Report 1

Essex Net Zero Policy – Technical Evidence Base

July 2023

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Contents

1.0 Executive Summary

Executive Summary

The Essex Climate Action Commission have commissioned Introba to develop this evidence base to understand the technical and cost implications of delivering net zero buildings and the implications for owners, occupiers, developers and local planning authorities to inform and develop a consistent approach to emerging planning policy across Essex. This evidence base builds on the work of existing evidence bases, including Cornwall Council, Delivering Net Zero, and the recently published 'Net Zero Carbon Viability Study' for Essex produced by Three Dragons. The report uses the results of existing stock models developed by Etude, Inkling, Levitt Bernstein and Introba.

The Essex Climate Action Commission have also commissioned Introba to develop "*Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements*" which gives a high-level summary of the proposed Net Zero policy requirements, evidence and validation requirements for different planning applications, monitoring guidance and high-level design guidance for two different domestic typologies.

This Report 1 sets out the technical and financial evidence to support the recommended Net Zero policy requirements for all new residential buildings based on the 6 residential typologies: terrace block, bungalow, semi-detached house, block of flats (low rise), block of flats (mid-rise), block of flats (high-rise). In addition, analysis has also been undertaken for the following 3 non-domestic typologies: office, school and industrial. Predictive energy modelling using Passive House Planning Package (PHPP) for domestic, and CIBSE TM54 for non-domestic typologies, was carried out to support the technical evidence base and inform local planning policies.

An overarching 'Net zero carbon new buildings in operation' policy is recommended, with supporting technical and financial evidence base. The Policy includes setting standards for buildings for space heating; fuel; energy efficiency; and renewable energy. The Policy is aligned with local and national climate targets to help enable Essex to meet climate change commitments.

Capital cost analysis of the building typologies and specifications modelled that comply with the recommended net zero policy has been undertaken by Currie & Brown. The likely capital cost uplift from a current Part L 2021 Building Regulations baseline using an Essex/South England Q1 2023 cost base has been estimated. For the residential typologies modelled the uplift ranges from 3% to 7% (£100 – £150/m^2), and for non-residential typologies between 2% and 12% (£77 – £100/m^2). The cost estimates in this study are similar or lower to those used in the net zero carbon viability study for Essex by Three Dragons, which is positive for viability.

Recommended Policy: Net Zero Carbon New Buildings in Operation is the overarching policy.
All new buildings must be designed and built to be Net Zero Carbon in operation. They must be ultra-low energy buildings, be fossil fuel free, and generate renewable energy on-site to at least match annual energy use. All new buildings are required to comply with the requirements listed in Figure 1.

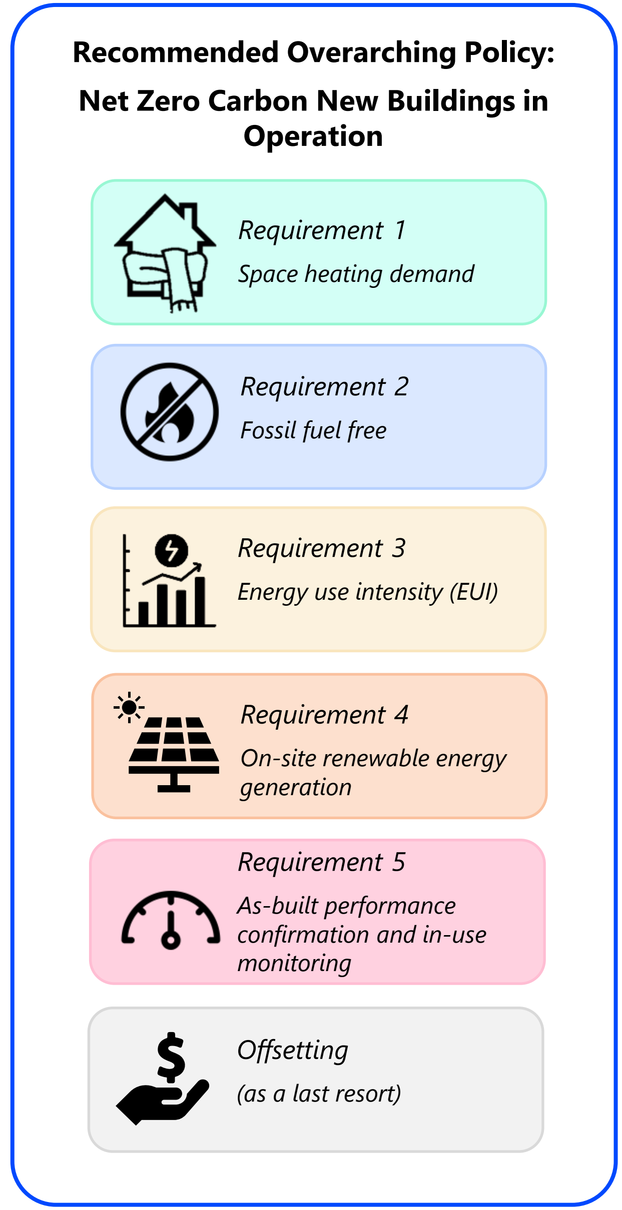


Figure 1: Net Zero Carbon New Building in Operation policy requirements

2.0 Evidence of Need

Essex Local Plans must comply with national carbon reduction commitments

There is a climate emergency

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

National commitment

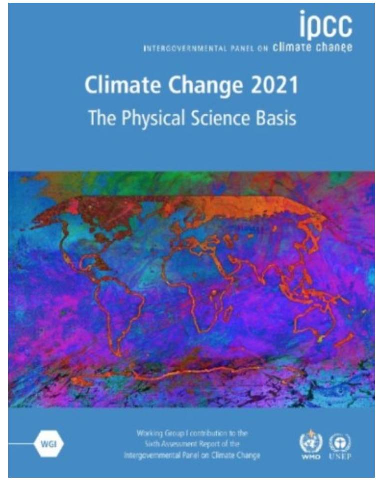
The UK's national commitment is set through the Climate Change Act 2008, which was updated in 2019. It legislates that the UK must be net zero carbon by 2050 and sets a system of carbon budgets to ensure that the UK does not emit more than its allowance between now and 2050. This legal requirement is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

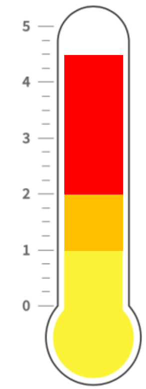
The concept of carbon budgets is absolutely critical to understand: Net Zero is not about a destination, it is very importantly about a very significant and fast required decarbonisation pathway from now on.

Achieving Net Zero Carbon

Key measures identified by the CCC include:

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

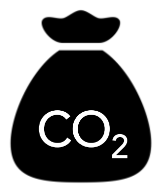




4-5°C the temperature rise we are likely to see if we continue on a **business as usual** path

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

1°C The temperature rise already created



380,000 $MtCO_2$

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

9 years

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

New buildings can be part of the solution

New buildings are currently adding to the problem

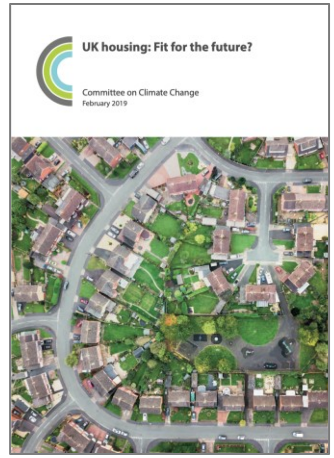
Operational carbon emissions associated with new buildings (that meet current regulations) are still very significant. They are not energy efficient enough, they continue to use fossil fuels for heating and hot water, and likely generate very small amounts of renewable energy. In summary, they keep adding 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 local carbon budgets and that is not sustainable.

They create a future retrofit burden

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

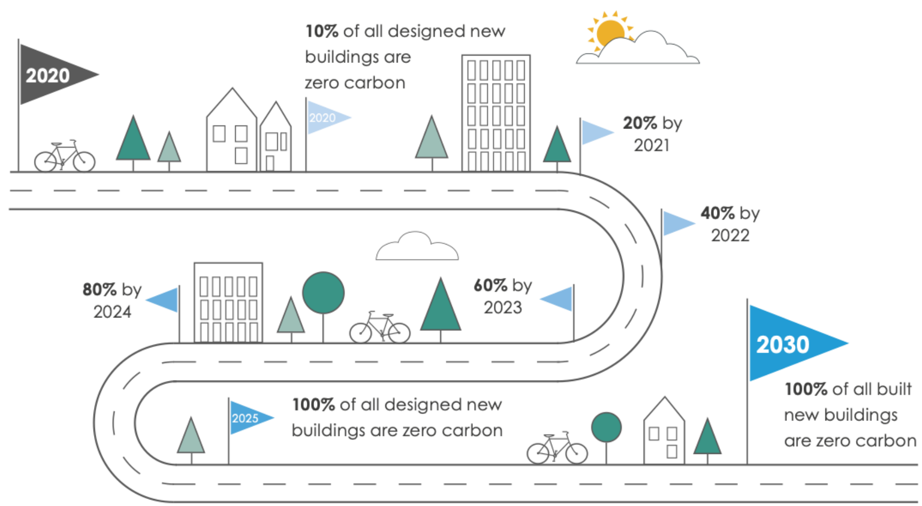
New buildings compliant with our climate change commitments

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



"New homes should deliver ultra-high levels of energy efficiency as soon as possible and by 2025 at the latest, consistent with a space heat demand of 15-20 kWh/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

Energy cost crisis

A growing concern

Energy costs have always been a concern for those affected by fuel poverty but it is now a bigger concern.

The role of new buildings

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

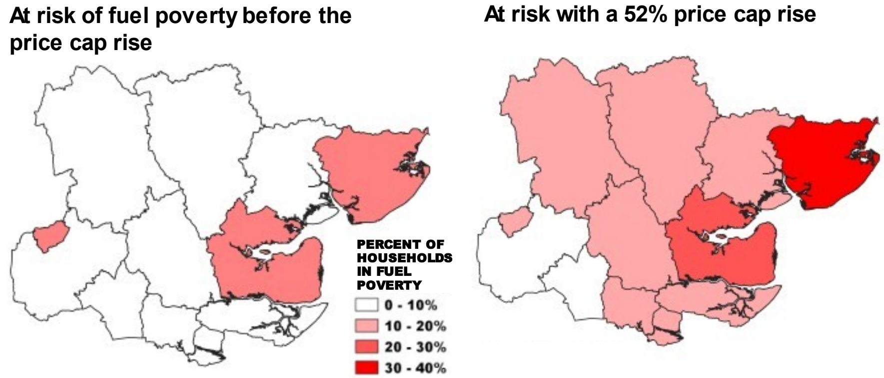
The two key benefits of energy efficiency

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

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

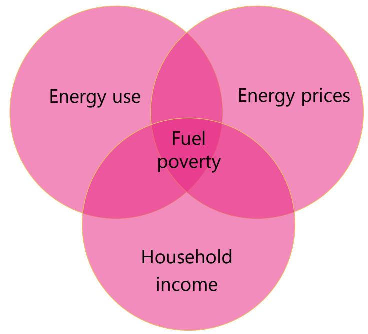
The positive role of renewable energy generation on bills

The significant amount of PV generation on a Net Zero carbon building can and should benefit residents. A solar PV system, together with fabric efficiency, can reduce the running cost of a home by 25-50%.



Based on sample of 315,704 Essex households (49% of total housing stock)

Percent of households in fuel poverty in Essex in 2021 (Produced by Essex County Council Chief Executive's Office)



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

3.0 Defining Net Zero Carbon Buildings in Operation

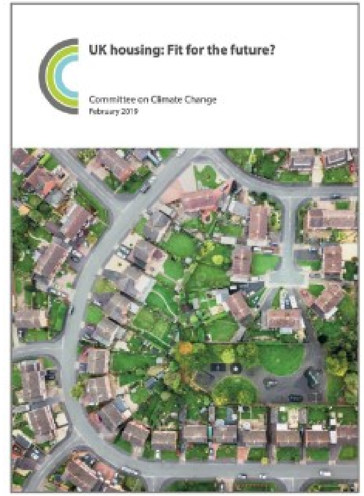
There is an industry definition of Net Zero carbon buildings in operation

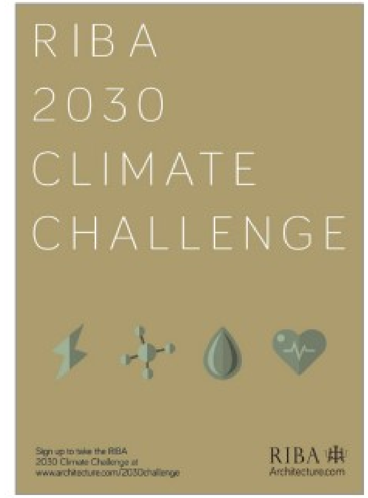
In order to achieve Net Zero, it is crucial that new buildings become part of the solution as soon as possible, instead of adding to the problem. In order to do this, and from now on, new buildings need to use energy much more efficiently, stop using fossil fuels on site for heating and hot water and 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.

