Energy Efficiency Obligation Scheme: Cross-Sector Deemed Scores

Q1 2023

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V1.0

Report prepared for SEAI by:
Fuinniv Independent Consulting

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.

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1. Introduction

This document describes analysis carried out on data from SEAI's domestic Building Energy Rating database to determine the impact on delivered energy when a series of energy upgrade measures are applied to a typical or "average" dwelling. The resulting delivered energy savings figures are to be used as a basis for deemed energy credits in residential upgrades. Deemed energy credits are pre-determined figures based on savings derived when set measures are applied to an average dwelling.

The methodology in this report follows the approach used in the Q4 2021 SEAI report "Energy Efficiency Obligation Scheme Uplift Calculations" to derive a starting or "baseline" dwelling against which upgraded dwellings are compared. This baseline dwelling derivation is restated in this Energy Credits Update report for completeness. The baseline represents the dwelling before measures are applied.

The steps to derive energy credits are summarised as follows:

- Derive "median" BER grade and associated dwelling entries for a DEAP (Dwelling Energy Assessment Procedure) calculation to give the "baseline" delivered energy in kWh/ m^2/yr
- For each measure apply relevant changes to the baseline dwelling's DEAP calculation to derive delivered energy post upgrade
- Subtract the upgraded dwelling's delivered energy from the baseline delivered energy to calculate delivered energy savings in kWh/ m^2/yr
- Energy savings for heating controls upgrades are halved to account for the principle of "additionality" as outlined in the Energy Efficiency Directive methodology, specifically the EU Commission's guidance that controls only have a lifetime of 5 years.
- A correction factor of 0.91 is applied to the above energy savings to account for prebound and rebound factors (actual energy savings based on user behaviour "rebound" and "prebound" effect). This factor was previously published in the EEOS Guidance document.
- The per m^2 delivered energy saving with correction factor applied is multiplied by 110m^2 (typical average house area) to give the energy saving per measure for houses
- The per m^2 delivered energy saving with correction factor applied is multiplied by 70m^2 (typical average apartment area) to give the energy saving per measure for apartments

The methodology used to derive the median BER grade was agreed with SEAI during the "uplift" project and is described in Section 2 before deriving the resulting baseline dwelling as per Section 3 below. The measures under consideration for deemed energy credits are outlined in Section 4 and were also agreed with SEAI. The resulting energy credits are also detailed in Section 4.

2. Median BER Grade derivation

The BER dataset was filtered during the "Energy Efficiency Obligation Scheme Uplift Calculations" study based on a set of criteria agreed with SEAI prior to generating the baseline dwelling. This section describes the process for the "Median" BER grade derivation.

The purpose of this task was to filter the published BER Research Tool data to determine the average primary energy per m^2 per year (and associated average BER grade) weighted by floor area from relevant dwellings. This task also determines average heat pump efficiencies for space and water heating in existing dwellings. Reasoning for application of filters is outlined as follows:

- BER research tool data downloaded 17th June 2021.
- 969,990 total number of dwellings
- Of these, 849,599 are existing
    - This study is based on existing dwellings only. New dwellings are not included.
- Of these, 278,506 were published on or after April 2017
    - This is when the electricity primary energy factor of 2.08 was first applied. This 2.08 electricity factor was in place at the time this study was carried out. This filter ensures that higher "older" primary energy factors don't skew the median BER grade.
- Of these, 270,515 have primary energy <= 600kWh/m^2/yr
    - This is applied to reduce likelihood of "outliers" (e.g., assessments with erroneous data entered, or assessments that were incomplete yet valid for BER assessment)
- Of these, 219,295 have main space heating from oil / gas / LPG
    - These are by far the most common fuels and it is best to ensure that average system efficiencies taken into account are reflective of these fuels. According to the CSO [1] at the time of the "uplift" study, oil and mains gas are used in over ¾ of dwellings with BERs.
- Of these 219,295 dwellings:
    - Total of all floor areas = 26,306,959 m^2 (call this TFA)
    - Total of all floor areas * BER grades = 5,735,566,444. This is a "sumproduct" type calculation. Call this SUMPRODUCT)
    - Weighted BER grade = SUMPRODUCT/TFA = 218kWh/m^2/yr. This is a C3 rating and is the median BER grade used to derive the baseline dwelling for the purposes of this analysis. [2]
    - As an aside, the unweighted average BER grade is 226kWh/m^2/yr (this is a D1, but is very close to C3).

