Fuel factors within the Home Energy Model: FHS assessment

A technical explanation of the methodology

December 2023

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Contents

Background to the Home Energy Model: Future Homes Standard assessment

What is the Home Energy Model: Future Homes Standard assessment?

The Home Energy Model: Future Homes Standard assessment is a calculation methodology designed to assess compliance with the 2025 Future Homes Standard (FHS).It builds on the government's Home Energy Model, which will replace the government's Standard Assessment Procedure (SAP).

The Home Energy Model: FHS assessment is still under development and its first version will be implemented alongside the FHS in 2025. We are publishing information about the model while it is still at a formative stage to enable industry to participate in the ongoing development process.

Where can I find more information?

This document is part of a wider package of material relating to the Home Energy Model:

Home Energy Model: FHS assessment technical documentation (e.g. this document)

What: This document is one of a suite of technical documents, which go into further detail on the assumptions and the validation exercises that have been carried out. We intend to update and produce further technical documentation throughout the model development process.

Audience: The technical documentation will be of interest to those who want to understand the justifications and evidence base behind the assumptions used in the model.

The Home Energy Model: Future Homes Standard assessment consultation

What: The Home Energy Model: Future Homes Standard (FHS) assessment consultation seeks views on the proposed methodology for demonstrating compliance with the FHS.

Audience: The Home Energy Model: FHS assessment consultation will be of interest to those who want to understand the proposed standardised assumptions around occupancy, energy demand etc. to be used when assessing compliance with the FHS, as well as the methodology for the calculation of the proposed FHS compliance metrics.

The Home Energy Model reference code

What: The full Python source code for the Home Energy Model and the Home Energy Model: FHS assessment has been published as a Git repository. This code is identical to that sitting behind the consultation tool. We are currently considering whether the open-source code could serve as the legal approved methodology for demonstrating whether new homes comply with energy performance standards in the Building Regulations.

Audience: The reference code will be of interest to those who want to understand how the model has been implemented in code, and those wishing to fully clarify their understanding of the new methodology. It will also be of interest to any potential contributors to the Home Energy Model.

Overview

This paper sets out the methodology for deriving the emissions and primary energy factors for fuels used within the FHS assessment wrapper. These factors are applied to the relevant fuel consumption figures for the dwelling to determine the dwelling emissions rate (DER) and dwelling primary energy rate (DPER). These are both indicators used in Approved Document L to demonstrate compliance.

A list of the Future Home Standard consultation factors can be found in Annex A.

Methodology

This methodology is split into the following sections:

1. Scope and system boundary
2. Period of interest for the factors
3. Greenhouse Gas emissions factors including data sources
4. Primary energy factors including data sources and methodology
5. Factors for renewable electricity generated on-site
6. Additional factors included for reference (non-domestic)

1. Scope and system boundary

Figures produced using the FHS emissions and primary energy factors are for regulatory purposes only, and do not contribute to any kind of official accounting such as the National Atmospheric Emissions Inventory (NAEI). It is therefore deemed appropriate to include emissions and energy use outside of this boundary to account for upstream emissions/energy consumption overseas where they differ significantly compared to domestically produced fuels. This may be significant where there is a substantial contribution from the transportation of imports. This aims to best reflect the total environmental impact of using a certain fuel.

The system boundary for energy consumption and emissions in this context starts when production begins. For fossil fuels this is the extraction stage, for biomass it is cultivation, and for waste products it is the transportation from the location of its production. The system is not an entire lifecycle assessment, and stops at the point of combustion, ignoring any consequential emissions from the disposal of subsequent waste produced. The manufacture of machinery and infrastructure are not included either. This is mapped in figure 1 below.

