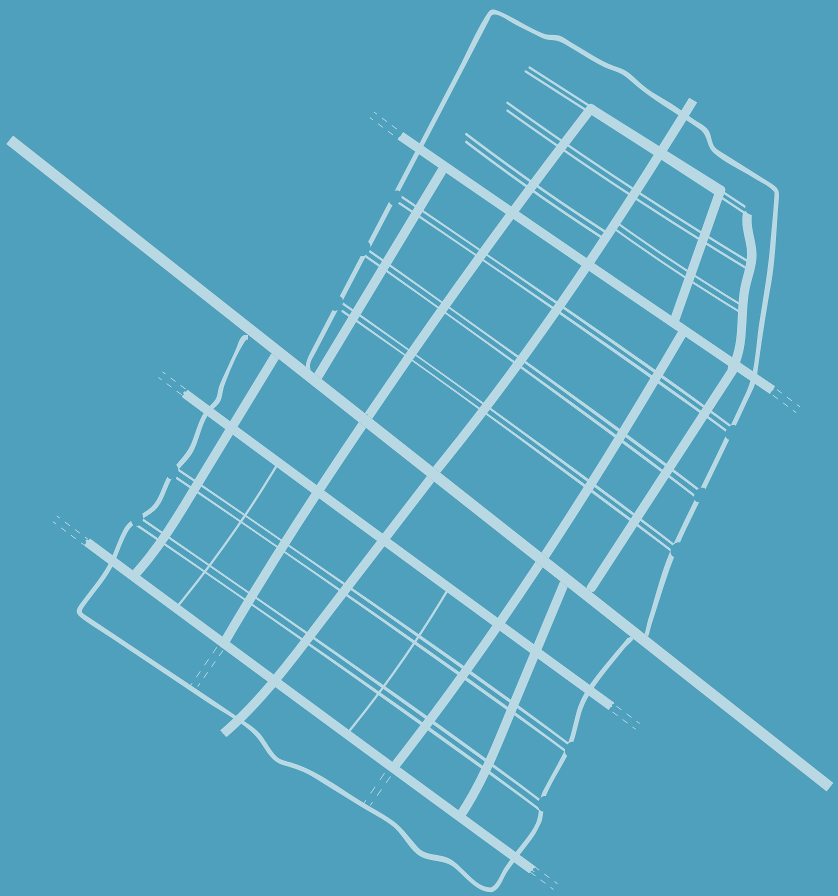

Viable Homes

Guidelines for planners on the design and building of low carbon, low rise, medium density housing in Ireland - V1.0.

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Construct Innovate
Built Environment Research Ireland

Contents

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Scoil na hAiltireachta, na Pleanála agus an Pholasaí Chomhshaoil UCD

IGBC Irish Green Building Council

Introduction

The intent of this handbook is to highlight to planners and other key stakeholders the whole life carbon impacts of constructing new dwellings on greenfield sites and to provide recommendations to mitigate these impacts. To date, in the construction industry, the emphasis has been placed upon the reduction in operational energy and little emphasis has been placed on the embodied energy of construction and in particular associated external areas and infrastructure.

The Viable Homes project has quantified for the first time in an Irish context this greater carbon cost of dwellings due to infrastructure and identified carbon hotspots. In the case of a typical greenfield development, infrastructure adds approximately 30% additional embodied carbon per dwelling. This handbook therefore shows that the optimisation of newly built areas and efficiency of infrastructure per dwelling must play a critical role in reducing carbon emissions at an early design stage.

This handbook and the accompanying report is the first part of a longer ongoing research project carried out by researchers from the School of Architecture, Planning and Environmental Policy at University College Dublin (UCD) and the Irish Green Building Council (IGBC) to understand, quantify and provide guidance on the connection between compact growth, development typologies and carbon mitigation through assessing the climate impact of housing size, mix, layout and density.

This handbook should be seen as a living document and will be refined and expanded upon as this research continues.

How to use this handbook:

We have described each recommendation under a series of headings which are explained below.

Recommendation 00

Description: An outline of the proposal.

Embodied carbon benefit: The reduction in embodied carbon which will be achieved by following this recommendation.

Operational carbon benefit: The reduction in operational carbon which will be achieved by following this recommendation.

Additional benefits: Added extras beyond carbon (usually qualitative) that this recommendation will result in.

Consideration: Items that require further thought before progressing.

Implementation: Suggested strategies for making this recommendation happen.

