Net Zero Carbon Targets

Evidence Base for the Winchester Council

August 2023 | Rev F

Winchester City Council

ELEMENTA

Currie & Brown

Etude

Who prepared this evidence base?

The Winchester City Council commissioned a multidisciplinary team of engineers, cost consultants and energy specialists to develop this evidence base.

The work was directed by Adrian Fox (Strategic Planning Manager), Bethany Stokes (Strategic Planning Officer) and Anna Wyse (Sustainability Officer).

Elementa Consulting, a member of Integral Group, provides Mechanical, Electrical and Public Health (MEP) services design, fire and lighting design, resilience consultancy, strategic sustainability, wellness consultancy and advanced energy modelling for projects in the UK and abroad.

Elementa operates in all sectors of the built environment.

Currie & Brown has developed over the last 15 years specialist expertise in cost, technical and commercial advice on sustainability in construction, high performance and low carbon buildings. They provide specialist cost and techno-economic modelling to support the development of national policy and work with a range of private and public developers to maximise the benefits of their projects.

Etude is a SME of engineers specialising in energy and sustainability and dedicated to finding solutions to the climate crisis. One of its strengths is to combine building projects and strategic technical work on Net Zero carbon, including evidence bases and action plans. They regularly advise Local Authorities on carbon reduction, including Greater Cambridge, Cornwall Council, and many London Boroughs.

Elementa, Currie & Brown and Etude have all been heavily involved in LETI for the last 5 years. LETI was initiated by Elementa Consulting and Clara from Elementa chairs the LETI steering group

Document Control

10226-ELE-XX-XX-T-OS-5101

Issue	Date	Description	Prepared by	Signed Off
01	20 July 22	First draft	MG/ZK	CBG
02	12 August 22	Second draft	MG/ZK	CBG
03	18 August 22	Final	MG/ZK	CBG
04	13 September 22	Final	MG/ZK	CBG
05	18 August 23	Final	ZK	CBG
06	29 August 23	Final with minor amendments	ZK	CBG

Project Office

Elementa Consulting

3rd Floor

10 Whitechapel High Street

London

EC1 8QS

Project Contact:

Clara Bagenal George

clara.bg@elementaconsulting.com

+44 (0) 203 818 8266

The August 2023 "Issue 06" update to this report includes a change to the design and cost evidence base for the semi detached and detached house archetypes as follows:

- Adoption of costs for a decentralised mechanical extract ventilation system in lieu of a whole house mechanical ventilation with heat recovery system for the baseline Part L 2021 home. This change corrects an error in the cost models and aligns with the energy modelling undertaken of the baseline homes. The impact of this change is to increase the relative costs of the zero-carbon home in comparison to the Part L 2021 baseline by £1,400 per unit for the detached house and £1,500 per unit for the semi-detached house.

The impact of this change from the original modelling is to change the relative costs of meeting the proposed zero carbon standard in comparison to the Part L 2021 baseline to £11,200 (£79 per m^2) or 5.4% for the detached home and £9,400 (£101 per m^2) or 6.9% for the semi-detached home.

Contents

1.0 Executive Summary

2.0 Evidence of Need

3.0 Definition of Net Zero Carbon Buildings

4.0 Regulations & Policies

5.0 Evidence for Policy Changes

6.0 Technical Evidence Base

7.0 Cost Evidence Base

8.0 Conclusion

9.0 Appendices

1.0 Executive Summary

Executive summary

1.1 Summary of analysis

i. The purpose of this report is to assess the energy, carbon and cost implications associated with meeting Net Zero Carbon for new residential developments in Winchester Council. This has been reviewed across different fabric and system scenarios and includes capital and running cost analysis for a typical 3-bed semi detached and a 4-bed detached house.

ii. The analysis conducted in this study has showed that proposals under Part L 2021 and Future Homes Standard consultation do not currently go far enough to meet the reduction in emissions required to achieve Net Zero emissions in 2030.

iii. LETI provides a common set of metrics and targets that are aligned with meeting Net Zero. LETI guidance sets a recognised path on how new buildings can operate at Net Zero levels by 2030. This has been rigorously developed by a large group of multiple stakeholders. It has been developed in collaboration with UKGBC and supported by the Good Homes Alliance, RIBA and CIBSE.

iv. A key benefit is the reduction of energy bills for homes that achieve the LETI targets (compared to Building Regulations Part L), as shown in Table 1.1 based on the analysis in this report.

v. The analysis presented in the report herein has shown that for future developments in Winchester City Council, it is both technically and financially feasible to achieve Net Zero Carbon when following LETI targets, as this results in:

Net Zero Carbon

Achieves Net Zero Operational Carbon

Capital Cost

5-7% Uplift over Building Regs

Energy bills

24-33% Reduction to Building Regs

Table 1.1 Analysis results summary for Detached and Semi-Detached House in Winchester against the Baseline and LETI option

	Semi Detached House		**Detached House**	
	Baseline – Part L 2021	**C – LETI**	**Baseline – Part L 2021**	**C – LETI**
Space Heating Demand (kWh/m²/yr)	58	14	67	15
EUI (kWh/m²/yr)	95	30	95	26
Carbon Emissions (kgCO_2)	1,316	0	2,065	0
Capital Cost Percentage Uplift (%)	n/a	6.9%	n/a	5.4%
Energy bills (£/yr)	806	541	913	697

2.0 Evidence of Need

Global carbon reduction targets

2.1 There is a climate emergency

i. 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.

ii. Winchester City Council declared a climate emergency in June 2019. The council is committed to becoming a carbon neutral local authority by 2024 and is aiming for the wider district to be carbon neutral by 2030.

2.2 The Glasgow Agreement (2021)

i. International negotiations on climate change are governed through the United Nations Framework Convention on Climate Change (UNFCCC). The most recent negotiations concluded with the Glasgow Agreement in 2021. Nations collectively agreed to work to reduce the gap between existing emission reduction plans and what is required to reduce emissions.

2.3 Global carbon budgets

i. The concept of carbon budgets is an important one. The IPCC Special Report *"Global Warming of 1.5°C"* has estimated the quantity of CO_2 that can be emitted globally and still be consistent with keeping global temperatures well below 2°C and pursuing 1.5°C. The report gives different budgets for different temperature rises and probabilities.

ii. The Tyndall Centre Carbon Budgets reports have selected from the IPCC report a global budget figure of 900,000 $MtCO_2$ as the basis of their work.

iii. Keeping global warming to below 1.5°C with at least 66% probability corresponds to current global emissions rates for less than 10-14 years.

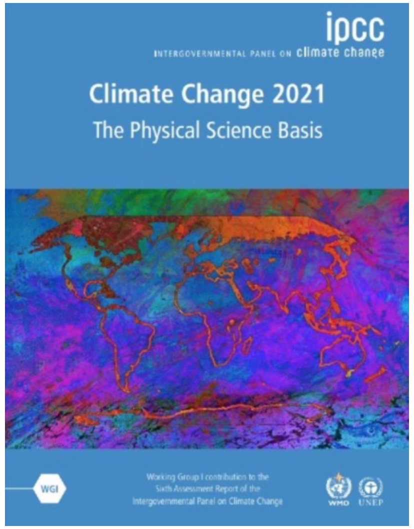
CO_2

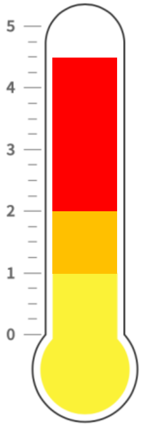
900,000 $MtCO_2$

Estimation of **remaining global carbon budget** (from 2020) for a chance of limiting temperature rises to well below 2°C and pursuing 1.5°C (Source: Tyndall Centre)

10-14 years

The number of years it would take to **consume our entire global carbon budget** at current global emissions rates





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

National carbon reduction commitments

2.4 National Commitment

i. The UK's national commitment is set through the Climate Change Act 2008 - which legislates that the UK carbon account for 2050 must be 100% lower than 1990 levels – i.e., the UK must be net zero carbon by 2050. This legal requirement is underpinned by the Climate Change Committee's report "Net Zero: *The UK's Contribution to Stopping Global Warming*". The Climate Change Committee (CCC) is an independent body formed to advise the UK government on tackling and preparing for Climate Change.

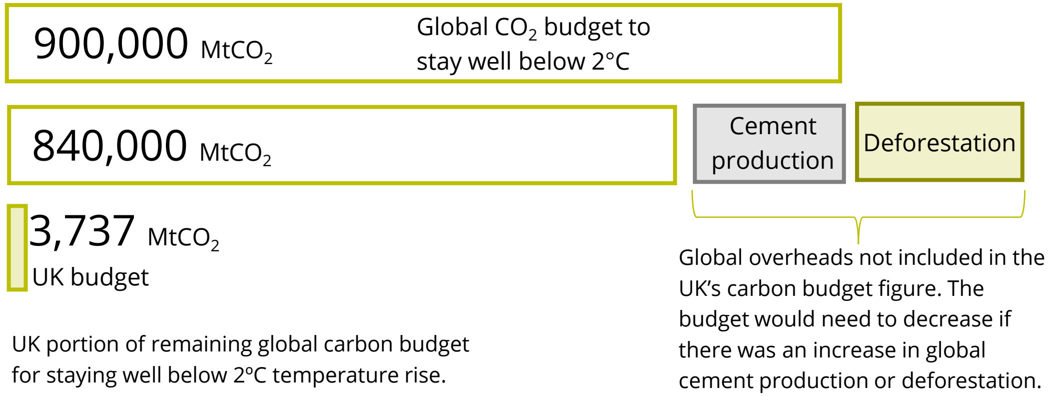
2.5 Achieving Net Zero Carbon by 2050

i. 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; and
   - Significant afforestation and restoration of land, including peatland.

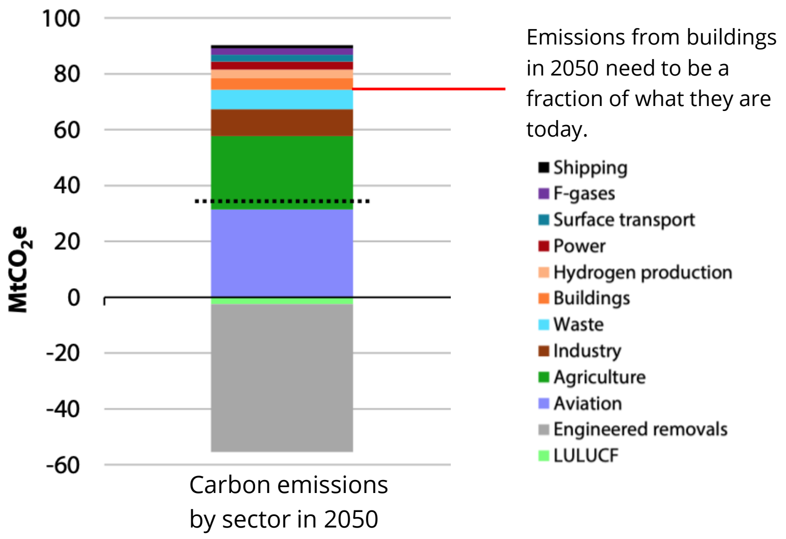
2.6 The carbon budget for the UK

i. To help understand the magnitude and pace of carbon reductions required, the IPCC Special Report 2021 estimates the amount of carbon we can emit globally to stay within certain temperature rises.

ii. Following this, the Tyndall Centre Carbon Budgets reports estimate the carbon budget for the UK to be 3,737 $MtCO_2$. This represents the UK operational carbon budget across all sectors.



Tyndall Centre estimation of remaining UK carbon budget (from 2020)
Aviation and Shipping included in UK budget (Image not to scale)



Remaining emissions in the "Further Ambition" scenario by sector, Committee on Climate Change (CCC). The bar chart shows that emissions from buildings need to be reduced to a minimum by 2050.

Local carbon reduction commitments

2.7 The Tyndall Carbon Budget for Winchester

i. Tyndall Carbon Budget Reports provide UK local authority areas with budgets for energy related CO_2 emissions from 2020 to 2100. They are informed by the latest science on climate change and carbon budget setting. This page illustrates the carbon budget (top right) and required reduction pathway (bottom right) for Winchester.

ii. In summary, the report recommends the following:

iii. The Winchester City Council should stay within a maximum cumulative CO_2 emissions budget of 5.2 $MtCO_2$ for the period 2020-2100. If emissions continue at 2017 levels, the entire carbon budget for the area would be used within 6 years (from 2020), i.e., by 2026;

iv. Emission reductions should average a minimum of -13.9% per year;

v. Net zero should be achieved no later than 2041; and

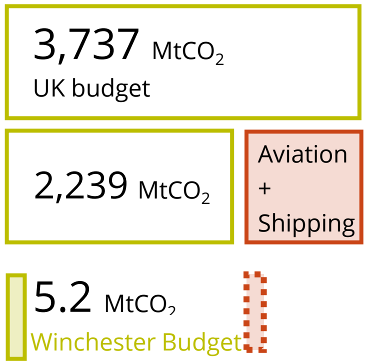
vi. Meeting the budget must not rely on carbon offsets.

vii. The chart to the right shows Winchester's total (finite) carbon budget, as per the Tyndall Centre, spread over different budget periods. The huge reductions needed year on year lead to the conclusion that new construction must be zero carbon as soon as possible. It is preferable to use the carbon budget for sectors that are harder to decarbonise, this might include existing building stock.

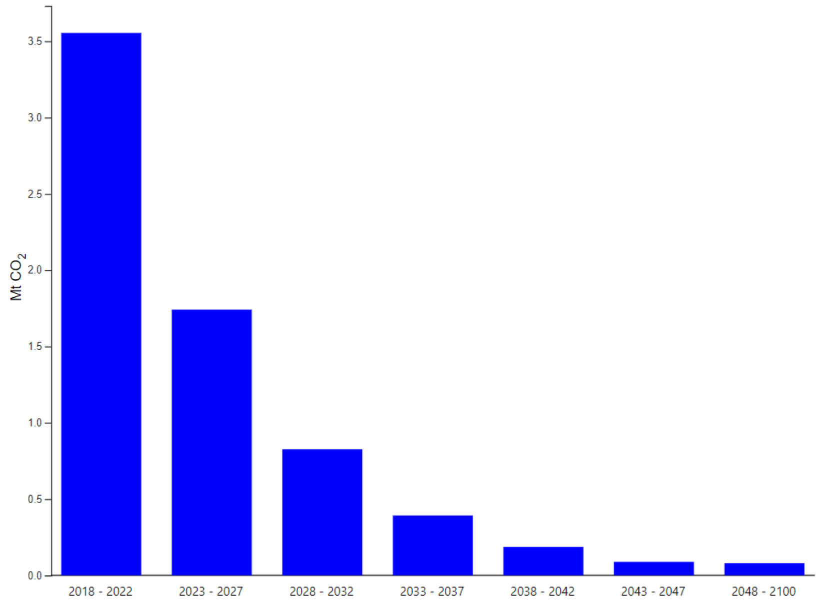
2.8 Comparison with other carbon budgets

i. The Tyndall Centre's carbon budgets are not directly comparable with the UK government's carbon budgets for several reasons. The UK carbon budgets do not apply the equity principle* (as defined in the Paris Agreement); they include allowances from the EU emissions trading scheme (and therefore do not reflect actual carbon emitted by the UK); and budgets until 2032 were set on the basis of an 80% reduction in GHG emissions (not 100% as now required).

