WOKINGHAM BOROUGH COUNCIL

Wokingham Council

Net Zero Policy – Technical Evidence Base

September 2024

Currie & Brown Introba Etude

10617-IRB-XX-XX-T-OS-5101

Issue	Description	Date (DD.MM.YY)	Prepared By	Signed Off
01	Draft report	27.08.2024	ZK	YM
02	Final report	18.09.2024	ZK	AS
03	Final report with minor updated	20.09.24	ZK	YM

Project Office
Introba Consulting Ltd
150 Holborn
London
EC1N 2NS
+44(0) 20 3697 9300

Project Contact:
Zeina Krayim
zeina.krayim@introba.com

V3.0

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1.0 Executive Summary

Executive Summary

Wokingham Council have commissioned Currie&Brown, Etude and Introba to develop this evidence base to understand the technical and cost implications of delivering net zero buildings.

This report sets out the technical and financial evidence to support the recommended Net Zero policy requirements for all new residential buildings based on the three residential typologies: detached house, semi-detached house and a low-rise block of flats. In addition, sensitivity analysis has also been undertaken on the three typologies to understand the impact of form factor, orientation and glazing ratios. Predictive energy modelling using Passive House Planning Package (PHPP) was carried out to support the technical evidence base and inform local planning policies. Predictive energy modelling was used over Part L compliance modelling as it provides a more accurate indication of a building's energy use thus drives better design and construction decisions.

An overarching 'Net zero carbon new buildings in operation' policy is recommended, with supporting technical and financial evidence base.

Recommended Policy: Net Zero Carbon New Buildings in Operation is the overarching policy.
All new buildings must be designed and built to be Net Zero Carbon in operation. They must be ultra-low energy buildings, be fossil fuel free, and generate renewable energy on-site to at least match annual energy use. All new buildings are required to comply with the requirements listed in Figure 1.1.

Capital cost analysis of the building typologies and specifications modelled that comply with the recommended net zero policy has been undertaken by Currie & Brown. The likely capital cost uplift from the current Part L 2021 Building Regulations baseline using a South England Q3 2024 cost base has been estimated, in addition to cost uplifts against the Future Homes Standard Options 1 and 2 scenarios. The cost analysis showed uplift ranges of 6.0% to 7.7% (£111 – £149/m^2) against the current Part L 2021 Building Regulations, 1.7% to 2.8% (£33 – £55/m^2) against the FHS Option 1, and 3.8% to 6.8% (£73 – £123/m^2) against the FHS Option 2 scenario. Further details can be found in Section 10.

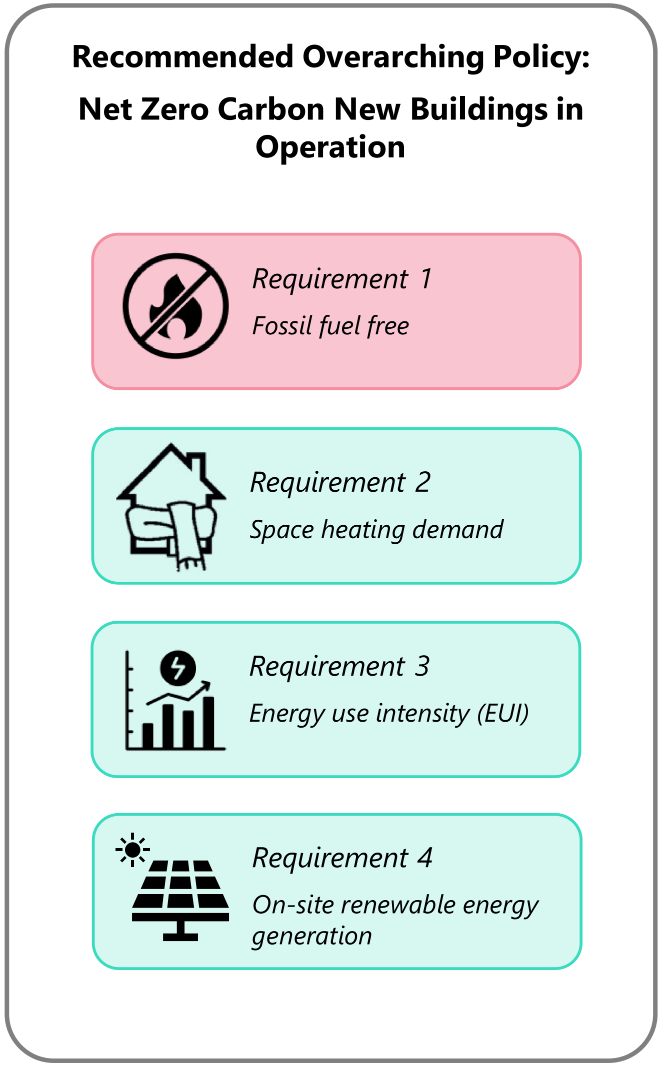


Figure 1.1: Net Zero Carbon New Building in Operation policy requirements

2.0 Evidence of Need

Wokingham Council's Local Plan Update (LPU) must comply with national carbon reduction commitments

There is a climate emergency

There is overwhelming scientific consensus that significant climate change is happening. This is evidenced in the latest assessment of the Intergovernmental Panel on Climate Change (IPCC AR6). The IPCC special report published in 2022 on the impacts of global warming of 1.5°C above pre-industrial levels highlights the urgency for action and has generated a high level of interest and concern in society as a whole.

National commitment

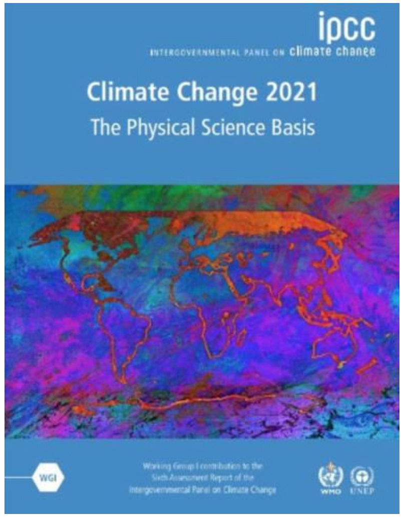
The UK's national commitment is set through the Climate Change Act 2008, which was updated in 2019. It legislates that the UK must be net zero carbon by 2050 and sets a system of carbon budgets to ensure that the UK does not emit more than its allowance between now and 2050. This legal requirement is underpinned by the Climate Change Committee's (CCC) report *'Net Zero: The UK's Contribution to Stopping Global Warming'*.

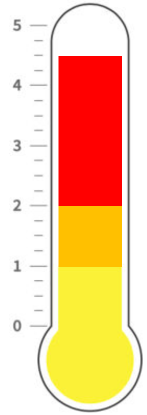
The concept of carbon budgets is absolutely critical to understand: Net Zero is not about a destination, it is very importantly about a very significant and fast required decarbonisation pathway from now on.

Achieving Net Zero Carbon

Key measures identified by the CCC include:

- 100% low carbon electricity by 2050
- **Ultra-efficient new homes and non-domestic buildings**
- **Low carbon heat to all but the most difficult to treat buildings**
- Ambitious programme of retrofit of existing buildings
- Complete electrification of small vehicles
- Large reduction in waste and zero biodegradable waste to landfill
- Significant afforestation and restoration of land, including peatland.

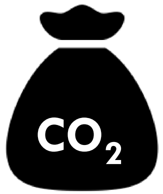




4-5°C the temperature rise we are likely to see if we continue on a **business as usual** path

1.5-2°C The maximum temperature rise above pre-industrial levels the IPCC recommends

1°C The temperature rise already created



380,000 $MtCO_2$

Estimation of **remaining global carbon budget** (from 2022) for a chance of limiting temperature rises to below 1.5°C. (Source: Tyndall Centre)

7 years

The number of years it would take to **consume our entire global carbon budget** at current global emissions rates for a good chance of limiting temperature rises to below 1.5°C (projection assumed from 2022 baseline). (Source: Tyndall Centre)

New buildings can be part of the solution

New buildings are currently adding to the problem

Operational carbon emissions (those arising from all energy consumed by a building in-use such as heating and lighting) associated with new buildings (that meet current Building Regulations) are still very significant. Homes built to existing building regulations standards are not energy efficient enough to safeguard occupants from the effects of climate change or mitigate emissions to anywhere close to the amount required for the UK to meet its decarbonisation goals. Significantly, as of 2024 many continue to use fossil fuels for heating and hot water, and likely generate very small amounts of renewable energy. Provisional UK emissions data for 2023 shows that 13.45% of total UK emissions arose from fuel consumption in residential buildings alone (Source DESNZ).

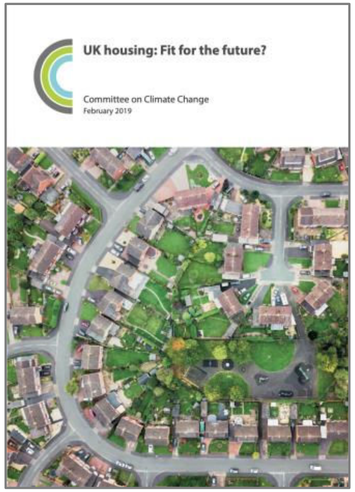
In summary, homes built to current standards keep adding to the problem of climate change as they are using far too much of the remaining local carbon budgets, making the UK off-track from meeting international, national and local carbon reduction and Net Zero commitments.

They create a future retrofit burden

If new buildings continue to be designed and built to the current standards, they will need to be retrofitted before 2050 in order to reduce their carbon emissions. For example, their new gas boiler will have to be replaced with a low carbon heating system. This would be much more expensive and disruptive than designing and constructing them to the right standard now.

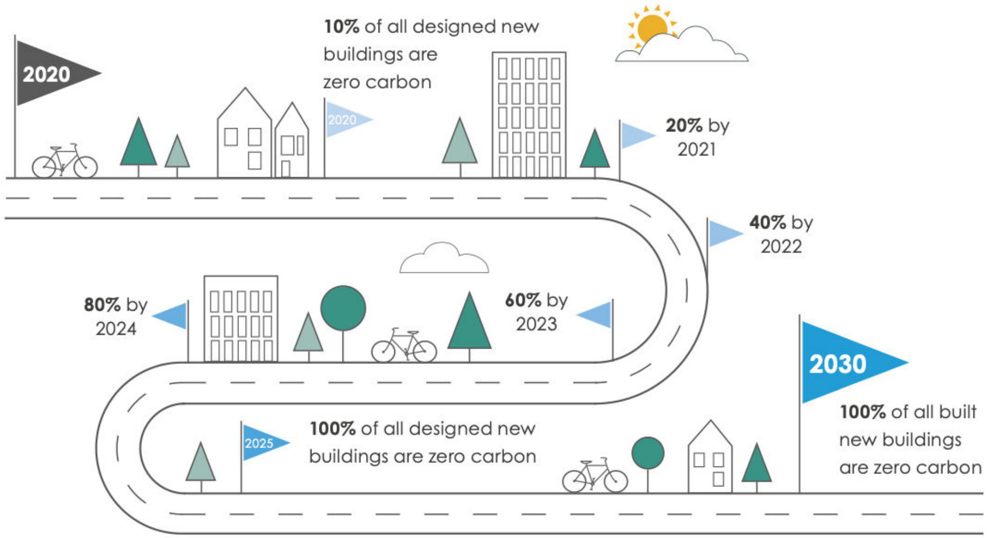
New buildings compliant with our climate change commitments

New buildings designed and built, today, with available and affordable skills, techniques and technologies can be compliant with these national climate change commitments (stated on page 7) and part of the solution to deliver net zero. They are referred to as Net Zero Carbon buildings (in operation). Their definition and key features are detailed further in the next section of this report.



"New homes should deliver ultra-high levels of energy efficiency as soon as possible and by 2025 at the latest, consistent with a space heat demand of 15-20 kWh/m^2/yr. Designing in these features from the start is around one-fifth of the cost of retrofitting to the same quality and standard."

Extract from UK Housing: Fit for the Future? Committee on Climate Change, 2019



Roadmap to Zero Carbon homes from the LETI Climate Emergency Design Guide: How new buildings can meet UK climate change targets

Energy cost crisis

A growing concern

Energy costs have always been a concern for those affected by fuel poverty, but it is now a bigger concern due to different economic and political factors. This will ultimately exacerbate inequality across different earning households. Wealthier households will be able to afford adaptation measures while less earning households (who are already more vulnerable to climate change risks) may be stuck with homes that use a lot of energy (and therefore cost more to run), don't adequately provide thermal comfort and are trapped using fossil fuels.

The role of new buildings

There are three factors contributing to fuel poverty: energy prices (set by the market/energy suppliers), the household income and the dwelling's energy demand. The latter is the only criterion which can be positively influenced through the planning process by including specific policy requirements regarding energy efficiency requirements for new buildings in local plans.

The two key benefits of energy efficiency

An energy efficient dwelling would help to reduce energy use in a sustainable way, which would mechanically reduce energy costs. It would also make the temperature more stable, enabling a 'smart' heating system to make the most of flexible dynamic electricity prices. If electricity is used for heating, this benefit would be much more substantial. Other wider benefits include:

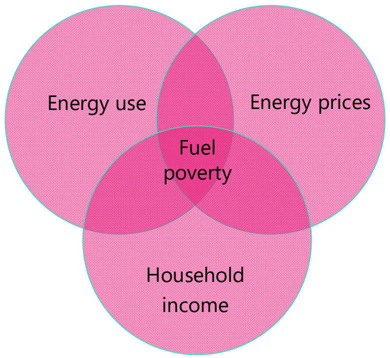
- Less pressure on the electricity grid, which is going to have to cope with 50% increase demand in electricity through the electrification of transport and heating by 2035.
- Creates an opportunity for accommodating on-site photovoltaic panels (PVPs), rather than installing them on green field site. Generating on-site energy is also more efficient as there are less transmission and distribution losses.
- Creates energy security as this will lead to less reliance on energy imports.

The positive role of renewable energy generation on bills

The significant amount of PV generation on a Net Zero carbon building can and should benefit residents. A solar PV system, together with efficient fabric performance, can reduce the running cost of an average home currently by 25-50%, based on the team's previous project experiences.

5.3% of households in fuel poverty

Percent of households in fuel poverty in Wokingham in 2021 (Source: Government Official Statistics)



The dwelling's energy use is one of the three key factors contributing to fuel poverty. Net Zero Carbon buildings would help to reduce it, contributing to the sustainable reduction in fuel poverty in Wokingham.

3.0 Why current Building Regulations will not deliver Net Zero Carbon Buildings and why local planning policy needs to be strengthened

Wokingham Borough Council has declared a climate emergency

In July 2019, Wokingham Borough Council (WBC) declared a climate emergency and committed to do as much as possible to become a carbon neutral borough by 2030.

In support of this declaration, a Climate Emergency Action Plan (CEAP) has been prepared. The CEAP is a strategic document that outlines a collection of measures and policies to reduce greenhouse gas emissions and actively address climate challenges in the borough. It defines reduction goals based on local priorities and develops a framework with tactical actions to help achieve these.

The CEAP establishes 10 key priority areas and over 100 actions to mitigate CO_2 emissions, which are listed below. The priorities listed in red below are those that the local plan policies aim to address.

1. Reduce carbon dioxide emissions from transport.
2. **Generate more renewable energy in the borough.**
3. Reduce carbon dioxide emissions from domestic and business property.
4. Increase the levels of carbon sequestration in the borough through greening the environment.
5. Engage with young people and support sustainable schools.
6. Reduce waste sent to landfill.
7. **Utilise planning policies to minimise emissions from new developments**
8. Achieve sustainable procurement practices throughout the Council
9. Encourage behaviour change.
10. WBC to lead the way on carbon neutrality, by improving its own operations.

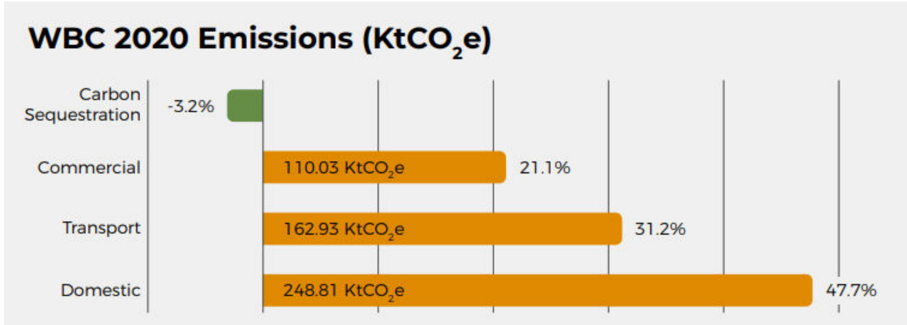


Figure 2.1: Wokingham Borough Carbon Footprint 2020 (ktCO2e). Domestic, Commercial and Transport adds up to 100%, and Carbon sequestration reduces total emissions by 3.2%. Domestic emissions are the greatest source of emissions in the borough, therefore reducing emissions from this area is crucial to achieving carbon neutrality.

Review of current policy in Wokingham Borough Council

WBC's current planning policies are set out in the Core Strategy Local Plan (2010) and the Managing Development Delivery (MDD) Local Plan (2014). Both local plans look towards the year 2026.

Current planning policy in Wokingham needs to be strengthened to align with the pathways to Net Zero

Each of the current local plans have high-level overarching policies that seek to address climate change and reduce carbon emissions; however they do not set specific targets relating to space heating and energy reduction.

To ensure planning policies remain effective, WBC is currently preparing a new Local Plan Update (LPU) which will put in place an updated set of planning policies to manage development in the period 2023 to 2040.

The forthcoming LPU seeks to take an energy-based approach to reducing greenhouse gas emissions arising from development and aligning with the Net Zero pathways, by setting targets for energy use intensity and space heating demand which are reflective of current industry best practice. This is different to the current Part L of the Building Regulation's approach which requires a % reduction improvements relative to a "notional building" set through the UK Building Regulations. The reason for this change is discussed on pages 13 and 14 of this report.

Core Strategy Local Plan Policy CP1 – Sustainable Development

Planning permission will be granted for development proposals that contribute towards the goal of reaching zero-carbon developments as soon as possible by:

a) Including appropriate on-site renewable energy features; and

b) Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.

Managing Development Delivery Policy CC04 – Sustainable Design and Construction

Planning permission will only be granted for proposals that seek to deliver high quality sustainably designed and constructed developments by – in respect of all new homes:

a) Seeking to achieve the requirements of the full Code for Sustainable Homes Level 4;

b) Meet internal potable water consumption targets of 105 litres or less per person per day (as part of the requirement to meet full Code for Sustainable Homes Level 4).

Managing Development Delivery Policy CC05 – Renewable Energy and Decentralised Energy Networks

Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology.

Building Regulations | Part L 2021 Volume 1: Dwellings

Part L 2021 is the current Building Regulations, which has come into force in 2022. It covers matters relating to the energy efficiency of buildings and sets limits on the CO_2 emissions arising from energy use. It also provides guidance on energy performance in terms of building envelope and building services.

It has two volumes; Volume 1: Dwellings and Volume 2: Buildings other than dwellings. It is estimated to improve CO_2 emission performance by approximately 31% and 27% for dwellings and buildings other than dwellings respectively, compared with the previous Building Regulations (i.e., Part L1A 2013).