[1] https://www.cso.ie/en/releasesandpublications/er/dber/domesticbuildingenergyratingsquarter12021/

[2] There are a few of reasons the median is better than the D1 or D2 we might usually expect:

- These dwellings are slightly larger than average (120m^2). Likely because of the fossil fuel source used. Apartments and smaller holiday homes might lean towards electric heating. Larger dwellings tend to have a better BER, all other things being equal.
- Only the electricity primary energy factor of 2.08 is used, so electricity "primary energy" is a better reflection of current electricity usage, but gives a "better" BER.
- As the fuel is oil/gas/LPG, these would likely lower better "primary energy" usage, on which the BER is based, thanks to their lower primary energy factor relative to electricity. These appliances would generally be more efficient than solid fuel main space heating (also excluded).

- **WRT heat pumps typical efficiency derivation:**
  - Of the 849,599 existing dwellings, filter to show only ratings with:
    - date of assessment from 2016 onwards: this is when the use of Ecodesign data and more advanced heat pump efficiency calculation came into force in DEAP. There are 366,098 dwellings meeting this criteria.
    - For each of space and water heating
      - Filter to show fuel = electricity
      - Filter to show efficiency >= 200 (space heating) and >= 150 (water heating)
      - Filter to show efficiency adjustment factor = 1 (indicates probability that the 2016 methodology was used by the assessor).
      - The 7,637 space heating heat pumps meeting this criteria have average efficiency = 391%.
      - The 6,865 water heating heat pumps meeting this criteria have average efficiency = 219%.

3. Baseline dwelling development

Following the filtering process in Section 2, the median BER grade is known, and therefore the baseline dwelling at that BER grade can be defined. The 219,925 rows referenced above are filtered to show relevant rows ("C3" grade dwellings only).

There are 28,492 C3 dwellings in the filtered dataset from Section 2 above. The relevant entries in DEAP are derived based on typical values for C3 dwellings using means or modes depending on the field in question, rounding to integers where appropriate. The resulting entries are sense checked to ensure there are no unreasonable entries in the median dwelling BER assessment. The overall goal is to give an objective assessment of "typical" values so that a baseline dwelling can be recreated in a DEAP calculation.

The baseline dwelling derivation is carried out in a workbook split into two tabs:

- **DwellingEntries** includes:
  - The name of 90 fields required for the DEAP calculation
  - The "tab" in which those fields are found in the Excel version of the DEAP calculation
  - The corresponding BER research tool field
  - A text summary of how the DEAP field is derived from the BER data
  - The resulting value to be used in the DEAP assessment.
- **SourceData** shows the BER research tool database filtered showing the 28,492 C3 grade dwellings only. The DEAP entry for relevant fields is derived from this tab. The following is a non-exhaustive list of examples:
  - Number of storeys for the DEAP ventilation section is a simple average of the number of storeys for each dwelling in the filtered dataset. It is rounded to zero decimal places to give a value of "2" for the baseline dwelling as shown in the following excerpt in Figure 1 from the "SourceData" tab:

R4 =ROUND(AVERAGE(R6:R50000),0)

	A	R	S	T	
1	**How is DEAP entry derived**	Average (round to integer)		Most common value (mode). Trim trailing spaces	Mo trai
2	**DEAP tab**	Vent		ER1	ER
3	**DEAP field name**	Number of storeys in the dwelling		Fuel: Space heating - main	Fu
4	**DEAP entry value**	2.00		Mains Gas	
5	**CountyName**	**NoStoreys**	**CO2Rating**	**MainSpaceHeatingFuel**	**M**
6	Co. Tipperary	1	55.75	Heating Oil	He
7	Co. Dublin	2	43.5	Mains Gas	Ma
8	Co. Meath	1	39.97	Mains Gas	Ma