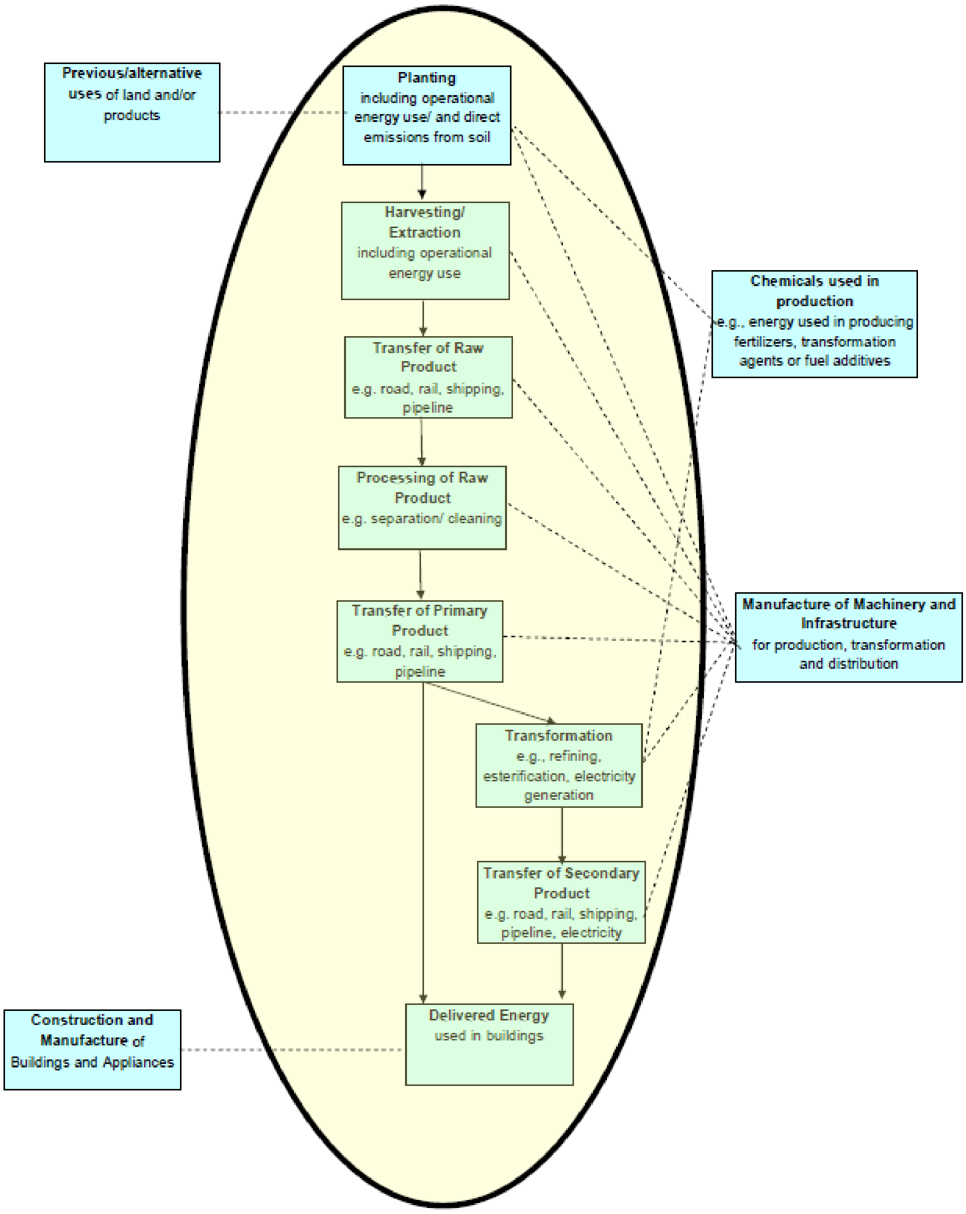

Figure 1 – System boundary for FHS emissions and primary energy factors

This boundary is compliant with the recommended default values in BS EN ISO 52000-1:2017 Table B.26.

2. Period of interest

The FHS is expected to define the new building regulations from 2025. When providing factors, it is therefore important to project the best estimates of environmental impact over the compliance period rather than a current or historical impact.

For most fuels, the factors can be expected to stay relatively stable over time, and so the most recently available figures can be assumed to be applicable. For electricity however, the mixture of the supply is subject to more variation. The factors for these fuels should account for the projection of the generation mix over the compliance period by using an average of the projected values.

The selected time period for electricity is 2025 – 2029. This 5-year period is long enough to improve the accuracy of the representation of these fuels over the compliance period, but is short enough to reduce the uncertainty raised from the use of long-term projections. In addition to potentially over/under-estimating the green credentials of future grid generation, relying on projections too far into the future could encourage too many new dwellings to use electricity (as the forecasted decarbonisation of the grid makes the factors most favourable), which could ultimately overwhelm the grid and in turn increase the factors from their forecasted values.