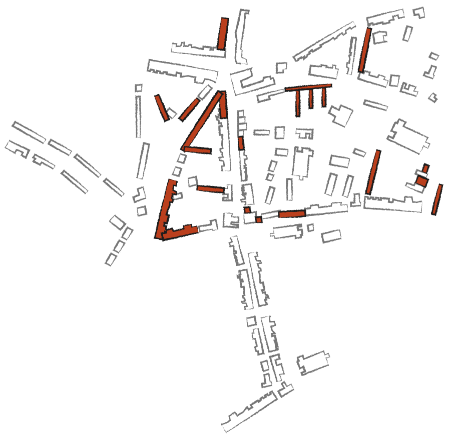
Policy alignment: Existing policy which our recommendation reinforces.

Relevant case studies & references: Built examples and further reading.

Recommendation 01 Site Location

Description: Prioritise housing development on infill sites in existing urban cores over edge-of-town greenfield sites.

Low density greenfield development



Medium-high density infill development

Embodied carbon benefit: External areas and infrastructure associated with greenfield housing developments add approximately 30% additional embodied carbon for each dwelling (measured for life cycle stages A1-A5). Comparable infill developments can plug into existing infrastructural systems representing a saving. In this case existing services may need to be upgraded, but this will still be less carbon intensive than providing entirely new infrastructure.

Operational carbon benefit: Reduced car usage.

Additional benefits:

- Increase in active travel and casual social interaction, reduced car dependency
- Compact urban growth and revitalisation of town centres and business viability
- Reduction in land consumption and protection of natural resources for agriculture or landscape amenity

Consideration: Upgrading of existing infrastructure may be necessary.

Implementation: Acknowledge the true social, environmental and economic impact of greenfield development through for example creating tax incentives (or disincentives) to encourage compact urban growth and land use restrictions where appropriate infill sites are available. Charge higher planning fees and contributions for greenfield developments.

Policy alignment:

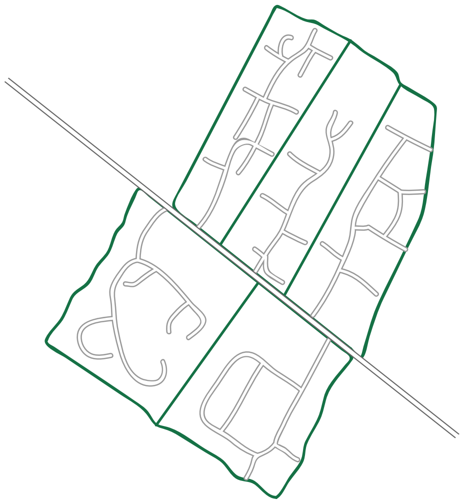
- National Planning Framework
- Town Centre First (Action 13)

Relevant case studies & references:

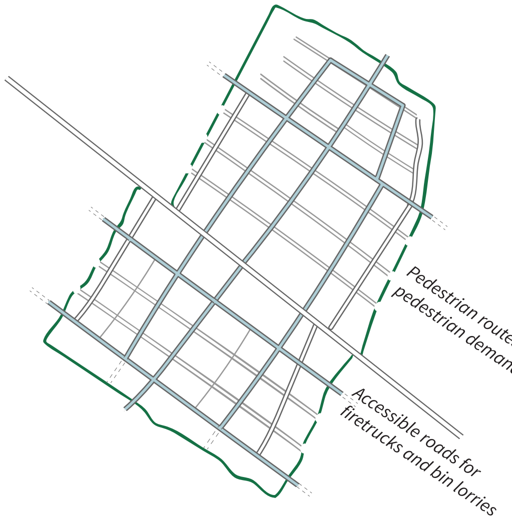
- Twelve Houses, Sorgenfri by Förstberg Ling
- Georges Place, Dun Laoghaire by DLRCOCO Architects with A2 Architects
- 14 Dwellings in Formentera by Instituto Balear de la Vivienda (Ibavi)
- How to design housing schemes that are at home in their place by Proctor and Matthews
- Further reading: Pelsmakers, The Environmental Design Pocketbook, Edition 2, 2015 pp.63

Recommendation 02 Site Layout

Description: Design and build connected neighbourhoods irrespective of ownership boundaries.



