arrangements cited in the relevant Building Regulation TGD L.

DEAP confirms that the fabric heat loss is limited as defined in the 2005, 2008, 2011, 2019 and 2021 Building Regulations TGD L. DEAP checks that the building air permeability is limited as defined in the Building Regulations 2008, 2011, 2019 and 2021 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 where allowable) as 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.

## 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<sub>2</sub> emissions for the provision of space heating, space cooling, 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
- Cooling system efficiency
- Hot water usage, system efficiency, storage and distribution characteristics
- Solar gains through glazed openings
- Thermal storage (mass) capacity of the dwelling
- Fuels used to provide space and water heating, space cooling, 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, cooling, hot water demand, as well as usage of electricity for ventilation, pumps and lighting. It is thus independent of the individual characteristics of the household occupying the dwelling when the rating is calculated, for example:

1. Actual household size and composition
2. Individual heating patterns and temperatures
3. 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. Where a fixed space cooling system is installed, DEAP calculates and aggregates the monthly space cooling energy balance for the cooling season (June, July and August). DEAP then calculates the hot water energy demand based on dwelling size and various uses of hot water in the dwelling and accounts for heating system control, responsiveness and efficiency characteristics, fuel type and calculated lighting energy (electricity) requirement to determine the overall results.

A warm air heat pump (for example air to air, brine to air, exhaust air to air) is assumed to be reversible and to also provide cooling. If the cooling function in a specific product or system is not available, evidence must be provided of how the function has been disabled or is not available in the product, with specific references to manufacturer's instruction manuals. This must be signed-off at commissioning by the same installer filling out the designer/installer sign-off form.

For hydronic heat pumps (for example using radiators or underfloor heating), it should be assumed that there is no cooling present, unless otherwise specified by the design/installer in their sign-off. If the BER assessor comes across other evidence indicating that a hydronic system may be reversible and used for

cooling, they should contact the helpdesk for specific advice. As in the case of reversible warm air systems, unless evidence can be sourced to substantiate the SEER entry, the default value should be used.

A given dwelling specification will yield the same result in all parts of Ireland in respect of building regulations compliance and BER, that is 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).

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 <https://www.seai.ie/energy-in-business/ber-assessor-support/deap/> along with regular updates and examples provided in additional domestic BER guidance documents at the above link. The Building Regulations Part L (current and previous) can be found under <https://www.housing.gov.ie/node/5535>.

## 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. A dwelling for the purpose of the DEAP assessment has a maximum of eight bedrooms in line with part B of the building regulations.

Where a dwelling contains or has attached a room or space that is intended or used for commercial purposes (for example 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). If the only access to the domestic accommodation is through a commercial space, then this domestic living accommodation should be included in the non-domestic BER assessment for the commercial space as detailed in the NEAP guidance (iSBEMie User Guide). Please refer to the iSBEMie user guide which details the domestic-type activities that were added to the options available under the building type 'Residential Spaces' in iSBEMie to allow the energy calculations for the generation of one BER certificate for a building which contains residential accommodation above a non-domestic space (e.g. a shop or a pub) provided that the residential space can only be accessed from within the non-domestic space, that is the residential part not designed or altered for use as a separate independent dwelling.

If domestic accommodation has its own separate external access, regardless of internal access between the commercial and residential spaces, the BER requirement is as follows:

- a domestic BER for the self-contained unit, AND
- a non-domestic BER for the commercial space.

Each living unit requires an independent BER specific to that individual unit. This is regardless of whether an additional dwelling such as a 'granny flat' adjoining a main dwelling uses the same heating system or Meter Point Reference Number (MPRN) as the main dwelling.

A **bedsit**, that is accommodation with kitchen and living/sleeping area and bathroom shared with other similar bedsits, is not a self-contained dwelling. Therefore, it is not possible to publish BERs for bedsits. Minimum standards are set out in the Housing (Standards for Rented Houses) Regulations 2008 – 2019. These regulations specify requirements covering a range of matters such as structural repair, absence of damp and rot, sanitary facilities, heating, ventilation, light and safety of gas and electrical supply. Full details are available on [www.housing.gov.ie](http://www.housing.gov.ie) for existing tenancies, a four-year phasing-in period was allowed for some of the standards in the regulations. The phasing-in period ended on 31 January 2013 so

rental properties must now meet all the standards. The above legislation does not permit the renting of bedsits from 1 February 2013 onwards.

For a **mews** (detached from the main dwelling and designed for habitation) heated off the main dwelling's heating system and on the same MPRN, both will require independent BERs using the same MPRN number for

both, (the mews is a detached unit, separate envelope, and could at a later stage be offered for rent). The heating system will be 'Group heating' (if it has already been determined that there are two separate dwelling areas, and that both are supplied from the same boiler) as detailed in this manual. If the mews has its own heating system, its BER assessment heating system will be 'individual' in DEAP.

A standalone construction within the curtilage of the dwelling (room in garden) that is not considered to be a mews should be treated as follows:

- If heated by the same system as the dwelling, it should be included within the BER for the dwelling.
- If unheated or independently heated, it can be excluded from the BER.

Shared accommodation and student accommodation are typically assessed under the non-domestic energy assessment procedure (NEAP).

**Decisions made by the BUILDING CONTROL OFFICER or LOCAL AUTHORITY on whether one or more BERs is to be carried out must be followed.**

## General principles

### Input precision and rounding

Data should be entered as accurately as possible, although it is unnecessary to go beyond three 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<sup>2</sup> solid ground floor and 75m<sup>2</sup> 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 [here](#) 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, NSAI Agrément Certificates or equivalent), assessors may occasionally need to use other sources to substantiate DEAP data entries. The acceptable data sources are detailed in relevant sections throughout this document.

### **Accredited or certified data**

The following applies to use of product test data for DEAP assessments:

- 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 to test to the relevant standard. This may be demonstrated as follows:
  - The governing accreditation signatory body for the country in which the test laboratory is based can be found under <https://european-accreditation.org/ea-members/search-facility/> . This governing body may list the test laboratory as accredited;
  - The accredited laboratory may be found under <http://ec.europa.eu/growth/tools-databases/nando/> ;
  - Performance data on CE-marked literature is acceptable provided that the literature refers to the relevant test performance standard.
  - A Declaration of Performance (DoP) as used for CE marked products is acceptable for DEAP assessments provided the following requirements are met:

- The DoP must display the relevant standard for the product in question as referenced in the DEAP methodology.
- The DoP must show the relevant performance data for use in DEAP in sufficient detail for the data to be used in DEAP.
- If the above data is available on the DoP document, the product must have a CE mark referencing the DoP reference number being used. The CE mark would typically be on the product itself, associated literature or product packaging. This DoP reference number on the CE marked literature/label must match the DoP reference number on the DoP document being used or else the DoP cannot be used. A copy of the CE mark showing the DoP number along with a copy of the DoP itself must be retained by the BER assessor as supporting evidence.
- If using a DoP document as supporting evidence for a BER, the above data suffices, without the need to verify that the DoP document follows the required format to the exact requirements in the regulation. Verifying the DoP format any further than the above is beyond the scope of what would be required of a BER assessor. Only the relevant data is checked for the BER assessment.
- Self-declaration literature from manufacturer referencing the Ecodesign Directive, efficiency and relevant test performance standard where applicable in DEAP guidance.

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. Section 3 details the relevant standards and requirements for U-value calculations and supporting evidence.

### ***Thermal bridging - linear thermal transmittance ( $\Psi$ -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  $\Psi$ -values referenced in TGD L Appendix D and  $\Psi$ -values from Acceptable Construction Details (Introduction Document) Appendices.
- c) On the basis of the length of each junction and user-supplied certified  $\Psi$ -values as described in [Appendix K](#). It is not necessary to supply  $\Psi$ -value for each junction type – values referenced in TGD L 2021 (TGD L 2019 for dwellings required to demonstrate compliance with Part L 2019, or TGD L 2011 for dwellings required to demonstrate compliance with Part 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. The frame factors (representing the glazed fraction of the window) should be taken from test certificates. If frame factors

are not available on test certificates, then the defaults in Table 6c are used. Section 3.6 details the requirements for assessment of curtain walling for DEAP assessments.

**Internal heat capacity**

Internal heat capacity of the dwelling is estimated on the basis of the extent of 'thermally heavy' construction relative to total floor area. Thermal mass categories should be determined in accordance with Table 11 or Appendix S. The dwelling thermal mass is applied to the space heating and cooling demand calculation.

**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 (PCDB) Database, 2005 version (formerly SEDBUK), 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 [here](#).

**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 Ecodesign, HARP or certified data. Default values from Table 4a may be used in the absence of non-default. [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. Section 4.2 provides background of the hot water storage losses calculated in DEAP.

**Air leakage - pressure test (also called permeability test) result**

Air leakage pressure test results can be used instead of the default air infiltration calculation. All new homes require an air pressure test.

An air permeability design value may be used for new dwelling provisional BERs, subject to verification when the dwelling is built:

- Default of 0.25ac/h may be used in DEAP for provisional dwellings without balanced mechanical ventilation proposed (CIBSE TM 23 best practice)
- Default of 0.15ac/h may be used in DEAP for provisional dwellings with balanced mechanical ventilation proposed
- Non-default can be made via a permeability test for a similar building with all the following;
  - Same builder/ developer
  - Same structure type (timber frame/masonry/ ICF)
  - Same dwelling type
  - Same floor area

Assessors should verify the pressure test result relate to building area and that the building elements are appropriate for the new building type.

**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 may be used in place of the default values in Table 4g, subject to the guidance in Section 2.6:

- positive input ventilation from outside (not loft)
- mechanical extract
- balanced whole house ventilation
- exhaust air heat pump

**Technical specifications**

A reference to a technical specification is to the latest edition (including any amendments, supplements or addenda) current at the date of publication of this document. However, if this version of the technical specification is subsequently revised or updated by the issuing body, the new version may be used as a source of guidance provided it continues to address the relevant requirements of the regulations.

Where a European Commission regulation or communication for that regulation references a specific standard, that version of the standard should be used until such time as any future communication refers to an alternate, or a harmonised standard is developed.

**Cooling Seasonal Energy Efficiency Ratio (SEER)**

The cooling SEER is relevant where a fixed cooling system is installed (that is air conditioning or a heat pump system). SEER values and sources are defined in Section 0. Cooling demand is only calculated in DEAP where a fixed cooling system is installed.

**Existing dwellings**

Default values may be used when assessing existing dwellings subject to the guidance in [Appendix S](#). Non-default values must 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. BER assessors are 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 and cooling 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, for example 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
- Major renovation
- Other

## 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 a dwelling's energy performance. Reference data tables accompany the DEAP software. Mandatory fields are displayed with an asterisk (\*). The BER assessor should proceed through the individual tabs and sub-tabs as shown in the table below, leading ultimately to the display of results in the 'Results' tab and 'View assessment' section<sup>23</sup>:

Tab	Main user entry actions
<b>My portal</b>	<u>Create new DEAP assessments/surveys</u>
<b>Start new survey</b>	Administrative details of the dwelling and BER assessment including electricity Meter Point Reference Number (MPRN), BER number, new/existing dwelling, TGD L version, construction date and dwelling type, planning details, Eircode.
<b>Ventilation</b>	<p><b>Infiltration due to openings:</b> Chimneys, open flues, fans/vents, flueless combustion room-heaters, draught lobby.</p> <p><b>Structural air tightness:</b> Record results of an air permeability test if available in this section. Otherwise, record structure type, suspended ground floors. Attic hatch draught stripping (if any) and number of sheltered sides are also recorded in this section.</p> <p><b>Mechanical ventilation:</b> entries (where applicable) such as product characteristic database figures for fan power, heat recovery heat exchanger efficiency, make, model, number of wetrooms (+kitchen) ventilated, insulation of ductwork outside dwelling envelope.</p>
<b>Building:</b> Floors, walls, roofs, doors	<p>Heat loss building element dimensions and U-values. Default U-values may be used for existing dwellings.</p> <p>When calculating a U-value for a new or existing dwelling roof, wall or floor in DEAP, 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.).</p>

<sup>2</sup> A number of parameters additional to those shown in the table above are visible in DEAP but do not require user data entry, so are not listed in the table shown above

<sup>3</sup> The 'View assessment' section displays a detailed view of calculation results generated and used by DEAP throughout the DEAP calculation. This includes summary of data entries and results for lighting, heating, hot water, ventilation, the building envelope, gains/losses, Part L compliance and overall results. Evidence supporting entries within each section can be uploaded under 'View assessment', which allows the user to simulate results for previous years by selecting alternative electricity factors to the year the assessment is carried out. Select 'View survey' to return to the data entry section for the assessment being undertaken in DEAP.

(contd)	Floor section includes storey height, principal floor area dimensions of all storeys (including floors with and without heat loss) to be considered in the assessment, room in roof floor area details, area of living room, and number of storeys.
<b>Building:</b> rooms	Optional information on each room type, the storey in which it exists, the name of the room.
<b>Building:</b> windows	Window and glazed door dimensions, orientations, U-values and shading characteristics. Defaults may be used for new or existing dwellings if acceptable non-default data is unavailable. Draught stripping and opening sections on windows are also included here. DEAP includes a searchable library of window types, which can be expanded over time by the assessor.
<b>Building:</b> global factors	Thermal bridging factor (categorised as default, non-default or one of the options applicable under relevant parts of building regulation's part L), thermal mass category
<b>Space heating:</b> controls and responsiveness (individual heating system)	Heating system category, and subcategory, heat emitter type, controls details.
<b>Space heating:</b> controls and responsiveness (group heating system)	Simplified list of options for heating system category, and subcategory, heat emitter type, controls details.
<b>Space heating:</b> pumps and fans	Pumps for central heating (default or non-default energy consumption) and oil fuel, as well as gas boiler flue fan and presence of a warm air heating system.
<b>Space heating:</b> heat sources (individual heating system)	Space heating appliance make/model, efficiency, efficiency adjustment and fuel data. CHP system if present, including efficiency (thermal and electrical). The HARP is searchable from within the 'Heat sources' tab. Detailed heat pump data from Ecodesign can be entered in this section of the software. Additional data sources can be used subject to guidance in Appendix G.
<b>Space heating:</b> heat sources (group heating system)	Percentage of heat from solar space heating system. Percentage of heat, fuel type, efficiency for one or more heat sources toward main space heating. CHP system, fuel type and efficiency. Distribution loss factor, details on charging basis (flat rate or based on heat consumed). District heating primary energy and CO <sub>2</sub> details.
<b>Cooling</b>	Specify if there is a fixed cooling system installed, the fuel used by that system and the Seasonal Energy Efficiency Ratio (SEER).
<b>Space heating:</b> summer internal temperature	Effective air change rate of dwelling

<b>Water heating:</b> options and storage	Water heating system characteristics, including supplementary electrical water heating, showers, baths, storage/distribution, wastewater heat recovery, hot water pipework losses, combi boiler.
<b>Water heating:</b> solar	Aperture area, zero loss collector efficiency, collector heat loss coefficient, annual radiation, overshadowing factor and dedicated solar storage data. Also includes details of solar collector make/model details.
<b>Water heating:</b> heat source	Water heating appliance make/model, efficiency, efficiency adjustment and fuel data. Fraction of hot water met by CHP system.
<b>Lighting and internal gains</b>	Where lighting design details are available: enter lamp power, lamp types, efficacy (if known). Where lighting design unknown, enter number of and types of lamps in the dwelling.
<b>Renewables</b>	Specify renewable thermal, electrical or energy saving technologies not specified elsewhere in the assessment following guidance in Appendix Q.
<b>Results</b>	None
<b>Evidence</b>	Upload evidence supporting entries for each part of the assessment where available.

## 1. Dwelling dimensions

[Tab: 'Building: floors']

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 sills, 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**

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**

This should be measured as the actual floor area, that is 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.

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 the dwelling considered to be cooled during the three months of the cooling season (where a fixed cooling system is installed) is the same as the total floor area taken into account for the eight months of the heating season.

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 is the floor 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*.

**Table 1.1 - Porches**

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	<b>YES</b>
YES	YES	n/a	<b>YES</b>
YES	n/a	NO	<b>YES</b>
YES	NO	YES	<b>NO</b>

**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.

**Storerooms 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 [Appendix A](#). 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, 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, that is 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 2m 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 are not preventing free movement.
- Water cistern is 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:

- i. The attic floor space is not included in the floor area if the attic is open to the storey below, that is 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 is considered to extend into the attic roof. This results in a higher average storey height.
- ii. 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, for example by a partition ceiling and closable attic hatch.

When porches or garages are not included in the assessment 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 (that is 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 (that is 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

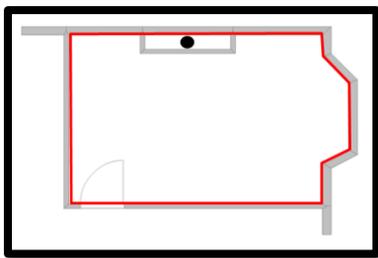
where there is an internal door between the staircase and the dwelling.

- 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.

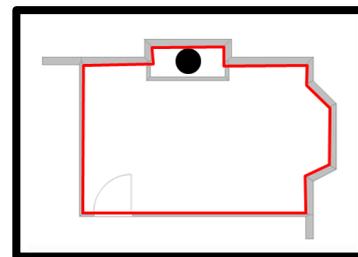
### **Notes on Chimney Breasts and other small areas**

The following guidance applies to living area calculation and floor area calculation in the 'Building: floors' tab in DEAP.

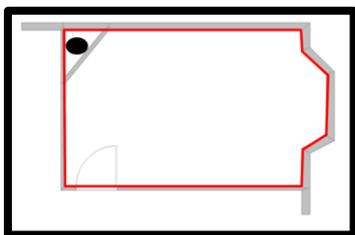
1. The area occupied by bay windows, door entrances or recesses, chimney breasts and other small areas are included in the total floor area unless otherwise outlined in the DEAP manual (unless they are part of a space outside the dwelling floor area as specified in the 'Dimensions' section of this manual). Similarly, these spaces are included in the living room area measurement in DEAP if they form part of the living room as identified in the 'Living area' guidance below.
2. In the diagrams shown below, the red lines detail the floor area within a room to be included in the total floor area/living area measurement of those rooms in DEAP.
3. The floor area is calculated as if the chimney breast was not present, in other words do **not** deduct the chimney breast area from the calculated floor areas.
4. If the chimney breast is recessed into the wall, assume the bounding line for the floor area follows the line of the wall as shown in diagram (b) below.
5. A chimney breast may contain an open flue or balanced flue rather than an opening that would be designated as a chimney for ventilation assessment purposes within DEAP. This guidance applies to all types of chimneys and flues.
6. If a 'through the wall' flue is present and there is no chimney breast, no adjustment to the floor area is necessary in respect of the flue passing through the wall.



a) Example of chimney breast protruding from wall.



b) Chimney breast recessed into



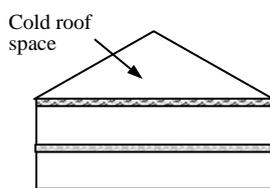
c) Chimney breast in the corner of a room.

### ***Pitched roofs***

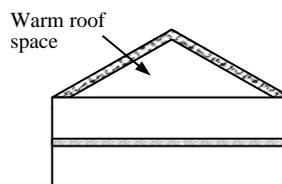
There are three main types of pitched roof construction:

1. Pitched roof with insulation at ceiling level, insulated between (and perhaps also above) joists, shown in figure 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 Building tab as the heat loss roof (accounting for the insulation at rafter level as per BRE 443<sup>[8]</sup>);
3. Pitched roof insulated either at ceiling level or at rafter level, with roof space converted into habitable space, shown respectively in figures 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. The elements bounding the room in roof are entered in the Building tab as the heat loss elements for both figures c) and d).

4.

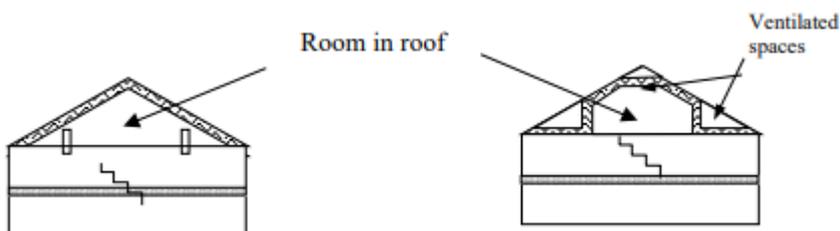


a) Insulation at ceiling level

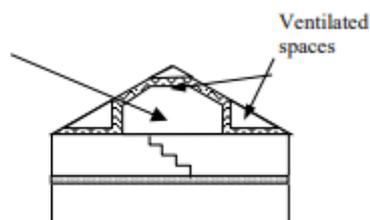


b) Insulation at rafter level

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 pitched roof insulated at rafter level



d) Room in roof built into a pitched roof insulated at ceiling level

In the cases of figures 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, therefore curtains are not considered as a partition. Partitions should be clearly identifiable when dwelling plans are being used.

Public rooms are typically called one of the following: living room, sitting room, lounge, parlour, drawing room, family room, good room or common room.

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:

**Table 1.2a – Living area**

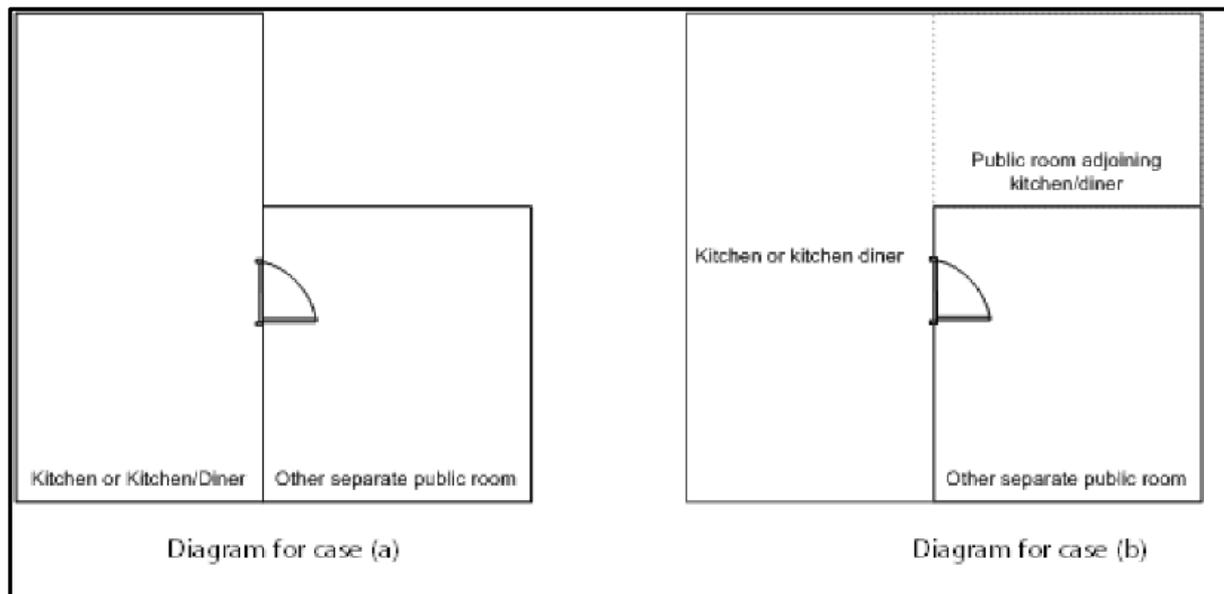
Dwelling contains a kitchen (or kitchen/diner)	Dwelling contains other public room(s)	Living area specified in DEAP
√	√	Other separate public room with largest floor area
√	X	Kitchen - as there is no public room

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

**Table 1.2b – Living area**

Situation	Living Area
Public area of kitchen $\geq$ 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.



In figure (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 (the option that results in larger living area of the potential valid options available 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 and building: windows/doors tabs]

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 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. These openings are entered in DEAP using the guidance below, regardless of whether there is a pressurisation test carried out or not. The contribution of designed ventilation features is given in Table 2.1 below.

**Table 2.1 Ventilation rates**

Item	Ventilation rate (m <sup>3</sup> /h)
Chimney	40
Open flue	20
Fan (intermittent)	10
Passive vent	10
Flueless fixed combustion room heaters <sup>4</sup>	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
- Exhaust air heat pump

---

<sup>4</sup> Note that in the case of 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 40 m<sup>3</sup>/hr in Table 2.1 includes an allowance for these permanent vents.

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.<sup>5</sup>

If a vent on a permanently blocked/restricted chimney/flue can be closed to less than 3,500 mm<sup>2</sup> open area, then it is not considered a chimney/flue but rather is ignored. If the chimney/flue is being ignored, any permanent vent on the external fabric of the room associated with the chimney/flue is counted under the normal background ventilation section as per Section 2.2 below.

If a fireplace has a hearth, it is considered to be capable of supporting a fire, even if there is no grate present. However, where a hearth is in place, and includes a gas supply pipe, with no gas room heater installed in the hearth, it is not considered capable of supporting a gas or solid fuel fire in its current state. The rules around identification of the chimney opening apply subject to this section, regardless of whether the fireplace is capable of supporting a fire or if the fire is not considered as a secondary heater subject to rules in DEAP Appendix A.

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<sup>2</sup>)
- 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 200 mm. Efficiency for this appliance is that of an open fireplace from Table 4a.

---

<sup>5</sup> Note the following when reviewing permanent vents associated with combustion appliances:

- A permanent vent is only discounted if it is in the same room as the open chimney or open flue. This includes other spaces such as in open plan arrangements or where there is an opening with no closable door between adjoining rooms. As with staircases, a connected room does not extend over more than one storey.
- Intermittent extract fans are not discounted against open chimneys or open flues in the same room. Where an intermittent fan is installed in the same room as the chimney/open flue, the intermittent fan must be accounted for in DEAP.

Ventilation rates should be entered only for open flues and should not be included for room sealed (for example 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**

These typically exhaust air from the kitchen via cooker hoods or bathroom via 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, these are included under 'intermittent fans and passive vents' in the ventilation method 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**

These 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<sup>2</sup>. If the controllable vents in a room can be closed to less than 3500 mm<sup>2</sup> (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<sup>2</sup> 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 3400 mm<sup>2</sup> is not included.
- Two vents in the same room with combined minimum open area of 5000 mm<sup>2</sup> are counted as a single vent in DEAP.
- If a tumble dryer is connected to a vent, the vent is not accounted for in DEAP as this is a closable vent.

## 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 must be completed in accordance with IS EN ISO 9972 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 entries of the ventilation: structural air tightness tab and building; windows/doors tabs (structure type, suspended wooden ground floor, draught-stripping of

windows, doors and attic hatches<sup>6</sup>) are not used. Section 1.5.4 of Building Regulations TGD L and [SEAI's DEAP support webpage](#) provide further detail on air permeability pressure testing.

The result of a pressurisation test remains valid provided dwelling envelope changes (such as area changes, replacement of exposed elements, breaking of air barrier (for example inserting additional vents to the external) 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: infiltration due to openings 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 forming an enclosed space on the main entrance to the dwelling. To be specified as a draught lobby in a house in DEAP, the enclosed space must satisfy all the following criteria:

- It is located at the main entrance of the dwelling (the front door);
- It is at least 2 m<sup>2</sup> in floor area;
- It has a minimum depth of 1.2 m and a minimum width of 1.2 m;
- It opens via a single door (or double doorway) into a circulation area (such as a hall, corridor or staircase);
- The space is separated from the remainder of the dwelling by one closable doorway, although it may also have an adjoining cloakroom;
- It may be heated or unheated.