A growing evidence base has led to an industry definition

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





What is Net Zero?

The term 'net zero' is often used in the built environment industry, but there is little clarity in what this practically means. Buildings can't be 'absolute zero carbon' as they require the use of non-organic materials to build them. Buildings are carbon neutral if you compensate for the carbon emissions through offsets. However to meet our climate crisis and limit global warming to 1.5 °C the built environment needs to limit its carbon emissions. There is a finite amount of offsets available, so a different approach needs to be taken.

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

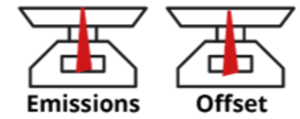
A building emits carbon throughout its whole lifetime. Whole life thinking involves considering all life cycle stages of a project, from raw material extraction, product manufacturing, transport and installation on site through to operation, maintenance and eventual material disposal.

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

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

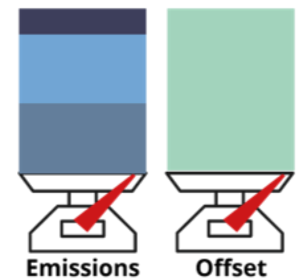
Absolute Zero Carbon

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



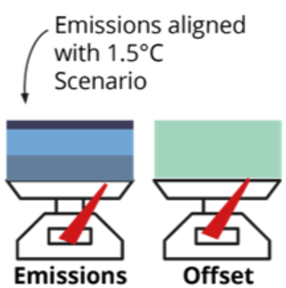
Carbon neutral

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



Net Zero (whole life) Carbon

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



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

The principles of Net Zero Carbon in operation

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

1 - Energy efficiency

Buildings use energy which includes both regulated energy (heating, hot water, ventilation, lighting, cooling) and unregulated energy (plug loads, lifts, IT, cooking and appliances). All energy use within the building must be considered and need to comply with a maximum value, the Energy Use Intensity (EUI) which varies depending on the building type (for Building Regulations, only "regulated" energy use is considered).

2 – Fossil Fuel Free

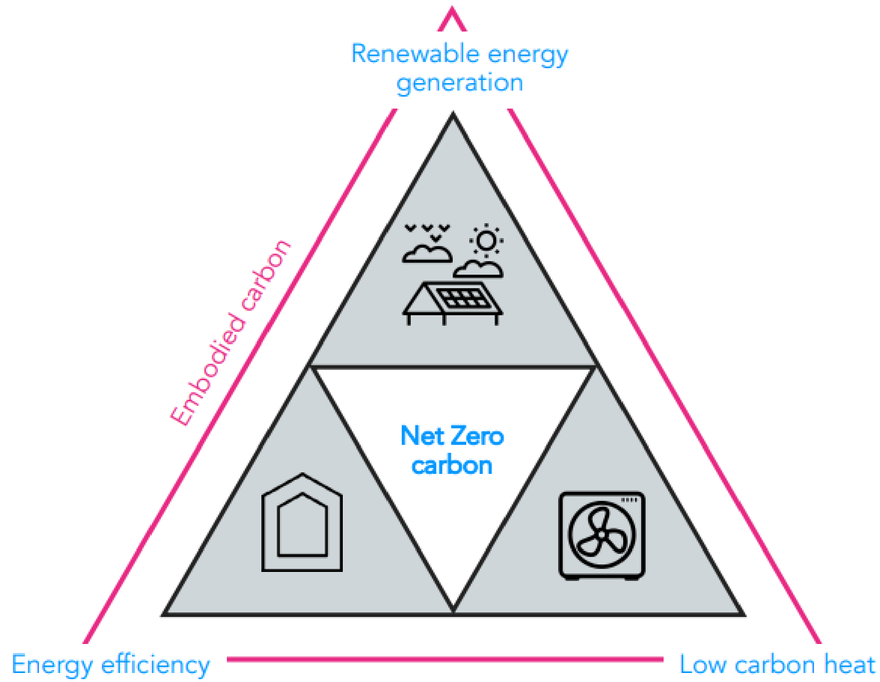
Low carbon heat is an essential feature of Net Zero Carbon buildings. All new buildings should be built with a low carbon heating system and must not connect to the gas network or, more generally, use fossil fuels on-site.

3 - Renewable energy generation

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

Embodied carbon

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



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

4.0 Building Regulations

Building Regulations | Part L 2021 Volume 1: Dwellings

Part L 2021 is the current Building Regulations, which has come into force in 2022. It has two volumes; Volume 1: Dwellings and Volume 2: Buildings other than dwellings. It is estimated to improve CO_2 emission performance by approximately 31% and 27% for dwellings and buildings other than dwellings respectively, compared with the previous Building Regulations (i.e., Part L1A 2013).

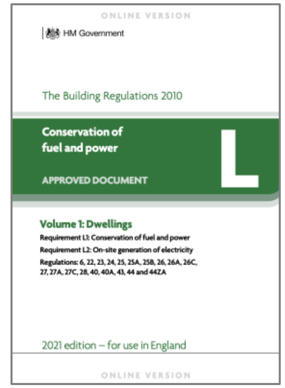
Compliance criteria with Building Regulations Part L 2021

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

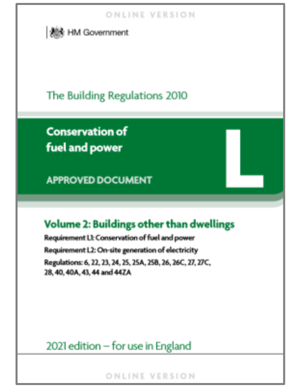
- **Primary energy rate** – Where a dwelling/building is erected, the dwelling/building primary energy rate (DPER)/(BPER) must not exceed the target primary energy rate (TPER). The primary energy use relates to how much energy is required by the new home. It is then converted (using primary energy factors)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

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

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



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



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

1 – Primary energy rate (kWh/m^2)

TPER ≥ DPER BPER

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

TER ≥ DER BER

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

TFEE ≥ DFEE

Summary of key criteria for Domestic buildings compliance with Building Regulations

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

Review of current local planning policy, evidence and targets in Essex

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

Within Essex there are 14 local authorities including Basildon, Braintree, Brentwood, Castle Point, Chelmsford, Colchester, Epping Forest, Harlow, Maldon, Rochford, Southend, Tendring, Thurrock and Uttlesford.

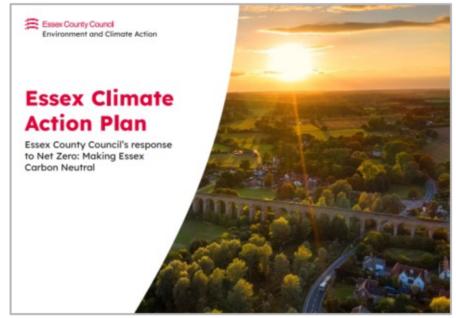
Each of the current local plans have high-level overarching policies that seek to address climate change and reduce carbon emissions. They do not set specific targets relating to space heating and energy reduction.

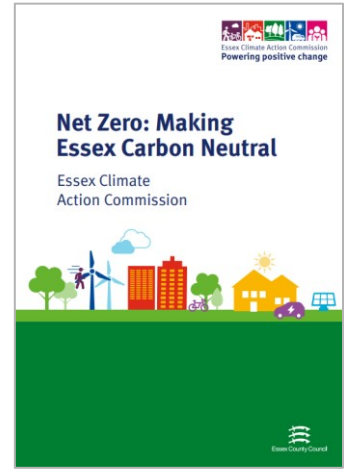
Essex Climate Action Commission (ECAC)

The Essex Climate Action Commission (ECAC) was set up to advise about tackling climate change. The purpose of the commission was to set out recommendations on the tackling climate crisis, which included devising a roadmap to get Essex to net zero by 2050.

Net Zero: Making Essex Carbon Neutral report

The independent ECAC report Net-Zero: Making Essex Carbon Neutral (July 2021) was published in July 2021 and the ECC Response later in 2021. The report puts forward recommendations to reduce the county's greenhouse gas emissions to net zero by 2050. Its recommendations are relevant to all Essex local authorities, parish and town councils, as well as Essex businesses, residents, and community groups. Essex County Council (ECC) is working alongside partners to secure the highest standards required to address climate change and deliver net zero carbon development and to embed these standards within Local and Neighbourhood Plan policies. The Essex Climate Action Annual Report 2021-22 follows the publication of the Climate Action Plan (November 2022) and outlines the immediate actions ECC is taking directly and with partners to drive effective progress against the Essex Climate Action Commission's (ECAC) recommendations.





Essex Climate Action Commission

Net Zero Carbon Viability and Toolkit Study (Three Dragons report)

The ECAC recommends that all new homes and new non-domestic buildings granted planning permission to be:

- Net zero by 2025
- Carbon positive by 2030

The Net Zero Carbon and Viability study is the first piece of evidence commissioned, which aims to help shape and inform net zero carbon planning policies and design advice for on new developments.

Following the recommendations of this study the ECAC is aiming to commission follow-on pieces of evidence, such as this report.

The Net Zero Carbon Viability Study for Essex produced by Three Dragons can be viewed here.

Issues with the current main planning metric (% improvement over Part L)

A metric which cannot be measured post-completion

Current planning policy is often based on a required improvement over a baseline: the 'notional building'. The notional building has the same shape, orientation and, up to a point, glazing proportions as the actual building. For clarity, the notional building is fictional and is used only for building regulations purposes.

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

A more efficient building form is not incentivised

Improving the design of a building by reducing the extent of heat loss areas, the amount of junctions, and by optimising elevation design for winter solar gains are widely considered as essential components of an energy efficient design. However, comparing a development to its own notional building does not reward efficient design as it essentially neutralises the impact of these measures. Moreover, the use of a notional building does not penalise inefficient building designs and enables these to achieve similar levels of performance as good design practice, due to the use of the wrong metrics.

Additional issues with changing carbon and primary energy factors

Furthermore, current performance targets in Part L rely on carbon emission factors and primary energy factors that introduce additional complexity. For example, the carbon factor for electricity has changed very significantly over the last 10 years and will continue to change over the next 10 years. This in itself has an impact on the % improvement over Part L which could be misleading.

The exclusion of unregulated energy

Current planning policy only takes into account regulated carbon emissions and does not require any reduction in 'unregulated' energy use. Therefore, 100% carbon emission reduction over Part L does not mean that the building will meet net zero operational carbon.

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

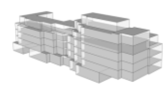
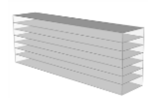
% improvement over notional building

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

kWh/m²/yr at the meter (EUI)

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

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

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

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

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

Part L modelling

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

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

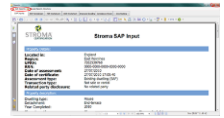
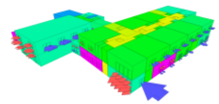
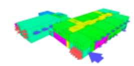
However, it is important to note that these Part L energy assessment methodologies were developed only to check compliance with Building Regulations. They were never meant to perform some of the functions that would be required to deliver Net Zero carbon buildings, and most importantly the prediction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

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

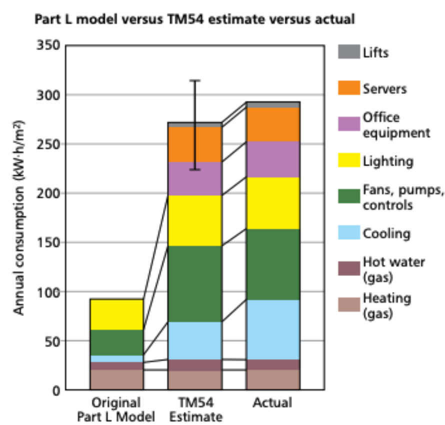
It seems that when these tools were mandated at planning stage approximately 15 years ago it was to minimise the burden on applicants and negate the need for a specific predictive energy use assessment. There is now a consensus in the industry that a different and better type of energy modelling is now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

Why predictive energy use is necessary

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

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

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



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

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

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

6.0 Introduction to recommended policy – Absolute energy performance targets

Recommended Policy | How does it work?