Current practice



Coordinated masterplan with connected hierarchy of pedestrian streets and minimal driveable routes

Embodied carbon benefit: Reduction in the quantity of roads and infrastructure required to service developments leads to a reduction in embodied carbon. Furthermore, drivable roads and sewage services are not siloed between developments. Our research shows that each typical suburban dwelling creates approximately an additional 11 tonnes of CO2 embodied carbon for external areas and infrastructure, approximately 27% of the total for the dwelling.

Operational carbon benefit: Reduced car journey times and usage.

Additional benefits:

- Walkable neighbourhoods
- Social cohesion

Considerations:

- Land ownership and site assembly
- Phasing and timing of developments
- Biodiversity and hedgerows

Implementation: Acknowledge the requirement for joined-up forward planning. Introduce a requirement for neighbourhood wide contextual master plans for all greenfield development irrespective of land ownership patterns.

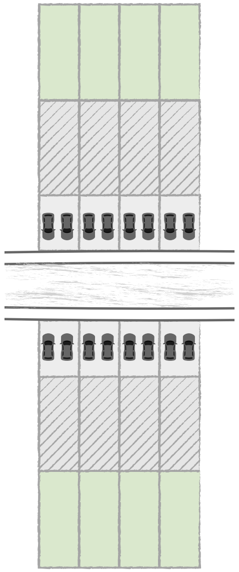
Policy alignment: Sustainable Residential Development and Compact Guidelines for Planning Authorities (Appendix C)

Relevant case studies & references:

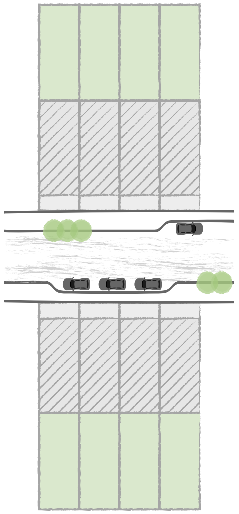
- Vauban Sustainable Urban District Freiburg by Kohlhoff and Kohlhoff Architects
- Accordia Masterplan Cambridge by Fielden Clegg Bradley Architects
- Abode at Great Kneighton by Proctor & Matthews Architects
- Distinctively Local by Proctor and Matthews

Recommendation 03 Car Parking

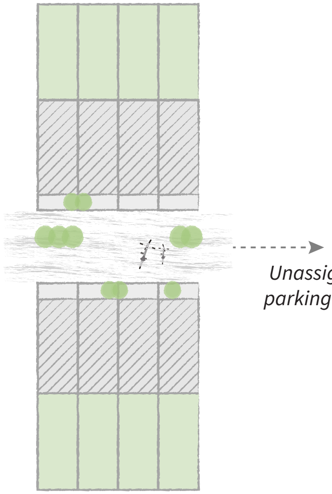
Description: Minimise the quantum of car parking and prioritise unassigned off-curtilage parking.



Current standard practice



Off-curtilage parking



Shared surface with near site parking

Embodied carbon benefit: Provision of car parking spaces and associated road has a high embodied carbon (see recommendation 01 & 02). Through a reduction in the quantity of drivable roads and reduction in width of dwellings (often defined by the width of two car parking spaces), the quantum of carbon will be reduced.

Operational carbon benefit: Potentially reduced car usage through disincentivization.

Additional benefits:

- Safer neighbourhoods
- Higher quality public space
- Less visual clutter
- Fewer impermeable surfaces

Considerations:

- Access for emergency vehicles
- Public transport provision
- Technical Guidance Document M requirements
- Electric vehicle charging points

Implementation: Quantum of parking to be minimised and provided via unassigned off-curtilage spaces with the exception of TGD requirements

Policy alignment:

- Sustainable Residential Development and Compact Guidelines for Planning Authorities (Chapter 5, SPPR 3)
- Design Manual for Urban Roads and Streets (DMURS)
- Designing Streets for Kids

Relevant case studies & references:

- Abode at Great Kneighton by Proctor & Matthews Architects
- Goldsmith Street, Norwich by Mikhail Riches Architects