Figure 1: Example: derivation of number of storeys from BER data

The DEAP entries ready for use in DEAP-> Vent are shown in Figure 2 in the DwellingEntries tab, with the number of storeys derived as per Figure 1 highlighted:

	A	B	C	D	E
	DEAP tab	DEAP field name	BERResearchTool field name	How is DEAP entry derived	DEAP entry valu
1	Vent	Number of chimneys	NoOfChimneys	Average (round to integer)	1
2	Vent	Number of open flues	NoOfOpenFlues	Average (round to integer)	0
3	Vent	Number of intermittent fans and passive vents	NoOfFansAndVents	Average (round to integer)	3
4	Vent	Number of flueless combustion room heaters	NoOfFluelessGasFires	Average (round to integer)	0
5	Vent	Is there a draught lobby on main entrance?	DraftLobby	Most common value (mode)	NO
6	Vent	Number of storeys in the dwelling	NoStoreys	Average (round to integer)	2
7	Vent	Has an air permeability test been carried out?	PermeabilityTest	Most common value (mode)	NO
8	Vent	Structure type	StructureType	Most common value (mode)	Masonry
9	Vent	Is there a suspended wooden ground floor?	SuspendedWoodenFloor	Most common value (mode). Overriding to match DEAP workbook terminology. "None" dominates	None
10	Vent	Percentage of windows and doors draughtstripped [%]	PercentageDraughtStripped	Average of all values	94.41
11	Vent	Air Tightness Test Reference Number	n/a as "no test" dominates	n/a	
12	Vent	Air permeability test in m3/hr/m2 (q50). Follow TGD L guidance.	n/a as "no test" dominates	n/a	
13	Vent	Number of sides sheltered	NoOfSidesSheltered	Average (round to integer)	2
14	Vent	Ventilation method	VentilationMethod	Set to natural ventilation as text is abridged in research tool	Natural ventilation
15	Vent	Mechanical ventilation info	n/a as "natural ventilation" dominates	n/a	

SourceData DwellingEntries

Figure 2: Example: collating DEAP "Vent" tab entries

- Floor areas (for the DEAP dimensions section) are a simple average of all available corresponding floor areas. Note for first, second, third and room in roof floor areas, the results are combined into a single first floor: this reflects the fact that this typical dwelling has 2 storeys consisting of ground and first floors only.
- Corresponding floor heights are averaged for each storey. Again, the height is combined into the first floor from first, second, third, room in roof heights, weighted by the area of each corresponding floor.
- U-values for each building element are weighted by the corresponding area of each building element. The corresponding building element areas are a simple average of the available values.
- Several fields are based on a "mode", identifying the most frequently occurring value in the filtered dwellings such as:
  - Each fuel type field
  - Structure type for DEAP's ventilation tab
  - Presence of hot water storage
- Some fields are not available in the BER research tool, requiring assumptions to be made, such as:
  - Window orientation is assumed to be East/West and represents an average solar gain
  - Solar gain and frame factor are assumed to be based on double glazing: this is the best estimate based on the average U-value identified.
  - The BER research tool is based on DEAP3 so has incomplete information on the latest changes to DEAP's water heating system and lighting calculations. To overcome this:
    - The dataset indicates that there is no low energy lighting in DEAP assessments carried out in DEAP 4. On this basis, the low energy lighting average is derived from assessments carried out in 2017 and 2018 only (before DEAP 4 commenced). The result is converted to the efficacy for use in the DEAP 4 workbook (assuming that 100% low energy lighting would have efficacy of 66.9 Lumens/Watt: the efficacy for LEDs/CFLs according to DEAP Appendix L).
    - The dataset doesn't show information on baths or showers. On this basis, DEAP4 is allowed to work out hot water usage purely based on number of occupants rather than hot water outlets (as was the approach in DEAP3).