** This gives developed nations a smaller share of the global carbon budget, and less developed nations a larger share, accounting for the fact that less developed nations will need to spend more carbon to put essential infrastructure in place.*



Tyndall Centre estimation of remaining carbon budget (from 2020) for Winchester staying "well below 2°C and pursuing 1.5°C temperature rise. Aviation and Shipping are regarded as a national overhead and not included in local budgets. Image not to scale.



5-yearly carbon budgets for Winchester's total contribution, showing the pathway for staying "well below 2°C and pursuing 1.5°C" global temperature rise. Reductions in carbon emissions associated with buildings need to, at the least, mimic this trajectory. Data source: Tyndall Centre Carbon Budgets Report.

Currie & Brown Etude

New buildings can be part of the solution

2.9 New buildings are currently adding to the problem

i. Operational carbon emissions associated with new buildings (that meet current regulations) are still very significant. They are not energy efficient enough, they continue to the use of fossil fuels for heating and hot water, and likely generate very small amounts of renewable energy. In summary, they keep adding to the problem of climate change and are not compliant with international, national and local carbon reduction and Net Zero commitments. They keep on using far too much of the Winchester's City Council carbon budgets and that is not sustainable.

2.10 They create a future retrofit burden

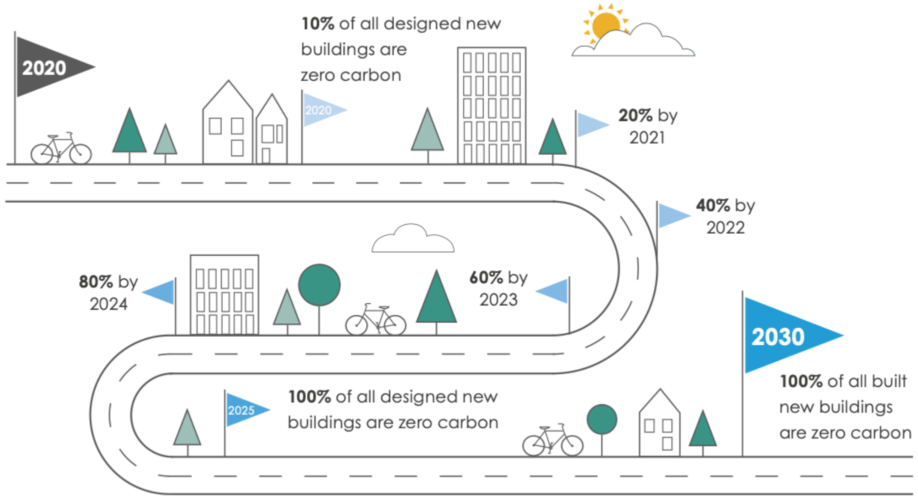
i. If new buildings continue to be designed and built to the current standards, they will need to be retrofitted in the next 10-30 years in order to reduce their carbon emissions. For example, their new gas boiler will have to be replaced with a low carbon heating system. This would be much more expensive than designing and constructing them to the right standard now.

2.11 New buildings compliant with our climate change commitments

i. New buildings designed and built, today, with available and affordable skills, techniques and technologies can be compliant with these climate change commitments 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/m²/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

Currie & Brown
Etude

3.0 Definition of Net Zero Carbon Buildings

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

3.1 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. In order to do this, and from now on, new buildings need to use energy much more efficiently, 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 during construction and their long-term environmental impact, including looking at end of life practices and how building materials are re-used.

3.2 A growing evidence base has led to an industry definition

i. 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).

3.3 Different criteria from the definition

i. We have learnt over the last 15 years that delivering high quality energy efficient and low carbon buildings requires us to address several aspects. It is not one-dimensional hence why the delivery of Net Zero carbon buildings relies on meeting requirements in different areas.

3.4 Future evolution of this definition

i. It is possible that the definition of Net Zero Carbon buildings evolve over time, for example as a result of the work currently undertaken by the building industry on the Net Zero Carbon building standard. This evidence base has sought to be consistent with this work.

Guidance on buildings to help them meet our climate change targets has been published by the CCC, the RIBA, the UKGBC and LETI.

Currie & Brown Etude

Net Zero Operational Carbon

Ten key requirements for new buildings

By 2030 all new buildings must operate at net zero to meet our climate change targets. This means that by 2025 all new buildings will need to be designed to meet these targets. This page sets out the approach to operational carbon that will be necessary to deliver zero carbon buildings. For more information about any of these requirements and how to meet them, please refer to the: UKGBC - Net Zero Carbon Buildings Framework; BBP - Design for Performance initiative; RIBA - 2030 Climate Challenge; GHA - Net Zero Housing Project Map; CIBSE - Climate Action Plan; and, LETI - Climate Emergency Design Guide.

Low energy use

1. Total Energy Use Intensity (EUI) - Energy use measured at the meter should be equal to or less than:
   - **35 kWh/m²/yr** (GIA) for residential[1]

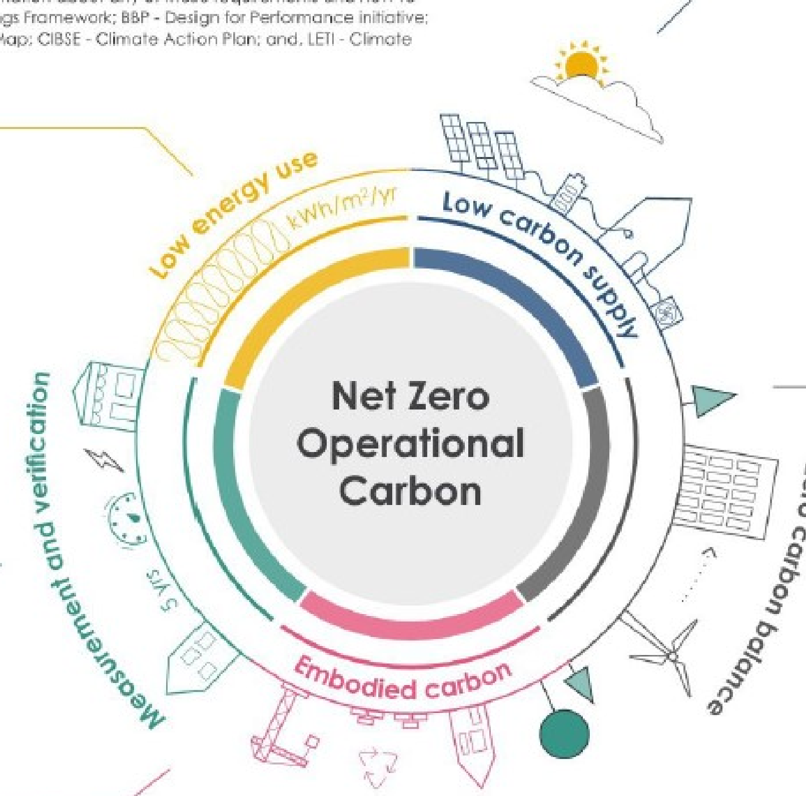
   For non-domestic buildings a minimum DEC B (40) rating should be achieved and/or an EUI equal or less than:
   - **65 kWh/m²/yr** (GIA) for schools[1]
   - **70 kWh/m²/yr** (NLA) or **55 kWh/m²/yr** (GIA) for commercial offices[1,2]
2. Building fabric is very important therefore space heating demand should be less than **15 kWh/m²/yr** for all building types.

Measurement and verification

3. Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years. This can be done on an aggregated and anonymised basis for residential buildings.

Reducing construction impacts

4. Embodied carbon should be assessed, reduced and verified post-construction.[3]



Low carbon energy supply

5. **Heating and hot water should not be generated using fossil fuels.**
6. The average annual carbon content of the heat supplied (gCO₂/kWh) should be reported.
7. On-site renewable electricity should be maximised.
8. Energy demand response and storage measures should be incorporated and the building annual peak energy demand should be reported.

Zero carbon balance

9. A carbon balance calculation (on an annual basis) should be undertaken and it should be demonstrated that the building achieves a net zero carbon balance.
10. Any energy use not met by on-site renewables should be met by an investment into additional renewable energy capacity off-site OR a minimum 15 year renewable energy power purchase agreement (PPA). A green tariff is not robust enough and does not provide 'additional' renewables.

Notes:

Note 1 – Energy use intensity (EUI) targets
The above targets include all energy uses in the building (regulated and unregulated) as measured at the meter and exclude on-site generation. They have been derived from predicted energy use modelling for best practice; a review of the best performing buildings in the UK; and a preliminary assessment of the renewable energy supply for UK buildings. They are likely to be revised as more knowledge is available in these three fields. As heating and hot water is not generated by fossil fuels, this assumes an all electric building until other zero carbon fuels exist. (kWh targets are the same as kWh___). Once other zero carbon heating fuels are available this metric will be adapted.

Note 2 – Commercial offices
With a typical net to gross ratio, 70 kWh/m² NLA/yr is equivalent to 55 kWh/m² GIA/yr. Building owners and developers are recommended to target a base building rating of 6 stars using the BBP's Design for Performance process based on NABERS.

Note 3 – Whole life carbon
It is recognised that operational emissions represent only one aspect of net zero carbon in new buildings. Reducing whole life carbon is crucial and will be covered in separate guidance.

Note 4 – Adaptation to climate change
Net zero carbon buildings should also be adapted to climate change. It is essential that the risk of overheating is managed and that cooling is minimised.

Developed in collaboration with: London Energy Transformation Initiative, UKGBC, BBP Better Buildings Partnership

Developed with the support of: Good Homes Alliance, RIBA Architecture.com, CIBSE

Currie & Brown Etude

Ten key requirements for a Net Zero Carbon building in operation - A summary

Developed by LETI in collaboration with UKGBC and BBP and supported by the Good Homes Alliance, RIBA and CIBSE

The principles of Net Zero Carbon in operation

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

1 - Energy efficiency

Buildings use energy for heating, hot water, ventilation, lighting, cooking and appliances. All energy use within the building must be considered, i.e., not only ”regulated” energy use. The efficient use of energy reduces both running costs and carbon emissions.

2 - Low carbon heat

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

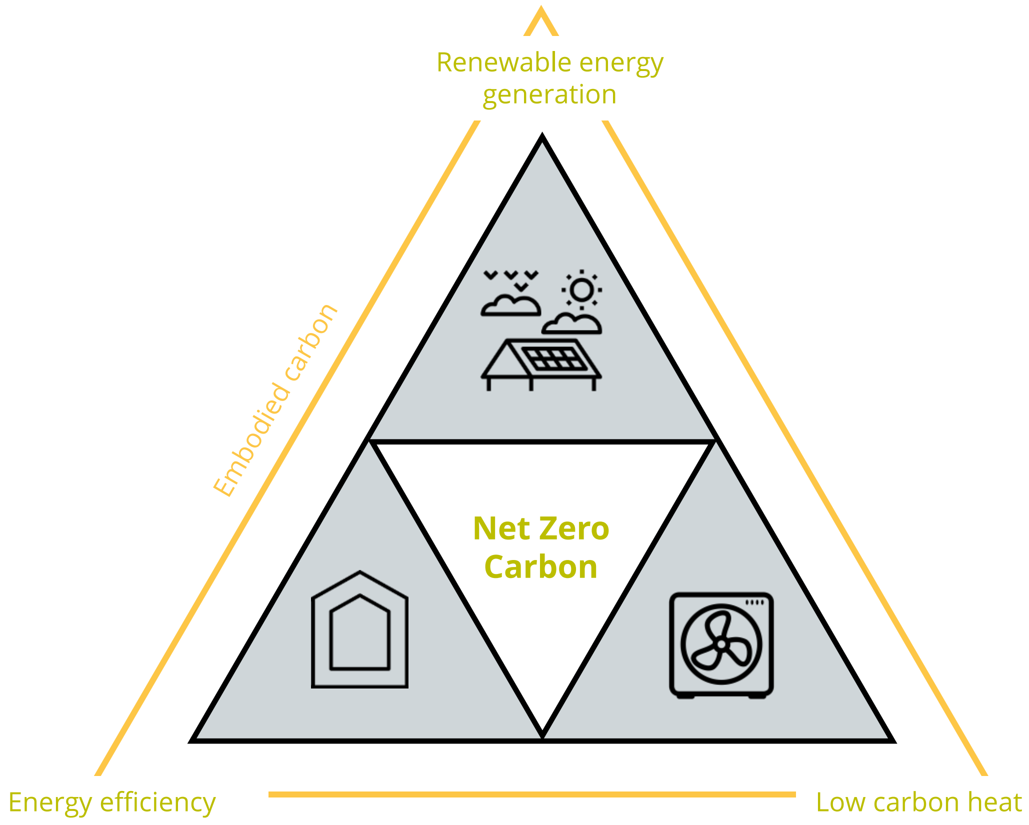
New buildings should seek to add at least as much renewable energy generation to the energy system as the energy they will use in an annual basis. In Winchester, solar photovoltaic (PV) panels is considered to be the most suitable renewable energy technology to deliver this objective.

4 - 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.

No offsetting... or a very limited role for it

The Climate Change Committee (CCC) is clear: offsetting must have a very limited and defined role if we are to achieve Net Zero by 2050, and it should not be relied on as a key mechanism to decarbonise new buildings. Its role should therefore be clearly defined and restricted.



The four core principles of a ”Net Zero” building: energy efficiency, low carbon heat, renewable energy generation and embodied carbon.

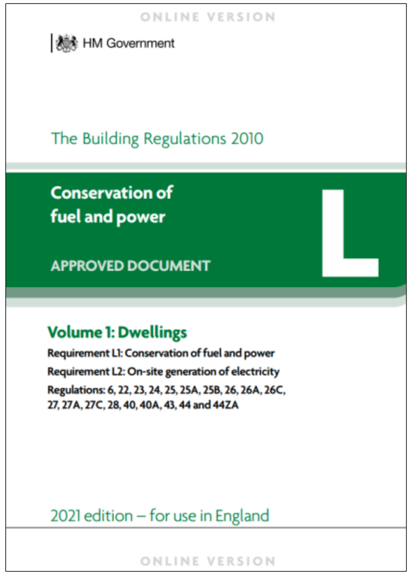
Currie & Brown
Etude

4.0 Regulations & Policies

4.1 Building Regulations – Part L (2021)

i. The Building Regulations set out requirements for specific aspects of building design and construction. Regulation 26 of the Building Regulations states that "Where a building is erected, it shall not exceed the target CO_2 emission rate for the building…". Part L 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.