Recommendation 04 Water Attenuation

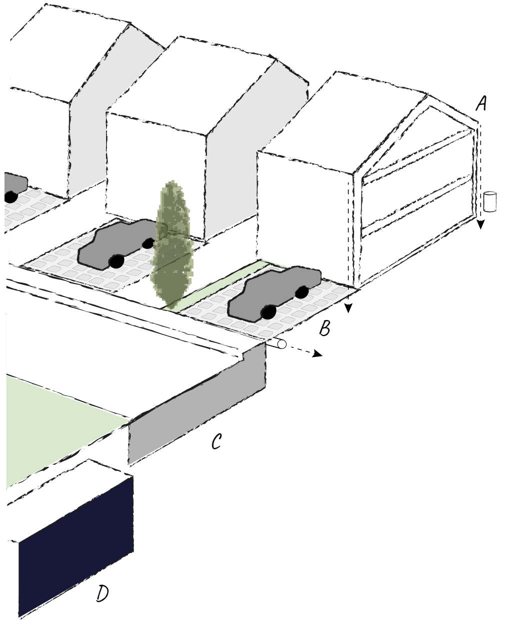
Description: Design for nature-based water attenuation through the use of Sustainable Drainage Systems (SuDS) rather than below-ground tanks.

A. *Runoff coefficient of pitched roof 90%. Water butt sometimes required but rarely included in calculations.*

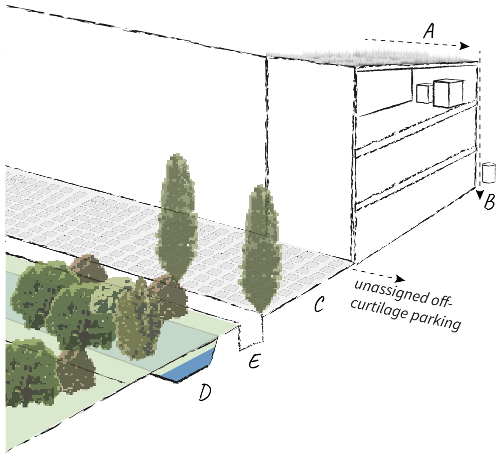
B. *SuDs in parking areas with small patches of green area maintained by maintenance companies.*

C. *Footpaths and roads runoff coefficient 85%-90%. Driveable areas require deeper infill and have higher carbon impact than SuDs areas.*

D. *Large attenuation tanks have been identified as a carbon hotspot. Large areas of excavation and requirements for root protection have a negative impact on planting trees and biodiversity potential.*



Standard water attenuating practice



Opportunities for reducing volume of below ground attenuation tanks

A. *Runoff coefficient reduced to 10-40% using green roof.*

B. *Water storage at high level allows for gravity-fed systems for landscape irrigation etc.*

C. *Prioritise pedestrian access areas and reduce driveable road surfaces.*

D. *Wet swales offer a low carbon alternative to attenuation tanks.*

E. *Dry swale.*

Embodied carbon benefit: Reduction in the number and volume of attenuation tanks as these are high carbon offenders. In a typical development studied as part of this research, the attenuation tank was made of polypropylene, and accounted for an additional 4% embodied carbon over and above that of the dwelling. This figure does not include the concrete and plastic pipework that serve these tanks, which we have accounted for separately.

Operational carbon benefit: No pump operation required.

Additional benefits: Nature based solutions increase biodiversity. Where below ground tanks are used, tree and root growth need to be controlled and planting options are reduced.

Considerations:

- More space required for wet swales. This can be offset by denser plots.
- Maintenance and safety.
- Placement of attenuation

Implementation: Limit water attenuation to nature based solutions through for example the introduction of attenuation at roof level and swales.

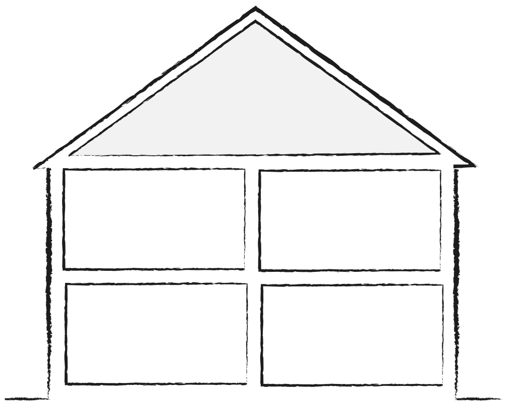
Policy alignment: Nature based solutions to the management of rainwater and surface water runoff in urban areas.