Now that the DEAP entries for the baseline dwelling (based on the C3 median BER grade) are available, a DEAP4 (Excel based) file automatically sources the DEAP fields generated above so that the baseline dwelling DEAP calculation can be carried out. A new tab (EEOS_KPIs) is added to this DEAP calculation to summarise relevant data

for each DEAP calculation as shown in Table 1. This new tab is also used after measures are applied to enable a comparison of KPIs across all measures against the baseline dwelling.

Most of the values in EEOS_KPIs are taken directly from the DEAP workbook tabs.

The following are the basic parameters of the baseline dwelling:

- 2 storey
- 116m^2 total floor area with 75m^2 ground floor and 24m^2 living room area
- HLI = 2.57
- Gas heating with efficiency ~ 83%
- East/West orientation is assumed (as orientation is not listed in the BER research tool)
- Semi-detached is the most common house type in the C3 dwellings in the BER dataset[3]

[3] This corresponds to a certain extent to the floor, wall and opening areas, depending on the "shape" and "form" of the C3Median dwelling.

Tab	Field	Value
Dim	Ground or lowest floor area	75
Dim	First floor area	42
Dim	Total floor area [m2] area	116
Dim	Living area	24
Vent	Number of storeys in the dwelling	2
Vent	Infiltration rate - final [ac/h]	0.68
Win	Orientation	East/West
Fab	**Areas**	**Areas**
Fab	Windows/rooflights	21.03
Fab	Doors	3.20
Fab	Floor	73.55
Fab	Walls	100.21
Fab	Roof	75.75
Fab	**U values**	**U values**
Fab	Windows/rooflights	2.73
Fab	Doors	2.89
Fab	Floor	0.49
Fab	Walls	0.62
Fab	Roof	0.36
Fab	HLI	2.57
Light	Average Efficacy	26
Light	equivalent low energy lighting %	39%
WH	HW cylinder insulation type	Factory Insulated
WH	HW cylinder insulation thickness	33
WH	Is supplementary electric immersion heating used in summer?	NO
SH	Heating system control category (Table 4e)	1
ER1	Main space heating efficiency	83%
ER1	Main space heating fuel	Mains Gas
ER1	Main water heating efficiency	84%
ER1	Main water heating fuel	Mains Gas
ER1	Secondary space heating efficiency	43%
ER1	Secondary space heating fuel	solid multi-fuel
Result	Delivered energy[kWh/m2 y]	183
Result	Primary energy[kWh/m2 y]	206.13
Result	Building Energy Rating	C3
Heat pump readiness		**HP ready**
	HLI <=2?	FALSE
	HLI in 2 to 2.3 band?	FALSE
	HLI > 2.3?	TRUE
	Heat pump ready?	**FALSE**
Number of dwellings in filtered stock	**for this "typical" dwelling**	**28492**

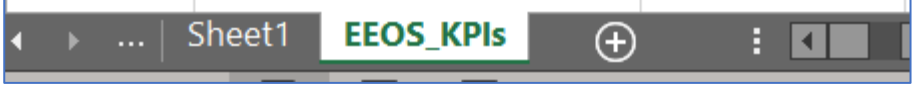

Table 1: KPIs for the baseline dwelling DEAP calculation

4. Energy upgrade measures and energy credits derivation

Following entry of the baseline dwelling in the DEAP workbook, measures are defined and applied to the baseline dwelling as per Section 4.1 and 4.2. The impact of those measures in terms of delivered energy and resulting energy credits are shown in Section 4.3.

4.1. Applying measures to the baseline dwelling

The following 29 measures were agreed with SEAI and applied to the baseline dwellings. In each case, only the relevant DEAP entries are overridden with the values required by the measure in question. Application of measures in DEAP is generally straightforward (e.g., 1-2 entries changed for an individual measure), although some measures are more complex (e.g., heating controls plus heating system measures) requiring changes on several tabs for the water and space heating system.