3. Greenhouse Gas emissions factors

The following section describes the scope of the emissions factors used for the FHS, as well as the relevant underlying data sources. The description of any associated assumptions or methodology is grouped by fossil fuels, biofuels and electricity.

The UK is legally required to report its Greenhouse Gas emissions, and so there are established figures related to the reporting of greenhouse gas emissions from the use of various fuels. The emissions factors used for the FHS include carbon dioxide (CO2), nitrous oxide (N2O) and methane (CH4) measured in terms of CO2 equivalent (kgCO2e).

Greenhouse gas emissions are generally split into 3 scopes. The 3 scopes that emissions can fall within are as defined in the GHG Protocol:

- **Scope 1** emissions are direct emissions, or the point-of-use emissions of a fuel. For example, the combustion of mains gas within a dwelling’s boiler produces greenhouse gases that are considered to be scope 1.
    - An exception to this is the carbon dioxide produced from the combustion of biomass, which is considered “outside of scope” and reported separately.
- **Scope 2** accounts for indirect emissions from purchased electricity/heat.
- **Scope 3** emissions are all other indirect emissions. This covers all upstream emissions that result from the extraction, refining and transportation of the fuel to the home.

The emissions values chosen for the FHS are inclusive of emissions falling into scopes 1-3 for any given fuel. An additional emissions factor including out-of-scope emissions is also provided to include the carbon dioxide produced upon the combustion of biomass. This is considered of interest even if it is not part of the official accounting procedure and has been provided for informative purposes. The consultation FHS factors do not include out-of-scope emissions.

3.1 Data sources

All emissions factors (excluding electricity) are sourced from the 2022 Government Greenhouse Gas Conversion Factors for Company Reporting. For each fuel, the emissions factors for the different scopes are summed to produce the final factor. Sources highlighted below are all referenced in the Government Conversion Factors methodology.

The direct emissions factors (i.e. scope 1 emissions) are based on conversion factors used in the UK Greenhouse Gas Inventory (GHGI) for 2019/20. These factors are independent of the application - CO2 emissions are assumed to arise from fully oxidised and combusted fuel, and other emissions are the product of a weighted average over various uses. In practice there may be some variation in the combustion conditions of these fuels which lead to different direct emissions, but these factors are widely accepted as a good indication of scope 1 emission.

The Government Conversion Factors source upstream emissions (scope 3) for natural gas and heating oil from the 2015 Exergia, EM Lab and COWI report. This report involved the detailed modelling of upstream emissions associated with a large range of oils used in EU refining, the transport based on the location of ports and refineries, and country-specific refinery emissions. Additional estimations were made for imported products from US and Russia. For upstream emissions not covered in this report, figures in the government conversion factors are taken from a few different sources, primarily a report from the 2019 JEC Well-To-Wheels report v5 produced by the Joint Research Council (JRC) in collaboration with some other stakeholder groups. Scope 3 emissions capture a broad range of activities and are significantly harder to track than scope 1 emissions. There is much more uncertainty in these figures, but the report covers detailed pathways looking at the associated emissions for the extraction, production and transportation of fuels that are used within the EU. It is assumed that the EU and UK figures will be sufficiently similar for the fuels chosen.

As a projection of the factor for electricity is required and not a current value, the values are taken from the 2022 Green Book Supplementary Guidance for the Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal. These figures are based on modelling from the Department for Energy Security and Net Zero.

Most fuels are easily identified from the fuel types available in the Government Conversion Factors, but some notes are included below.

3.2 Fossil fuels

- All the FHS LPG fuels (bulk/bottled/subject to Special Condition 11F) use the same LPG factor.
- House coal, anthracite and manufactured smokeless fuel are also all assumed to have the same emissions factor as domestic coal.
- Heating oil - uses the factor for ‘burning oil’, which is assumed to be the same as kerosene.

- Mains gas uses the conversion factor for 'natural gas' – this is weighted for UK imports of LNG, but is not the exact mix of the mains gas supply (although very similar).

3.3 Biofuels

All out of scope emissions (i.e. CO2 from combustion) are taken from Forest research data.

For biogas and biomass (excluding wood logs), the scope 3 emissions come from the 2015 Ofgem UK Solid and Gaseous Biomass Carbon Calculator and the 2021 Biofuels carbon calculator RTFO. For wood logs, which are not available in the Ofgem calculators, the scope 3 emissions are taken from the Biomass Environmental Assessment Tool (BEAT) from DEFRA.