---

<sup>6</sup> Specification of draught-stripping on openings is used to estimate air infiltration through gaps between the openable part of a door, attic hatch or window and the surrounding frame. In practice, it is unnecessary to measure the perimeter or area of each openable section when identifying draught stripping. The assessor may identify the number of openings with draught stripping as well as the total number of openings. Inspect all openings including openable sections of windows, doors and attic hatches between the dwelling and unheated spaces or open air.

If it is not possible to inspect an openable section to determine whether it has draught stripping, for example it is painted shut, the most prevalent draft stripping status identified for other openings of the same type where inspection is possible in the dwelling is applied. If this does not resolve the status, assume no draught stripping for this openable section.

Where air tightness improvement measures (e.g., retrofit of draught stripping) are applied to a dwelling, this can also be assessed and reflected in DEAP through a pressurisation test of the dwelling being assessed.

An unheated draught lobby in the form of an external or thermally separated 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.

The 'draught lobby' entry in DEAP does not have a bearing on whether the lobby is included in the dwelling floor area or not. Determining whether the lobby is included in dwelling floor area is decided as per Section 1 as applied to the DEAP building: floors tab.

## 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;
- the width of the obstacle (or the combined width of several obstacles) subtends an angle of at least  $60^\circ$  within the central  $90^\circ$  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  $60^\circ$  angle.

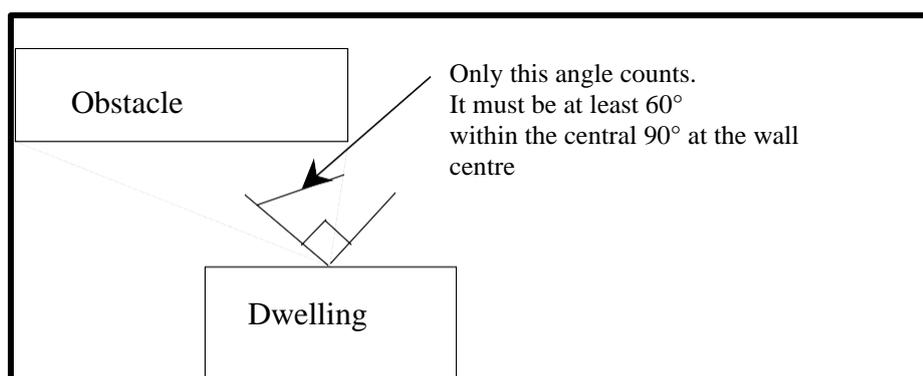


Figure 2.1 Shelter angle

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***

This 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 based on the factor  $\eta_v$  where  $\eta_v = 66\%$  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 non-default test values for ducted systems are listed on the [UK Product Characteristics Database](#) (PCDB), formerly known as SAP Appendix Q.

The testing methodology for inclusion of MVHR devices on the PCDB 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.

BER assessors 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 plus three wet rooms).

For balanced whole-house mechanical ventilation systems with heat recovery, the assessor selects whether system ductwork outside the dwelling envelope is uninsulated:

- This option is not selected if all of the duct system outside the dwelling envelope is continuously insulated to a minimum depth of 25 mm with thermal conductivity of 0.04 W/mK or less as required by the UK domestic ventilation compliance guide.
- This option is not selected if all of the ventilation system ductwork is inside the insulated dwelling envelope.
- This option is selected if there is ductwork outside the insulated dwelling envelope and the above conditions have not been met.

In cases where external ductwork has not met the condition (in other words is uninsulated), DEAP multiplies the heat recovery system exchanger efficiency by a factor of 0.85.

Semi-rigid duct systems included in the Products Characteristics Database have demonstrated that their aerodynamic performance, when installed in a variety of configurations, is at least that for rigid ducts. Where these duct systems are used with balanced mechanical ventilation, they are considered as equivalent to rigid ducting for the purpose of DEAP assessments. Otherwise, where the duct type referenced on PCDB performance data for balanced mechanical ventilation systems does not match the

duct type installed in the dwelling, then default values must be used in DEAP for the balanced mechanical ventilation system.

As detailed in TGD F, a wet room is a room used for domestic activities such as cooking, clothes washing, bathing, which, by their nature, are likely to give rise to significant production of water vapour. Typical wet rooms in dwellings are kitchens, utility rooms, bathrooms and sanitary facilities containing provision for showering or bathing.

### ***Positive input ventilation***

This 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 m<sup>3</sup>/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***

This 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 mechanical extract ventilation on the [PCDB](#). The assessor must specify the number of wet rooms where the unit extracts exhaust air.

### ***Exhaust air heat pumps***

These are fan driven ventilation systems extracting air from the dwelling which use the exhaust air as a heat source for the heat pump, in compliance with Ecodesign test conditions. The mechanical ventilation component does not provide fresh air. The DEAP calculation is based on the effective air changes per hour through the mechanical system. The air flow rate should be taken from the Ecodesign technical data sheet for the heat pump; it is entered in DEAP in (m<sup>3</sup>/h). This air flow rate is used to calculate the effective air change rate, with a minimum throughput of 0.5 ach.<sup>7</sup>

The extract ventilation running time is based on the hours of operation of the heat pump.

The calculation requires information on specific fan power (SFP) of mechanical ventilation fans. Default data is 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 mechanical extract ventilation on [PCDB](#). The assessor must specify the number of wet rooms where the unit extracts exhaust air.

---

<sup>7</sup> The method to account for impact of a larger than expected air flow rate (m<sup>3</sup>/h) is based on SAP 10 from BRE.

Where there is insufficient documentary evidence to support the performance of the exhaust air heat pump and default values are being used for the efficiency of the heat pump, the volume of air can be left blank, as a minimum throughout of 0.5 ach will be assumed.

**Two or more systems are used in the same dwelling:**

- If the systems are identical, use the data for the system corresponding to half (in the case of two systems for example) the actual number of wet rooms. If there is an odd number of actual wet rooms, round upwards (for example for kitchen plus six wet rooms, use data for kitchen plus three wet rooms). This may be a dwelling with two heat recovery systems of the same make/model.
- If the systems are of the same 'ventilation method', but have different efficiency/SFP, use an average for the systems, weighted according to the number of wet rooms served by each system. This could, for example, be a system with two heat recovery systems of different make/model.
- If one of the systems is not listed on the PCDB website, the default data applies to the unlisted system when calculating the averages outlined above.

### 3. Heat losses

[Building 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 to the same extent/occupancy as a dwelling are assumed to be zero as detailed in Section 3.5.

BER assessors should allow for elements of differing U-value (for example 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 Building: windows tab, 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) non default solar transmittance must also be used. Non default data must be supported by acceptable certified documentation supporting both the U-value and solar transmittance.
- 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<sup>2</sup>), a glazing ratio to floor area for daylighting purposes, and a solar gain rate (W/m<sup>2</sup>) 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 library 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 Building: global factors tab. The default value of 0.15 W/m<sup>2</sup>K must be chosen unless contrary evidence is available as defined in [Appendix K](#).

The 'View assessment' section details 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 indicator (W/K m<sup>2</sup>), also called the HLI. The HLI is also displayed on the Results tab.

The heat losses are used to calculate the overall heat demand for the heating season and cooling demand for the cooling season (where a fixed cooling system is installed).

### 3.1 U-values of opaque elements

U-values for the floor, walls and roof should be calculated when construction details are known. This applies to new dwellings assessed using information gathered on site and from building plans and specifications. Information on the use of default U-values for existing dwellings is provided in [Appendix S](#). Alternatively, use of non-default values may be applied to 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 2021 TGD L (Table A1), I.S. EN ISO 10456 or the CIBSE Guide, Section A3<sup>[6]</sup>. 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 Agrément Certificates from the NSAI or equivalent. Certified data from other sources can also be used, bearing the following text in mind (taken from Building Regulations 2021 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: 2012. 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***

These 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 <sup>[8]</sup> 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 entered in DEAP for a window must be for the whole window opening including the window frame. There are a number of typical sources for window U-value and solar transmittance data such as Window Energy Performance (WEP) certificates, British Fenestration Rating Council (BFRC) certificates, accredited test data / Declaration of Performance to relevant standards, calculations to relevant standards, defaults from DEAP Tables 6a/6b and defaults from DEAP Appendix S.

Measurements of thermal transmittance for doors and windows should be made according to IS EN ISO 12567:

- All non-default data used in calculations must be obtained from accredited sources.

Alternatively, U-values of windows and doors may be calculated using IS EN ISO 10077-1 or IS EN ISO 10077-2:

- These calculations must be carried out by a competent person and in a software tool using these standards.
- Confirmation of the glass used in the window system must be provided.
- The performance of the glass used must be sourced from:
  - A CE-Marked / Declaration of Performance certificate for the g-value and U-value of the glass; or:
  - The glass manufacturer's calculator, once that calculator has been validated by an accredited body.

The standards detail default data for use in calculations where non-defaults are unavailable. 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 6 and S9 provide values for use 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 is prohibited when using these tables.

The window U-value, solar transmittance, frame factor and light transmittance are used in the DEAP calculation. There is typically a trade-off between these different window characteristics. For example, lower (improved) window U-values often coincide with lower solar transmittance (reduced heat gains) and lower light transmittance (increased requirement for artificial lighting). The frame factor is usually influenced by the frame material. A higher frame factor implies a higher proportion of glazing in the opening and therefore allows greater heat gains through the window.



Where certified window data is not available, defaults can be selected depending on the dwelling type as outlined in the following text.

**Defaults for 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.

**Defaults for existing dwellings:**

Assessors have 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:

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

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 and correct selection of roof window orientations.

**Use of standard sizes for U-value testing or calculation:**

It is common practice to establish, for example through calculation or WEP/BFRC certificates or other certified data, a standard U-value for a window of 1.48 m x 1.23 m with a central vertical divider, comprised of one opening section and one fixed section. If the standard sized window (1.48 m high \* 1.23 m 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.

**Table 3.1 – Standard testing sizes of window and doors**

Window or door?	Actual window/ door size	Size of standard window/door (metres)
Window	All sizes	1.48 ( -25% ) * 1.23 ( ± 25%)
Window	>2.3 m <sup>2</sup>	1.48 ( +25% ) * 2.18 ( ± 25%)
Door	<=3.6 m <sup>2</sup>	1.23 ( ± 25% ) * 2.18 ( ± 25%)
Door	>3.6 m <sup>2</sup>	2.00 ( ± 25% ) * 2.18 ( ± 25%)

In the case of larger doors or windows, Annex E of the standard I.S.EN 14351-1:2006 details other standard sizes for U-value derivation, as set out in Table 3.1. Therefore, it is also acceptable to use certified data provided for the U-value of a window/ door of a standard size as per Table 3.1 for an actual window/door of corresponding size, provided the standard window and actual window are of the same type.

In this context, windows are of the same type if, for example, they are the same make and model, or have the same frame, glazing, draught stripping and shape (casement, sliding, etc.).

Note that the standard allows for tolerances in the dimensions of the test window/door; these are shown in Table 3.1 in brackets, as a percentage of the target dimension.

### 3.3 U-values of elements adjacent to an unheated space

The procedure for treatment of U-values of elements adjacent to unheated space (also referred to as semi-exposed elements) is described in IS EN ISO 6946 and IS EN ISO 13789 and BR443 Appendix A. 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 2021 TGD L).

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

Where:

$U$  = resultant U-value of the element adjacent to unheated space,  $W/m^2K$ ;

$U_o$  = U-value of the element between heated and unheated spaces calculated as if there were no unheated space adjacent to the element,  $W/m^2K$ ;

$R_u$  = effective thermal resistance of unheated space.

$R_u$  for typical unheated structures (including garages, access corridors to flats and rooms in roof), are given in Building Regulations 2021 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. For room in roof the  $R_u$  value of  $0.5 m^2K/W$  applies to both the heat loss wall of room in roof and heat loss ceiling of room below adjacent to the unheated space. Refer to Figure 3.1.

Alternatively,  $R_u$  can be calculated using the following formula as detailed in BRE 443 and in Building Regulations 2021 TGD L Appendix A, to represent more accurately the resistance through the fabric and unheated space e.g. in apartment walls facing unheated corridors:

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

Where:

$A_i$ ;  $A_e$  = respective areas of internal and external elements ( $m^2$ ), excluding any ground floor

$U_e$  = U-values of external elements ( $W/m^2K$ )

$V$  = volume of unheated space ( $m^3$ )

$n$  = air change rate of unheated space (ach)

Please see SEAI's Excel calculator 'DEAP elements adjacent to unheated spaces' for determining  $R_u$  according to the above equation for elements adjoining unheated spaces. This calculator is based on BRE443 and is published [here](#).

The effect of unheated spaces, however, need not be included if the area of the element covered by the unheated space is small (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. When using non-default U-values for semi-exposed elements in both new and existing dwellings, apply the above calculation based on  $U_o$  and  $R_u$ .

### 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 2021.

### 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 2021 TGD L.

Table A4 of Building Regulations 2021 TGD L refers to corridors and stairwells. The  $R_u$  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  $R_u$  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, 2011, 2019 or 2021 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, 2011, 2019 and 2021 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 fulfil 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. The same approach applies to other separating element types (e.g., walls and doors). If any one of the separating element types does not meet

this thermal separation criterion, then thermal separation is not achieved.

- 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  $R_u$  value of elements between thermally separated conservatory and the heated dwelling is given in Building Regulations 2021 TGD L Table A5. The following table summarises how condition (ii) for thermal separation of a conservatory from the dwelling can be met:

**Table 3.2 - Conservatories**

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). Room thermostat only.	Yes	No	No
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 2021 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 (or later) 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 (or later).
- Existing dwelling built to Building Regulations 2008 (or later) 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.

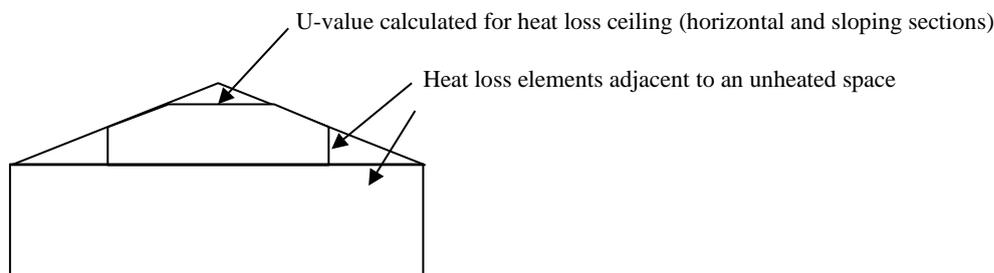
Windows between the dwelling and excluded unheated spaces other than conservatories (such as a window between the dwelling and a thermally separated excluded garage) should be entered under 'walls' rather than 'windows' as the light and solar transmittance is low through these windows.

### 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 3.3. The same applies to the ceiling of the room below.



**Figure 3.1 Room in roof**

**Table 3.3 -  $R_u$  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
	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](#). Appendix S details the scenarios in which this approximation may be used.

### 3.4 Thermal bridging

The DEAP calculation includes thermal bridging, at junctions between elements and around openings. If linear thermal transmittance ( $\Psi$ ) 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  $\Psi$ - 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 (that is heated to a similar pattern and to similar temperatures). In this context, adjoining premises should be heated to 18°C or more for at least seven of the eight 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 eight 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 S6.1 of the DEAP manual provides guidance on default U-value for walls in this case in existing dwellings in the absence of supporting information for a non-default wall U-value.

Section S6.5 of the DEAP manual applies a default U-value of 1.0 W/m<sup>2</sup>K for floors in this case in existing dwellings in the absence of supporting information for a non-default floor U-value.

Where the BER assessor is unable to determine the nature of the neighbouring premises, 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. For curtain walling, a site-specific thermal transmittance calculation should be undertaken by a competent person (such as a façade engineer) and calculated in accordance with IS EN 12631:2017 taking on board the specific geometry of the installed product/ system.

- Confirmation of the glass used in the curtain walling system must be provided;
- The performance of the glass used must be sourced from CE Marked/ Declaration of Performance certificates for the g-value and U-value of the glass. These can be from glass manufacturers calculators, once the calculator is validated from an accredited body.

The U-value of curtain walling is that for the whole façade, that is an average value including mullions, transoms, glazing and spandrel panels. Calculations should be made 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, 1.05 W/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, it may be entered as a window in DEAP. 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.

### 3.8 Perspex or plastic roofs

Perspex or plastic roofing is treated as glass when relying on defaults for solar transmittance and U-values. If there is more than a single layer (such as double or triple layers of Perspex), assume it is double or triple

glazing (air filled). Use the associated default U-values and solar transmittance from Tables 6a/6b for Perspex for entry into DEAP as a roof window. Assume the Perspex is uncoated with 6 mm air gap unless proven otherwise.

## 4. Domestic hot water

['Water Heating' tab]

The demand for domestic hot water (DHW) is based on the SAP methodology (SAP 10). It is derived from the dwelling floor area and calculated taking account of heating, storage and distribution losses as well as several other parameters such as:

- Number of electric showers (this uses electricity directly rather than from the water heating system)
- Mixer showers, fed from the water heating system;
  - presence of flow restrictors on the mixer shower. Flow restrictors must be permanently fitted (in other words cannot be removed without the use of tools).<sup>8</sup>
  - is the mixer shower unvented?
  - is the mixer shower vented (and does it have a pump)?
  - is the flow rate (L/min) known for the mixer shower<sup>9</sup>?
- Is there an instantaneous wastewater heat recovery unit (WWHR) listed on the SAP PCDB fitted to the mixer shower? The WWHR utilisation factor and efficiency are entered based on PCDB 2012 figures.
  - Instantaneous WWHR systems use a heat exchanger to recover heat from waste warm water as it flows through the waste plumbing system to pre-heat the cold water feed of a shower and a combi boiler or mains pressure hot water system (thermal store or unvented cylinder). The calculation in DEAP deals with instantaneous WWHRs linked to thermostatic mixer showers (where the shower water is a mixture of cold feed and that from the combi boiler or mains pressure hot water system). It is assumed that the WWHR is located inside the heated envelope. A WWHR linked to an instantaneous electric shower (IES) is not covered by this procedure.
- Presence of a bath/baths. Bath taps fitted with temporary/portable shower head that is not fixed in place, is entered as a bath and not as a shower in DEAP. Bath taps fitted with fixed/permanent shower head is entered as a bath and shower in DEAP.
- Water usage (hot and cold) per person, per day. The methodology to determine the water usage in the dwelling is detailed in Appendix I 'Water efficiency calculation methodology' of the DEAP manual.

Consequent heat gains from storage cylinders (within the heated space), distribution pipe work, electric showers and combi boilers are 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.

---

<sup>8</sup> Flow restrictors may also be identified on the [European Water Label](#) product database.

<sup>9</sup> (i). Flow rate of each shower at the outlet using cold water in litres per minute measured at a dynamic pressure of  $3 \pm 0.2$  bar ( $0.3 \pm 0.02$  MPa) for high pressure (Type 1) supply systems, or at a dynamic pressure of  $0.1 \pm 0.05$  bar ( $0.01 \pm 0.005$  MPa) for low pressure (Type 2) supply systems (EN 1112:2008, Sanitary tapware. Shower outlets for sanitary tapware for water supply systems type 1 and 2. General technical specifications).

(ii) A minimum of 6L/Min is applied by DEAP to all mixer showers.



## 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 some instantaneous electric water heaters. Where an instantaneous electric water heater contains storage, add this storage volume to the hot water storage volume in DEAP. 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 NSAI Agrément Certificate or equivalent.

The cylinder loss stated on labels / nameplates can be used where:

- the label has a CE-marking and state the relevant standard;

or:

- the label has a reference to the relevant Ecodesign or Energy Labelling Directive.

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: options and storage 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: options and storage 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 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 well exceed 60%.

System designers should refer to the document SR 50-2:2012: Building Services Code of Practice Part 2: Thermal Solar Systems).

### 4.5 Group/community heating and district heating schemes

Group/community heating is defined as a system serving multiple dwellings from a central source within the boundaries of the site, where full details of the heat sources and spaces served are available.

District heating is defined as a central system serving multiple dwellings from a system outside the boundaries of the site. Details of the performance of the system must be provided by the district heating scheme operator.

Where hot water is provided from a group heating or district 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 1.672 kWh/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 electricity. Section 10.3.3 provides further detail on electric water heating supplementing solid fuel boilers during the summer months.

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 during summer 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 main water heater 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 homeowner 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 thermostat(s) 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 deselected. The efficiency of the main water heater is determined based on heat pump system data entered in accordance with Appendix G.

## 5. Lighting and internal heat gains

[‘Lighting’ 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’ tab as described in [Appendix L](#). Savings due to low energy lights (defined in [Appendix L](#)) are calculated, allowing for detail on lighting design and/or lighting type as appropriate. 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 based on entries in the ‘Space heating: pumps and fans’ tab.

## 6. Solar heat gains

### [Building: windows 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:

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

Where:

- $G_{\text{solar}}$  is the average solar gain in kWh/m<sup>2</sup> 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) in m<sup>2</sup>
- $S$  is the solar radiation on a surface of relevant orientation, from Table 1b, kWh/m<sup>2</sup> 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, partially glazed doors or solid doors according to the percentage of glazed area (the percentage of total area of opening that is glass, that is 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	Partially 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 (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 partially glazed doors. See footnotes to Table 6a. For glazed doors, the U-value must be calculated by the assessor as an area weighted average between the glazing and opaque U-values.

If a door has an adjoining window within the same opening, the window is not part of the door and is therefore considered separately as a window.

In some cases, a window opening includes a PVC, metal or wooden panel or spandrel panel. Where this panel is not the external layer on a wall, it is treated as a door under the 'Building: doors' tab. There is no solar gain through these panels.

## 6.3 More than one glazing type

Where a dwelling has more than one type of glazing (for example 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

[Building: floors and global factors tabs]

### 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 net space heat demand calculated by DEAP:

- **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 (say 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 categories are**: low, medium-low, medium, medium-high or high. The category is determined using one of the following options:

1. For existing dwelling assessments, the thermal mass category may be derived using Section S10 or Table 11 (optionally combined with the calculation method outlined below following EN ISO 13786).
2. For new final or new provisional dwelling assessments, the thermal mass category may be derived using Table 11 (optionally combined with the calculation method outlined below following EN ISO 13786). Section S10 is not used for new dwelling assessments.

As an alternative way of determining whether an element is thermally light or heavy, the internal heat capacity of the element may be calculated as described in EN ISO 13786:2017 using a time period of 24 hours and with surface resistances included. A result of 38 kJ/m<sup>2</sup> K or greater is considered to have high thermal mass, and a lower result is considered thermally light. The resulting figures are then used as per Table 11 to determine the Am/Af ratio and the resulting thermal mass category.

Thermal mass also impacts the cooling energy demand for dwellings with fixed cooling systems installed.

## 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. 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 based on data entered under 'Space heating: controls and responsiveness' in Section 9.

## 8. Space heat use

[Net Space Heat Demand calculation in DEAP]

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 carried out 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, 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 net 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

[Space heating tab]

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**.

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 when calculating the net space heat demand.

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 HARP database, certified test data, Ecodesign data where applicable or from Table 4a or 4b. The PCDB in the UK may also be used following guidance in the DEAP manual. A similar calculation is carried out in respect of hot water heating, applying results based on entries in the 'Water heating' tab.

Calculations are completed based on group or individual heating systems, depending on whether one or more dwellings are heated by the space heating system specified in DEAP.

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 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 [here](#).

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:
  - boiler manufacturer;
  - boiler supplier;
  - 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 responsibility of the user/designer/assessor to ensure 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, 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 subject to DEAP Appendix A).

For oil and solid fuel room heaters with boilers, the gross efficiency is an overall value (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 subject to DEAP Appendix A).

### 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:

- Ecodesign compliant technical data;
- Certified data from an accredited laboratory;
- Table 4a;
- HARP (to the applicable standard as per Appendix G).

Entries for derivation of heat pump performance is detailed in [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, seek guidance from SEAI.

In cases where the burner unit is replaced, a non-default efficiency value from HARP, PCDB (2005 – formerly SEDBUK) 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 'Heat source' tabs under 'Space heating and water heating', based on Table 4c. Examples of factors addressed by Table 4c include condensing boilers with under floor heating, heating controls (such as the absence of a boiler interlock), and heat pump system details.

## 9.3 Heating controls

The influence of the heating system controls is based on entries in the 'Space heating: controls and responsiveness' 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. A regular room thermostat, as defined in Section 9.3, does not meet the criteria of a delayed start thermostat.

### 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. Towel rails are not considered in the TRV count.

### 9.3.7 Cylinder thermostat

A cylinder thermostat measures the temperature of the hot water cylinder and can switch on and off the water heating. A single target temperature may be set by the user, or the thermostat may have a pre-set temperature.

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.

A cylinder thermostat is assumed present when the main water heating is from a group heating plate heat exchanger, an immersion heater, an integrated thermal store, a combi boiler or a CPSU. See Table 2 for further detail.

### 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.

See Table S11 for details of when to assume interlock in existing dwellings.

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 override. It is equivalent to a hard-wired interlock. Other features such as weather compensation or load compensation are considered separately using the relevant DEAP guidance (for weather compensation refer to Section 9.3.13).

### 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 one or more independent temperature controls (room thermostat) **per zone**. It is not necessary for these zones to correspond exactly with the zone division that defines the living area fraction (Section 7.2). Where the dwelling is more than 300 m<sup>2</sup> floor area, then extra time/temperature zones are required as follows:

Table 9.1 – Number of zones required for time and temperature zone control

Dwelling total floor area (m <sup>2</sup> )	Number of space heating zones with time and temperature control required for time and temperature zone control
50	2
100	2
200	2
<300	2
>=300 and <400	3
>=400 and <500	4
Add 1 zone for each extra 100m <sup>2</sup>	

In the case of wet systems, separate plumbing circuits are required, either with their own programmer, or separate channels in the same programmer. By contrast, conventional TRVs provide only independent temperature control. If a TRV can be time controlled, and provides the same functionality as a room thermostat, it is considered as part of a fully zoned system subject to the guidance on control of the number of zones required as outlined in the table above.

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. A regular room thermostat, as defined in Section 9.3, does not meet the criteria of a weather compensator.

#### 9.3.14 Load compensator

A device or feature that adjusts the temperature of the water circulating through the heating system according to the temperature measured inside the building. A regular room thermostat, as defined in Section 9.3, does not meet the criteria of a load compensator.

#### 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).

#### 9.3.16 Appliance thermostats on room heaters

Appliance thermostats on room heaters are typically identified as a thermostat mounted on the appliance, allowing its average heat output to be adjusted. The actual room temperature in the room may or may not be indicated on the appliance thermostat control.

#### 9.3.17 Enhanced user interfaces

In some cases, controls providing the functionality represented in different sections above are provided via mobile devices and enhanced systems incorporating software and user displays. These are entered in DEAP based on the applicable level of control identified in Sections 9.3 to 9.3.16 above.

## 10. Total energy use

[‘Results’, ‘Space heating’, ‘Water heating’, ‘Renewables’ tabs and ‘View assessment’ section]

### 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 for fixed cooling systems;
- energy produced or saved from renewable and energy saving technologies.

### 10.2 Fuel factors

Primary energy factors and CO<sub>2</sub> emission factors associated with different fuels are calculated using the data given in Table 8. Other primary energy or CO<sub>2</sub> factors are not used for the purpose of this calculation.

Since fuels must relate to realistic heating systems, it is important that practical combinations of fuel types are used.

The primary energy (renewable and non-renewable) and CO<sub>2</sub> 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<sub>2</sub> emissions factors for electricity are updated in line with the agreed methodology and based on the National Energy Balance.