Measure	Minimum Specification to claim credits- All measures installed must meet the minimum specification listed below	Key parameters for calculation of energy credits in DEAP
Baseline	Baseline dwelling prior to any upgrade measures	n/a this is the baseline dwelling
Roof Insulation	Insulation as per TGD L 2008 • On the ceiling to U-Value 0.16 W/m²K • On the rafter to 0.2 W/m²K • On flat roofs to 0.22 W/m²K	Roof U-value = 0.16W/m^2K
External Wall Insulation	To U-Value 0.27 W/m²K as per TGDL 2008	Wall U-value 0.21W/m^2K
Internal Dry Lining Wall Insulation	To U-Value 0.27 W/m²K as per TGDL 2008	Wall U-value 0.27W/m^2K
Cavity Wall Insulation	To U-Value 0.50 W/m²K	Wall U-value 0.35W/m^2K
Floor Insulation	To U-Value 0.36 W/m²K	Floor U-value 0.36W/m^2K
Full Window Replacement (incl doors with > 60% glazing)	To U-Value 1.4 W/m²K	Window U-value 1.4W/m^2K Solar factor = 0.63
External Door Replacement	To U-Value 1.4 W/m²K	Door U-value 1.4W/m^2K
High Efficiency Gas or Oil fired Boiler with Fully integrated Heating Controls Upgrade	90%+ Boiler gross seasonal efficiency as per HARP database, full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 80mm hot water cylinder insulating jacket	90% space and water heating efficiency. Full time and temperature zone controls. 80mm lagging jacket added to existing cylinder insulation.
Fully integrated Heating Controls Upgrade	Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008	Full time and temperature zone controls
High Efficiency Gas or Oil fired Boiler with Entry Level Heating Controls Upgrade	90%+ Boiler gross seasonal efficiency as per HARP database, 24hr/7day programmer and room thermostat	90% space and water heating efficiency with entry level controls below
Biomass boiler with thermal store and Fully integrated Heating Controls Upgrade	Min gross efficiency of 77% as per HARP. Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 80mm hot water cylinder insulating jacket	82% space and water heating efficiency. Full time and temperature zone controls. 80mm lagging jacket added to existing cylinder insulation.
Biomass boiler without thermal store and Fully integrated Heating Controls Upgrade	Min gross efficiency of 82% as per HARP. Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 80mm hot water cylinder insulating jacket	82% space and water heating efficiency. Full time and temperature zone controls. 80mm lagging jacket added to existing cylinder insulation.
Entry Level Heating Controls Upgrade only	24 hour 7 day programmer & room thermostat	Room thermostat. Hot water cylinder thermostat. Boiler interlock. Time control of space and water heating.
Solar Water Heating Installation	Sized and installed in accordance with SR 50-2	Solar water heating system achieving 55% solar fraction. 200L combined cylinder with 50mm factory fitted insulation and thermostat
Water to Water Heat Pump with Fully integrated Heating controls Upgrade	Water to Water Heat pump, minimum SPF of 485. Listed on the HARP, EHPA, Ecolabel or Eurovent database3 Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 50mm pre insulated hot water cylinder	391% space heating efficiency. 219% water heating efficiency. Full controls and factory insulated cylinder

