Derivation of Primary Energy and CO$_2$ Factors for Electricity in DEAP and NEAP

2023

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Disclaimer

Sustainable Energy Authority of Ireland
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Document version	Date	Notes
1.0	16/11/2022	First version

1   Introduction

The Domestic Energy Assessment Procedure (DEAP) and Non-domestic Energy Assessment Procedure (NEAP) calculate the energy demand for space and water heating, cooling, ventilation and lighting in buildings. As part of this, the electrical energy delivered to the building for these demands is calculated. DEAP and NEAP then calculate the CO_2 emissions and primary energy associated with this electrical energy as follows:

- Primary energy from electricity demand = delivered electrical energy * Electricity Primary Energy Factor

- CO_2 emissions from electricity demand = delivered electrical energy * Electricity CO_2 factor

The purpose of this document is to explain the methodology used to calculate the Electricity Primary Energy Factor and the Electricity CO2 Factor used in DEAP and NEAP.

Transitional arrangements are also set out for the use of the old and new factors.

2   Calculation method

The Primary Energy Factor (PEF) and CO_2 factor are calculated based on electricity grid fuel/renewables mix, as described in EN ISO 52000-1. This grid mix is based on averages of forecasted figures from 2022-2030 as sourced from SEAI's Data and Insights Energy Modelling team and are based on the Irish government policy targets[1] for the electricity to be generated from 80% renewable energy by 2030. These factors may be revised prior to 2030 subject to availability of new forecast figures.

The results are further adjusted based on the following:
- Fuel usage is based on Gross Calorific Value of fuels input to electricity generation stations. This is consistent with the method applied to all fuel energy sources in DEAP and NEAP. Fuels are quantified in ktoe (kilo-tonne oil equivalent).
- An 8% energy overhead is assumed in the processing and transport of fuels to electricity generating stations to derive "primary energy" values. The Building Research Establishment (BRE) estimate that while it is reasonable to assume that the supply of fuels in bulk to electricity generation results in a lower primary energy overhead than the 10% value generally assumed for fuels delivered to buildings, an 8% figure is reasonable. This is supported by the following information:
  - According to the Department of Environment, Climate and Communications with regard to Ireland's natural gas supply[2]: "*Ireland is expected to be dependent on over 80% imports by the mid-2020s and over 90% by 2030*".

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[1] National Development Plan
[2] Dept. Environment, Climate and Communications: Policy information on gas

- o Given the growing dominance of gas amongst thermal generation, it is reasonable to base the overhead factor for generation on gas, and, given our increasing reliance on gas via the UK, it is reasonable to base our overhead factor to that used in the UK (8%).
- Electricity imports are forecasted out to 2030 and accounted for in derivation of the electricity factors. Primary energy factor for imported electricity is assumed from the Energy Efficiency Directive of 2.1. The default CO2 factor for imports of 0.42 is based on EPB EN52000-1 Annex B.

3   Implementation

The updated primary energy and CO_2 factors will be implemented in DEAP and NEAP in January 2023. From the implementation date, all BERs will be published using the updated factors.

The use of the updated primary energy and CO2 factors may impact on Part L compliance calculations in the DEAP and NEAP software.

In accordance with transitional arrangements, older factors may still be used to generate draft Part L reports in DEAP, in simulation mode and in NEAP using the software version prior to the one including the update. A copy of the current NEAP software that has not been updated should be maintained in a separate folder on the user's PC for this purpose. BER assessors may produce a Part L report based on the currently published factors or on the primary energy factors that applied at the date of application for planning permission, as outlined in section 11.4.1 of the DEAP Guidance Document.

The primary responsibility for compliance with the requirements of the Building Regulations rests with the designers, builders and owners of buildings. Interpretation of the legislation is, ultimately, a matter for the Courts and implementation of the Building Control system is a matter for the local Building Control Authority.