### 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 [here](#).

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 use the following fuels. This list details whether the fuel listed is prohibited within smokeless fuel/smoky coal ban areas:

- Standard and premium coal (house coal) (prohibited)
- Anthracite (not prohibited)
- Manufactured smokeless fuel (not prohibited)
- Peat briquettes (not prohibited)
- Sod peat (not prohibited)
- Wood logs (not prohibited)
- Wood pellets (not prohibited)
- Wood chips (not prohibited)

Some models, referred to as 'multi-fuel', can use 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 to 4 until a choice is made.

1. If the heating appliance is designed to burn only a wood fuel, in other words 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 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.

2. If the appliance is designed to burn a particular coal-based or peat-based fuel type, that should be chosen as the fuel, with the exception of house coal if the dwelling is located in a smoke control area.

3. If the appliance can burn more than one fuel type (open fires and many closed room heaters 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 on the previous page:

**Table 10.1 – Fuel selection**

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 room heaters with boilers, an alternative system (such as an electric immersion) may be provided for heating water in the summer. DEAP assumes that a fraction of 0.33 of the annual water heating is provided by the supplementary electric water heating. Supplementary electric water heating is 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 [this facility](#) under or following guidance on the [Department of Environment, Climate and Communications](#). Individual Local Authorities may have further details. In outside smoke control areas, any fuel can be used subject to the manufacturer's instructions for the appliance concerned. Within smoke control areas, follow [this guidance](#).

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:

1. If the appliance fuel type in DEAP matches the test data fuel type, the gross efficiency is used if it is shown on the test certificate or on HARP. HARP always lists gross seasonal efficiencies.
2. If the appliance fuel type in DEAP matches the test certificate fuel type but the test certificate only shows the net efficiency, the net/gross conversion described in Appendix E must be applied (see Table E4).
3. If the appliance fuel type in DEAP is solid multifuel, 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, the average of these can be used in DEAP. If the test data efficiencies are net, 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 HARP, certified data (following the relevant appendix in DEAP) or Table 4a and the fuel options may 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, is recorded as a warm air heating system in the DEAP 'Space heating: pumps and fans' tab;
- Whole house mechanical ventilation;
- Keep-hot facility (electric) for gas combi boilers;
- Solar water heating pump;
- Electricity for electric showers;

- 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. See Table 4f.

## 10.7 Electricity for lighting

The electricity used for lighting is calculated based on entries in the 'Lighting' tab according to the procedure in [Appendix L](#). The calculation allows for low-energy lighting provided by fixed outlets based on lighting design details (such as lamp power and efficacy), lamp type, and number of lamps as detailed in Appendix L.. The tariff applicable to lighting is the on-peak rate.

## 10.8 Group/community heating and district heating schemes

Group/community heating is defined as a system serving multiple dwellings from a central source within the boundaries of the site, where full details of the heat sources and spaces served is available.

District heating is defined as a central system serving multiple dwellings from a system outside the boundaries of the site.

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 1/2/3/4

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; Seasonal efficiency of heat pumps based on inputs according to Appendix G;
- 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 main 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 [here](#).

### 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 percentage 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 district heating

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 district heating. 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 plants 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, this is entered in the 'Water heating: solar' 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 'Renewables' tab 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<sub>2</sub> 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 'Renewables' tab to contribute towards the renewable energy requirement of Building Regulations 2008, 2011, 2019 and 2021 TGD L.

### 10.10 Energy for cooling

Energy for cooling is calculated for dwellings with a fixed cooling system installed (that is air conditioning or heat pump providing cooling). The calculation derives the net space cooling requirement and accounts for the impact of thermal mass on heat losses as offset by gains. The cooling system is assumed to operate for six hours per day, maintain an internal temperature of 24°C for the months of June, July and August. The resulting energy requirement is calculated by DEAP based on this net space cooling requirement and the seasonal energy efficiency ratio (SEER) as entered by the user. The calculation is carried out according to the EPBD overarching CEN standards (EN ISO 52016-1:2017).

Notes:

- SEER for the make/model of installed cooling appliance must be source from one of:
  - Ecodesign datasheets according to regulation 606/2011;
  - EN14825 test results for electrical cooling appliances from a suitably accredited test laboratory (or EN12309 for GAHP units).
- Cooling systems can be powered by electricity, mains gas or LPG.
- Where more than one cooling system is installed, the average SEER is used. In this case, it must be weighted by the cooling design load of the units as declared in test data.
- Where efficiencies are unavailable, the SEER is taken to be 2.16 for electrically fuelled units.
- If a cooling system heat pump can also operate in heating mode, it is considered a heat pump heating system in DEAP subject to the guidance in DEAP Appendices A and G.

## 11. Energy, emissions and costs

[‘Results’ tab and View Assessment section]

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

DEAP automatically calculates the **standardised number of occupants** in the dwelling (N) as follows:

- IF TFA ≤ 13.9 m<sup>2</sup>; N = 1,
- IF TFA > 13.9 m<sup>2</sup>; N = 1 + 1.76 \* (1 - EXP(-0.000349 \* (TFA - 13.9)<sup>2</sup>)) + 0.0013 \* (TFA - 13.9)

TFA is the total floor area [m<sup>2</sup>].

**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<sub>2</sub> per year: Emissions are calculated on the basis of primary energy consumption; 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 ‘View assessment’ section along with up-to-date domestic fuel cost [here](#). Table 10a and Table 10b 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 and ‘View Assessment’ section]

The procedure and software may be used to generate BER labels and BER advisory reports as required under the EPBD and subsequent EPBD recast. This provision applies to new dwellings and existing dwellings as detailed in S.I. 243 of 2012. The format and content of the BER label is detailed [here](#).

The energy rating ranges from G (largest primary energy usage) to A1 (lowest primary energy usage). It is critical to note that multiple factors including dwelling dimensions, orientation, ventilation, dwelling fabric, water heating, lighting, space heating, space cooling, 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 and ‘View assessment’ section]

DEAP allows BER assessors to demonstrate a new dwelling’s conformance to certain sections of Building Regulations 2005 - 2021 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<sub>2</sub> 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, 2011, 2019 and 2021 TGD L conformance demonstration

DEAP performs the following checks for new dwellings where Building Regulations 2008, 2011 and 2019 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, 2011, 2019 and 2021 TGD L. The MPEPC is defined in Section 1.1.2 of Building Regulations 2008, 2011, 2019 and 2021 TGD L.
- The calculated CO<sub>2</sub> 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, 2011, 2019 and 2021 TGD L. The MPCPC is defined in Section 1.1.2 of Building Regulations 2008, 2011, 2019 and 2021 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, 2011, 2019 and 2021 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 ‘Renewables’ 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 ‘Renewables’ tab 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). TGD L 2008 and 2011 define the renewable energy requirement as an absolute figure in kWh renewable energy per m<sup>2</sup> floor area per year, whereas TGD L 2019 and 2021 define it as a renewable energy ratio (RER). DEAP automatically derives the renewable energy ratio for all different renewable technologies. Full detail of the DEAP algorithms including RER is available in the published Excel Workbook version of DEAP.

- The exposed elements of the dwelling fabric are required to meet the constraints detailed in Section 1.3 of Building Regulations 2008, 2011, 2019 and 2021 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, 2011, 2019 and 2021 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, 2011, 2019 and 2021 for further guidance. DEAP allows BER assessors 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, they 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.

BER assessors should also ensure that clients are 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 DBEIS by BRE (<https://www.bregroup.com/sap/>).

2005 - 2021 Building Regulations, Technical Guidance Document L, Conservation of Fuel and Energy (<https://www.housing.gov.ie/node/5535> )

EU Energy Performance of Buildings Directive legislation documents: [https://www.dccae.gov.ie/en-ie/energy/legislation/Pages/Energy-Performance-of-Buildings-Directive-\(EPBD\).aspx](https://www.dccae.gov.ie/en-ie/energy/legislation/Pages/Energy-Performance-of-Buildings-Directive-(EPBD).aspx)

Limiting Thermal Bridging and Air Infiltration. Acceptable Construction Details (<https://www.housing.gov.ie/node/5535> )

### 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. Henderson J and Hart J: BREDEM 2012 – A technical description of the BRE Domestic Energy Model V1.1.
4. Anderson BR, Energy assessment for dwellings using BREDEM worksheets, BRE Information Paper IP 13/88, BRE, Garston, 1988.
5. CIBSE Guide A3, The Chartered Institution of Building Services Engineers (CIBSE), London, 2015.
6. Anderson BR, BRE 443: Conventions for Calculating U values. BRE Scotland. 2006 Edition
7. SR 50-2:2012 Building Services Code of Practice - Part 2: Thermal Solar Systems (NSAI)
8. SR 50-1:2010 (draft) Code of practice for building services – Part 1: Domestic plumbing & heating (NSAI)
9. SR 54: 2014 Code of practice for the energy efficient retrofit of dwellings (NSAI)

10. Domestic Technical Standards and Specifications. 2019. SEAI

11. Domestic Heating Design Guide. 2017. CIBSE

## 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
IS EN ISO 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
I.S. EN ISO 12631 : 2017	Thermal performance of curtain walling - Calculation of thermal transmittance	Assessment of curtain walls
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 ISO 52016-1:2017	Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads - Part 1: Calculation procedures (ISO 52016-1:2017)	Annual heating and cooling energy use for a building
IS EN ISO 9972	Thermal performance of buildings. Determination of air permeability of buildings. Fan pressurization method	Permeability testing method
IS EN 613:2000	Independent gas-fired convection heaters	Gas fired room heater testing
I.S. EN 13278:2013	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 7977-1:2009+A1: 2013	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 A102:2004	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

IS EN 9806:2017	Solar energy – solar thermal collectors – 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 16510- 1:2018	Residential solid fuel burning appliances – Part 1: general 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- 5:2012	Heating boilers – part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW – Terminology, requirements, testing and marking	Solid fuel boiler testing
IS EN 14511- 2:2018	Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers with electrically driven compressors. Part 2: 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 16147:2017	Heat pumps with electrically driven compressors – Testing, performance rating and requirements for marking of domestic water units	Heat pump testing (water heating)
IS EN 14825:2018	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors, for space heating and cooling - Testing and rating at part load conditions and calculation of seasonal performance	Heat pump testing
IS EN 15316- 4-2:2017	Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems	Heat pump system efficiencies

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 410:2011	Glass in building – Determination of luminous and solar characteristics of glazing	Glazing solar transmittance
IS EN 200:2008	Sanitary tapware, single taps and combination taps for supply systems of type 1 and 2. General technical specifications	Sanitary tapware – single and combination taps
IS EN 1112:2008	Sanitary tapware. Shower outlets for sanitary tapware for water supply systems type 1 and 2. General technical specifications.	Sanitary tapware – shower outlets
BS 8525 - 1	Part 1 - Greywater systems. Code of Practice	Greywater systems
EN 16941-1:2018	On-site non-potable water systems - Part 1: Systems for the use of rainwater	Use of rainwater
IS EN ISO 12241:2008	Thermal Insulation for building equipment and industrial installations - Calculation rules	Calculation of pipework losses
IS EN ISO 14683:2017	Thermal bridges in building construction - Linear thermal transmittance - Simplified methods and default values	Identification of default PSI values for existing dwellings
IS EN 50465:2015	Gas appliances – Combined heat and power appliance of nominal heat input inferior or equal to 70kW	Efficiency of CHP units

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 (such as 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, in other words 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, 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, in other words 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

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.

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](#) 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 six habitable rooms with one gas fire would be treated as being electrically heated with a gas secondary heater (one room out of six). If there were two gas fires (two rooms out of six), the gas fires are the primary heating and electricity the secondary. If there were four habitable rooms, and one gas fire (one out of four), 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 (such as a 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:

SR 50

- Code of practice for building services - Part 1: Domestic plumbing and heating (to be published by NSAI)
- Code of practice for building services - Part 2: Thermal solar systems

Additional information for system design and installation is provided in SEAI's contractor domestic standards and specifications document and SR 54 (both aimed at retrofitting dwellings) as well as the CIBSE domestic heating design guide.

### A3.5 Estimating the required boiler size

DEAP should not 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  $\Delta T$  (usually -3 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 'View assessment' section 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\*24 \*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 HARP database (see Section 9.2.1) contains, in addition to efficiency, all the boiler parameters relevant to DEAP calculations. The UK Product Characteristic Database ([PCDB](#)) may also be used for boiler efficiencies (select the SAP 2005 seasonal efficiency).

### 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.

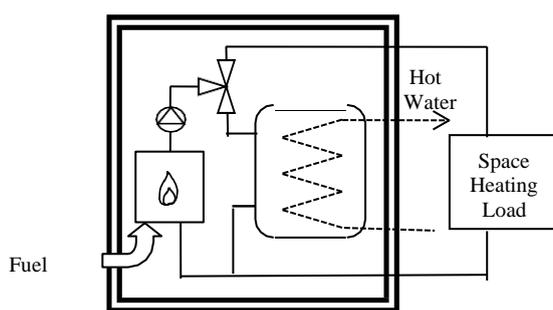
#### B2.1 Combination boilers

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 combination boiler

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.

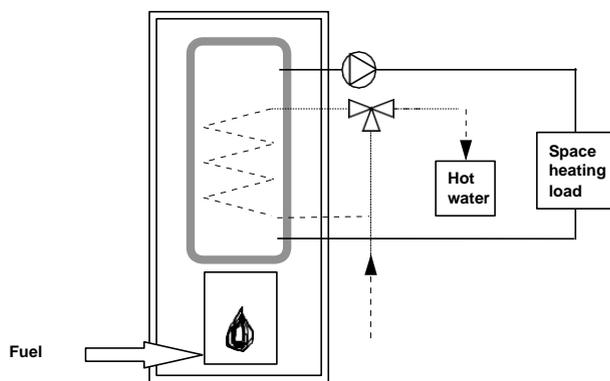
## B2.4 Boiler selected by date

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 (for example, if it is 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)**

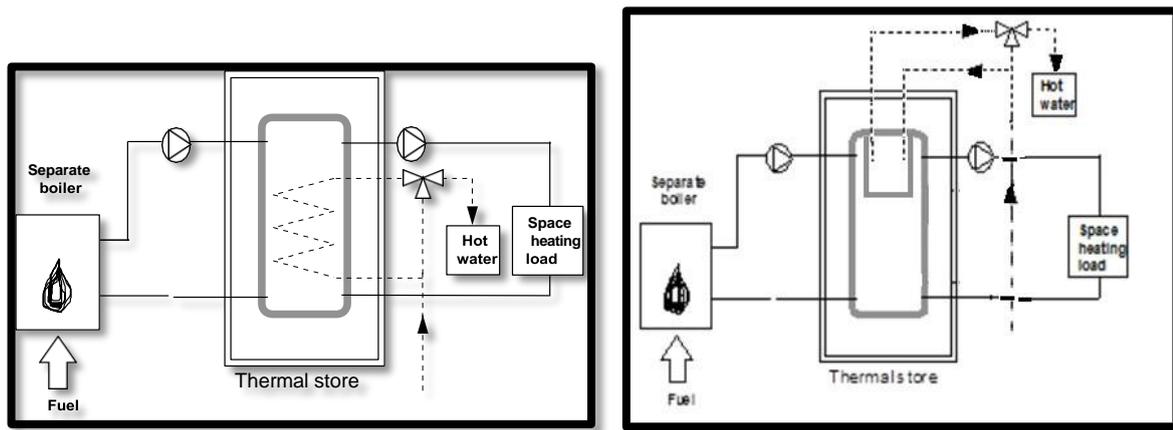
## B3 Boilers with a thermal store

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 (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.

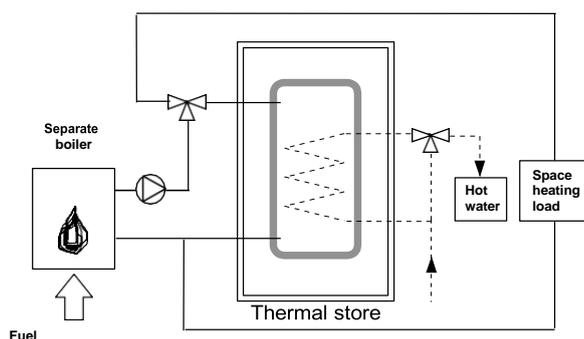


**Figure B3 Integrated thermal store**

Tank in tank storage units such as in the second diagram above are also considered as thermal stores in DEAP. A tank in tank arrangement would typically have a larger tank heated directly by the heat source and provides heat directly to the space heating load. They also contain a smaller tank of domestic hot water within the larger tank. The heat loss storage volume entered in DEAP in this case is the sum of the large tank and the smaller tank therein.

**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. The hot water storage volume includes the large tank and any smaller coil or tank therein.



**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 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 (community) heating/ district heating schemes

Group/community heating is defined as a system serving multiple dwellings from a central source within the boundaries of the site, where full details of the heat sources and spaces served is available.

District heating is defined as a central system serving multiple dwellings from a system outside the boundaries of the site

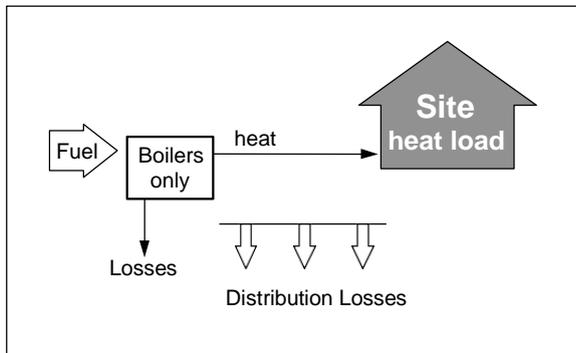
### C1 Group heating where heat is produced by centralised unit by dedicated plant

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

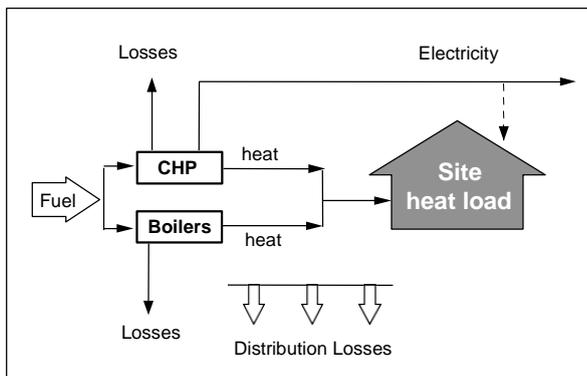
CHP (combined heat and power) is defined as the simultaneous generation of heat and electrical power in a single process.

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.



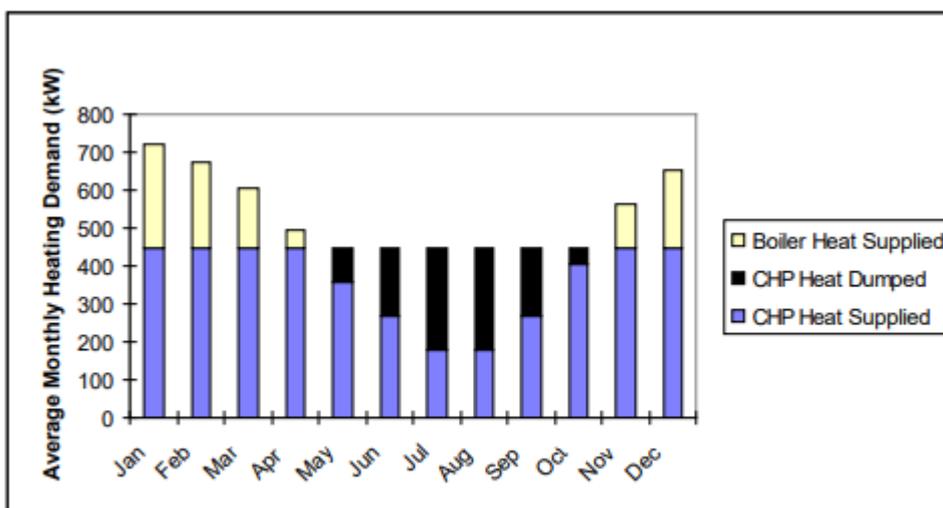
**Figure C1** Group heating with heat supplied by boilers only



**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<sub>2</sub> 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 based on entries in the Space heating (Group) tab, designed for calculating energy usage when space and water heating is provided by group heating (with or without CHP). The CO<sub>2</sub> emission and primary energy factors for group heating are taken from Table 8. These relate to delivered heat, so the emission factor is given in units of kilograms of CO<sub>2</sub> 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 is deselected 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<sub>2</sub> 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, 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, 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 from the group heating system.

## C2 District heating

District heating is defined as a central system serving multiple dwellings from a system outside the boundaries of the site

District heating schemes include a range of systems:

- Utilisation of waste heat from process and power stations
- Utilisation of renewable energy sources
- Utilisation of conventional heat sources

The proportions of heat from the district heating scheme 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, both renewable and non-renewable, should be provided by a suitably qualified engineer based on data from the district heating scheme operator. The basis and proposed factors should be submitted to SEAI/DHPLG before use in the DEAP methodology, alternatively defaults are taken from Table 8 for district heating served by waste heat from power stations or waste.

## C3 Permutations of heat generators in group schemes

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 heat generators or three sets of heat generators, using different fuels such as mains gas and biomass. Multiple boilers are specified using 'Heating system 1/2/3' in the DEAP software. Where a heat pump is present, the group heating heat pump calculator should be completed.
3. CHP plant and boiler(s), calculations according to Section C1.
4. Utilisation of district heating, 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.

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 heat generators 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 (set to 'individual heating' in DEAP). 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 applicable for water heating when the group scheme provides DHW only.

## C5 Group scheme providing cooling via air conditioning or heat pumps

Group schemes with cooling from air conditioning or heat pumps are treated the same way as individual cooling systems by identification of the SEER from test data, as outlined in Section 0.

## 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<sup>10</sup>.

Manufacturers' declarations of gross seasonal efficiency values calculated in this way should be accompanied by the form of words and certification in D3, and BER 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 PCDB (formerly 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 (in other words, 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.

---

<sup>10</sup> 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

### D1.6 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.

### D1.9 Modulating instantaneous combination boiler

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

### D1.10 Storage combination boiler

A combination boiler with an internal hot water store of capacity at least 15 litres but less than 70 litres,  
OR

a combination boiler 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 storage 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.

### D1.12 Modulating storage combination boiler

A storage combination boiler 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 non-condensing boiler designed as a low temperature boiler and tested as a low temperature boiler as prescribed by the Boiler Efficiency Directive (part load test carried out at average boiler temperature of 40°C).

### D1.16 Keep-hot facility

A facility within an instantaneous combination boiler 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.

In some cases, it is not possible to identify if there is a keep-hot facility, if it is timed and the fuel type used for the keep-hot facility. In these cases, the following guidance applies:

- If not possible to identify if there is a keep-hot facility, or HARP states 'unknown' for the appliance in question, assume there is an electric keep-hot facility.
- If not possible to identify if the keep-hot facility is controlled by a time clock, assume it is not controlled by a time clock.
- If there is a keep-hot facility, assume the HARP specified fuel (electricity or same fuel as the boiler). Use HARP listed keep-hot facility power following DEAP Table 3a and Table 4f footnotes.
- If HARP states the keep-hot facility as N/A, there is no keep-hot facility to be specified in DEAP.

## 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 is 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.

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

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

Where boiler test efficiency data is provided on a gross rather than net basis, then f is assumed to be 1. In this case, the maximum gross efficiency value is calculated by multiplying the Table D2.1 value by the net-to-gross conversion factor from Table D2.2. For example, the maximum full load gross efficiency where gross calorific value (GCV) based efficiency is provided for a condensing gas boiler is  $0.901 \times 101 = 91.001\%$

#### 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  $t < 10 \text{ mm}$  :  $L = 0.0945 - 0.0055t$

if  $t \geq 10 \text{ mm}$  :  $L = 0.394/t$

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; 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)	107	$E = 0.5(E_{full} + E_{part}) - (0.539 \times L \times V_{cs}) - 4p$
D1.14: Modulating combined primary storage unit (condensing and non-condensing)		

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, 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.

- Note the restrictions set out at the start of D2, still apply.
- 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.
- 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  $\pm 5\%$  of the natural gas figure.
- Determine by measurement the percentage dry CO<sub>2</sub> 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).
- 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.

- 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 (in other words, 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,  $\Phi_{\text{input,net}}$ , in kW.
- heat transfer to the water under full load conditions,  $\Phi_{\text{water}}$ , in kW
- flue loss (net) under full load conditions,  $\Phi_{\text{flue,net}}$ , 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

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

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

4. If  $\Phi_{\text{case}}$  exceeds either of  $0.05 \times \Phi_{\text{water}}$  or 1 kW, reduce  $\Phi_{\text{case}}$  to  $0.05 \times \Phi_{\text{water}}$  or 1 kW (whichever is the smaller).
5. Provide the values of  $\Phi_{\text{case}}$  and  $\Phi_{\text{water}}$  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 613:2000	Independent gas-fired convection heaters
IS EN 13278:2013	Open-fronted gas-fired independent space heaters
IS EN 1266:2002	Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases
BS 7977-1:2009	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 A102:2004	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 16510-1:2018	Residential solid fuel burning appliances – Part 1: general requirements and test methods (supersedes IS EN 13240 and IS EN 13229)
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<sup>11</sup>**

Fuel	Net-to-gross conversion factor
Natural gas	0.901
LPG (propane or butane)	0.921
Oil (kerosene or gas oil)	0.937
Biodiesel or bioethanol	0.937
Coal	0.97
Anthracite or manufactured smokeless fuels	0.98
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 wording 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.

## E3 Use of HETAS for solid fuel room heater efficiencies

The preferred source of efficiency data is HARP and certified data may also be used. However, efficiencies for solid fuel heaters **without** boilers can be sourced from the [HETAS listing](#). Use the gross efficiency if listed, or else use table E4 to convert to a gross efficiency from net efficiency. Apply rules from DEAP Section 10.3.3 to identify the correct efficiency dependent on fuel type. Do not use HETAS to source efficiencies for DEAP for boilers or appliances with back boilers.

---

<sup>11</sup> Source: SAP 10

## 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 three 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: options and storage' tab, using data from Table 2.

## Appendix G: Heat pumps<sup>12</sup>

### G1 Introduction

This appendix details the guidance for entry of heat pumps in DEAP. The heat pump methodology follows several key principles:

- Use of test results from standards aligned to the Energy Labelling<sup>13</sup> and Ecodesign<sup>14</sup> Directives as applied to heat pumps. These directives are mandatory for products placed on the market from 26 September 2015.
- Where a heat pump is installed in a dwelling from 26 September 2015, BER assessors must work on the basis that the heat pump make/model complies with the Energy Labelling and Ecodesign Directives unless the manufacturer or supplier provides documentary evidence to support the reasoning for the product's non-compliance. This applies to:
  - All new-final and new-provisional domestic BER assessments;
  - All existing dwelling assessments with the heat pump installed after 26th September 2015.
- If the heat pump in these cases does not comply with the directives, and where insufficient supporting evidence has been provided to justify the lack of compliance with the mandatory directives, default efficiencies must be taken from Table 4a of the DEAP manual.
- For heat pumps installed prior to 26 September 2015, that heat pump make/model may or may not comply with these directives.
- Where a heat pump make/model was installed before 26 September 2015 and does not comply with the directives referenced above, that heat pump can still be entered in DEAP using the methodology previously applied to heat pumps prior to 2016 as outlined in Appendix G2. However, where the make/model does comply with the directives, the new approach detailed in Appendix G3 must be applied in DEAP assessments.
- For space heating, the methodology based on the data available from the directives is incorporated using IS EN 14825 test data for heat pumps and the calculation methodology for system efficiency is based on IS EN 15316-4-2:2017.
- For water heating, the new methodology based on the data available from the directives is incorporated using IS EN 16147 test data and the calculation methodology for system efficiency is based on EN15316-4-2:2017.
- The methodology in this appendix and the DEAP software are supplemented by the following documents published [here](#) :
  - A sheet for collecting relevant design details from the dwelling's heating system designer or installer;
  - A document detailing a number of example cases for the heat pump methodology<sup>15</sup>.

