Future Homes Hub
Whole Life Carbon Conventions for New Homes

May 2024

v1

Future Homes Hub

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Homebuilders:

Barratt Developments
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Keepmoat
Latimer (Clarion)
Lendlease
Miller Homes
Places for People
Redrow
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Taylor Wimpey
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VerdeGO

Wider industry and suppliers:

AES
Arup
BLP Technical Services (UK)
BRE
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Construction Carbon
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Elmhurst
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Contents

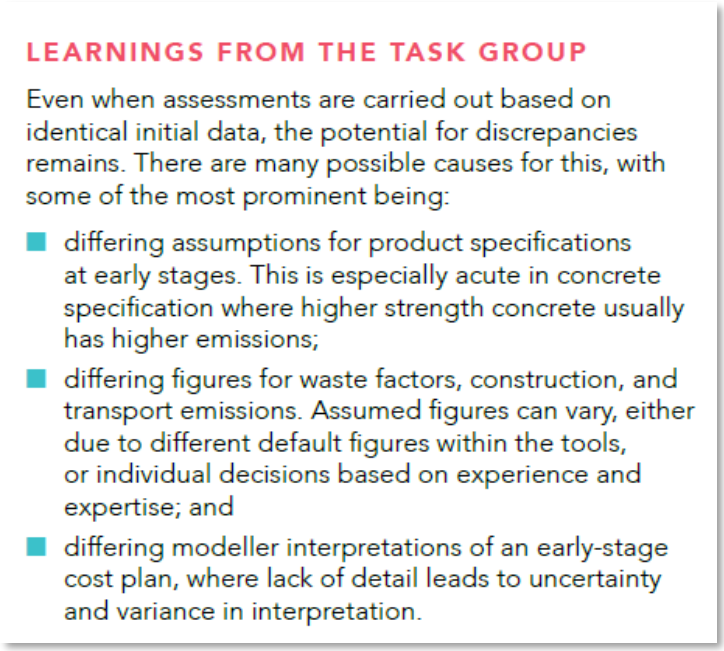
1 Introduction

1.1 Context: Purpose of the FHH WLC Conventions

In January 2023, Future Homes Hub (FHH) issued the *Embodied and Whole Life Carbon (WLC) implementation plan for the homebuilding industry*. The plan recommended the development of standard defaults and assumptions (or conventions) to enable consistent calculation of Whole Life Carbon for the homebuilding sector.

These conventions aim to address the underlying issue of variance between assessments – most likely caused by inconsistency between material and methodological assumptions chosen by different consultants using different tools and reference points.

This issue has been observed anecdotally by many – including FHH during our first phase work, noted within the *FHH Implementation Plan* and the *UKGBC Embodied Carbon Modelling and Reporting Guidance* (2023).



LEARNINGS FROM THE TASK GROUP

Even when assessments are carried out based on identical initial data, the potential for discrepancies remains. There are many possible causes for this, with some of the most prominent being:

- differing assumptions for product specifications at early stages. This is especially acute in concrete specification where higher strength concrete usually has higher emissions;
- differing figures for waste factors, construction, and transport emissions. Assumed figures can vary, either due to different default figures within the tools, or individual decisions based on experience and expertise; and
- differing modeller interpretations of an early-stage cost plan, where lack of detail leads to uncertainty and variance in interpretation.

Figure 1-1: UKGBC Embodied Carbon Modelling and Reporting

The key aim of the Future Homes Hub WLC conventions for new build homes is to **help homebuilders assess their carbon impact of their design options in a quick and consistent way** – reducing the barrier to Whole Life Carbon assessment and savings, particularly for those who may be just starting their carbon journey.

In parallel, the Hub is developing a free, simple-to-use tool based on these conventions and working with commercial tool providers to enable reporting to these conventions from within existing tools.

1.2 Summary

The Future Homes Hub Whole Life Carbon Conventions for New Homes (FHH WLC Conventions) reference the same core methodology defined by *EN 15978 Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method* (EN 15978) and *RICS Whole Life Carbon Assessment for the Built Environment 2nd Edition* (RICS PS 2023), while providing a "wrapper" in terms of input assumptions and output framework to ensure that assessments or design options can be compared like-with-like.

The WLC Conventions for new homes;

- Provide a consistent set of generic carbon impact factors for materials and product-types commonly used in new homes – for use at early design stages.
- Define clear lifecycle stage and building element scopes across various levels of assessment.
- Adopt a consistent approach to calculate location-specific regulated and unregulated energy consumption, based on outputs from SAP assessment.
- Define a reporting format that requires transparency of assumptions, including the quantity, material and whole life cycle assumptions used.

Why not use the RICS PS 2023 defaults?

Along with defining a core methodology, RICS PS 2023 also provides some default assumptions that can be used for early-stage assessments. However;

- RICS PS 2023 assumptions are not intended to be sector specific and are therefore not fully reflective of the UK new homes sector,
- Operational energy for new homes can vary largely depending on assumptions and operational energy modelling,
- Assumptions are unlikely to be updated between RICS PS versions – this could lead to out-of-date information being used for assessments in between document updates.

The FHH WLC conventions address these challenges, by providing assumptions and recommendations which are clear, specific to new build homes, and – whilst currently largely aligned with RICS PS 2023 – have the flexibility of being updated regularly as manufacturing sectors provide new and more up to date generic data.

1.2.1 How to apply the WLC Conventions wrapper

The concept of a "wrapper" was put forward by the Government as part of the Home Energy Model consultation to describe the set of standardised and user inputs to specify the model, and the outputs the model will provide in a specific use case – for example, when calculating Future Homes Standard compliance. This is adapted here as a way of understanding how the WLC conventions for new homes relate to existing EN 15978 and RICS PS 2023 guidance.