For bio oils, the scope 1 emissions are assumed to be the same as the scope 1 emissions for the corresponding factors for diesel/petrol/LNG/CNG, excluding the CO2 component. The scope 3 emissions are from Department for Transport renewable fuel stats.

The FHS biofuels mostly align directly with the same fuel in the conversions factors, with a few deviations.

- Bio-liquid FAME from animal/vegetable oils – treated as generic 'Biodiesel ME' because FAME can refer to tallow and vegetable oils, so is a safer assumptions
- B30K – not in the Conversion Factors, this is assumed to be 30% FAME and 70% burning oil, calculated using a proportional sum of the relevant factors.

3.4 Electricity

The emissions factor for electricity uses the Green Book Supplementary Guidance grid average consumption-based electricity emissions factors. These figures are produced by the DESNZ Dynamic Dispatch Model (DDM). This model considers electricity supply and demand up to 2050 and is cycled with the Energy and Emissions Projections (EEP) to produce a detailed breakdown of the projected mix of electricity generation.

The emissions factors for generation fuels within the DDM are not the same as those in the Government Conversion Factors (i.e. not the same as the factors used in the FHS). These factors are based on the Green House Gas Inventory figures and do not include scope 3 emissions for the fuels. The final emissions factors in the Green Book Supplementary guidance therefore do not account for the upstream emissions associated with the extraction and processing of the fuels used in generation. Additionally, the electricity factors do not account for imports as the boundary is limited to onshore. In practice this makes up a very small proportion of the total emissions. As the final emissions factor used is also based on a projection, the uncertainty of this projection is deemed to cause more variation in the final factor than the omission of upstream emissions.

The consumption-based supplementary guidance figures are provided as a time series indicating the emissions factors for every unit of demand. This includes accounting for contributions from factors such as losses in grid transmission. The factors are averaged over the 2025 – 2029 period to give a representative factor for the compliance period.

3.5 Unmet demand/energy supply shortfall

Where there is a failure to provide the amount of energy demanded by a household, this is penalised by applying double the electricity emissions factor. This is to encourage well-sized systems in dwellings.

4. Primary Energy factors

The following section describes the scope of the primary energy factors used for the FHS, as well as the relevant underlying data sources. The description of any associated assumptions or methodology is grouped by fossil fuels, biofuels and electricity.

The definition of primary energy used for these factors aligns with EPBD Art. 2(5) which defines primary energy as energy from renewable and non-renewable sources. The purpose of using primary energy is to try and account for all energy required to extract and process a fuel before its use to more accurately reflect the total environmental impact of a fuel.

For renewable sources such as solar and wind, the primary energy factor is taken as 1 at the point of generation. This reflects the first point at which the renewable source is harnessed into useable energy. Any subsequent energy use associated with using this energy is then added to the primary energy factor. This is similar for biomass and waste, where a factor of 1 is assigned at the point of creation. As a secondary fuel, generated electricity from power-stations must take into account the primary energy required for the primary fuels used, as well as the transformation losses from the efficiencies of these fuels, and associated distribution losses.

The primary energy factor (PEF) is calculated as follows:

$$\mathrm{PEF} = 1 + \frac{\sum_{\text{all process stages}} \text{energy use}}{\text{energy content of delivered fuel}}$$

The resulting factor is equivalent to the primary energy consumed per unit of fuel used.

To simplify the calculation, it is assumed that most fuels will have a PEF close to 1. This is equivalent to assuming that energy consumed in processing a fuel is equal to the primary energy consumed in processing a fuel. If this was not assumed, there would be a need for recursive calculations for every factor, for a negligible gain in precision. The only fuel that this is not the case for is electricity, as the PEF is significantly more than 1. The primary energy factor from SAP 10.2 is used as a basis and applied wherever electricity is used in the production of a fuel, kWh primary energy use per kWh electricity use = electricity used (kWh) x PEF electricity from SAP 10.2.

4.1 Data sources

Primary energy is accounted for in many different ways and the definition can be interpreted differently in different countries/industries. Although there are some national statistics concerning primary energy in the UK, this data is aggregated in a way that is inappropriate for the purpose of calculating primary energy factors for the FHS assessment and does not account for energy use outside of the UK.