An overarching policy

The recommended policy includes an overarching policy requirement that all new buildings must be designed and built to be Net Zero Carbon in operation by complying with the following requirements:

- **Space heating demand**
- Fossil fuel free
- **Energy Use Intensity (EUI)**
- On-site renewable energy generation
- As-built performance confirmation and in-use monitoring
- Offsetting (as last resort)

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

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

Recommended Overarching Policy:

Net Zero Carbon New Buildings in Operation

Requirement 1
Space heating demand

Requirement 2
Fossil fuel free

Requirement 3
Energy use intensity (EUI)

Requirement 4
On-site renewable energy generation

Requirement 5
As-built performance confirmation and in-use monitoring

Offsetting
(as a last resort)

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

Raising the bar on energy efficiency standards in Essex

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

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

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

The **Climate Change Act 2008** sets a clear direction for the UK. It obliges the government to set policy that will enable the UK to meet its carbon budgets.

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

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

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

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

Since 2019: the turning point of Net Zero

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

At the same time, many local authorities, including most in Essex, declared a climate and ecological emergency and the County Council set up the Essex Climate Action Comission.

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

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

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

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

23

LETI metrics and targets provide a nationally consistent methodology

The LETI (Low Energy Transformation Initiative) metrics and targets provide a nationally consistent methodology that is different to the Building Regulations.

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

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

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

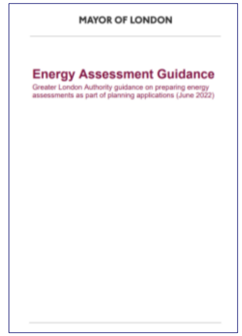
RIBA 2030 Climate Challenge Version 2 (2021)

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

Local Plans

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

- Greater Cambridge Local Plan (First Proposals November 2021)
- Bristol Local Plan Review (Further Consultation – November 2022)
- Bath and North East Somerset Local Plan Partial Update (adopted 19 January 2023)
- Cornwall Council Climate Emergency DPD – (adopted 21 February 2023)
- Central Lincolnshire Local Plan (adopted 13 April 2023)
- Merton Local Plan – (at examination) seeks to adopt EUI targets enforced from 2025



Reporting Energy Use Intensity (EUI) and space heating demand

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

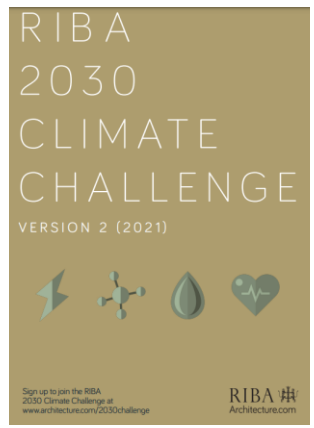
Table 4: *EUI and space heating demand values*

Building type	Energy Use Intensity (kWh/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

Policy Review | Bath & Northeast Somerset

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

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

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

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

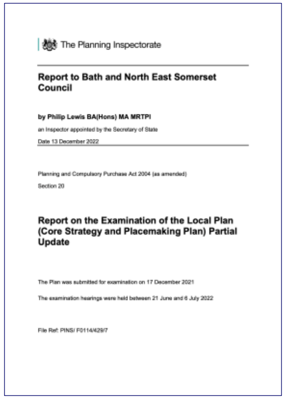
Source: B&NES Council's website

Policy SCR6 - New Build Residential

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

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

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



The Planning Inspectorate

Report to Bath and North East Somerset Council

by Philip Lewis BA(Hons) MA MRTPI

an Inspector appointed by the Secretary of State

Date 13 December 2022

Planning and Compulsory Purchase Act 2004 (as amended)

Section 20

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

The Plan was submitted for examination on 17 December 2021

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

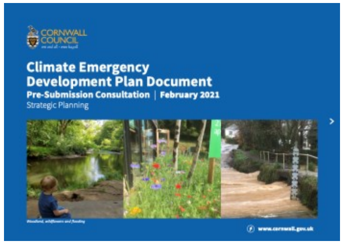
File Ref: PINS/ F0114/429/7

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

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

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

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



Policy SEC1 – Sustainable Energy and Construction

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

2b. New Development – Residential

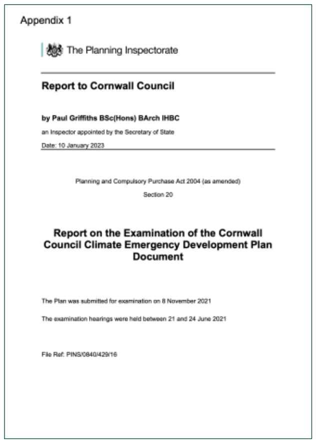
Residential development proposals will be required to achieve Net Zero Carbon and submit an 'Energy and Carbon Statement' that demonstrates how the proposal will achieve:

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

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

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

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


Appendix 1

The Planning Inspectorate

Report to Cornwall Council

by Paul Griffiths BSc(Hons) BArch IHBC

an Inspector appointed by the Secretary of State

Date: 10 January 2023

Planning and Compulsory Purchase Act 2004 (as amended)

Section 20

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

The Plan was submitted for examination on 8 November 2021

The examination hearings were held between 21 and 24 June 2021

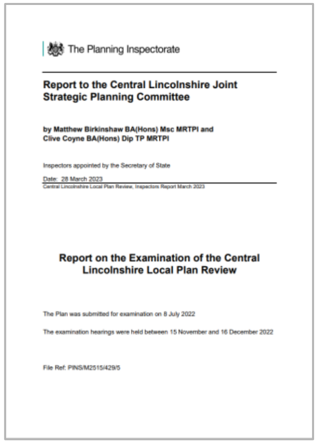
File Ref: PINS/0840/429/16

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

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

Conclusion

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



The Planning Inspectorate

Report to the Central Lincolnshire Joint Strategic Planning Committee

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

Inspectors appointed by the Secretary of State

Date: 28 March 2023

Central Lincolnshire Local Plan Review, Inspectors Report March 2023

Report on the Examination of the Central Lincolnshire Local Plan Review

The Plan was submitted for examination on 8 July 2022

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

File Ref: PINS/M2515/429/5

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

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

Reducing Energy Consumption in New Build

Design Principles for Efficient Buildings – Policy S6

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

Reducing Energy Consumption – Residential Development - Policy S7

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

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

Essex Legal Advice – Energy Policy and Building Regulations

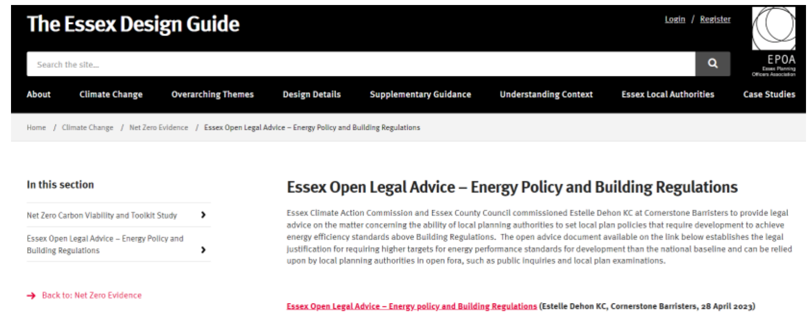
Essex Climate Action Commission and Essex County Council commissioned Estelle Dehon KC of Cornerstone Barristers to advise on the ability of local planning authorities to set local plan policies mandating energy efficiency standards for new building which exceed those in the Building Regulations, Part L, and also go beyond the 19% improvement over Building Regulations standards.

The conclusion of the legal opinion piece is stated below, confirming the local planning authorities ability to set local plan policies with energy efficiency standards and targets that go above Building Regulations.

68. In light of the above, LPAs have statutory authority to set energy efficiency targets that exceed the baseline in national Building Regulations, and to mandate that a proportion of the energy used in development in their area be from renewable and/or low carbon sources in the locality of the development. Nothing in law or national policy prevents them from doing so, or limits the amount by which they may exceed the baseline, provided that the relevant policies are reasonable, properly prepared, and do not conflict with any other national planning policies.

69. The amendment limiting the scope of section 1(c) of the PEA 2008 will not be brought into force, nor are any other amendments to the Act planned. The 2015 WMS has been overtaken by events and regard does not need to be paid to it, nor to the portion of the PPG on Climate Change which cites it. Government ministers and planning inspectors alike have recognised the power of LPAs to set ambitious energy efficiency targets through their local plans.

Extract from legal opinion piece, confirming local authorities ability to set their own energy targets for new buildings, above Building Regulations.



The open advice document is published on the [Net Zero Evidence webpage of the Essex Design Guide.]

8.0 Recommended net zero carbon new building policy requirements for Essex

Policy recommendation | Net Zero Carbon New Buildings in Operation

Introduction

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

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

Recommended overarching policy:

Net Zero Carbon New Buildings in Operation

Proposed policy wording

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

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

- **Requirement 1:** Space heating demand
- **Requirement 2 :** Fossil fuel free
- **Requirement 3 :** Energy Use Intensity (EUI)
- **Requirement 4 :** On-site renewable energy generation
- **Requirement 5 :** As-built performance confirmation and in-use monitoring
- Offsetting (as last resort)

Requirement 1

Space heating demand

Meeting space heating demand limits for residential and non-residential developments.

Demonstrated using predictive energy modelling.

Requirement 2

Fossil fuel free

Fossil fuels, such as oil and natural gas shall not be used to provide space heating, hot water or used for cooking.

Requirement 3

Energy use intensity (EUI)

Meeting energy use intensity (EUI) limits for residential and non-residential developments.

Demonstrated using predictive energy modelling.

Requirement 4

On-site renewable energy generation

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

Requirement 5

As-built performance confirmation and in-use monitoring

All developments should submit as-built performance information, at completion and prior to occupation. In-use energy monitoring is recommended.

Offsetting

(as a last resort)

Energy offsetting expressed in £/kWh should be used as a last resort to achieve planning policy compliance. When renewable energy generation policy is not met

Policy recommendation | Requirement 1: Space Heating Demand limits

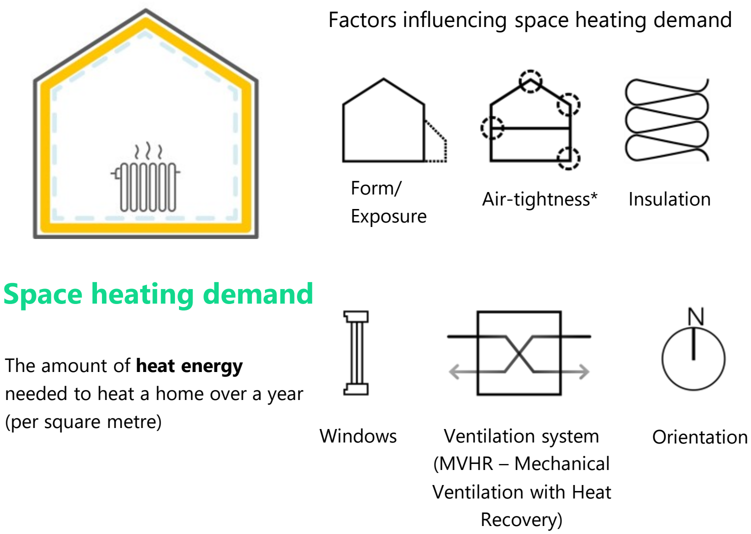
The space heating demand is the amount of heat energy needed to heat a home over a year and is expressed in kWh/m²/yr. It is a measure of the thermal efficiency of the building elements.

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

The Climate Change Committee recommends a space heating demand of 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.

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

Refer to Appendix 2.0 for further guidance on space heating demand calculations.



*High standards of air tightness are required for meeting space heating demand limits and net zero carbon targets; sufficient levels of ventilation and glazing ratios will ensure that indoor comfort conditions are maintained.

Requirement 1: Space Heating Demand

Proposed policy wording

- All residential** buildings, apart from bungalows, must achieve a space heating demand of less than 15 $kWh/m^2_{GIA*}/yr$.
- All bungalows, must achieve a space heating demand of less than 20 $kWh/m^2_{GIA*}/yr$.
- All non-residential buildings must achieve a space heating demand of less than 15 $kWh/m^2_{GIA*}/yr$.

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

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

** Residential buildings include use classes C3 and C4.
***Minor applications following the "minimum standards approach" (without an energy model), do not have to report their space heat demand, energy use intensity and offset contribution. Refer to "Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements" for further guidance.