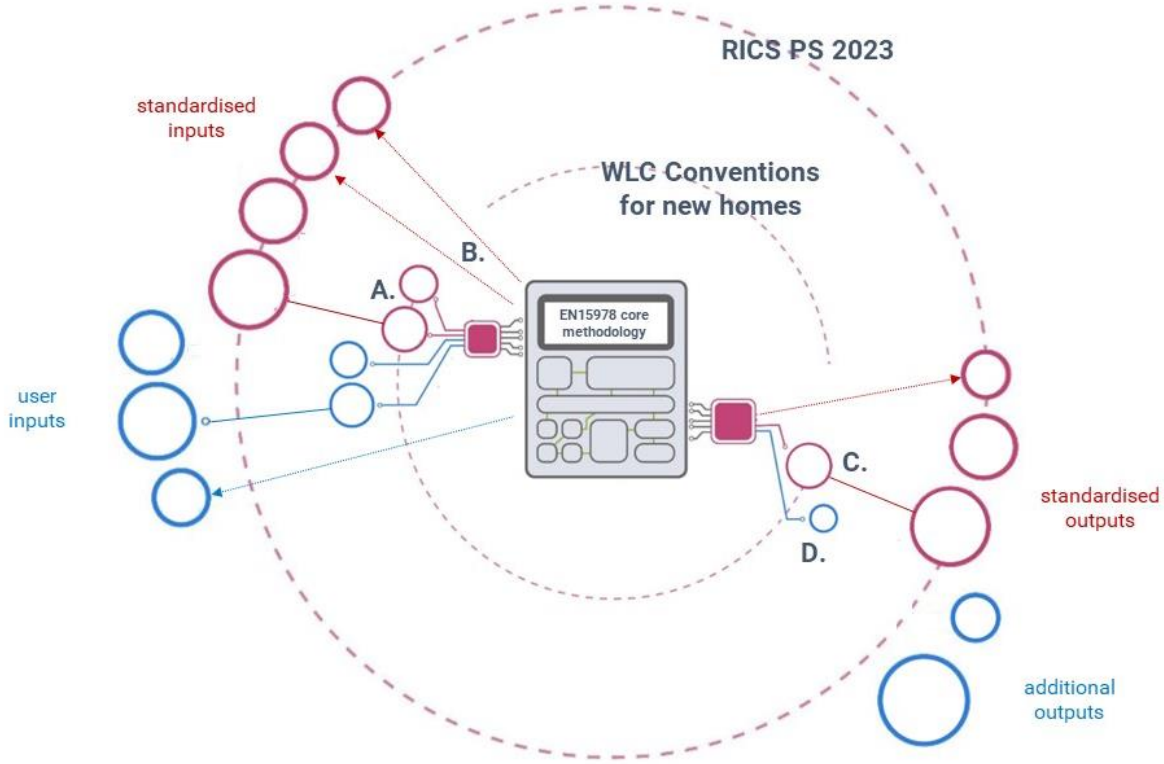


Figure 1-2: 1.2.1 How to apply the WLC Conventions 'wrapper'

A. For new homes assessments, refer to the WLC Conventions material and carbon default dataset, at early project stages or where manufacturer- and product-specific EPDs are unavailable.
B. For materials / products not included in the dataset (or calculation of additional outputs) refer to RICS PS 2023 standardised inputs and guidance.
C. Standardised outputs for FHH Conventions refer to standard scopes – see Section 2.3.
D. Additional outputs may be reported separately.

2 Scope

The conventions identify three standard scopes for disclosure of Embodied and Whole Life Carbon for new homes:

1. Dwelling level – upfront
2. Dwelling level – whole life
3. Project level – whole life

Table 2-1 summarises the life-cycle stage and building element scopes for each of these.

- **Dwelling level** scopes consider only the building itself – be it a home, row of terraces or apartment building – whereas **project level** scope includes associated infrastructure and external works.
- **Upfront** scope considers only the embodied carbon of construction (to practical completion), whereas **whole life** scope considers all lifecycle stages, through use to end of life stages.

The breakdown by building element and life cycle stage should be reported in each case.

Life-cycle Stages

All stages [A-C], including carbon sequestration, must be considered for the Whole Life Carbon calculation at both dwelling and project level.

A5.4 Worker Transport and B8 User carbon are optional and can be reported separately, but do not form part of the core scope. Module D is required for whole life scopes and should always be reported separately.

Building elements

At dwelling level, the core building element scope must include substructure, superstructure, internal finishes, fixed FF&E, and services.

All building elements, including facilitating and external works, must be included within the project level scope.

The dwelling level assessments are a subset of the project level calculations.

Table 2-1: Lifecycle Stage and Building Element Scope Summary

		Dwelling Level – Upfront	Dwelling Level – Whole Life	Project Level – Whole Life
Life-cycle Stage	Biogenic Carbon	Reported Separately	✓	✓
	[A0] Pre-construction	-	-	✓
	[A1-A3] Product	✓	✓	✓
	[A4] Transport	✓	✓	✓
	[A5] Construction and Installation*	✓	✓	✓
	[B1-B5] Embodied In-use**	-	✓	✓
	[B6] Operational Energy	-	✓	✓
	[B7] Operational Water	-	✓	✓
	[B8] User Carbon	-	-	-
	[C1-C4] End of Life	-	✓	✓
	[D] Benefits and loads beyond the system boundary	-	Reported Separately	Reported Separately
Building Elements	0.1 Facilitating Works	-	-	✓
	1 Substructure	✓	✓	✓
	2 Superstructure	✓	✓	✓
	3 Finishes	✓	✓	✓
	4 Fixed FF&E	✓ (Building Related)	✓ (Building Related)	✓ (Building & Non-Building Related)
	5 MEP Services	✓ (Building Related)	✓ (Building Related)	✓ (Building & Non-Building Related)
	6 Pre-fabricated buildings and units	-	-	✓
	7 Works to existing buildings	-	-	✓
	8 External works	-	-	✓

* *[A5] Construction and Installations Impacts includes submodules A5.1-A5.3 only.*
[A5.4] Worker Transport, noted as an optional submodule in RICS PS 2023, does not form part of the FHH Core scope and must be reported separately.