One of the primary sources of data used is the [2022 Digest of UK Energy Statistics (DUKES)](). These tables show the commodity balances for each fuel and include imports, exports, production and uses. They are used in these calculations to account for the energy consumed by the energy industry within the UK for aggregated activities that fall under various extraction/processing/distribution losses headings for different fuels. The contribution to the primary energy factor for these activities can then be calculated. The data in these tables is not granular enough to provide the level of detail needed for all the calculations and does not account for energy use outside of UK, such as the transportation of fuel imports into the UK.

Another major source used is the JEC WTW v5 report, as with the emissions factors. The different fuel pathway appendices provide the energy use in terms of energy ratio (GWh/GWh_{output}) for each stage included in their calculations. Not all the stages are relevant, so these are left out where appropriate.

4.2 Fossil fuels

The energy expended in the extraction of all fossil fuels is determined using the figures for the production of the fuel and the ‘Energy Industry use’ of each fuel for the appropriate extraction activity from the relevant DUKES commodity balances. As there is no similar available data for the extraction processes within other countries the UK imports from, it is assumed that the extraction processes in these countries are similar to that within the UK.

For the energy used in the transportation of fuels:

- **Oil:** it is assumed that supply is similar to that of the EU, and so the JEC WTW value is used for transportation
- **Gas**: the 2020 gas mix from the National Grid is used to proportionally assign the transportation of LNG and piped natural gas from Norway/UK. Both the energy used for LNG transportation and the recompression of piped Norwegian gas imports are taken from the JEC WTW report, assuming a distance of 1116km transport for Norwegian piped gas. There is also an allowance for the recompression of gas when transporting within the National Grid, assuming a maximum of 200km transportation at high pressure.

- **Coal**: the energy used for the transportation of coal is based on the origin and volume of imports into the UK using estimated distances/modes of travel. All imports are assumed to travel 500km in their country of origin, an estimated distance by ship based on an appropriate origin port, and then 200km within the UK. All land journeys are assumed to be 20% by road and 80% by rail. The conversion factors from the Government Conversion factors 2022 for the transport type are applied to convert to an energy consumption.

For oil, an additional stage of refining is taken from the 'Energy Industry use' in DUKES to determine the energy consumed in refining oils. The petroleum products is used to determine how much LPG is from refineries and so how much should be assigned this additional processing stage.

Distribution losses of mains gas within the grid are taken from the DUKES commodity balance.

4.3 Biofuels

Very little data is available for the upstream energy use of biofuels. Data is adapted from the JEC WTW report v5 where possible as this is the most recent data available.

For **biogas**, the PEF is calculated as an average of the pathways included in the JEC WTW report v5. The following sources were considered:

- Municipal organic water closed digestate storage (OWCG1)
- Wet manure closed/open digestate storage (OWCG21/22)
- Sewage sludge closed digestate storage (OWCG3)
- Maize (whole plant) and double cropping, both with closed digestate storage (OWCG4/5)

The relevant stages are converted into the correct units (to ensure that they are in terms of energy content of the delivered fuel) and totalled for each pathway.

The primary energy use in the production of **bio oils** is taken from a 2003 Sheffield Hallam University paper produced for Department of Trade and Industry. Relevant elements have been taken from the appendices summarising the energy balances for the fuels. Those stages that lie outside of the boundary of these factors have not been included. Bio diesel is based on biodiesel from oilseed rape, whilst bioethanol is an average of ethanol from sugar beet and from wheat.

Biomass figures are derived from the stages detailed in a JRC study on Solid and gaseous bioenergy pathways. The relevant stages have been identified from sections 6.1 and 6.2 and their values taken from the tables provided.

For wood chips, these stages include:

- Diesel for forest residue collection
- Cultivation and harvest of stemwood
- Diesel for chipping
- Accounting for losses in seasoning/chipping

For wood pellets, this includes the stages for wood chips plus:

- Heat for drying
- Electricity for pelleting
- Diesel for pellet handling
- Accounting for losses in pelleting

The large majority of wood chips and pellets are imported from countries around the world. Data is available from Forest Research statistics 2022, detailing the volume of imports and country of origin for wood pellets. The primary source of imports is the USA and Canada (providing a total of 73% of total UK supply in 2021). Suitable ports from origin countries were identified and the same assumptions applied as for coal transportation i.e. 20% of land transportation by road and 80% by rail, assuming 500km in country of origin and 200km within the UK. The shipping distances were calculated using the selected ports. Energy use factors from the Government Conversion Factors were then applied to convert distances and modes of transport to primary energy consumption, which was then proportionally averaged based on the import statistics. No similar data for wood chips supply is available, so it is assumed that they have similar origins.