Relevant case studies & references:

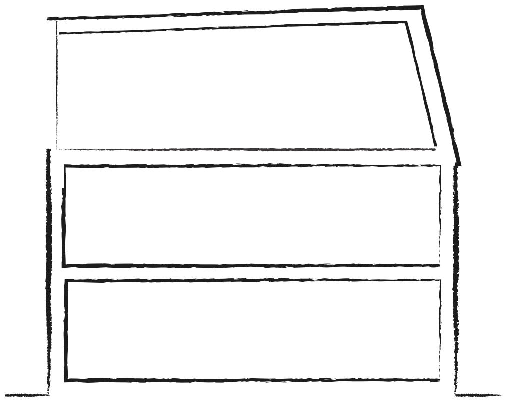
- Knights Park, Cambridge by Alison Brooks Architects
- Constitution Hill, Dublin by Grafton Architects
- Further reading: Pelsmakers, The Environmental Design Pocketbook, Edition 2, 2015 pp. 124
- Green & Blue Roof Guide by Dublin City Council 2021
- Sustainable Drainage Explanatory Design & Evaluation Guide 2022 by South Dublin County Council

Recommendation 05a Envelope | Roofs

Description: Reduce the size of pitched roofs and simplify profiles or provide a habitable space at roof level.



Standard non-habitable roof, carbon hotspot



Habitable roof space, similar carbon consumption

Embodied carbon benefit: Our research (refer to report) has identified that pitched roofs make up 16% of the total carbon of a 2-storey dwelling.

- By reducing the size of roofs, this will reduce materials used in construction.
- Alternatively, by designing the roof as a habitable space, efficiencies in footprint and infrastructure will result.
- Roof design can facilitate planted attenuation that reduces the load on the surface water infrastructure (refer to recommendation 04).

Operational carbon benefit: Simplified profiles with correct orientation allow for more efficient installation of photovoltaic panels.

Additional benefits: Greater amount of habitable space or potential for adaptation.

Considerations: Dwelling depth and structural spans, orientation.

Implementation: Clear rationalisation for roof design to reduce roof volume or allow for a habitable space at roof level to be outlined at planning stage.

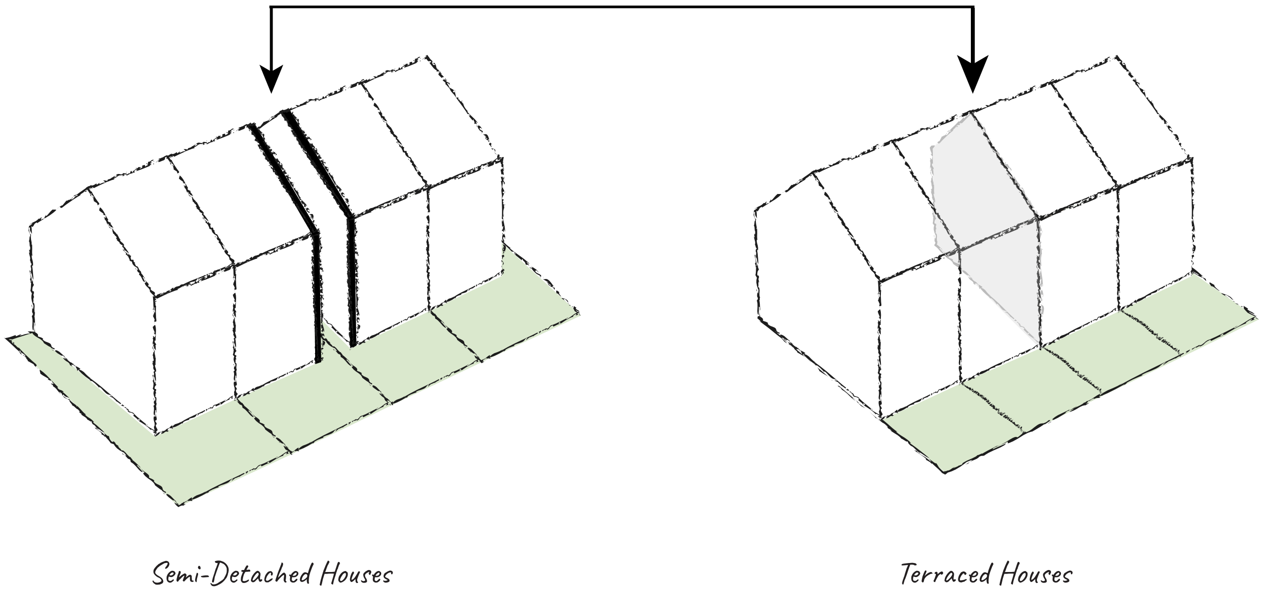
Policy alignment: Nature based solutions to the management of rainwater and surface water runoff in urban areas.