Policy recommendation | Requirement 2: Fossil fuel free

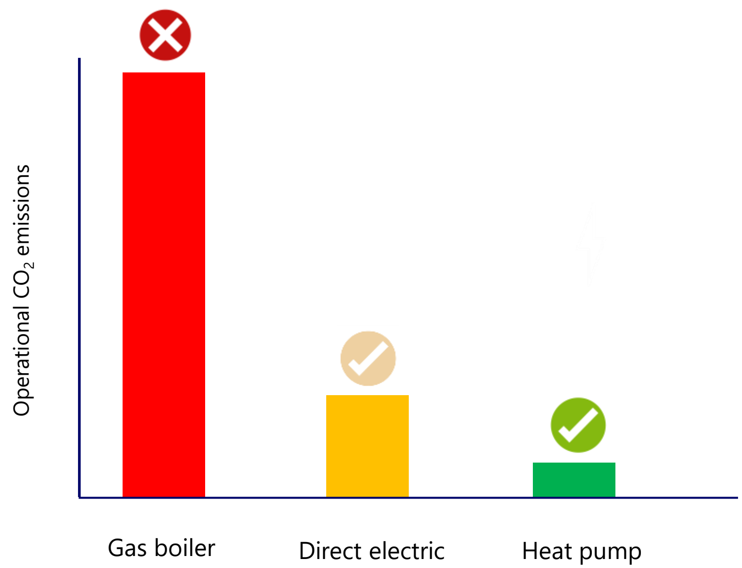
New buildings cannot continue to burn fossil fuels for heating if Essex is to stay within carbon budgets. Low carbon heat is therefore an essential component of a Net Zero Carbon building.

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

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

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

Refer to Appendix 2.0 for further guidance on discouraged low carbon heat alternatives.



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

Requirement 2: Fossil fuel free

Proposed policy wording

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

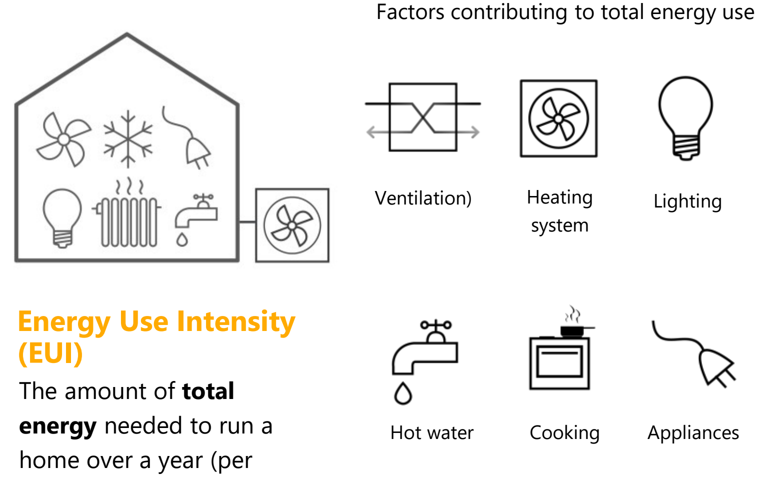
Policy recommendation | Requirement 3: Energy Use Intensity limits

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

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

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

Refer to Appendix 2.0 for further guidance on energy use intensity calculations.



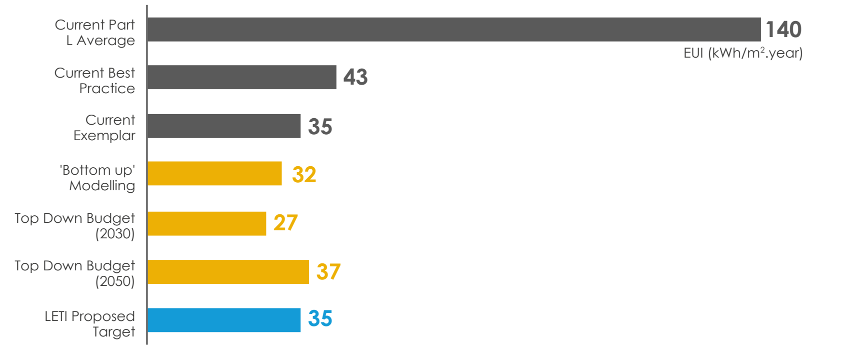
Energy Use Intensity (EUI)

The amount of **total energy** needed to run a home over a year (per square metre)

Requirement 3: Energy Use Intensity (EUI) limits

Proposed policy wording

- **Residential**** - All dwellings must achieve an Energy Use Intensity (EUI) of no more than 35 kWh/m$^2_{GIA*}$/yr to be demonstrated using predictive energy modelling.
- **Non-residential** - Non-domestic buildings must achieve an Energy Use Intensity (EUI) of no more than the following (where technically feasible) by building type or nearest equivalent to be demonstrated using predictive energy modelling.
  - Offices – 70 kWh/m$^2_{GIA*}$/yr
  - Schools – 65 kWh/m$^2_{GIA*}$/yr
  - Light Industrial – 35 kWh/m$^2_{GIA*}$/yr



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

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

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

** Residential buildings include use classes C3 and C4.
***Minor applications following the "minimum standards approach" (without an energy model), do not have to report their space heat demand, energy use intensity and offset contribution. Refer to "Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements" for further guidance.

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

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

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

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

Requirement 4: On-site renewable energy generation

Proposed policy wording

- Renewable energy must be generated on-site for all new developments.
- The renewable energy generation provision must meet the greater of:
  - Route 1*: The amount of energy generated in a year should match or exceed the predicted annual energy use of the building, i.e. Renewable energy generation ($kWh/m^2/yr$) = or > predicted annual energy use ($kWh/m^2/yr$).
  - Route 2*: as a minimum, the amount of energy generated in a year must be:
    - at least 80 $kWh/m^2_{building\ footprint}$ per annum for all building types
    - at least 120 $kWh/m^2_{building\ footprint}$ per annum for industrial buildings

The renewable energy generation output should be calculated following the [Microgeneration Certification Scheme](MCS) guidance method including the impact of shading.

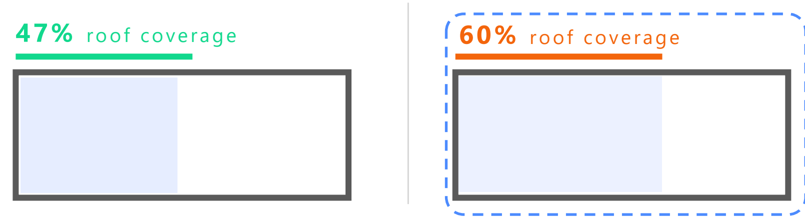
*When this is not technically possible and suitably justified, the applicant should contribute to the Council's offset fund (equivalent to the shortfall in meeting the annual energy consumption of the building) (see Offsetting section for further guidance).

Worked examples

Route 1: Matching predicted energy use

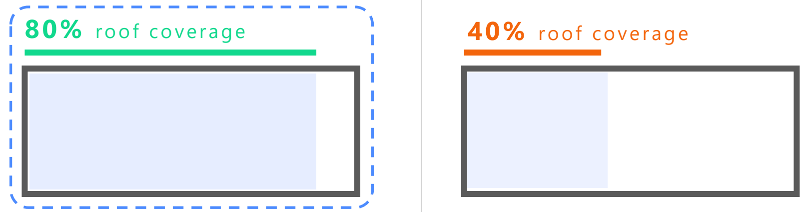
Route 2: Minimum PV generation

Industrial Building



Since Route 2 results with more PV panels being installed on this industrial building's roof - compliance would be achieved by following Route 2 minimum PV generation requirements.

Mid-Rise Apartment Block



Since Route 1 results with more PV panels being installed on this mid-rise apartment block's roof - compliance would be achieved by following Route 1 minimum PV generation requirements.

Policy recommendation | Requirement 5: As-built performance confirmation and in-use monitoring

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.

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.

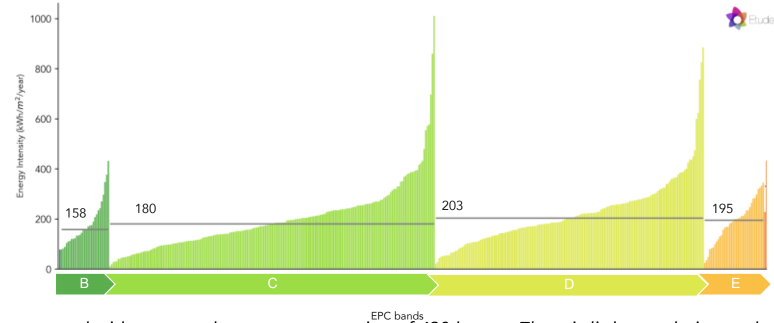
Refer to Appendix 2.0 for further guidance on in-use energy monitoring.

Requirement 5: As-built performance confirmation and in-use monitoring

Proposed policy wording

- All developments must submit as-built performance information, at completion and prior to occupation, as listed in Table (1).
- In-use energy monitoring is recommended for the first 5 years of operation, in order to understand how buildings are performing and minimise the performance gap. In-use energy monitoring will become a policy compliance requirement in the future; therefore applicant are encouraged to implement this sooner rather than later.

**Minor applications following the "minimum standards approach" (without an energy model), do not have to report their space heat demand, energy use intensity and offset contribution at as-built stage. Applications need to re-confirm the specifications that the development has been built to. Refer to "Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements" for further guidance.*



EPC data compared with measured energy consumption of 420 homes. There is little correlation and only marginal improvement on average energy consumption per EPC rating which demonstrates the existence of a performance gap between intended and actual energy performance. Credit: Etude

#	**Table 1: As-built stage performance indicators** (Required information to be submitted at completion, prior to occupation)
1	**Update parameters** • Use or typology • Gross Internal Area (GIA) (m²) • Energy supply (fossil fuel free?)
2	**Update performance modelling** • Space heat demand using predictive energy model (kWh/m²/year) • Energy Use Intensity using predictive energy model (kWh/m²/year) • As Built stage Energy Performance Certificate (EPC) (U-values and airtightness check) • Draft Display Energy Certifcate (DEC) for non residential (regardless of user)
3	**Confirm renewable energy installation** • Installed solar PV (kW_p) and annual output from PV generation meter • Any other installed renewable (i.e solar thermal)
4	**Update offset contribution** • Assess energy balance based on data supplied and confirm whether any offset payment is required, and how much
5	**Confirm process for collecting 'in use' data** • Confirm if in-use monitoring and reporting will be carried out • If yes, state what monitoring strategy is in place and confirm how data collected will be published

Policy recommendations | Offsetting (as last resort)

*The Climate Change Committee is clear: offsetting must have a very limited and defined role if the UK is to achieve Net Zero by 2050. Its role in the Net zero carbon new buildings policy should therefore be limited to a mechanism which enables buildings which **cannot technically achieve Net Zero Carbon on site** to be 'deemed compliant' with planning policy.*

Our recommendation is to limit the role and scope of the offset mechanism to a 'renewable energy offset' with the offset price expressed in £/kWh instead of £/tCO_2. This would make it independent from carbon factor changes.

Refer to Appendix 2.0 for further guidance on offset calculations.

Offsetting (as last resort)

Proposed policy wording

If Policy Requirement 4 is not technically possible and suitably justified, the applicant must establish the shortfall in renewable energy generation to enable the annual renewable energy generation to match the energy use of the building in kWh/yr (Route 1).

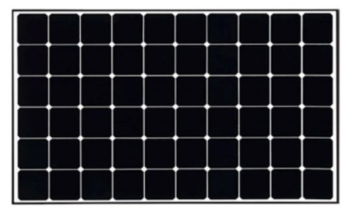
Renewable energy generation (kWh/m^2/yr) = predicted annual energy use (kWh/m^2/yr).

The applicant must pay into the Council's offset fund a sum of money to cover the purchasing and installation of a PV renewable energy system elsewhere in the plan area, which is to meet the shortfall in renewable energy generation.

An offset price of £1.35/kWh is recommended for Essex. This tariff should be reviewed at least every 3 years.

Reduced operational energy consumption	**Achieve a Space Heating Demand and an Energy Use Intensity (EUI) lower than the levels required in the Local Plan**	✓
Low carbon energy supply	**No gas connection or fossil fuel use on site** (or connection to heat networks using fossil fuels)	✓
On-site renewable energy generation	**Maximizes on-site renewable energy generation**	✓
Net Zero energy balance	**Annual balance of zero** for the whole development showing predicted energy use and renewable energy generation on-site.	✗ (offset role)

List of requirements an application would have to meet before being allowed to use offsetting as a planning compliance mechanism. It is proposed to restrict the offset mechanism to fund 'missing' PVs.