Air to Water Heat Pump with Fully integrated Heating controls Upgrade	Air to Water Heat pump, minimum SPF of 350. Listed on the HARP, EHPA, Ecolabel or Eurovent database3. Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 50mm pre insulated hot water cylinder	
Brine to Water Heat Pump with Fully integrated Heating controls Upgrade	Brine to Water Heat pump, minimum SPF of 390. Listed on the HARP, EHPA, Ecolabel or Eurovent database3. Full zone control on space and water heating, with at least 2 zones for space heating as recommended in TGD L 2008 and 50mm pre insulated hot water cylinder	
Air to Air Heat Pump with Fully integrated Heating controls Upgrade	Air to Air Heat pump, minimum SPF of 325%. Listed on the HARP, EHPA, Ecolabel or Eurovent database* Full zone control with at least 2 zones for space heating as recommended in TGD L 2008. 50mm pre insulated hot water cylinder	361% space heating efficiency with full space heating controls
High heat retention storage heaters	High heat retention storage heaters (as per SAP 2013) replacing existing electric storage system Heat retention not less than 45% as measured in accordance with EN 60531. Test results must be from or endorsed by a body accredited to test to EN 60531	100% space heating efficiency with storage heating automatic controls
High heat retention Cylinder (minimum standing loss of 0.5W/litre)	Replacement of existing uninsulated/jacket insulated hot water cylinder with a High heat retention cylinder as per the Heating and Domestic Hot Water Systems for dwellings – Achieving compliance with Part L 2008 document: (i.e. that the heat loss from the cylinder will not exceed 1.6 X (0.2 + 0.051V2/3) kWh per 24 hours, where V is the nominal cylinder capacity in litres), or a standing loss less than 0.5W/l per hr Tested to BS 1566: 2002 Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods and/or BS 7206:1990 Specification for unvented hot water storage units and packages	Cylinder loss based on 0.5W/L
Mechanical ventilation	• Whole-house extract ventilation • Detailed list of relevant standards and performance criteria in Section 6.31 of SEAI DTSS.	0.25 Q50/20 airtightness 0.3W/L/S Specific fan power as per DTSS
Air tightness	Air tightness test value for measure	0.25 Q50/20 airtightness

Table 2: Minimum measures specification and parameters in DEAP for energy credits derivation

See Figure 3 for an example of applying the roof insulation measure: the U-value is changed to 0.16.

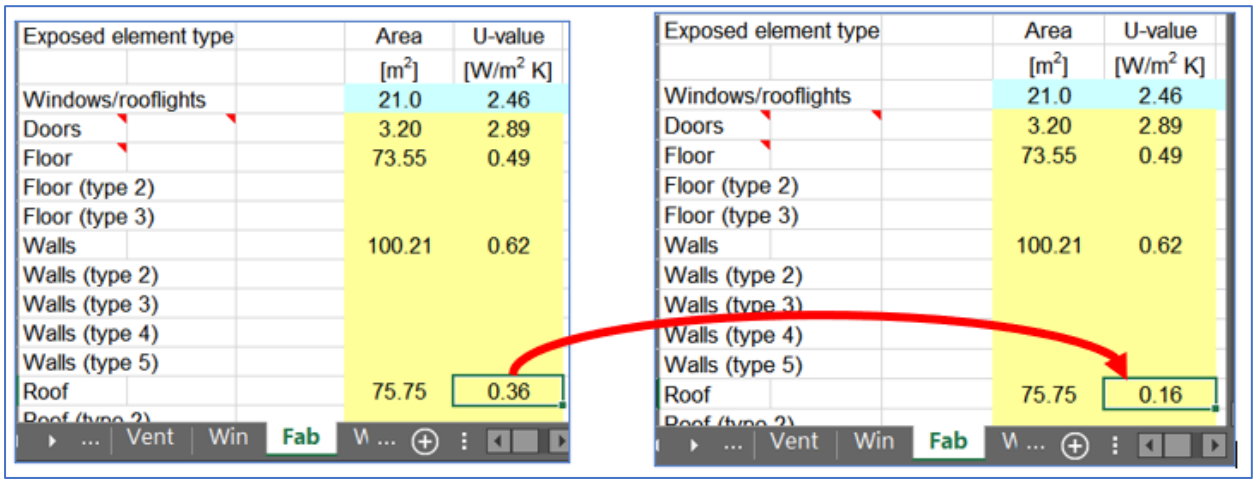

Figure 3: Applying the roof insulation measure (U-value = 0.16 W/m²K) to the baseline

4.2. Credits derivation

4.2.1. Credits derivation example: roof measure

Taking the example of the roof measure above (setting the U-value to 0.16 W/m^{2}K in DEAP), the resulting change is reflected in the summary KPIs below. The HLI (heat loss indicator) improves from 2.57 to 2.44. There is an improvement of 8.23kWh/m^2/yr in delivered energy. Applying the correction factor of 0.91 (referenced in Section 1) , gives an adjusted kWh saving per m^2 of 7.5. This gives energy credits of 824 in a house (typically assumed to be 110m^2) and 524 in an apartment (typically assumed to be 70m^2).