** *The core FHH scope excludes B5 Impacts from retrofit/refurbishment/planned changes. [B5] carbon impacts must be reported separately.*

3 Conventions

3.1 Alignment to standards

The FHH WLC Conventions are aligned with the RICS PS 2023 calculation methodology and therefore BS EN 15978, which the RICS PS 2023 is based on.

Any deviations from these documents have been outlined within the following sections.

3.2 Reference Study Period

A 60-year Reference Study Period (RSP) must be considered for FHH aligned WLC assessments.

It is accepted that many homes will have a longer building life cycle, however a study period value has been assumed in accordance with the RICS PS 2023 guidance.

3.3 Information hierarchy

Material quantity information and carbon impact data should be provided based on the best available data.

At the detail design and as built stages, the preferred option is to use manufacturer- and product-specific data/EPDs. However, at the early design stages (when specific products / materials systems may not be determined) the preferred option is to use collective/default data sets. RICS PS 2023 references this approach in Section 4.7.

The information hierarchy, including indicative design stages associated with each information source, is shown below:

	Indicative Stage	*Material Quantity Data Hierarchy*	*Carbon Data Hierarchy*
Decreasing accuracy	***Post-Construction***	Exact Quantities of materials and products used based on as-built information.	Carbon data based on up-to-date manufacturer and product specific EPDs for all materials and products. Construction and site waste carbon emissions based on site recorded data.
	RIBA 4-5	Material quantities from detailed design models, design specifications, and developed cost plans.	Carbon data based on manufacturer and product specific EPDs for most materials. Where specific products have not yet been selected – generic material impact data and assumptions should be used. Construction and site waste carbon emissions based on default assumptions.
	RIBA 2-3	Material quantities from early-stage design models / estimated quantities.	Carbon data based on generic material impact factors and assumptions. Construction and site waste carbon emissions based on default assumptions.
	RIBA 0-1	Benchmark data.	Benchmark data.

Figure 3-1: Information hierarchy

3.4 Life cycle stage calculations

Key considerations and calculations have been included in the following section, however RICS PS 2023 and supplementary data sources should be consulted for a further detail and guidance, where these sources are referenced.

3.4.1 Product Stage (A1-A3)

In line with RICS PS 2023, the A1-A3 product stage carbon is calculated as follows;

A1-A3 Product = **Material quantity** (kg) x **Material A1-A3 embodied carbon factor** (kgCO2e/kg)

It should be noted that the material or product area/volume/number of units can be used in lieu of mass if the A1-A3 carbon factor is provided in a different unit.

At early design stages, or in the absence of actual, project specific material data – the FHH material and carbon default dataset should be used. The default dataset can be found in Appendix A.

3.4.2 Transport (A4)

The A4 carbon factor for each quantified material or product must be calculated in accordance with RICS PS 2023;

A4 Transport = **Material quantity** (tonne) x **Transport distance** (km) x **Carbon conversion factor** (kgCO2e/tonne/kg)

Transport impact for each material is aggregated. Carbon conversion factors should be differentiated for the outward and return journeys and include an empty running factor in line with RICS PS 2023.

The FHH material and carbon default dataset includes transport scenarios (distances and transport modes) for all materials listed, which should be used at early design stages, or in the absence of project-specific material transport information – See Appendix A.

Note: Transport scenarios in Appendix A are broadly aligned RICS PS 2023, Table 17 (Default transport scenarios for UK projects) with the exception of timber products, which are aligned with TDUK 2024 Embodied Carbon Data for Timber Products.

Carbon conversion factor values for road, rail, and sea journeys should be taken from the *UK Government GHG Conversion Factors for Company Reporting 2023 ('Freighting Goods' + 'WTT Delivery Vehicles and Freight')*:

- Average diesel All HGV (road) – Average laden: **0.12448** $kgCO_2e$/tonne/km
- Average cargo container ship (sea): **0.019773** $kgCO_2e$/tonne/km

Empty running factors should be taken as:

- **43%** for road freight, except for concrete mixers – where **100%** should be used.
- **0%** for transportation routes via sea or rail.

3.4.3 Construction Installation Process (A5)

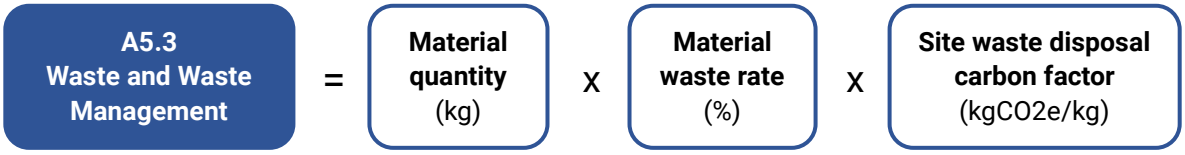
In the absence of actual, project specific data;

- **A5.1 Pre-construction demolition** should be assumed to be **35** $kgCO_2e/m^2$ demolished area, in alignment with RICS PS 2023.

  It should be noted that pre-construction demolition emissions are associated with demolition required to enable the new building and are included as part of the A5 Construction and Installation Process module. These should not be included in A0 Preconstruction.

- **A5.2 Construction Activities** should be taken to be **40** $kgCO_2e/m^2$ GIA. This assumption is aligned with the RICS PS 2023 baseline building-specific impacts related to construction activities in the UK.

- **A5.3 Waste and Waste Management** for quantified materials (excluding Building Services) must be calculated in accordance with RICS PS 2023;



The **material waste rate** is the percentage of the material quantity (A1-A3) that is wasted on-site.

The **site waste disposal embodied carbon factor** is dependent on the end of life (EOL) disposal scenario – i.e. what proportion of each material type is typically reused, recycled, incinerated or sent to landfill – and should be calculated based on A1-A3, A4, C2, C3, and C4 information, in line with RICS PS 2023, Table 19.