---

<sup>12</sup> The guidance in this appendix has been updated to incorporate the DEAP heat pump methodology in use since 2016 and amended to facilitate integration of the full heat pump calculation into the DEAP software (prior to this, the calculation tool was in a standalone Microsoft Excel workbook). The heat pump tool as integrated into the DEAP software supersedes the Microsoft Excel version of the calculation for the purposes of BER assessments and Part L compliance checking.

<sup>13</sup> Regulation (EU) 2017/1369 setting a framework for energy labelling and repealing [Directive 2010/30/EU](#) on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products.

<sup>14</sup> Directive [2009/125/EC](#) establishing a framework for the setting of Ecodesign requirements for energy-related products.

<sup>15</sup> The examples document currently reflects the Microsoft Excel version of the heat pump calculator and is due to be updated to reflect the heat pump inputs in the DEAP software. The inputs in the software are similar to those in the Excel tool, although many

- The heat pump calculation uses climate data for Dublin from Version 2.0 of ASHRAE's International Weather Files for Energy Calculations (IWEC2).
- The directives and associated regulations refer to different types of heat pumps, broadly categorised as providing space heating only, water heating only or combination heaters (providing space and water heating).
- As per the BER assessors Code of Practice, all data used in compiling the BER assessment must be retained on file by the BER assessor. For heat pumps, this includes but is not limited to:
  - Heat pump test performance documentation used in the calculation according to relevant standards/regulations/directives.
  - The designer/installer signoff sheet filled out for the dwelling being assessed as referenced in G1.2.
  - Any calculations demonstrating a lower design flow temperature for space heating other than the default values calculated by DEAP. This applies where a non-default design flow temperature is specified in DEAP.

**Table G1 – Default Flow Temperatures**

Heat emitter type	Default supply temperature
Radiators	55°C
Fan coil radiators	45°C
Underfloor heating	35°C

The following diagram outlines the approach to use based on availability of Ecodesign data or associated test data where the heat pump is the main space and/or water heater in the dwelling:

---

are no longer visible as DEAP automatically passes several fields to and from the heat pump calculation to the remainder of the DEAP assessment, thereby simplifying the process for the user.

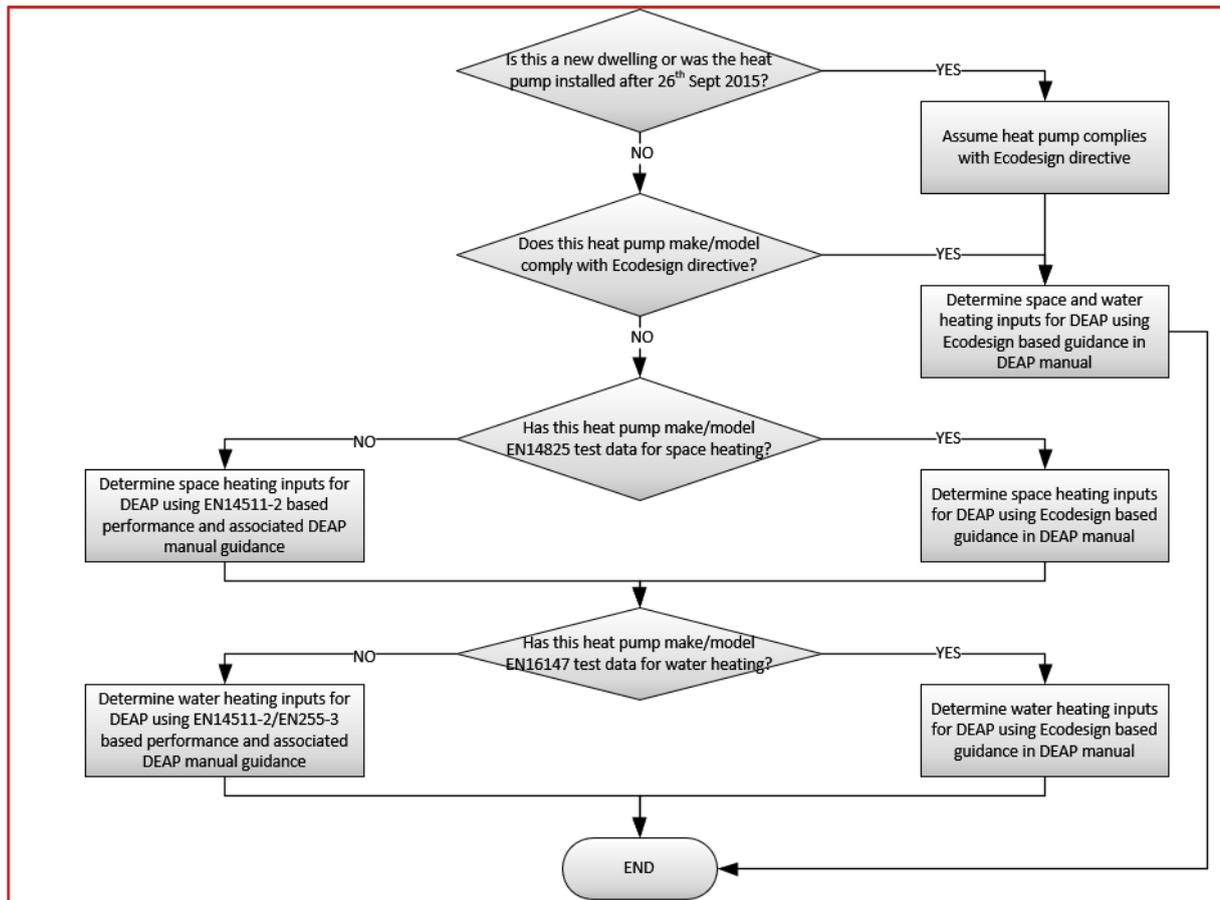


Figure G1: When to use Ecodesign methodology for heat pumps in DEAP

### G1.1 General guidance for the heat pump methodology

Data for the heat pump system is entered in the DEAP software under the 'Space heating: heat sources' tab. DEAP uses the data entered for the heat pump along with heat demand calculations based on inputs to the Building and Ventilation tabs. DEAP then derives system efficiency figures for the space and water heating calculation in DEAP.

When entering the heat pump in the 'Heat source' sub-tab, there are several fields to be completed. A new heat pump is entered by selecting 'add new item to library' in DEAP:

- Basic properties sub tab
  - Select 'Heat source' as the item type, and 'Heat pumps' as the heating source type
  - Enter manufacturer/model details for the heat pump.
  - Specify the space heating standard if the heat pump is the main space heating system. The standard is IS EN 14825 where Ecodesign applies or data to this standard is available as per Figure G1 above.
  - Specify the water heating standard if the heat pump is the main water heating system. The standard is IS EN 16147 where Ecodesign applies or data to this standard is available as per figure G1 above.
  - The seasonal space heating energy efficiency is entered as a percentage. This is the seasonal space heating energy efficiency ( $\eta_s$ ) taken directly from Ecodesign data (see G3

below)

- The water heating efficiency ( $\eta_{wh}$ ) is entered as a percentage and is taken directly from Ecodesign data (see G3 below)
- If Ecodesign does not apply, and test data to the standards above is not available, the test standard IS EN 14511 applies (or EN255-2 / EN255-3 as outlined in this appendix). In this instance, the seasonal space heating efficiency and the water heating efficiency are taken from HARP (or from DEAP Table 4a defaults if HARP data is not available).
- Enter the type of heat pump (e.g. A/W; B/W etc.)
- Where a 'to air' system is selected, the SEAI heating design sheet (or equivalent) must be filled out by the designer/installer. **The heating design sheet must reflect what is installed in the dwelling.** This must be retained by the BER assessor as documentary evidence for the BER. The heating design sheet contains the following information for each room in the dwelling:
  - Room heat loss (Watts) calculations in accordance with any of the following:
    - CIBSE domestic heating design guide
    - SR 50-1 Code of practice for building services: Domestic plumbing and heating (to be published by NSAI).
    - SEAI room heat loss and radiator sizing guidance.
    - Heat output.
    - Design room temperature.
    - Supply air temperature, where greater than 27°C, must be supported by manufacturers' data.
    - Air volume for each room, where applicable.

Where evidence is not available or does not meet the heating demand, the guidance in Appendix A must be followed.

- Identify the type of temperature control (capacity control) as identified in Ecodesign test data where applicable. This will be 'Fixed' or 'Variable' outlet.
- Enter the operation limit temperature (TOL – °C) and heating water operating limit temperature (WTOL - °C) taken from Ecodesign technical data where applicable.
- If IS EN14511-2 applies for water heating, then see Section G2 below when specifying the presence of an immersion and the flow temperature of the heat pump.
- Heat pump test data sub tab
  - Heating system test data: IS EN 14825 and IS EN 16147<sup>16</sup> for space and water heating:
    - Using the standards identified under the 'Heat pump data' section above, DEAP displays the required heat pump performance entries for space and water heating.
    - Section G3 below provides further detail on the data required.
- NB: Hot water storage in heat pumps is identified as integrated or separate under the 'Options and storage' sub tab in the DEAP water heating tab.
  - Select whether the heat pump has a separate hot water store, an integral hot water store or no hot water store. An integral store is defined as a store within the heat pump casing

---

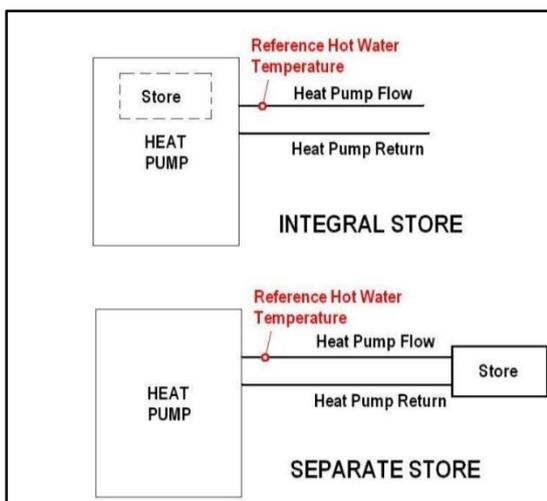
<sup>16</sup> Test data similar to IS EN 16147 is required if specifying data to IS EN 255-3

and is part of the heat pump. Therefore, the reference hot water temperature from the heat pump test data is after/ downstream of the store.

- DEAP determines the required hot water flow temperature from the heat pump based on the presence of an integrated or separate hot water store.
- Determining maximum temperature achieved by the heat pump in DHW store/supply:

According to requirements of standards and guidelines addressing Legionnaires Disease, DHW is required to be stored and supplied at a temperature of 60°C or more. It is necessary for the user to select whether the heat pump reaches the required flow temperature (or not) if using IS EN 14511- 2 test data for water heating. The following rules apply when determining if this requirement is met for DEAP:

- Where the DHW store is separate from the heat pump, in order to achieve a 60°C storage temperature the flow temperature from the heat pump must be at least 65°C. Otherwise, the heat pump is not assumed to be capable of heating the DHW store and supply to 60°C. This is based on an assumed temperature drop of 5°C from the heat pump to the DHW store as established in the SAP methodology.
- Where there is no DHW store outside the heat pump (for example there is an internal store only or no hot water storage), the heat pump must be able to reach a flow temperature of at least 60°C. Otherwise, the heat pump is not assumed to be capable of heating the DHW store/supply to 60°C.
- If it is not clear if the heat pump can heat the DHW store/supply to 60°C, assume that it cannot.



**Figure G2: Identifying the store type**

- 'Edit primary heat source' sub-tab: once the heat pump has been successfully entered, the heat pump calculation requires additional information on the heat pump system specific to the dwelling being assessed:
  - Select the number of running hours per day that the heat pump is in operation based on dwelling design data: eight, sixteen or twenty-four hours. If not provided by the designer/installer, assume the default of eight hours, as based on the DEAP heating schedule. The number of hours chosen should be based on the closest value to the design proposal. This is the number of hours during which the heat pump can be activated by thermostatic/load control devices to maintain the occupant's required thermal conditions in the dwelling according to the system designer/installer.

- Enter details of backup main space and water heating systems (if present), including fuel type, and efficiency. Backup efficiency data can be sourced from HARP, certified data or DEAP defaults. The main space heating backup heater is not the secondary heating system. It is any other system capable of heating multiple rooms in the dwelling and supplementing the heat pump, such as a backup boiler. If a system is considered as a heat pump backup, it is not eligible to be considered as a secondary heating system in DEAP. The combination of a space heating heat pump and backup space heater are considered as the main space heater in DEAP. The combination of a water heating heat pump and backup water heater are considered as the main water heater in DEAP.

If the backup heater is a room heater with boiler, the methodology outlined in Section 9.2.4 of the DEAP manual is followed.

- Enter design flow temperature (°C). This is either defaulted by DEAP or overridden by the user based on dwelling design data. Where non-default flow temperatures are used, the SEAI heating design sheet (or equivalent) must be filled out by the designer/installer. **The [heating design sheet](#) must reflect what is installed in the dwelling.** This must be retained by the BER assessor as documentary evidence for the BER. The heating design sheet contains the following information for each room in the dwelling:
  - Room heat loss (Watts) calculations in accordance with any of the following:
    - CIBSE domestic heating design guide
    - SR 50-1 Code of practice for building services: Domestic plumbing and heating (to be published by NSAI)
    - SEAI room heat loss and radiator sizing guidance
    - Type of emitter along with radiator/ fan coil unit manufacturer & model/size where applicable
    - Single heat emitter output, no. of emitters, total heat emitter output
    - Design room temperature
    - The  $\Delta T$  for heat output for radiator and fan coil systems, where applicable
    - $W/m^2$  for underfloor heating, where applicable

### G1.2 Input from the designer/installer

The following data is required from the system designer or installer for heat pumps to enable assessment of the heat pump in DEAP. The BER assessor will require that for any heat pump to which Ecodesign, EN14825 or EN16147 is applied (see figure G1), a sign off sheet is completed and signed by the designer/installer of the heat pump system. The sheet may be provided by the designer/installer in hardcopy or softcopy format signed using one of the following methods:

- Hardcopy signed by the designer/installer, or
- Softcopy format with an electronic (e.g. scanned) signature from the designer/installer, or
- Softcopy format accompanied by an email from the designer/installer confirming that the data with the sign-off sheet is correct.

SEAI has provided a template for this sheet to accompany the DEAP heat pump assessment:

**Table G2 – Designer/installer sign-off sheet required data**

<b>Designer/installer sign-off sheet</b>	
<b>General Information</b>	<b>Notes</b>
- includes dwelling details	
<b>Purpose of installation</b>	
- identifies if the heat pump is supplying space / heating / domestic hot water / both	Confirm during site survey
<b>Heat pump selection</b>	
- Make, model and any model qualifier for the heat pump identified in the dwelling being assessed	Confirm during site survey & for “to air”, the completed heating design sheet (or equivalent) must be obtained from the designer/installer
- Type of heat pump (e.g. A/W; B/W etc.)	
- Date of installation	Any heat pump installed after 26 September 2015 must be Ecodesign and Energy Label Directive compliant
- Confirmation of compliance with the Ecodesign and Labelling Directive	
- Confirmation of test standards for the heat pump	
- Confirmation of hours of operation per day, (eight, sixteen, twenty-four) closest to the number of hours of operation expected by the design. This is the number of hours during which the heat pump can be activated by thermostatic/load control devices to maintain the occupant’s required thermal conditions in the dwelling.	
- Confirmation of any backup systems installed to supplement the heat pump including backup heater details and fuel type.	The main space heating backup heater is not the secondary heating. It is any other system capable of heating multiple rooms in the dwelling and supplementing the heat pump, such as a backup boiler. If a system is considered as a heat pump backup, then it is not eligible to be considered as a secondary heating system in DEAP.
<b>Heat emitter design</b>	
- Heat emitters present in the dwelling	Confirm during site survey
- Heating controls within dwelling	Confirm during site survey
- Design flow temperature based on design conditions	Where this is a non-default flow temperature, the completed heating design sheet (or equivalent) must be obtained from the designer/installer
<b>Domestic hot water</b>	
- Confirmation of hot water temperature based on certified data.	Check against certified data
- Confirmation of the type of store present	Confirm during site survey
- Confirmation of the presence of immersion/ electric element in the heat pump capable of providing domestic hot water.	This must be specified even if this integral immersion is only installed as a backup to the heat pump.

<b>Confirmation</b>	
- Sign-off and details of system designer/installer is required.	

## G2 Heat pumps not compliant with Ecodesign/Energy Labelling Directives

Where a heat pump make/model is not compliant with the Ecodesign and Energy Labelling Directives and has no EN14825 / EN16147 test data, that heat pump is entered in DEAP following the guidance in this section. This section is used for space heating only where the heat pump make/model is not compliant with the Ecodesign and Energy Labelling Directives and does not have valid EN14825 test data. This section is used for water heating only where the make/model is not compliant with the Ecodesign and Energy Labelling Directives and does not have valid EN16147 test data. Where the make/model is compliant with the directives and/or has EN14825 and EN16147 data, then the approach for heat pumps compliant with Ecodesign and Energy Labelling Directive detailed in Section G3 must be applied in DEAP. See Figure G1 above.

For new buildings or where the heat pump is installed after 26th September 2015, it is assumed that the heat pump is compliant with the Ecodesign and Energy Labelling Directives as these are mandatory after 26 September 2015. If such a heat pump is not compliant, the BER assessor must demonstrate, using confirmation from the heat pump manufacturer/supplier, why the heat pump is not required to comply with the directives. Otherwise, the BER assessor must use heat pump efficiency defaults from Table 4a of the DEAP manual for that heat pump.

Where a heat pump make/model was installed before 26 September 2015 and does not comply with the directives, that heat pump can still be entered in DEAP as explained in this section. However, where the make/model does comply with the directives, then the new approach detailed in Section G3 of this document must be applied in DEAP assessments.

In all instances where the make/model of the heat pump is compliant with the Ecodesign and Energy Labelling Directive, the methodology outlined in Section G3 of this document must be followed.

If the heat pump is not required to comply with the Ecodesign Directive, values from the HARP database are used where available if there is no data from Ecodesign technical data or its associated standards EN14825/EN16147 for the heat pump make/model in question. In this instance, if there is no SPF for the heat pump listed on HARP, then certified data from or endorsed by an accredited laboratory may be used to calculate the SPF. Accredited data requirements are detailed in the DEAP manual section 'Accredited or certified data'. The calculation method requires test certificates from EN14511-2, IS EN 255-2 or EN 15879. Full details of this SPF calculation method as applicable to several types of heat pump are available in the HARP heat pump database submission notes<sup>17</sup>.

---

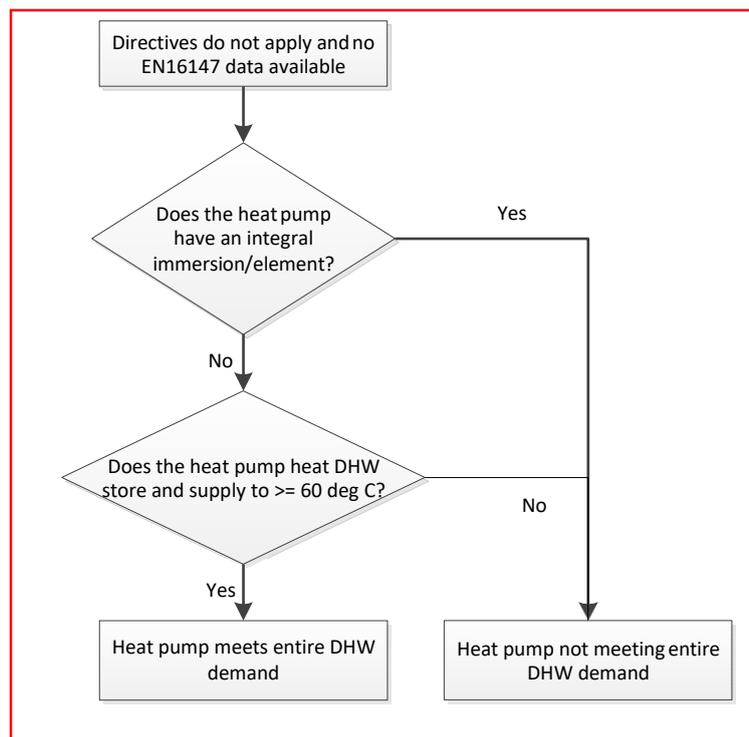
<sup>17</sup> <https://www.seai.ie/energy-in-business/ber-assessor-support/harp-database/>



### G2.1 Domestic hot water: not compliant with Ecodesign/ Energy Label Directive

If the heat pump is not required to comply with the Ecodesign and Energy Label Directives or has not been tested to I.S. EN 16147, the following methodology is applied.

It is necessary to determine if the heat pump can meet all of the DHW demand where the directives do not apply. Where the heat pump can heat the DHW to the required temperature and does not have an integral immersion or integral electric element capable of providing hot water, the heat pump is assumed to meet all of the DHW demand in DEAP and Section G2.1.3 below applies. If the heat pump has an integral immersion/element OR cannot heat the stored/supplied DHW to the required temperature, then Section G2.1.1 below applies:



**Figure G3: Does the heat pump meet the DHW demand?**

#### **Ability of heat pump to meet temperature:**

- As detailed in Section G1.1, the temperature required by the heat pump to meet the DHW requirement is based on the type of installation.
- The maximum flow temperature output from the heat pump is taken from CE marked literature, CE marked data plates or accredited test data for the heat pump in question.

#### **Identifying integral immersion/electric element for water heating**

The following rules apply when identifying integral immersion/element for water heating in a heat pump:

- An immersion or water heating electric element is considered to be integral if it is within the heat pump unit and is capable of providing DHW. This would typically be part of the DHW circuit in the heat pump unit or part of a DHW store built into the unit.

- An integral immersion/element must be considered present regardless of whether it is used during normal operation or if it is only provided as a backup to the heat pump.
- An immersion/element is not considered to be integral if it is either absent or is only present in a DHW store physically separate from the heat pump unit.
- Evidence of presence or absence of an integral immersion is taken from product literature, test data, site evidence or a written statement from the system designer/installer for the heat pump make/model and dwelling being assessed.
- If it is not clear if there is an immersion/element integral to the heat pump DHW circuit, assume that it is present.

### G2.1.1 DHW heated by heat pump not meeting all DHW demand

This section applies for heat pumps not required to comply with the Ecodesign or Energy Labelling Directives or without EN16147 test data and there is an integral immersion/element in the heat pump or the heat pump cannot meet the required DHW temperatures detailed above. The water heating efficiency and water heating efficiency adjustment factor in DEAP are set out below and are automatically derived by DEAP.

Where the heat pump does not meet all of the DHW demand and EN14511-2/ EN255-2 or Table 4a default data is used as the basis for the DHW efficiency, DEAP assumes that 50% of DHW is heated by the heat pump and 50% by an immersion heater. The heat pump water heating efficiency is adjusted by DEAP as follows:

$$\frac{100}{[50 \div SPF] + 0.50}$$

*Equation G1*

- SPF is the seasonal performance factor of the heat pump entered by the user in DEAP as determined by one of the following methods and is entered in kW/kW units (e.g., 320% would be 3.2):
  - EN 14511-2 (from HARP or certified test data averaged from test points in DEAP Appendix G).
  - EN 255-2 (from HARP or certified test data test data averaged test points in DEAP Appendix G).
  - Table 4a default in DEAP manual.
- The water heating efficiency adjustment factor is set to 1 by DEAP in this case.

### G2.1.2 DHW efficiency in DEAP based on EN 255-3

Where the heat pump has been tested to EN255-3 and this is used as the basis for the DHW efficiency, DEAP bases the proportion of domestic hot water provided by the heat pump on the 'Reference hot water temperature' from the EN 255-3 test certificate and calculates the remaining portion to be provided by the backup water heater. The efficiency for water heating is calculated based on the COP of the heat pump to EN 255-3 and the fraction of hot water provided by the backup heater (if present) and the corresponding efficiency of the backup heater. Key data entries are as follows:

- COP (in kW/kW rather than as a percentage) is taken directly from EN255-3 certified data and entered by the user in DEAP.
- The reference hot water temperature (°C) and heating capacity are entered in DEAP. Where reference hot water temperature is unknown, default it to 40°C.
- DEAP calculates the overall efficiency based on the requirement for backup heater as the efficiency of main water heating system.
- The water heating efficiency adjustment factor is set to 1 by DEAP.

### *G2.1.3 DHW heated by heat pump meeting all DHW demand*

This section applies for heat pumps not required to comply with the Ecodesign or Energy Labelling Directive or EN16147 test data where there is no integral immersion/element in the heat pump and the heat pump meets the required DHW temperatures detailed above. The water heating efficiency and adjustment factor in DEAP are set out below.

Where the heat pump meets all of the DHW demand and EN14511-2 or EN255-2 are used as the basis for the DHW efficiency, it is assumed that all of the DHW is heated by the heat pump:

- SPF is the seasonal performance factor of the heat pump entered by the user is determined from one of the following methods
  - EN 14511 -2 (from HARP or certified test data averaged from test points in DEAP Appendix G)
  - EN 255-2 (from HARP or certified test data averaged from test points in DEAP Appendix G)
- DEAP sets the efficiency adjustment factor to 0.7.

### *G2.1.4 DHW heated by immersion only*

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

## **G2.2 Space heating: not compliant with Ecodesign / Energy Label Directive**

This section applies where the heat pump is used for space heating and is not required to comply with Ecodesign/ Energy Label Directives and does not have EN14825 test data.

The following guidance summarises how to identify the key entries related to the heat pump system.

- **Seasonal performance factor (SPF)**

The SPF is entered as the space heating efficiency as a percentage where the heat pump is identified as the main space heater according to DEAP Appendix A. It is derived as detailed at the start of Section 2 above and is preferably taken from HARP but may also be based on accredited test data (to EN14511-2 or EN255-2) or the defaults in DEAP Table 4a.

- **Efficiency adjustment factor**

The efficiency adjustment factor for space heating is based on DEAP Table 4c (e) for heat pumps. The efficiency adjustment factor is automatically calculated by DEAP based on system data including the design flow temperature and controls.

## **G3 Heat pumps compliant with Ecodesign and Energy Labelling or EN16147 / EN14825**

Where a heat pump make/model is compliant with the Ecodesign and Energy Labelling Directive or has EN14825 / EN16147 test data, the associated test data and heat pump information must be entered in DEAP following the guidance in this section. This section is used for space heating where the heat pump is compliant with the Ecodesign and Energy Labelling Directive or has valid EN14825 test data. This section is used for water heating where the heat pump is compliant with the Ecodesign and Energy Labelling Directive or has valid EN16147 test data as applied to water heating.

Test data for Ecodesign/Labelling is based on EN14825 for space heating and on EN16147 for water heating. Test data will generally either be based on test certificates or technical data sheets which are required to be in declarations made publicly available under the Ecodesign Directive.

Technical data declared by the manufacturer must clearly apply to the heat pump make/model/qualifier being assessed and include a reference to the Ecodesign Directive and/or relevant standards. Alternatively, details of the heat pump's compliance with the directives must be provided in addition to the test result data. So, when using the Ecodesign based methodology, technical data being used for DEAP assessments must reference the Ecodesign Directive and/or regulation 813/2013 for space heating. Water heating technical data must reference the Ecodesign Directive and/or regulation 813/2013 and/or 814/2013. Alternatively, relevant performance data for the heat pump for space heating can be taken from accredited test data or CE marked data referencing EN14825. Relevant performance data for the heat pump for water heating can be taken from accredited test data or CE marked data referencing EN16147.