4.4 Electricity

The underpinning methodology for the calculation of primary energy factors for electricity is more controversial than other fuels, with even less consensus on acceptable approaches.

The approach adopted for the FHS factors aims to maintain consistency with the assumptions employed for other fuels presented here, as well as to reflect the actual impact of using different fuels as closely as possible. Some key methodological choices are highlighted below with these principals in mind, which remains in line with BS EN ISO 52000:

- The system boundary is that presented at the beginning of the document
- Electricity is a secondary energy source. The primary energy factors for the respective fuels used in generation are applied to the amount of those fuels consumed to find the total primary energy demand.
- Total primary energy factors are used – this includes both the renewable and non-renewable primary energy, as this is consistent with the methodology for other fuels.
- Conversion efficiencies are taken into account for all electricity generation, including nuclear power.

The generation mix is based on the electricity supply for Great Britain.

The PEF for electricity uses data from the DESNZ Dynamic Dispatch Model (DDM). The scenario used is an average of the Net Zero Strategy high and low demand scenarios, including the introduction of hydrogen-based power generation from 2030. These are the scenarios that were published in Annex O of the EEP Net Zero Strategy baseline (partial interim update December 2021) in a more aggregated form.

The DDM provides the annual generation of electricity and the amount of fuel used for this generation, separated by fuel type, for each year up to 2050. The fuel consumption figures account for the thermal efficiency of each fuel type as well as the self-consumption. The only fuel for which this is not the case, is nuclear generated electricity as the outputted figures do not feed into further analysis and so are not processed. Under the definition of primary energy employed for these factors, it is deemed that the thermal conversion efficiency of nuclear power should be included. A conversion efficiency of 36% is applied for nuclear power, based on the DUKES electricity generation tables.

The primary energy consumption is calculated by multiplying the PEF for each fuel by the total fuel used for generation. The PEF for ‘Thermal Renewables’ is taken as an average of wood pellets and wood chips, and nuclear fuel is taken as 1.21 (from JEC WTW v5 pathway for nuclear electricity) to account for the mining, treatment and transportation of uranium to produce plutonium. The primary energy of electricity from imports is unknown so a figure of 2.833 is taken from the JEC WTW report for European high voltage electricity using the 2016 mix. The accounting methods for this figure are the same as the figures used in this report and for UK electricity here.

4.5 Unmet demand/energy supply shortfall

Where there is a failure to provide the amount of energy demanded by a household, this is penalised by applying double the electricity primary energy factor. This is to encourage well-sized systems in dwellings.

5. Renewable electricity generated on-site

Renewable electricity generated on-site has a primary energy factor of 1 and an emissions factor of 0 by convention. This electricity can either be exported to the grid, used immediately or stored on-site for later use.

When exporting surplus electricity to the grid, the grid is saved from generating this electricity. The emissions avoided are therefore the difference between the grid electricity emissions and the on-site generated emissions for the given amount of electricity generated. The same approach is adopted for primary energy.

In practice, this means that exporting electricity will result in a net reduction of dwelling emissions/primary energy of:

$$\left(factor_{grid\ electricity} - factor_{on-site\ generated}\right) \times exported\ electricity\ (kWh)$$

When generating electricity on-site and immediately using it within the dwelling (referred to as self-use), the amount of electricity imported from the grid is reduced. When calculating the total dwelling emissions/primary energy, the imported electricity is assigned the appropriate factor. To account for the self-use which is not imported, the following emissions/primary energy is added to the total for the dwelling:

$$factor_{on-site\ generated} \times onsite\ generated\ self - use\ (kWh)$$

This has the same practical impact as exported electricity, in that the net benefit to the dwelling is the difference between the emissions/primary energy for the grid generation avoided and the emissions/primary energy for the electricity generated on-site.