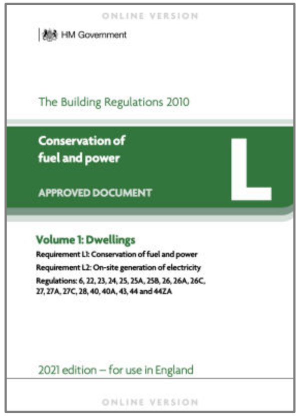
Compliance criteria with Building Regulations Part L 2021

The list below summarises the key compliance criteria set by Part L 2021 for Volumes 1 and 2:

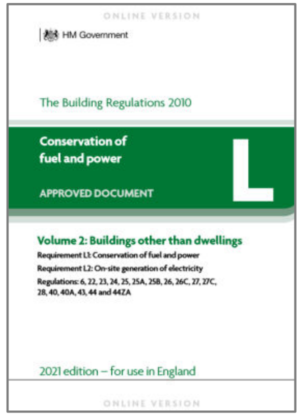
- **Primary energy rate** – Where a dwelling/building is erected, the dwelling/building primary energy rate (DPER)/(BPER) must not exceed the target primary energy rate (TPER). The primary energy use relates to how much energy is required by the new home. It is then converted (using primary energy factors) into primary energy. This is reported as kWh/m^2 year.

- **Carbon emission rate** – Where a dwelling/building is erected, the dwelling/building emission rate (DER)/(BER) must not exceed the target emission rate (TER). The electricity carbon factor in the current Building Regulations is 0.136 $kgCO_2$ which is 75% lower than the electricity carbon factor in Part L 2013, and which is now lower than gas carbon factor. The implication is that electric modes of heating (e.g. heat pumps, direct electric) are now much lower carbon than fossil fuel heating (e.g. gas boilers).

- **Fabric energy efficiency rate –** Where a dwelling is erected, the dwelling fabric energy efficiency rate (DFEE) must not exceed the target fabric energy efficiency rate (TFEE). This metric only applies to dwellings.

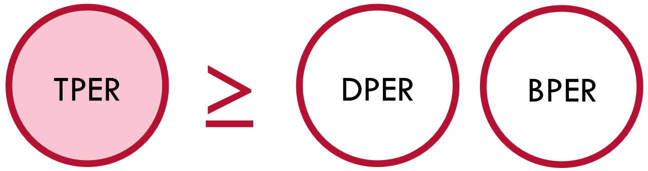


Part L 2021 – Conservation of fuel and power – Volume 1: Dwellings

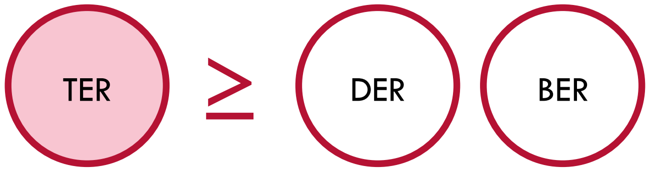


Part L 2021 – Conservation of fuel and power – Volume 2: Buildings other than dwellings

1 – Primary energy rate (kWh/m^2)



2 – Carbon emission rate ($kgCO_2/m^2$)



3 – Fabric energy efficiency rate (kWh/m^2/year) – Dwellings only

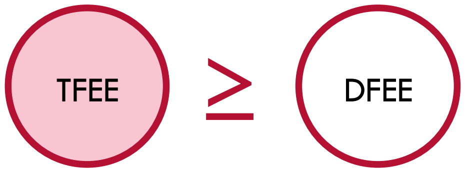


Figure 2.2: Summary of key criteria for Domestic buildings compliance with Building Regulations

Issues with linking planning policies to % improvement over Building Regulations Part L

Current Building Regulations and planning policy is always, with minor exceptions, based on a required improvement over a baseline: the 'notional building', which has the same shape, orientation and, up to a point, glazing proportions as the actual building.

A metric which cannot be measured post-completion

The % improvement over a notional building is an intangible, relative performance requirement that cannot be measured once a building is occupied. This causes confusion and inability to compare the actual performance of different buildings. It makes post-construction verification and learning from a feedback loop more complicated.

A more efficient building form is not incentivised

Improving the design of a building by reducing the extent of heat loss areas, the amount of junctions, and by optimising elevation design for winter solar gains are widely considered as essential components of an energy efficient design. However, comparing a development to its own notional building does not reward efficient design as it essentially neutralises the impact of these measures.

Additional issues with changing carbon and primary energy factors

Current performance targets in Part L rely on carbon emission factors and primary energy factors that introduce additional complexity. This in itself has an impact on the % improvement over Part L which could be misleading.

The exclusion of unregulated energy

Building Regulations and current planning policy only take into account regulated carbon emissions and does not require any reduction in 'unregulated' energy use. Unregulated energy is defined as the energy consumption resulting from a system or process that is not controlled, such as IT equipment, lifts, appliances, external lighting, etc. Therefore, 100% carbon emission reduction over Part L does not mean that the building will meet net zero operational carbon.

Due to the points made above, it is necessary for new local planning policy to fill the gap left by the current planning metric and be used as a mechanism for the true delivery of net zero carbon buildings in operation to achieve local and national climate change commitments.

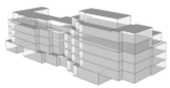
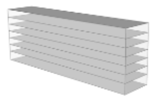
%
improvement over notional building

- ✗ Is not a 'physical' metric
- ✗ Is a concept only experts can understand
- ✗ Cannot be checked during operation
- ✗ Cannot be used to 'close the loop' and improve the system over time
- ✗ Does not reward good design e.g. form

kWh/m²/yr
at the meter (EUI)

- ✓ Is a 'physical' metric which can be measured
- ✓ Can be understood by all professionals, and most consumers
- ✓ Can be checked against in-use data
- ✓ Can be checked to improve Standard Assessment Procedure (SAP) prediction of energy use over time

The relative metric used by current planning policy (i.e. % improvement over Part L) has a number of unintended consequences which hinder the continuous improvement of building design, consumer trust and performance outcomes.

		Improvement over Part L (%) SAP	**Space heating demand** (kWh/m²/yr) SAP	**Space heating demand** (kWh/m²/yr) PHPP
High form factor		**35%**	**18**	**26**
Medium form factor		**35%**	**15**	**20**
Low form factor		**37%**	**11**	**13**

A more efficient form is important for low energy buildings, but it is not rewarded by the notional building approach: with similar specifications (e.g. U-values) the performance against Part L (%) calculated by SAP for the three buildings above is broadly similar despite the fact that space heating demand is much smaller with a more efficient design. Furthermore, there's a discrepancy in the calculated space heating demand by SAP vs PHPP, showing how SAP tends to significantly underestimate space heating demand, which is a significant issue.

Issues with the energy modelling methodology: Part L vs Predictive energy modelling

Part L modelling

Part L energy assessment methodologies (e.g., SAP for domestic buildings and NCM for non-domestic buildings) are currently used to evidence the energy and carbon efforts for all planning applications and demonstrate their compliance with Building Regulations and current policy requirements.

SAP (Standard Assessment Procedure) is used for residential buildings through the associated SAP software and the NCM (National Calculation Methodology) for non-domestic buildings through SBEM (Simplified Building Energy Model) and Dynamic Simulation Modelling (DSM) tools.

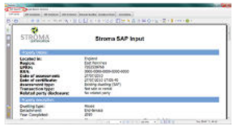
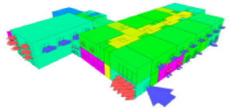
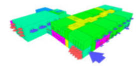
However, it is important to note that these Part L energy assessment methodologies were developed only to check compliance with Building Regulations. They were never meant to perform some of the functions that would be required to deliver Net Zero carbon buildings, and most importantly the prediction of future energy use.

This is a widely accepted fact in the industry which all stakeholders agree with. There is no debate on this aspect.

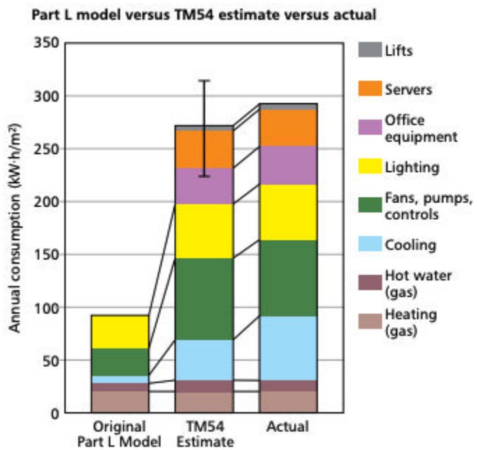
It seems that when these tools were mandated at planning stage approximately 15 years ago it was to minimise the burden on applicants and negate the need for a specific predictive energy use assessment. There is now a consensus in the industry that a different and better type of energy modelling is now required if Net Zero Carbon buildings are to be delivered.

Why predictive energy use is necessary

The accuracy of energy modelling is important to ensure it provides a reasonable indication of real-world performance. While behaviours may vary once a building is occupied, energy modelling can be used to reliably establish predicted energy use and therefore drive suitable design and construction decisions.

	Part L modelling	**Predicted energy use modelling**
Domestic	 SAP (Part L1A)	 PHPP
Non-domestic	 NCM (Part L2A)	  PHPP or DSM (TM54)

There is a significant difference between Part L modelling currently used to demonstrate compliance with planning policy and predicted energy use modelling.



In the UK, energy models are used at the design stage to compare design options and to check compliance with Building Regulations. ***These energy models are not intended as predictions of energy use, but are sometimes mistakenly used as such****.*

In some other countries, total energy use at the design stage is estimated through voluntary standards. For example, the Australian NABERS (a building rating system) encourages the estimation of energy use at the design stage and provides guidance for designers/modellers.

Extracts of CIBSE Technical Memorandum 54 (TM54): Evaluating operational energy performance of buildings at the design stage

4.0 Defining Net Zero Carbon Buildings in Operation

There is an industry definition of Net Zero carbon buildings in operation

In order to achieve Net Zero, it is crucial that new buildings become part of the solution as soon as possible, instead of adding to the problem. From now on, new buildings need to use energy much more efficiently, consider energy use at all stages of design and stop using fossil fuels on site for heating and hot water and be powered by renewable energy sources.

Emphasis must also be placed on reducing their embodied carbon (the emissions associated with the extraction and manufacture of building materials, as well as construction) and their long-term environmental impact, including looking at end of life practices and how building materials are re-used.

Figure 4.1 – Industry best practice guidance on Net Zero

A growing evidence base has led to an industry definition

A significant amount of work has been undertaken over the last three years to define and articulate the requirements of Net Zero carbon buildings. This includes the work undertaken and published by the Climate Change Committee, the Royal Institute of British Architects (RIBA), the Chartered Institute of Building Services (CIBSE), the UK Green Building Council (UKGBC), the Better Buildings Partnership (BBP), the Passivhaus Trust, the Good Homes Alliance (GHA) and the Low Energy Transformation Initiative (LETI). This work has led to an industry definition of a Net Zero carbon building in operation (see following page).

The UK Net Zero Carbon Building Standard

The UK Net Zero Carbon buildings Standard (NZCBS) is the first cross-industry Net Zero Carbon Buildings Standard that brings together Net Zero Carbon requirements for all major building types, based on a 1.5°C trajectory.

This voluntary standard will be applicable to new buildings, retrofits and existing buildings. The Pilot version of the Standard will be released in September 2024, which will contain all the technical details on how a building should meet the Standard, what limits and targets it needs to meet, the technical evidence needed to demonstrate this, and how it should be reported.

It is a joint initiative between BBP, BRE, the Carbon Trust, CIBSE, IStructE, LETI, RIBA, RICS, and UKGBC , PIA, RIAS and ICE. The intention is that all of the current standards, targets and best practise guidance from these organisations will be superseded by the NZCBS.

The key metrics for the standard are:

- **Energy Use Intensity (EUI)** limits (kWh/m^2/yr)
- **Upfront (A1-A5) embodied carbon** (kg CO2/ m$^{2)}$)
- **Life cycle (A1-C4) embodied carbon limits** (kg CO_2/ m^2)

Other metrics – such as space heating/cooling demand and peak load – are also to being considered.

Figure 4.2 – The UK Net Zero Carbon Building Standard is currently being developed

What is Net Zero?

The term 'Net Zero' is often used in the built environment industry, but there is little clarity in what this practically means. Buildings can't be 'absolute zero carbon' as there will always be some emissions resulting from building them. Buildings are carbon neutral if you compensate for the carbon emissions through offsets. However to respond adequately to the climate crisis and limit global warming to 1.5 °C the built environment needs to limit its carbon emissions. A different approach needs to be taken as there is a finite amount of offsets available i.e finite amount of space for woodlands, buildings to retrofit, renewables to install. Furthermore, procuring carbon offsets does not improve, or add value to assets, as it's not possible to accurately know how well they work and how much carbon they move, it's very much associated with greenwashing.

A 'Net Zero (whole life) Carbon' Asset is one where the sum total of all asset related green house gas (GHG) emissions, both operational and embodied, over an asset's life cycle (Modules A1-A5, B1- B8, C1-C4) are minimized, which meets local carbon, energy and water targets or limits, and with residual offsets, equals zero .

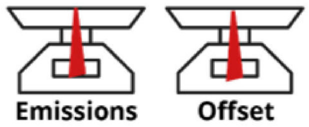
A building emits carbon throughout its whole lifetime. Whole life thinking involves considering all life cycle stages of a project, from raw material extraction, product manufacturing, transport and installation on site through to operation, maintenance and eventual material disposal.

The BS EN 15978 and the RICS Professional Statement set out a modular approach to a built asset's life cycle, breaking it down into different stages, as listed below:

- **Product stage**: Modules A1 – A3
- **Construction stage**: Modules A4 – A5
- **In-use stage**: Modules B1 – B5
- **In-use stage (operational carbon)**: Modules B6 – B7
- **End of life stage**: Modules C1 – C4

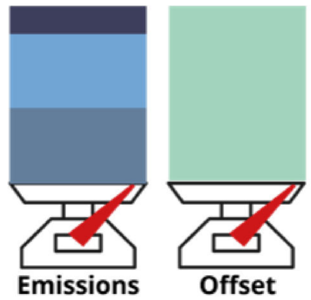
Absolute Zero Carbon

Eliminating all carbon emissions without the use of offsets[1]



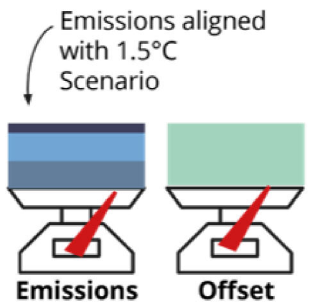
Carbon neutral

All carbon emissions are balanced with offsets based on carbon removals or avoided emissions[1]



Net Zero (whole life) Carbon

A 'Net Zero (whole life) Carbon' Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle are minimized, which meets carbon, energy and water targets or limits, and with residual 'offsets', equals zero[1]



[1] *https://www.leti.uk/carbondefinitions*

The principles of Net Zero Carbon in operation

Net Zero carbon buildings in operation are supported by four core principles.

1 - Energy efficiency

Buildings use energy which includes both regulated energy (heating, hot water, ventilation, lighting, cooling) and unregulated energy (plug loads, lifts, IT, cooking and appliances). All energy use within the building must be considered and total usage needs to comply with a maximum value, the Energy Use Intensity (EUI) which varies depending on the building type. Current Building Regulations, only consider "regulated" energy use and therefore are not representative of best practice operational Net Zero definitions.

2 – Fossil Fuel Free

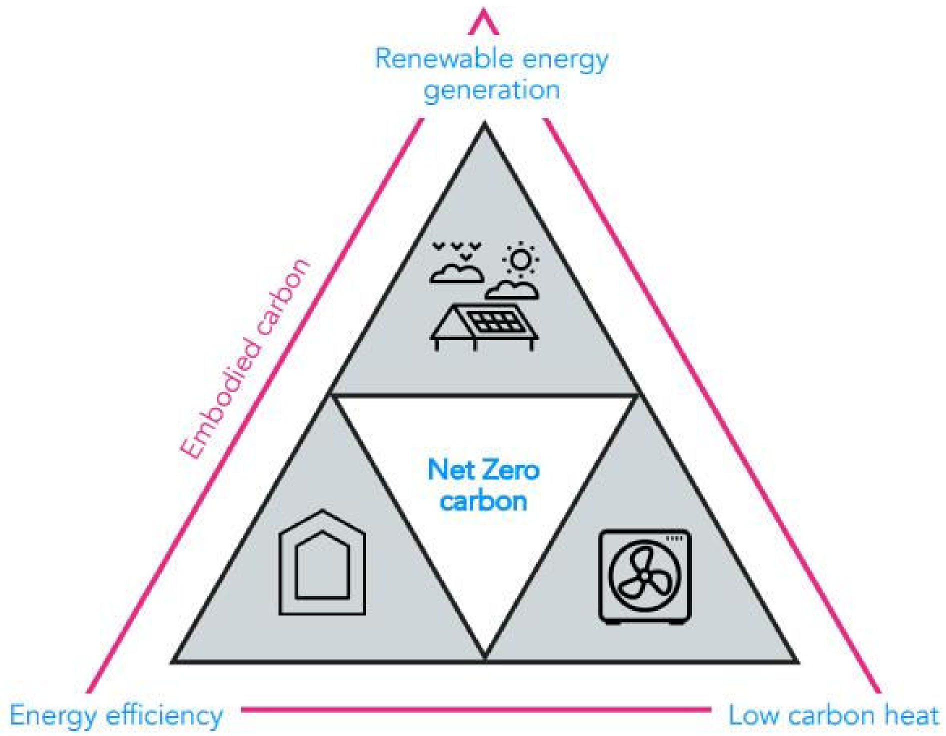
Low carbon heat is an essential feature of Net Zero Carbon buildings. All new buildings should be built with a low carbon heating system and must not connect to the gas network or, more generally, use fossil fuels on-site.

3 - Renewable energy generation

New buildings should seek to add at least as much renewable energy generation to the energy system as the energy they will use on an annual basis. In Essex, photovoltaic panels (PVPs) is currently recommended as the renewable energy system to deliver this objective.

Embodied carbon

Operational carbon is only part of the story. Net Zero Carbon buildings should also minimise embodied carbon in materials and their impact throughout their lifecycle, including demolition.



The four core principles of a "net zero" building: energy efficiency, low carbon heat, renewable energy generation and embodied carbon. Source: Etude

5.0 Evidence supporting Local Authorities setting their own energy targets for new buildings

Raising the bar on energy efficiency standards in Wokingham

The role of local authorities in mitigating climate change in the UK has changed over the years. Three distinct phases can be noted.

2008-2014: The realisation that the planning system has a key role to play to mitigate climate change

The **Planning and Compulsory Purchase Act 2004** requires local plans to ensure that development and use of land contribute to mitigation of, and adaptation to, climate change.

The **Climate Change Act 2008** sets a clear direction for the UK. It obliges the government to set policy that will enable the UK to meet its carbon budgets and achieve net zero by 2050[1].

The **Planning and Energy Act 2008** empowers Local Planning Authorities (LPAs) to set "reasonable requirements" for new builds to comply with "energy efficiency standards that exceed … building regulations" and "supply a proportion of their energy from nearby renewable or low carbon sources".

2015-2019: Deregulation and the misguided reliance on ambitious national standards (incl. Zero Carbon homes policy)

The **Deregulation Act 2015** was intended to dis-apply Section 1(1)(c) of the Planning and Energy Act to dwellings removing the ability of LPAs to impose local requirements above Building Regulations on energy efficiency standards. However, this has not been brought into force.

On 25th March 2015, a **Written Ministerial Statement** stated that for the specific issue of energy performance LPAs will be able to set and apply polices in their local plans which exceed Building Regulations until change to optional requirements under Deregulation Act 2015 takes place. This was expected to happen alongside the introduction of zero carbon homes policy late in 2016. Until then LPAs were expected not to set conditions with requirements above Code for Sustainable Homes (CfSH) level 4 (i.e., 19% improvement over Part L 2013). However, there has been no adoption of a zero carbon homes policy at a national level.