- A new building must not have higher regulate carbon emissions than an "Notional Building"
- The Notional Building has the same shape, location and typology as the Actual Building
- Target carbon savings compared to previous regulations (2013): 31% for new homes, 27% for new non-domestic buildings (likely to be about 5% less operational carbon emissions in use)
- The Notional Building includes PV – The number of PVs is based on foundation area, conditioned area and number of floors
- Updated fuel carbon factors - Monthly variable grid-electric factors



4.2 Part L Metrics

- Primary energy target
- CO_2 emissions target
- Fabric Energy Efficiency (FEE) target
- Minimum standards for fabric and fixed building services

4.3 "Net Zero" Target

i. The Part L 2021 requires: "Where a building is erected, it must be a nearly zero-energy building". It is not clear what this means in practice and is not aligned with meeting our climate targets.

4.4 Future Homes Standard Consultation (2019)

i. The FHS consultation sets out the Government's response to the first stage of a two-part consultation on proposed changes to Part L (Conservation of fuel and power) of the Building Regulations. The future homes standard will be implemented in 2025. FHS consultation document states that the FHS will require new build homes to be future-proofed with low carbon heating and world-leading levels of energy efficiency with 75-80% less carbon emissions than homes delivered under 2013 regulations.

ii. However, our modeling shows that FHS notional specification set out in the consultation document will achieve a space heating demand of of 50-60 kWh/m^2/ yr. This is much higher than the CCC recommendation of 15-20 kWh/m$^{2/}$yr and the LETI Net Zero Carbon space heating demand requirement of 15 kWh/m$^{2/}$yr.

iii. Local authorities will continue to be allowed to set higher energy efficiency standards for new homes in their area once the Future Homes Standard is published.

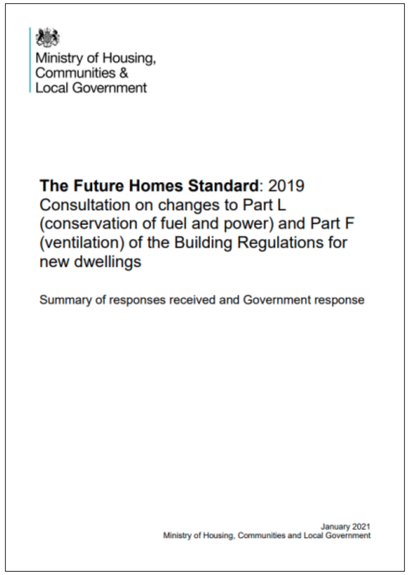
4.5 FHS vs Part L 2021

i. The differences between the proposed Part L 2021 notional building parameters and indicative Future Homes Standard specifications are:

- FHS sets more ambitious targets in terms of fabric efficiency (U-values);
- FHS specifies a low carbon heating system (i.e., heat pump) while Part L's notional specification is a gas boiler;
- FHS notional specification does not include renewable technology use (PV) while Part L does;
- FHS notional specification does not include for wastewater heat recovery while Part L 2021 does.

4.6 "Net Zero" Target

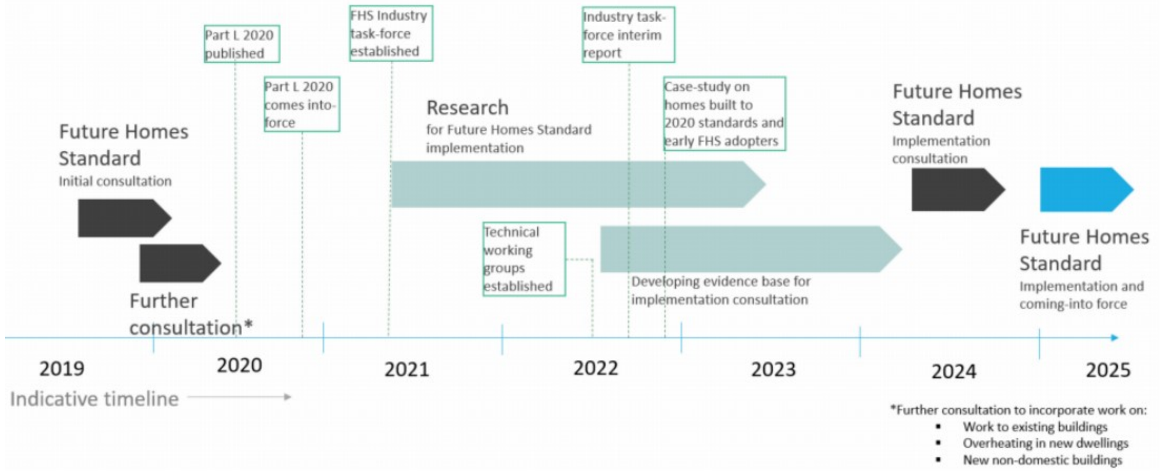
i. The Future Homes Standard states: "From 2025, the Future Homes Standard will deliver homes that are zero-carbon ready". It is not clear what this means in practice and our analysis shows that it is not aligned with meeting climate targets.


Ministry of Housing, Communities & Local Government

The Future Homes Standard: 2019
Consultation on changes to Part L (conservation of fuel and power) and Part F (ventilation) of the Building Regulations for new dwellings

Summary of responses received and Government response

January 2021
Ministry of Housing, Communities and Local Government



Source: Regen Transforming Energy

Summary of local energy and carbon policy

4.7 Current Winchester District Local Plan (2013)

i. The Winchester's Council current Local Plan addresses energy use and carbon emissions from buildings in Policy CP11 - Sustainable Low and Zero Carbon Built Development and Policy CP12 - Renewable and Decentralised Energy.

4.8 Current requirements under the Local Plan Policy CP11

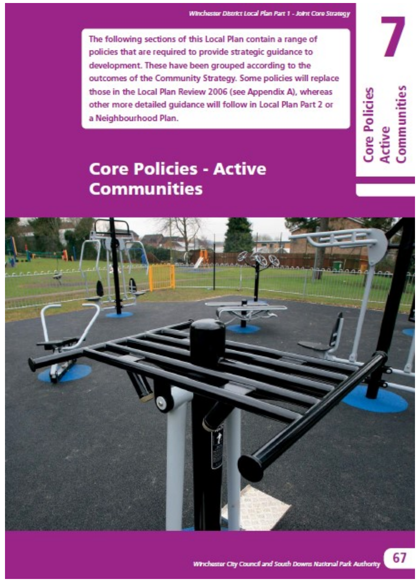
i. Developments should achieve the lowest level of carbon emissions which is practical and viable. Specifically, the Local Planning Authority will expect:

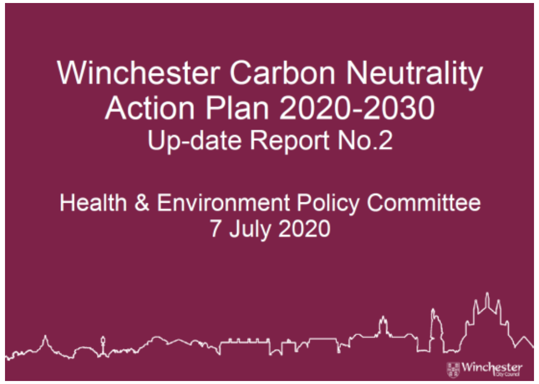
- Prior to the commencement of the development hereby permitted, detailed information demonstrating that the development will achieve a dwelling emission rate (DER) at least 19% lower than the 2013 Part L Target Emission Rate (TER) (Equivalent of Code for Sustainable Homes Level 4 for Energy) in the form of a "design stage" Standard Assessment Procedure (SAP) calculation shall be submitted to and approved in writing by the Local Planning Authority.

ii. As the Part L 2021 regulation is in force and it is a tighter standard than the Winchester Local Plan Policy CP11, it is assumed that the Part L 2021 Regulations replace Local Plan Policy CP11.

4.9 Winchester Carbon Neutrality Action Plan 2020-2030 (2020)

i. Winchester City Council has set out actions to achieve ambitious carbon neutrality targets in its Carbon Neutrality Action Plan. This was developed and adopted following the council's declaration of a climate emergency in June 2019. It commits the council to review its own activities to reach carbon neutrality by 2024 and sets the same ambitious goal for the wider district by 2030.





Identifying the problem

4.10 Part L modelling

i. 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 policy and regulation requirements.

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

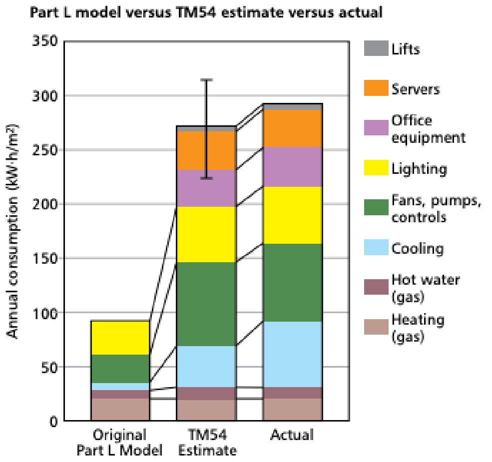
4.11 Issues with the Part L modelling methodology

i. It is important to note that Part L energy assessment methodologies were developed only to check compliance with Building Regulations. The NCM methodology was not developed in order to predict energy use and thus can't be used to calculate energy consumption (cannot be used to predict the EUI target).

ii. The figures to the right shows the difference between energy consumption from Part L modelling and predicted modelling software such as PHPP and TM54. Ccomparative SAP/ PHPP modelling undertaken on different residential typologies suggest that SAP underestimates space heating demand by more than 50%. The under-estimation of space heating is detrimental as it leads to under-estimating the potential benefits of measures to reduce space heating demand (e.g., better U-values, triple-glazed windows, more airtight dwellings). If SAP is continued to be used to demonstrate compliance with Net Zero policies, it is recommended that its outputs are corrected to better represent likely future energy use. The results have shown that the current Building Regulations Part L 2021 methodology, together with the indicator "Carbon emission reductions, compared to the notional building" disguises the performance of a building. Percentage carbon reduction is not a useful indicator to understand the future energy performance of the building and whether the development is aligned with meeting Zero Carbon.

4.12 A proven methodology: the Passive House Planning Package (PHPP)

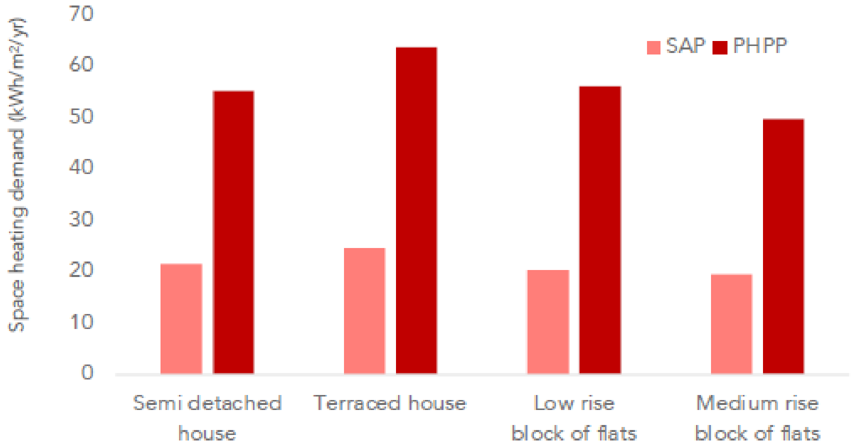
i. The PHPP methodology an excel based tool has been shown to predict energy use much more accurately than SAP. PHPP modelling is increasingly undertaken on UK projects both pre- and post planning submission to better predict the energy performance and likely total energy use of new development. For the purposes of this exercise, only the PHPP predictive modelling tool has been used and not a SAP software tool.



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.



Comparison between space heating demand estimated by PHPP vs SAP for four residential typologies from previous project experience.

Review of current planning metric

4.13 Issues with the Part L relative metric

i. The Part L Building Regulations methodology compares the regulated carbon emissions from the "actual" building to a "notional" building. Policy often takes this a step further and requires a % improvement on part L. Various issues with this are outlined below:

- **Carbon factors** - Carbon factors for electricity have changed very significantly over the last 10 years and will continue to change over the next 10 years. This has an impact on the % improvement over Part L which could be misleading.
- **Form factor** - Part L does not incentivise efficient form factor as the notional building has the same form (shape, orientation and, up to a point, glazing proportions) as the actual building. Comparing a development to its own notional building does not reward efficient design as it essentially neutralises the impact of these measures.
- **Low energy specifications** – Insufficient fabric efficiency and ventilation performance appear to be satisfactory when they are significantly less efficient than they should, therefore the % improvement over the notional building does not drive energy efficiency sufficiently (i.e., to the level recommended by the Climate Change Committee).
- **Verification** - The % improvement over a notional building is an intangible, relative performance requirement that cannot be measured once a building is occupied (in-use).
- **Zero Carbon** - 100% carbon emission reductions do not mean that the building will meet net zero operational carbon.
- **Energy bills -** Does not give a clear indication of energy use thus hard to understand impact on energy bills

4.14 EPC rating

i. Using an EPC rating to achieve CO_2 emissions reductions is unlikely to have the desired effect, as the cheapest way to achieve a higher EPC rating is to add a small amount of PV. Instead, the key is to improve the fabric performance, which will have a much more significant and long-lasting effect and will also be independent of energy sources whose carbon intensities are constantly changing over time.

4.15 Moving to absolute metrics: a recommended focus on outcomes

i. Absolute, measurable targets (e.g., kWh/m²/yr) are therefore recommended to consistently deliver Net Zero Carbon buildings.

Requirement to comply with the notional building target

✗ 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)

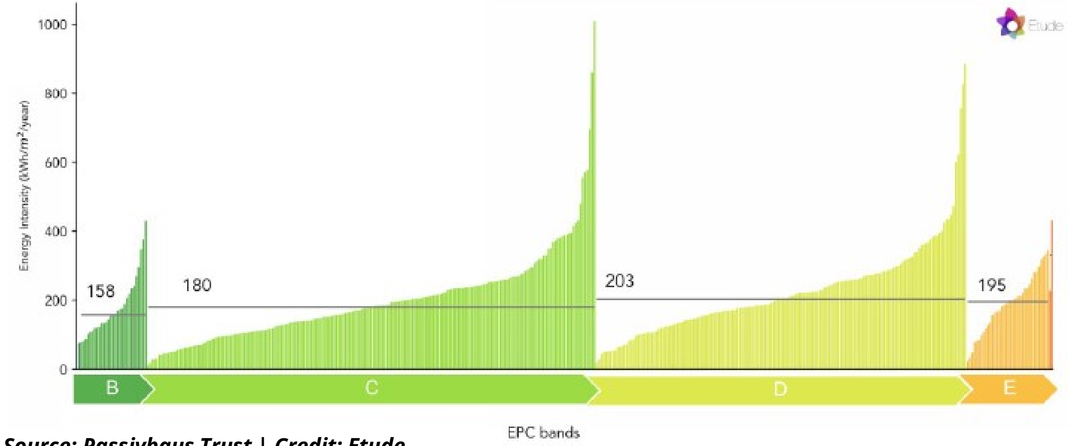
✓ Is a "physical" metric which can be measured

✓ Can be understood by all professionals, and most consumers

✓ Can be checked against in-use data

✓ Can be checked to improve 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.



