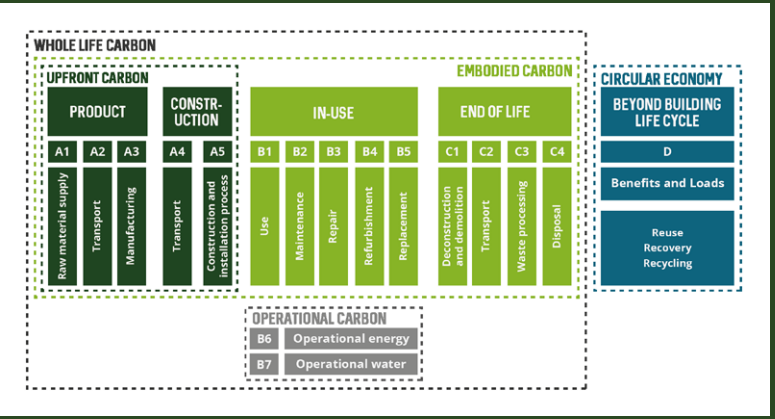
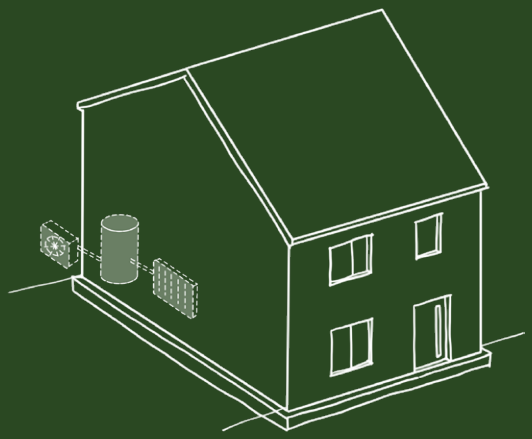


BUILDING SERVICES

Estimation of upfront embodied carbon impacts as described in CIBSE TM65.1 : 2021 Embodied carbon in building services: residential heating. For further information on calculations and assumptions as well as guidance on individual and communal systems please refer to the original document.

Illustrated per m^2 of GIA.

Excludes refrigerant leakage.



Based on a 96m^2 3B5P terraced house with ultra-low building fabric

We focus on Upfront carbon as they are most likely the majority of embodied carbon impacts associated with a project.

Included are Product stages A1-A3, plus Transport A4 to wales and Material waste from Construction installation A5W.
Excluded are emissions due to energy usage on site during construction installation A5a.

The impact of building services and MEP equipment on whole life embodied carbon can be significant, especially due to short replacement cycles throughout a building's lifetime.

There can be huge variation in impacts of different Heating, Ventilation and hot water systems and, as always, Both operational and embodied carbon impacts need to be considered together when making design decisions.

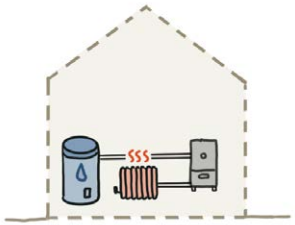
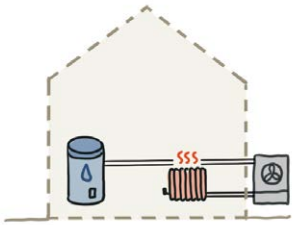
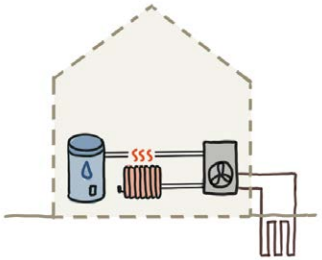
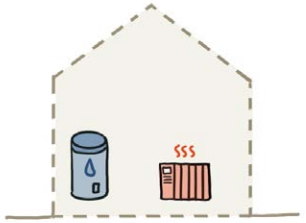
It's also important to balance energy and carbon in relation to a building's fabric, design and layout, and wider user and project requirements.

EMBODIED CARBON IMPACTS

BUILDING SERVICES

EMBODIED CARBON: EXAMPLE OF BUILDING SERVICES

A1-A4
based on a 96m² 3B5P terraced home

	Gas Boiler	Air Source Heat Pump (ASHP)	Ground Source Heat Pump (GSHP)	Direct Electric (DElec)
				
Estimated Upfront Carbon Impacts per m2 GIA	**15** **kgCO2e/m² GIA** A1-A5w upfront carbon	Biogenic carbon stored 0 kgCO2e/m²	**17** **kgCO2e/m² GIA** A1-A5w upfront carbon	Biogenic carbon stored 0 kgCO2e/m²	**19** **kgCO2e/m² GIA** A1-A5w upfront carbon	Biogenic carbon stored 0 kgCO2e/m²	**7** **kgCO2e/m² GIA** A1-A5w upfront carbon	Biogenic carbon stored 0 kgCO2e/m²

refer to CIBSE TM65.1: 2021, Embodied carbon in building services: residential heating

IT'S IMPORTANT TO KNOW THAT REFRIGERANT LEAKAGE HAS NOT BEEN INCLUDED IN THESE FIGURES, BUT THIS CAN HAVE A HUGE ENVIRONMENTAL IMPACT! REFRIGERANT CHOICE CAN INCREASE THE OVERALL EMBODIED CARBON IMPACT OF A HEAT PUMP SYSTEM BY UP TO 30%.

WHILE DIRECT ELECTRIC SYSTEMS HAVE THE LOWEST UP-FRONT EMBODIED CARBON IMPACT, IT'S IMPORTANT TO CONSIDER THAT THEY CAN HAVE A HIGHER OPERATIONAL CARBON IMPACT THAN HEAT PUMPS.