4   DEAP and NEAP primary energy factor for electricity – 2023

The primary energy conversion factor in DEAP and NEAP is multiplied by the delivered electrical energy at the building to determine the primary energy usage of the building. The primary energy conversion factor is the inverse of electricity production efficiency from fuel source to electricity at the building.

Steps in the calculation are outlined as follows showing forecasts for the year 2025 as an example, with an average Primary Energy Factor to be used in DEAP and NEAP shown in the last row:

ID	Description	Derivation	Units	Example for 2025	
(a)	Total annual energy forecasted for use by Irish based power plant and renewables in generating electricity (includes overheads; in GCV)	Annual sum of all renewables and fuels (in GCV, including overhead)	ktoe	Total=	5983
(b)	Total forecasted electrical energy output by Irish based power plant and renewables	Annual electricity generated	ktoe	Total=	3681
(c)	Forecasted annual delivered electrical energy (or Total Final Consumption)	Annual TFC	ktoe	Total=	3219
(d)	Forecasted annual distribution losses (and own use)	Annual distribution losses	ktoe	Total=	349
(e)	Distribution losses / (TFC + Distribution losses)	d/(c+d)	%	Total %	9.77%
(f)	Portion of the TFC attributable to Irish Power Plants is calculated based on this	(1-e)*b	ktoe	Total=	3322
(g)	Combined efficiency of the grid and Irish generation plant	f / a	%	Total %	56%
(h)	Annual Irish electricity primary energy factor	1 / g	-	PEF=	1.80
(i)	Forecasted annual imports as a % of total electricity	NECP forecast	%	Total %	7%
(j)	Primary energy factor for imports (from Energy Efficiency Directive)	EED figure	-	PEF=	2.10
(k)	Primary energy factor adjusted for imports (Result for use in BERs)	Weighted (h) and (j) based on (i)	-	PEF=	1.822
Result	Average of all years to 2030 for Primary Energy Factor based on above calculations. For use in BERs	Average of above to 2030	-	PEF=	1.75

Table 1: Calculation of PEF for 2025 and overall resulting PEF

5   DEAP and NEAP CO2 factor for electricity – 2023

The CO_2 conversion factor in DEAP and NEAP is multiplied by the delivered electrical energy at the building to determine the CO_2 emissions (in kg) associated with that delivered electrical energy. The CO_2 factor is based on the carbon/energy content of each fuel forecasted for use in generating the consumed electrical energy. Emissions per unit energy of fuels are based on EPA data. Like the primary energy factor, the CO_2 factor is based on the fuel input to Irish Power Plant with an additional 8% for processing/transport on a GCV basis.

Steps in the calculation are outlined as follows showing forecasts for the year 2025 as an example, with an average CO_2 to be used in DEAP and NEAP shown in the last row:

ID	Description	Derivation	units	Example for 2025
(i)	Multiplication factor converting [kg/kWh] to [kton/ktoe]	From IEA	-	Factor= 11.630
(f)	Portion of the TFC attributable to Irish Power Plants	As per primary energy factor table above	ktoe	Total= 3322
(ii)	CO2 emitted for all fuels. CO2 from Hydro, wind and other renewables assumed to be 0	Annual sum of CO2 from all fuels (in GCV, including overhead)	kt/yr	Total= 8993
(iii)	CO2 per ktoe	(ii)/f	kt/ktoe	Total= 2.71
(iv)	CO2 per kWh	(iii) /(i)	kg/kWh	Total= 0.233
(v)	CO2 factor for imports (EPB EN52000-1 Annex B)	EN52000-1 Annex B	kg/kWh	CO2 factor= 0.42
(vi)	CO2 factor adjusted for imports with CO2 factor from EPB EN52000-1 Annex B	Weighted (iv) and (v) based on 5% above	kg/kWh	CO2 factor= 0.246
Result	**Average of all years to 2030 for CO2 Factor based on above calculations. For use in BERs**	**Average of above to 2030**	**kg/kWh**	**CO2 factor= 0.224**

Table 2: Calculation of CO2 factor for 2025 and overall resulting CO2 factor

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