When storing energy on-site for later use, the amount of electricity imported from the grid is reduced. However, the reduction in grid import will be less than the amount of generated electricity sent to storage due to round-trip losses. This means that storing electricity for later use will result in a net reduction of dwelling emissions/primary energy of:

$$\left(factor_{grid\ electricity} - factor_{on-site\ generated}\right) \times on - site\ generated\ sent\ to\ storage\ (kWh) \times storage\ efficiency$$

Combining these equations with the calculation of emissions/primary energy due to export and simplifying gives the following equation for the overall net emissions/primary energy:

$$(electricity\ imported - electricity\ exported) \times factor_{grid\ electricity} + electricity\ generated \times factor_{on-site\ generated}$$

6. Additional factors (non-domestic)

Some additional factors that do not make up part of the core FHS figures are included in the table below for information. These figures are for use in non-domestic buildings only.

Fuels such as fuel oil and industrial coal are differentiated in the Government Greenhouse Gas Conversion factors and so have a unique emissions factor. The methodology for primary energy however is not detailed enough to allow differentiation between domestic and non-domestic products, so the factors are assumed to be the same for both.

The exact mix of biomass used in industry for heat is unknown. As biomass can refer to a whole host of different sources, the highest factors are chosen from the appropriate fuels which are for wood pellets. This is a safer, more conservative assumption than previously when the factors for grass/straw were used.

The factors for dual fuel appliances that can use mineral and wood fuels in a non-domestic setting have been calculated using data from DUKES to determine the ratio of coal to wood used within a non-domestic environment. These totals do not include fuel used in the transport

sector or by the energy industry. The data indicates that coal contributes 77.5% of the energy in these appliances and the corresponding factors are apportioned as such, assuming the rest is wood pellets. Ideally it would be based on the ratio used for heat alone, but there is limited available data.

Waste heat refers to heat recovered from power stations. The basis for this factor is that generally the process would happen anyway, so the heat has no associated emissions or primary energy. However, where heat is drawn off from the turbine, usually as steam, the electricity produced will fall. It is typical that electricity produced will fall by 1 unit for every 10 units of heat drawn off. This is referred to as the ‘z’ factor. An additional assumption is that the heat will require pumping to distribute the water through the network. The electricity required to do this pumping is assumed to be 1% of the energy required for space/water heating. Therefore for every single unit of heat produced, it is assumed that 1 / 10 units of electricity is lost and 1 / 100 units of electricity is used for pumping. The final factors are scaled by the electricity factors to account for this.

Future development

These factors will be updated prior to consultation using the latest available data for the sources referred to in the document. This may include a new set of Government Conversion figures, Green Book electricity projections and DUKES. These are not expected to create significant variation for most factors.

Annex A – FHS fuel factors

Fuel	Emissions factor (kgCO2e/kWh)	Emissions factor (kgCO2e/kWh) including out-of-scope emissions	Primary energy factor kWh/kWh delivered
electricity	0.086	0.086	1.969
renewable electricity generated on-site	0.0	0.0	1.0
mains gas	0.214	0.214	1.120
bulk LPG	0.240	0.240	1.104
bottled LPG (for main heating system)	0.240	0.240	1.104
bottled LPG (for secondary heating)	0.240	0.240	1.104
LPG subject to Special Condition 11F	0.240	0.240	1.104
biogas (including anaerobic digestion)	0.029	0.228	1.442
heating oil	0.298	0.298	1.136
bio-liquid HVO from used cooking oil	0.041	0.300	1.010
bio-liquid FAME from animal/vegetable oils	0.058	0.314	1.152
B30K	0.226	0.303	1.141
bioethanol from any biomass source	0.072	0.330	1.348
house coal	0.398	0.398	1.094
anthracite	0.398	0.398	1.094
manufactured smokeless fuel	0.398	0.398	1.294
wood logs	0.023	0.375	1.065

wood pellets (in bags for secondary heating)	0.048	0.397	1.306
wood pellets (bulk supply for main heating)	0.048	0.397	1.306
wood chips	0.018	0.372	1.069
energy supply shortfall	0.172	0.172	3.938
fuel oil (non–domestic)[1]	0.327	0.327	1.136
coal (non – domestic)[1]	0.378	0.378	1.094
biomass (non-domestic)[1]	0.048	0.397	1.306
waste heat (non-domestic)[1]	0.009	0.009	1.216
dual fuel (mineral and wood) (non-domestic)[1]	0.303	0.382	1.142

[1] Indicative of potential SBEM factors – subject to change and not part of the FHS

This publication is available from: https://www.gov.uk/government/publications/home-energy-model-future-homes-standard-assessment-technical-documentation