Source: Passivhaus Trust | Credit: Etude

A comparison of the EPC's energy efficiency rating with metered energy consumption of 420 homes shows a huge variance within the energy consumed within each rating band. There is little correlation between EPC rating and the energy consumption of homes. This is problematic, as the construction industry has been focusing on improving the EPC ratings of buildings, rather than focusing on reducing the energy consumption of buildings.

Currie & Brown Etude

Does Part L 2021 deliver Net Zero new homes?

4.16 Energy, not CO_2 or primary energy is the best metric

i. The best way of achieving buildings that do not contribute CO_2 to our atmosphere through their operation is to focus on energy: energy efficiency, low carbon heat and renewable energy. Energy metrics are absolute and tangible - they allow us to directly compare the performance of one building against another, and to compare as designed performance with in-use performance. At any point they can be converted to carbon emission figures.

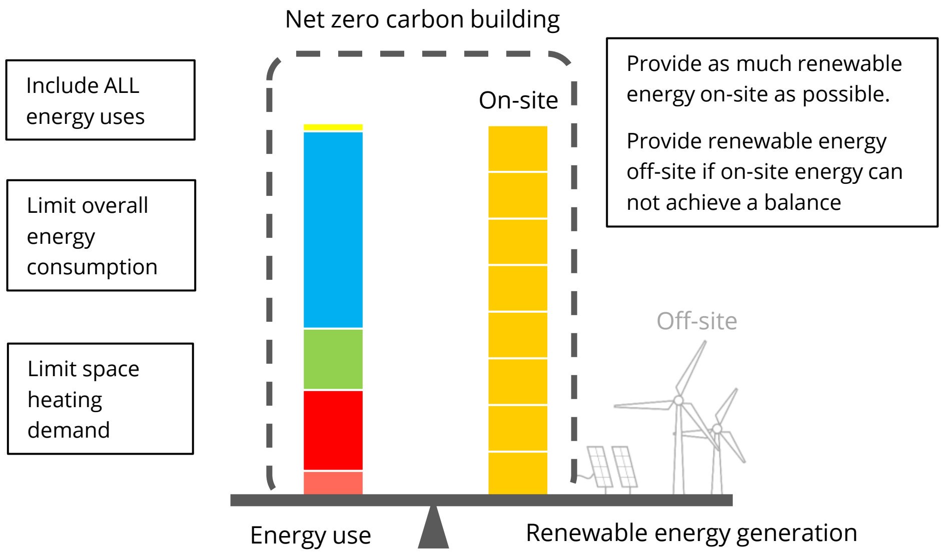
4.17 Primary Energy is not the best metric

i. Primary energy metric has been introduced in the new version of Building Regulations. Primary is the energy from renewable and non-renewable sources, that has not undergone any conversion or transformation process. This metric uses primary energy factors which change over time, and this can have an impact on the % improvement which could be misleading (the same with the CO_2 metric). Primary energy production is not energy use which would be a more understandable metric for the homeowner/ tenant as it is more closely related to household running costs.

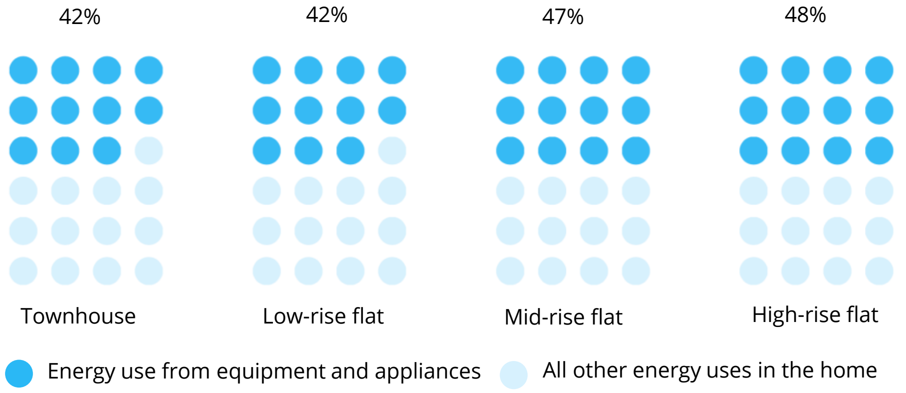
4.18 Planning policy methodology does not consider total energy use

i. The Building Regulations methodology which is used to show compliance with planning policy does not include energy consumption and CO_2 emissions from equipment and appliances. This represents approximately 50% of energy use in a low energy home. In summary, current policy:

- does not drive energy efficiency sufficiently;
- does not cover unregulated energy use;
- still allows gas boilers, a significant source of carbon emissions;
- does not facilitate closing the performance gap, leading to more emissions than were agreed at planning; and
- Does not give a clear indication of energy use thus hard to understand impact on energy bills.



Using energy metrics to deliver zero carbon buildings. *The goal is simple and tangible – to achieve a balance between energy consumption and renewable energy generation on-site. The definition also includes the requirement to limit the energy required for space heating and limit overall energy use, which reduces the amount of renewable energy needed on-site.*



Proportion of total energy use by equipment and appliances. *Energy for equipment and appliances becomes and very significant source of energy (and carbon emissions) in low energy homes (as modelled in PHPP for ultra-low energy scenario with individual heat pump). Planning policy and building regulations current do not incentivise reducing it.*

Currie & Brown Etude

Does the Future Homes Standard deliver Net Zero new homes?

4.19 Future Homes Standard

i. Although there are certain limiting values for fabric and systems the future homes standard ultimately provides a "flexible" approach to meeting regulations. In order to meet FHS, the carbon emissions and primary energy must not be higher than the notional building. This can be achieved though a mixture of fabric efficiency, systems efficiency and renewable generation.

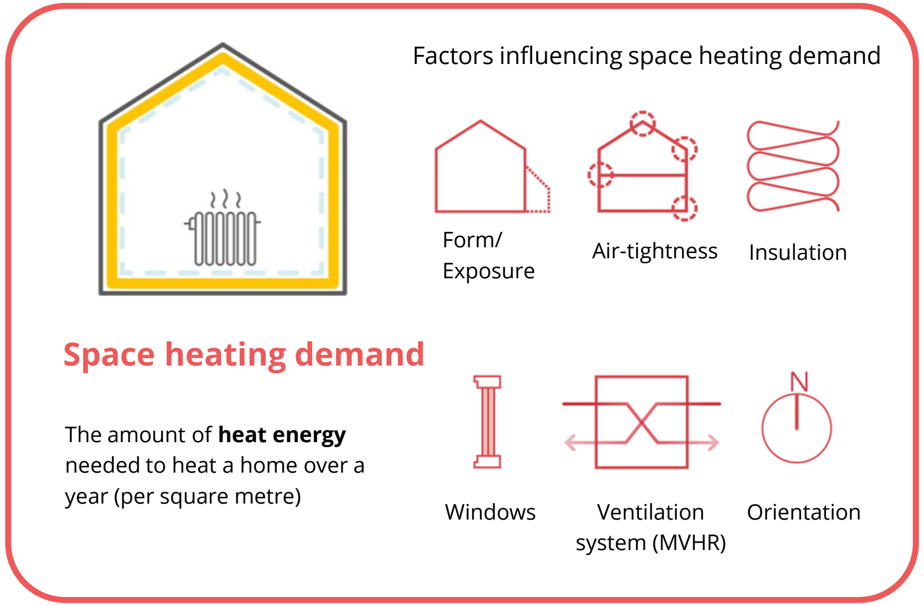
4.20 Space heating demand

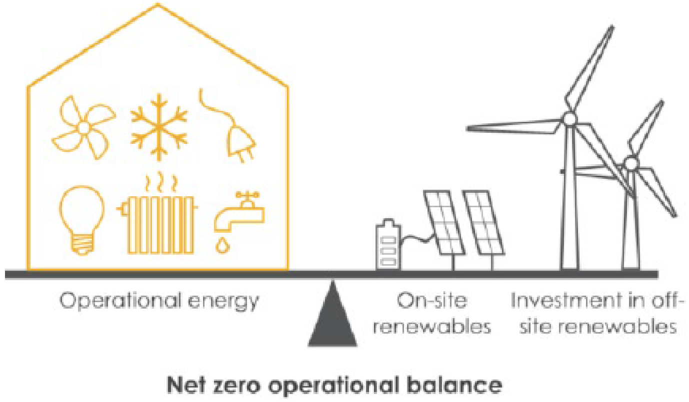
i. The space heating demand is the amount of heat energy needed to heat a home over a year and is expressed in kWh/m²/yr. It is a measure of the thermal efficiency of the building elements. Various design and specification decisions affect space heating demand including building form and orientation, insulation, airtightness, windows and doors and the type of ventilation system. The Climate Change Committee recommends a space heating demand of less 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. A low space heating demand means there will be a lower peak demand on the grid in winter, as well as this a dwelling with a low space heating demand would lose heat very slowly, 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.

ii. Our modeling shows that FHS notional specification set out in the consultation document will achieve a space heating demand of 50-60 kWh/m²/ yr which is much higher than the targets recommended by CCC and LETI. Moreover, since in the draft FHS guidance, there is no target for space heating demand, it will be possible to meet the FHS with a higher space heating demand than notional specification with a project that installs PV and or more efficient systems then the notional specification.

4.21 Renewable technology

i. Due to the flexible approach to meeting the FHS, onsite renewable generation is not required. New buildings should contribute to the significant increase in renewable energy generation required between now and 2050. For new build low rise residential buildings this can be delivered onsite. 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. When this is not technically possible and suitably justified, renewable energy generation (equivalent to the shortfall) should be funded elsewhere in the borough/ council.





Source: LETI Climate Emergency Design Guide

5.0 Evidence for Policy Changes

Raising the bar on energy efficiency standards in Winchester

5.1 The role of local authorities in mitigating climate change in the UK and what they have been encouraged and allowed to do has changed over the years. Three distinct phases can be noted.

5.2 2008-2014: The realisation that the planning system has a key role to play to mitigate climate change

i. The **Planning and Compulsory Purchase Act 2004** requires the local plan to ensure that development and use of land contribute to mitigation of climate change.

ii. 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.

iii. The **Planning and Energy Act 2008** empowers local plans 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".

5.3 2015-2019: Deregulation and the misguided reliance on ambitious national standards (incl. Zero Carbon homes policy)

i. 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.

ii. On 25th March 2015, a **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 CfSH level 4 (i.e., 19% improvement over Part L). However, there has been no adoption of a zero carbon homes policy at a national level.

5.4 Since 2019: the turning point of Net Zero

i. 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.

ii. At the same time, a very large number of local authorities, including the Winchester City Council, declared a climate and ecological emergency.

iii. An updated NPPF (National Planning Policy Framework) (2021) expects the planning system to contribute to a "radical reduction in greenhouse gas emissions" (Para 148) and plans to take a proactive approach (Para 149).

iv. In 2021, the Government also published their **response to the Future Homes Standard** consultation stating the following:

v. *"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."*

vi. *"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."*

The Department of Levelling up, Housing and communities have confirmed to Winchester City Council that Winchester City Council has the power to set higher energy standards than Building Regulations

LETI metrics and targets provide a nationally consistent methodology

5.5 The LETI metrics and targets provide a nationally consistent methodology that is different to the Building Regulations.

5.6 These metrics and targets are now being referenced in policy and emerging policy as well as in briefs for developers. They have been developed in collaboration with UKGBC and supported by the Good Homes Alliance, RIBA and CIBSE.

5.7 GLA Energy Assessment Guidance (June 2021)

i. 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.

5.8 RIBA 2030 Climate Challenge Version 2 (2021)

i. 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.

5.9 Local Plans

i. The targets and metrics are being implemented in many emerging policies, although it is important to note that some are implementing looser targets:

- Greater Cambridge Local Plan (first proposals)
- Basingstoke Local Plan – EUI and energy monitoring only (pre-examination)
- Cornwall Council Climate Emergency DPD – (in examination)
- Central Lincolnshire Local Plan (in consultation)
- Merton Local Plan – Adopted with EUI targets enforced from 2025

MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)

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/m²/year)	Space Heating (kWh/m²/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/m²/y	120 kWh/m²/y	< 60 kWh/m²/y	< 35 kWh/m²/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

Currie & Brown Etude

Development and implementation of LETI metrics and targets

5.10 The LETI metrics and targets have been developed by a large group of multiple stakeholders including developers, engineers, housing associations, housebuilders, architects, planners, academics, sustainability professionals, contractors and facilities managers.

5.11 Development of LETI metrics and targets

i. A rigorous review and consultation process was undertaken. Over the last 5 years LETI has been trying to build consensus on the steps that need to be taken for a Zero Carbon built environment. Taken in total, over 1500 built environment professionals' support, the implementation of an EUI - total energy use in kWh/m^2/yr (regulated and unregulated). There may be some double counting, over the different consultation exercises, but this show that there is incredibly strong support for this metric in the industry. See Appendices for details.

5.12 Implementation

i. As of spring 2021, LETI were aware of over 30,000 homes at masterplan stage and 2,500 at pre-construction stage that were seeking to implement LETI EUI targets.

ii. For example, Collida (Willmott Dixon) have a housing product that meets LETI targets. LETI targets are begin implemented in the TFL sustainable development framework.

5.13 House design

i. Homes can be designed to meet LETI targets that look traditional or modern. The images to the right show new homes that have been built that meet the LETI space heating target.

5.14 Practical implementation

i. Meeting the targets involves predictive energy modelling (e.g., PHPP) in the design phase and checking that the space heating and EUI target are met. For an example of a specification that meets these targets see the Appendices. This typically involves ultra-low energy building fabric, airtight design, low form factor, MVHR and a heat pump.

Examples of homes that have been built that meet the LETI space heating target

Currie & Brown Etude

6.0 Technical Evidence Base

6.1 Typology Selection

i. Energy modelling has been undertaken for two residential typologies using the Passive House Planning Package (PHPP) tool, which is a predictive energy modelling tool.

ii. The main criteria for selection was that these typologies needed to be representative of both current residential development in Winchester and that which is expected to come forward over the next local plan period. This was influenced by discussion with Winchester Council's officers and their viability consultants.