Measure title		Baseline	Roof 0.16
Fab	**U values**	**U values**	**U values**
Fab	Windows/rooflights	2.73	2.73
Fab	Doors	2.89	2.89
Fab	Floor	0.49	0.49
Fab	Walls	0.62	0.62
Fab	Roof	0.36	0.16
Fab	HLI	2.57	2.44
Result	Delivered energy[kWh/m2 y]	182.56	174.33
Result	Primary energy[kWh/m2 y]	206.13	197.07
Result	Building Energy Rating	C3	C2
Deliv energy per m2 saving RAW	**kWh/m2/yr no adjustment applied**	**0**	**8.23**
Deliv energy per m2 saving (apply correction factor)	**kWh/m2/yr apply correction factor of 0.91**	0	7.5
Multiply by typical house area. m2 = 110	**Delivered energy saving kWh/yr (House)**	**0**	**824**
Multiply by typical apartment area. m2 = 70	**Delivered energy saving kWh/yr (apartment)**	**0**	**524**

Figure 4: Roof measure: credits derivation

4.2.2. Credits derivation example: boiler with controls

In the case of the boiler upgrade, including full heating controls and additional cylinder lagging jacket, a number of facets of the baseline dwelling's DEAP calculation are changed. Namely:

- Water heating section of DEAP:
  - Hot water cylinder insulation thickness
  - Hot water cylinder temperature factor multiplier based on DEAP table 2 (account for hot water thermostat and time control)
  - Primary circuit loss type (account for thermostatic control of hot water)
- Distribution system losses and gains and heating source:
  - Space heating temperature adjustment and control category adjusted
  - Room thermostat accounted for in central heating pump energy usage
  - Increase boiler efficiencies and efficiency adjustments (interlock now achieved)

Measure title		Baseline	Ctrls	BoilerOnly	BoilerCtrlsCyl
Measure description		No values changed. This is the baseline	Full heating controls	Boiler90% (and lagging jacket)	Boiler90%+LaggingJacket+Ctrls
Tab	**Field**	**Value**	**Value**	**Value**	**Value**
Fab	HLI	2.57	2.57	2.57	2.57
WH	HW cylinder insulation type	Factory Insulated	Factory Insulated	Factory Insulated	Factory Insulated
WH	HW cylinder insulation thickness	33	33	73	73
WH	Is supplementary electric immersion heating used in summer?	NO	NO	NO	NO
SH	Heating system control category (Table 4e)	1	3	1	3
ER1	Main space heating efficiency	83%	83%	90%	90%
ER1	Main space heating fuel	Mains Gas	Mains Gas	Mains Gas	Mains Gas
ER1	Main water heating efficiency	84%	84%	90%	90%
ER1	Main water heating fuel	Mains Gas	Mains Gas	Mains Gas	Mains Gas
ER1	Secondary space heating efficiency	43%	43%	43%	43%
ER1	Secondary space heating fuel	solid multi-fuel	solid multi-fuel	solid multi-fuel	solid multi-fuel
Result	Delivered energy[kWh/m2 y]	183	155	170	144
Result	Primary energy[kWh/m2 y]	206	175	193	164
Result	Building Energy Rating	C3	C2	C2	C1
Deliv energy per m2 saving RAW	**kWh/m2/yr no adjustment applied**	**0.00**	**27.93**	**12.33**	**38.15**
Deliv energy per m2 saving (ctrls adjustment)	**kWh/m2/yr halve the impact of controls**	**0.00**	**13.97**	**12.33**	**25.24**
Deliv energy per m2 saving (apply correction factor)	**kWh/m2/yr apply correction factor of 0.91**	0.00	12.71	11.22	22.97
Multiply by typical house area. m2 = 110	**Delivered energy saving kWh/yr (House)**	**0**	**1398**	**1234**	**2527**
Multiply by typical apartment area. m2 = 70	**Delivered energy saving kWh/yr (apartment)**	**0**	**890**	**785**	**1608**