£1.35 /kWh

Recommended offset price (based on the energy balance shortfall)

Our recommendation is that the offset contribution is used to fund PV systems in the plan area. The main reason for this is that the shortfall it is trying to compensate is a renewable energy generation shortfall.

As the source of the energy offset is the gap between energy use and renewable energy generation (or the gap between the required and actual renewable energy generation on site), its price should be set on the basis of the cost of PVs.
*Therefore, the offset price should be set at a level which enables the Council to find, manage, fund and deliver these PV systems off-site. Using a reasonable cost rate for a high output PV system with micro-inverters(i.e. £1,075/kWp) and applying a 20% additional rate for administering and managing the PV funding process, would give an energy offset price of **£1.35/kWh.***
This is assuming a conservative energy generation rate for the PV system of 800 kWh/kWp

**Minor applications following the "minimum standards approach" (without an energy model), do not have to report their space heat demand, energy use intensity and offset contribution. Refer to "Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements" for further guidance.

Further guidance

Alternative approach to policy compliance

Passivhaus:

An alternative approach to policy compliance is through the certified PassivHaus Classic or higher PassivHaus standard. Where a development is proposed to be built and certified to this standard, policy requirement 1 and 3 are deemed to be met through the Passivhaus certification. Requirements 2, 4 and 5 of the policy will have to be met to achieve compliance. The energy offsetting mechanism will only be allowed as a last resort in circumstances where requirement 4 cannot be fully met.

BREEAM:

As the BREEAM energy credits follow the same framework of the Part L Building Regulations, using BREEAM as an alternative approach to policy compliance will not be accepted.

☑ Can be used as an alternative policy compliance approach

☒ Cannot be used as an alternative policy compliance approach

Non-modelled typologies

For non-domestic typologies (other than office, school and light industrial), applicants are expected to comply with all the policy requirements, apart from Requirement 3: Energy Use Intensity limits. Applicants should instead report their energy use intensity, but are not expected to comply with a certain limit. Net Zero energy use intensity limits are being developed by the UK Net Zero Carbon Building Standard in 2023 as it is recommended that applicants seek to meet these limits.

Extensions and conversions

Extensions and conversions are encouraged to meet the policy requirements where possible. It is recommended that the fabric meets the minimum standard approach fabric specifications, and that on-site renewable energy generation is installed and maximised.

9.0 Technical evidence base for new domestic buildings

Typology Selection

Energy and cost analysis have been undertaken for six domestic typologies, which represent a range of building forms and sizes as dwelling density can have an impact on energy efficiency and renewable energy generation. The typologies selected were based on typical domestic archetypes and what is expected to come forward in Essex over the next local plan periods.

Note that some of the domestic typologies are smaller than the minimum nationally described space standard (NDSS) gross internal area (GIA) requirements. It is important to note that typologies with smaller floor plates are harder to meet the space heating demand and energy use intensity limits, therefore homes with bigger floor plates than the ones shown in this evidence base will be easier to comply with the proposed policy limits.

1. Terrace Block

Typical 4 bedroom - 95 m^2

This building represents the generic **Terrace block** typology

2. Bungalow

1 storey - 93 m^2

This building represents the generic **Bungalow** typology

3. Semi-detached house

2 storeys - 108m^2

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

4. Block of flats - Low-Rise

3/4 storeys - 641 m^2

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

5. Block of flats – Mid-Rise

5 storeys - 3200 m^2

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

6. Block of flats - High-Rise

15 storeys - 15,500 m^2

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

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

Requirement 1 of the Net Zero policy requires:

- all dwellings, apart from bungalows, to achieve a space heating demand of less than **15 kWh/m²/year**.
- all bungalows, to achieve a space heating demand of less than **20 kWh/m²/year**.

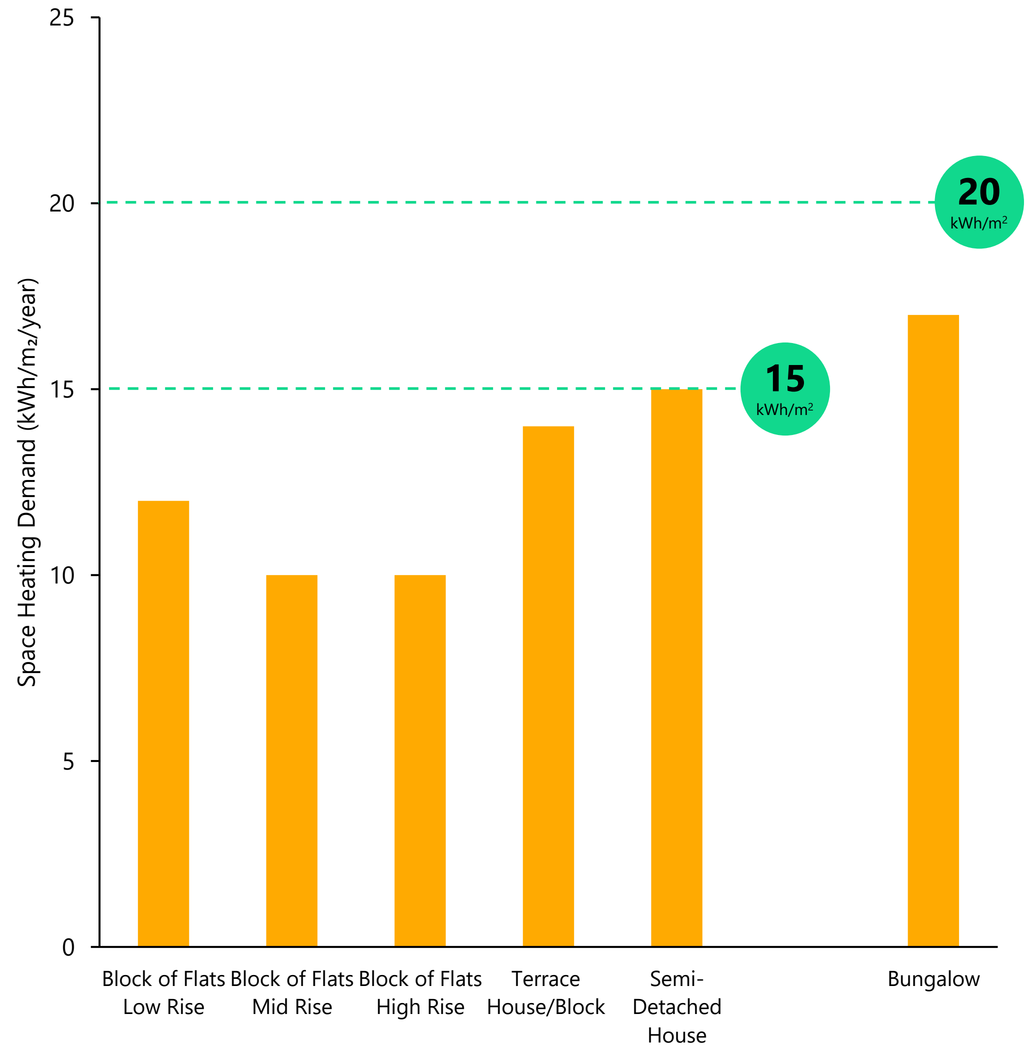
Technical Feasibility

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

The space heating demand results and the proposed policy limit are shown on *Graph 9.1*.

Conclusion

All dwellings and bungalow achieve a space heating demand of less than 15 kWh/m²/year and 20 kWh/m²/year respectively, demonstrating that the proposed Net Zero policy requirement 1 is technically feasible.



Graph 9.1: Space heating demand results from PHPP modelling of all the domestic typologies

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

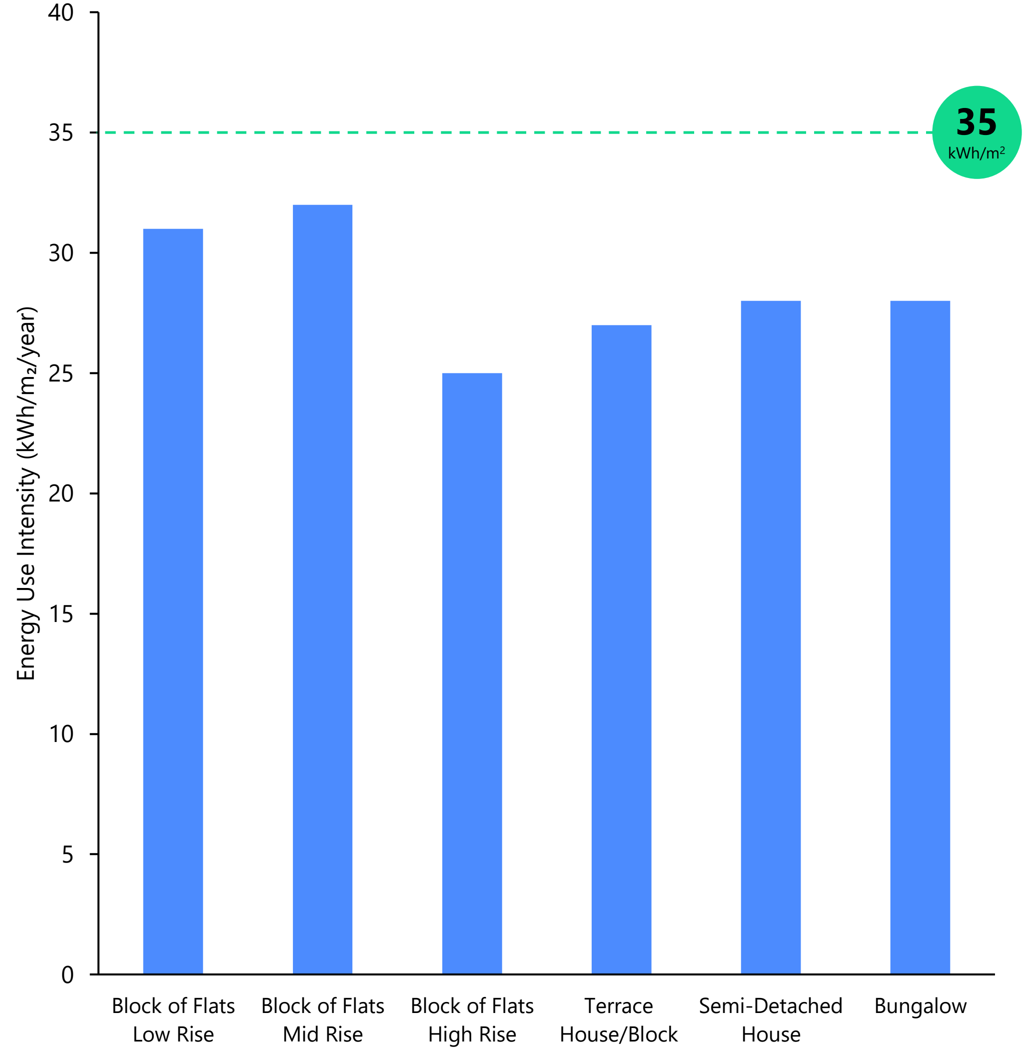
Technical Feasibility

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

The energy use intensity results with the proposed policy limit of 35 kWh/m²/year are shown on *Graph 9.2*.

Conclusion

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



Graph 9.2: Energy use intensity results from PHPP modelling of all the domestic typologies

10.0 Technical evidence base for new non-domestic buildings

Typology Selection

Energy and cost analysis have been undertaken for three non-domestic typologies, which represent typical non-domestic archetypes and what is expected to come forward in Essex over the next local plan periods.

1. Office

7 storeys - 4,000 m^2

This building represents the generic **office building** typology

2. School

3/4 storeys - 6,000 m^2

This building represents the generic **primary school building** typology

3. Industrial

2 storeys - 9,000 m^2

This building represents the generic light operation **industrial building** typology (distribution/warehouse)

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

Requirement 1 of the Net Zero policy requires all non-domestic buildings, to achieve a space heating demand of less than 15 kWh/m²/year.