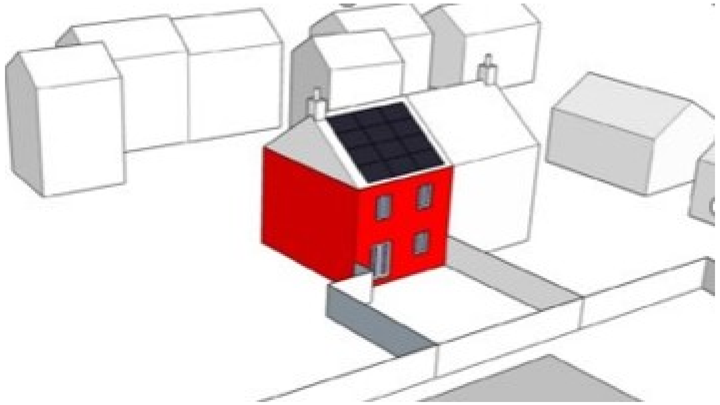
iii. It was also important to model a range of building forms and sizes as dwelling density can impact energy efficiency and the ability to match on-site energy renewable generation with on-site consumption.

iv. The actual buildings selected all come from recent planning applications, either in Winchester Council and other Boroughs:

- **3-bed Semi Detached House**
- **4-bed Detached House***

v. For each typology, and in order to demonstrate that the proposed new policies are both feasible and viable, energy and cost modelling was undertaken for the scenarios below. Modelling assumption details have been listed in the Appendix.

- Baseline Part L 2021
- A – FHS **
- C – LETI
- B – Reduced Fabric Performance
- C.1 – LETI without PVs



3-bed Semi Detached House

GIA: 93m²

4-bed Detached House

GIA: 142m²

** This study has considered semi detached and detached homes in detail as these are very popular forms of new housing. The analysis is also applicable to other similar house types such as low-rise flats.*

*** To align with the initial draft version of the Future Home Standard*

Currie & Brown Etude

6.2 Will the Part L 2021 deliver Net Zero Carbon buildings?

i. The problem is that this level of ambition is not consistent with the Climate Change Committee recommendation that new buildings should achieve ultra low energy efficiency levels, equating to a space heating demand of 15-20 kWh/m²/yr, or the space heating demand criterion in the definition of Net Zero Carbon buildings: 15 kWh/m²/yr.

ii. This is illustrated by the adjacent bar chart: the space heating demand results for the current policy compliant typologies are comprised between 60 and 70 $kWh/m^2_{GIA}/yr$, well in excess of the Climate Change Committee limit and the Net Zero Carbon space heating demand criterion.

iii. As a result, applications with insufficient fabric efficiency and ventilation performance appear to be satisfactory when they are significantly less efficient than they should be to achieve net zero.

6.3 Will the Future Homes Standard deliver Net Zero Carbon buildings?

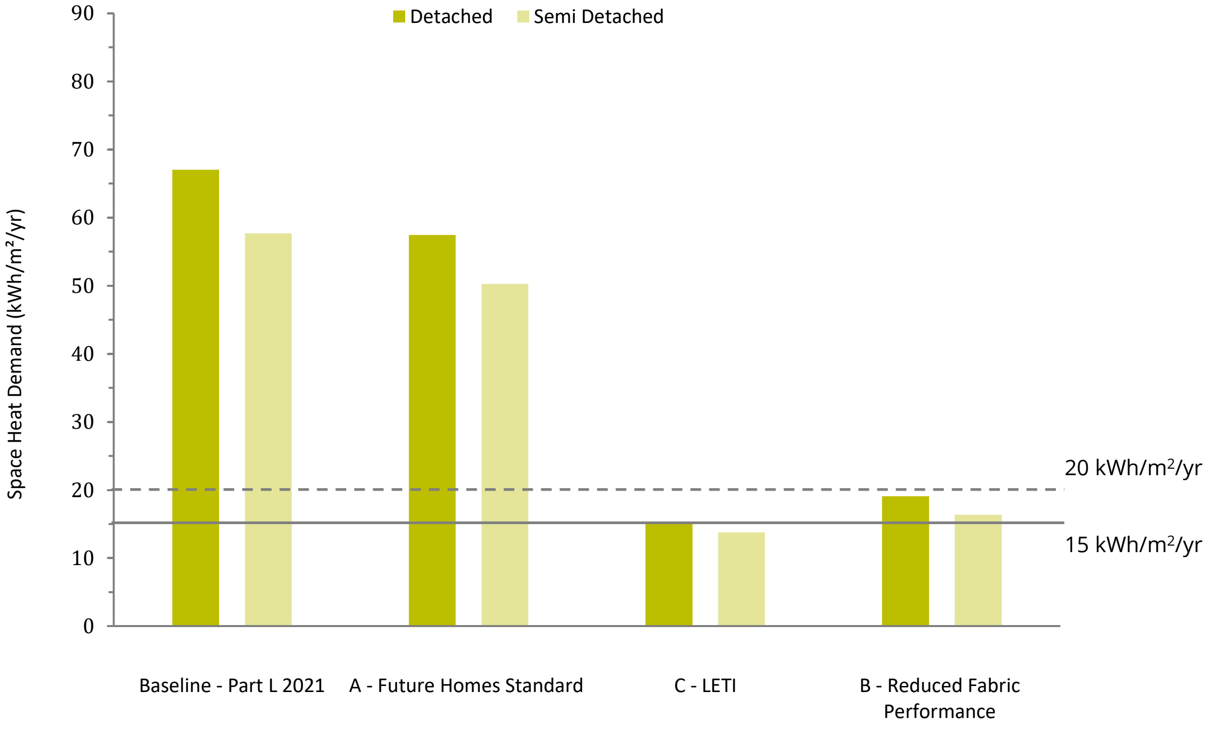
i. The forthcoming Future Homes Standard is unlikely to deliver the scale of improvement required, with energy modelling demonstrating space heating demand between 50-60 $kWh/m^2_{GIA}/yr$, still in excess of the Climate Change Committee limit and the LETI Net Zero Carbon space heating demand criterion.

6.4 Will the LETI recommendations deliver Net Zero Carbon buildings?

i. LETI targets can achieve less than 15 $kWh/m^2_{GIA}/yr$ for both residential typologies tested.

6.5 Conclusion

i. The graph on the right shows that with current policy compliance (Building Regulations - Part L) and likely FHS energy specifications, the space heating demand would be significantly higher than the CCC recommendation of 15-20 kWh/m².yr and the LETI Net Zero Carbon space heating demand requirement of 15 kWh/m².yr. With LETI scenario, the CCC recommendation of 15-20 kWh/m².yr is achieved.



Predicted space heating demand from PHPP modelling for both residential typologies

Currie & Brown

Etude

Energy modelling results | Energy Use Intensity (kWh/m²/yr)

6.6 Will the Part L deliver Net Zero Carbon buildings?

i. The new version of the Building Regulations (Part L 2021) is unlikely to deliver the scale of improvement required, with energy modelling demonstrating an EUI of around 95 kWh/m^2_{GIA}/yr, still in excess of the Net Zero Carbon EUI target.

6.7 Will the Future Homes Standard deliver Net Zero Carbon buildings?

i. The forthcoming Future Homes Standard is unlikely to deliver the scale of improvement required, with energy modelling demonstrating an EUI between 40-45 kWh/m^2_{GIA}/yr, still in excess of the Net Zero Carbon EUI target.

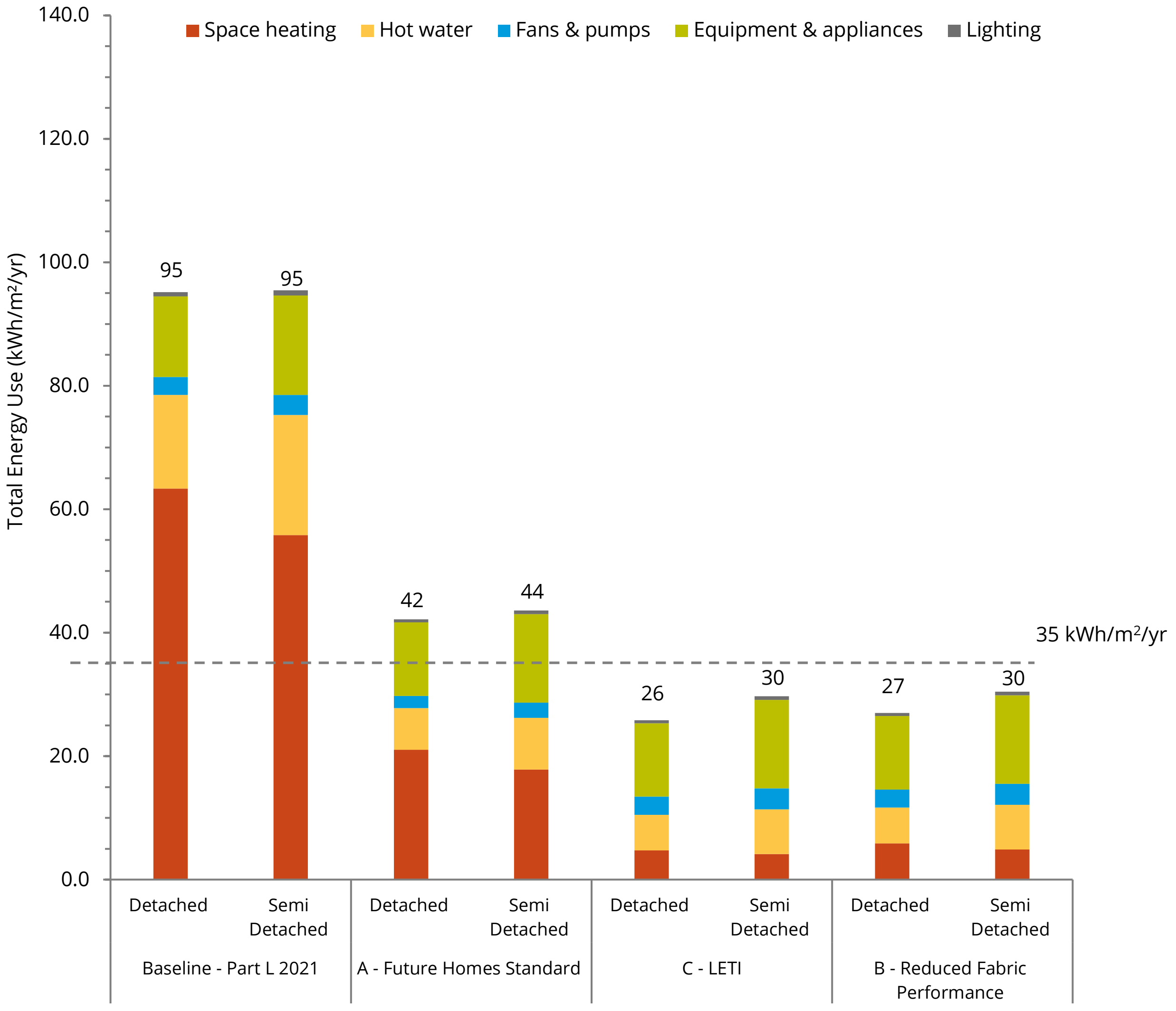
6.8 Will the LETI recommendations deliver Net Zero Carbon buildings?

i. LETI targets can achieve less than 35 kWh/m^2_{GIA}/yr for both residential typologies tested.

6.9 Conclusion

i. The LETI scenario is consistent with the requirement of the Net Zero Carbon EUI target. Thus, reaching Net Zero Carbon on new buildings is technically possible. This is assuming that an exemplar level of energy efficiency is achieved, that a low carbon heating system is used, and that renewable technology is maximised*. The graph on the right shows that with the recently updated policy (Building Regulations - Part L) and likely Future Homes Standard (FHS) energy specifications, the EUI would still exceed the recommendation of 35 kWh/m².yr.

** The EUI target does not include renewable generation, as the renewable energy generation must make up the other side of the operational zero carbon balance. This means that if two buildings are built identically, but one has a roof filled with PV panels and the other does not, they will both have the same EUI.*



Predicted Energy Use Intensity (EUI) from PHPP modelling for both residential typologies

Currie & Brown Etude

7.0 Cost Evidence Base

Introduction to cost analysis

7.1 The next step is to demonstrate whether the policies are financially viable. High level capital cost analysis was undertaken by Currie & Brown to benchmark the likely build cost for the typologies under the different specification scenarios. The ultra low energy scenario build costs can be compared to a baseline build cost to assess financial viability.

7.2 General approach to cost analysis

i. The residential costs presented in this report are current for Q2 2022 for a medium sized developer, building several hundred to a thousand homes a year in the Winchester area.

ii. It is important to note that the costs of development, particularly for housing, can vary very widely for a range of factors, not least: location, ground conditions, site constraints, access, topography, quality of finishes, design complexity, supply chain and management. Construction costs can also be subject to sudden and significant change because of market or economic factors. For example, varying exchange rates, skills or materials shortages and interest rates. In the 12 months from February 2021 to February 2022 average housing materials costs increased by nearly 8% and will have accelerated further following global events including the war in Ukraine. This number conceals much larger variations in the costs of specific items. These extensive factors mean that a benchmark cost analysis is only indicative of overall cost implications of different policy options and their relative significance, nonetheless we believe that the cost benchmarking undertaken is indicative of the scale and direction of cost impacts even if individual developers/ contractors experience different rates in practice due their product, supply chain, scale, and experience.

iii. As with any performance-based standard, it is likely that the collective innovation of the design and construction community will identify alternate strategies, technologies or methods by which costs can be driven down and it is likely that, other things being equal, costs of achieving higher performance standards will fall as the industry learns. The costs used in this report represent those anticipated for a moderately experienced project team, i.e., they are not “first of a kind” costs but neither do they assume a high level of optimisation and sophistication in approach.

7.3 Viability assessment

i. The outputs of this study have been combined with the cost modelling and analysis undertaken for the Local Plan Viability Assessment. This Viability Assessment used the information provided and reported to assess the financial impact that energy efficiency improvements over and above Part L of the Building Regulations standards. It also analysed the financial implications for other policy requirements in the Local Plan such as affordable homes, following an iterative process.

7.4 How were the baseline build costs calculated

i. The assumed baseline build cost is based on Scenario 1 of this study, that is the current policy compliant, gas boiler and PV case. This scenario uses the Part L 2021 notional building specification and does not look to surpass demands of current carbon policy. A benchmark £/m² cost is estimated for each building type. This reflects the current experience of building costs for these developments and is drawn from Currie & Brown’s experience of a wide range of relevant developments across the UK. Overall baseline capital cost will vary according to the level of external and internal finishes, fittings etc. The benchmark costs assume a medium specification.

7.5 How were the running costs calculated

i. The assumed running costs have been calculated as a balance of the gas and electricity consumption together with standing charges as well as the revenue from the export of energy generated by PV arrays (assumed to around 70% of the energy generated). Energy price assumptions for gas and electricity were taken from Ofgem's most recent energy price cap determination.

ii. They do not include home insurance, utility/ tax/ TV/ broadband/ phone bills, maintenance and other homeowner costs related with running a house. These calculations are the outcome of a simplified approach, as these are based on running costs which vary according to the operation patterns and occupants’ behaviour.

