Methodology

Two scenarios were developed to understand the carbon impacts of building in urban areas at density, versus building at low density on the urban fringe.

Scenario 1

Demolish and densify: this assumes 50 semi-detached houses are already in an urban area. These 50 houses are then demolished and replaced by 300 flats in a six storey block.

Scenario 2

No demolition: this assumes 50 semi-detached houses are already in an urban area. These are not demolished, but 250 new semi-detached houses are built on the urban fringe.

Total emissions for both scenarios were calculated using the embodied carbon associated with the construction of the new flats and semi-detached homes. We estimated residents' heat use, as well as the emissions from car use, dependent on the lifestyle of both the urban and urban fringe residents.

Embodied carbon for construction of a new six storey block of flats was assumed to be 332kgCO_2 per m_2, and the embodied carbon for construction of a new semi-detached house was assumed to be 394kgCO_2 per m_2, based on M Drewniok, et al (2022).[1] Emissions from demolition in Scenario 1 were assumed to be 3.4kgCO_2/m_2.[2]

Gas and electricity consumption for semi-detached houses and flats based on their EPC rating was taken from the National Energy Efficiency Data Framework 2014.[3]

Emissions from car use were calculated using the emissions factors from the Climate Change Committee's 'balanced net zero pathway' in the sixth carbon budget. The average miles driven per person per year was assumed to be 3,661 for an urban resident, and 4,935 for a non-urban resident, based on the National Travel Survey (2022).[4]

Assumptions

The average lifespan of a building was assumed to be 60 years, based on the Royal Institute of Chartered Surveyors (2017).[5]

Each household was assumed to have two residents and two bedrooms, regardless of the type of property, or whether it was urban or non-urban.

The floor area of a flat was assumed to be $62m_2$, and the floor area of a semi-detached home was assumed to be $65m_2$.[6]

Emissions from car use

The percentage of households with internal combustion engine, plug-in hybrid and battery electric vehicles estimated over time and the associated emissions factors were based on the Climate Change Committee's 'balanced net zero pathway' in the sixth carbon budget. Miles driven per person per year were assumed to be average miles driven per person for urban and non-urban residents and this was assumed to stay constant.

Energy efficiency

All new builds were assumed to be EPC A or B; all existing dwelling were assumed to be EPC D.

Heat decarbonisation

All older build homes have a heat pump installed in the year 2030. We assume gas boilers are 70 per cent efficient, and heat pumps are 324 per cent efficient.[7] Decarbonisation of the electricity grid is taken from the Climate Change Committee's 'balanced net zero pathway' in the sixth carbon budget.

Endnotes

[1] M Drewniok, et al., 2022, 'Mapping material use and embodied carbon in UK construction', *Engineering Enrgxiv* archive
[2] Ibid
[3] Department for Energy and Climate Change, 2014, 'National energy efficiency data framework anonymised dataset'
[4] Department for Transport, 2022, *National travel survey 2021*
[5] Royal Institute for Chartered Surveyors, 2017, Whole life carbon assessment for the built environment
[6] M Drewniok, et al., op cit
[7] EDF Energy, 'Air source heat pumps: a complete guide', www.edfenergy.com