Ecodesign / EN 14825/ EN16147 test data is not yet facilitated on HARP so must be manually entered in DEAP. Under the Ecodesign Directive, the relevant technical information is required to be in declarations made publicly available and is referenced as Ecodesign data in DEAP.

The key references for regulations as applied to the directives are as follows. These detail the data that must be displayed on manufacturer literature, website declarations etc. for compliant devices.

- [811/2013](#) "*supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device*".
- [812/2013](#) "*supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device*".
- [813/2013](#) "*implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for space heaters and combination heaters*".
- [814/2013](#) "*implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for water heaters and hot water storage tanks*".
- [S.I. 454: 2013](#): "*European Union (Ecodesign requirements for certain energy related products) (amendment) Regulations 2013*".
- [2014/C 207/02](#): "*Commission communication in the framework of the implementation of Commission Regulation (EU) No 813/2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for space heaters and combination heaters*".
- [2014/C 207/03](#): "*Commission communication in the framework of the implementation of Commission Regulation (EU) No 814/2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for water heaters and hot water storage tanks*".

The regulations above, coupled with the directives set out the full details of the directives and associated requirements. Specific to the heat pump methodology in this document, please bear in mind the following:

The regulations clearly set out that the directives are mandatory for heat pumps placed on the market after 26 September 2015.

- Regulations 813/2013 and 814/2013 detail the technical parameters that must be declared on

instruction manuals for installers and end users, as well as free access websites of manufacturers, their authorised representatives and importers. The technical parameters listed must be declared for space heating heat pumps, combination heat pumps and water heating heat pumps.

- The documents 2014/C 207/02 and 2014/C 207/03 detail the relevant standards as EN14825 for space heating and EN16147 for water heating.

- Where the BER assessor is unable to obtain the relevant data to complete the entries for an Ecodesign compliant heat pump, they should request the EN14825 and EN16147 test data as required from the heat pump manufacturer or supplier.
- If the data declared in publications from the manufacturer/supplier is unclear, the assessor should contact the heat pump manufacturer or supplier directly for clarification.
- If uncertain whether the heat pump complies with Ecodesign, the assessor should contact the heat pump manufacturer or supplier directly for clarification.

Assessors may require additional test data to complete the calculation including from the following:

- CE marked literature or accredited test certificates referencing EN 14825 for space heating.
- CE marked literature or accredited test certificates referencing EN 16147 for water heating.
- Manufacturer's literature referencing the relevant directives/regulations as detailed above.

### G3.1 Space heating: Compliant with Ecodesign / Energy Label Directives or EN14825 data available

If a heat pump has space heating test data available from Ecodesign Directive or EN14825, that data must be entered in DEAP as follows:

- Specify test data, where available, for each test condition (low temperature, medium temperature, high temperature, very high temperature). All sets of available valid test data must be used. High temperature data (55°C) is mandatory.
- DEAP requires a number of figures at different test points depending on the test conditions, the type of heat pump and whether the capacity control of the heat pump is variable or fixed outlet. These figures include the following and are taken from the Ecodesign or certified EN14825 data:
  - Heating capacity (kW), Coefficient of Performance (CoP) entered in kW/kW at 100%, 88%, 54%, 35% and 15% load. These are entered under 'heat pump test data'.
  - Under 'basic properties':
    - Temperature operation limit (TOL - °C)
    - Heating water operating limit temperature (WTOL - °C)

DEAP uses this data to determine the space heating efficiency and efficiency adjustment factor based on the EN15316-4-2:2017 calculation methodology.

DEAP determines the efficiency based on a number of factors:

- The ability of the heat pump to meet the heat demand within the dwelling.
- The efficiency of the heat pump based on climate data, operating hours and design flow temperatures within the dwelling.
- The backup heater, if applicable, is also accounted for by DEAP when deriving the overall heat pump efficiency.

### **G3.2 DHW: Compliant with Ecodesign/ Energy Labelling Directive or EN16147 data available.**

Where the heat pump has DHW test data available compliant with the Ecodesign/ Energy Labelling directives or EN16147, that data must be used in DEAP.

The required data from EN16147 test data or Ecodesign technical data or certified EN16147 data is as follows:

- Coefficient of Performance for domestic hot water (CoP) or the water heating energy efficiency ( $\eta_{wh}$ ). The CoP is the term used in EN16147 test reports and is expressed in kW/kW, for example 2.5. The term  $\eta_{wh}$  is the water heating efficiency displayed on Ecodesign technical data and is expressed as a percentage, for example 100%.
- Reference hot water temperature ( $^{\circ}\text{C}$ ). Where reference hot water temperature is unknown, default it to  $40^{\circ}\text{C}$ .
- Heating capacity DHW (kW).
- Declared load profile.
- Standby heat loss (kWh/day), set as 0 if unknown.
- Volume of DHW accounted for in test (L).

Where the volume of DHW accounted for in testing does not meet the requirements in the regulations for the Ecodesign directive (see references in Section 3 above), assessor must seek revised test data to meet the Ecodesign requirements from the manufacturer/supplier.

Where the installed hot water storage in the dwelling doesn't meet the requirements in the regulations for the Ecodesign directive, DEAP advises BER assessors to contact the client and designer/installer, advising that the installed hot water cylinder doesn't meet the requirements for the Ecodesign Directive and therefore the heat pump will not perform to the calculated efficiency. The BER assessor is also advised to seek the correct data (such as revised tapping cycle data) in this instance.

In both of these instances, the assessor may still use the test data available, but must seek revised data as indicated from the supplier/manufacturer.

DEAP uses the test data along with system information and hot water demand calculations from the DEAP survey to determine the water heating efficiency and efficiency adjustment factor. DEAP determines if and to what extent a backup water heater is required to meet the dwelling's water heat requirements when deriving the overall heat pump efficiency.

## **G4 Other heat pump system types**

There are a number of heat pump types which may or may not have relevant Ecodesign EN14825 or EN16147 data. Generally speaking, the guidance in Sections G1, G2 and G3 applies to these systems with additional information provided as follows.

### **G4.1 Air to air heat pumps**

Air to air heat pumps heat air rather than wet heating system emitters such as radiators and underfloor heating. These systems typically source their heat from external air and do not provide DHW.

DEAP can accept Ecodesign based or HARP based data for these devices and applies an efficiency adjustment factor of 1.

## G4.2 Exhaust air heat pumps (EAHP)

EAHPs are considered as a mechanical extract ventilation and heat pump unit in DEAP. For EAHP units not required to comply with Ecodesign/Labelling directives, please contact the BER helpdesk for guidance.

Where an EAHP is Ecodesign Directive compliant, follow section G3 above. The flow rate for the EAHP is entered in the DEAP ventilation section as detailed in Section 2.6 of this manual.

## G4.3 Double-duct heat pumps and heat recovery systems incorporating heat pump functionality

Double duct air conditioners and heat recovery systems incorporating heat pump functionality (referred to hereafter as double duct air conditioners) are accounted for in the current version of DEAP as follows. The double duct air conditioner is broken down into its mechanical ventilation heat recovery (MVHR) and heat pump components:

- Enter the heat recovery ventilation component using entries for MVHRs in the Ventilation tab with data defaulted from DEAP or using non-defaults from the PCDB if available.
- Enter the space heating heat pump component as an air-to-air heat pump as follows:
  - EN14511-2:2018 is used to test the performance of these units and this data can be used in DEAP. This includes data for the heat pump only from units tested to EN13141-7, as this standard requires the heat pump functionality to be tested to EN 14511-2.
  - Source accredited EN14511-2 test data for the double duct air conditioner. As the required level of detail is not displayed in Ecodesign technical documentation or declarations of performance for these units, test data MUST be sourced on test certs from a suitably accredited body.
  - Where the unit is tested to EN 14511-2, a minimum of three test points are required, Those tested in compliance with EN 13141-7 require the heat pump to be tested to EN14511-2 to the following conditions:

**Table G3 – Test Conditions**

Extract air inlet dry bulb (wet bulb) temperature	Outdoor air inlet dry bulb (wet bulb) temperature
20 (12) °C	7 (6) °C
20 (12) °C	2 (1) °C
20 (12) °C	-7 (-8) °C

The performance of the heat pump from EN 13141-7 must exclude heat recovery performance.

Where the performance of the unit combines the heat recovery and heat pump performance, the heat pump performance must be separated based on the following methodology for each of the test points.

Output of heat pump =  $1.2 \times \text{air flow rate (l/s)} \times (\text{air temp off} - \text{air temp on})$ , where:

Output of heat pump = heat pump capacity

Air temp off = air temperature of supply air outlet off the condenser

Air temp on = air temperature on to the condenser (after the heat recovery)

The CoP is then output of heat pump divided by the electricity to heat pump.

EN 13141-7 requires that the unit is tested with the heat pump switched off to determine the efficiency (%) of the heat recovery unit. This is used to determine the air temperature on to the condenser;

Air temp on =  $\% \times (\text{extract air temp} - \text{outside air temp}) + \text{outside air temp}$

- Select EN14825 as the test standard in DEAP methodology to allow multiple test points to be entered in line with other heat pumps
- 5 test points from EN14511-2 are ordinarily required for entry in the DEAP heat pump calculation methodology, where only three test points are available, for example under EN 13141-7 the unit is not required to be tested at TOL and 12°C, then use the following in place of the missing test points. As always, SEAI encourages use of non-defaults to the relevant standards rather than relying on defaults. As an example, if the TOL and 12°C source temperature test points are missing, BER assessors must take the following approach:
  - TOL set at -8oC
  - CoP at TOL to be based on CoP (A-7)
    - CoP at A12 to be based on CoP (A7)
    - Capacity at TOL to be based on capacity (A-7)
    - Capacity at A12 to be based on capacity (A7)
- When selecting heat pump test data, care must be taken not to double count the benefit from heat recovery (e.g., by assuming higher CoPs for the heat pump component due to presence of the heat recovery component as well as entering the heat recovery ventilation component). In case of any doubt, the test data should be sent to the BER helpdesk to confirm the correct approach.

#### G4.4 Thermodynamic solar/heat pump systems

Thermodynamic solar/heat pump systems are treated the same as air/water heat pumps but use a flat plate solar collector (usually unglazed) instead of an outdoor fan as a means of collecting heat. These systems are treated as follows in DEAP:

- Enter the solar thermal collector following the guidance for solar collectors under DEAP Appendix H. Use Appendix H defaults if HARP or certified data is not available/applicable for the collector in the thermodynamic heating system. As always, installation instructions in the test certificate on which the stated performance depends must be adhered to.
- Treat the heat pump component of the thermodynamic system as an air/water heat pump, following the guidance in this appendix for air/water heat pumps.

#### G4.5 Group heating using heat pumps not required to comply with Ecodesign / Labelling Directives

Appendix C3 details the approach for heat pumps in a group heating scheme. The DEAP methodology allows for heat pumps in group heating schemes by determining the proportion of the total group scheme occupied by the dwelling being assessed. As detailed in Appendix C3, where a heat pump is present, the group heating heat pump calculator should be completed.

#### G4.6 Direct exchange and other types of heat pumps

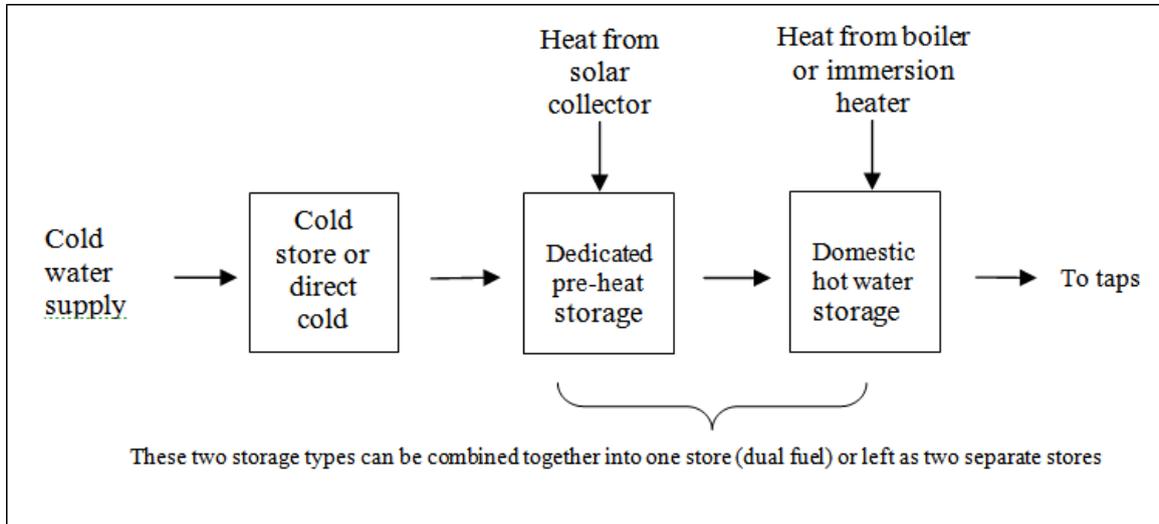
There are some heat pump types not currently facilitated in the DEAP heat pump calculation (such as gas fired or direct exchange heat pumps). These will be considered at a subsequent edition of DEAP.

#### G4.7 Cooling systems

In some cases, the group heat pump or air conditioning system provides cooling. In this case, the cooling efficiency is identified from suitably accredited test data or Ecodesign technical documentation as per Section 0 so that energy for cooling demand can be accounted for in DEAP.

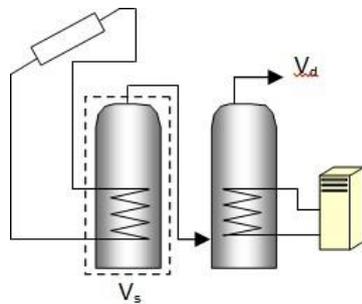
## Appendix H: Solar water heating

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.

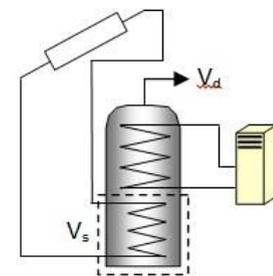


**Figure H1: Working principle of solar water heating.**

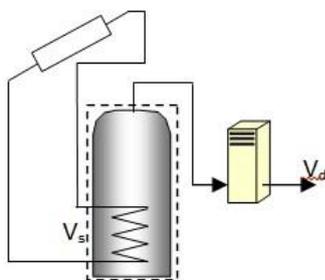
$V_s$  (indicated by the dashed line) is the dedicated solar storage volume. See text below concerning the effective solar volume.  $V_d$  is the daily hot water demand.



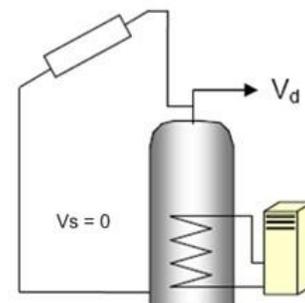
a) With separate solar cylinder



b) With a twin-coil cylinder<sup>1</sup>



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:

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

Where:

$Q_s$  = solar input, kWh/year

$S$  = total solar radiation on collector, kWh/m<sup>2</sup>/year  $Z_{\text{panel}}$  = overshadowing factor for the solar panel

$A_{\text{ap}}$  = aperture area of collector, m<sup>2</sup>

$\eta_0$  = zero-loss collector efficiency  $UF$  = utilisation factor

$a_1$  = linear heat loss coefficient of collector, W/m<sup>2</sup>K  $f(a_1/\eta_0)$  = collector performance factor = (see H10 below)  $V_{\text{eff}}$  = effective solar volume, litres

$V_d$  = daily hot water demand, litres

$f(V_{\text{eff}}/V_d)$  = solar storage volume factor =  $1.0 + 0.2 \ln(V_{\text{eff}}/V_d)$

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:

- The HARP database;
- Certified data for the collector concerned according to IS EN 12975-2, *Thermal solar systems and components – Solar collectors – Part 2: Test methods* or IS EN 9806:2017 *Solar Energy – Solar Thermal Collectors – Test Methods*. The aperture area, and the performance characteristics  $\eta_0$  and  $a_1$  related to aperture area, are obtained from the test certificate.
- 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 assessors 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, such as 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, $m^2$ <i>If only the gross area can be established reliably, multiply it by ratio in Table H1</i>		<input type="text"/>	(H1)
Zero-loss collector efficiency, $\eta_0$ , from test certificate or Table H1		<input type="text"/>	(H2)
Collector heat loss coefficient, $a_1$ , from test certificate or Table H1		<input type="text"/>	(H3)
Collector performance ratio $a_1/\eta_0$	(H3) $\div$ (H2) =	<input type="text"/>	(H4)
Annual solar radiation per $m^2$ from Table H2		<input type="text"/>	(H5)
Overshading factor from Table H3		<input type="text"/>	(H6)
Solar energy available	(H1) $\times$ (H2) $\times$ (H5) $\times$ (H6) =	<input type="text"/>	(H7)
Solar-to-load ratio	(H7) $\div$ [EnerUsage + DistLoss] =	<input type="text"/>	(H8)
Utilisation factor	if (H8) > 0, $1 - \exp[-1/(H8)]$ , otherwise enter "0" in box (H9)	<input type="text"/>	(H9)
	<i>if the cylinder is heated by a boiler and there is no cylinderstat, reduce the utilisation factor by 10%</i>		
Collector performance factor	If (H4) < 20, $0.87 - 0.034 \times (H4) + 0.0006 \times (H4)^2 =$ else. $0.604 - .0087 \times (H4) =$	<input type="text"/>	(H10)
Dedicated solar storage volume, $V_s$ , litres <i>volume of pre-heat store, or dedicated solar volume of a combined cylinder</i>		<input type="text"/>	(H11)
If combined cylinder, total volume of cylinder, litres		<input type="text"/>	(H12)
Effective solar volume, $V_{eff}$ <i>if separate pre-heat solar storage or a thermal store, (H13) = (H11)</i> <i>if combined cylinder, (H13) = (H11) + 0.3 <math>\times</math> [(H12) - (H11)]</i>		<input type="text"/>	(H13)
Daily hot water demand, $V_d$ , (litres)		<input type="text"/>	(H14)
Volume ratio $V_{eff}/V_d$	(H13) $\div$ (H14) =	<input type="text"/>	(H15)
Solar storage volume factor $f(V_{eff}/V_d)$	$1 + 0.2 \times \ln(H15) =$	<input type="text"/>	(H16)
Solar DHW input $Q_s$	(H7) $\times$ (H9) $\times$ (H10) $\times$ (H16) =	<input type="text"/>	(H17)

*Note: 'HwReq' and 'Distloss' are values derived by DEAP based on entries for the water heating system tab. HwReq is the 'Hot water energy requirement' and DistLoss is the 'Distribution loss'.*

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

**Table H1: Default collector parameters**

Collector type	$\eta_0$	$a_1$ (W/m <sup>2</sup> K)	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/m<sup>2</sup>**

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 m<sup>2</sup> and 1 litre).

*Example:* A block of 24 flats, eight with floor area of 50 m<sup>2</sup> and 16 with floor area of 60 m<sup>2</sup>. Total aperture area of solar panels is 40 m<sup>2</sup> and the total solar storage volume is 1000 litres. The small flats are each assigned 1.47 m<sup>2</sup> and 37 litres, and the larger flats 1.76 m<sup>2</sup> 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 described in H1 for single systems, with the above parameters and the orientation, pitch and overshadowing 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 H2.

The solar storage in this case is not entered as a heat loss cylinder as 'Storage losses on the 'Water Heating: options and storage' 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 I: Water efficiency calculation methodology

This appendix sets out the water efficiency calculation methodology for assessing the whole house potable water consumption in the dwellings. The [water efficiency calculation tool](#) is to be used to assess the water use within the dwelling. It is not a design tool for water supply and drainage systems. Behaviour and changing behaviour can also affect the amount of potable water used throughout a home.

Hot water usage in DEAP is reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold).

### I: Sanitary fitting

The calculation methodology requires the use of water consumption figures provided from manufacturers' product details. Before the assessment can be carried out, figures will need to be collected from manufacturers' product information to determine the consumption of each terminal fitting, including:

#### I.1.1: WCs

- Flushing capacity for the WC suite including consumption at full and part flush for dual flush WCs.
- Where multiple WCs are specified with various flushing capacities, the average effective flushing volume must be used as set out in 'Water efficiency calculation tool: consumption from multiple fittings'.

#### I.1.2 Bidets

- Bidets are excluded from the water efficiency calculator for dwellings due to their minimal water consumption, and although there is insufficient research to quantify this consumption, anecdotal evidence shows that there is evidence that bidets often displace other water consumption rather than increase consumption.

#### I.1.3 Taps

- Flow rate of each tap, at full flow rate in litres per minute measured at a dynamic pressure of  $3 \pm 0.2$  bar ( $0.3 \pm 0.02$  MPa) for high pressure (Type 1) taps, or at a dynamic pressure of  $0.1 \pm 0.02$  bar ( $0.01 \pm 0.002$  MPa) for low pressure (Type 2) taps (EN 200:2008, sanitary tapware, single taps and combination taps for supply systems of type 1 and 2. General technical specifications) including any reductions achieved with flow restrictions.
- Where multiple taps are to be provided (such as separate hot and cold taps) the flow rate of each tap will be needed in order to calculate an average flow rate in accordance with 'Water efficiency calculation tool: consumption from multiple fittings'.
- For click taps and other taps with a water break, the manufacturer's stated full flow rate should be used to perform calculations (measured as described above). Do not use the flow rate at the break point. A factor for percentage of flow rate is already assumed within the use factor for taps. There is currently no research to provide a separate use factor for 'click taps' so a standard use factor is applied
- Taps on baths should not be included in the calculation as the water consumption from bath taps is taken account of in the use factor for baths.

#### I.1.4 Baths

- Total capacity of the bath to overflow, in litres (excluding displacement, this is already included in the use factor for baths)
- Where multiple baths are specified with various capacities, the average must be used as set out in 'Water efficiency calculation tool: consumption from multiple fittings'.
- Spa hot tubs are not included in the water efficiency calculator as they are generally not filled on a daily basis and their water consumption over a year is minimal.

#### I.1.5 Dishwashers

- Litres per place setting derived from the value quoted on the EU energy label, in other words annual water use divided by (280 x number of place settings).
- Where no dishwasher is to be provided and therefore consumption figures are unknown, a figure of 1.25 litres per place setting must be assumed.
- Where multiple dishwashers are specified with various consumptions, the average must be used as set out in 'Water efficiency calculation tool: consumption from multiple fittings'.

#### I.1.6 Washing machines

- Litres per kilogram of dry load derived from the value quoted on the EU energy label, in other words annual water use divided by (220 x capacity in kg).
- Where no washing machine is to be provided and therefore consumption figures are unknown, a figure of 8.17 litres per kg must be assumed.
- Where multiple washing machines are specified with various consumptions, the average must be used as set out in 'Water efficiency calculation tool: consumption from multiple fittings'.

#### I.1.7 Showers

- Flow rate of each shower at the outlet using cold water ( $T \leq 30^{\circ}\text{C}$ ), in litres per minute measured at a dynamic pressure of  $3 \pm 0.2$  bar ( $0.3 \pm 0.02$  MPa) for high pressure (Type 1) supply systems, or at a dynamic pressure of  $0.1 \pm 0.05$  bar ( $0.01 \pm 0.005$  MPa) for low pressure (Type 2) supply systems (EN 1112:2008, Sanitary tapware. Shower outlets for sanitary tapware for water supply systems type 1 and 2. General technical specifications).
- Where multiple showers are specified with various flow rates, the average must be used as set out in 'Water efficiency calculation tool: consumption from multiple fittings'.

#### I.1.8 Water softeners (where present)

- Percentage of total capacity used per regeneration cycle
- Water consumed per regeneration cycle (litres).
- Average number of regeneration cycles per day
- Number of occupants (based on two occupants in the first bedroom and one occupant per additional bedroom assuming two occupants in studio flats).
- Water softeners that do not have a water consumption such as electromagnetic types, are not included in the calculation.

#### I.1.9 Waste disposal units (where present)

- Where present, a standard consumption of 3.08 litres per person per day must be assumed.

### I.1.10 External taps

- Flow rates of external taps are not included in the calculation as a fixed allowance of five litres per person per day is assumed for external water use.

## I.2 Rainwater

Where rainwater harvesting and greywater recycling is used as a means of reducing water consumption to achieve higher water efficiency performance levels, the calculation is as follows:

### I.2.1 Greywater (in accordance with BS 8525)

- Manufacturer or system designer details on the percentage of used water to be recycled, taking into account the storage capacity of the system.
- The volume of recycled water collected from waste bath, shower and wash hand basin, dishwasher and washing machine usage, with the volume collected calculated in accordance with water efficiency calculation tool.
- The consumption of fittings where greywater is to be used in accordance with water efficiency calculation tool which can include WCs and washing machines or Tables 1 and 2 within the tool where greywater is just being used in a proportion of fittings.

### I.2.2 Rainwater (in accordance with EN 16941:2018)

- Collection area
- Yield co-efficient and hydraulic filter efficiency
- Rainfall (average mm/year)
- Daily non-potable water demand

## I.3 Large water consuming installations

Large water consuming installations such as swimming pools and spa hot tubs where the water is replaced over a greater time interval do not need to be included as part of the water calculations.

## 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, 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. Do not use HETAS to source efficiencies for boilers or appliances with back boilers in DEAP.

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

### J.1 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.

### J.2 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:

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

and the efficiency at part load from:

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

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:

$$\text{Gross seasonal efficiency} = 0.5 * (E_{\text{full}} + E_{\text{part}}) \quad (\text{J3})$$

### 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:

$$\text{Gross seasonal efficiency} = 0.975 E_{\text{full}} \quad (\text{J4})$$

4)

### 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 2021 TGD L Appendix D should be read for further information. The linear thermal transmittance,  $\Psi$  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  $\Psi$  applies.

If details of the thermal bridges are not known, use

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

where y is the thermal bridging factor (also known as the y-value) and  $A_{exp}$  is the total area of exposed elements.

The following text sets out a number of options for deriving the y-value for use in DEAP and how to source  $\Psi$  values if necessary. Use of acceptable construction details (ACDs) and numerically modelled  $\Psi$  values detailed below is aligned to the building fabric guidance set out in TGD L.

In the context of thermal bridging, the use of a thermal bridging factor other than the default of 0.15 W/m<sup>2</sup>K requires supporting evidence as outlined below. This supporting evidence must be provided and signed-off by one of:

- Developer;
- Builder;
- Architect;
- Engineer;
- Assigned certifier.

A default value of y=0.15 W/m<sup>2</sup>K applies for all dwellings except the following:

1. **y=0.08 W/m<sup>2</sup>K:** for **new dwellings** whose details conform with 'Limiting thermal bridging and air infiltration – acceptable construction details' (<https://www.housing.gov.ie>) as referenced in Building Regulations 2008, 2011, 2019 and 2021 TGD L.

This value of 0.08 W/m<sup>2</sup>K applies to **new dwellings only**, where the dwelling has been designed and constructed in accordance with the acceptable construction details. It is important to note the following in relation to the use of a 0.08 W/m<sup>2</sup>K y-factor:

If a  $\gamma$ -value of  $0.08 \text{ W/m}^2\text{K}$  is being used to calculate the BER, **the relevant person must provide evidence to support the default of  $0.08 \text{ W/m}^2\text{K}$ .**

This would require the relevant person to provide the following:

- i. Drawings and schedule containing the following information:
  - reference to the dwelling being assessed;
  - list **all** junctions in the dwelling;
  - reference to the associated ACD for each **key** junction.