The FHH material and carbon default dataset in Appendix A includes material waste rates and EOL disposal scenarios for all materials listed, which should be used at early design stages, or in the absence of project-specific material transport information.

Note: Waste rates in Appendix A are broadly aligned RICS PS 2023, Table 18 (Recommended waste rate data) with the exception of concrete products, which are aligned with research by Reusefully: Wastage rates for blocks and ready mixed concrete (2023).

- **Module A5.4 Worker Transport** does not form part of the core FHH life-cycle stage scope. If assessors wish to include A5.4 – emissions must be reported separately.

3.4.4 In-use stage (B1–B5)

In-use embodied carbon impacts (B1-B5) should be calculated in line with the RICS PS 2023.

Note the following defaults:

In-Use Impacts (B1)

- In-use material emissions and removals (B1.1) accounts for off-gassing of blowing agents from insulation, carbonation of cement products. No early-stage defaults exist, therefore EPD and project specific information should be used.

- In-use fugitive emissions (B1.2) account for refrigerant leakage from MEP equipment. No early-stage defaults exist. Therefore, project specific information – including refrigerant charge and refrigerant GWP, along with default annual leakage rates for systems of different types from CIBSE TM65 – should be used.

Maintenance impacts (B2)

- In absence of EPD and project specific information, for all building element categories, B2 impacts should be taken to be **1% of modules A1-A5**, or **10 kgCO_2e/m^2 GIA** (whichever is greater).

Repair impacts (B3)

- In absence of project specific information, repair impacts (B3) for all building element categories excluding building services should be assumed to be **25% of B2** maintenance impacts.

- For building services components, repair impacts should be assumed to be **10% of A1-A3** impacts.

Replacement impacts (B4)

- In the absence of project specific information, material / product replacement cycles for building components / materials should be defined in line with RICS PS 2023 Table 20: Indicative component lifespans.

- The FHH material and carbon default dataset in Appendix A, which includes indicative material / product replacement cycles for all components listed, references these defaults.

Impacts from retrofit/refurbishment/planned changes (B5)

- Planned alterations, such as house extensions or conversions, throughout the building's study reference period are excluded from the core FHH scope and may be reported separately.

3.4.5 Operational Energy Use (B6)

The operational carbon impact associated with energy consumption of a built asset (B6) is calculated by multiplying the annual energy consumption of the building (kWh) by carbon factors (kgCO2e/kWh) associated with the type of fuel used.

Key point of difference from RICS PS 2023:

1. **FHH WLC Conventions** require the B6 calculation for new homes to reference SAP outputs for energy consumption (kWh/yr). In due course, once HEM is launched, this should be expected to update to the latest Part L methodology.
2. **RICS PS 2023** requires the use of 'predictive energy models' to calculate Whole Life Carbon, and specifically excludes the use of Part L 2021 calculation results.

In all other aspects, the calculations are aligned.

B6 Operational Energy use = $\sum$ **Total annual energy consumption** (kWh/yr) x **Carbon conversion factors** (kgCO2e/kWh)

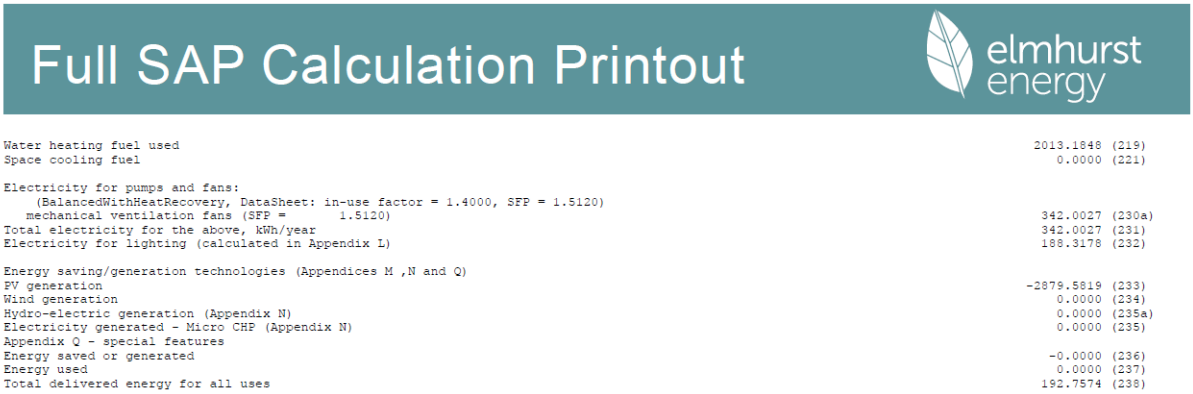
Aggregated for each year of use and each fuel type.

- Total annual energy consumption is comprised of consumption for regulated and non-regulated uses, which are calculated separately and aggregated.
- Carbon conversion factors for each fuel type should be taken from RICS PS 2023 *Energy-supplementary-tables Appendix*.

Regulated energy

B6 Operational Energy Use – Regulated energy consumption should be calculated as follows;

- The total regulated energy consumption must be taken from SAP 10.2, Box 238 'Total delivered energy for all uses'.
    - In some cases energy generated from renewables (Boxes 233–235a) must be deducted – see 'On-site renewable energy generation' section below.



Full SAP Calculation Printout

elmhurst energy

Water heating fuel used	2013.1848 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 1.5120)	
mechanical ventilation fans (SFP = 1.5120)	342.0027 (230a)
Total electricity for the above, kWh/year	342.0027 (231)
Electricity for lighting (calculated in Appendix L)	188.3178 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2879.5819 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	192.7574 (238)

Figure 3-2: SAP Calculation Output Example.