Since 2019: the turning point of Net Zero

Further to a special report completed by the Climate Change Committee (CCC), the **Climate Change Act** was updated in 2019: the overall greenhouse gas reduction was changed from an 80% reduction to a 100% reduction by 2050, i.e., Net Zero, relative to 1990 baseline emissions.

At the same time, many local authorities, including Wokingham, declared a climate emergency, where its committed to do as much as possible to become carbon neutral by 2030.

The National Planning Policy Framework (NPFF) was updated in 2021 requiring the planning system to contribute to a "radical reduction in greenhouse gas emissions" (Para 152) and for local plans to take a proactive approach to mitigating and adapting to climate change (Para 153).

In 2021, the Government also published their **response to the Future Homes Standard** (which is the next iteration of Part L of the Building Regulations) consultation stating the following:

"*All levels of Government have a role to play in meeting the net zero target and local councils have been excellent advocates of the importance of taking action to tackle climate change. Local authorities have a unique combination of powers, assets, access to funding, local knowledge, relationships with key stakeholders and democratic accountability. This enables them to drive local progress towards our national climate change commitments in a way that maximises the benefits to the communities they serve.*"

"*We recognise that there is a need to provide local authorities with a renewed understanding of the role that Government expects local plans to play in creating a greener built environment; and to provide developers with the confidence that they need to invest in the skills and supply chains needed to deliver new homes from 2021 onwards. To provide some certainty in the immediate term, the Government will not amend the Planning and Energy Act 2008, which means that local planning authorities will retain powers to set local energy efficiency standards for new homes.*"

LETI metrics and targets provide a nationally consistent methodology

The LETI (Low Energy Transformation Initiative) metrics and targets provide a nationally consistent methodology that is different to the Building Regulations, but are recognised as best practice energy use targets for new buildings.

These metrics and targets are now being referenced in adopted policy and emerging local plan policies as well as in briefs for developers. They have been developed in collaboration with UKGBC (UK Green Building Council) and supported by the Good Homes Alliance, RIBA and CIBSE.

GLA (Greater London Authority) Energy Assessment Guidance (June 2021)

The GLA have now referenced the targets in their Energy Assessment Guidance. The policy does not mandate that the EUI or space heating demand target are met, but it does mandate that these are reported, and it encourages that developments aim for these targets.

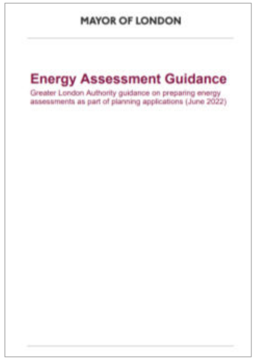
RIBA 2030 Climate Challenge Version 2 (2021)

RIBA has developed the 2030 Climate Challenge to help architects design within a climate conscious trajectory. The 2030 Climate Challenge provides a stepped approach towards reaching Net Zero. It sets a series of targets for practices to adopt to reduce operational energy, embodied carbon and potable water, using the same target as LETI.

Local Plans

The targets and metrics are being implemented in many emerging local plan policies of which several are now adopted, although it is important to note that some are implementing looser targets:

- Greater Cambridge Local Plan (First Proposals November 2021)
- Bristol Local Plan Review (Submitted for examination – April 2024)
- Bath and North East Somerset Local Plan Partial Update (adopted 19 January 2023)
- Cornwall Council Climate Emergency DPD – (adopted 21 February 2023)
- Central Lincolnshire Local Plan (adopted 13 April 2023)
- Merton Local Plan – (at examination) seeks to adopt EUI targets enforced from 2025



Reporting Energy Use Intensity (EUI) and space heating demand

7.13. Applicants should report the EUI[21] and space heating demand of the development. Applicants should aim to achieve the values[22] in Table 4, and are encouraged to improve performance where possible.

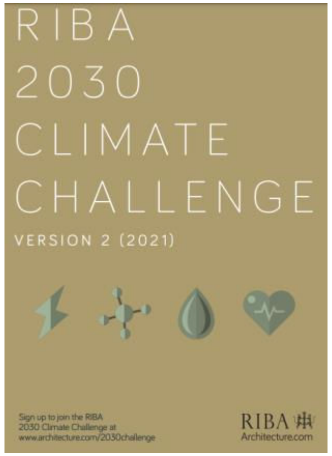
Table 4: *EUI and space heating demand values*

Building type	Energy Use Intensity ($kWh/m^2/year$)	Space Heating ($kWh/m^2/year$)
Residential	35	15
School	65	15
Office	55	15
Hotel	55[23]	15
All other non-residential	55	15

7.14. Table 5 outlines the information which should be reported via the carbon emissions reporting spreadsheet. The methodology used to calculate these values should also be reported in the spreadsheet and applicants are encouraged to explain if performance differs from the values presented in Table 4. Applicants can use the 'be seen' methodology or an alternative predictive energy modelling methodology. Reported values should exclude any renewable energy contribution.

[22] These values are taken from the LETI Climate Emergency Design Guide and are supported by RIBA, UKGBC and CIBSE. The Committee on Climate Change has also recommended the residential space heating demand values.
[23] This recommended value is taken from the Greater Cambridge Local Plan: Net Zero Carbon evidence base

EUI and space heating demand targets in the London Plan energy assessment guidance



RIBA 2030 Climate Challenge target metrics for domestic / residential

RIBA Sustainable Outcome Metrics	Business as usual (new build, compliance approach)	2025 Targets	2030 Targets	Notes
Operational Energy $kWh/m^2/y$	120 $kWh/m^2/y$	< 60 $kWh/m^2/y$	< 35 $kWh/m^2/y$	Targets based on GIA. Figures include regulated & unregulated energy consumption irrespective of source (grid/renewables). BAU based on median all electric across housing typologies in CIBSE benchmarking tool. 1. Use a 'Fabric First' approach 2. Minimise energy demand. Use efficient services and low carbon heat 3. Maximise onsite renewables

EUI targets in RIBA 2030 climate challenge

Policy Review | Bath & Northeast Somerset

Bath and North East Somerset Council adopted their new policy in the Local Plan Partial Update in January 2023, becoming the first council in England to successfully adopt an energy-based net zero housing policy as part of its commitment to tackling the climate emergency.

"The new housing development policy will ensure the energy use of any proposed development is measured and meets a specified target — setting a limit on the total energy use and demand for space heating. It will also require sufficient on-site renewable energy generation to match the total energy consumption of the buildings — ensuring the development is 100% self-sufficient.

The council will also impose net zero operational carbon standards for new major non-residential development.

The policy is the first new housing policy to be net-zero aligned based on 2030 trajectories of industry-leading organisations such as the London Energy Transformation Initiative (LETI), the Royal Institute of British Architects (RIBA) and the Chartered Institute of Building Services Engineers (CIBSE)."

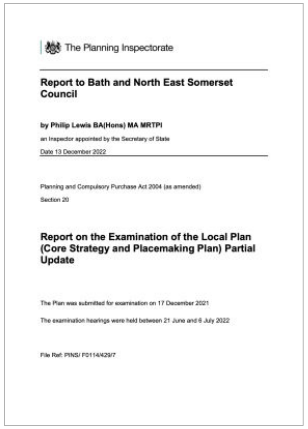
Source: B&NES Council's website

Policy SCR6 - New Build Residential

New build residential development will be required to meet the standards set out below.

New build residential development will aim to achieve zero operational emissions by reducing heat and power demand then supplying all energy demand through onsite renewables. Through the submission of an appropriate energy assessment, having regard to the Sustainable Construction Checklist SPD, proposed new residential development will demonstrate the following:

- Space heating demand less than 30kWh/m^2/annum;
- Total energy use less than 40kWh/m^2/annum; and
- On site renewable energy generation to match the total energy use, with a preference for roof mounted solar PV
- Connection to a low- or zero-carbon district heating network where available



The Planning Inspectorate

Report to Bath and North East Somerset Council

by Philip Lewis BA(Hons) MA MRTPI

an Inspector appointed by the Secretary of State

Date 13 December 2022

Planning and Compulsory Purchase Act 2004 (as amended)

Section 20

Report on the Examination of the Local Plan (Core Strategy and Placemaking Plan) Partial Update

The Plan was submitted for examination on 17 December 2021

The examination hearings were held between 21 June and 6 July 2022

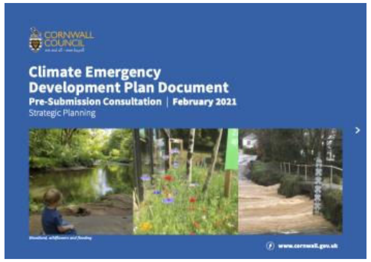
File Ref: PINS/ F0114/429/7

Relevant extracts of the Planning Inspector's report include the following:

*79. Policy SCR6 is concerned with sustainable construction for new residential buildings, aiming to achieve zero operational emissions by reducing heat and power demand and supplying all energy demand through onsite renewables. The Policy includes **limits on space heating and total energy use**, taking an **energy based approach**, rather than being based upon carbon reduction as per the Building Regulations. The approach taken in the Plan to energy usage applies to **both regulated and non-regulated energy use**, which is a further difference to that taken in the Building Regulations which are concerned only with regulated energy use.*

85. I therefore consider that the relevance of the WMS 2015 to assessing the soundness of the Policy has been reduced significantly. […] For the reasons set out, that whilst I give the WMS 2015 some weight, any inconsistency with it, given that it has been overtaken by events, does not lead me to conclude that Policy SCR6 is unsound, nor inconsistent with relevant national policies.

*86. **I am satisfied that the energy efficiency standards set out in Policy SCR6 are justified and that they would not threaten deliverability or viability of housing development***



Policy SEC1 – Sustainable Energy and Construction

Development proposals will be required to demonstrate how they have implemented the principles and requirements set out in the policy below.

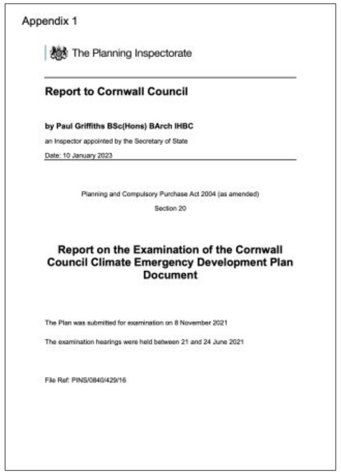
2b. New Development – Residential

Residential development proposals will be required to achieve Net Zero Carbon and submit an 'Energy and Carbon Statement' that demonstrates how the proposal will achieve:

- Space heating demand less than 30kWh/m2/annum;
- Total energy use less than 40kWh/m2/annum; and
- On-site renewable generation to match the total energy use, with a preference for roof mounted solar PV.

Where the use of onsite renewables to match total energy consumption is demonstrated to be not technically feasible (for example with apartments) or economically viable, renewable energy generation should be maximised as much as possible; and/or connection to an existing or proposed district energy network; or where this is not possible the residual carbon offset by a contribution to Cornwall Council's offset fund.

Cornwall Council's Climate Emergency DPD has successfully completed the examination process and was adopted in February 2023. Policy SEC1 Sustainable Energy and Construction is being implemented on a phased approach for applications received from 15th June 2023.


Appendix 1

The Planning Inspectorate

Report to Cornwall Council

by Paul Griffiths BSc(Hons) BArch IHBC

an Inspector appointed by the Secretary of State

Date: 10 January 2023

Planning and Compulsory Purchase Act 2004 (as amended)

Section 20

Report on the Examination of the Cornwall Council Climate Emergency Development Plan Document

The Plan was submitted for examination on 8 November 2021

The examination hearings were held between 21 and 24 June 2021

File Ref: PINS/0840/429/16

Relevant extracts of the Planning Inspector's report include the following:

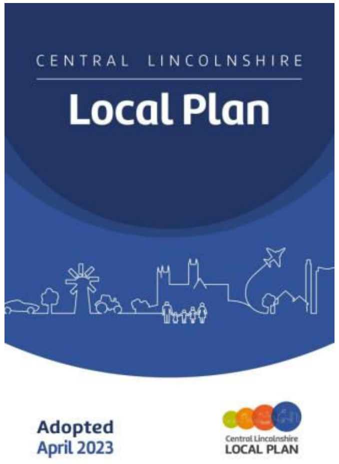
172. *[...] the Plan requires residential development proposals to achieve net zero carbon with applications to be accompanied by an Energy and Carbon Statement demonstrating how the proposal will achieve: space heating demand of less that 30kWh per square metre per annum; total energy consumption of less than 40kWh per square metre per annum; and on-site renewable energy generation to match the total energy consumption with roof mounted solar PV as a preference. It goes on to say that where meeting onsite energy demands through renewables is not possible on-site technically, or not viable, renewable energy generation on-site should be maximised and/or a connection to an existing or proposed District Heating Network facilitated. If this is not possible, then the residual carbon should be offset through a contribution to Cornwall Council's offset fund.*

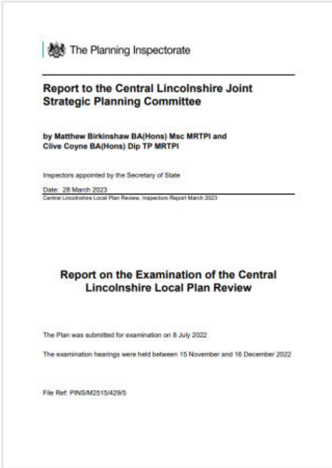
174. *Broadly, as set out above, this approach is soundly based and justified. There is however a need to make some parts of these requirements more transparent given that the policy is aimed at energy use, not carbon emissions. First, given the approach taken the initial part of this policy element needs to say that what is required is an Energy Statement rather than an Energy and Carbon Statement. Second, and linked to that point, it needs to set out that it is the residual energy that must be offset by a contribution rather than the residual carbon. These changes are needed to make the policy effective.*

Conclusion

182. *With these MMs, my view is that the requirements of Policy SEC1 are acceptable in the light of what the Plan aims to achieve.*

Policy Review | Central Lincolnshire





The Planning Inspectorate

Report to the Central Lincolnshire Joint Strategic Planning Committee

by Matthew Birkinshaw BA(Hons) Msc MRTPI and Clive Coyne BA(Hons) Dip TP MRTPI

Inspectors appointed by the Secretary of State

Date: 28 March 2023

Central Lincolnshire Local Plan Review, Inspectors Report March 2023

Report on the Examination of the Central Lincolnshire Local Plan Review

The Plan was submitted for examination on 8 July 2022

The examination hearings were held between 15 November and 16 December 2022

File Ref: PINS/M2515/429/5

The Central Lincolnshire Local Plan was formally adopted in April 2023 and will be used in making decisions on planning applications across the City of Lincoln, North Kesteven District and West Lindsey District areas. The Plan places climate change at its core with a set of policies aimed at making Central Lincolnshire net zero carbon, including in making sure new homes are efficient, attracting renewable energy generation, and ensuring new homes are adaptable to climate change. It includes a policy to deliver net zero carbon buildings based on the energy-based approach similar to Bath and North East Somerset and Cornwall Councils. The policy sets 2 primary requirements:

1. Schemes must generate at least the same amount of renewable electricity on site as the electricity they need to operate.
2. Schemes must reduce energy demand in the first place and target a space heating demand of around **15-20 kWh/m²/year**, with a total energy demand of **35 kWh/m²/year** achieved through a 'fabric first' approach to construction.

Reducing Energy Consumption in New Build

Design Principles for Efficient Buildings – Policy S6

167. Policy S6 is an over-arching design policy and relates to some of the principles which are expanded upon in the policies that follow, such as reducing energy needs and generating energy from renewable sources. Because the policies that follow include caveats and flexibility, **MM4** is needed to ensure internal consistency. It is also required for effectiveness and states that the design expectations should be considered (rather than used) in new development.

Reducing Energy Consumption – Residential Development - Policy S7

168. The Plan is supported by a suite of comprehensive evidence which set the context and background of climate change, identify the need to reduce energy consumption and generate more renewable energy and test ways in which the aims and objectives can be met by development plan policies.[23] In summary, the evidence shows that existing buildings in Central Lincolnshire account for around 43% of all greenhouse gas emissions. Because a Local Plan has a limited influence on retrofitting existing buildings, in order to reach both national and local targets for carbon reductions[24], significant reductions in the energy requirements of new buildings are needed now.

169. For new residential development, Policy S7 therefore includes two primary requirements. The first is that schemes must generate at least the same amount of renewable electricity on site as the electricity they need to operate. To help achieve this, the second requirement aims to reduce demand in the first place and targets a space heating demand of around 15-20 kWh/m2/year, with a total energy demand of 35 kWh/m2/year achieved through a 'fabric first' approach to construction. In doing so, Policy S7 seeks to deliver new homes to net zero carbon standards.

Why the 2023 WMS should not represent a barrier to the proposed policies

The 2023 Written Ministerial Statement

A Written Ministerial Statement (WMS) was made on 13th December 2023 by the Parliamentary Under Secretary of State for Levelling Up, Housing and Communities. A key extract of the statement is:

> *Any planning policies that propose local energy efficiency standards for buildings that go beyond current or planned buildings regulation should be rejected at examination **if they do not have a well-reasoned and robustly costed rationale** that ensures:*
>
> - *That development remains viable, and the impact on housing supply and affordability is considered in accordance with the National Planning Policy Framework.*
> - *The additional requirement is expressed as a percentage uplift of a dwelling's Target Emissions Rate (TER) calculated using a specified version of the Standard Assessment Procedure (SAP).*

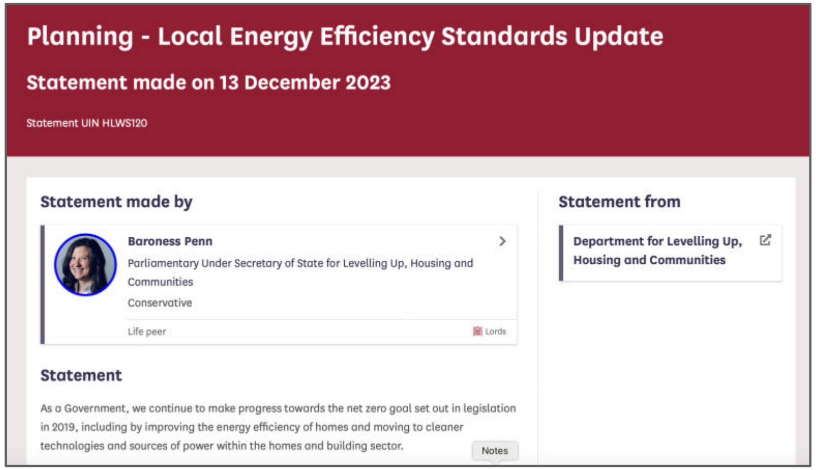


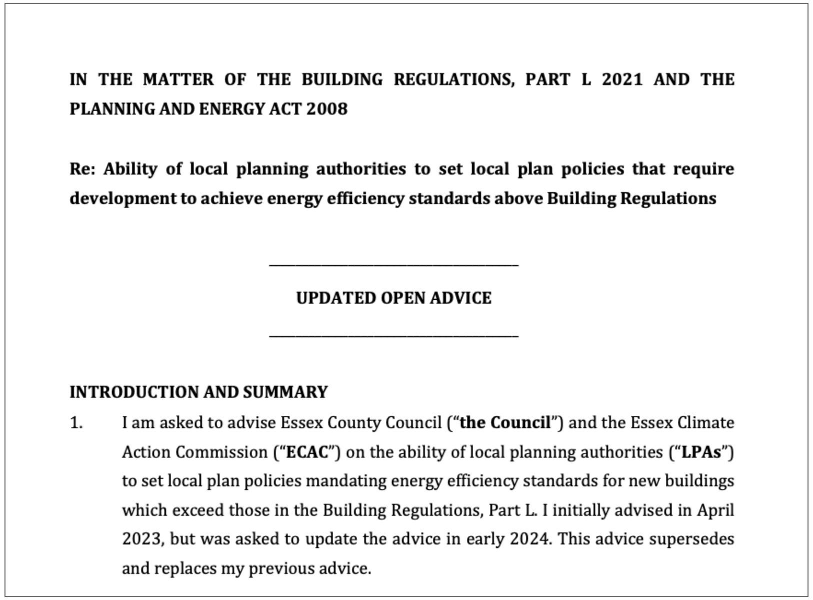
Figure 5.1 – The 2023 Written Ministerial Statement on Planning – Local Energy Efficiency Standards Update can be found at https://questions-statements.parliament.uk/written-statements/detail/2023-12-13/hlws120

Reaction to the 2023 WMS

Essex County Council have published the written legal advice provided to them by Estelle Dehon KC. The written advice concludes that the WMS should not prevent local authorities from exercising their statutory powers and duties.