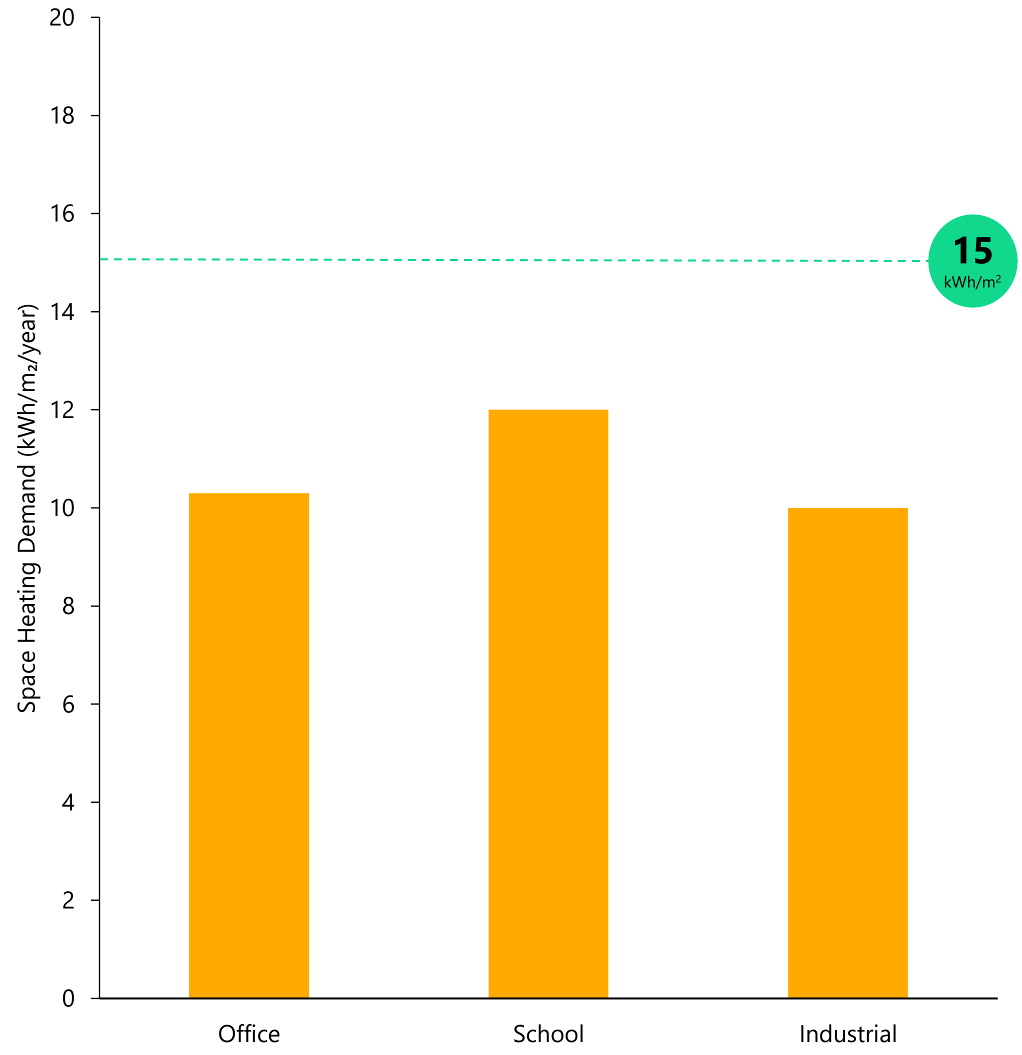
Technical Feasibility

Predictive energy modelling using IESVE (Integrated Environmental Solutions Virtual Environment) software following the CIBSE TM54 methodology was carried out for the three non-domestic typologies using different fabric and systems specifications, which are listed in Appendix 1.

The space heating demand results with the proposed policy limit are shown on *Graph 10.1*.

Conclusion

All the non-domestic typologies achieve a space heating demand of less than 15 kWh/m²/year, demonstrating that the proposed Net Zero policy requirement 1 is technically feasible.



Graph 10.1: Space heating demand results from TM54 modelling of all the non-domestic typologies

Requirement 3 of the Net Zero policy requires all non-domestic buildings, to achieve an energy use intensity of no more than the following:

- Offices – 70 kWh/m^2_{GIA}/yr
- Schools – 65 kWh/m^2_{GIA}/yr
- Light Industrial – 35 kWh/m^2_{GIA}/yr

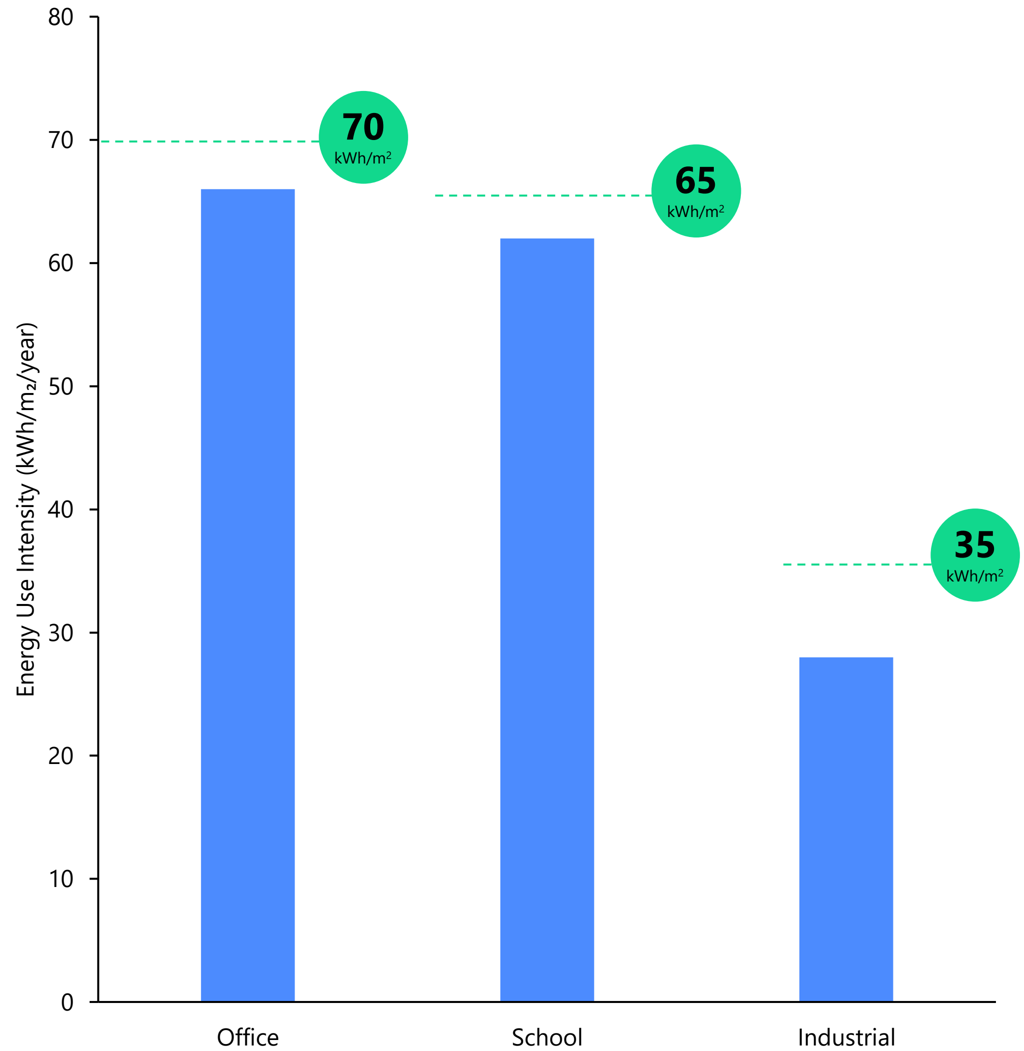
Technical Feasibility

Predictive energy modelling using IESVE (Integrated Environmental Solutions Virtual Environment) software following the CIBSE TM54 methodology was carried out for the three non-domestic typologies using different fabric and systems specifications, which are listed in Appendix 1.

The energy use intensity results with the proposed policy target are shown on Graph *10.2*.

Conclusion

Results show that all the non-domestic typologies achieve an energy use intensity of no more than recommended limits in policy requirement 3, demonstrating that the proposed Net Zero policy requirement 3 is technically feasible.



Graph 10.2: Energy use intensity results from TM54 modelling of all the non-domestic typologies

11.0 Cost evidence base to inform viability testing

Introduction to cost analysis

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 capital cost for the typologies under the modelled specifications for complying with the proposed net zero policy.

Costing approach

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

The costs are based on Q1 2023 prices and reflect a South England / Essex cost base.

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

How were the baseline build costs calculated

The assumed baseline build cost is based on a current Part L 2021 policy compliant scenario. This scenario uses the Part L 2021 notional building specification and does not look to surpass demands of current carbon policy. A benchmark £/m^2 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 region. Overall baseline capital cost will vary according to the level of external and internal finishes, fittings etc. The benchmark costs assume a medium specification.

Cost Uplift

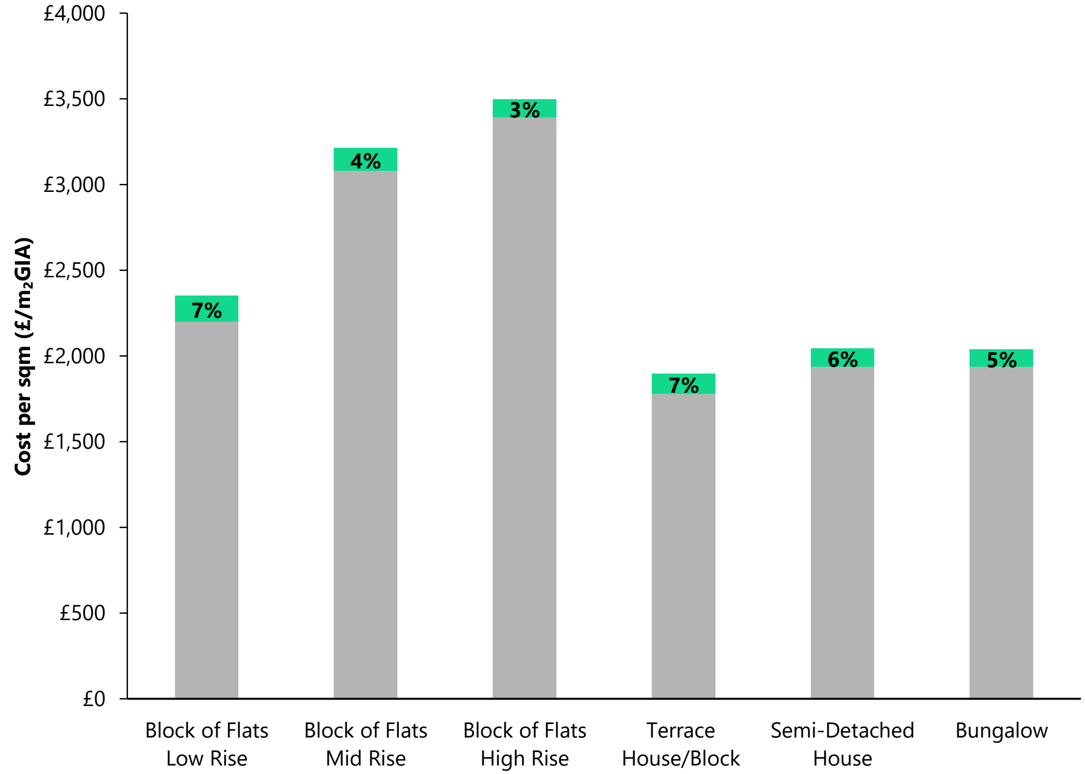
To meet the Net Zero policy energy use intensity and space heating demand limits, the total capital cost uplift over Part L 2021 Building Regulations (does not include running cost) ranges between **3% - 7%.**

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

- Fabric costs are particularly high for bungalows due to the high fabric standard within the specification (U-value of <0.1Wm²K) together with the greater area of external envelope per m² of internal space in this building type.
- Additional MEP (mechanical, electrical and plumbing systems) costs are higher for low rise flats than other homes because the alternative (Part L 2021) scenario for this archetype involves the use of a combi boiler which does not require a cylinder. The change to a heat pump involves both the cost of the heat pump and the additional of a hot water cylinder. In homes where the Part L2021 solution involves a system boiler and cylinder the cost of the cylinder is similar to that used with a heat pump system.
- The costs of PV arrays required to meet the Net Zero specifications vary by archetype. Houses, with roof area to internal area ratios between 0.5 and 1, typically require similar or even less PV than would be needed to meet Part L 2021. This is because Part L 2021 specifies the required PV area on the basis of building footprint rather than in response to actual energy demand. As a result, cost uplifts are small or in the case of bungalows negative. For flats the Net Zero specifications requires more PV than would be needed to meet Part L 2021 resulting in a more significant cost uplift for these archetypes.
- Total cost uplift is particularly high for low rise flats due to a combination of higher cost per m² (see point 2 above) and a large unit size (92m² per flat).