Unregulated energy

- B6 Operational Energy Use – Unregulated carbon impact should be calculated as follows:

$$\textbf{Total Unregulated Energy Consumption} = \left[\text{Yearly Appliances Consumption} + \text{Yearly Cooking Consumption}\right] * \text{Reference Study Period}$$

$$\textbf{Yearly Cooking Consumption} = \begin{cases} 171 + 98 * Occ & \text{kWh/yr for electric cooking} \\ 236 + 135 * Occ & \text{kWh/yr for mixed cooking, of which:} \\ \quad \begin{cases} 86 + 49 * Occ & \text{kWh/yr is electricity} \\ 150 + 86 * Occ & \text{kWh/yr is non-electric} \end{cases} & \\ 299 + 171 \times Occ & \text{kWh/yr for non-electric cooking} \end{cases}$$

$$\textbf{Yearly Appliances Consumption} = 145.04(A * Occ)^{0.4856} \quad \text{kWh/yr for electric appliances}$$

Where;
A is Total Floor Area, as defined by SAP 10.2.
Occ refers to the number of occupants – this should be based on expected occupancy or, if unavailable, SAP standard occupancy.

This aligns with the FHS assessment wrapper (HEMFHS-TP-04) for appliances and cooking taken from the latest work done by BRE to underpin the Future Homes Standard consultation.

- The cooking assumption must be clearly stated.

Operational Energy Use Carbon Conversion Factors

The relevant carbon conversion factors set must be selected based on the purpose of the WLC assessment, in line with RICS PS 2023;

- **Set 1 Carbon factors** should be used throughout design to understand the consequences of design decisions.
- **Set 2 carbon factors** should be used for the purpose of reporting, benchmarking, and to enable comparison across different projects.

Set 1 and Set 2 carbon factors values should align with RICS PS 2023 *Energy Supplementary Tables Appendix*.

It should be noted that the carbon conversion factor set selection has direct implications on the treatment of on-site renewables and on-site renewable energy generation equipment – see 'On-site renewable energy generation' section below.

On-site renewable energy generation

On-site renewable energy generation should be accounted for in line with RICS PS 2023. This differs depending on the purpose of the assessment as shown in Table 3-1.

Table 3-1: Treatment of on-site renewable Energy

Purpose of Assessment	Carbon Conversion Factor Set	Treatment of on-site renewables
Design decision making	**Set 1**	On-site renewable energy generation must be **excluded** from the WLC total. Embodied carbon associated with on-site renewable energy plant should be **excluded** from the WLC total.
Reporting, Benchmarking, and predicting the carbon emissions over the Reference Study Period (e.g. to predict offsetting)	**Set 2**	On-site renewable energy generation should be **included** within the WLC total. For further information on how to account for renewable energy, the RICS Professional Statement 2023 should be consulted (Appendix H4). Embodied carbon (upfront, in-use, and EoL) associated with on-site renewable energy plant should be **included** within the WLC total.

Operational Energy Use – Grid Decarbonisation

Operational Energy Use B6 carbon impacts, whether referring to Set 1 or Set 2, should be presented for both non-decarbonised and decarbonised scenarios.

The decarbonised carbon conversion factors must reference the Future Energy Scenario Falling Short Scenario, in line with RICS PS 2023.

3.4.6 Operational water use (B7)

Operational Water Use – Calculation

Operational carbon impacts associated with water consumption of a built asset (B7) must be calculated by multiplying carbon factors (kgCO2e/m^3) per type (treated water, ground water, grey water, etc.) by the associated water consumption (m^3).

Water consumption should be estimated based on **Approved Document, Part G** (litres/person/day) and the known or assumed occupancy; aggregated for each year of use.

At early design stages, if project specific water calculator output is not available, the following assumption should be used;

- Residential maximum total water consumption (excluding external uses): **120 litres/person/day**

Where carbon conversion factors for mains water provision and offsite treatment published by the local water supplier are unavailable, the following factors (from *UK Government GHG Conversion Factors for Company Reporting 2023*) should be used:

- Water Supply: **0.177** $kgCO_2e/m^3$
- Water Treatment: **0.201** $kgCO_2e/m^3$

Operational Water Use – Grid Decarbonisation

Operational Water Use B7 carbon impact results should be presented for both non-decarbonised and decarbonised scenarios.

In line with RICS PS 2023, where decarbonisation scenarios for B7 are not available, the same decarbonisation rate that is used for Operational Energy Use B6 should be used.

3.4.7 End-of-life stage (C1–C4)

The end-of-life carbon impacts should be calculated in line with RICS PS 2023.

Note the following defaults:

Deconstruction and demolition (C1)

- In absence of specific project information, C1 deconstruction and demolition impacts should be taken to be **25% of A5.2**, in line with the RICS PS 2023 Business as Usual scenario.

Transport (C2)

- The transport distance should be defined as the distance to the waste processing facility. Should project specific information be unavailable, the average distance between two closest construction waste processing sites / energy-from-waste sites / landfill sites should be taken to be **50 km**.
- Empty running factors should be taken in line with RICS PS 2023.
- Assumed carbon conversion factor for transport of waste:

- Average diesel All HGV (road) – 50% laden: **0.15256** $kgCO_2e$/tonne/km

Waste processing for reuse, recycling or other recovery (C3) and Disposal (C4)

- The FHH material and carbon default dataset in Appendix A includes assumptions for EOL disposal scenarios for all materials listed, which should be used at early design stages, or in the absence of project-specific material transport information.

3.4.8 Biogenic Carbon

Biogenic carbon should be accounted for in line with RICS PS 2023 *Section 4.11.1*.

- When reporting **upfront scope**, A1-A3 emissions should exclude biogenic carbon, with upfront biogenic carbon removals (negative emissions) being reported separately.
- When reporting **whole life scope**, upfront biogenic carbon removals (negative emissions) should be included in A1-A3 and the corresponding biogenic carbon emissions (positive emissions) should be reported within modules C3 at the product's end of life.

3.4.9 Module D

Module D should be calculated in line with RICS PS 2023 and must be reported separately to the Whole Life Carbon (A-C) Results.