7.6 Application to other house types

i. This study has considered semi detached and detached homes in detail as these are very popular forms of new housing. The cost analysis, is also applicable to other similar house types such as **low-rise flats** and bungalows. The costs associated with these options will be slightly different to those shown for semi and detached housing with costs lower for flats and higher for bungalows. This is largely a reflection of their different external envelope to internal area ratios. In general, **bungalows** have the highest uplift costs and cost uplifts might be 1-2% higher than for detached houses. However, bungalows are also the development forms which are land inefficient and so are only developed in locations that can sustain the relative high values needed for viability. Uplift costs for **medium/ high rise flats** will be of a similar order to those shown in this study albeit the technologies used will vary as, for example, centralised heating systems may be employed, and less use of PV given the more limited roof area available to each flat unit

7.7 Capital cost uplift

i. To meet the LETI targets, the total capital cost (does not include running cost) is increased by **6.9%** over Building Regulations. The running cost is reduced by **33%** compared to Building Regulations.

ii. The graph to the right outlines the total build cost for the semi-detached house, and the percentage uplift in the total capital cost of the different modelled scenarios compared to the Baseline (Building Regulations Part L). This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and PVs. Cost changes for each intervention are outlined in the table.

7.8 Conclusion

i. FHS vs Baseline: Although cost uplift is minor (0.9%), running cost is 36.9% more than the baseline

ii. LETI vs Baseline: 6.9% cost uplift over baseline, however, achieves 33% running cost reduction.

iii. LETI vs Reduced fabric performance: Minor percentage difference (0.8%) in the cost uplift between Scenarios C and B which can be explained by the balance between fabric and MEP systems. However, the running cost is 3.2% less for Scenario C (LETI).

iv. LETI vs LETI without PVs: Small percentage difference (2.5%) in the cost uplift between Scenarios C and C.1 from the implementation of PVs. However, the running cost is 41% less for Scenario C (LETI).

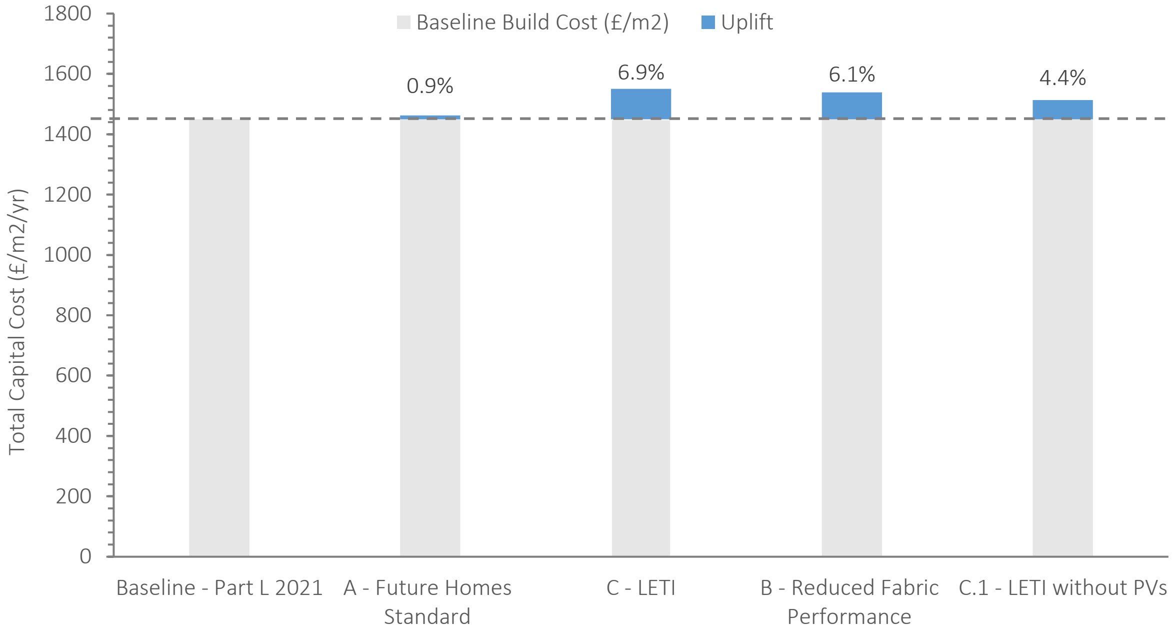


Table 7.1 Cost modelling results breakdown of the different modelled scenarios for the Semi-Detached House

Cost Breakdown	Baseline – Part L 2021	A – FHS	C – LETI	B – Reduced fabric performance	C.1 – LETI without PVs
Base build	783	783	783	783	783
Fabric	585	604	659	647	659
MEP	37	75	71	71	71
Solar	44	-	37	37	-
Total (£/m²)	1,450	1,462	1,551	1,539	1,514
Running Cost (£/year)	806	1,278	541	559	923
Running Cost (£/m²/year)	8.7	13.7	5.8	6.0	9.9

Currie & Brown
Etude

7.9 Cost uplift

i. To meet the LETI targets, the total capital cost (does not include running cost) is increased by **5.4%** over Building Regulations. The running cost is reduced by **24%** compared to Building Regulations.

ii. The graph to the right outlines the total build cost for the detached house, and the percentage uplift in the total capital cost of the different modelled scenarios compared to the Baseline (Building Regulations Part L). This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and PVs. Cost changes for each intervention are outlined in the table.

7.10 Conclusion

i. FHS vs Baseline: Although cost uplift is minor (0.3%), running cost is almost double the baseline

ii. LETI vs Baseline: 5.4% cost uplift over baseline, however, achieves 24% running cost reduction.

iii. LETI vs Reduced fabric performance: Minor percentage difference (0.9%) in the cost uplift between Scenarios C and B which can be explained by the balance between fabric and MEP systems. However, the running cost is 6.2% less for Scenario C (LETI).

iv. LETI vs LETI without PVs: Small percentage difference (1.8%) in the cost uplift between Scenarios C and C.1 from the implementation of PVs. However, the running cost is 41% less for Scenario C (LETI).

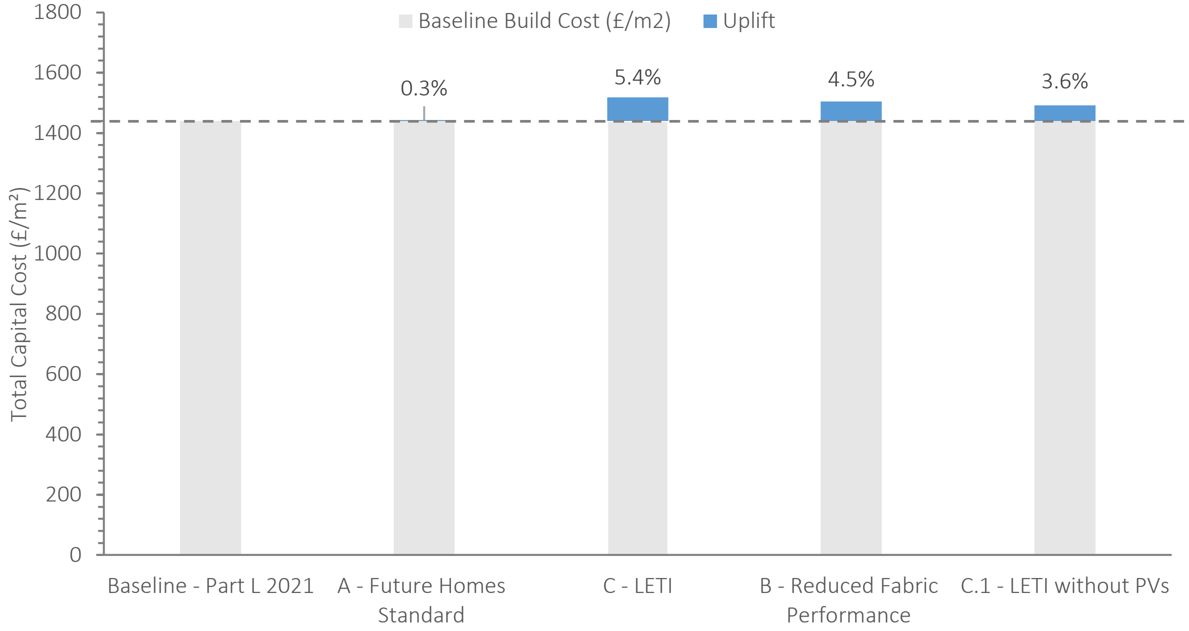


Table 7.2 Cost modelling results breakdown of the different modelled scenarios for the Detached House

Cost Breakdown	Baseline – Part L 2021	A – FHS	C – LETI	B – Reduced fabric performance	C.1 – LETI without PVs
Base build	719	719	719	719	719
Fabric	640	665	720	707	720
MEP	41	59	52	56	52
Solar	40	-	27	27	-
Total (£/m²)	1,440	1,443	1,518	1,505	1,491
Running Cost (£/year)	913	1,809	697	743	1,172
Running Cost (£/m²/year)	6.4	12.7	4.9	5.2	8.3

Cost modelling results | Summary

Table 7.3 Analysis results summary for Detached House in Winchester against all the modelled options

Detached House	Options				
	Baseline - Part L 2021	**A - Future Home Standard**	**C - LETI**	**B - Reduced Fabric Performance**	**C.1 - LETI without PVs**
Space Heating Demand (kWh/m²/yr)	67	57	15	19	15
EUI (kWh/m²/yr)	95.1	42.2	25.8	27.0	25.8
Carbon Emission* ($kgCO_2$)	2,065	419	0	0	257
Capital Cost Percentage Uplift (%)	0.0%	0.3%	5.4%	4.5%	3.6%
Energy Bills (£/yr)	913	1,809	697	743	1,172

Table 7.4 Analysis results summary for Semi-Detached House in Winchester against all the modelled options

Semi Detached House	Options				
	Baseline - Part L 2021	**A - Future Home Standard**	**C - LETI**	**B - Reduced Fabric Performance**	**C.1 - LETI without PVs**
Space Heating Demand (kWh/m²/yr)	58	50	14	16	14
EUI (kWh/m²/yr)	95.4	43.6	29.7	30.4	29.7
Carbon Emissions* ($kgCO_2$)	1,316	284	0	0	193
Capital Cost Percentage Uplift (%)	0.0%	0.9%	6.9%	6.1%	4.4%
Energy Bills (£/yr)	806	1,278	541	559	923

It is important to highlight that the energy bills for the LETI scenario are much lower than all other scenarios

**Carbon factors were applied to gas and electricity consumption, and solar PV generation. Gas carbon factor of 0.210 $kgCO_2$/kWh is taken from SAP 10 as it is not expected to change significantly. Electricity carbon factor of 0.07 $kgCO_2$/kWh is taken from HM Treasury Green Book domestic consumption-based grid average figures for the next 30 years.*

7.11 The cost analysis demonstrates that for an additional 7% or less to the cost of a Part L 2021 compliant home (with a gas boiler), it is possible to achieve an ultra high fabric specification with space heat demand of 15kWh/m² and significant onsite generation. Uplift costs are linked to higher specification, glazing, MVHR systems, insulation and airtightness and PV technology.

7.12 Cost trends

i. It would be hoped that more airtight construction with reduced thermal bridges will become less expensive overtime as construction teams become more experienced and as new build methods and offsite manufactured systems become more widespread. Further, the costs of MVHR systems are likely to see cost reductions as these become a more mainstream part of the home specification. Significantly lower cost systems are already becoming available in the UK, albeit with a reduced level of heat recovery efficiency. It would be expected that the costs of MVHR units will continue to fall perhaps by 25-30% in current cost terms over through to 2030 with further associated reductions in the costs of installation as designers become more experienced at efficiently integrating these systems into home designs.

7.13 Heat pump systems are already based on highly mature technologies but there are additional costs incurred in the UK due to the relatively generic nature of the products and the relatively high costs of installation due to the low existing installer base. It would be expected that heat pump units will be developed that are better sized for high efficiency homes and there are already some innovative ducted heat pump units on the market that do not require an external unit, these have the potential to further reduce cost where heat demand is low. Internal ducted systems will be easier to deploy in flats and terraced housing. Despite the over 85% reduction in the capital cots of photovoltaic arrays in the last 15 years, further savings of around 25-30% in the current cost of this technology are anticipated by 2030.

8.0 Conclusion

8.1 Introduction

i. This section details policy recommendations for Winchester Council's new Local Plan in terms of operational energy and carbon. For each policy, a summary justification is provided along with the proposed policy wording.

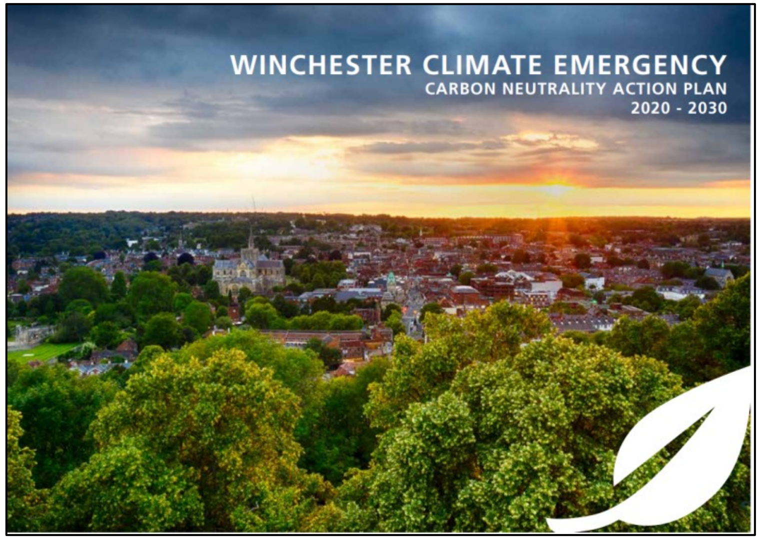
8.2 Carbon neutrality by 2030

i. New buildings should be designed and constructed to energy efficiency standards to enable the Winchester Council to be carbon neutral by 2030. This is also in line with the UK's legally binding target of Net Zero carbon by 2050.

ii. All new residential developments should be able to demonstrate Net-Zero operational carbon on site. They should be ultra-low energy buildings, use low carbon heat and contribute to the generation of renewable energy on-site.

iii. This relies on compliance with the following policies:

- Policy 1: Low carbon heat
- Policy 2: Space heating demand
- Policy 3: Energy Use Intensity (EUI)
- Policy 4: On-site renewable energy generation



Currie & Brown Etude

8.3 Recommended Policy 1

i. Net Zero Carbon new buildings: Low carbon heat

ii. *New buildings cannot continue to burn fossil fuels for heating and hot water if the Winchester Council is to stay within carbon budgets. Low carbon heat is therefore an essential component of a Net Zero Carbon building.*

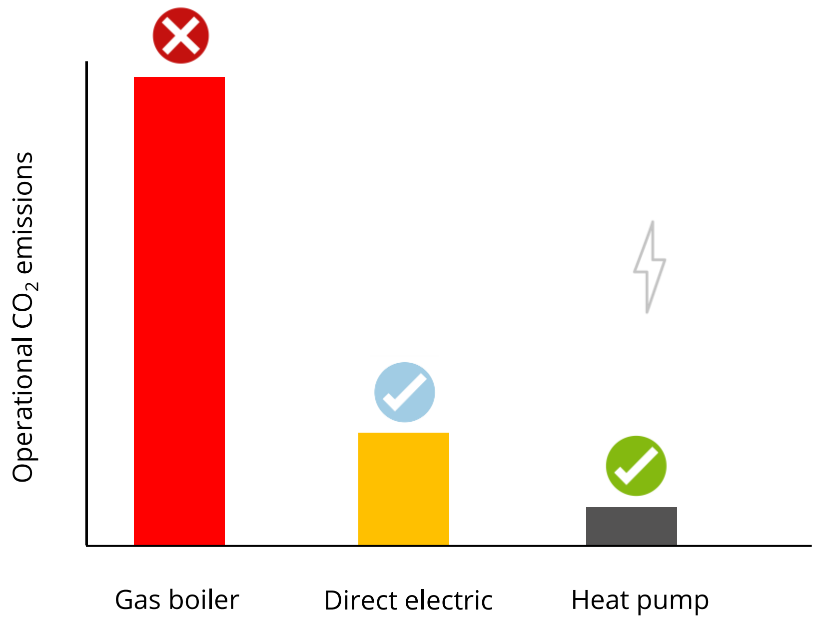
iii. *Low carbon alternatives that are available now include heat pumps and direct electric heating. Electricity can be provided through on-site renewables and through grid electricity, which is becoming increasingly decarbonised.*

iv. *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 250-300% for an Air Source Heat Pump.*

v. *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.*

8.4 Policy 1 wording

i. All new residential developments should not use fossil fuels on-site for space heating or hot water provision.