Costs in range of £100-£150m² applicable to most types. Cost build up varies according to characteristics of home type.

Refer to Appendix 3.0 for a further breakdown of capital cost



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

Cost Uplift per m2 GIA	Block of Flats Low Rise	Block of Flats Mid Rise	Block of Flats High Rise	Terrace Block	Semi-Detached House	Bungalow
Fabric	£66	£60	£47	£66	£50	£86
MEP	£69	£45	£47	£54	£57	£52
Solar	£17	£30	£15	£0	£2	-£35
Total (£/m²)*	**£152**	**£135**	**£108**	**£120**	**£110**	**£103**
Total per home	**£14,000**	**£10,800**	**£9,400**	**£11,400**	**£11,880**	**£9,579**

* totals do not sum exactly due to rounding

Cost Modelling | Non-Domestic Typologies

Cost Uplift

To meet the Net Zero policy energy use intensity and space heating demand limits, the total capital cost uplift over Part L 2021 Building Regulations (does not include running cost) ranges between **2% - 12%.**

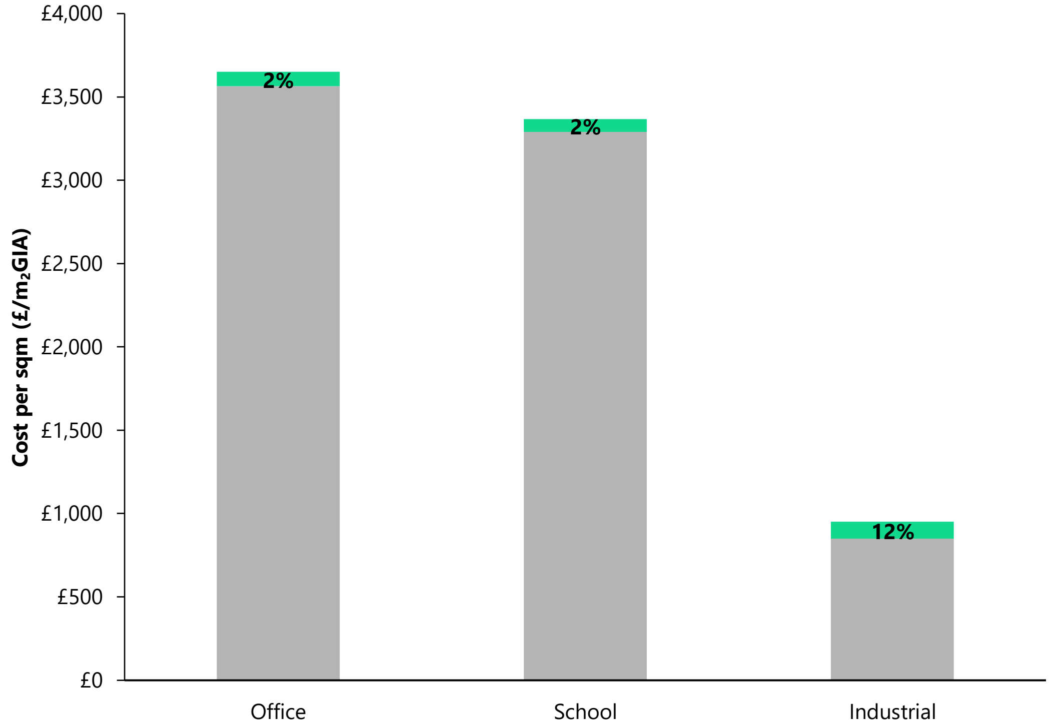
The graph outlines the total capital cost for the non-domestic typologies, and the percentage uplift compared to the Baseline building (Part L 2021 Notional Building), further information on the specifications modelled can be found in Appendix 1.0. The table gives the cost uplift breakdown for fabric, systems and PV panels.

Absolute and relative cost uplifts are highest for the Industrial building, partly because it has a relatively inexpensive base build cost at less than £1,000/m² but also because there is a greater need to improve both fabric and services to achieve the energy efficiency targets.

The school building can achieve the 65kWh/m² target with relatively little additional build cost with some of the investment in higher fabric standards offset by savings in the size of the heating plant and reduced need for internal plant room. It is noted that the Essex CC Infrastructure Delivery team are already achieving better than the 65kWh/m² target in their new school projects. Furthermore, they also build to these standards in projects that are classed as 'Permitted Development' and don't need to submit a planning application.

Additional costs for office building area also relatively small at c.2% of total capital costs. Fabric specifications are relatively unchanged from Part L notional specifications with savings achieved through low carbon systems and high efficiency lighting and ventilation systems.

Refer to Appendix 3.0 for a further breakdown of capital cost



Graph 11.2: Non-domestic typologies capital cost per square meter and cost uplift % of Net Zero policy over Building Regulations Part l 2021 Notional Building.

Cost Uplift per m2 GIA	Office	School	Industrial
Fabric	£9	£26	£53
MEP	£46	-£14	£41
Solar	£33	£65	£7
Total (£/m²)*	**£87**	**£77**	**£100**

* totals do not sum exactly due to rounding

Conclusions

This analysis indicates that the modelled Net Zero specifications can be achieved for a cost uplift over Part L 2021 of £100-£150m² for domestic buildings and £75-£100m² for non-domestic construction.

The domestic cost analysis reflect the cost base of a medium sized housebuilder or contractor and it is likely that costs would vary for self-build / bespoke designs, in these instances the overall build cost will also vary and in most instances is likely to be substantially higher than that for medium or larger housebuilders. The relative percentage uplifts in cost (eg 3-7% for homes) are considered representative of the scale of cost uplift that would be incurred by different developer types.

This analysis provides a detailed analysis of the costs of adopting zero carbon policy in Essex and illustrates that the uplift costs are similar (for 1-2 bed flats) or lower (houses) than those previously estimated for the county (see table right).

This means that viability should be improved when using these cost estimates in comparison to those calculated previously. The spread of archetypes and designs is quite broad meaning that planning authorities should be able to select a suitable mix of home types for most development scenarios.

Figure 10.8 additional specifications required to achieve carbon reduction standards

Building Type	Cost of achieving Standard (£s)		
	2021 Building Regulations*	2025 Future Homes (+)	net zero (+)
Average 2-bedroom terraced house – circa 70m²	3,000	12,000	14,000
Average larger 3-bedroom house, or small 4 bedroom – circa 97m²	3,000	13,500	16,000
Average 1 or 2-bedroom apartment – circa 56m2 NIA (i.e. plus circulation)	1,900	8,000	11,000
	*Additional costs on current Regulations + Additional costs on 2021 Regulations		

Extract taken from the "Net Zero Carbon Viability and Toolkit Study" prepared by Three Dragons, Qoda and Ward Willaims Associates.

12.0 Appendices

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

Appendix 1: Energy modelling and costing specifications: domestic typologies

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

Domestic Developments		Baseline (Part L 2021 Notional Building)	Block of Flats Low Rise	Block of Flats Mid Rise	Block of Flats High Rise	Terrace Block	Semi-Detached House	Bungalow
Fabric	Floor U-value	0.13	0.08	0.08	0.08	0.08	0.09	0.08
	External Wall U-value	0.18	0.10	0.13	0.13	0.11	0.13	0.09
	Roof U-value	0.11	0.10	0.1	0.1	0.1	0.1	0.09
	Windows U-value	1.2	0.80	0.8	0.9	0.8	0.8	0.8
	Windows G-value	0.5	0.50	0.50	0.50	0.6	-	-
	External doors U-value	-	-	-	-	1.2	0.9 - 1	0.9-1
	Thermal bridging	As calc	0.04 W/m^2K	0.04 W/m^2K	0.04 W/m^2K	0.04 W/m^2K	0.02 W/m^2K	0.02 W/m^2K
	Air permeability	5 ach	<1 ach	<1 ach	<1 ach	<1 ach	0.64 ach	0.45 ach
Systems	Ventilation system	dMEV	MVHR	MVHR	MVHR	MVHR	MVHR	MVHR
	Ventilation system heat recovery	n/a	90%	90%	90%	90%	88%	88%
	Ventilation system specific fan power (W/l/s)	n/a	0.85	0.85	0.85	0.85	0.85	0.85
	Space heating system	Gas Boiler	Individual ASHP	Communal ASHP	Communal ASHP	Individual ASHP	Individual ASHP	Individual ASHP
	Space heating efficiency	90%	190%	190%	190%	270%	270%	270%
	DHW system	Gas Boiler	Individual ASHP	Instantaneous through HIU	Instantaneous through HIU	Individual ASHP	Individual ASHP	Individual ASHP
	DHW efficiency	90%	210%	210%	210%	210%	210%	210%
	Lighting Efficacy (lm/W)	-	95	95	95	95	95	95

Appendix 1: Energy modelling and costing specifications: non-domestic typologies

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

Non-Domestic Developments		Baseline (Part L 2021 Notional Building)	Office	School	Industrial
Fabric	Floor U-value	0.15 (industrial 0.22)	0.12	0.12	0.13
	External Wall U-value	0.18 (industrial 0.26)	0.18	0.18	0.14
	Roof U-value	0.15 (industrial 0.18)	0.13	0.13	0.11
	Windows U-value	1.4 (industrial 1.6)	1.4	1.2	1.2/1.4
	Windows G-value	0.3	0.4	0.5	0.4/0.5
	External doors U-value	1.9 (external door)/1.3 (vehicle door)	1.5	1.6	1.5 (external door)/1.3 (vehicle door)
	Thermal bridging	-	3% of losses	25% added to U-values	1% of losses
	Air permeability	3ach (industrial 5ach)	3	3	2
Systems	Ventilation system	AHU + HR	MVHR	MVHR	MVHR
	Ventilation system heat recovery	76%	90%	70%	80%
	Ventilation system specific fan power (W/l/s)	-	1.2	1.6	1.2
	Space heating system	Gas Boiler	VRF	Heat pump	ASHP - warehouse VRF - Offices
	Space heating efficiency	90%	350%	400%	300% - warehouse 450% - Offices
	DHW system	Gas Boiler	Direct Electric	Direct Electric	Direct Electric
	DHW efficiency	90%	100% for WC 300% for showers	100%	100%
	Cooling system	Air cooled chiller (office)	VRF	NA	VRF
	Cooling efficiency	4.4 SEER	3.5 EER 5.0 SEER	NA	3.5 EER 5.0 SEER
	Lighting Efficacy (lm/W)	95	140	105	115

Acronyms

AHU – Air handling unit

AHU + HR – Air handling unit with heat recovery

ASHP – Air source heat pump

DHW – Domestic hot water

dMEV – Decentralised mechanical extract ventilation

EER – Energy efficiency ratio

HIU – Heat interface unit

MVHR – Mechanical ventilation with heat recovery

SEER – Seasonal energy efficiency ratio

Appendix 2.0
Additional information

Additional information on policy requirements

Policy requirement 1 – Space heating demand limits

Internal room temperature – The typologies in this evidence base have been modelled with the following internal room temperatures:

- All domestic: 20°C
- All non-domestic (excluding light industrial): 21°C
- Light industrial: 18°C
- **Other building typologies** - when undertaking space heating demand calculations, to show that the policy is met, building typologies that have not been included within this evidence base, should be modelled with an internal room temperature of **21°C**.

Policy requirement 2 – Fossil fuel free

Heating provided through wood burners and biomass boilers are discouraged for air quality purposes.

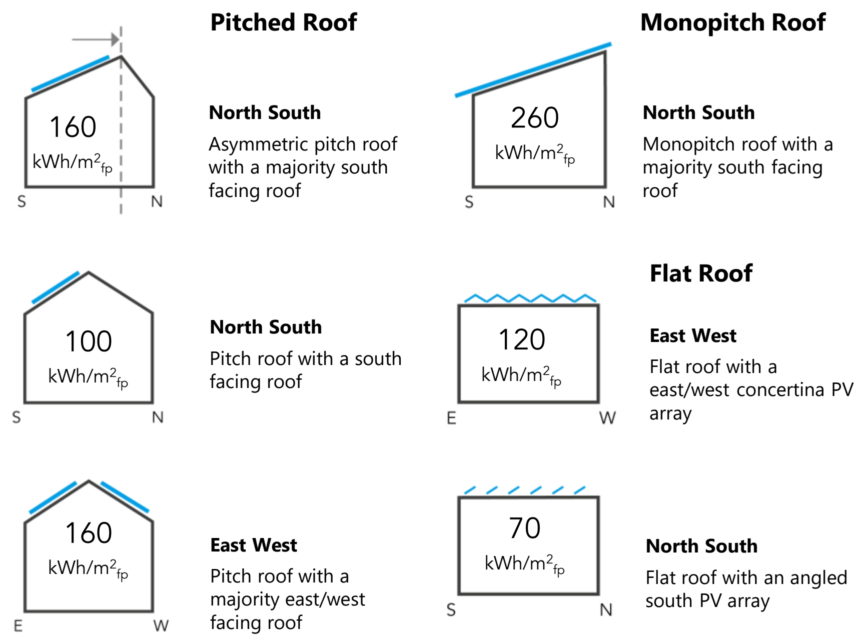
Policy requirement 3 – Energy use intensity limits

Appliances energy rating – appliances in the upper quartile of currently available models are recommended for achieving the proposed energy use intensity limits.

