



Building the Case for Net Zero:

A case study for low carbon residential developments

Foreword

With the UK's ambition to deliver 300,000 new homes a year and cut emissions by 78% by 2035, we are left with a very serious challenge. How does our industry continue to plan and deliver new communities at scale whilst minimising impact on the environment? Little has been done to better understand how the design choices we make when masterplanning new residential communities will impact our net zero ambitions.

This report gives insight into some of the key considerations that developers, housebuilders, local authorities and consultants should think about when planning new large-scale residential communities. To help facilitate this work, we put forward one of our development sites, Trumpington Meadows on the southern fringe of Cambridge, to use as a real-world example of what could be possible.

The findings of this study show us that there are real improvements to be made if we embrace the low carbon design challenge, which can in fact lead to delivering a far more attractive and healthier environment in which to live. Some examples of co-benefits can be found in the shift away from the private car and traditional drainage solutions, creating more space for amenity and allowing biodiversity to flourish.

What has been evidenced is that embodied carbon measurement is the critical first step to uncovering the most significant carbon hotspots. With grey infrastructure – roads and parking – making up the majority of the embodied carbon, it is clear we need a cultural shift away from car ownership and towards the adoption of active travel methods. Whilst there are emerging materials with lower embodied carbon, many are still untested and in their infancy, highlighting the need to encourage people out of their cars. Clearly reducing areas for cars, providing convenient, attractive, safe alternatives must be the start but we need to be more radical and progressive with those Local Authorities willing to flex old standards. We need less asphalt and more green spaces!

In order to meet the net zero challenge we must be bold, drive innovation and be prepared to look at things through a new lens. Most importantly, we must take others on the journey with us.



Andy Sharpe
Director of Project Management,
Strategic Land
Grosvenor Property UK

Executive Summary

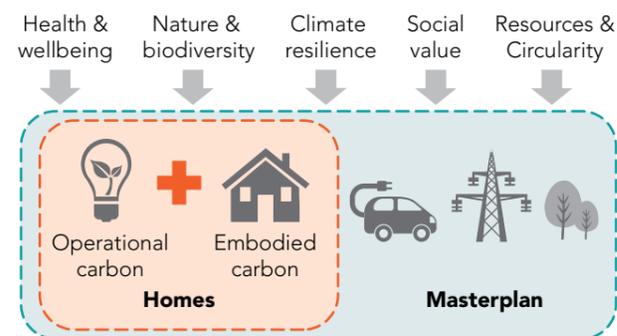
UKGBC's Net Zero Whole Life Carbon Roadmap states that embodied carbon emissions will make up over half of built environment emissions by 2035.¹ For the residential sector, much of the focus on embodied carbon is on homes, leaving the embodied carbon from the masterplan works – including roads, utilities and energy infrastructure – unchecked and ill-considered. Gaining insight into these embodied carbon impacts can also uncover opportunities to improve the masterplan holistically, including climate resilience and resident amenity.

UKGBC's Advancing Net Zero programme² is helping to drive the transition towards net zero, including through its development of the Net Zero Carbon Buildings Framework³. Whilst much of the focus remains on net zero carbon buildings, the carbon impacts outside the property boundary must also be considered. Each tonne of carbon from the built environment, irrespective of sector or project lifecycle stage, must be measured and mitigated in order for the UK's net zero target to remain within reach.

The embodied carbon from masterplan works – which can span many years and consume large amounts of materials – is currently unregulated and is only beginning to be measured by some residential developers. Measurement is the critical first step to understanding the size of the challenge for new developments, before implementing 'quick wins' to cut embodied carbon. An embodied carbon assessment can reveal the greatest sources of emissions – such as from roads, hard surfaces, utilities, and energy infrastructure – and allow testing of different design strategies to mitigate these carbon impacts.

Ultimately, new residential developments must be designed for both people and planet – ensuring they are healthy and habitable for residents, within and beyond their property boundary. Carbon must also be considered alongside a range of other social, environmental, and economic factors, as indicated in Figure 1.

Figure 1: Net zero carbon homes (shown in orange) need to be considered within the broader context of the masterplan (shown in blue) in which they are situated, alongside a range of other factors.



PURPOSE

This report presents the findings from a study examining the design and cost implications of minimising embodied carbon for a real-world, low-rise residential development – Trumpington South in Cambridgeshire. The findings are intended to help 'build the case' for other projects seeking to tackle embodied carbon from masterplan works by providing examples of design strategies which can be practically implemented today.

