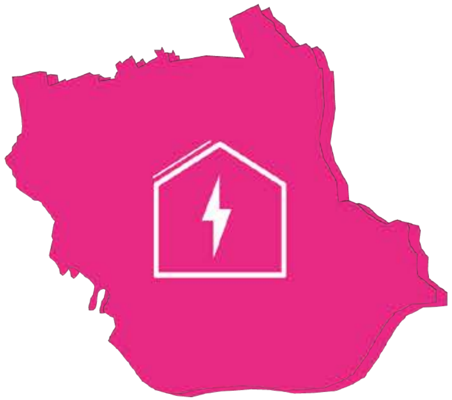
Newham London



NEW LOCAL PLAN | CLIMATE EMERGENCY

Operational energy and carbon evidence base

May 2022 | Rev H

Levitt Bernstein People.Design ELEMENTA Currie & Brown Etude

Who prepared this evidence base?

Newham London

The London Borough of Newham commissioned a multidisciplinary team of architects, engineers, cost consultants and energy specialists to develop this evidence base.

The work was directed by Ellie Kuper Thomas (Planning Policy Manager) and James Scantlebury (Senior Planner).

Levitt Bernstein People.Design

Levitt Bernstein is an award-winning architectural practice with a progressive and sustainable outlook.

Levitt Bernstein have specialised in the design of homes since 1968 and have a national reputation for our work in policy, standards and regulation. This includes work on the Nationally Described Space Standard and the three-tier standard for Approved Document M..

ELEMENTA

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

Elementa operate in all sectors of the built environment.

Currie & Brown

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

Etude

Etude is a SME of engineers specialising in energy and sustainability and dedicated to finding solutions to the climate crisis. One of our strengths is to combine building projects (which we work on at all phases) and strategic technical work on Net Zero carbon, including evidence bases and action plans. We regularly advise Local Authorities on carbon reduction, including Greater Cambridge, Cornwall Council, and many London boroughs.

This evidence base

Seven new policies are proposed to reduce operational energy and carbon emissions from new buildings in order to enable the London Borough of Newham to meet its climate change commitments.

Policy 1 Net Zero Carbon new buildings is the overarching policy.

All new buildings should be designed and built to be Net Zero Carbon in operation. They should be ultra-low energy buildings, use low carbon heat, contribute to the generation of renewable energy on-site and be constructed with low levels of embodied carbon.

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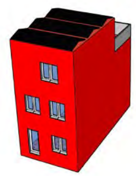
It relies on compliance with six other proposed policies.

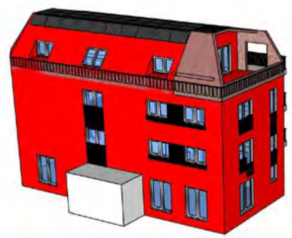
- Policy 2: Space heating demand
- Policy 3: Low carbon heat
- Policy 4: Energy Use Intensity (EUI)
- Policy 5: On-site renewable energy generation
- Policy 6: Assured energy performance
- Policy 7: Offsetting (as last resort)

Proposed policies on embodied carbon, retrofit and overheating are dealt with in other documents.

After evidencing the need for these policies, this document demonstrates why current policies are not fit for purpose anymore and why these proposed policies are technically feasible using six different building typologies as case studies: four residential and two industrial. It is providing an assessment of their additional costs, which can feed into the viability assessment of the proposed new Local Plan.

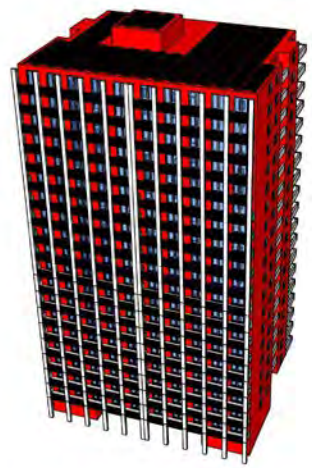


3-bed Townhouse
GIA: 116m²

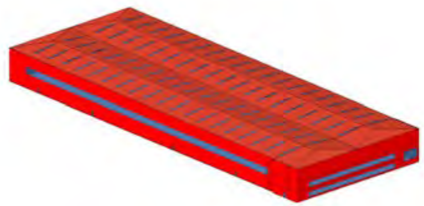


Low rise block (7 units)
GIA: 641m²

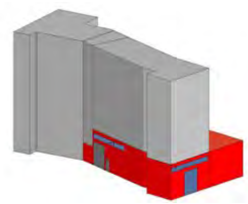
Mid rise block (28 units)
GIA: 2,1256m²



High rise block (169 units)
GIA: 15,541m²



Large Industrial Unit
GIA: 12,153m²



Small Industrial Unit
GIA: 466m² (4 small units)
(Resi above- shown in grey)

Contents

1.0

Evidence of Need

This section sets out the evidence justifying why energy use and carbon reductions from new buildings need to be drastically reduced if Newham's Local Plan is to be consistent with global, national, regional and local carbon reduction commitments

The Newham Local Plan must comply with global 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. Newham Council declared a climate emergency in 2019.

The Glasgow Agreement (2021)

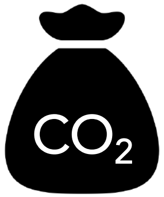
International negotiations on climate change are governed through the United Nations Framework Convention on Climate Change (UNFCCC). The most recent negotiations concluded with the Glasgow Agreement in 2021. Nations collectively agreed to work to reduce the gap between existing emission reduction plans and what is required to reduce emissions, so that the rise in the global average temperature can be limited to 1.5 degrees.

Global carbon budgets

The concept of carbon budgets is an important one. The IPCC Special Report on 1.5°C has estimated the quantity of CO_2 that can be emitted globally and still be consistent with keeping global temperatures well below 2°C with an outside chance of stabilising at 1.5°C. The report gives different budgets for different temperature rises and probabilities.