3.4.10 Material Decarbonisation

A **50% material decarbonisation factor** for all predicted impacts associated with **B1.2, B2-B4 and C1-C2** should be applied in accordance with RICS PS 2023 Decarbonisation scenarios for embodied impacts.

Results accounting for material decarbonisation must been shown in addition to the no-decarbonisation scenario.

3.4.11 Whole Life Carbon Uncertainty Factor

The Whole Life Carbon Uncertainty Factor (WLC UF), as defined by RICS PS 2023, should be calculated in line with RICS PS 2023 based on:

1. A contingency factor,
2. A carbon data uncertainty factor, and
3. A quantities uncertainty factor.

The WLC UF factor must be applied to all modules A–D before reporting total upfront, embodied, and operational carbon. The applied WLC UF must be clearly reported for transparency, in line with Section 2.7 Reporting below.

3.5 Reporting

Reporting templates for dwelling level and project level reporting have been included in Appendix B. The templates define the minimum reporting requirements, which must be included.

These are summarised below;

- **Project Details** – including;
  - Project Name and description.
  - House type, total number of dwellings, and total number of occupants.
  - Project location.
  - Year of Construction (Actual or Predicted).
  - RIBA Stage.

- **Building Construction and Geometry** – including;
  - Gross Internal Floor Area (GIA).
  - Total Floor Area.
  - Number of storeys – above ground and below ground.
  - Demolished GIA of existing buildings (if demolition was required to enable a new build).
  - Description of primary construction for the following elements: foundations, basement, ground floor, upper floors, vertical structural elements, external walls, roof.
  - Description of building servicing strategy, including heating, cooling, and ventilation.

- **Assessment Information**:
  - Building Element and Lifecycle Stage Scope.
  - Relevant Guidance Standard followed.
  - Name of Assessor.
  - WLCA Software used.
  - Date of assessment.
  - WLC Uncertainty Factor.
  - Whether assessment results have been third-party verified.

- **Source of Information**:
  - Source of material quantity data (e.g. early-stage estimation, design model, as-built).
  - Source of operational energy consumption.
  - Source of operational water consumption.

- **Material and product assumptions** – including:
  - Total material quantity.
  - A1-A3 material carbon factors and factor source.
  - Transport distances.
  - Material Waste factors.
  - Repair and replacement rates.
  - End of life disposal scenarios.

Carbon result reporting should;

- Provide an overview of overall project carbon performance by summarising total upfront, whole life embodied, and operational carbon emissions.
- Provide a detailed overview of performance by key building elements.
- Clearly detail total carbon emissions, showing disaggregated data – providing RICS building element category, material type, material quantity, and associated carbon emissions for each material stage.

4 References

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APPENDIX A – Default Material and Carbon Dataset

The full FHH default material and carbon dataset is provided separately as an Excel spreadsheet.

The sources referenced represent the best freely available generic data points for early-stage Whole Life Carbon assessments for new homes. A Future Homes Hub working group will review and update this appendix periodically, as manufacturing sectors provide new and more up to date generic data.

Below is a list of column headings and example data:

Column Headings	Example
Material Product Name	*Aggregate - Compacted Type 1*
Impact Factor ID	*AGG-001*
Material Type	*Aggregates*
Description	*…*
Type (Collective EPD, ICE database, Other sources)	*ICE database*
Density (kg/declared unit)	*1600*
Declared unit	*kg*
Total carbon A1-A3 (incl. Biogenic) kgCO2e per declared unit	*0.01*
Upfront Biogenic carbon kgCO2e per declared unit	*0*
Total A1-A3 Excl. Biogenic kgCO2e per declared unit	*0.01*
Transportation category (RICS PS 2023)	*Locally manufactured (general)*
km by road	*50*
km by sea	*0*
Lifespan (years)	*60*
Wastage rate (%)	*10%*
End-of-life scenario - Reuse	*0%*
End-of-life scenario - Recycling	*98%*
End-of-life scenario - Incineration	*0%*
End-of-life scenario - Disposal	*3%*
C3 Assumptions	*C3: Waste processing factor for aggregates taken from EPD One tonne of recycled stand/ aggregate/ 6FS/ or silt/ clay (BREG EN EPD No 000510) (UK): 0.0095 kgCO2e/kg*

APPENDIX B.1 – Dwelling Level Reporting template

The full reporting template is provided separately as an Excel spreadsheet.

Below images included for information only.

Project data

Madatory Field			
Optional Field			
Project Details			
Project Name			
Project Description			
Project Type			*New build, New Build and Extension, Refurbishment, Other*
Dwelling Type			*Detached House, Semi-Detached House, Terraced House, Bungalow or Apartment Block.*
Building part of wider masterplan?			
Number of Homes			*The total number of dwellings in the building.*
Number of Occupants			*The total number of occupants in the building (across all dwellings).* *Further Guidance* *For a Detached house, this refers to the total number of occupants in the house. For an Apartment Block or Terraced Housing Block, this refers to the total number of occupants for the building block.*
Location (Town / City)			
Year of Completion (Actual or Predicted)			
Current RIBA Stage			*Early Concept and Design Stages (0-3), Detail design (4), Construction (5), As built (6), In use (7)*
Building Construction and Geometry			
Gross Internal Floor Area (GIA)		Sq Metres	*Gross Internal Area (as defined by RICS Code of Measuring Practice) is the area of a building measured to the internal face of the perimeter walls, at each floor level.*
Total Floor Area (TFA)		Sq Metres	*Total Floor Area (TFA), in alignment with the SAP 10.2 definition of TFA, includes the entire internal floor plan of all storeys within a dwelling. If your building has multiple dwellings - please include the Total Floor Area for all dwellings.* *Further Guidance* *The area above the stairs (which is not in fact usable floor space) is included, as is the inaccessible floor area under internal walls.*
Number of Storeys - Above ground		Storey(s)	*Number of storeys above ground including ground floor.*
Number of Storeys - Below ground		Storey(s)	*Number of storeys below ground excluding ground floor.*
Floor-to-Floor Height		Metres	*Average, if varied.*
New Build GIA		Sq Metres	
Existing Building Retained GIA		Sq Metres	
Existing Building Demolished GIA		Sq Metres	*The combined Gross Internal Area of all existing buildings to be demolished to enable the new building. If there are no existing buildings on site, the value would be 0.*
Description of primary construction			*Description of primary construction for the following elements: foundations, basement, ground floor, upper floors, vertical structural elements, external walls, roof.*
Description of building servicing strategy			*Description of building servicing strategy, including heating, cooling, and ventilation.*
Assessment Information			
Name of Assessor			
Date of Assessment			
WLCA Software Used for Assessment			
Primary WLCA Guidance / Standard Followed			*E.g. RICS 2017, RICS 2023, Other*
Does the assessment align with the FHH WLC Conventions "Wrapper"?			
Has the assessment been third-party reviewed and verified?			