A judicial review of the 2023 WMS has also been undertaken for which Wokingham Borough Council submitted a witness statement highlighting the impacts the WMS could have. The judgment by Mrs Justice Lieven (published on 2 July 2024) rejects the three grounds which formed the basis of the judicial review. It highlights that Government "*has chosen to put considerable weight on the impact that might have on the supply of new housing, over the potential benefits of imposing higher standards. This is a policy choice for the Minister and is explained in the assessment, and does not disclose any error of law. Experts might disagree on the issue, but that is a matter for policy makers and not the Court*". This highlights the importance for Wokingham Borough Council to demonstrate that the proposed policies will not negatively impact housing supply.

It should be noted that at time of writing, further challenge to the 2023 WMS is expected through the appeals process.



IN THE MATTER OF THE BUILDING REGULATIONS, PART L 2021 AND THE PLANNING AND ENERGY ACT 2008

Re: Ability of local planning authorities to set local plan policies that require development to achieve energy efficiency standards above Building Regulations

UPDATED OPEN ADVICE

INTRODUCTION AND SUMMARY

1. I am asked to advise Essex County Council ("**the Council**") and the Essex Climate Action Commission ("**ECAC**") on the ability of local planning authorities ("**LPAs**") to set local plan policies mandating energy efficiency standards for new buildings which exceed those in the Building Regulations, Part L. I initially advised in April 2023, but was asked to update the advice in early 2024. This advice supersedes and replaces my previous advice.

Figure 5.2 – Written legal advice provided to Essex County Council

6.0 Introduction to recommended policy – Absolute energy performance targets

Recommended Policy | How does it work?

An overarching policy

The recommended policy, based on best practice industry advice and examples of exemplar policy adopted by other local planning authorities, includes an overarching policy requirement that all new buildings must be designed and built to be Net Zero Carbon in operation by complying with the following requirements:

- Fossil fuel free
- **Space heating demand**
- **Energy Use Intensity (EUI)**
- On-site renewable energy generation

Space Heating Demand (kWh/m²/year) – is the active heat input required to heat a building. It is influenced by factors such as passive design, fabric performance, internal gains, and heat recovery on the ventilation system. It is independent of the heating system type and efficiency (e.g. boiler, heat pump) which meets that demand.

Energy Use Intensity (EUI) (kWh/m²/year) - the energy use per m² that is required by a building over a year, including regulated (i.e. domestic hot water, space heating and cooling, lighting, and ventilation) and unregulated loads (e.g. lifts, IT, domestic appliances). It is a measure of the building's performance and therefore includes all energy supplied to the building, whether from the grid or on-site systems. EV charging is excluded from the calculation. Renewable energy is excluded from energy use intensity calculations.

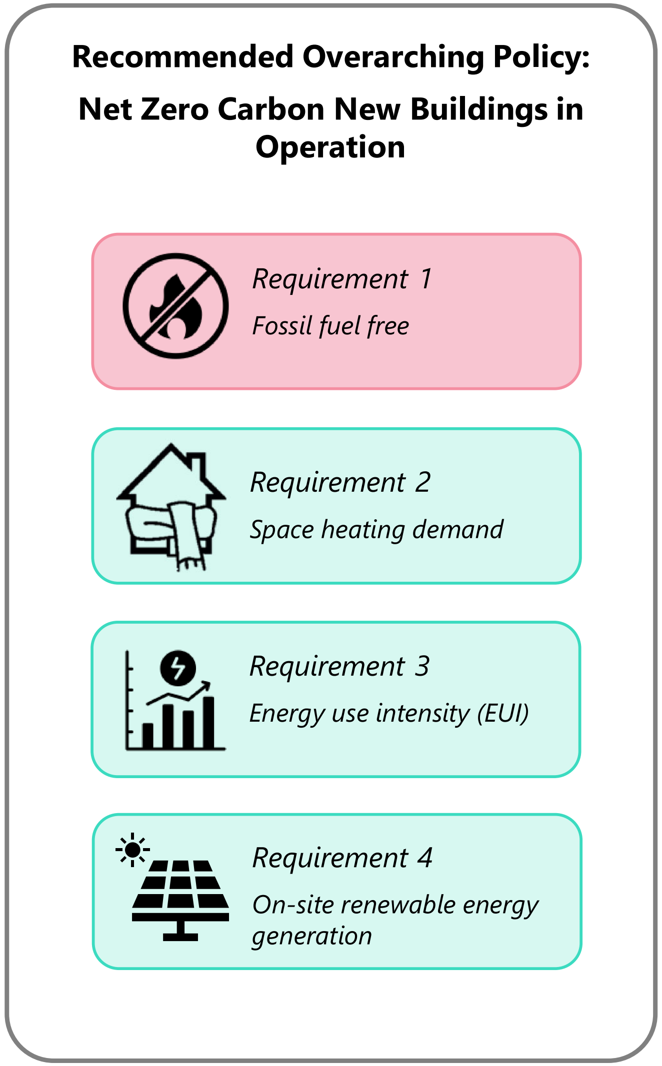


Figure 6.1: Net Zero Carbon New Building in Operation policy requirements

7.0 Recommended net zero carbon new building policy requirements for Wokingham

Policy recommendation | Net Zero Carbon New Buildings in Operation

Introduction

This section details policy recommendations for Local Plan preparation in Wokingham in terms of operational energy and carbon. For each policy, a summary justification is provided along with the proposed policy wording.

Net Zero Carbon New Building in Operation is the recommended net zero overarching policy, which states that all new buildings should be designed and built to be Net Zero Carbon in operation, to enable Wokingham to stay within the challenging remaining carbon budgets. This is also in line with the recommendations of the Climate Change Committee, the Low Energy Transformation Initiative (LETI) and the Royal Institute of British Architects (RIBA).

Recommended overarching policy:

Net Zero Carbon New Buildings in Operation

Proposed policy wording principles

All new buildings must be designed and built to be Net Zero Carbon in operation. They must be ultra-low energy buildings, be fossil fuel free, and generate renewable energy on-site to at least match annual energy use.

All new buildings are required to comply with the following requirements:

- **Requirement 1:** Fossil fuel free
- **Requirement 2 :** Space heating demand
- **Requirement 3 :** Energy Use Intensity (EUI)
- **Requirement 4 :** On-site renewable energy generation

It is understood that the LPU proposed policies take a site average approach to meeting the space heating demand and energy use intensity (EUI) targets, however the analysis in this evidence base has tested the typologies individually and does not reflect the intricacies of targeting average space heating demand and EUI performance. Taking a site average approach to policy means that there's more flexibility in meeting the proposed targets which would aid viability.

Requirement 1 ***Fossil fuel free***	*Fossil fuels, such as oil and natural gas shall not be used to provide space heating, hot water or used for cooking.*
Requirement 2 ***Space heating demand***	*Meeting space heating demand limits for residential and non-residential developments.* *Demonstrated using predictive energy modelling.*
Requirement 3 ***Energy use intensity (EUI)***	*Meeting energy use intensity (EUI) limits for residential and non-residential developments.* *Demonstrated using predictive energy modelling.*
Requirement 4 ***On-site renewable energy generation***	*100% of the annual energy consumption required by buildings shall be generated using on-site renewables, for example through solar PV.*

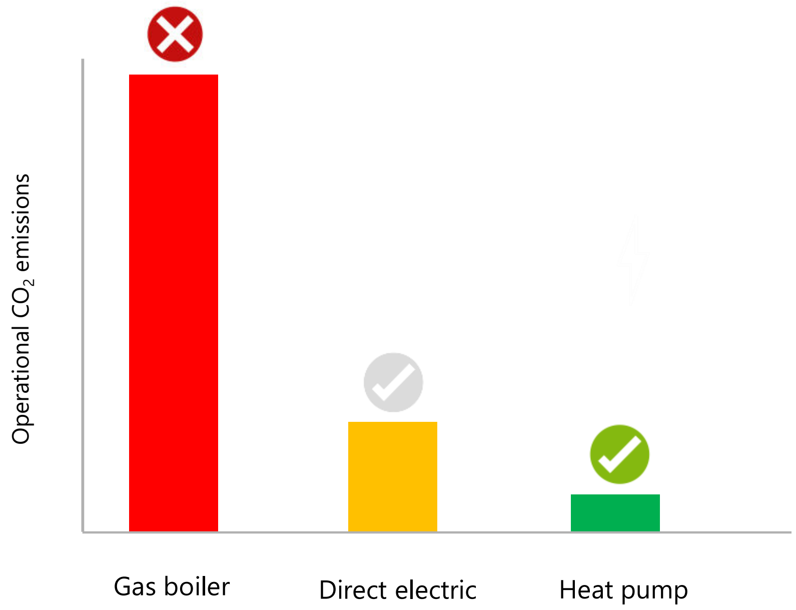
Policy recommendation | Requirement 1: Fossil fuel free

New buildings cannot continue to burn fossil fuels for heating if Wokingham is to meet its local goals on emissions reduction or be aligned with national carbon budgets. Low carbon heat is therefore an essential component of a Net Zero Carbon building.

Low carbon alternatives that are available now (sustainable green hydrogen is not currently an option) include heat pumps and direct electric heating. Electricity can be provided through on-site renewables and through grid electricity, which is becoming increasingly de-carbonised.

Heat pumps use refrigerant to efficiently move heat from one place (outside the building) to another (inside the building). Heat sources can include outside air, the ground or a local water source. Heat pumps can provide both space heating and domestic hot water and can serve individual homes or communal heating systems. The key benefit of heat pumps is their efficiency. Efficiencies vary but are typically around 250-400% for an Air Source Heat Pump.

Direct electric heating systems convert electricity directly into heat through resistive heating. It is typically 100% efficient. The price of electricity can make this a relatively expensive means of heating buildings and providing hot water though, unless cheaper off-peak electricity is used.



The choice of heating system will affect operational CO_2 emissions over a long time. Electric forms of heating (direct electric and heat pumps) will emit a fraction of a gas boiler carbon emissions (see above the average over 2022-2050)

Requirement 1: Fossil fuel free

Proposed policy wording

- No new developments to be connected to the gas grid.
- Fossil fuels must not be used on-site to provide space heating, domestic hot water or cooking.
- Space heating and domestic hot water must be provided through low carbon fuels.

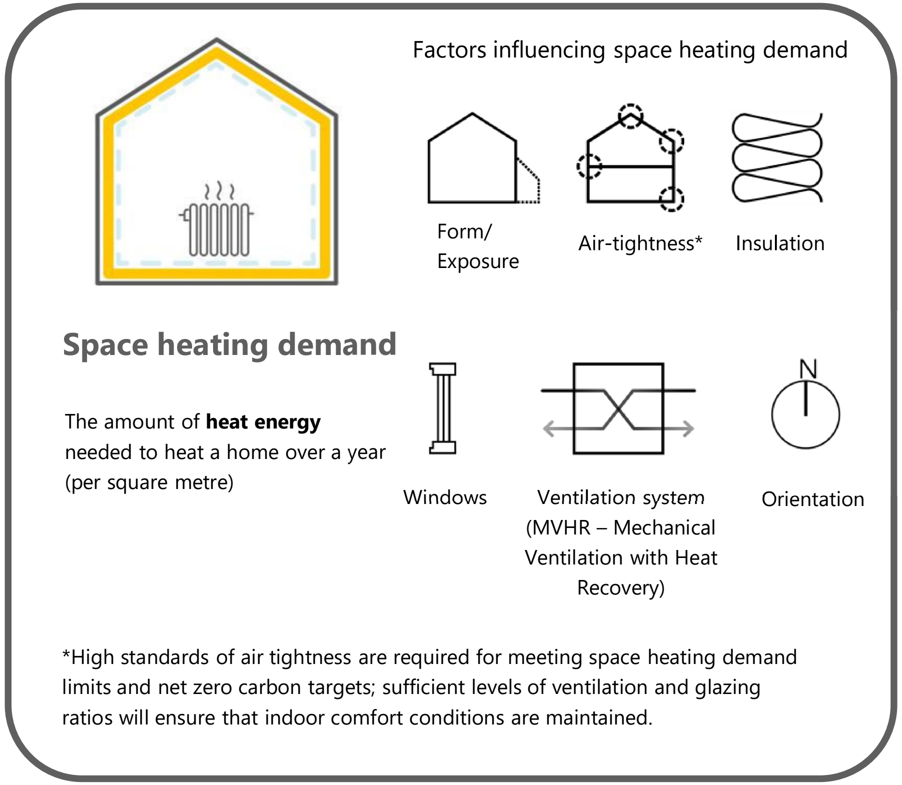
Policy recommendation | Requirement 2: Space Heating Demand limits

The space heating demand is the amount of heat energy needed to heat a home over a year and is expressed in kWh/m²/yr. It is a measure of the thermal efficiency of the building elements.

Various design and specification decisions affect space heating demand including building form and orientation, insulation, air-tightness, windows and doors and the type of ventilation system.

The Climate Change Committee recommends a space heating demand of no more than 15-20 kWh/m²/yr for new homes. This recommendation is also in line with the recommendations of the Royal Institute of British Architects (RIBA), the Low Energy Transformation Initiative (LETI) and the UK Green Building Council.

Buildings with low space heating demand would lose heat very slowly, therefore it will make it easier for the wider energy system to deliver energy in a flexible way, helping to maximise the contribution from renewable energy and reduce energy cost benefits for the residents.



Requirement 2: Space Heating Demand

Proposed policy wording

- All residential buildings are expected to achieve a space heating demand of no more than 15-20kWh/m^2_{GIA*}/yr.

Space heating demand in all buildings should be demonstrated using predictive energy modelling.

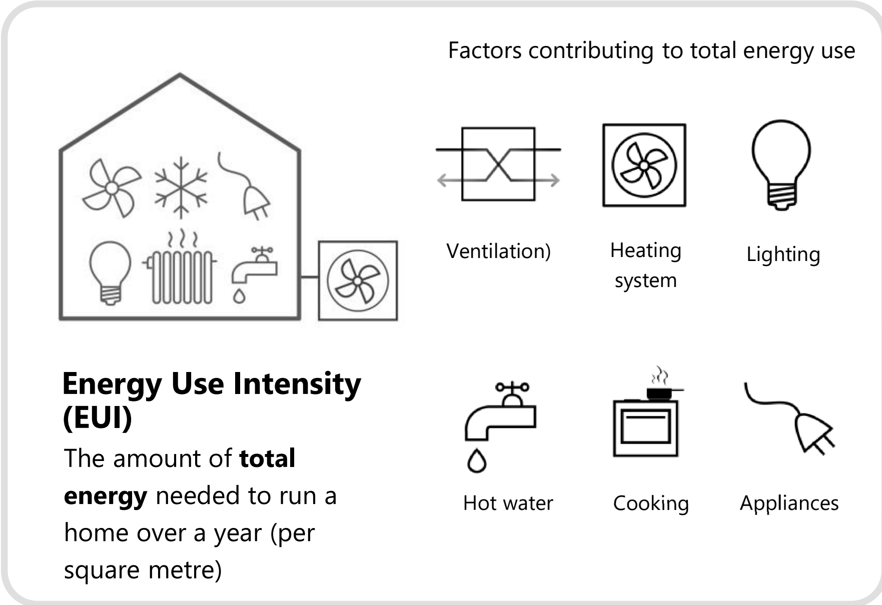
*GIA (Gross Internal Area) - is the area of a building measured to the internal face of the perimeter walls at each floor level.

Policy recommendation | Requirement 3: Energy Use Intensity limits

In order for new buildings to be compliant with the UK climate change targets, they need to use a total amount of energy which is small enough so that it can be generated entirely, on an annual basis, with renewable energy and nuclear energy. Reducing total energy use is also beneficial as it would directly reduce energy costs for residents and building users.

Energy Use Intensity (EUI), or metered energy use, is the total energy needed to run a home over a year (per square meter). It is a measure of the total energy consumption of the building (kWh/m²/yr). The EUI of a building covers all energy uses (regulated and unregulated): space heating, domestic hot water, ventilation, lighting, cooking and appliances. EV charging is excluded from the calculation. Whether the energy is sourced from the Electricity grid or from onsite renewables does not affect the calculation.

This metric is also very beneficial as it can be measured post-construction, therefore helping to drive down the performance gap which is such a significant issue in the construction industry.

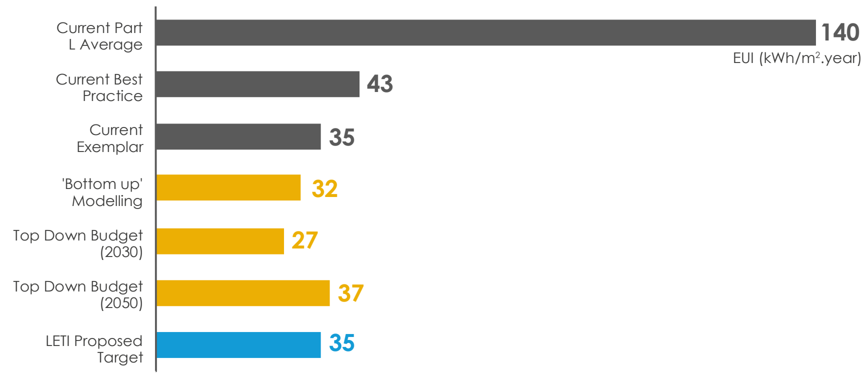


Requirement 3: Energy Use Intensity (EUI) limits

Proposed policy wording

- All residential buildings are expected to achieve an Energy Use Intensity (EUI) of no more than 35 kWh/m$^2_{GIA*}$/yr to be demonstrated using predictive energy modelling.

*GIA (Gross Internal Area) - is the area of a building measured to the internal face of the perimeter walls at each floor level.



LETI residential top-down analysis taken from LETI Climate Emergency Design Guide

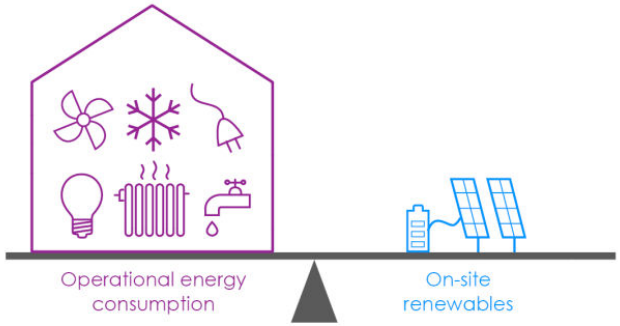
LETI has undertaken some top-down and bottom-up analysis establishing which levels of total energy use (or Energy Use Intensity – EUI) would be both achievable and compatible with the level of renewable energy generation likely to be available in the UK by 2050.