This guidance aims to help local authorities, investors, housebuilders, developers and the whole value chain better

understand the delivery of low carbon residential developments and, in doing so, demonstrate the residential sector's leadership in meeting the UK's net zero challenge.

Later in 2022, UKGBC will be publishing a follow-up report examining the delivery of new net zero carbon homes on the Trumpington South scheme. The report will illustrate design strategies to reduce both embodied carbon and operational carbon by achieving current industry performance targets.

This report is split into two main sections:



1. Design changes

The study is based on a real-world residential scheme for 750 homes in Cambridgeshire, Trumpington South, which is considered representative of a typical urban extension currently going through the planning process. UKGBC convened a task group to undertake a range of masterplan-level design interventions to reduce embodied carbon as much as possible, whilst also considering other aspects such as climate resilience and resident amenity.

The original design was used as a baseline from which two low carbon scenarios were developed, 'intermediate' and 'stretch'. The scope of the study included typical masterplan works – such as roads and hard surfaces, utilities, energy infrastructure – to ensure the findings are widely applicable for other low-rise residential schemes.



2. Cost changes

In parallel, an analysis of the changes to capital costs to practically deliver the design interventions was also undertaken. The findings reveal strong interrelationships between the design of homes and masterplan infrastructure, for example heat infrastructure, and provide a more rounded understanding of where the true costs lie.

The analysis focused on capital costs which can be more accurately estimated based on today's market prices. However, it is widely recognised that these costs are likely to reduce over time as the industry gears up to deliver low carbon projects in the future. Furthermore, other intangible benefits – such as adaption to climate risks, additional green space, and improved resident amenity – have been highlighted as key considerations alongside capital cost.

3. Discussion

In light of this study acting as a pathfinder for other projects seeking to measure and minimise embodied carbon, a third section raises a range of supporting discussion points. These should provide further points of interest and are intended to help stimulate further discussion.

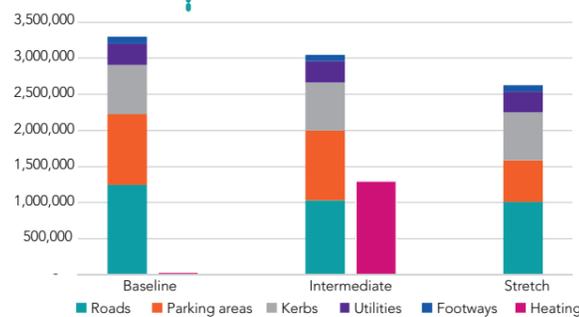
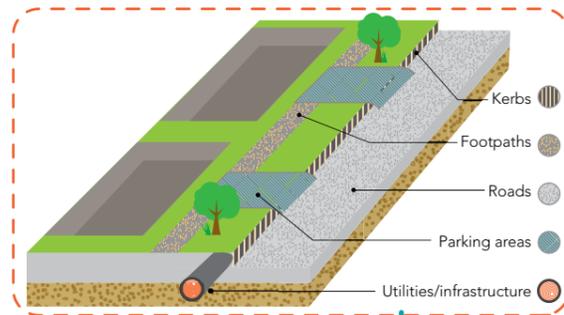
Key discussion points:

- Embodied carbon measurements and agreed limits
- Contribution to organisational commitments
- Design efficiency and circularity
- Resilience and nature-based solutions
- Wider social benefits

Key findings

The study examines the embodied carbon of a typical residential masterplan, which includes roads, utilities, stormwater, energy systems and other related infrastructure. Embodied carbon related to the construction stage (module A) makes up 85% of the masterplan's total embodied carbon (modules A to C), highlighting the importance of low carbon product and material selection at the design and construction stages.

See page 9 to find out more

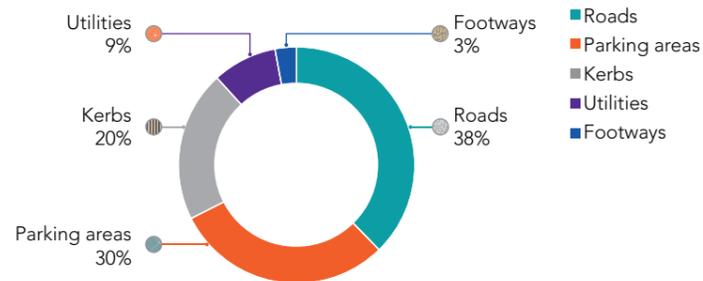


The embodied carbon from the baseline masterplan is 3,300,000 kgCO₂e, which is roughly the equivalent of the total embodied carbon from 80 terrace houses. A reduction of 670,000 kgCO₂e (or 20.3% of the baseline total) was achieved in the stretch scenario through a range of 'easy wins' and cost-effective design interventions.