Scope and assumptions:

Building Element Scope

	Project Building Element Scope Assessed	FHH Building Element Scope Requirement (Dwelling Level)	Comments
0.1 Treatment and demolition works		-	
1 Substructure		✓	
2.1 Frame		✓	
2.2 Upper Floors		✓	
2.3 Roof		✓	
2.4 Stairs and ramps		✓	
2.7 Internal walls and partitions		✓	
2.8 Internal doors		✓	
3 Finishes		✓	
4 Fixed FF&E		✓	
5.1 Sanitaryware		✓	
5.2 Water systems		✓	
5.3 Heating and Cooling		✓	
5.4 Ventilation		✓	
5.5 Electrical installations		✓	
5.6 Life safety		✓	
5.7 Fuel installations		✓	
5.8 Lift and conveyor installations		✓	
5.9 Services equipment Disposal installations Specialist installations		✓	
5.10 Builders work in connection with services		✓	
6 Pre-fabricated buildings and units		-	
7 Works to existing building		-	
8 External works (associated with the works)		-	

Lifecycle Stage Scope

	Project Lifecycle Stage Scope Assessed	FHH Lifecycle Stage Scope Requirement (Dwelling Level - WLC)	Comments
Biogenic Carbon		✓	
[A0] Pre-construction		-	
[A1-A3] Product		✓	
[A4] Transport		✓	
[A5] Construction and Installation*		✓	
[B1-B5] Embodied In-use**		✓	
[B6] Operational Energy		✓	
[B7] Operational Water		✓	
[B8] User Carbon		-	
[C1-C4] End of Life		✓	
[D] Benefits and loads beyond the system boundary		Reported Separately	

Notes:
** [A5] Construction and Installations Impacts includes submodules A5.1-A.3 only.*
[A5.4] Worker Transport, noted as an optional submodule in RICS PS 2023, does not form part of the FHH Core scope and must be reported separately.

*** The core FHH scope excludes B5 Impacts from retrofit/refurbishment/planned changes. [B5] carbon impacts must be reported separately.*

Source of information

Source of material quantity data		*E.g. Early stage estimation, Design Models, Cost Plan, As-Built Data.*
Source of Operational Energy Consumption - Regulated		*E.g. Benchmark estimation, SAP 10.2, TM54 / Detailed operational energy modelling, Metered Data*
Source of Operational Energy Consumption - Regulated		*E.g. Benchmark estimation, FHS assessment wrapper (HEMFHS-TP-04), Detailed operational energy modelling, Metered Data*
Source of Operational Water Consumption		*E.g. Benchmark estimation, Approved Document Part G, CIBSE Guide G / IoP Plumbing Engineering Services Design Guide / Detailed modelling, Metered Data*

Summary carbon data:

Carbon intensity (kgCO2e/m2) for each of the standard scopes reported to. Assumptions as follows for benchmarking:

- Set 2 carbon factors.
- Decarbonised grid factors for operational energy.
- Decarbonised materials for replacement.

Disaggregated carbon data:

For each building element category, carbon impacts broken down by material/product and life cycle stage.

Material Assumptions:

Material assumptions for the top 10 most contributing materials, including carbon factors, source of EPD data, transport assumptions, waste rates, and end of life scenarios.

APPENDIX B.2 – Project Level Reporting template

The full reporting template is provided separately as an Excel spreadsheet.

Below images included for information only.

Project data

Madatory Field			
Optional Field			
Project Details			
Project Name			
Project Description			
Project Type			*New build, New Build and Extension, Refurbishment, Other*
Building part of wider masterplan?			
	Number of buildings	Number of Homes in the building	
Detatched Houses			
Semi-Detached Houses			
Bungalows			
Terraced Blocks			
Apartment Buildings			
Number of Occupants			*The total number of occupants in the development (across all dwellings).* *Further Guidance* *For a Detached house, this refers to the total number of occupants in the house. For an Apartment Block or Terraced Housing Block, this refers to the total number of occupants for the building block.*
Location (Town / City)			
Year of Completion (Actual or Predicted)			
Current RIBA Stage			*Early Concept and Design Stages (0-3); Detail design (4); Construction (5); As built (6); In use (7)*