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).

8.5 Recommended Policy 2

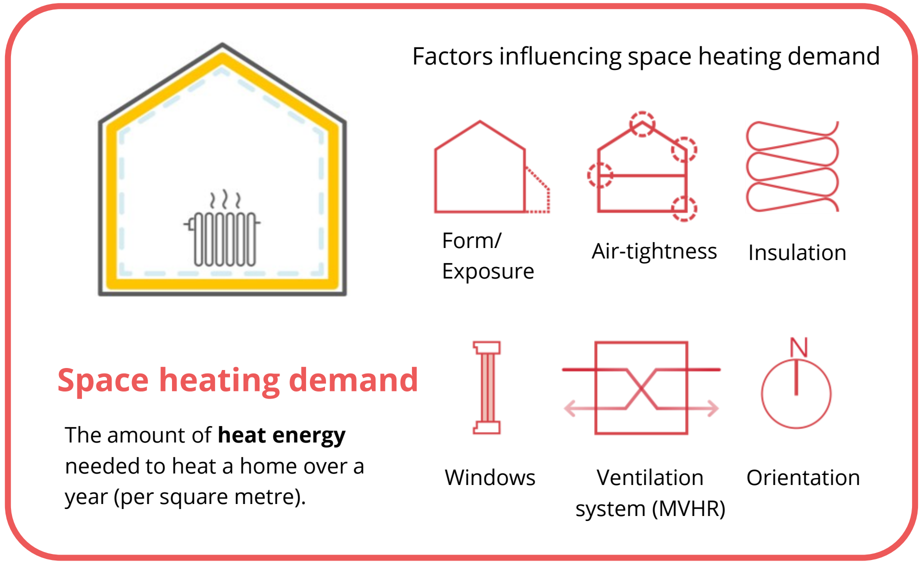
i. Net Zero Carbon new buildings: Space heating demand

ii. *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.*

iii. *Various design and specification decisions affect space heating demand including building form and orientation, insulation, airtightness, windows and doors and the type of ventilation system.*

iv. *The Climate Change Committee recommends a space heating demand of less 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.*

v. *As a dwelling with a low space heating demand would lose heat very slowly, 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.*

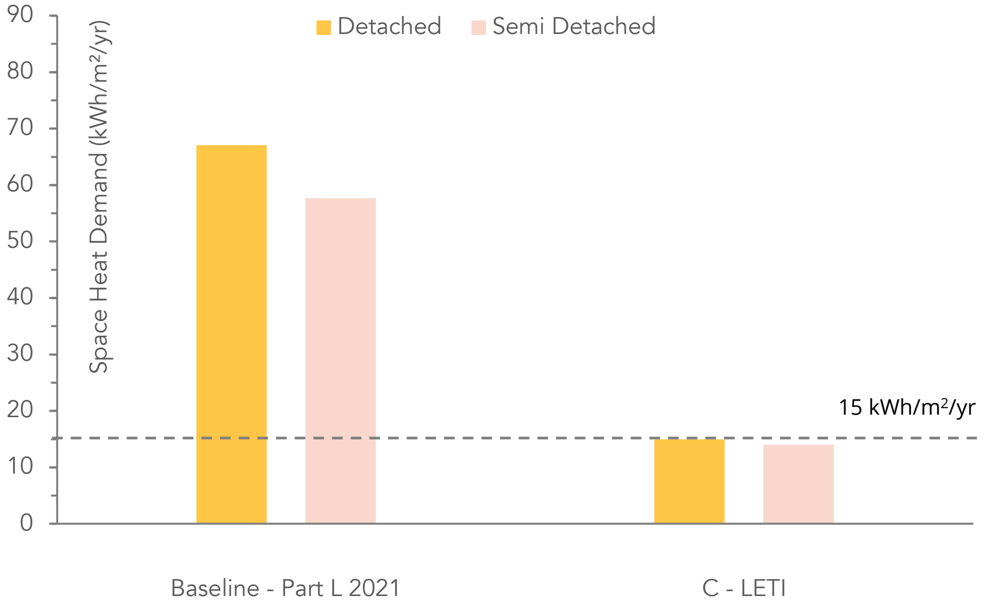


8.6 Policy 2 wording

i. All new residential developments should achieve a space heating demand of less than 15 kWh/m$^2_{GIA}$/yr.

8.7 Policy 2 technical evidence

i. The graph on the right shows that with current policy (Building Regulations - Part L), the space heating demand would be significantly higher than the CCC recommendation of 15-20 kWh/m².yr and the LETI Net Zero Carbon space heating demand requirement of 15 kWh/m².yr. With LETI scenario, the CCC recommendation of 15-20 kWh/m².yr is achieved.



Currie & Brown
Etude

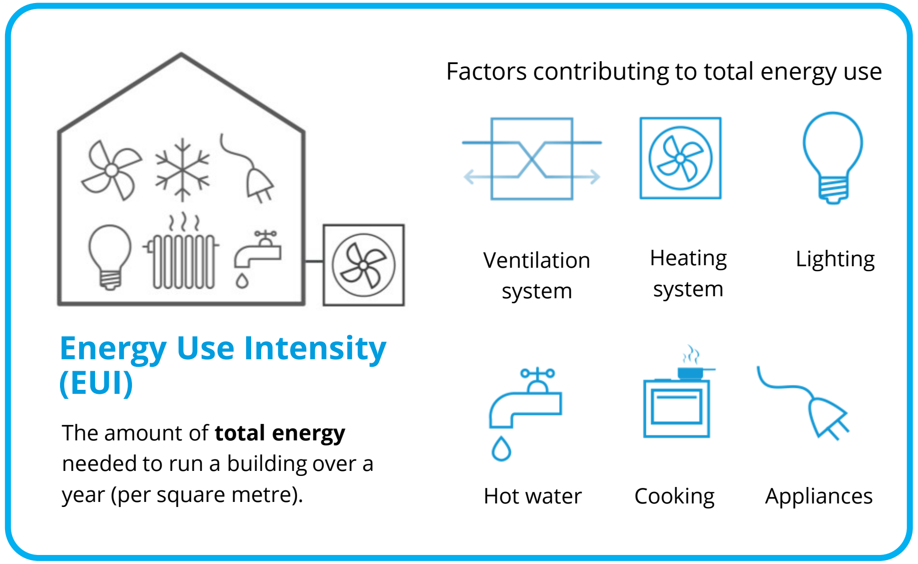
Policy recommendations | Energy Use Intensity (EUI)

8.8 Recommended Policy 3

i. Net Zero Carbon new buildings: Energy Use Intensity (EUI)

ii. *For new buildings to be compliant with 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.*

iii. *Energy Use Intensity (EUI), or metered energy use, is the total energy needed to run a building over a year (per square metre). It is a measure of the total energy consumption of the building (kWh/m²/yr). The EUI covers all energy uses: space heating, domestic hot water, ventilation, lighting, cooking and appliances. This metric is also very beneficial as it can be measured postconstruction, therefore helping to drive down the performance gap which is such a significant issue in the construction industry.*

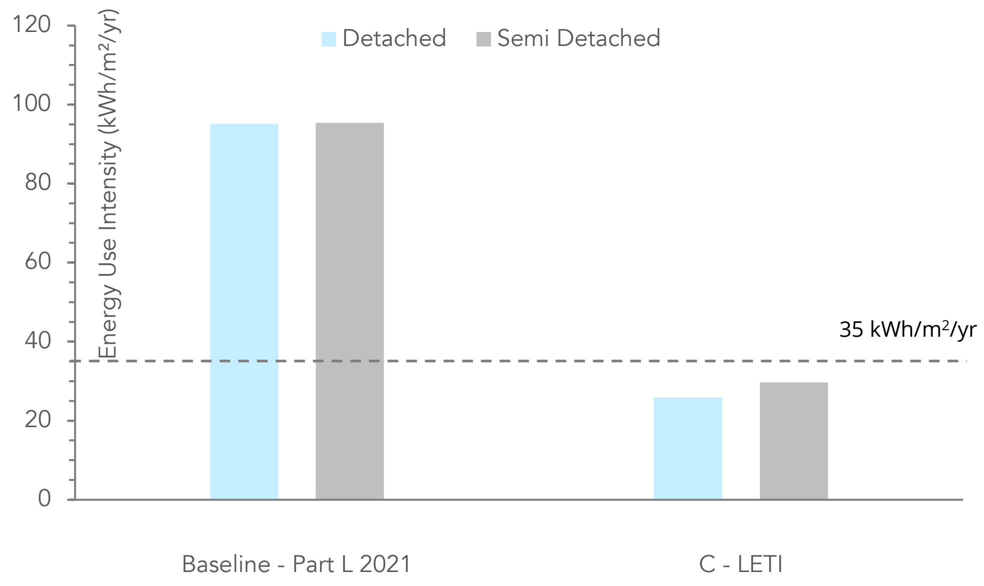


8.9 Policy 3 wording

i. All new residential developments should achieve an Energy Use Intensity (EUI) of no more than 35 $kWh/m^2_{GIA}/yr$, including regulated and unregulated energy consumption.

8.10 Policy 3 technical evidence

i. The graph on the right shows that with current policy (Building Regulations - Part L), the EUI would be significantly higher than the Net Zero Carbon target. With LETI scenario, the 35 kWh/m².yr recommendation can be achieved.



Currie & Brown Etude

8.11 Recommended Policy 4

i. Net Zero Carbon new buildings: On-site renewable energy generation

ii. *New buildings should contribute to the significant increase in renewable energy generation required between now and 2050.*

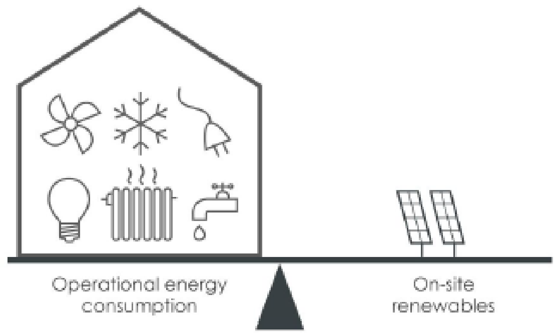
iii. *The most robust way to deliver the overall objective of a balance between total energy use and renewable energy generation for new buildings at a system level is to seek to achieve this balance at the site level.*

iv. *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.*

8.12 Policy 4 wording

i. All new residential developments should generate on-site renewable energy.

ii. The amount of energy generated in a year should match or exceed the predicted annual energy demand of the building, i.e., Renewable energy generation (kWh/m²/yr) = or > EUI (kWh/m²/yr).



Energy balance

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

A key component of a net zero carbon building is achieving an energy balance – the amount of renewable energy generated in a year matches the energy used by the building in a year.

8.13 Energy related recommendations

We recommend introducing the following to set the new Local Plan for Winchester Council on the right path towards Net Zero Carbon.

1. **Low carbon heat:** New buildings cannot continue to burn fossil fuels if the Winchester Council is to stay within carbon budgets. Low carbon heat is therefore an essential component of a Net Zero Carbon building. All new residential developments should not use fossil fuels on-site for space heating or hot water provision.
2. **Space heating demand target**: The use of a space heating demand target would provide an absolute metric in kWh/m^2/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, airtightness, windows and doors and the type of ventilation system. All new residential developments should achieve a space heating demand of less than 15 kWh/m^2GIA/yr.
3. **Energy Use Intensity (EUI) target**: The use of an EUI target would provide an absolute metric in kWh/m^2/yr. EUI is independent from carbon and can be easily verified by the building/ homeowner/ tenant after completion. All new residential developments should achieve an EUI of no more than 35 kWh/m^2GIA/yr, including regulated and unregulated energy consumption.
4. **On-site renewable energy generation:** New buildings should contribute to the significant increase in renewable energy generation required between now and 2050. All new residential developments should generate on-site renewable energy. The amount of energy generated in a year should match or exceed the predicted annual energy demand of the building, i.e., Renewable energy generation (kWh/m^2/yr) = or > EUI (kWh/m^2/yr).

Fabric

< 15 kWh/m^2/yr *of space heating demand for residential developments.*

Demonstrated using predicted energy modelling.

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.*

Energy efficiency

< 35 kWh/m^2/yr *of total metered energy use for residential developments.*

Meeting EUI targets demonstrated using predicted energy modelling.

Zero operational carbon balance - Renewable energy **generation**

100% of the energy consumption required by buildings shall be generated using on-site renewables, for example through solar PV.