These documents should be signed by the relevant person, confirming the junctions identified were designed and built in accordance with the associated ACDs. (For new-provisional ratings, it is sufficient to confirm design only, as the dwelling has not yet been built.)

- ii. A copy of the ACDs for all of the **key** junctions in the dwelling. Each detail should be signed by the relevant person.
2. **y = 0.11 W/m<sup>2</sup>K**: Only applies to new dwellings where Building Regulations 2005 TGD L applies. This value may be used when sign-off by the relevant person (as defined in the previous section) 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 fifth or later editions of the Homebond manual.
  3. Alternatively, values of  $\Psi$  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  $\Psi$ -value associated with that junction can be taken from TGD L 2021 Appendix D or from Introduction document for acceptable construction details or other certified  $\Psi$  values.

If a y-value is calculated for the BER assessment, **the relevant person must provide the following**:

- i. Drawings and schedule containing the following information:
  - reference to the dwelling being assessed;
  - list **all** junctions in the dwelling;
  - reference to the associated ACD or certified detail for each **key** junction;
  - Junction lengths of all key junctions or junctions marked up on as built drawing.

These documents should be signed by the relevant person, confirming the junctions identified were designed and built in accordance with the associated ACDs or certified details. (For new-provisional ratings it is sufficient to confirm design only, as the dwelling has not yet been built.)

- ii. A copy of the ACDs and/or certified details for all of the **key** junctions in the dwelling, as listed in the junction schedule. Each detail should be signed by the relevant person.

This will allow the assessor to calculate the non-default y-value.

- $\Psi$  values from certified details as per TGD L 2021, 2019 or 2011, depending on the applicable

regulations for the dwelling, Section 1.3.3. Certification of the detail in accordance with Appendix D of TGD L should be certified by a third party certification body such as a member of the NSAI thermal modellers' certification scheme or INAB certification or equivalent; this is a means of meeting the requirements in TGD L and DEAP for calculation of  $\Psi$  values.

- Once the  $\Psi$  values adhere to these requirements, junction lengths with valid  $\Psi$  values are used to determine the thermal bridging  $\gamma$ -factor for use in DEAP. SEAI has developed a tool to carry out this calculation [here](#).

## Appendix L: Energy for lighting

The calculation of lighting use is based on the installed fixed lighting, and on the contribution of daylight. This appendix details the calculations automatically carried out in DEAP based on user entries, and is based on SAP 10.

DEAP first calculates the annual base lighting requirement,  $\Lambda B$  (klmh/yr):

$$\Lambda B = 11.2 \times 59.73 \times (TFA \times N)^{0.4714}$$

Where:

- TFA is the total floor area in m<sup>2</sup>
- N is the assumed number of occupants
  - W/lm is the assumed efficacy of traditional tungsten bulbs
- The coefficient and power constants are from SAP 2012 I

The total lighting requirement is subdivided into two parts for further consideration: fixed lighting and portable lighting. The fixed lighting requirement,  $\Lambda req$  (klmh/yr) is assumed to be 2/3rds of the total:

$$\Lambda req = 2/3 \times \Lambda B \times C_{daylight}$$

Where  $C_{daylight} = C2$  as derived below. The procedure differs depending on availability of the lighting design details. However, portable lighting is treated the same way in both cases.

### **Portable lighting**

The specific lamps to be considered are only those associated with fixed fittings within the dwelling. Portable fittings are not assessed as part of the dwelling and so are assigned an average efficacy of 21.3 lm/W<sup>181</sup> in all cases. Portable lighting is assumed to account for one-third of the total lighting, so the energy required for portable lighting,  $EL_{portable}$  (kWh/yr), is:

$$EL_{portable} = 1/3 \times \Lambda B \times C_{daylight} / 21.3$$

This applies to assessments with and without an available lighting design.

### **Lighting design known**

A reference fixed lighting capacity,  $CL_{ref}$  (lm), is defined based upon supplying adequate illumination to all rooms.

$$CL_{ref} = 330 \times TFA$$

The assessor enters the number and type of lamps in the dwelling, including rated power (W) and luminous efficacy (lm/W) (if available) for each. This data is available from the EU energy rating certificate for light bulbs. Efficacy may be inferred based on lamp type if unavailable.

The capacity of the fixed lighting provided,  $CL_{fixed}$  (lm), is calculated as:

---

<sup>18</sup> Based on averages for dwellings from survey carried out by BRE

$$CL_{\text{fixed}} = \sum (\text{luminous efficacy}_{\text{Lamp}} \times \text{Watts}_{\text{Lamp}})$$

The average efficacy of fixed lighting provided,  $\epsilon_{\text{fixed}}$  (lm/W), is calculated as:

$$\epsilon_{\text{fixed}} = \text{CL}_{\text{fixed}} / \sum \text{power of fixed lighting outlets}$$

The fixed lighting provision,  $\Lambda_{\text{prov}}$  (klmh/yr), is calculated as:

$$\Lambda_{\text{prov}} = \Lambda_{\text{req}} \times \text{CL}_{\text{fixed}} / \text{CL}_{\text{ref}}$$

If the capacity of lighting provided is less than required for adequate lighting top-up lighting is assumed to be used such that sufficient lighting is provided. The amount of lighting supplied by top-up lighting,  $\Lambda_{\text{topup}}$  (klmh/yr), is:

- If  $\Lambda_{\text{prov}} < \Lambda_{\text{req}}/3$ , then  $\Lambda_{\text{topup}} = \Lambda_{\text{req}}/3 - \Lambda_{\text{prov}}$
- If  $\Lambda_{\text{prov}} \geq \Lambda_{\text{req}}/3$  then  $\Lambda_{\text{topup}} = 0$

The energy required for fixed lighting,  $\text{EL}_{\text{fixed}}$  (kWh/yr), excluding the top-up, is then calculated by dividing by the average efficacy of the fixed lighting provided.

- If  $\Lambda_{\text{req}} \geq \Lambda_{\text{prov}}$  then  $\text{EL}_{\text{fixed}} = \Lambda_{\text{req}} / \epsilon_{\text{fixed}}$
- If  $\Lambda_{\text{req}} < \Lambda_{\text{prov}}$  then  $\text{EL}_{\text{fixed}} = \Lambda_{\text{prov}} / \epsilon_{\text{fixed}}$

The energy required for top-up lighting,  $\text{EL}_{\text{topup}}$  (kWh/yr), is assumed to be provided by lamps of average efficacy (from portable lamps).

$$\text{EL}_{\text{topup}} = \Lambda_{\text{topup}} / 21.3$$

The total energy required for lighting,  $\text{EL}$  (kWh/yr), is the sum of the fixed, top up and portable components:

$$\text{EL} = \text{EL}_{\text{fixed}} + \text{EL}_{\text{topup}} + \text{EL}_{\text{portable}}$$

### **Lighting design detail unknown**

Where the lighting design details are not available. A generic factor to calculate installed lighting capacity is applied:

$$\text{CL}_{\text{fixed}} = 185 \times \text{TFA}$$

Lamp efficacy is based on lamp type (as recorded by the assessor along with number of each lamp type). Otherwise, the procedure is the same as given for an assessment with an available lighting design.

**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.

$$C_2 = 52.2 G^2 + 9.94 G_L + 1.433$$

if  $G_L \leq 0.095$  (L3)

$$C_2 = 0.96$$

if  $G_L > 0.095$

(L4)

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

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).

**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 other sources, such as external lighting or lighting of unheated spaces. The average rate of heat gain from lighting is:

$$G_L = E_L \times 0.85 \times 0.9 \times (1000 / (24 \times \text{HsDays})) \text{ [W]} \quad (L6)$$

Where HsDays is the duration of the heating season in days (243 days).

**Identifying lamp types:**

The type of lamps identifiable in DEAP and their associated default efficacy values are as follows:

Lamp type	Lumens/Watt
• Linear fluorescent	80.5
• LEDs/ CFL	66.9
• Halogen LV	26.1
• Halogen lamps	15.7
• Incandescent	11.2

Where several bulbs are controlled by a single switch, each bulb must be counted.

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 fixed lighting in the dwelling.

## 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<sup>2</sup> at 25°C). Peak power depends on the type of PV 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<sup>2</sup> of PV collector. Test data for PV collectors may also be taken from SEAI's Triple E product register. Triple E meets the PV test data criteria detailed above.

2. The electricity produced by the PV module in kWh/year is:

$$0.80 \times \text{kWp} \times S \times Z_{PV} \quad (\text{M1})$$

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 'Photovoltaic/ wind turbine' entry (formerly in the 'Energy produced or saved' entry) in the Renewables tab. The delivered energy is acceptable as renewable (electrical) energy for TGD L conformance.

3. For calculation of CO<sub>2</sub> 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  $\beta$ , in the range 0.0 to 1.0, and is the proportion of the generated electricity used directly within the dwelling. The value of  $\beta$  depends on the coincidence of electricity generation and electricity demand. At present the value of  $\beta = 0.30$  should be used if performing fuel cost calculations: this will be reviewed in future if relevant data becomes available. All normal fuel costs are available [here](#).

The fuel price is calculated as:

$$\beta \times \text{normal electricity price} + (1 - \beta) \times \text{exported electricity price.}$$

Where the PV array is mounted on the building concerned or wholly within its curtilage, and its output is directly connected to the dwelling's electricity supply, the output calculated by (M1) is included in DEAP. In the case of a building containing more than one dwelling, such as a block of flats, then if the PV output goes to particular individual flats, the annual output is credited to the flats concerned.

An inverter is needed for each flat with a PV electricity supply.

Note that electricity supplied to common areas in a development is not considered in DEAP assessments. Where the PV (or wind) system is only used for heating (say directly wired to immersion or storage heaters), the BER Helpdesk should be contacted for further guidance.

## M2 Micro wind turbines on the dwelling or within its curtilage<sup>19</sup>

The procedure 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<sup>20</sup> and the wind speed correction factors given in MIS 3003<sup>21</sup>. 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:

---

<sup>19</sup> From SAP Appendix M2

<sup>20</sup> [www.greenspec.co.uk/html/energy/windturbines.html](http://www.greenspec.co.uk/html/energy/windturbines.html) (accessed 15<sup>th</sup> September 2011)

<sup>21</sup> 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.

1. The output power  $P_{\text{wind}}$  of one turbine in watts at a wind speed of "s" m/s is:

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

- 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 =  $0.6125 \text{ s}^3$
- G is the efficiency of the generator
- IE is efficiency of the inverter (allowing for power drawn by the inverter)<sup>22</sup>

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

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

- $N_{\text{turbines}}$  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
  - 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  $0.25 \times \pi \times (\text{rotor diameter})^2$ .

5. Average annual wind speed 's', should be taken from a calibrated anemometer<sup>23</sup> located at the same height and position as the wind turbine. Where this wind power data is not available, a default wind speed of 5m/s<sup>24</sup> 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.

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'.

---

<sup>22</sup> 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.

<sup>23</sup> In accordance with MEASNET standards or similar. <http://www.measnet.com/>

<sup>24</sup> While the default average is 5m/s, actual wind speeds will clearly vary

7. For calculation of the cost savings the factor  $\beta$  is taken from Section M1.

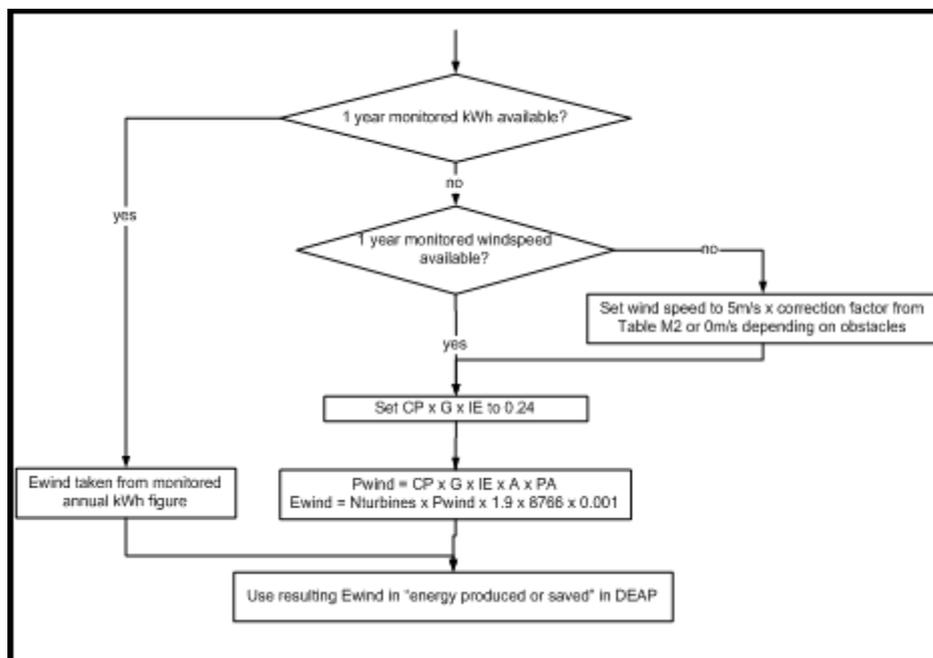


Figure M2: Calculation method summary for micro wind turbines

Table M2: Wind speed correction factors<sup>25</sup>

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
	6	0.67

<sup>25</sup> Factors in Table M2 derived from data in The Designer's Guide to Wind Loading of Structures, N.J. Cook, Butterworths, 1986

Low rise urban/suburban (town or village situations with other buildings well spaced)	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		

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

### N1 Overview

Micro-cogeneration from combined heat and power (CHP) 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 plus 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 is based on appropriate European standards (IS EN 50465:2015) 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, 2011, 2019 and 2021.

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

Enter the fraction of the total main space and water heat derived from CHP thermal output under the 'Space and water heating: heat source' tabs.

DEAP calculates the total main space heating demand as the value 'Annual space heating requirement' shown on the 'View assessment' tab minus the percentage of heat from secondary/supplementary system.

The total main water heating demand is the value 'Output from main water heater' shown on the 'View assessment' tab.

The 'Heat source' section of the 'Space heating' tab allows the user to enter the thermal efficiency (CHP  $H\eta$ ) and electrical efficiency (CHP  $E\eta$ ) 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 installation in a group heating system

Appendix C of the DEAP manual explains how the DEAP software caters for CHP installations in a group heating system. DEAP uses the following equation to calculate 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):

$$\text{Saved Primary Energy} = \text{Heat Demand}_{\text{CHP}} \times \left[ \left[ \frac{\text{PEF}_{\text{gas}}}{0.91} \right] + \left[ \frac{\text{CHP}_{\text{eff\_elec}} \times \text{PEF}_{\text{elec}}}{\text{CHP}_{\text{eff\_heat}}} \right] - \left[ \frac{\text{PEF}_{\text{gas}}}{\text{CHP}_{\text{eff\_heat}}} \right] \right]$$

Heat Demand<sub>CHP</sub> = heat demand for the CHP plant for space and water heating (kWh)

PEF<sub>gas</sub> = primary energy factor of natural gas

PEF<sub>elec</sub> = primary energy factor of electricity

CHP<sub>eff\_elec</sub> = electrical efficiency of the CHP plant (entered as a factor), defined as the annual electrical output divided by the gross calorific fuel input

CHP<sub>eff\_heat</sub> = heat efficiency of the CHP plant (entered as a factor), defined as the annual heat output divided by the gross calorific fuel input

The heat demand for 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 cooling calculation is carried out as per Section 0.

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 (such as an upper floor flat) or secure night-time ventilation is available (including 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,  $H_v^{\text{summer}}$ , using the formula:

$$H_v^{\text{summer}} = 0.33 \times n \times V \quad (\text{P1})$$

Where:

$n$  = air change rate during hot weather, ach

$V$  = volume of the heated space of the dwelling,  $\text{m}^3$

3. Calculate the heat loss coefficient under summer conditions:

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

The total fabric heat loss is the same as for the heating season.

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.

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

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),  $\text{m}^2$

$S$  is the solar flux on a surface during the summer period from Table 1c,  $\text{W}/\text{m}^2$

$g_{\perp}$  is the total solar energy transmittance factor of the glazing at normal incidence from Table 6b as entered in the DEAP software.

$\text{FF}$  is the frame factor for windows and doors (fraction of opening that is glazed) from Table 6c  $Z_{\text{summer}}$  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  $Z_{\text{summer}}$  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:

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

6. Obtain the summer mean external temperature,  $T_e^{\text{summer}}$ , 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, $T_e^{\text{summer}}$ , used for estimating mean internal temperature in summer [°C]
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.

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

where

$$\begin{aligned} \Delta T_{\text{mass}} &= 2.0 - 7 \times \text{HCP} && \text{if HCP} < 0.28 \\ \Delta T_{\text{mass}} &= 0 && \text{if HCP} \geq 0.28 \end{aligned}$$

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**

$T_{\text{threshold}}$	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

$Z_{\text{summer}}$  is given by

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

subject to

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

where

$Z_{\text{blinds}}$  is a shading factor for blinds or curtains

$Z$  is the solar access factor from Table 6d

$Z_{\text{overhangs}}$  is a shading factor for overhangs

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

### 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**

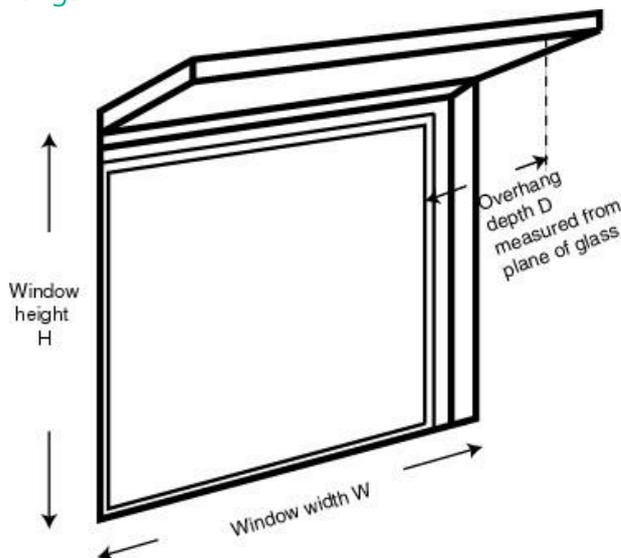
Blind or curtain type	$Z_{\text{blind}}$
Net curtain (covering whole window)	0.80
Net curtain (covering half window)	0.90
Dark-coloured curtain or roller blind (note 1)	0.85
Light-coloured curtain or roller blind (note 1)	0.60
Dark-coloured venetian blind (note 2)	0.88
Light-coloured venetian blind (note 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  $f \times Z_{\text{blind}} + (1 - f)$ .
2. Factor applies for venetian blind with slats at  $45^\circ$  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  $f \times Z_{\text{blind}} + (1 - f)$ .
3. External shutters are not applicable to roof windows.

## P3.2 Overhangs



Where the overhang is at least twice as wide as the window (such as 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  $Z_{\text{overhangs}}$  can be applied to all the windows on a given façade on the basis of an average depth-to-height ratio.

**Table P5:  $Z_{\text{overhangs}}$  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:  $Z_{\text{overhangs}}$  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 DEAP.

This method may only be used for technologies whose characteristics have been recognised as part of DEAP and described [here](#). In general, a technology may use one form of energy to achieve savings in another form of energy.

In DEAP's 'Renewables' tab, enter the delivered energy produced or saved, and the delivered energy consumed by the technology, to the appropriate fields. Then enter the primary and CO<sub>2</sub> factors for the energy produced or saved, and the energy consumed.

The technologies typically included in this section of DEAP are:

- Wind energy using micro-turbines (see Appendix M2);
- Space heating from solar thermal panels (see [here](#));
- Flue gas heat recovery systems (these are not the same as ventilation heat recovery systems) with efficiency data from PCDB;
- 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, instantaneous waste water heat recovery, 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 DEAP methodology for existing homes

The methodology is summarised below and relates to the sections earlier in the DEAP manual and the associated tabs in DEAP:

#### ***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 (including number of chimneys, flues, air vents, extract fans, and flueless combustion room heaters, 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 ductwork, and results of a pressurisation test) are to be identified during on-site survey.

**Building elements**

The construction of heat loss 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 heat loss building element entered are the internal areas. Appropriate default U-values are set out in tables in this appendix. Other U-values must 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<sup>2</sup> 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<sup>2</sup> when using the default door area in existing dwellings.
- Window areas are measured on site. Other window characteristics (such as orientation, overshadowing, 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.
- The thermal mass category of the dwelling is identified from default table 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 the site survey. The appropriate temperature adjustment factors are selected from Table 2. Site survey must also identify the type and number of showers present as well as baths, flow restrictors and water quantity usage data (if available).

**Lighting**

The type and quantity of fixed lamps within a dwelling are recorded through the site survey.

**Controls and responsiveness**

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.

**Space and water heat sources**

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 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. Efficiencies are taken from non-default data where acceptable evidence is available.

**Cooling**

Cooling system entries are as per Section 0. All other relevant heat loss and gains details to derive the net space cooling demand are derived by DEAP based on the same information input for the heating calculation. Therefore, the only additional information for the cooling system relates to the cooling system make / model / efficiency and detailing whether there is a cooling system installed or not.

### S3 Dwelling type and purpose of rating

The dwelling type and purpose of rating fields in DEAP are not 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, 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.

Many dwellings have one or more extensions of a different construction or insulation standard added to the main part of the dwelling (such as 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 (for example, 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 storerooms, thermally separated conservatories or thermally separated porches (please see the Dimensions section for further 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 (such as party walls, a floor or a ceiling wholly above or below another apartment, or walls adjoining 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. <sup>26</sup>
- Opaque heat loss areas may be rounded to nearest 0.5m<sup>2</sup>. Glazed areas and doors may be rounded

---

<sup>26</sup> Note that small bay windows, small porches, small door entrances or recesses, small chimney breasts must be included in measurement of total floor area and living room area.

to 0.1m<sup>2</sup>.

- 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  $.05 \text{ W/m}^2\text{K}$  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 -2009
K	2010 onwards

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.

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**

Year of regulations	Applicable age band	U-values (W/m <sup>2</sup> K)		
		Roof	Wall	Floor
1976 (Draft)	F <sup>27</sup>	0.4	1.1	0.6
1981 (Draft)	G	0.4	0.6	0.6
1991	H <sup>28</sup>	0.35	0.55	0.45/0.6
1997	I	0.35	0.55	0.45/0.6
2002 / 2005	J	0.25	0.37	0.37
2008	K	0.22	0.27	0.25

<sup>27</sup> 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.

<sup>28</sup> 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<sup>29</sup>**

Age band	A	B	C	D	E	F	G	H	I	J	K
Wall type											
Stone	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37	0.27
225mm solid brick	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37	0.27
325mm solid brick	1.64	1.64	1.64	1.64	1.64	1.1	0.6	0.55	0.55	0.37	0.27
300mm cavity	2.1	1.78	1.78	1.78	1.78	1.1	0.6	0.55	0.55	0.37	0.27
300mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37	0.27
solid mass concrete	2.2	2.2	2.2	2.2	2.2	1.1	0.6	0.55	0.55	0.37	0.27
concrete hollow block	2.4	2.4	2.4	2.4	2.4	1.1	0.6	0.55	0.55	0.37	0.27
timber frame	2.5	1.9	1.9	1.1	1.1	1.1	0.6	0.55	0.55	0.37	0.27
Unknown	2.1	2.1	2.1	2.1	2.1	1.1	0.6	0.55	0.55	0.37	0.27
425 mm Cavity Wall	1.73	1.51	1.51	1.51	1.51	1.1	0.6	0.55	0.55	0.37	0.27
425 mm filled cavity	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.55	0.55	0.37	0.27

As a simple example, take a stone wall from age band B and add 50mm ( $d_{ins}$ ) of insulation with thermal conductivity  $0.035\text{W/m}\cdot\text{K}$  ( $\lambda_{ins}$ ). 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  $2.1\text{W/m}^2\text{K}$ .  $R_{stonewall} = 0.4762\text{m}^2\text{K/W}$ . The resistance of the extra insulation is  $R_{ins} = d_{ins}/\lambda_{ins} = 0.05/0.035 = 1.429\text{m}^2\text{K/W}$ .

Total wall resistance =  $R_{wall} = R_{ins} + R_{stonewall} = 0.4762 + 1.429 = 1.9052\text{m}^2\text{K/W}$ . Insulated wall U-value =  $U_{wall} = 1/R_{wall} = 0.525\text{W/m}^2\text{K}$ .

In cases where an existing cavity wall has been filled with insulation, this method may be applied and requires the following information:

1. the original default U-value of the wall from Table S3;
2. the type and thickness of the newly added insulation preferably as identified on site and documented by the BER assessor. Alternatively, by using receipts or invoices as detailed in the survey guide;
3. 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.

<sup>29</sup> 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.

4. Where a cavity is filled in a case such as this, as the cavity accounted for in the individual wall default is now filled with insulation, the resistance of that cavity must be subtracted from the total wall resistance. As per BR 443, cavities in wall constructions normally have a resistance of 0.18 m<sup>2</sup>K/W. This resistance must be subtracted from the filled cavity wall resistance when using this method. Total filled cavity wall resistance =  $R_{\text{wall}} = R_{\text{ins}} + R_{\text{cavitywall}} - R_{\text{cavity}}$

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 m<sup>2</sup>K/W if the dwelling is a house.
- 0.4 m<sup>2</sup>K/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  $R_u$  values to the default U-value. Alternatively, assessors may apply the relevant default  $R_u$  value from TGD L 2021 Appendix A. Table S3 should only be used for walls between an apartment and unheated space when there is documentary evidence to support the presence of insulation.

Often, the wall between an apartment and unheated spaces (corridor or stairwell for example) will be uninsulated. Where this is the case, the U-values in Table S3a are used if non-defaults are unavailable. In these cases, the 'Wall is semi-exposed' option is not available in DEAP as the  $R_u$  value is already built into the defaults for these uninsulated walls.

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).

*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

The U-value of a wall adjoining a partially heated premises is taken as half the U value of the wall. This applies typically for a flat adjoining a non-domestic premises that are not heated to the same extent or duration as the flat. The U value of the wall should be based on an uninsulated exposed element (Age band A in Table S3). However, if there is enough information available (and proof thereof) to calculate the actual wall U-value, then this should be done, and the result halved as per DEAP Section 3.5(c) to attain the wall U-value.

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/mK and the assessor has insufficient detail on the actual thermal conductivity of the installed insulation. Table S3b applies where the insulation is an addition to that of the original wall and none of the original insulation

has been removed. If the original insulation was removed and the starting point before drylining is an uninsulated wall, then Table S3b can be used by assuming the 'original wall U-value' of an uninsulated wall - select the appropriate wall type from Table S3 and use age band E or earlier. Where the actual installed insulation thickness for the new insulated drylining 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
0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.19

### 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/m <sup>2</sup> K) and identify retrofitted U-value from Table S3b. User enters resulting U-value (1.05W/m <sup>2</sup> K).

Plasterboard is not likely to have been used in buildings constructed before 1950. So, for a building originally constructed prior to 1950 (that is, where age band A, B, or C applies), if plasterboard is present it is acceptable to assume that the plasterboard has been retrofitted. On that basis the U-value for 'Plasterboard + 0mm Insulation' from Table S3b can be used.

### 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)<sup>30</sup>**

Insulation thickness (mm)	Assumed roof U-value (W/m <sup>2</sup> K)
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/m <sup>2</sup> K) (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
K	0.22

<sup>30</sup> 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/m<sup>2</sup>K unless another U-value can be substantiated.