Policy recommendation | Requirement 4: On-site renewable energy generation

New buildings should contribute to the significant increase in renewable energy generation required between now and 2050. The most robust way to deliver the overall objective of a balance between total energy use and renewable energy generation for new buildings at a system level is to seek to achieve this balance at the site level. This would also have the advantage of generating 'free' electricity close to its point of use, helping to deliver significant energy cost savings for residents and building users.

Currently, the most suitable method for renewable energy generation is the installation of photovoltaic panels.

Refer to Appendix 2.0 for further guidance on renewable energy generation.



Energy balance

The amount of renewable energy generated in a year should match or exceed the EUI

Requirement 4: On-site renewable energy generation

Proposed policy wording

- Renewable energy must be generated on-site for all new developments.
- The amount of energy generated in a year should match or exceed the predicted annual energy use of the building, i.e. Renewable energy generation (kWh/m^2/yr) = or > predicted annual energy use (kWh/m^2/yr).

*When this is not technically possible and suitably justified, the applicant should contribute to the Council's offset fund (equivalent to the shortfall in meeting the annual energy consumption of the building) (see Offsetting section for further guidance).

Future Policy Considerations | Embodied Carbon

A building's whole life carbon emissions is comprised of both operational and embodied carbon. As new buildings become more efficient, operational emissions start to increasingly reduce, thus embodied carbon emissions make up a greater proportion of the total building whole life carbon. This evidence base only focusses on the operational carbon emissions, however it is important that appropriate consideration is given to embodied carbon emissions, and the impact is reduced as far as possible through good design and planning.

It is suggested that short term policy requires all reasonable and practical opportunities to consider and minimize embodied carbon emissions. In the longer term, potentially as part of a future plan review process, it is suggested that specific embodied carbon limits are introduced within policy. As a first step towards this it is recommended that upfront embodied carbon is calculated and reported.

Embodied carbon is not regulated but the Royal Institution of Chartered Surveyors (RICS) Whole life assessment guidance provides a nationally recognized methodology to calculate embodied carbon.

Upfront embodied carbon targets disclosed by applicants can be compared against the best-practice targets for 2020 and 2030.

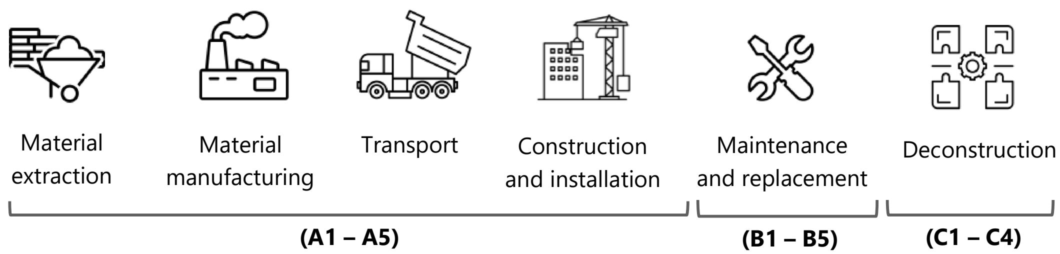
Applicants should use the methodology set out by the latest version of the RICS Whole Life Carbon Assessment for the built environment guidance.

Eventually, it is recommended that an embodied carbon policy is introduced that requires a limit on the embodied carbon of a dwelling. Although, embodied carbon limits are not proposed in the current Local Plan update, current monitoring for embodied carbon could help inform this policy in the future and prepare the development industry by encouraging it to adopt the skills necessary to measure whole life carbon.

The Net Zero Carbon Building Standard is currently in development which will set out embodied carbon limits for dwellings. These limits could be introduced in future policy once published.

		Upfront embodied carbon $kgCO_2e/m^2$ (A1-A5)
	Band	**Residential (6+ storeys)**
	A++	<100
	A+	<200
LETI 2030 Design target →	A	<300
	B	<400
LETI 2020 Design target →	C	<500
	D	<675
	E	<850
	F	<1000
	G	<1200

In 2021 best practice targets for upfront and lifecycle embodied carbon were published - a collaboration between LETI, RIBA, WLCN and The Institute of Structural Engineers which included targets for residential buildings 6 stories and above.



Definitions

Upfront embodied carbon (Modules A1 – A5): 'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion. Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion. [1]

Life cycle embodied carbon (Modules A1-A5, B1-B5, C1-C4) : 'Embodied Carbon' emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset.[1]

[1]LETI WLCN Carbon definitions for the built environment document

8.0 Technical evidence base for new domestic buildings

Predictive Energy Modelling | Overview

Predictive energy modelling using PHPP software was undertaken for the three domestic typologies, to estimate space heating demand and the total energy use (EUI) for each scenario. The fabric and system specifications modelled are listed in Appendix 1. The three domestic typologies represent a range of building forms and sizes as dwelling density can have an impact on energy efficiency and renewable energy generation. The typologies selected were based on typical domestic archetypes and what is expected to come forward in Wokingham over the next local plan periods. Although a terraced house typology has not been tested as part of this evidence base, the energy performance of this typology lies would lie between a semi-detached house and low-rise block of flats, therefore could be expected to meet the space heating demand and energy use intensity proposed targets.

1. Detached House

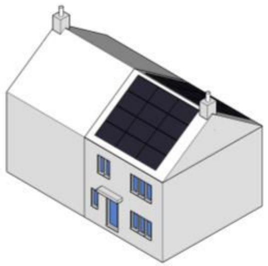
Typical 4 bedroom – 142 m^2

This building represents the generic **Detached house** typology

2. Semi-detached house

2 storeys – 93 m^2

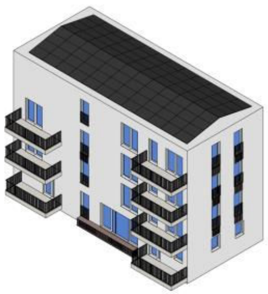
This building represents the generic **Semi-detached house** typology



3. Block of flats - Low-Rise

3/4 storeys - 672 m^2

This building represents the generic **Low-rise block of flats** typology



Predictive Energy Modelling | Space Heating Demand (kWh/m²/year)

Requirement 2 of the Net Zero policy requires all dwellings, to achieve a space heating demand of no more than **15-20 kWh/m²/year**.

Technical Feasibility

Predictive energy modelling using PHPP software was undertaken for the three domestic typologies, using different fabric and systems specifications, which are listed in Appendix 1.

The space heating demand results of different orientations (North, East, South and West) are shown on *Figure 8.1* with the proposed policy limit.

Conclusion

All dwellings achieve a space heating demand of less than 20 kWh/m²/year, demonstrating that the proposed Net Zero policy requirement 2 is technically feasible.

The low-rise block of flats in particular achieve a space heating demand of less than 10 kWh/m²/year due to their more efficient form factor, indicating that this typology could be built to a more relaxed set of specifications in practice.

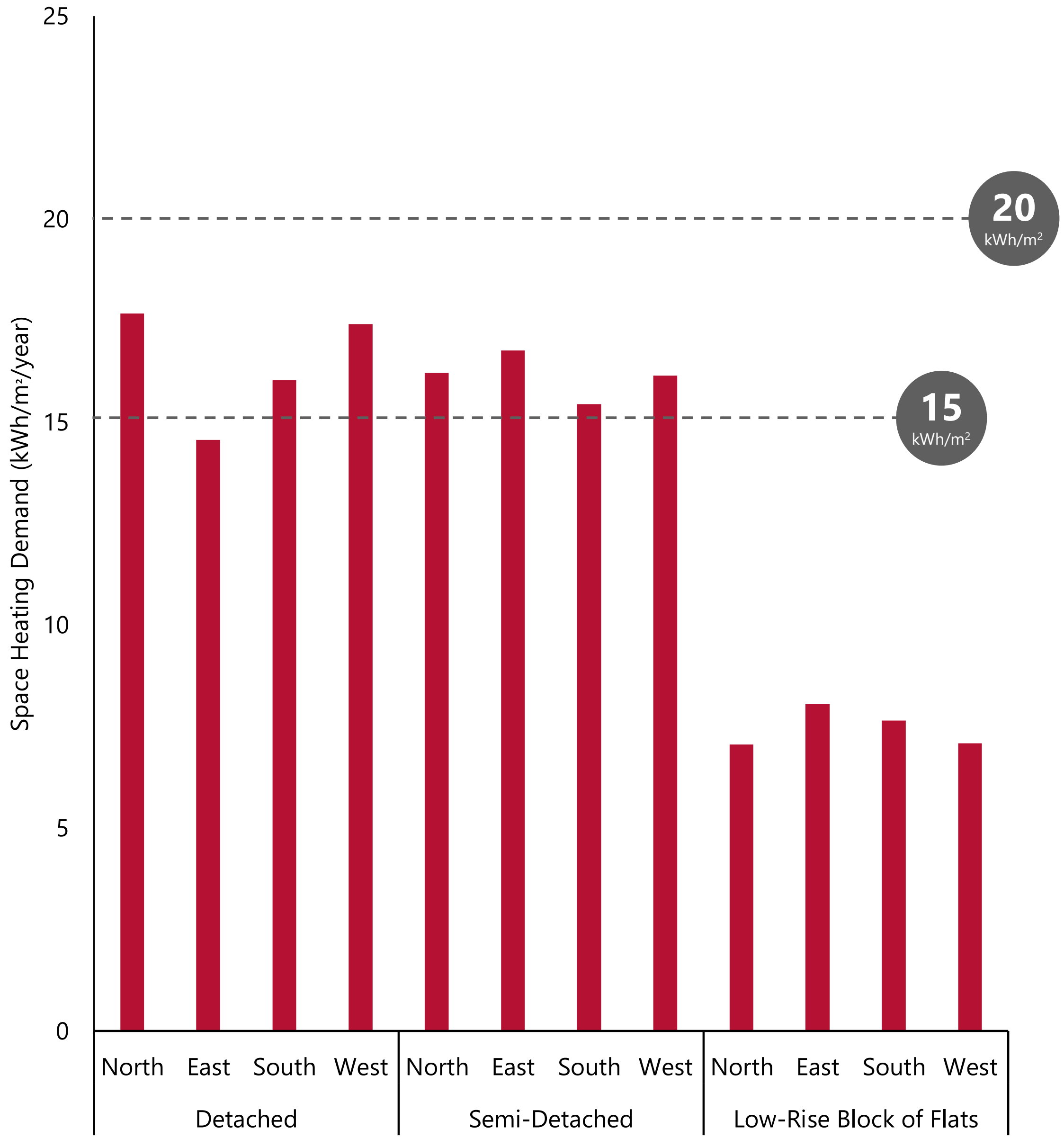


Figure 8.1: Space heating demand results from PHPP modelling of all the domestic typologies at different orientations

Predictive Energy Modelling | Energy Use Intensity (kWh/m²/year)

Requirement 3 of the Net Zero policy requires all dwellings, to achieve an energy use intensity of no more than **35 kWh/m²/year**.

Technical Feasibility

Predictive energy modelling using PHPP software was undertaken for the three domestic typologies, using different fabric and systems specifications, which are listed in Appendix 1.

The energy use intensity results of different orientations (North, East, South and West) are shown on *Figure 8.2* with the proposed policy limit of 35 kWh/m²/year.

Conclusion

All dwellings achieve an energy use intensity of no more than 35 kWh/m²/year, demonstrating that the proposed Net Zero policy requirement 3 is technically feasible.

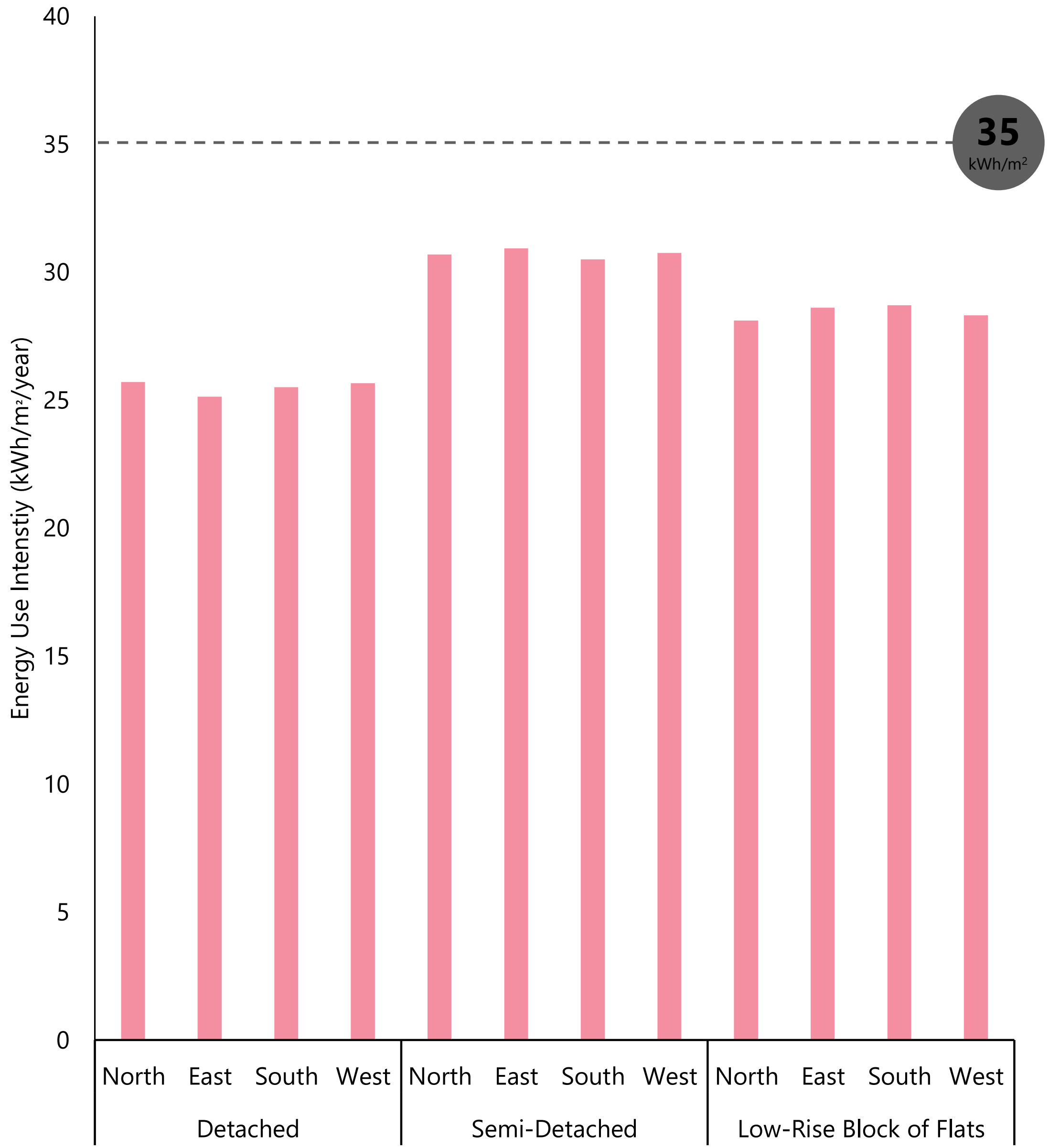


Figure 8.2: Energy use intensity results from PHPP modelling of all the domestic typologies at different orientations

Energy Modelling | Renewable Energy Generation (kWh/m²/year)

Requirement 4 of the Net Zero policy requires all dwellings to generate on site renewable electricity. The amount of energy generated in a year should match or exceed the predicted annual energy use of the building, i.e. Renewable energy generation (kWh/m²/yr) = or > predicted annual energy use (kWh/m²/yr).

Technical Feasibility

The modelled energy use intensity and renewable energy generation intensity results for each typology is presented in *Figure 8.3.* The renewable energy generation policy requires that all dwellings achieve an energy balance on site, by meeting the dwelling's energy consumption through on-site renewable energy generation.

Conclusion

All dwellings with the modelled form factor achieve an energy balance on site, demonstrating that the proposed Net Zero policy requirement 3 is technically feasible.

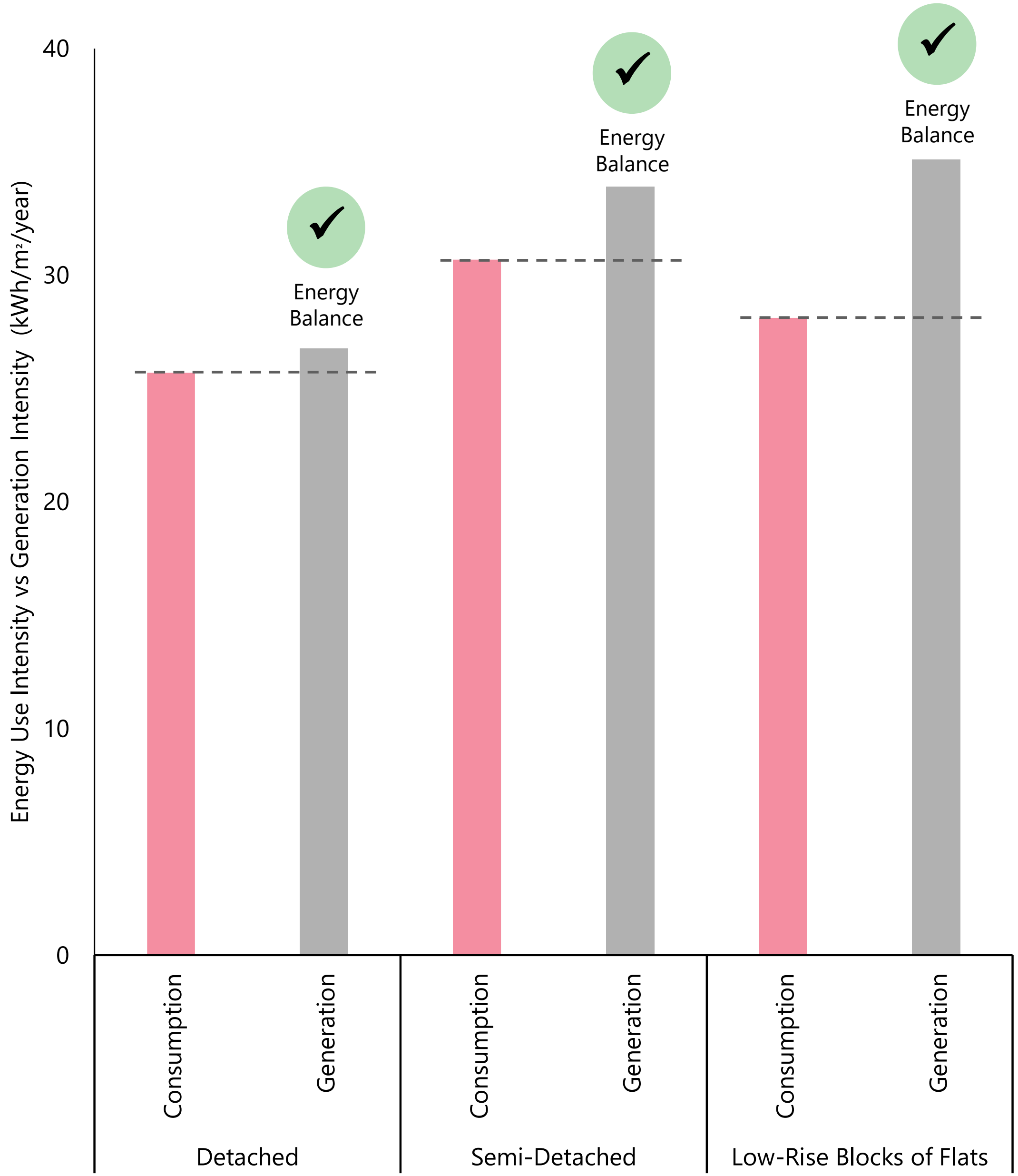


Figure 8.3: Energy use intensity vs PV generation from PHPP modelling of all the domestic typologies at different orientations

9.0 Sensitivity Testing

Sensitivity Testing | Introduction

A building's energy demand can be significantly impacted by its **form factor, orientation and glazing ratios**. Although fabric and building services specifications are fundamental in determining a building's energy demand, it is very important that the building is designed right first. *Figure 9.1* outlines the different scenarios tested for each typology to understand the impact of these factors on energy use and space heating demand.