District heat networks – developments connected to a district heat network are expected to meet the proposed EUI limits. The limits set for EUI for each building should be the same irrespective of the heating system that is proposed, to allow a fair comparison between different heating options. The EUI calculations for a scheme connected to a district heat network would have to include the energy consumption of the district heating heat generation plant. This means that the EUI includes the heat losses of the district heating system.

Policy requirement 4 – Renewable energy generation

The following shows the potential deliverable levels of generation for developments with roofs at different orientations.



Roof design can be optimised to maximise energy output from photovoltaics. A useful indicator of this is expressed in kWh generated per m² of building footprint (kWh/m^2_{fp})

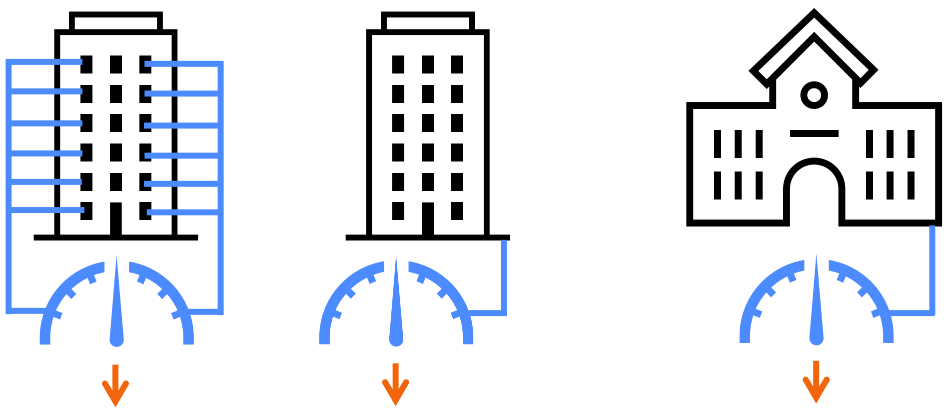
Additional information on policy requirements

Policy requirement 5 – As-built performance confirmation and in-use monitoring

As-built performance confirmation is a policy requirement and the information to submit is set out on Page 35 – Table 1. In-use energy monitoring is encouraged to be started now by developers on their sites to help aid continuous learning and improvement on the delivery of net zero buildings, and also in readiness for when this is introduced as a policy requirement in the future. More information on how to carry out in-use monitoring is discussed below:

Block of Flats

Non-Domestic



Automated meter reading (AMR) or clamp on meters or Building Management System (BMS). Data can be extracted by building management and fed into the council's reporting platform.

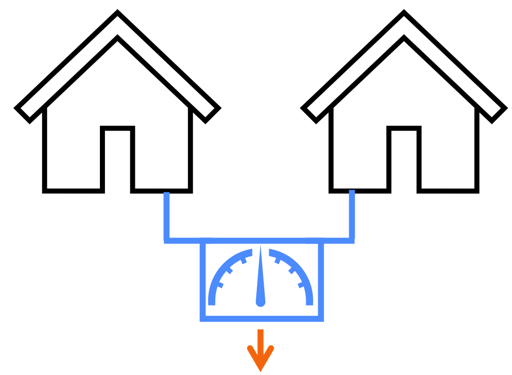
Pros

- ✓ Monitor and compare in-use energy consumption with predicted design stage energy consumption
- ✓ Helps minimize the performance gap
- ✓ Identifies inefficient /non-compliant buildings
- ✓ More likely to achieve policy outcome if reporting energy performance is required

Cons

- ✗ A lot of data gathering
- ✗ Potential privacy issues for individual homes
- ✗ Local council have to fund reporting platform
- ✗ Reporting responsibility issues

Individual Homes



More difficult to implement for individual homes.
Clamp on meter reading system could be installed, or manual readings given by Tenant. This will require agreement from tenant to have an additional clamp on meter added to their property.

Data can be extracted and fed into the council's reporting platform.

Additional information on policy requirements

Offsetting (as a last resort)

Worked example of the offset calculation

Step 1: Calculate building annual energy consumption

= EUI x GIA

= 35 kWh/m^2/year X 15,500 m^2 = 542,500 kWh/year

Installed PV system will have to generate 542,500 kWh/year.

Step 2: Calculate if required PV system can fit on the development.

Assuming that a single PV panel generates 450 kWh/panel/year and each panel has an area of 2.6 m^2, meeting the building annual energy consumption would require a total PV area of 3,136 m^2

Due to the fact that this is a high-rise block of flats with limited roof space, the roof area cannot accommodate all of the required PV area to meet annual energy consumption (can only accommodate 477.5m^2 of PVs, which is equivalent to 82,644 kWh/year)

Step 3: Calculate the shortfall in renewable energy generation to match the building's annual energy consumption

The shortfall is 542,500 – 82,644 = **459,856 kWh/year** .

Step 4: Calculate the one-off offset contribution based on an offset price of £1.35/kWh

= Generation shortfall X Offset price

= 459,856 kWh X £1.35/kWh

= £620,574

Worked example building specifications:

Use type	Residential - high rise block of flat
Gross Internal Area - GIA (m^2)	15,500 m^2
Area of PV that fits on the roof (m^2)	477.5 m^2
Energy Use Intensity - EUI (kWh/m^2/year)	35 kWh/m^2/year
Offset price (£/kWh)	£1.35/kWh

Additional information

In addition to this report, the Essex Climate Action Commission have commissioned Introba to develop "*Report 2: Essex Net Zero Policy – Summary of Policy, evidence and validation requirements*" which gives a high-level summary of the proposed Net Zero policy requirements, evidence and validation requirements for different planning applications, monitoring guidance and high-level design guidance for two different domestic typologies. The below summarises the contents of the report:

1.0 Recommended Policy for Essex: Net Zero Carbon New Buildings in Operation → **2.0 Evidence and validation requirements** → **3.0 Monitoring of the policies** → **4.0 Design guides** → **5.0 Appendices**

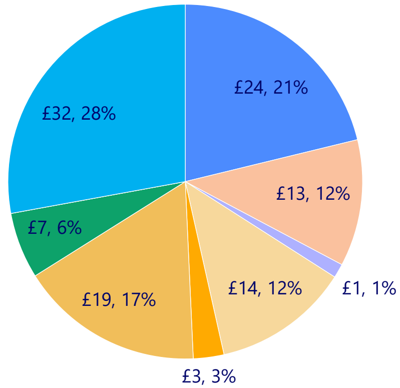
Appendix 3.0
Cost breakdown

Cost Breakdown for Residential Typologies

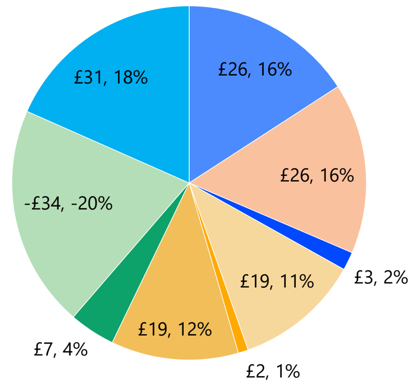
The following pie charts break down the total capital cost for the residential typologies. The results are presented in % and £/m².

Key:

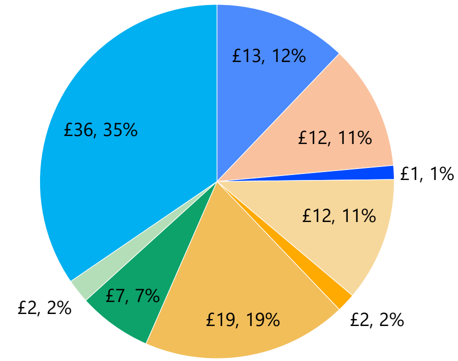
- Floor
- External Wall
- Roof
- Window
- Thermal Bridging
- Ventilation
- Airtightness
- PV
- Heating Source



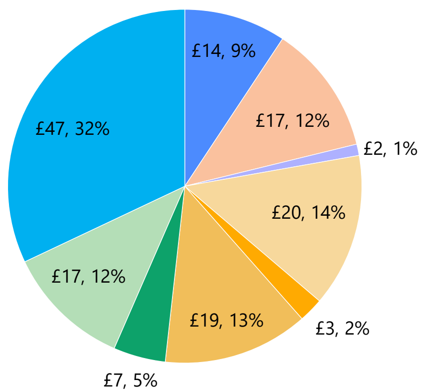
1. Terrace Block



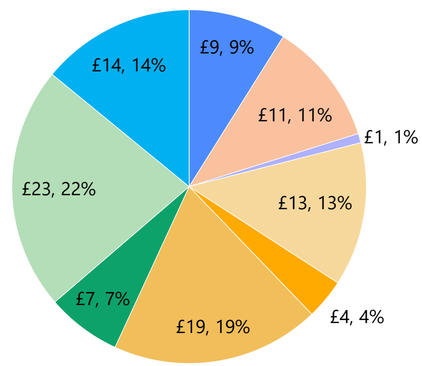
2. Bungalow



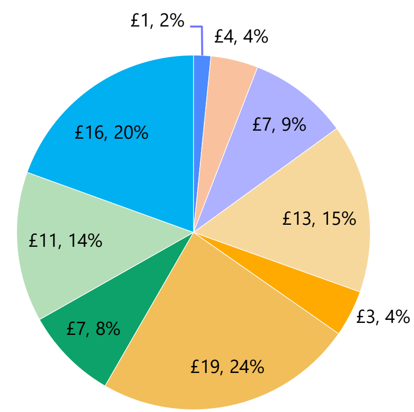
3. Semi-detached house



4. Block of flats - Low-Rise



5. Block of flats – Mid-Rise



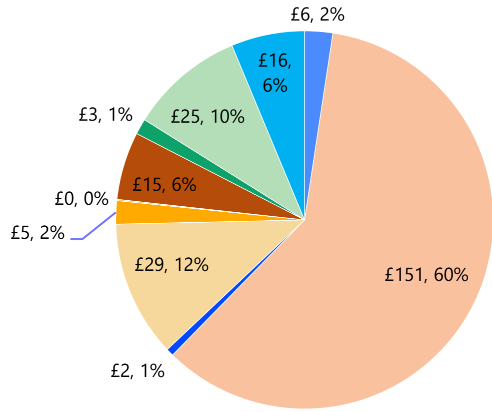
6. Block of flats - High-Rise

Cost Breakdown for Non-Residential Typologies

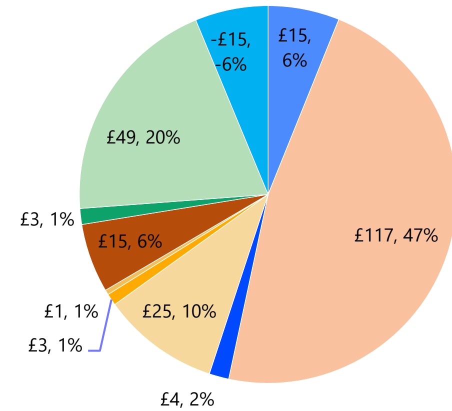
The following pie charts break down the total capital cost for the non-residential typologies. The results are presented in % and £/m^2.

Key:

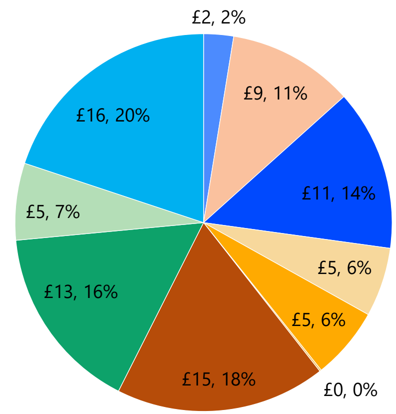
- Floor
- External Wall
- Roof
- Window
- Thermal Bridging
- Ventilation
- Lighting
- Airtightness
- PV
- Heating and cooling



1. Office



2. School



3. Industrial