See page 18 to find out more

'Grey infrastructure' – comprised of roads, parking and kerbs – makes up 88% of the masterplan's total embodied carbon. The findings demonstrate that this can be reduced by 645,000 kgCO₂e primarily by reducing parking areas and switching from asphalt to permeable paving for tertiary roads

See page 19 to find out more

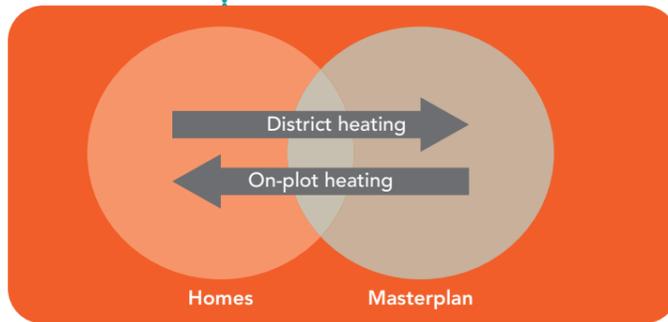


Extending the swale network to include primary and secondary streets reduces embodied carbon from the stormwater network, whilst also increasing the provision of 'blue/green networks'. This highlights the general principle of reducing materials used, in place of nature-based solutions that help deliver holistic benefits, including climate resilience.

See page 21 to find out more

By anticipating the increased use of vehicle sharing in future, parking provision per home has been reduced which frees up land for more greenery and additional dwellings. The number of homes can be increased by 5.3% (or around 39 homes across the 750-home scheme).

See page 24 to find out more

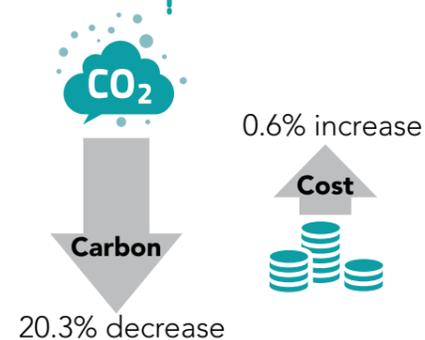
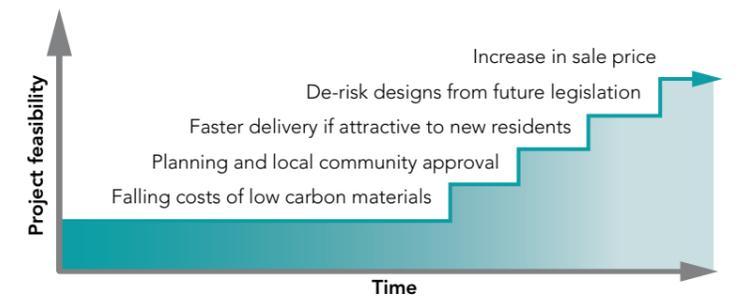


A communal district heat network has been modelled which highlights that embodied carbon can shift from homes to the masterplan, depending on the heating solution selected. This exemplifies the need to take a holistic view during design to consider wider impacts beyond a home's own boundary.

See page 28 to find out more

A range of other value drivers – outside of capital cost – will help improve the feasibility of low carbon residential developments over time. This includes increasing appeal within the planning process and for potential new residents.

See page 12 to find out more



Overall, a 20.3% embodied carbon reduction was achieved between the baseline and stretch scenarios for the masterplan, with a negligible impact on capital costs (0.6% increase). Heating has been modelled and costed separately as it is highly dependent on the design solution used for homes.

See page 33 to find out more

This study explores the design and cost implications of delivering low carbon residential developments. We welcome input from any interested stakeholders on the content and potential future areas of study.

If you have any questions on this report or would like to provide feedback, please email ANZ@ukgbc.org



UK Green Building Council

The Building Centre
26 Store Street
London WC1E 7BT

T 020 7580 0623
E info@ukgbc.org
W ukgbc.org