Form factor

Form factor is defined as the ratio of the exposed surface areas of the building fabric to the internal floor area. The lower the form factor, the lower the heat losses thus the lower the energy demand, thus the more efficient the building. Form factor is measured by dividing the exposed external surface area by the building's gross internal floor area.

Orientation

It is important that orientation is considered at an early stage of the design to reduce its space heating demand by properly capturing useful solar gain opportunities. This can be achieved by orientating the largest elevation to face South (+/- 30°), in addition to arranging the rooms with the highest occupied hours along the South façade. However, it is important that the amount of glazing and solar shading is considered alongside orientation to prevent the risk of overheating in the summer.

Glazing Ratio

To achieve a balance between capturing the useful winter solar gains, and preventing summer overheating risk, it is important that the window to wall ratios are considered. The window to wall ratio is measured by dividing the total glazing area by the total external wall area.

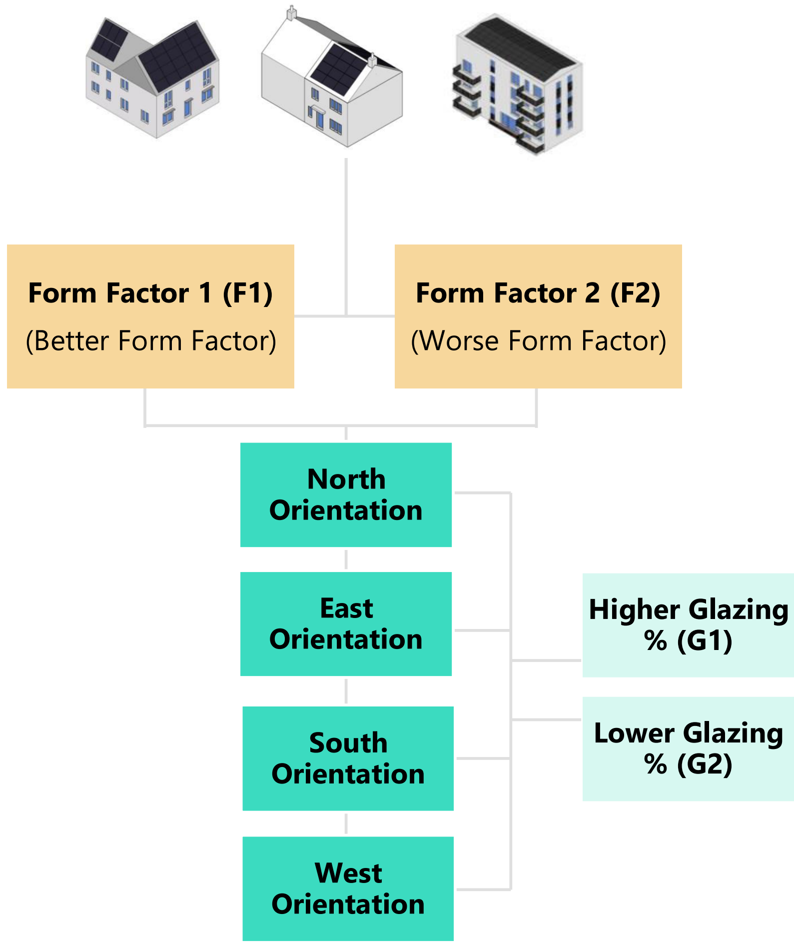


Figure 9.1: Illustration of the different scenarios tested

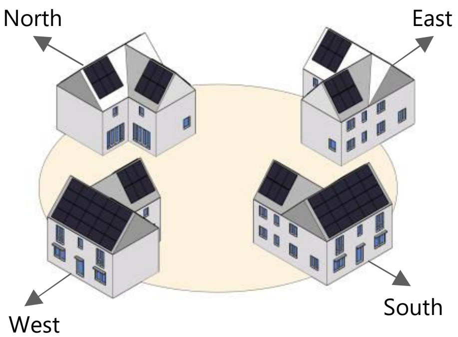
Sensitivity Testing | Tested Scenarios

The following table summarises the different scenarios tested against orientation, form factor and glazing ratios for the three housing typologies tested.

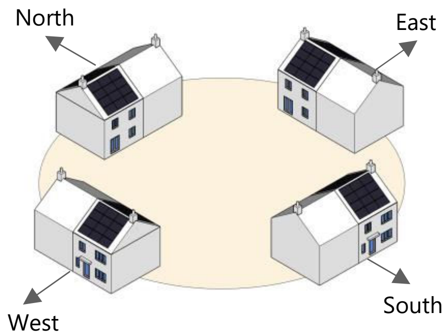
	Detached House	Semi-Detached House	Low-Rise House

Orientation

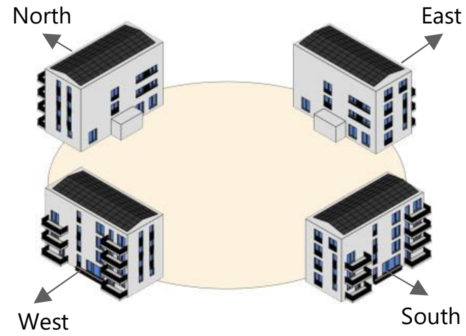
Detached House



Semi-Detached House



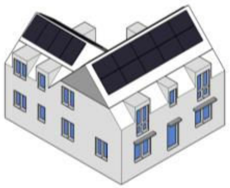
Low-Rise House



Form Factor

Detached House

F1 – **2.8**
Baseline



F2 – **2.9**
Addition of dormer windows

LETI Benchmark: 1.7-2.5

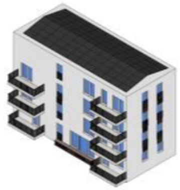
Semi-Detached House

F1 – **2.6**
Baseline

F2 – **2.7**
Addition of bay windows

LETI Benchmark: 1.7-2.5

Low-Rise House



F1 – **1.8**
Baseline

F2 – **2.0**
Complex roof form

LETI Benchmark: 0.8-1.5

Glazing Ratio

The following glazing proportions have been reported for the baseline form factor scenario facing south. The glazing proportions have been quoted below for the most beneficial orientation.

Detached House

	LETI Benchmark	**G1** Higher Glazing	**G2** Lower Glazing
North	10-15%	14%	9%
East	10-15%	10%	6%
South	20-25%	28%	28%
West	10-15%	16%	10%

Semi-Detached House

	LETI Benchmark	**G1** Higher Glazing	**G2** Lower Glazing
North	10-15%	22%	10%
East	10-15%	0%	0%
South	20-25%	30%	30%
West	10-15%	0%	0%

Low-Rise House

	LETI Benchmark	**G1** Higher Glazing	**G2** Lower Glazing
North	10-20%	15%	13%
East	10-15%	16%	13%
South	20-25%	36%	36%
West	10-15%	32%	16%

Sensitivity Testing | Orientation

Figure 9.2 shows the sensitivity analysis testing of the impact of orientation on space heating demand (SHD) for the three different typologies. The results presented are for the higher glazing (G1) and worse form factor (F2) scenario. For each typology, the largest glazed façade was taken as the starting point and then rotated at 90 degree increments to understand the impact of orientation.

Results

As expected, the space heating demand of particular orientations perform slightly better than others. As the dwelling is orientated in different directions, the presence of south facing windows are the largest contributors to the reduction of SHD irrespective of the dwelling's orientation. Generally, dwellings with south facing windows have the lowest SHD, due to the useful solar heat gains during the day which warm up the internal space. Although East and West windows can also provide useful solar gains, they can often lead to overheating due to the sun's low position at the start/end of day.

The east facing orientation of the detached house has the lowest SHD result of 16.7 kWh/m²/year, this is due to the fact that the largest glazed façade is facing south in this orientation. For the semi-detached house, the south facing orientation performs the best with a SHD 18.7 kWh/m²/year. And the low-rise block of flats achieves a SHD of less than 15 kWh/m²/year at all orientations due to their more efficient form factor, indicating that this typology could be built to a more relaxed set of specifications in practice.

It has also been found that different orientations had minimal impact on the energy use intensity of the buildings. This is because of the high efficiency heating systems specified for the buildings.

The impact of orientation on space heating demand has also been tested on the lower glazing (G1) scenario, in addition to the better form factor (F1) scenario. The results of these scenarios follow the same trend as those presented in *Figure 9.2* but with better SHD results. These results can be found in Appendix 2.0.

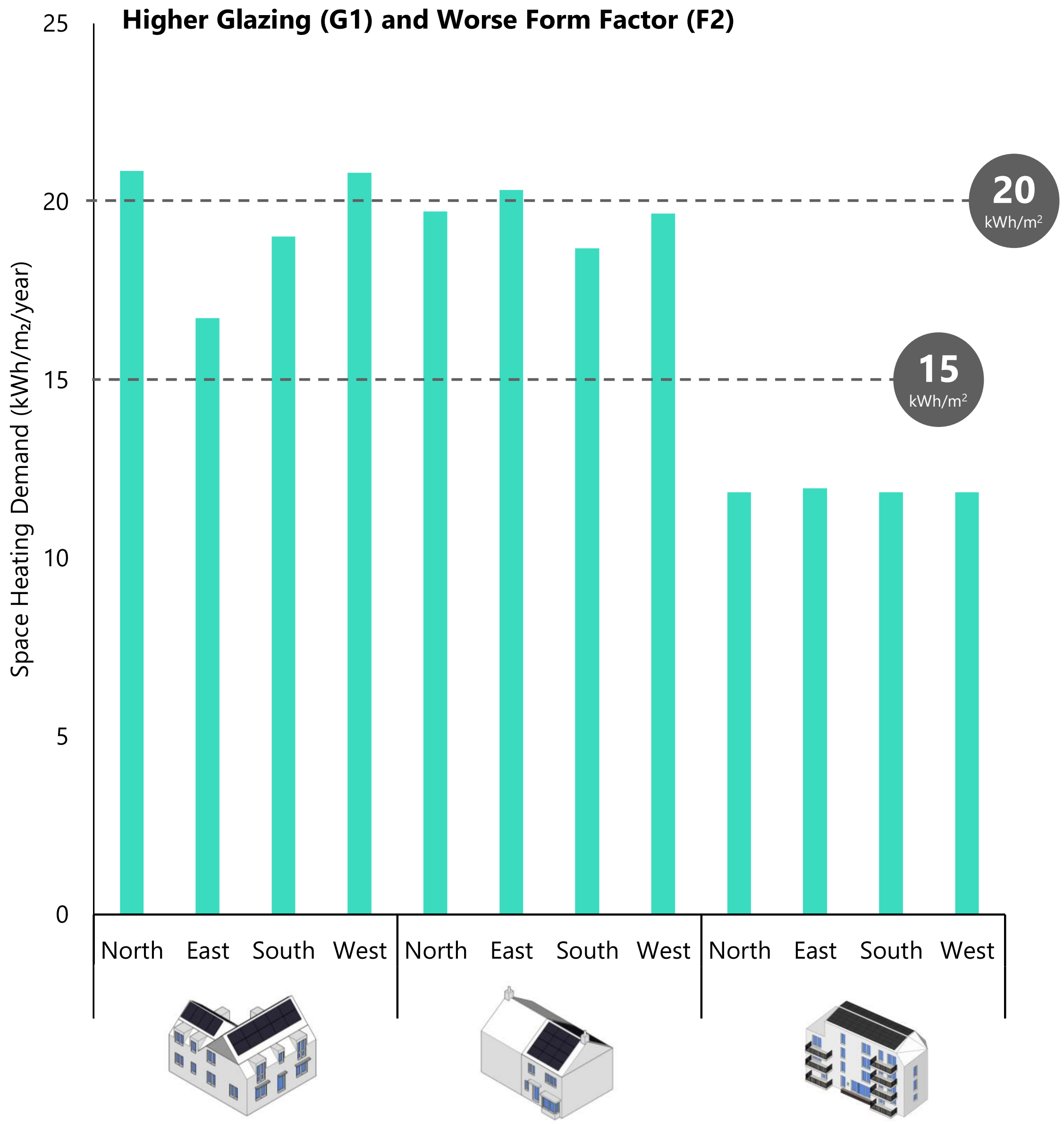


Figure 9.2: Space heating demand results from PHPP modelling of all typologies at different orientations for the worst-case scenario (G1,F2).

Sensitivity Testing | Form Factor

Figure 9.3 shows the sensitivity analysis testing of the impact of form factor on space heating demand for the three different typologies. The results presented are for the higher glazing (G1) and better form factor (F1) scenario orientated at 90-degree increments. The results have been compared against the original set of results presented in Figure 9.2 on page 43 (shown as a dotted bar on the chart) to understand the impact of improving the form factor.

Results

The results show that more efficient form factors tend to reduce the space heating demand (SHD) within a range of 1-2 kWh/m²/year. This is because of the reduced heat loss areas which lead to a lower energy demand.

All the typologies at different orientations meet the space heating demand of 20 kWh/m²/year, and the most significant improvement in results is noticed in the low-rise block of flats typology, as the SHD reduces from 12 kWh/m²/year for the higher form factor, to 9-10 kWh/m²/year for the better form factor.

In addition to the reduction in space heating demand, buildings with more efficient form factors tend to generally have a lower whole life carbon impact as they require less materials to construct simpler forms.

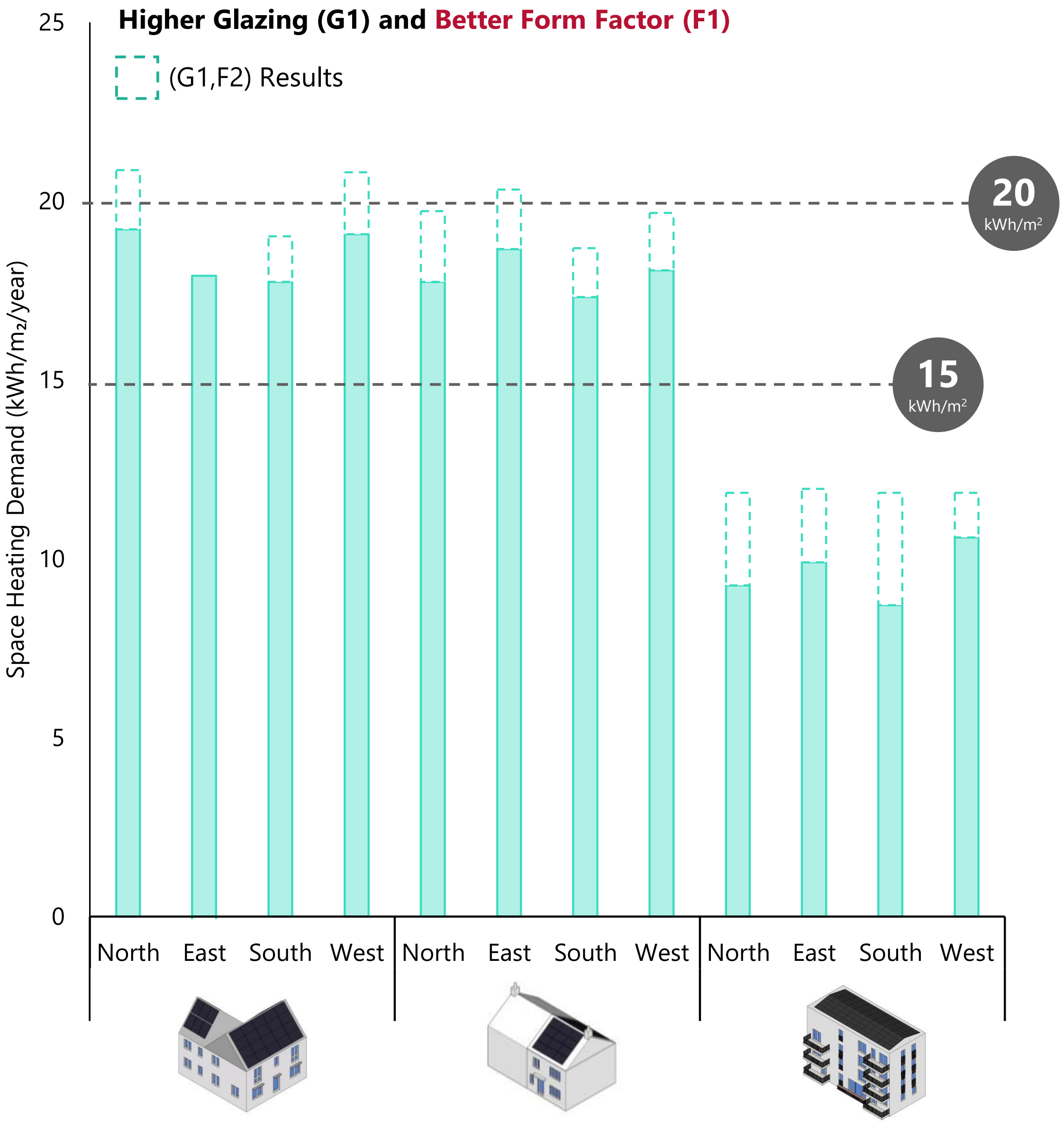


Figure 9.3: Space heating demand results from PHPP modelling of all typologies at different orientations for the better form factor scenario (G1,F1).

Sensitivity Testing | Glazing Ratio

Figure 9.4 shows the sensitivity analysis testing of the impact of glazing ratios on space heating demand for the three different typologies. The results presented are for the lower glazing (G2) and worse form factor (F2) scenario orientated at 90-degree increments. The results have been compared against the original set of results presented on page 43 (shown as a dotted bar on the chart) to understand the impact of improving the glazing ratios.

Results

Across the board, the lower glazing proportion consistently results in lower SHD values. This is primarily because windows generally have a higher U-value than walls, meaning more heat can escape through them. Reducing the glazing proportion decreases the area through which heat can escape, therefore reducing heat loss and the need for additional heating.