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:

$$Arr = Frr + 11 \sqrt{Frr / 1.5}$$

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 based on data in the 'Building: floors' 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 building: floors tab in DEAP as a room in roof floor area, along with average height of the actual room in roof.
4. Under the building tab (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 heat loss 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 'building: windows' tab.
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

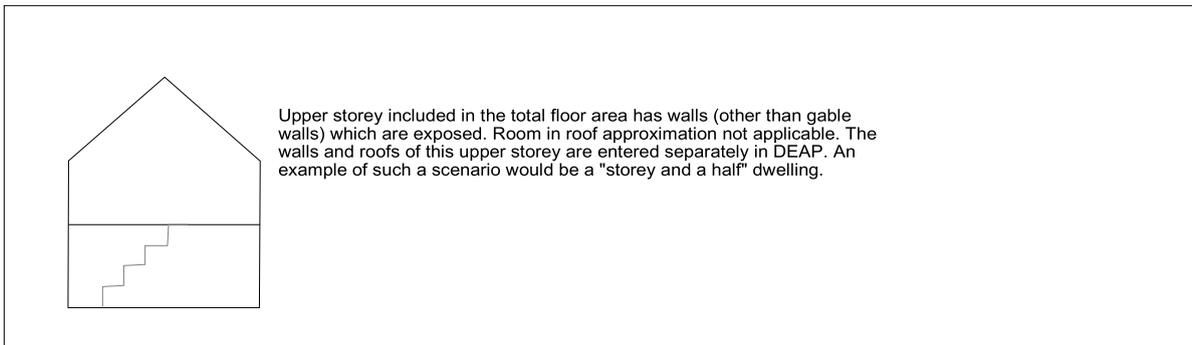
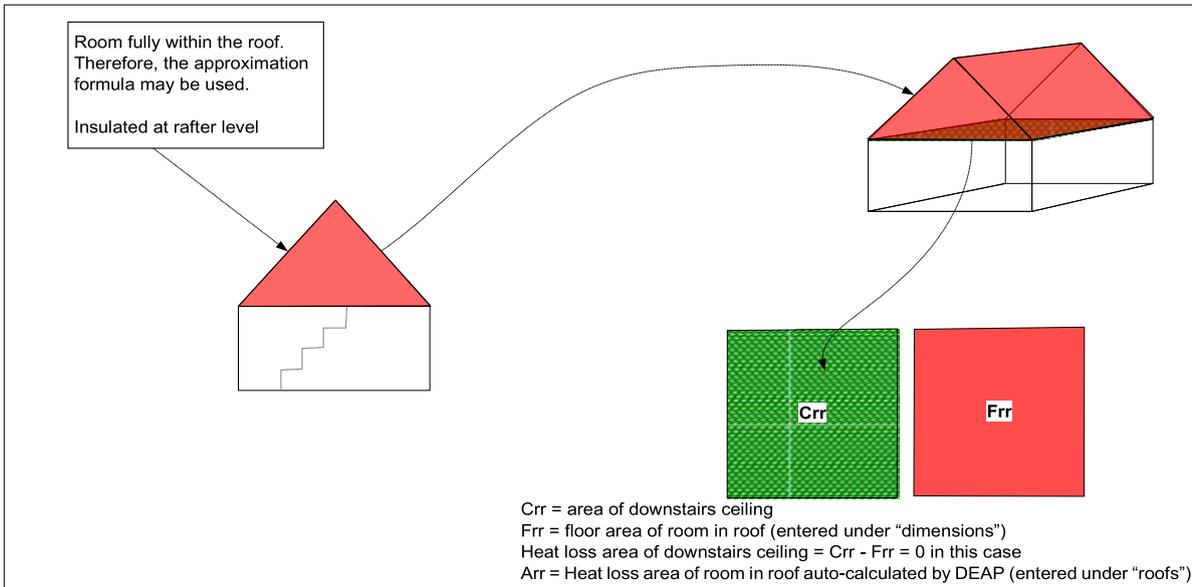
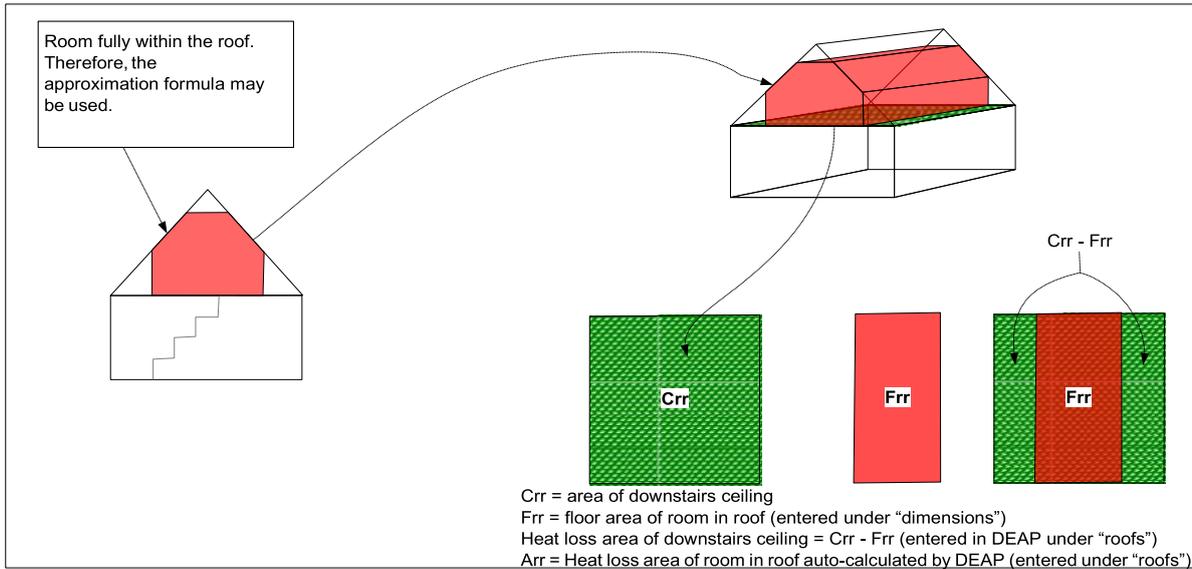
more time. This may need to be done in an existing dwelling BER when it can be shown that only some facades of the room in roof attain a non-default U-value and the other facades are not accessible. A default U-value applies to the inaccessible facades. In this case, the U-values of the room in roof 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. The approximation is typically only used where a default is being applied to all heat loss facades in the room in roof, as that scenario would not have varying non-default U values.

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  $R_u$  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:**



### 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)
- $R_{si} = 0.17 \text{ m}^2\text{K/W}$
- $R_{se} = 0.04 \text{ m}^2\text{K/W}$
- 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  $\text{m}^2/\text{m}$
- U-value of walls to underfloor space 1.5 W/m<sup>2</sup>K
- 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 <sup>31</sup>	12 mm
H or I	35 mm
J	50 mm
K	94 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 (for example, by a party wall) other heated properties (residential or commercial) is not included.

---

<sup>31</sup> If the dwelling is of age band F or G but the roof of the dwelling is shown to have no insulation, then all floor types must be assumed to be age band E (no insulation) where contrary evidence is not available.

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 (such as a 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, there is no distinction 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).

**Table S7: Exposed/Semi-exposed floor U-values**

Age band	U-value (W/m <sup>2</sup> K)
A to E	1.20
F, G	0.8
H, I	0.6
J	0.37
K	0.25

#### 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/m<sup>2</sup>K. 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/m<sup>2</sup>K 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	K
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	0.14
	0.2	0.46	0.46	0.46	0.46	0.46	0.38	0.38	0.29	0.29	0.26	0.19
	0.3	0.61	0.61	0.61	0.61	0.61	0.48	0.48	0.36	0.36	0.31	0.22
	0.4	0.73	0.73	0.73	0.73	0.73	0.57	0.57	0.41	0.41	0.34	0.24
	0.5	0.84	0.84	0.84	0.84	0.84	0.64	0.64	0.44	0.44	0.37	0.25
	0.6	0.94	0.94	0.94	0.94	0.94	0.7	0.7	0.47	0.47	0.39	0.26
	0.7	1.02	1.02	1.02	1.02	1.02	0.74	0.74	0.49	0.49	0.4	0.27
	0.8	1.1	1.1	1.1	1.1	1.1	0.79	0.79	0.51	0.51	0.42	0.27
	0.9	1.16	1.16	1.16	1.16	1.16	0.82	0.82	0.52	0.52	0.43	0.28
	1 or more	1.23	1.23	1.23	1.23	1.23	0.85	0.85	0.54	0.54	0.44	0.28
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	0.17
	0.2	0.44	0.44	0.44	0.44	0.44	0.39	0.39	0.32	0.32	0.28	0.22
	0.3	0.56	0.56	0.56	0.56	0.56	0.48	0.48	0.37	0.37	0.33	0.24
	0.4	0.65	0.65	0.65	0.65	0.65	0.55	0.55	0.42	0.42	0.36	0.26
	0.5	0.73	0.73	0.73	0.73	0.73	0.6	0.6	0.45	0.45	0.38	0.27
	0.6	0.8	0.8	0.8	0.8	0.8	0.64	0.64	0.47	0.47	0.4	0.28
	0.7	0.85	0.85	0.85	0.85	0.85	0.68	0.68	0.49	0.49	0.41	0.28
	0.8	0.9	0.9	0.9	0.9	0.9	0.71	0.71	0.50	0.50	0.42	0.29
	0.9	0.94	0.94	0.94	0.94	0.94	0.73	0.73	0.52	0.52	0.43	0.29
	1 or more	0.98	0.98	0.98	0.98	0.98	0.76	0.76	0.53	0.53	0.44	0.30
Ground floor – above unheated basement <sup>321</sup>	0.1	0.56	0.56	0.56	0.56	0.56	0.47	0.47	0.36	0.36	0.31	0.22
	0.2	0.75	0.75	0.75	0.75	0.75	0.60	0.60	0.43	0.43	0.36	0.25
	0.3	0.88	0.88	0.88	0.88	0.88	0.68	0.68	0.47	0.47	0.39	0.26
	0.4	0.98	0.98	0.98	0.98	0.98	0.73	0.73	0.50	0.50	0.41	0.27
	0.5	1.06	1.06	1.06	1.06	1.06	0.78	0.78	0.51	0.51	0.42	0.28
	0.6	1.12	1.12	1.12	1.12	1.12	0.81	0.81	0.53	0.53	0.43	0.28
	0.7	1.17	1.17	1.17	1.17	1.17	0.84	0.84	0.54	0.54	0.44	0.28
	0.8	1.21	1.21	1.21	1.21	1.21	0.86	0.86	0.55	0.55	0.44	0.29
	0.9	1.26	1.26	1.26	1.26	1.26	0.88	0.88	0.56	0.56	0.45	0.29
	1 or more	1.29	1.29	1.29	1.29	1.29	0.89	0.89	0.56	0.56	0.45	0.29

<sup>32</sup> 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	K
Basement – heated <sup>33</sup>	0.1	0.36	0.36	0.36	0.36	0.36	0.29	0.29	0.22	0.22	0.2	0.15
	0.2	0.54	0.54	0.54	0.54	0.54	0.42	0.42	0.31	0.31	0.27	0.19
	0.3	0.65	0.65	0.65	0.65	0.65	0.49	0.49	0.35	0.35	0.3	0.21
	0.4	0.73	0.73	0.73	0.73	0.73	0.54	0.54	0.38	0.38	0.32	0.22
	0.5	0.78	0.78	0.78	0.78	0.78	0.57	0.57	0.4	0.4	0.33	0.23
	0.6	0.81	0.81	0.81	0.81	0.81	0.59	0.59	0.41	0.41	0.34	0.24
	0.7	0.84	0.84	0.84	0.84	0.84	0.6	0.6	0.42	0.42	0.35	0.24
	0.8	0.86	0.86	0.86	0.86	0.86	0.62	0.62	0.42	0.42	0.35	0.24
	0.9	0.87	0.87	0.87	0.87	0.87	0.63	0.63	0.43	0.43	0.36	0.24
1 or more	0.89	0.89	0.89	0.89	0.89	0.63	0.63	0.43	0.43	0.36	0.24	
Partially heated below		1.0	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	0.25
Other	No default data											

### S6.6 Allowance for thermal bridging

The thermal bridging factor,  $y$ , is defaulted at 0.15 W/m<sup>2</sup>K.

---

<sup>33</sup> 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  $\geq 1.2$ m

e) If average basement depth below ground  $< 1.2$ m 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

## 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	Assume low E coating	Frame	Metal thermal break assumed	U-value (W/m <sup>2</sup> K) (based on Table 6a)	Solar transmittance (based on Table 6b)	Basis for derivation of U and g values
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 – pre 2004	No	Wood/PVC	n/a	3.1	.76	Air filled 6mm gap
Double – pre 2004	No	Metal	4mm	3.7	.76	air filled 6mm gap
Double – 2004 to 2009	Yes	Wood/PVC	n/a	2.2	.72	Air filled low E hard coat $\epsilon_n = .15$ 12mm gap
Double – 2004 to 2009	Yes	Metal	4mm	2.7	.72	Air filled low E hard coat $\epsilon_n = .15$ 12mm gap
Double – 2010 onwards	Yes	Wood/PVC	n/a	2.0	.72	Argon filled low E hard coat $\epsilon_n = .15$ 12mm gap
Double – 2010 onwards	Yes	Metal	4mm	2.5	.72	Argon filled low E hard coat $\epsilon_n = .15$ 12mm gap

When using Table S9, base the row selected on the age of the glazing and the frame type (wood/PVC/metal) and select the resulting U and g values.

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, the following defaults are assumed:

#### ***Installed before 2004:***

Glass is uncoated, with 6mm air filled gap. Metal framed window thermal break is 4 mm for metal framed windows.

#### ***Installed 2004-2009***

Glass is hard coated with  $\epsilon_n = 0.15$ . 12 mm air filled gap. Metal framed window thermal break is 4 mm.

#### ***Installed 2010 onwards***

Glass is hard coated with  $\epsilon_n = 0.15$ . 12 mm argon filled gap. Metal framed window thermal break is 4 mm.

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 (pre 2004), always assume glass is uncoated with a 6mm air filled gap;
  - U-value = 3.1 W/m<sup>2</sup>K;
  - 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  $\epsilon_n = 0.15$ . 12 mm air filled gap;
  - U-value = 2.2 W/m<sup>2</sup>K;
  - Solar Transmittance = 0.72.
- Double glazed windows installed in 2011 with a metal frame:
  - When using Table S9 for a 2011 window, always assume glass is hard coated with  $\epsilon_n = 0.15$ . 12mm argon filled gap;
  - Thermal break assumed is 4mm;
  - U-value = 2.5 W/m<sup>2</sup>K;
  - Solar Transmittance = 0.72.
- Double glazed windows installed in 2012 with a PVC frame:
  - When using Table S9 for a 2012 window, always assume glass is hard coated with  $\epsilon_n = 0.15$ . 12mm argon filled gap;
  - U-value = 2 W/m<sup>2</sup>K;
  - Solar transmittance = 0.72.

Where 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 for existing dwellings

The thermal mass category may be based on the following defaults for existing dwellings. Alternatively, the method in Table 11 may be used.

To derive the thermal mass category to be used in DEAP using Appendix S10, first identify each of the predominant element mass values for each of the four element types (ground floor, external walls, separating walls to adjoining premises and internal partitions) using Table 11a. For example, Table 11a defines the mass of a 'Suspended timber floor' as 'Light' and that of a separating 'Masonry with dense plaster' wall as 'heavy'. See Table 11a for a detailed list of thermal mass of different element types. Count the number of each type identified according to light, medium and heavy. Use Table S10 to identify the DEAP thermal mass category based on the applicable count.

**Table S10: Thermal mass category defaults**

Number of light elements	Number of medium elements	Number of heavy elements	Thermal mass category
4	0	0	Low
3	1	0	Low
3	0	1	Medium low
2	2	0	Medium-low
1	3	0	Medium-low
2	1	1	Medium
2	0	2	Medium
1	1	2	Medium
0	4	0	Medium
1	2	1	Medium
1	0	3	Medium high
0	3	1	Medium high
0	2	2	Medium-high
0	1	3	High
0	0	4	High

Notes:

1. When using Table S10, there are **four** element types to be considered: ground floors, external

walls, internal partitions and separating walls between the dwelling and adjoining premises.

2. As an example, if a dwelling has a 'medium' ground floor, 'light' internal partitions, 'heavy' external walls and 'heavy' separating walls, it will have 1 x medium, 1 x light and 2 x heavy. Therefore, from Table S10, the thermal mass category in DEAP is 'MEDIUM'.
3. For detached dwellings, apply the 'external wall' condition to the 'separating wall' column.
4. Where an element is a mixture of thermal masses for different sections, for example light and/or medium and/or heavy, the element mass occupying the largest area for that element type applies when identifying the mass for that element for use in Table S10. For example, if a dwelling has mostly plaster on timber frame internal partitions ('light' from Table 11a) and a smaller section of internal partition with masonry with plasterboard on dabs ('medium' from Table 11a), then the internal partitions are assumed to be 'light'.
5. Where ceilings are present with heavy mass, such as concrete intermediate floor in a dwelling or concrete floor of apartment above is the ceiling, the Section S10 default approach cannot be used. In this case, Table 11 must be used.

## S11 Space and water heating

Space and water heating systems and their controls are those defined in Table 4 and should be determined by DEAP survey guide. In any case, where the assessor is unable to determine heating system properties, pessimistic values must be used from Table 4 applicable to the fuel type on site. For example, if the boiler and controls cannot be accessed during survey, but an LPG/oil tank can be seen on site, then apply a pessimistic value for a boiler based on the fuel type on site. If an LPG tank is present then a non-condensing pre-1998 boiler is assumed with no thermostats, timers or zoning. If there is an oil tank present, then a non-condensing pre-1985 boiler is assumed with no thermostats, timers or zoning. A newer boiler age may be assumed depending on dwelling age band.

### 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	Storage installation date age bands A to G: none Storage installation date age band H: 25 mm foam (factory applied insulation) or equivalent Storage installation date age bands I or J: 35 mm foam (factory applied insulation) or equivalent Storage installation date age band K: 50 mm foam (factory applied insulation) or equivalent  In the case where the storage is retrofitted after the dwelling was constructed, the storage volume's age rather than dwelling age is relevant when determining the default insulation thickness. Where the storage volume age is unknown, it is assumed to have been installed when the dwelling was constructed.
Showers and baths <ul style="list-style-type: none"> <li>• Electric / mixer</li> <li>• Vented, unvented</li> <li>• Pump / no pump</li> <li>• Bath / no bath</li> </ul>	Where any of these aspects are unknown, assume the option from the parameters possible for the dwelling being assessed resulting in highest overall primary energy usage in DEAP. Default shower type: Vented with pump (highest flow rate)
Instantaneous waste water heat recovery	If the instantaneous WWHR system is not listed on the PCDB, do not include the WWHR in the DEAP assessment. Default for this entry is 'none present'
Is water usage target 125L/person/day?	No
Flow rate and flow restrictors	DEAP assumes defaults for shower flow rate if unknown. By default, assume flow restrictors are not present, unless proven otherwise.
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 onward: 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	<p>If solar collectors are present, the following data can be used for any unavailable parameters:</p> <ul style="list-style-type: none"> <li>- total aperture area of all collectors = 3 m<sup>2</sup></li> <li>-</li> <li>0 and/or a1 from Table H1</li> <li>- facing south, pitch 30°, modest overshading</li> <li>-</li> <li>combined cylinder, dedicated solar part one-third of total, or if a combi boiler the cylinder identified is a dedicated solar cylinder</li> <li>-</li> <li>ump is not solar powered</li> </ul>
Photovoltaics	<p>If PV collectors are present, the data for unavailable parameters are:</p> <ul style="list-style-type: none"> <li>-</li> <li>V area is roof area for heat loss, times percent of roof area covered by PVs, and if pitched roof divided by cos(35°)</li> <li>-</li> <li>Wp is 0.06 x PV area.</li> <li>-</li> <li>facing south, pitch 30°, modest overshading</li> </ul>
Group heating scheme	<p>If details cannot be ascertained they are defaulted to: system based on mains gas-fired boiler, efficiency 75%, piping installed before 1990, pre-insulated, flat-rate charging</p> <p>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</p>
Cooling Seasonal Efficiency (SEER)	Defaults as per Table S12.

## 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	<ul style="list-style-type: none"> <li>–Total floor area, average room height for each floor (including room in roof)</li> <li>–Floor area next to ground (including heated basement floors/walls) and associated exposed perimeters.</li> <li>–Floor area exposed to outside air or internal unheated air and associated exposed perimeters.</li> <li>–Floor area above partially heated space</li> <li>–Exposed wall areas</li> <li>–Semi exposed wall areas.</li> <li>–External door count</li> <li>–Exposed window area, orientation and detail on window construction as per Section 3.2.</li> <li>–Roof area</li> <li>–Living room area counted as per new dwellings</li> <li>–Estimate of thermal mass categories (mostly light, mostly heavy, medium).</li> </ul>	<p>Measured separately for main property and any extension</p> <p>For rooms-in-roof, measure floor area only, inside the dwelling</p>
Wall construction	One of types from Table S3 (also used for wall ventilation infiltration category)	Recorded separately for main dwelling and any extension.

Item	Data	Comment
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
Windows	External window area, orientation and detail on window construction as per Section 3.2.	
	Count of opening areas that have draught stripping based on a count of openable sections of windows, doors and attic/crawlspace hatches between the dwelling and the exterior or unheated spaces as described in Section 2.	
Ventilation	Openings: Count of chimneys, open flues, flueless combustion room heaters, intermittent fans and passive vents to be done in survey	
	Identify any whole house mechanical ventilation system present as one of the following, and determine specific fan power, heat exchanger efficiency and air flow rate here required: –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. –exhaust air heat pump Identify presence and adequate insulation of ductwork	

	outside the dwelling envelope. This requires minimum depth of 25 mm. with thermal conductivity of 0.04 W/mK or less.	
	Identify presence of a draught lobby	

Item	Data	Comment
	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	Number of each fixed lamp type	
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, and any other factors.	
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?	
	Showers and baths: flow rates, flow restrictors, type of shower (electric/mixer; pumped; vented/unvented)	
	Instantaneous wastewater heat recovery, efficiency, utilisation factor. Data from PCDB.	
	Target water usage 125L/person/day	
Mains available	gas Yes/no	
Solar heating	water 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 75% – 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	
Cooling system	Presence of a fixed cooling system (yes / no) Seasonal Energy Efficiency Ratio (SEER) default = 2.16 for electrical cooling systems.	

## Appendix U: Submission of BER assessments

DEAP allows registered BER assessors to create and save BER assessments in the web-based DEAP software. The completed assessment can be uploaded directly to SEAI's 'National Administration System for BER Assessments' (NAS) from within the DEAP software.

Incomplete assessments cannot be submitted to the NAS. The DEAP software can be found [here](#).

Information on how to access and use NAS, and how to submit completed assessments to NAS can be found [here](#).

DEAP allows you to see the Status of an uploaded assessment. The Status, will be one of the following values:

- Not yet published

The assessment has been uploaded to NAS from the DEAP Software but has not yet been published on the BER register. 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.

- Published

The BER assessor reviews and where applicable resolves the errors and notices associated with the not yet published BER assessment and then proceeds to publish the BER. The BER publication levy is applied when the BER status changes from not yet published to published. When a BER is published, the assessor generates the advisory report. The BER certificate and advisory report are available as pdfs in DEAP.

- Revoked

SEAI may revoke a BER certificate and advisory report where it has reasonable grounds for believing that the BER was not issued or completed in accordance with S.I. 243 of 2012 and the BER assessor Code of Practice.

- Errors resulting in a 'rejected' status

Assessments with errors will not be accepted on the NAS database. Assessments with errors must be corrected in DEAP and then resubmitted to the NAS database.

- Withdrawn

SEAI may withdraw a BER certificate and advisory report for administrative reasons including where there are errors in the dwelling address.

### **Warning notices**

Unexpected or unusual data may cause a warning notice to be generated when the assessment is uploaded to NAS.

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.

Warning notices have a severity indicator from 1 to 3 with 1 indicating the highest potential impact on the assessment. In accepting to publish the BER rating on the BER register, assessors are accepting to publish the BER in accordance with the DEAP methodology and the BER assessors' Code of Practice.

The DEAP software provides a number of functions for the user such as:

- Address search based on MPRN number;
- Validation of BER number against NAS register;
- BER assessment upload and download to and from NAS (requires registered assessor login);
- The HARP database.

Queries related to any aspect of the DEAP methodology, may be addressed under the DEAP Technical Guidance [here](#)..

Any further queries should be directed to the contacts [here](#)..

## TABLES

Most of the following tables are sourced from the UK Standard Assessment Procedure (SAP). 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 [°C]**

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/m<sup>2</sup> 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/m<sup>2</sup>]**

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 <sup>a) b)</sup>	0.60 <sup>a) b)</sup>
Storage combi boiler, primary store	n/a	Store volume $\geq$ 115 litres: 0.82 Store volume < 115 litres: $0.82 + 0.0022 \times (115 - V)$
Storage combi boiler, secondary store	n/a	Store volume $\geq$ 115 litres: 0.60 Store volume < 115 litres: $0.60 + 0.0016 \times (115 - V)$
Hot water only thermal store	0.89 <sup>c) d)</sup>	1.08 <sup>c) d)</sup>
Integrated thermal store and gas-fired CPSU	0.89 <sup>c) d)</sup>	1.08 <sup>c) d)</sup>
Electric CPSU: winter operating temp. 8 5°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 and heat pump systems only). A switch for summer/winter operation of space heating with a single timer shared between space and water heating is not considered to be separate time control of domestic hot water.
- 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	<b>96</b>
350	900	<b>72</b>
375	900	<b>84</b>
400	900	<b>96</b>
400	1050	<b>114</b>
450	675	<b>84</b>
450	750	<b>95</b>
450	825	<b>106</b>
450	900	<b>117</b>
450	1050	<b>140</b>
450	1200	<b>162</b>
450	1500	<b>206</b>
500	1200	<b>190</b>
500	1500	<b>245</b>
600	1200	<b>280</b>
600	1500	<b>360</b>
600	1800	<b>440</b>

**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.

In some cases, the cylinder or storage may be clearly much larger or much smaller than the values in Table 2a. In such instances, and in the absence of other information on labels or technical data based on relevant standards, the volume of a cylinder can be calculated by recording both the cylinder height and the diameter of the cylinder. The volume (which applies to hot water storage only) is then calculated as follows:

$$V = (\pi \times d^2/4) \times h / 1000$$

Where:

- d = diameter of the cylinder (cm)
- h = height of the cylinder (cm)
- pi = 3.142
- V = volume of the cylinder (litres)

- b) The storage vessel diameter may be determined based on vessel circumference, dividing the circumference by  $\pi$  (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 Agrément certificates

or a label on the vessel, provided the label also references a European or national standard (such as BS1566 or IS161) or is CE marked. While labels are regularly available on hot water storage vessels, they do not always show a relevant standard or CE mark.

- 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. Where there is a storage unit with a lagging jacket and a unit with factory insulation, the lagging jacket insulation is considered to be half as effective as factory foam insulation. Therefore, the thickness of the lagging jacket is multiplied by 0.5 and treated as factory fitted insulation. This average factory insulation thickness weighted by volume is then calculated.