Relevant case studies & references:

- Knights Park, Cambridge by Alison Brooks Architects
- Goldsmith Street, Norwich by Mikhail Riches Architects
- Twelve Houses, Sorgenfri by Förstberg Ling

Recommendation 05b Envelope | Walls

Description: Build row housing to lengths informed by urban design principles rather than to optimise the number of end-of-terrace dwellings.



Embodied carbon benefit: Connected dwellings lead to a reduction in the number of unnecessary external walls that have a high embodied carbon content. According to our research, side gable walls generate approximately 4-5 times more embodied carbon per square metre of wall than a party wall between dwellings in a terrace.

Operational carbon benefit: Reduced form factor resulting in reduced net space heat demand.

Additional benefits:

- Denser typologies forming high quality streetscapes
- Greater quantum of amenity space available
- Efficiency of land use and associated infrastructure

Considerations: Reduced access to rear gardens for bins and bikes.

Implementation: Acknowledge the requirement for master planning of future street layouts and dictate minimum terrace lengths.

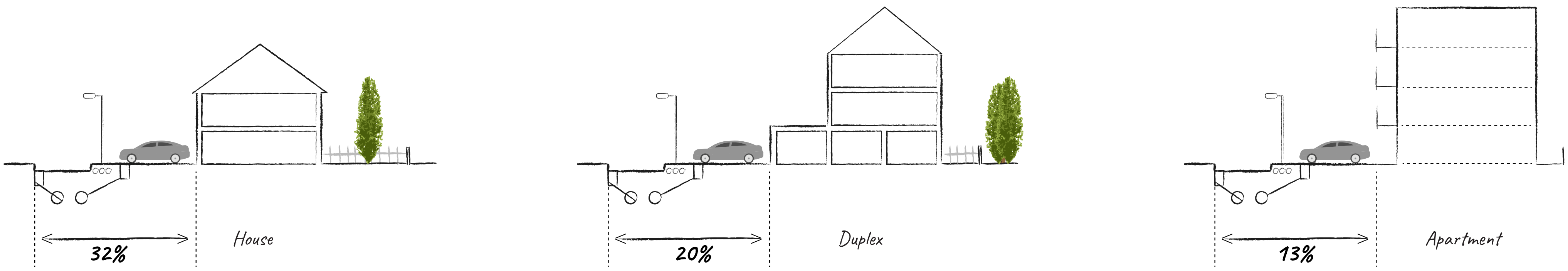
Policy alignment: Sustainable Residential Development and Compact Guidelines for Planning Authorities.

Relevant case studies & references:

- Goldsmith Street, Norwich by Mikhail Riches Architects
- For further reading refer to LETI's Embodied Carbon Primer page 27 'Reductions to embodied carbon by element'.

Recommendation 06 Density

Description: Stack dwellings to provide an even spread of density across sites rather than offsetting low-density 2-storey houses with multi-storey apartments.



Percentages of Embodied Carbon due to roads and infrastructure

Embodied carbon benefit: According to our research higher density stacked types such as duplexes are more efficient in their use of infrastructure and this provides savings in emissions of embodied carbon.

- Lower density two-storey house types require a large quantity of roadway and footpath to service the dwellings.
- Lower density types require individual service connections per dwelling, for example water mains connection.
- The ground floor slab has a more intensive carbon load than upper floors, where dwellings are stacked, the ground floor footprint reduces.
- There is a reduction in materials used in construction through a greater use of shared surfaces and roofs between dwellings.

Operational carbon benefit:

- Reduced form factor resulting in reduced net space heat demand.
- Greater opportunity for district heating saving both embodied carbon and operational carbon (particularly in small homes where individual heat pumps are prone to inefficient on-off cycling).

Additional benefits:

- Higher densities have benefits such as walkability, viability of community facilities, and viability of public transport.
- Stacked dwelling types such as duplexes and apartments consume less land compared to houses. This protects valuable land resources for other uses such as agriculture and landscape amenity.
- Denser typologies form high quality streetscapes and opportunity for greater quantum of green space.

Considerations: Requirements to meet TGD B and TGD M when units are stacked.

Implementation: Prioritise development of compact own door housing where there is an even spread of density across sites. Consider a dispensation for TGD M in certain circumstances, for example the use of TGD K stairs to access upper floor units in the case of own door housing.

Policy alignment: Sustainable Residential Development and Compact Guidelines for Planning Authorities.

Relevant case studies & references:

- Goldsmith Street, Norwich by Mikhail Riches Architects
- Woodmore Mews by Peter Barber Architects