Building Construction and Geometry			
Gross Internal Floor Area (GIA)		Sq Metres	*Gross Internal Area (as defined by RICS Code of Measuring Practice) is the area of a building measured to the internal face of the perimeter walls, at each floor level.*
Total Floor Area (TFA)		Sq Metres	*Total Floor Area (TFA), in alignment with the SAP 10.2 definition of TFA, includes the entire internal floor plan of all storeys within a dwelling. If your building has multiple dwellings - please include the Total Floor Area for all dwellings.* *Further Guidance* *The area above the stairs (which is not in fact usable floor space) is included, as is the inaccessible floor area under internal walls.*
External Works Area		Sq Metres	*For external works, the area must be the works within the project boundary but excluding the ground-level asset footprint*
New Build GIA		Sq Metres	
Existing Building Retained GIA		Sq Metres	
Existing Building Demolished GIA		Sq Metres	*The combined Gross Internal Area of all existing buildings to be demolished to enable the new building. If there are no existing buildings on site, the value would be 0.*
Description of primary construction			*Description of primary construction for the following elements: foundations, basement, ground floor, upper floors, vertical structural elements, external walls, roof.*
Description of building servicing strategy			*Description of building servicing strategy, including heating, cooling, and ventilation.*
Assessment Information			
Name of Assessor			
Date of Assessment			
WLCA Software Used for Assessment			
Primary WLCA Guidance / Standard Followed			*E.g. RICS 2017, RICS 2023, Other*
Does the assessment align with the FHH WLC Conventions "Wrapper"?			
Carbon Conversion Factor Set Used (Reference to RICS PS 2023 Carbon Sets for Energy)			*E.g. Set 1, Set 2*
Including Grid Decarbonisation?			*Yes/No*
Including Material Decarbonisation?			*Yes/No*
Contingency Factor	%		*This forms part of the WLC Uncertainty Factor, as defined by RICS PS 2023.*
Carbon Data Uncertainty Factor	%		*This forms part of the WLC Uncertainty Factor, as defined by RICS PS 2023.*
Quantities Uncertainty Factor	%		*This forms part of the WLC Uncertainty Factor, as defined by RICS PS 2023.*
Has the assessment been third-party reviewed and verified?			

Scope and assumptions:

Building Element Scope			
	Project Building Element Scope Assessed	FHH Building Element Scope Requirement (Project Level)	Comments
0.1 Treatment and demolition works		✓	
1 Substructure		✓	
2.1 Frame		✓	
2.2 Upper Floors		✓	
2.3 Roof		✓	
2.4 Stairs and ramps		✓	
2.7 Internal walls and partitions		✓	
2.8 Internal doors		✓	
3 Finishes		✓	
4 Fixed FF&E		✓	
5.1 Sanitaryware		✓	
5.2 Water systems		✓	
5.3 Heating and Cooling		✓	
5.4 Ventilation		✓	
5.5 Electrical installations		✓	
5.6 Life safety		✓	
5.7 Fuel installations		✓	
5.8 Lift and conveyor installations		✓	
5.9 Services equipment Disposal installations Specialist installations		✓	
5.10 Builders work in connection with services		✓	
6 Pre-fabricated buildings and units		✓	
7 Works to existing building		✓	
8 External works (associated with the works)		✓	

Lifecycle Stage Scope			
	Project Lifecycle Stage Scope Assessed	FHH Lifecycle Stage Scope Requirement (Project Level - WLC)	Comments
Biogenic Carbon		✓	
[A0] Pre-construction		✓	
[A1-A3] Product		✓	
[A4] Transport		✓	
[A5] Construction and Installation*		✓	
[B1-B5] Embodied In-use**		✓	
[B6] Operational Energy		✓	
[B7] Operational Water		✓	
[B8] User Carbon		-	
[C1-C4] End of Life		✓	
[D] Benefits and loads beyond the system boundary		Reported Separately	

Notes:
** [A5] Construction and Installations impacts includes submodules A5.1-A5.3 only.*
[A5.4] Worker Transport, noted as an optional submodule in RICS PS 2023, does not form part of the FHH Core scope and must be reported separately.

*** The core FHH scope excludes B5 impacts from retrofit/refurbishment/planned changes. [B5] carbon impacts must be reported separately.*

Summary carbon data:

Carbon intensity (kgCO2e/m2) for each of the standard scopes reported to. Assumptions as follows for benchmarking:

- Set 2 carbon factors.
- Decarbonised grid factors for operational energy.
- Decarbonised materials for replacement.

Disaggregated carbon data:

For each building element category, carbon impacts broken down by material/product and life cycle stage.

Material Assumptions:

Material assumptions for the top 10 most contributing materials, including carbon factors, source of EPD data, transport assumptions, waste rates, and end of life scenarios.

APPENDIX C – Default Component Benchmarks

The full detail of assumptions underlying the benchmarks is provided separately as an Excel spreadsheet.

It is recognised that at early stages, it is difficult to quantify many building components. FHH has developed a set of new homes component benchmarks for MEP/FF&E/Finishes.

Benchmark	Includes	Note	Unit	A1-A3
Heating and DHW – Houses*	*Heat source, DHW store, pipework, valves, controls and emitter*	*Estimation based on TM65.1 data*	kgCO2e/m2 GIA	14.4
Heating and DHW – Apartments*	*Heat source, DHW store, pipework, valves, controls and emitter*	*Estimation based on TM65.1 data*	kgCO2e/m2 GIA	26.1
Bathroom (and ensuite)*	*Bath/shower, WC, sink, taps, tiling*	*Benchmark Estimate developed with FHH Working Group 3*	kgCO2e/# bathrooms	222
WC*	*WC, small sink, taps*		kgCO2e/# WCs	121
Kitchen*	*Cabinets, worktops, drawers, sink, large appliances, tiling*		kgCO2e/# kitchens	3,387
Electrical*	*Lighting, cabling, consumer unit, fans, switches and sockets*		kgCO2e/m2 GIA	11.3
Water supply and drainage*	*Water supply, rainwater, soil and waste*		kgCO2e/m2 GIA	6.6
Stairs	*Stairs(Straight timber staircase)*	*Benchmark estimate based on available EPD data*	kgCO2e/#upperfloorstoreys * #staircores	303.7
Wall finishes and decoration	*Paint and wall tiling*		kgCO2e/m2 GIA	5.0
Floor finishes	*Carpet (75% GIA) and floor tiling (25% GIA)*		kgCO2e/m2 GIA	10.4
Internal doors and joinery	*Doors, lining and architraves, skirting*		kgCO2e/m2 GIA	TBC

*Note: *other life cycle stages calculated in line with Conventions defaults / TM65.1*

Note: reference Whole Life Carbon Uncertainty Factor (3.4.11), the FHH Default Component Benchmarks carbon figures already include a contingency and uncertainty factor.