Figure 5: Roof measure: credits derivation

As outlined in Section 1, the impact of controls is halved. So, for the standalone "full heating controls" measure, the per m^2 saving is halved from 27.93 to 13.97 (prior to applying the 0.91 correction factor). In the measure including boiler and controls, the halving of controls impact is accounted for as follows:

a. Delivered energy saving from boiler on its own = 12.33 kWh/m^2/yr
b. Delivered energy saving from boiler plus controls = 38.15 kWh/m^2/yr
c. Determine the impact of the boiler plus controls measure if the impact of controls is halved: 38.15 – (38.15 – 12.33)/2 = 25.24kWh/m^2/yr
d. Apply the correction factor: 25.24 * 0.91 = 22.97kWh/m^2/yr
e. Multiply by house or apartment area as required.

4.3. Energy savings per measure

The following table outlines the per m^2 delivered energy savings per measure according to the methodology detailed above. Resulting figures are also shown for a 110m^2 dwelling (house) and 70m^2 dwelling (apartment). These figures are proposed as the basis for energy credits per measure.

Measure	Delivered energy saving [kWh / m^2 / yr]. Correction factor = 0.91	Energy credit based on house [kWh/yr]. Assumed area = 110m^2	Energy credit based on apartment [kWh/yr]. Assumed area = 70m^2
Baseline	0.00	0	0
Roof Insulation	7.49	824	524
External Wall Insulation	20.82	2290	1457
Internal Dry Lining Wall Insulation	17.70	1947	1239
Cavity Wall Insulation	13.56	1492	949
Floor Insulation	4.90	538	343
Full Window Replacement (incl doors with > 60% glazing)	9.95	1095	697
External Door Replacement	2.39	263	167
High Efficiency Gas or Oil fired Boiler with Fully integrated Heating Controls Upgrade	22.97	2527	1608
Fully integrated Heating Controls Upgrade	12.71	1398	890
High Efficiency Gas or Oil fired Boiler with Entry Level Heating Controls Upgrade	15.91	1750	1114
Biomass boiler with thermal store and Fully integrated Heating Controls Upgrade	8.69	956	608
Biomass boiler without thermal store and Fully integrated Heating Controls Upgrade	8.69	956	608
Entry Level Heating Controls Upgrade only	5.62	618	393
Solar Water Heating Installation	12.75	1403	893
Water to Water Heat Pump with Fully integrated Heating controls Upgrade	109.76	12073	7683
Air to Water Heat Pump with Fully integrated Heating controls Upgrade	109.76	12073	7683
Brine to Water Heat Pump with Fully integrated Heating controls Upgrade	109.76	12073	7683
Air to Air Heat Pump with Fully integrated Heating controls Upgrade	86.98	9567	6088
High heat retention storage heaters	24.56	2701	1719
High heat retention Cylinder (minimum standing loss of 0.5W/litre)	1.25	137	87
Mechanical ventilation	6.00	659	420
Air tightness	6.21	683	435

Table 3: Energy credits calculated per measure

4.4. A note on comparisons between previous and latest credits

The deemed energy credits calculated above will not be the same as previously published. There are a number of reasons for this such as:

1) The median BER grade was a "D" and is now a C3. This means potential for energy savings is now lower relative to the baseline (median BER grade) dwelling.
2) The previous credits were calculated using DEAP Version 3 as opposed to DEAP Version 4. This will change the pre and post works dwelling performances.
3) Some of the measure parameters (heating efficiencies, U-value etc) have changed from when energy credits were previously calculated.
4) The correction factor mentioned in this document reduces the calculated energy savings.
5) Previous credits were on a primary energy basis which reduces calculated savings by at least 10%[4].

END OF DOCUMENT

[4] https://www.seai.ie/publications/EEOS-Guidance-Note-for-Public-Bodies.pdf (Section 3.4)