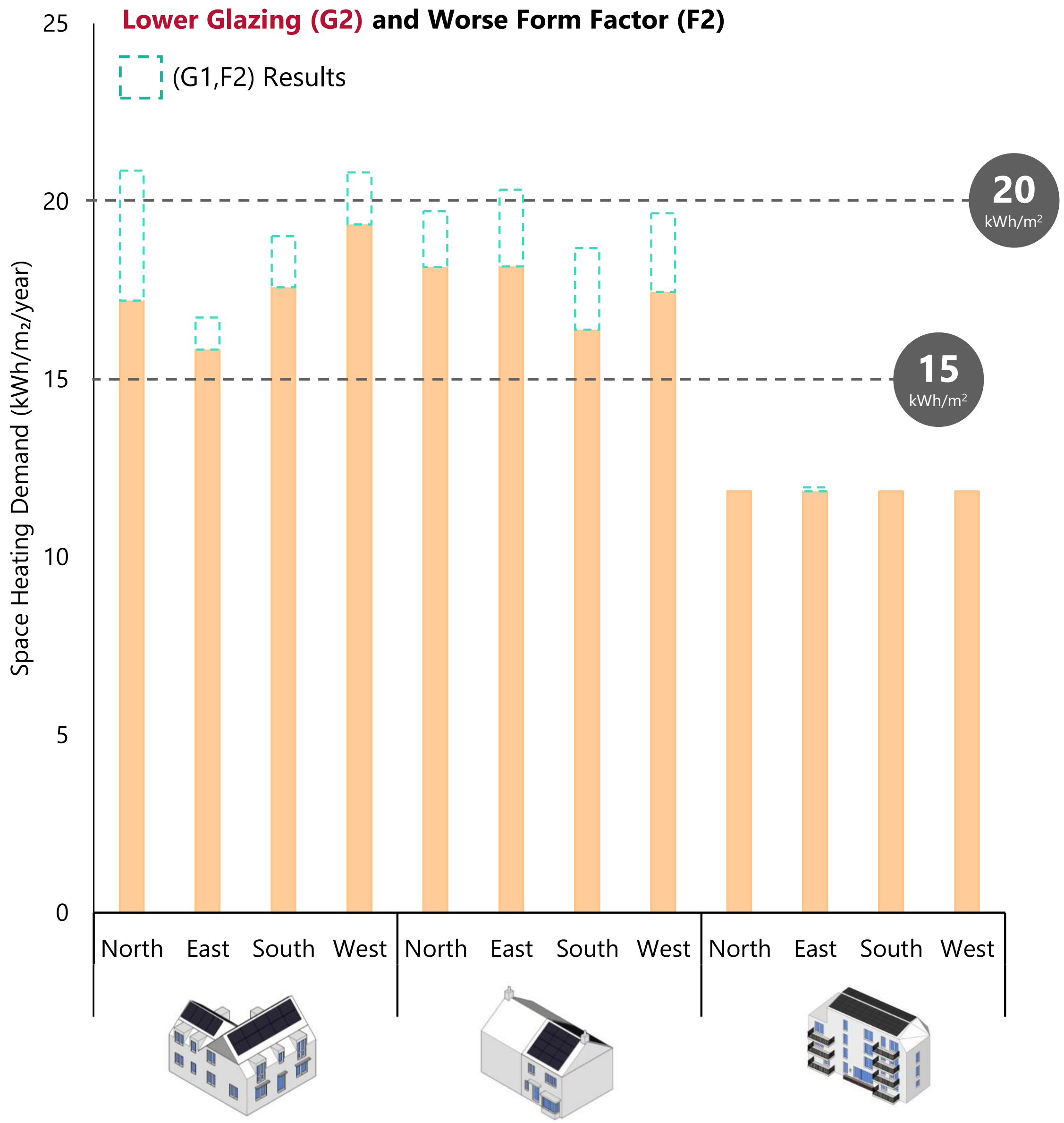


Figure 9.4: Space heating demand results from PHPP modelling of all typologies at different orientations for the lower glazing scenario (G2,F2).

Sensitivity Testing | Impact of Improved Glazing Ratios and Form Factor Combined

Figure 9.5 shows the sensitivity analysis testing of the impact of improved glazing ratios and form factor on space heating demand for the three different typologies. The results presented are for the best-case scenario which is lower glazing (G2) and better form factor (F1) orientated at 90-degree increments. The results have been compared against the original set of results presented on page 43 (shown as a dotted bar on the chart) to understand the impact of improving the glazing ratios.

Results

Figure 9.5 shows the SHD results for the best- and worst-case scenarios across the different typologies at different orientations. The results show that by simply designing a more efficient building envelope, the SHD decreases within a range of 2-5 kWh/m²/year.

Furthermore, the analysis has showed that reducing the glazing proportion is the most effective strategy for lowering space heating demand across all orientations and typologies. It is important that glazing proportion is considered alongside orientation to prevent the risk of overheating in the summer.

Orientation and form factor also influence SHD, but their impact is less significant compared to the glazing ratio. This is because lower glazing proportions mean lower heat losses through windows, minimised cold drafts, and enhanced overall building envelope efficiency.

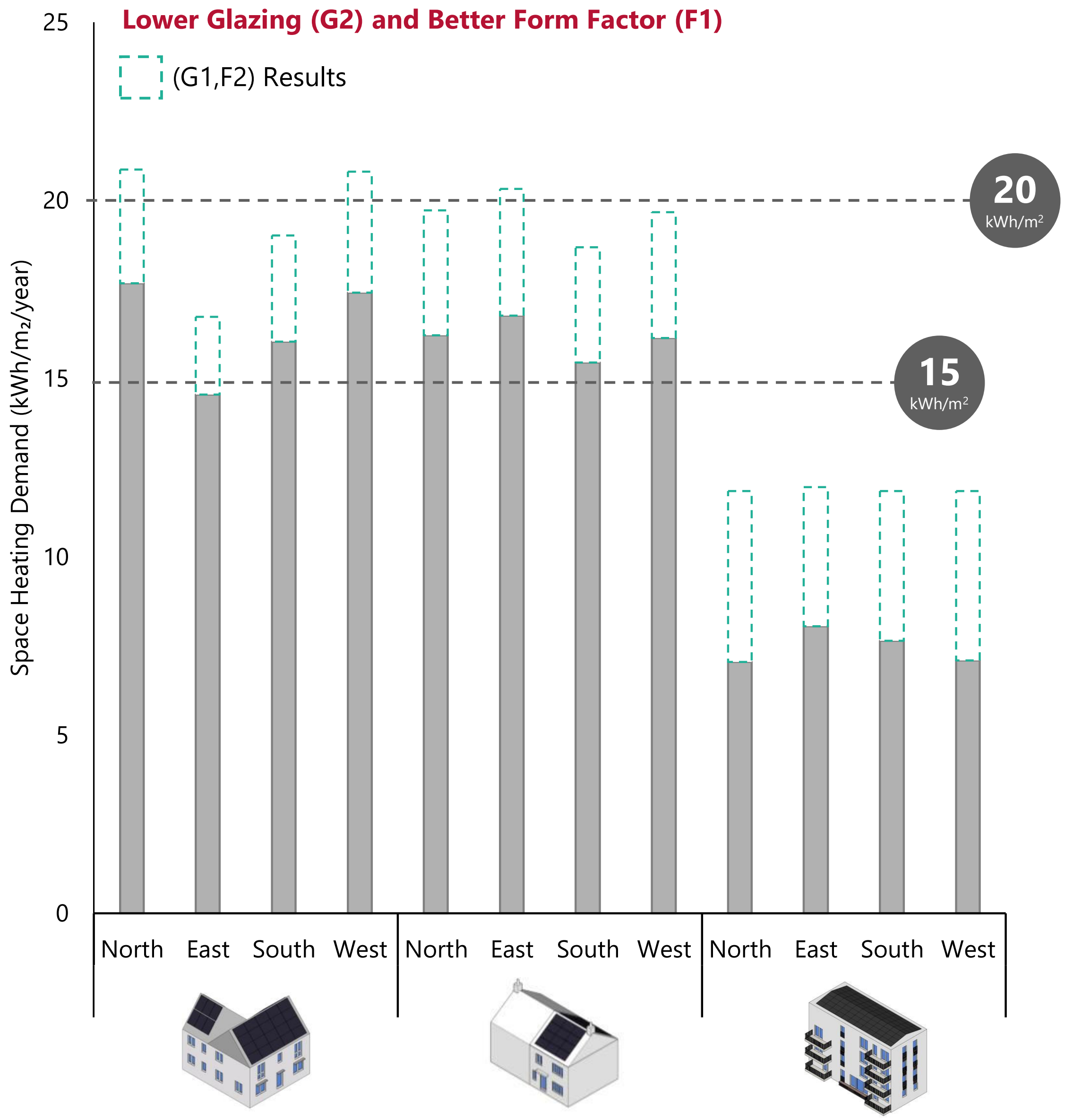


Figure 9.5: Space heating demand results from PHPP modelling of all typologies at different orientations for the best-case scenario (G2,F1).

Sensitivity Testing | Impact of Less Efficient Design on the Energy Balance

Figure 9.6 shows the sensitivity analysis testing of the impact of efficient design and less efficient design on the energy balance achieved on site for the low-rise block flats typology.

The efficient design results presented are for the lower glazing (G2) and better form factor (F1) scenario, and the less efficient design results presented are for the higher glazing (G1) and worse form factor (F2) scenario at 90-degree increments. For each typology, a comparison between the energy use intensity (EUI) and renewable energy generation intensity is presented.

The renewable energy generation policy requires that all dwellings achieve an energy balance on site, by meeting the dwelling's energy consumption through on-site renewable energy generation. The amount of renewable energy that is installed on the roof can be greatly influenced by the building's form factor. Putting photovoltaic panels (PVPs) on a poorly design building is not adequate, as it will struggle to meet the levels of energy generation required to achieve an energy balance on site.

The results presented in *Figure 9.6* for the low-rise block of flats show the impact of efficient design on achieving the energy balance on site. The less efficient design scenario generally has a higher EUI than the more efficient design scenario. In addition, the building has a less efficient form and layout, which means that the available roof space is insufficient to accommodate the required PV panels to meet the energy balance, therefore preventing the design from achieving energy balance on site. This emphasizes the impact of good design on the overall energy performance of a building and meeting the net zero policy targets.

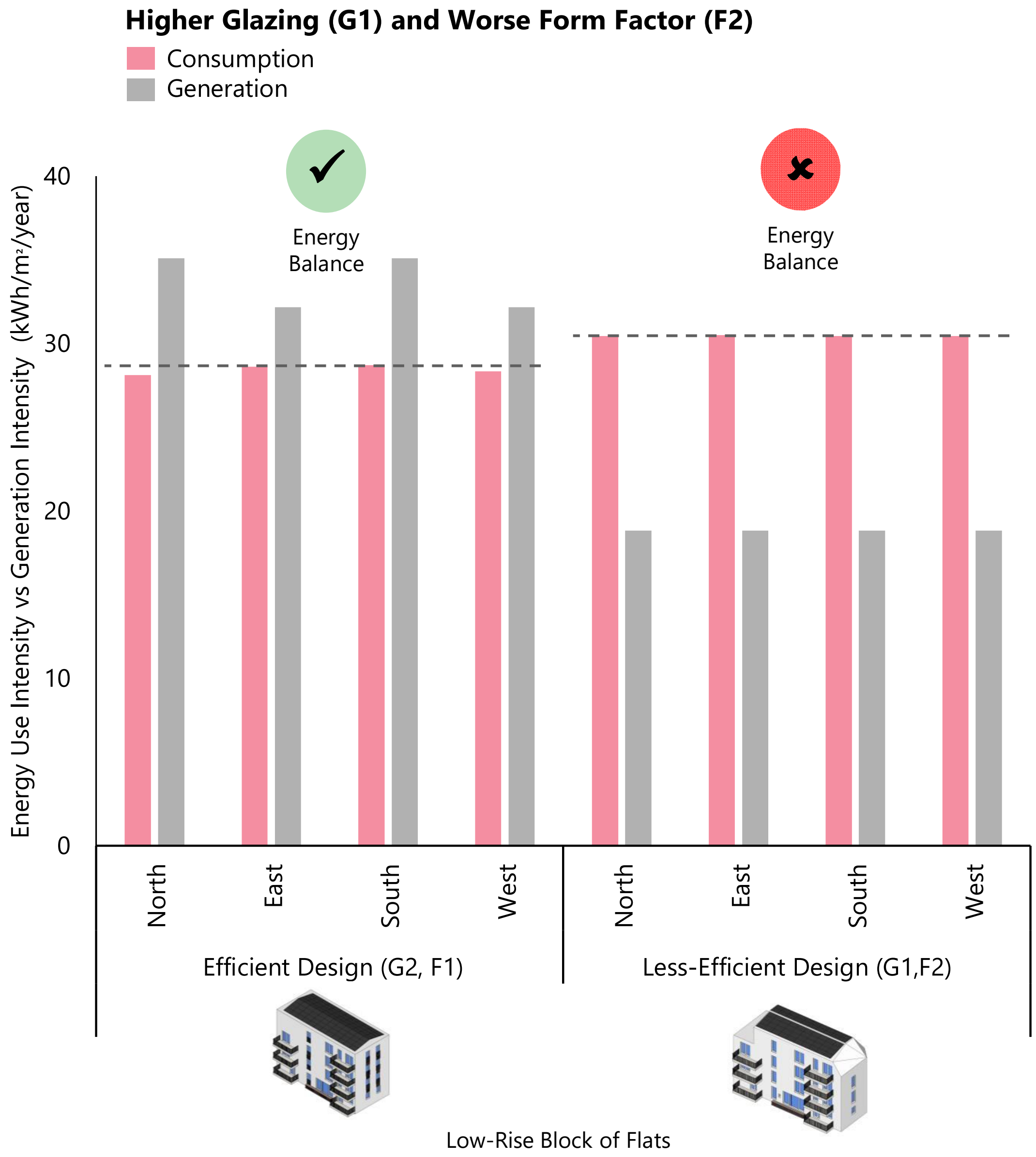


Figure 9.6: Energy use intensity vs PV generation from PHPP modelling of the low-rise block of flats typology at different orientations for the efficient and less efficient design scenarios.

10.0 Cost evidence base to inform viability testing

Introduction to cost analysis

The next step is to demonstrate whether the policies are financially viable. Capital cost analysis was undertaken by Currie & Brown to benchmark the likely capital cost for the typologies under the modelled specifications for complying with the net zero policy principles individually for each home.

Costing approach

The uplift costs associated with each specification option were estimated based on Currie & Brown's cost datasets for energy efficient and low carbon technologies which incorporate information from market prices, specific market testing and first principles cost planning by their specialist quantity surveyors.

The costs are based on Q3 2024 prices and reflect a South England cost base (including Wokingham).

Costs were developed for each affected element to identify the variance in price between the baseline and the enhanced specifications. Those elements that are not materially affected by the energy efficiency / low carbon technology options, e.g., substructure, roof coverings, kitchen and bathrooms, etc, were not costed in detail. Instead, these costs were incorporated within the 'balance of construction' cost estimated by reference to a typical whole building construction cost per m^2 for the building type in question. This whole building cost was then adjusted for each option based on the variance in the elements costed in detail to determine the overall percentage impact on construction costs.

Calculation of the baseline build costs

The assumed baseline build cost for a Part L 2021 policy compliant scenario. This scenario uses the Part L 2021 notional building specification and does not look to surpass demands of current policy. A benchmark £/m^2 cost is estimated for each building type based on cost data from BCIS from the period 2020-2024 adjusted for the South-East region and in Q3 2024 prices. Costs for detached houses were taken as the top quartile of the cost range for housing reflecting the higher cost of building these homes due to the greater external envelop per unit of floor space. The mean cost rate was used for semi detached houses reflecting that these homes are typically less expensive to build than detached houses but more expensive than mid terrace houses for the same reasons of external envelop to floor area ratio. Low rise flat costs were based on BICS rates for flats <5 storeys.

It was assumed that most of the cost data for homes completed from 2020 to Q2 2024 would typically reflect construction to a Part L 2013 standard, to create a baseline consistent with the Part L2021 standard (introduced in June 2022) an additional £48-55 m2 was added to the cost of detached and semi-detached houses respectively and an allowance of £24m2 added to the cost of low-rise flats. These cost allowances are specific to the archetypes included in this study and are based on allowances for enhanced fabric specifications, addition of waste-water heat recovery systems and PV panels as required in Part L 2021.

The benchmark costs assume a medium specification.

Calculation of costs for Future Homes Standard Options 1 and 2

For comparison with Future Homes Standard (Options 1 and 2) scenarios the costs of the proposed notional specifications are modelled for each house type in the same way as for the net zero specification. For Future homes Standard Option 1 additional cost allowances were modelled for each house type based on the required quantity of PV panels, the addition of an air source heat pump in lieu of a gas boiler and improvement in airtightness to 4m3m2hr. For Option 2 the changes included removal of both the PV panels and waste-water heat recovery systems from the Part L2021 compliant home and the addition of an air source heat pump in lieu of the gas boiler.

The costs of the changes to the notional specification were added to the baseline cost to create Future Homes Standard compliant baselines. the uplift costs of the net zero standard are then calculated as uplifts on the relevant notional specifications for either options 1 and 2.

Cost Uplift against Building Regulations Part L2021

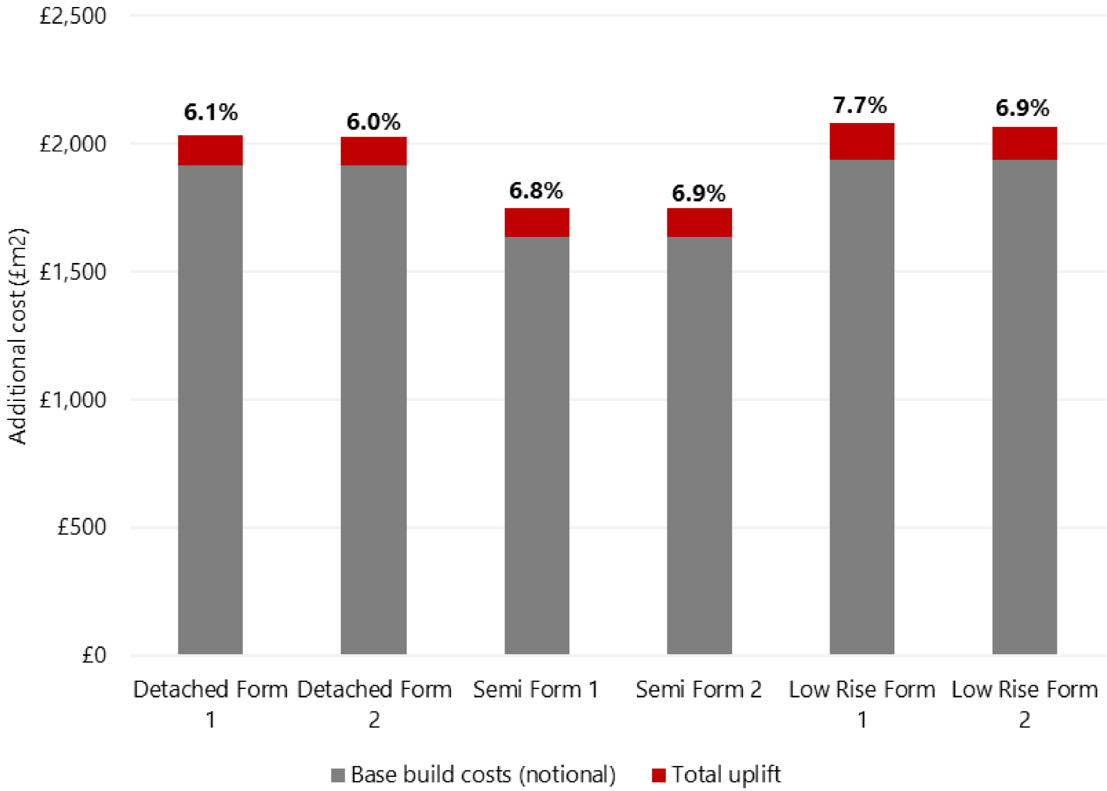
To meet the Net Zero policy energy use intensity and space heating demand limits, the total capital cost uplift over Part L 2021 Building Regulations ranges between **6.0% - 7.7%*.**

The graph outlines the total capital cost for the domestic typologies, and the percentage uplift compared to the Baseline building (Part L 2021 Notional Building specifications are shown in Appendix 1.0). The table gives the cost uplift breakdown for fabric, systems and PV panels.