Measurement and verification

Meter, monitor and report on ***energy consumption*** *and renewable energy generation post-completion*

Currie & Brown Etude

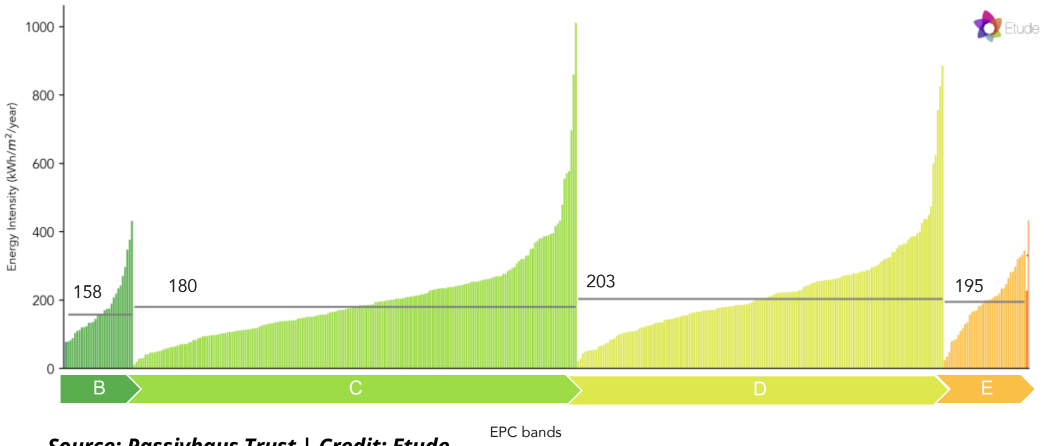
Energy measurement and verification

8.14 Net zero carbon new buildings: Energy measurement and verification

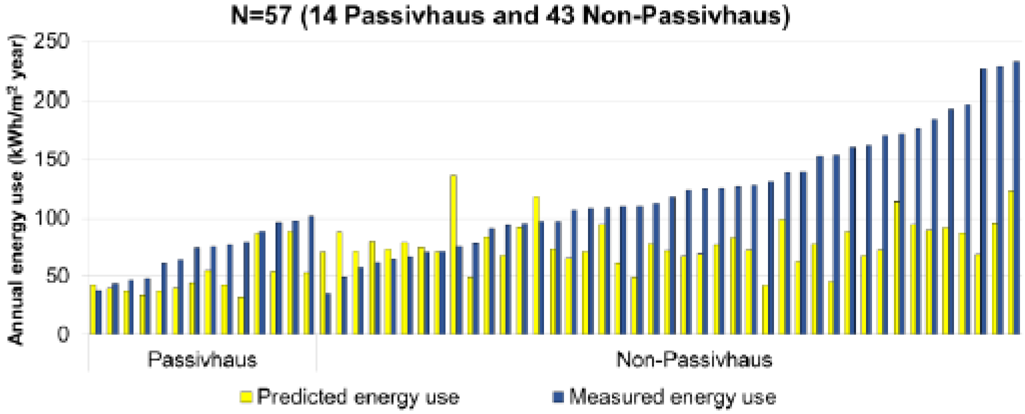
i. *In order for the Net Zero Carbon buildings policy to be effective, it is important that new buildings deliver their intended performance. Unfortunately, the actual energy performance of buildings often fails to meet the design standard. This difference is commonly referred to as "the Performance Gap". The Zero Carbon Hub concluded in their Evidence Review Report in 2014 that a compliance process focused on design rather than as built performance is a key contributor to the performance gap.*

ii. *Excellent design and detailing need to be matched by high quality construction and commissioning in order for the "performance gap" between the design and actual in-use energy to be reduced. This can be achieved by energy performance construction quality assurance schemes such as the Passivhaus standard or the AECB Building standards.*

iii. All new developments should confirm the metering, monitoring and reporting of their total energy use and renewable energy generation, as part of the detailed planning application.



Source: Passivhaus Trust | Credit: Etude
A comparison of the EPC's energy efficiency rating with metered energy consumption of 420 homes shows a huge variance within the energy consumed within each rating band. There is little correlation between EPC rating and the energy consumption of homes. This is problematic, as the construction industry has been focusing on improving the EPC ratings of buildings, rather than focusing on reducing the energy consumption of buildings.



Source: BPN State of the Nation report, 2020
One of the reasons for the success of the PHPP modelling methodology used in Passivhaus is the ability to better predict average energy use: measured energy is on average lower, but it is also closer to predictions than in other methods.

Currie & Brown Etude

9.0 Appendices

Modelling assumptions | Semi detached house

		Baseline – Part L 2021	A - Future Homes Standard	C – LETI	B – Reduced Fabric Performance	C.1 – LETI without PVs
Building fabric	Floor / Walls / Roof (W/m^{2}K)	0.130 / 0.180 / 0.110 Building regs fabric 2021	0.110 / 0.150 / 0.110 Building regs fabric 2025	0.100 / 0.100 / 0.100 Ultra-low energy fabric	0.100 / 0.120 / 0.100 Very-low energy fabric	0.100 / 0.100 / 0.100 Ultra-low energy fabric
	Windows / Doors (W/m^{2}K)	1.2 / 1.0 - 1.3 Double glazing	0.8 / 1.0 - 1.3 Triple glazing	0.8 / 0.9-10 Triple glazing	0.8 / 0.9-10 Triple glazing	0.8 / 0.9-10 Triple glazing
	Airtightness (ACH*)	5.0 Airtightness	5.0 Airtightness	0.6 Airtightness	1.0 Airtightness	0.6 Airtightness
	Ventilation heat recovery efficiency (%)	0% Extract fan only	0% Extract fan only	88% V High efficiency MVHR	88% High efficiency MVHR	88% V High efficiency MVHR
Heating and Hot water	Heating system T supply (° C)	60 Gas boiler	55 Heat Pump	45 Heat Pump	45 Heat Pump	45 Heat Pump
	DHW storage (litres) / WWHR** efficiency (%)	120 / 36 % Some DHW storage	180 / 0 % DHW storage	180 / 36 % DHW storage	180 / 36 % DHW storage	180 / 36 % DHW storage
Renewable energy	Solar panels (number)	9 PV panels	- No PV	7 PV panels	7 PV panels	- No PV

Air changes per hour indicates the air volume added to or removed in one hour, divided by the volume of the space. Air permeability values in m^3/h/m^2 will be slightly different and will vary depending on the volume to surface area ratio of the building.
***Waste-water heat recovery device to showers.*

Table 9.1 Modelling assumptions for the Semi-Detached House

Currie & Brown Etude

Modelling assumptions | Detached house

		Baseline – Part L 2021	A - Future Homes Standard	C – LETI	B – Reduced Fabric Performance	C.1 – LETI without PVs
Building fabric	Floor / Walls / Roof (W/m²K)	0.130 / 0.180 / 0.110 — Building regs fabric 2021	0.110 / 0.150 / 0.110 — Building regs fabric 2025	0.090 / 0.090 / 0.090 — Ultra-low energy fabric	0.090 / 0.120 / 0.090 — Very-low energy fabric	0.090 / 0.090 / 0.090 — Ultra-low energy fabric
Building fabric	Windows / Doors (W/m²K)	1.2 / 1.0 - 1.3 — Double glazing	0.8 / 1.0 - 1.3 — Triple glazing	0.8 / 0.9-10 — Triple glazing	0.8 / 0.9-10 — Triple glazing	0.8 / 0.9-10 — Triple glazing
Building fabric	Airtightness (ACH*)	5.0 — Airtightness	5.0 — Airtightness	0.6 — Airtightness	1.0 — Airtightness	0.6 — Airtightness
Building fabric	Ventilation heat recovery efficiency (%)	0% — Extract fan only	0% — Extract fan only	90% — V High efficiency MVHR	90% — High efficiency MVHR	90% — V High efficiency MVHR
Heating and Hot water	Heating system / T supply (° C)	60 — Gas boiler	55 — Heat Pump	45 — Heat Pump	45 — Heat Pump	45 — Heat Pump
Heating and Hot water	DHW storage (litres) / WWHR** efficiency (%)	120 / 36 % — Some DHW storage	180 / 0 % — DHW storage	180 / 36 % — DHW storage	180 / 36 % — DHW storage	180 / 36 % — DHW storage
Renewable energy	Solar panels (number)	14 — PV panels	- — No PV	8 — PV panels	8 — PV panels	- — No PV

**Air changes per hour indicates the air volume added to or removed in one hour, divided by the volume of the space. Air permeability values in m³/h/m² will be slightly different and will vary depending on the volume to surface area ratio of the building.*
***Waste-water heat recovery device to showers.*

Table 9.2 Modelling assumptions for the Detached House

LETI consultation on EUI metric

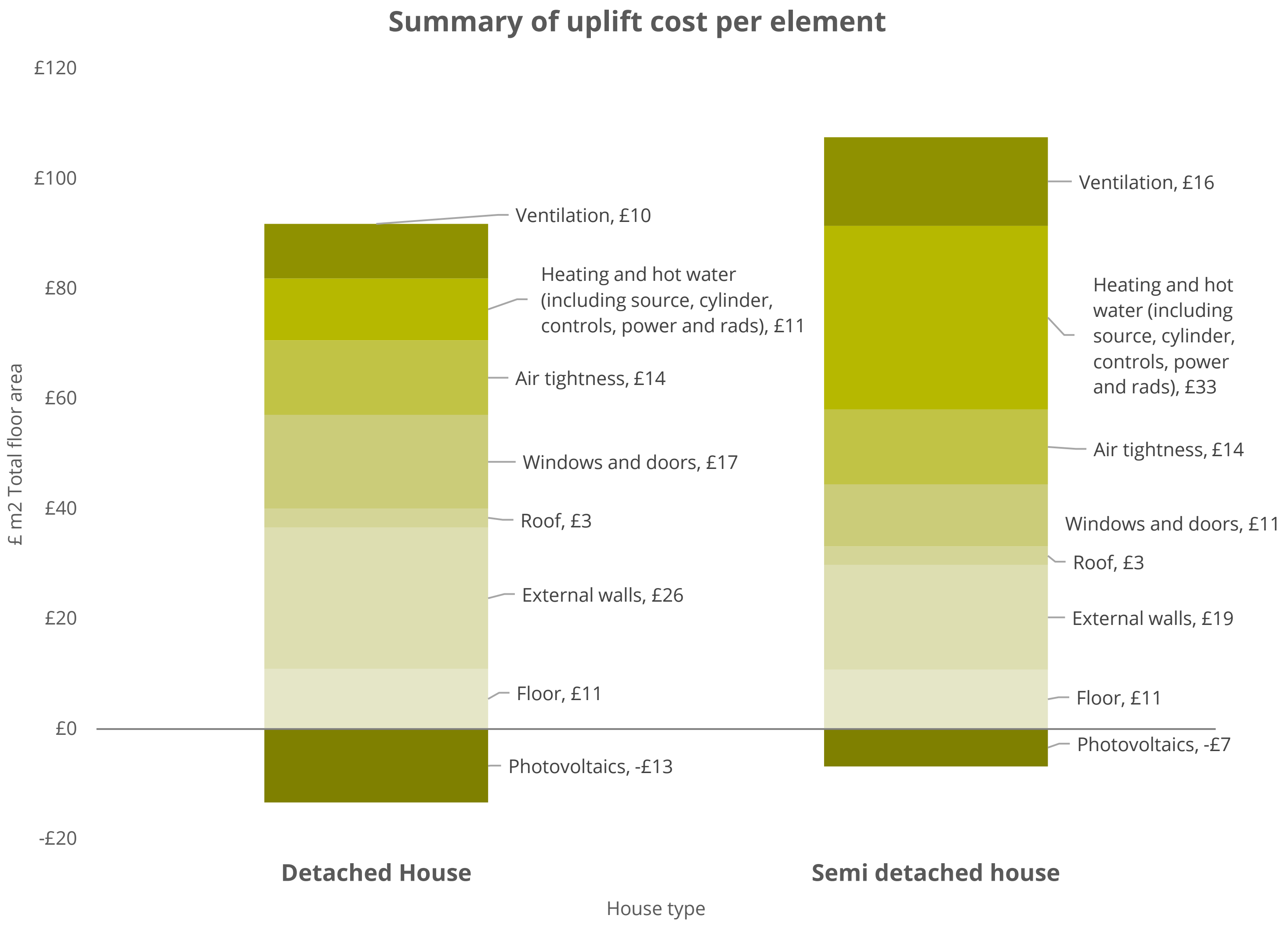
Table 9.3 LETI Consultation

Dates of consultation	Details	Outcome
LETI - GLA - London Plan consultation Jan17 (March 2018)	39 organisations and 200 individuals signed up to the LETI energy policy proposals which included the implementation of an EUI metric.	LETI started developing more detailed approach using the EUI metric.
LETI/UKGBC Net Zero framework consultation February (April 2018)	LETI has received feedback from 140 built environment professionals from 78 organisations through an online survey and through a workshop. 85% thought that net zero carbon framework must set a kWh/m² requirements for ach key building type.	LETI started developing more detailed approach using the EUI metric.
LETI – Reforming compliance modelling – June (August 2019)	Evidence based on specific survey that was completed by 99 built environment professionals in June/ July 2019, and a technical expert workshop of 20 people. 75% people stated that a key metric in regulation and policy should be metered energy consumption	
LETI – Operational Net Zero on pager (August - December 2019)	331 people took part in a survey that asked: Given that we are in a climate emergency and we need to reduce our carbon emissions as much as possible and as fast as possible, what should these targets be? • 28% said the result of bottom up approach based on industry best practice (e.g. Passivhaus) • 9% said the result of top down approach based on the amount of renewable energy that the UK can produce to power buildings • 56% based on a mixture of the two	Both a bottom-up and a top down approach was used to set the LETI EUI kWh/m² target. For more information see https://www.leti.london/cedg
LETI – FHS consultation response (March 2020)	LETI developed a key messaging document as part of the 2020 Future Homes standard consultation response. The key messaging included- including performance metrics such as Energy Use Intensity (EUI) in KWh/m²/y. LETI made this document available online and received strong consensus from a wide range of built environment disciplines in agreement with the issues identified. 219 organisations have signed up in support of this document, who between them employ over 8898 people. In addition, 833 individuals signed up in support, 665 of whom are built environment professional.	
LETI – Work for BEIS for the development of SAP 11 (November 2020)	337 people undertook a survey. 85% stated that energy use (kWh/m²) should be the key metric in SAP.	
LETI/ CIBSE – What is LETI survey (November 2021)	198 people responded to consultation Operational carbon: 175 respondents "expert" or "medium" • 90% agreed that meeting Net Zero Carbon - operational energy requires meeting Energy use target e.g. EUI, energy rate • 72% of participants voted an option that requires some type of space heating demand target	The LETI CIBSE FAQs on what is Net Zero, states that an energy use target must be met for Net Zero buildings. This work is supported by the Institution of structural engineers, RIBA, RICS, BRE, Good homes alliance and WLCN.

Breakdown of Additional Costs| Detached and Semi-detached houses

Most significant factors influencing costs for house are:

- Wall insulation and windows (esp. in Detached House)
- Airtightness – allowance includes for parge coat / wet plaster
- Heating system (esp. Semi-detached house where base model is for a combi boiler). Note net costs include savings from reduced number of radiators in ultra-high efficiency housing
- MVHR (mechanical ventilation with heat recovery) in lieu of dMEV (direct mechanical extract ventilation)



Currie & Brown

Etude