Table 3: Primary circuit losses\*\*

System type*	
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 <sup>a)</sup>
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 $\geq 55$ litres	0
Storage combi boiler** store volume $V < 55$ litres	$600 - (V - 15) \times 15$ <sup>a)</sup>

<sup>a)</sup> 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 in the 'Water Heating: options and storage' tab;
  - b) enter appropriate electricity consumption from Table 4f in the Water Heating: options and storage 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:

$$\text{Loss} = 8.76 \times P \text{ (kWh/year)}$$

where P is the power rating of the heater in Watts

4. The DEAP software will automatically add the fuel use (in other words, the additional combi loss minus any associated electricity consumption) to the fuel required for water heating, and account for the electricity consumption separately.

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 <sup>34</sup>
<b>CENTRAL HEATING SYSTEMS WITH RADIATORS OR UNDERFLOOR HEATING</b>		
<b>Gas boilers and oil boilers</b>		
<i>For efficiency, use HARP database (<a href="https://www.seai.ie/energy-in-business/ber-assessor-support/harp-database/harp-database-search/">https://www.seai.ie/energy-in-business/ber-assessor-support/harp-database/harp-database-search/</a>) if possible, otherwise use efficiency from Table 4b.</i>		
<i>Use Table 4c for efficiency adjustments.</i>		
<i>Use Table 4d for responsiveness category.</i>		
<i>Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.</i>		
<b>Micro-cogeneration (micro-CHP)</b>		
<i>See Appendix N. Performance data to be obtained from HARP database.</i>		
<i>Use Table 4c for efficiency adjustments.</i>		
<i>Refer to Group 1 in Table 4e for control options and temperature adjustments due to control.</i>		
<b>Solid fuel boilers</b>		
<i>For efficiency, use HARP database if possible, otherwise use efficiency from this table. For open fires with back boilers and closed room heaters with boilers the efficiencies are the sum of heat to water and heat to room.</i>		
<i>Refer to Group 1 in Table 4e for control options.</i>		
Manual feed independent boiler in heated space (mineral or wood) <sup>a)</sup>	60	2
Manual feed independent boiler in unheated space (mineral or wood) <sup>a)</sup>	55	2
Auto (gravity) feed independent boiler in heated space <sup>a)</sup>	65	2
Auto (gravity) feed independent boiler in unheated space <sup>a)</sup>	60	2
Open fire with back boiler to radiators	55	3
Closed room heater 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
<i>Note: <sup>a)</sup> Heated space means within the boundary of the dwelling as defined in Section 1, 'Dwelling dimensions'.</i>		

<sup>34</sup> 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 <sup>a)</sup>	100	2
Dry core storage boiler in heated space <sup>a) b)</sup>	100	2
Dry core storage boiler in unheated space <sup>a) b)</sup>	85	2
Water storage boiler in heated space <sup>a) b)</sup>	100	2
Water storage boiler in unheated space <sup>a) b)</sup>	85	2

<sup>a)</sup> Heated space means within the boundary of the dwelling as defined in Section 1, 'Dwelling dimensions'.

<sup>b)</sup> Store within boiler capable of meeting all space heating needs

### Heat pumps with radiators or underfloor heating <sup>35</sup> (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
Exhaust 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).

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:

Old (large volume) storage heaters	100	5
Modern (slimline) storage heaters	100	4
Convactor storage heaters	100	4
Fan storage heaters	100	3
Modern (slimline) storage heaters with Celect-type control	100	3
Convactor 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

<sup>35</sup> If using these defaults, treat the heat pump as having IS EN 14511-2 data and follow DEAP Appendix G2

Refer to Group 7 in Table 4e for control options

*Off-peak tariffs:*

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
Room heater, 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<sup>36</sup>**

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
Exhaust air-to-air heat pump (electric)	250	1
Gas-fired, ground or water source	120	1
Gas-fired, air source	110	1

<sup>36</sup> If using these defaults, treat the heat pump as having IS EN 14511-2 data and follow DEAP Appendix G2.

**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 (room sealed flue)	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 room heaters**

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(%)
<b>Gas boilers (including LPG) 1998 or later</b>	
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
<b>Gas boilers (including LPG) pre-1998, with fan-assisted flue</b>	
Low thermal capacity	72
High or unknown thermal capacity	68
Combi	70
Condensing combi	83
Condensing	83
<b>Gas boilers (including LPG) pre-1998, with balanced or open flue</b>	
Wall mounted	65
Floor mounted, pre1979	55
Floor mounted, 1979 to 1997	65
Combi	65
Back boiler to radiators (gas fire as secondary heating)	65
<b>Combined Primary Storage Units (CPSU) (mains gas and LPG)</b>	
With permanent pilot (non-condensing)	70
With automatic ignition (non-condensing)	74
With permanent pilot (condensing)	79
With automatic ignition (condensing)	83
<b>Oil boilers</b>	
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
<b>Range cooker boilers (mains gas and LPG)</b>	
Single burner with permanent pilot	46
Single burner with automatic ignition	50
Twin burner with permanent pilot pre 1998	60
Twin burner with automatic ignition pre 1998	65
Twin burner with permanent pilot 1998 or later	65
Twin burner with automatic ignition 1998 or later	70
<b>Range cooker boilers (oil)</b>	
Single burner	60
Twin burner pre 1998	70
Twin burner 1998 or later	75

**Table 4c: Efficiency adjustment factors**

Heating system	Multiply by:	efficiency
<b>Gas or oil boiler systems with radiators or underfloor heating:</b>		
<i>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. DEAP automatically calculates these adjustment factors based on user entries.</i>		
<b>(1) Efficiency adjustment due to lower temperature of distribution system:</b>		
	<b>Mains gas</b>	<b>Oil or LPG</b>
Condensing boiler with load compensator <sup>a)</sup>	1.02	1.01
Condensing boiler with weather compensator <sup>a)</sup>	1.02	1.01
Condensing boiler with under-floor heating <sup>a) b)</sup>	1.03	1.02
Condensing boiler with thermal store <sup>a)</sup>	1	1
<b>(2) Efficiency adjustment due to control system</b>		
No thermostatic control of room temperature <sup>c)</sup>	0.95	
No boiler interlock <sup>c)</sup>	0.95	
<b>Group heating systems:</b>		
<b>(3) Efficiency adjustment due to charging method</b>		
Flat rate charging <sup>d)</sup>	0.90	
<b>Heat pumps:</b>		
<b>(4) Efficiency adjustment due to temperature of heat supplied<sup>37</sup></b>		
	<b>Space</b>	<b>DHW</b>
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) <sup>e)</sup>	0.7	
Heat pump with standard radiators and load or weather compensation (regardless of presence of underfloor heating, fan coil or low temperature radiators) <sup>e)</sup>	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
<b>Range cooker boilers gas or oil fired:</b>		

<sup>37</sup> The values shown only apply where Ecodesign data and associated standards do not apply, and DEAP Appendix G2 is being followed. For Ecodesign compliant systems, or systems with IS EN 14825 / IS EN 16147 data available, DEAP sets an efficiency adjustment factor of 1.0 and automatically carries out any relevant efficiency adjustments within the calculation.

*The following adjustment is to be applied only to the space heating gross seasonal efficiency (in other words not water heating efficiency), and only where the efficiency is obtained from the HARP database or manufacturer's declared value. ' $\Phi_{case}$ ' is the heat emission from the case of the range cooker at full load (in*

*kW); and ' $\Phi_{water}$ ' is the heat transferred to water at full load (in kW).  $\Phi_{case}$  and  $\Phi_{water}$  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. 'Charging based on heat consumed' means that charges are based on the amount of heat used rather than being charged at a flat rate.
- e) DEAP Appendix G1.1 provides guidance on derivation of design flow temperature as used by DEAP when deriving the efficiency adjustment factor where Ecodesign based data is not in use for the heat pump (Appendix G2 applies).

**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) <sup>1</sup>	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:

- responsiveness category is 2 if the room defined as the living area is heated using radiators
- otherwise, responsiveness category is 3.

See Table 4a for electric underfloor heating responsiveness.

**Table 4e: Heating system controls**

- Use Table 4a to select appropriate group in this table.
- 'Control category' is derived in the 'Space heating: controls and responsiveness' tab based on heating system category and relevant controls details entered by the user.
- The 'Temperature adjustment' modifies the temperature of the living area during heating hours, and is derived based on heating system category and controls details selected by the user in the 'Space heating: controls and responsiveness' tab.

Type of control	Control category	Temperature adjustment (°C)	Ref. 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 <sup>(2)</sup>
Programmer, no room thermostat	1	+0.6	Table 4c <sup>(2)</sup>
Room thermostat only	1	0	Table 4c <sup>(2)</sup>
Programmer + room thermostat	1	0	Table 4c <sup>(2)</sup>
Programmer + at least two room thermostats	2	0	Table 4c <sup>(2)</sup>
Programmer + room thermostat + TRVs	2	0	Table 4c <sup>(2)</sup>
Programmer + TRVs (likely to include bypass)	2	0	Table 4c <sup>(2)</sup>
Programmer + TRVs + flow switch	2	0	Table 4c <sup>(2)</sup>
Programmer + TRVs + boiler energy manager	2	0	Table 4c <sup>(2)</sup>
Time and temperature zone control	3	0	Table 4c <sup>(2)</sup>

**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<sup>(1)</sup>

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 or integrated thermal stores	n/a	-0.1	n/a
Underfloor heating	n/a	n/a	Table 4c <sup>(1)</sup>

**GROUP 2: HEAT PUMPS WITH RADIATORS OR UNDERFLOOR HEATING**

No time or thermostatic control of room temperature	1	+0.3	Table 4c <sup>(4)</sup>
Programmer, no room thermostat	1	+0.3	Table 4c <sup>(4)</sup>
Thermostat only	1	0	Table 4c <sup>(4)</sup>
Programmer + room thermostat	1	0	Table 4c <sup>(4)</sup>
Programmer + at least two room thermostats	2	0	Table 4c <sup>(4)</sup>
Programmer + room thermostat + TRVs + bypass	2	0	Table 4c <sup>(4)</sup>
Time and temperature zone control	3	0	Table 4c <sup>(4)</sup>

**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 <sup>(4)</sup>
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 <sup>(3)</sup>
Programmer and roomstat	1	0	Table 4c <sup>(3)</sup>
Programmer and TRVs	2	0	Table 4c <sup>(3)</sup>
Time and temperature zone control	3	0	Table 4c <sup>(3)</sup>

*(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
Collect-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
<b>GROUP 7: OTHER SYSTEMS</b>			
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
<b>Heating system:</b>	
Central heating pump (supplying hot water to radiators or underfloor system)	130 <sup>a)</sup>
Oil boiler <sup>b)</sup> – pump (supplying oil to boiler and flue fan) <sup>c)</sup>	100 <sup>a)</sup>
Gas fired heating flue fan (if fan assisted flue) such as gas boiler, gas fired heat pump, or gas fired warm air heating	45
Warm air heating system fans <sup>d)</sup>	0.6 × V
<b>Keep-hot facility of a combi boiler:</b>	
Electricity for maintaining keep-hot facility <sup>e)</sup>	
- keep-hot facility, controlled by time clock	600
- keep-hot facility, not controlled by time clock <sup>f)</sup>	900
<b>Ventilation system:</b>	
Mechanical extract ventilation <sup>g)</sup>	SFP × 1.22 × V
Balanced whole house mechanical ventilation fans <sup>g)</sup>	SFP × 1.22 × V
Positive input ventilation (from loft space)	0
Positive input ventilation (from outside) <sup>g)</sup>	SFP × 1.22 × V
<b>Solar water heating pump:</b>	
Solar water heating pump, electrically powered	75
Solar water heating pump, PV powered	0
<b>Electric shower:</b>	
Electricity used by electric shower assumes 6 minute (0.1 hrs) showers with power rating of 9.3 kW. Total kWh for electric showers per year =	
<u>9.3*0.1*365*(Number of electric showers * Total showers per day / number of showers)</u>	

**Notes:**

- a) Default values applied by DEAP. Multiply by a factor of 1.3 if room thermostat is absent. Also see information below on use of pump power data based on pump energy labelling and the Energy Efficiency Index.
- 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 Space heating: pumps and fans tab.
- e) See notes to Table 3a for the definition of keep-hot facility.
- f) In the case of an electrically powered keep-hot facility where the power rating of the keep-hot heater is obtained from HARP, the electric part of the total combi loss is taken as:
- g)  $LE = 8.76 \times P$  (kWh/year) (subject to a maximum of the value from Table 3a) where P is the power rating of the heater in Watts with the remainder (either 600 – LE or 900 – LE) provided by the fuel.
- h) If the power rating of the electric heater is not known assume all the keep-hot energy is supplied by electricity.
- i) SFP is specific fan power in W/(litre/sec), see paragraph 2.6 and Table 4g, V is volume of the dwelling in m<sup>3</sup>.

**Note on use of non-default central heating pump electricity consumption:**

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. 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 below 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. The energy label may only be used for standalone pumps and is not applicable for integrated pumps (pump not separated from the heating appliance).
- Where the pump power is known, the pump power is multiplied by the value selected from the table below 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:

$$(67.6 \times 40 / 65) = 41.6 \text{ kWh/yr}$$

Energy label category <sup>38</sup>	Annual electricity consumption (kWh)	
	Boiler controlled by room thermostat	Boiler not controlled by room thermostat
<b>A</b>	52	67.6
<b>B</b>	78	101.4
<b>C</b>	104	135.2
<b>Other / don't know</b>	130	169

Where a pump has an Energy Efficiency Index (EEI) value displayed on the pump nameplate or technical data sheet (as required by EU Commission Regulation 641/2009). The EEI may be used for standalone or integrated pumps. The annual electricity consumption =

- 130 \* EEI (boiler/heat pump controlled by room thermostat)
- 169 \* EEI (boiler/heat pump not controlled by room thermostat)

Where multiple central heating pumps are installed, then the BER assessor enters the total electricity consumption based on the calculations above 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.

Where manufacturer's pump curves are used by a manufacturer, supplier or system designer/specifier to calculate actual installed pump power, it is permitted to use the power consumption as identified on the pump curve. In this case manufacturer's pump curves with power consumption showing the system operating point as calculated by the pump specifier should be retained by the BER assessor. Commissioning sheets by the installer should also be provided in the case of completed dwellings.

**Table 4g: Specific fan power for mechanical ventilation systems**

Type of mechanical ventilation system	SFP, W/(litre/se c)
Balanced whole house mechanical ventilation, with or without heat2.0 recovery	
Mechanical extract ventilation, or positive input ventilation from outside	0.8
Exhaust air heat pump (EAHP)	0.26

**Table 5: Gains from fans and pumps**

Function	Gains (W)
----------	-----------

<sup>38</sup> 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 [here](#).

Central heating pump in heated space <sup>a)</sup>	10
Oil boiler pump, inside dwelling <sup>b)</sup>	10
Warm air or fan coil heating system fans <sup>a) c)</sup>	$0.06 \times V$
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
- a) 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 'Space heating: pumps and fans' tab.

**Table 6a: Default U-values (W/m<sup>2</sup>K) 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 [here](#) Table S9 outlines use of defaults for windows in existing dwellings as an alternative to use of Table 6a.

	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, $\epsilon_n = 0.2$ , hard coat)	2.7	2.3	2.1	3.3	2.8	2.6
double-glazed, air filled (low-E, $\epsilon_n = 0.15$ , hard coat)	2.7	2.2	2.0	3.3	2.7	2.5
double-glazed, air filled (low-E, $\epsilon_n = 0.1$ , soft coat)	2.6	2.1	1.9	3.2	2.6	2.4
double-glazed, air filled (low-E, $\epsilon_n = 0.05$ , 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, $\epsilon_n = 0.2$ , hard coat)	2.5	2.1	2.0	3.0	2.6	2.5
double-glazed, argon filled (low-E, $\epsilon_n = 0.15$ , hard coat)	2.4	2.0	1.9	3.0	2.5	2.4
double-glazed, argon filled (low-E, $\epsilon_n = 0.1$ , soft coat)	2.3	1.9	1.8	2.9	2.4	2.3
double-glazed, argon filled (low-E, $\epsilon_n = 0.05$ , 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, $\epsilon_n = 0.2$ , hard coat)	2.1	1.7	1.6	2.6	2.1	2.0
triple-glazed, air filled (low-E, $\epsilon_n = 0.15$ , hard coat)	2.1	1.7	1.6	2.5	2.1	2.0
triple-glazed, air filled (low-E, $\epsilon_n = 0.1$ , soft coat)	2.0	1.6	1.5	2.5	2.0	1.9
triple-glazed, air filled (low-E, $\epsilon_n = 0.05$ , 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, $\epsilon_n = 0.2$ , hard coat)	1.9	1.6	1.5	2.3	2.0	1.9
triple-glazed, argon filled (low-E, $\epsilon_n = 0.15$ , hard coat)	1.8	1.5	1.4	2.3	1.9	1.8
triple-glazed, argon filled (low-E, $\epsilon_n = 0.1$ , soft coat)	1.8	1.5	1.4	2.2	1.9	1.8
triple-glazed, argon filled (low-E, $\epsilon_n = 0.05$ , 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:

<b>Wood or PVC-U frame</b>	<b>U-value adjustment for roof window, W/m<sup>2</sup>K</b>
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:

<b>Metal frames</b>	<b>Adjustment to U-value, W/m<sup>2</sup>K</b>	
	<b>Window</b>	<b>Roof window</b>
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/m<sup>2</sup>K] half-glazed with double glazing [low-E, hard coat, argon filled, 6 mm gap, U-value of 2.5 W/m<sup>2</sup>K] has a resultant U-value of  $0.5(3.0+2.5) = 2.75$  W/m<sup>2</sup>K).

Source: SAP 2005

4. When the window U-value is declared using certified data rather than from Table 6a, 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.
5. The roof window adjustment applies for all roof windows, regardless of whether default or non-default U-values are used. Where a certified user defined roof window U-value includes adjustment for the roof window (instead of table 6a notes 1 or 2), do not select the roof window check box in DEAP. Enter the adjusted certified U-value as well as a certified solar transmittance. Ensure horizontal or north is selected correctly from the orientation dropdown.
6. Selection of correct window orientation is detailed in Table 1b footnotes.

**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  $g_{\text{window}}$ , and the solar transmittance,  $g_{\perp}$ , is unavailable, then solar transmittance to be entered in DEAP =

$$g_{\perp} = g_{\text{window}} / [\text{Frame Factor} * 0.9].$$

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 " $g_{\text{window}} / [\text{Frame Factor} * 0.9]$ " 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.
4. As outlined above, there are different types and notations for solar transmittance. If in any doubt about the solar transmittance value provided in test data, check with the supplier/manufacturer/test laboratory to ensure you use or derive the correct  $g_{\perp}$  value.

**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 must be used instead of the data in Table 6c provided 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 must be used where available.

**Table 6d: Solar and light access factors**

<b>Overshading</b>	<b>% of sky blocked by obstacles</b>	<b>ID</b>	<b>Winter solar access factor</b> (for calculation of solar gains)	<b>Summer solar access factor</b> (for calculation of summer temperatures – Appendix P)	<b>Light access factor</b> (for calculation of lighting requirement)
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

**Note:** 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 estimate of the sky that 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	Percentage from secondary
All gas, oil, solid fuel, heat pump and group heating systems	all secondary systems	10%
Micro-cogeneration	all secondary systems	see Appendix N
Electric storage heaters (not integrated)	all secondary systems	
- not fan-assisted		15%
- fan-assisted		10%
Integrated storage/direct-acting electric systems		10%
Electric CPSU		10%
Electric room heaters		20%
Other electric systems		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<sup>(1)</sup>**

Fuel	Renewable primary energy factor, Fp, ren	Non renewable primary energy factor Fp, nren	Total primary energy factor	Emissions kg CO <sub>2</sub> per kWh
<b>Gas:</b>				
mains gas	0	1.1	1.1	0.203
bulk LPG (propane or butane)	0	1.1	1.1	0.232
bottled LPG	0	1.1	1.1	0.232
<b>Oil:</b>				
heating oil	0	1.1	1.1	0.272
Biodiesel from renewable sources only <sup>(7)</sup>	1	0.3	1.3	0.047
Bioethanol from renewable sources only <sup>(7)</sup>	1	0.34	1.34	0.064
<b>Solid fuel:<sup>(2)</sup></b>				
house coal	0	1.1	1.1	0.361
Anthracite	0	1.1	1.1	0.361
manufactured smokeless fuel	0	1.2	1.2	0.392
peat briquettes	0	1.1	1.1	0.377
sod peat	0	1.1	1.1	0.375
wood logs	1	0.1	1.1	0.025
wood pellets - in bags, for secondary heating	1	0.1	1.1	0.025
wood pellets - bulk supply, for main heating	1	0.1	1.1	0.025
wood chips	1	0.1	1.1	0.025
solid multi-fuel	0	1.1	1.1	0.369
<b>electricity<sup>(3)</sup></b>	(8) <sup>(3)</sup>	(8)	(8)	(8)
electricity displaced from grid	(8) <sup>(4)</sup>	(8) <sup>(4)</sup>	(8) <sup>(4)</sup>	(8) <sup>(4)</sup>
<b>District heating schemes:</b>				
heat from boilers – waste combustion	0	1.1	1.1	0.057
waste heat from power stations	0	1.05	1.05	0.018

**Notes**

1. Current domestic fuel costs per kWh are available [here](#). Cost calculation is not part of the BER assessment but may be done using the delivered energy values (on the 'View assessment' section) 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, that is to say 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<sup>3</sup>) 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<sub>2</sub> factors are published [here](#) . These figures are updated as new 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. These factors do not apply to individual heating systems heating the dwelling.

Heat distribution system	Factor
Mains piping system installed in 1990 or earlier, not pre-insulated medium or high temperature distribution (120-140°C), full flow system	1.20
Pre-insulated mains piping system installed in 1990 or earlier, low temperature distribution (100°C or below), full flow system.	1.10
Modern higher temperature system (up to 120°C), using pre-insulated mains installed in 1991 or later, variable flow system.	1.10
Modern pre-insulated piping system operating at 100°C 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 [here](#)

System	Fraction at on-peak rate
Integrated storage/direct acting systems (storage heaters and underfloor heating)*	0.20
Other storage heaters*	0.00
Direct-acting electric boiler*	0.90
Other direct acting electric space heating *	1.00
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 <sup>+</sup>	Fraction from Table 10b

\*Fraction applies to electricity for space heating

+Fraction applies to electricity for water heating

**Table 10b: On-peak fraction for electric water heating**

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.

$$\begin{aligned} \text{Dual immersion:} & \quad [(6.8 - 0.024V)N + 14 - 0.07V]/100 \\ \text{Single immersion:} & \quad [(14530 - 762N)/V - 80 + 10N]/100 \end{aligned}$$

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 Appendix F for the on peak fraction for an electric CPSU.

Source: SAP 2005

**Table 11: Thermal mass categories for the dwelling**

Category	AmAf ranges		Heat capacity per unit floor area	
	Low	High	[MJ/m <sup>2</sup> 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

**Notes:**

- Am = area of thermally heavy elements
- Af = Total dwelling floor area as calculated by DEAP and shown on Results tab
- AmAf = Area of thermally heavy elements divided by total floor area. As an example, any AmAf value between 0.26 and 0.75 results in the dwelling's thermal mass category being Medium-low in DEAP.
- UF: for calculation of utilisation factor
- IH: for calculation of effect of intermittent heating

**Procedure for use of Table 11:**

1. First, each opaque element type (walls, ceilings, floors, both external/ exposed and internal) are classed as either low, medium or heavy mass, by selecting the class of the construction from Table 11a most closely matching the construction in question.
2. If an element appears borderline between two of light/medium/heavy from Table 11a, then assume half of its area belongs to each of the two applicable mass categories.
3. The area of the heavy thermal mass elements is calculated as " $A_{\text{heavy}}$ "
4. The area of the medium thermal mass elements is calculated as " $A_{\text{medium}}$ " and is multiplied by 0.5.
5. Derive Am = Area of thermally heavy elements =  $A_{\text{heavy}} + (A_{\text{medium}} \times 0.5)$ . It does not include area of low thermal mass elements.
6. Divide Am by the total floor area of the dwelling to obtain the Am/Af value
7. Select the dwelling thermal mass category to be input into DEAP using Table 11 based on Am/Af

**Notes:**

- a) Where an element has two sides exposed to the heated space, e.g. internal partitions or intermediate floor, both sides of the element are included in the area calculation above.
- b) Where an element includes an opening, e.g. a door or window, the calculated area is net of that opening.
- c) The Table 11 methodology can be used for existing or new dwellings. Alternatively, Table S10 may be used for existing dwellings.
- d) Windows and doors are categorised as light and are not included in the Am/Af calculation.

**Table 11a: Mass of construction elements**

Table 11a is used to identify the mass for common floor and wall types. It is used when following the thermal mass derivation methods in Section S10 or the method above in Table 11. Section 7.3 outlines options for more detailed calculation of thermal mass.

Element type	Description	Mass
Ground floor	Suspended timber floor	Light
Ground floor	Solid floor	Medium
Ground floor	Suspended steel frame floor	Light
Ground floor	Suspended beam and block floor	Medium
Ground floor	Suspended concrete beam floor	Medium
Ground floor	Suspended concrete plank floor	Medium
External wall	Timber/steel frame	Light
External wall	Masonry cavity fill with plasterboard on dabs	Medium
External wall	Masonry externally insulated with plasterboard on dabs	Medium
External wall	Masonry internally insulated	Light
External wall	Masonry cavity fill with dense plaster	Heavy
External wall	Masonry externally insulated with dense plaster	Heavy
External wall	Curtain walling	Light
External wall	Aerated concrete blockwork with plasterboard on dabs	Light
Separating wall	Masonry with plasterboard on dabs	Medium
Separating wall	Masonry with dense plaster	Heavy
Separating wall	Timber/steel frame	Light
Internal partition	Plasterboard on timber/steel stud	Light
Internal partition	Masonry with plasterboard on dabs	Medium
Internal partition	Masonry with dense plaster	Heavy
Party Floors	Concrete floor slab	Medium
Party Floors	Timber I-joints	Light
Party Floors	Precast concrete planks floor, screed	Light
Party Floors	Chipboard floor, plasterboard ceiling	Light

**Notes:**

1. Ground floor: Can be bare, laminated, tiled, carpeted, or with wood laid directly over.
2. Masonry external walls includes all types of masonry, such as brick, concrete block, hollow concrete block, cast in situ concrete. The only exception is aerated concrete block which has a specific mass assignment if in combination with plasterboard on dabs as shown above.
3. Most ceilings will have a light mass. Where ceilings are present with heavy mass such as a concrete intermediate floor in a dwelling or concrete floor of apartment above is the ceiling, Section S10 approach cannot be used for existing dwellings. Where this is the case, Section 7.3 or Table 11 are used.
4. The derivation of the thermal mass category also requires knowledge of the thermal mass of internal partitions (as recorded during survey or review of dwelling plans).

**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/M <sup>3</sup> )	Thermal conductivity [ $\lambda$ ] (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	2880	3.500
Granite	2880	2.800
Limestone (soft)	1800	1.100
Limestone (hard)	2200	1.700
Marble	2800	3.500
Sandstone	2600	2.300
Straw thatch	240	0.07

Mud Phuska (cob)	1620	0.52
------------------	------	------

**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 [ $\lambda$ ] (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 (2021), CIBSE Guide A, IS EN ISO 10456, CE71 (EST).

**w:** <https://www.seai.ie/energy-in-business/ber-assessor-support/deap/>

**e:** [registered@ber.seai.ie](mailto:registered@ber.seai.ie)

**t:** 1890 252 738 / 01 248 6986

The Sustainable Energy Authority of Ireland, 3 Park Place, Hatch Street Upper, Dublin 2



Rialtas na hÉireann  
Government of Ireland