- MEP (mechanical, electrical and plumbing systems) costs are proportionately higher per m² for smaller homes (flats and then the semi-detached homes) because the absolute cost of the changes is similar across all typologies. The larger overall size of the detached home means that the uplift cost per m² of completed new home is smaller.
- For the detached houses and flats the cost of the PV panels are lower than the Part L2021 specification this is because the number of PV panels required to achieve an energy balance is lower than that which would be required for compliance with Part L2021.
- Additional fabric costs are highest for the detached house both on a per m² basis and overall, this is because of the increased area of exposed external surfaces on the detached house resulting in a greater cost to achieve the higher performance standards of the net zero specification.

Costs in range of £111-£149m² applicable to most types. Cost build up varies according to characteristics of home type.

* Note, if the mean rather than upper quartile build cost had been used for the detached house the cost uplift for this building type would be 7.0% and 6.9% for forms 1 and 2 respectively.



Graph 11.1: Domestic typologies capital cost per square meter and cost uplift % of Net Zero policy over Building Regulations Part l 2021 Notional Building.

Cost Uplift per m2 GIA	Detached Form1	Detached Form 2	Semi Form 1	Semi Form 2	Low Rise Form 1	Low Rise Form 2
Fabric	£67	£65	£40	£42	£53	£45
MEP	£56	£56	£68	£68	£102	£101
Solar	-£7	-£7	£4	£3	-£6	-£13
Total (£/m²)*	£116	£114	£111	£112	£149	£133
Total per home	£16,356	£16,074	£11,322	£11,424	£9,103	£8,125

* totals may not sum exactly due to rounding

Cost Modelling | Uplift over Future Homes Standard Option 1

Cost Uplift against Future Homes Standard Option 1

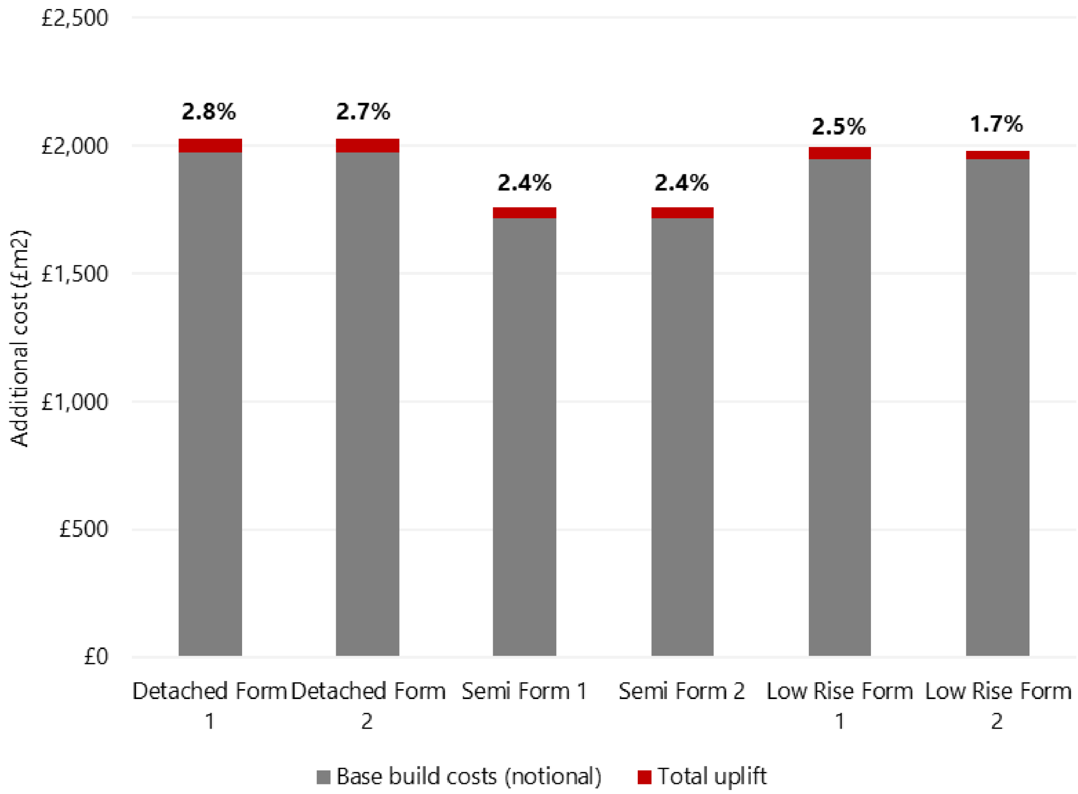
When compared to a Future Homes Standard Option 1 baseline the uplift costs associated with the net zero policy standard are substantially lower for all three domestic archetypes.

This is because this option includes both an increased capacity of PV panels (40% of floor area assuming 4.5m2 rather than 6.5m2 per kW peak capacity (kWp) and an air source heat pump together with slightly improved airtightness (4m^{3}m^{2}hr) compared to a Part L2021 compliant home.

To meet the Net Zero policy energy use intensity and space heating demand limits, the total capital cost uplift over Future Homes Standard Option 1 ranges between **1.7% - 2.8%,** however it is important to note that this is a smaller percentage uplift over a higher baseline cost and that the total construction cost is unchanged.

Because the Future Homes Standard Option 1 baseline cost includes for an Air Source Heat Pump (ASHP) and photovoltaic panels (PVPs) the additional costs of these elements are much lower than in comparison to the Part L2021 standard. There is still some additional cost linked to MEP systems due to the inclusion of MVHR within the net zero specification. The PV panels required for a net zero energy balance is less than would be required under Future Homes Standard Option 1 so there is a cost saving for the net zero specification in this area. Fabric costs are still higher for the net zero specification due to its enhanced fabric u values, triple glazed windows and improved airtightness.

Costs in range of £33-£55m^2.



Graph 11.2: Domestic typologies capital cost per square meter and cost uplift % of Net Zero policy over Future Homes Standard Option 1 Notional Building.

Cost Uplift per m2 GIA	Detached Form1	Detached Form 2	Semi Form 1	Semi Form 2	Low Rise Form 1	Low Rise Form 2
Fabric	£63	£62	£37	£39	£49	£42
MEP	£15	£15	£15	£15	£13	£12
Solar	-£23	-£23	-£11	-£12	-£14	-£21
Total (£/m^2)*	£55	£54	£41	£41	£49	£33
Total per home	£7,755	£7,614	£4,182	£4,182	£2,993	£2,016

* totals do not sum exactly due to rounding

Cost Modelling | Domestic Typologies

Cost Uplift against Future Homes Standard Option 2

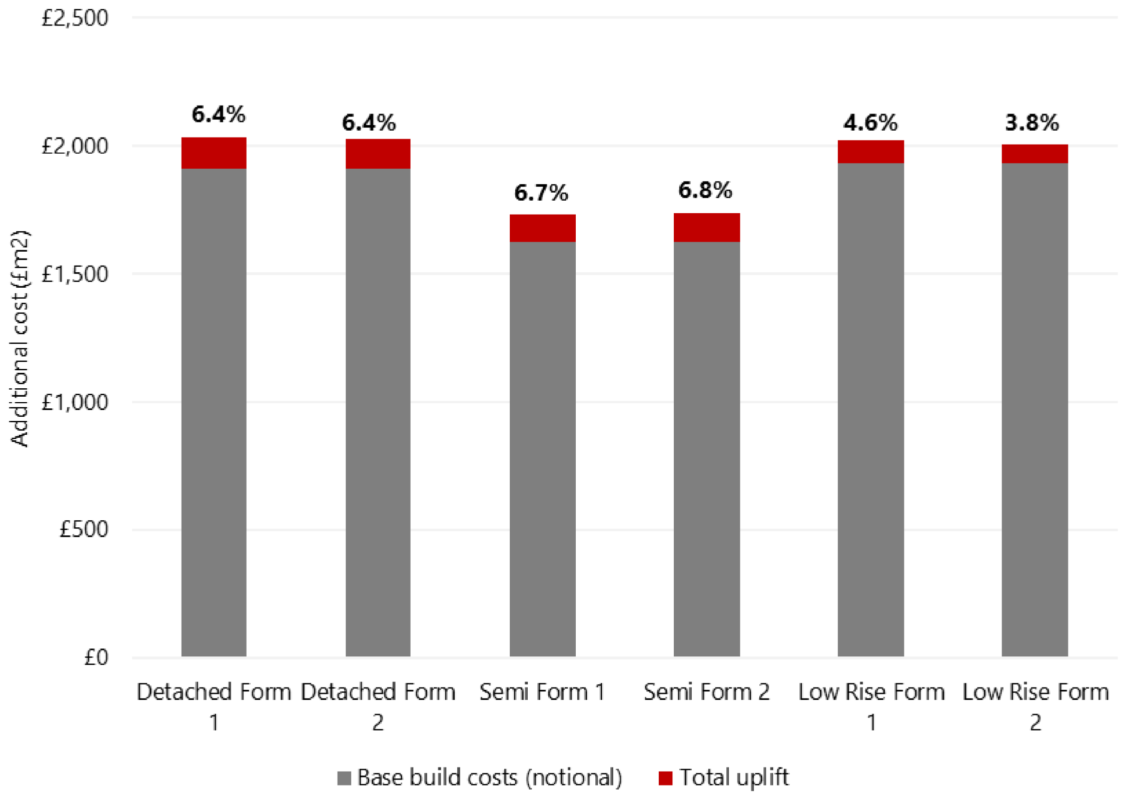
When compared to a Future Homes Standard Option 2 baseline the uplift costs associated with the net zero policy standard are similar albeit lower than for the Part L2021 baseline.

This is because while the Option 2 specification includes an air source heat pump it excludes photovoltaics and waste-water heat recovery entirely and does not include any further tightening of fabric standards. compared to a Part L2021 compliant home. As a result, much of the additional costs of the air source heat pump are offset by the removal of PV and to a lesser extent waste-water heat recovery systems.

To meet the Net Zero policy energy use intensity and space heating demand limits, the total capital cost uplift over Future Homes Standard Option 2 ranges between **3.8% - 6.8%,** however it is important to note that this is a smaller percentage uplift over a higher baseline cost and that the total construction cost is unchanged.

The uplift costs for houses are similar to the Part L2021 baseline. However, for flats the uplift is notably lower when considering the Future Homes Standard Option 2. This is because the cost of the net zero specification for these flats is primarily linked to the installation of heat pumps rather than PV panels and the Option 2 specification already includes a heat pump.

Costs in range of £73-£123m².



Graph 11.3: Domestic typologies capital cost per square meter and cost uplift % of Net Zero policy over Future Homes Standard Option 2 Notional Building.

Cost Uplift per m2 GIA	Detached Form1	Detached Form 2	Semi Form 1	Semi Form 2	Low Rise Form 1	Low Rise Form 2
Fabric	£67	£65	£40	£42	£53	£45
MEP	£18	£18	£19	£20	£21	£20
Solar	£39	£39	£50	£50	£14	£8
Total (£/m²)*	£123	£122	£109	£111	£88	£73
Total per home	£17,343	£17,202	£11,118	£11,322	£5,376	£4,460

* totals do not sum exactly due to rounding

Conclusions

The additional cost and percentage uplift of the net zero specification for each home type and form against current and potential future building regulations is shown in Table 11.4.

In comparison to current building regulations the uplift cost per m^2 and as a percentage of construction cost is highest for low rise flats at £133-£149m^2 or 6.9 to 7.7%. For flats most of this cost relates to decarbonisation of the heating system which is proportionately more significant for a smaller home than a larger one. However, both options of future building regulations, already include decarbonised heating systems and for these scenarios the uplift cost for flats is lower than for the detached houses.

If Future Home Standard Option 1 were adopted in 2025 then the additional cost of the net zero standard would be equivalent to between 1.7% and 2.8% of the capital cost of a home compliant with minimum regulations. If the Option 2 were selected the uplift cost would be higher by between 3.8 and 6.8% of the cost for a compliant specification. The difference reflects the higher performance standards and cost of the Option 1 specification.

The domestic cost analysis reflect the cost base of a medium sized housebuilder or contractor, and it is likely that costs would vary for self-build / bespoke designs, in these instances the overall build cost will also vary and in most instances is likely to be substantially higher than that for medium or larger housebuilders. The relative percentage uplifts in cost (eg 6.0-7.7% for homes) are considered representative of the scale of cost uplift that would be incurred by different developer types.

While not quantified, it could be expected that the cost per m^2 implications for a terrace house would be below those seen for any of the modelled home types. The fixed costs of the heat pump, MVHR and PV array would be similar to that for the semi-detached house, but the costs of fabric upgrades would be lower due to the reduced quantity of external wall area in these homes. In percentage terms it is likely that the uplift for a terrace house would be broadly similar to that seen for a semi-detached house. This is assumed on the basis that the total build costs of these homes would be proportionately lower than for an equivalent semi-detached home for the same reason of having less external wall area per m^2 internal area.

Total cost and percentage uplift against each baseline	Detached Form 1	Detached Form 2	Semi Form 1	Semi Form 2	Low Rise Form 1	Low Rise Form 2
Part L2021	£116 (6.1%)	£114 (6%)	£111 (6.8%)	£112 (6.9%)	£149 (7.7%)	£133 (6.9%)
FHS Option 1	£55 (2.8%)	£54 (2.7%)	£41 (2.4%)	£41 (2.4%)	£49 (2.5%)	£33 (1.7%)
FHS Option 2	£123 (6.4%)	£122 (6.4%)	£109 (6.7%)	£111 (6.8%)	£88 (4.6%)	£73 (3.8%)

Table 11.4: Additional cost and percentage uplift of net zero specification in comparison to current and potential future building regulations.

11.0 Appendices

Appendix 1.0
Fabric and system specifications used for energy and cost modelling

Appendix 1: Energy modelling and costing specifications: domestic typologies

The following table summarises the different fabric and systems assumptions modelled and used for the costing of the different domestic typologies.

Domestic Developments		Unit	Baseline (Part L 2021 Notional Building)	Detached House	Semi-Detached House	Block of Flats Low Rise
Fabric	Floor U-value	W/m²K	0.13	0.09	0.09	0.09
	External Wall U-value	W/m²K	0.18	0.12	0.12	0.12
	Roof U-value	W/m²K	0.11	0.10	0.10	0.10
	Windows U-value	W/m²K	1.2	0.8	0.8	0.80
	Windows G-value		0.5	0.55	0.55	0.55
	External doors U-value	W/m²K	-	1.00	1.00	1.00
	Thermal bridging	W/m²K	As calc	0.03 W/m²K	0.04 W/m²K	0.02 W/m²K
	Air permeability	m³/m².hr	5	0.6	0.6	0.6
Systems	Ventilation system		dMEV	MVHR	MVHR	MVHR
	Ventilation system heat recovery		n/a	88%	88%	88%
	Ventilation system specific fan power (W/l/s)		n/a	0.86	0.86	0.86
	Space heating system		Gas Boiler	Individual ASHP	Individual ASHP	Individual ASHP
	Space heating efficiency		90%	360%	360%	360%
	DHW system		Gas Boiler	Individual ASHP	Individual ASHP	Individual ASHP
	DHW efficiency		90%	360%	360%	360%
	Lighting Efficacy (lm/W)		-	120	120	120

Appendix 2.0
Sensitivity Testing Results

Sensitivity Testing | Space Heating Demand (kWh/m²/year)

The following graph shows the space heating demand results of the different tested scenarios for all the typologies.

Figure A.1: Space heating demand results from PHPP modelling of all typologies tested against different scenarios.

Sensitivity Testing | Energy Use Intensity (kWh/m²/year)

The following graph shows the energy use intensity results of the different tested scenarios for all the typologies.

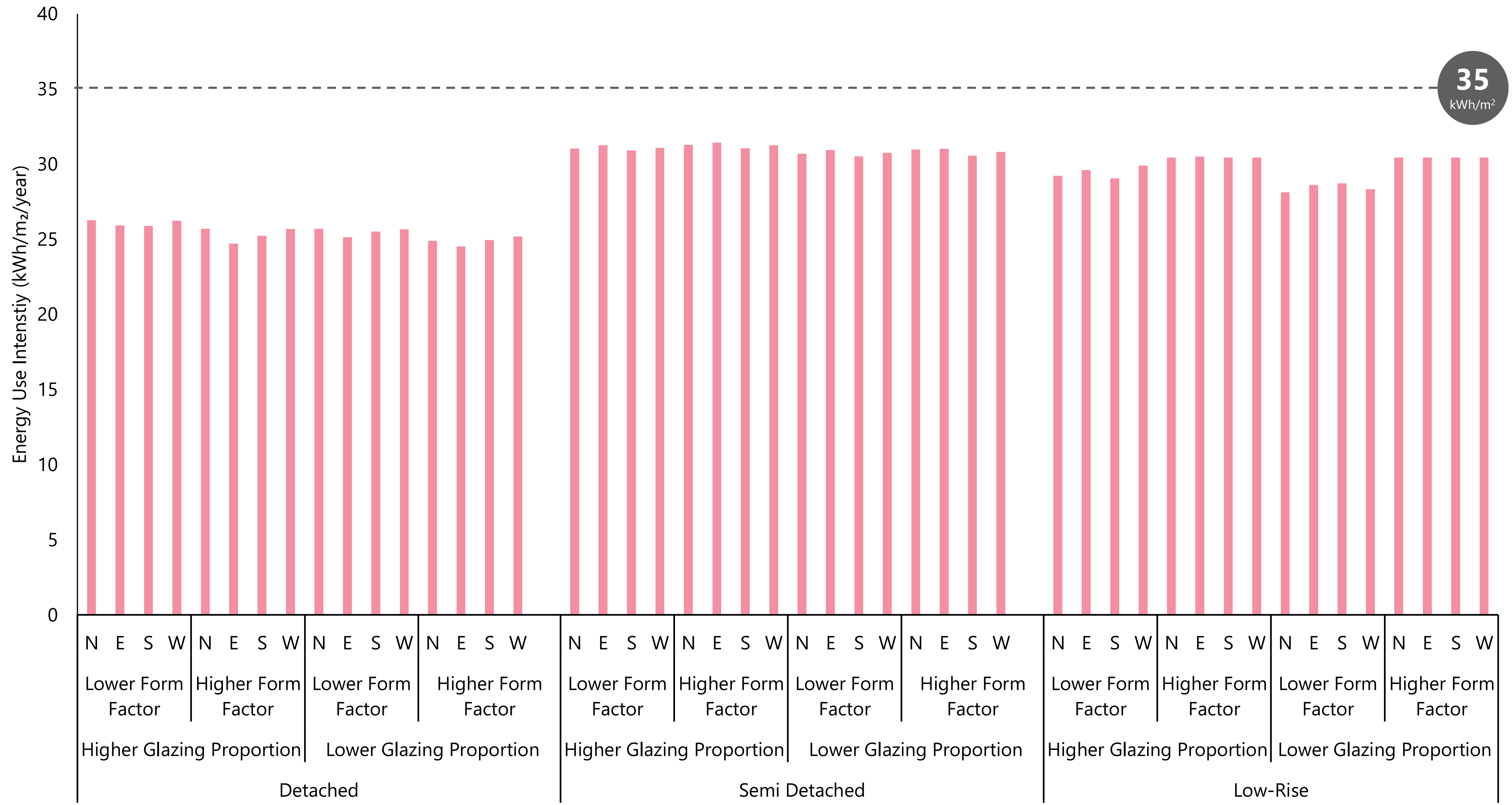


Figure A.2: Energy use intensity results from PHPP modelling of all typologies tested against different scenarios.