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

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

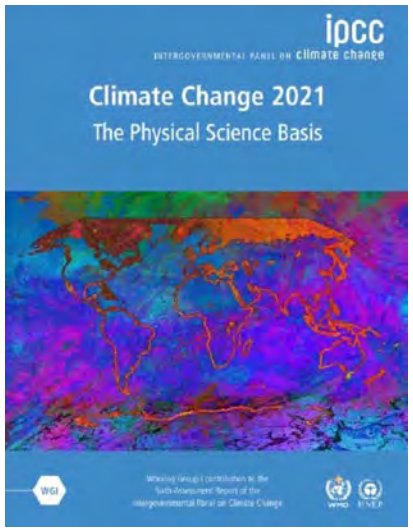


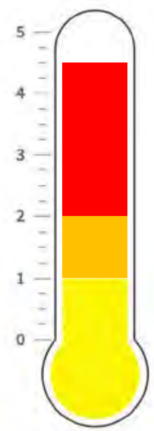
900,000 $MtCO_2$

Estimation of **remaining global carbon budget** (from 2020) for a chance of limiting temperature rises to below 1.7°C (Source: Tyndall Centre)

10-14 years

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





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

The Newham Local Plan must comply with national carbon reduction commitments

National commitment

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

Achieving Net Zero Carbon by 2050

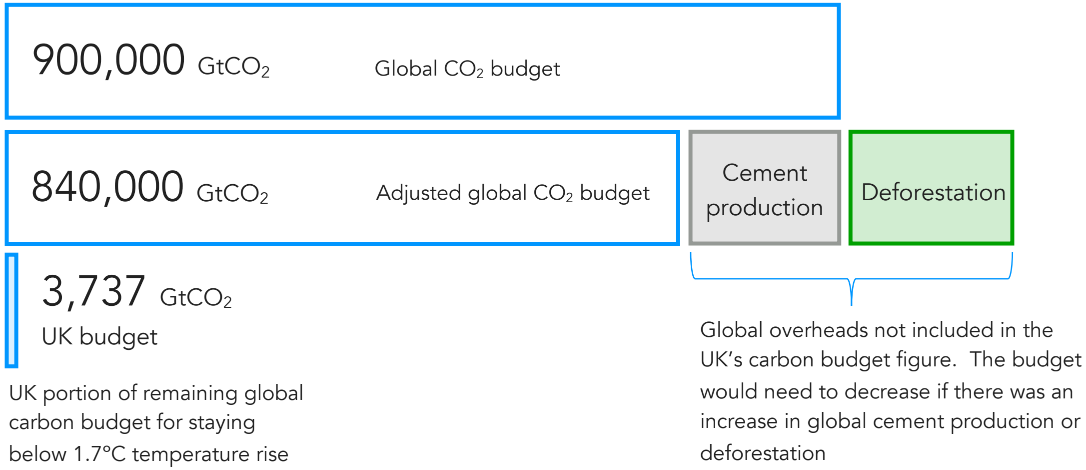
Key measures identified by the CCC include:

- 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.

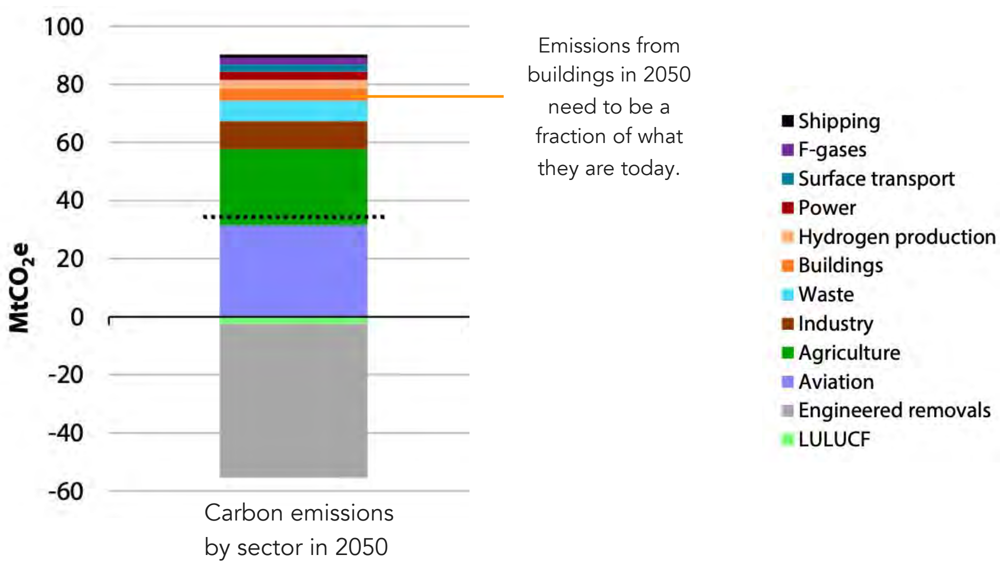
The carbon budget for the UK

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

Following this, the Tyndall Centre Carbon Budgets reports estimate the carbon budget for the UK to be 3,757 $MtCO_2$. This represents the UK operational carbon budget across all sectors. Embodied carbon from cement production is accounted for separately.



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



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

The Newham Local Plan must comply with regional carbon reduction commitments

Achieving Net Zero Carbon by 2030

The London Environment Strategy and the 1.5°C compatible Climate Action Plan, both published in 2018, set out pathways towards Net Zero London by 2050. However, in light of the science which has shown the need for urgent action, the Mayor has declared a climate emergency for London and has brought forward by 20 years the target for London to be Net Zero, which must now be achieved by 2030.

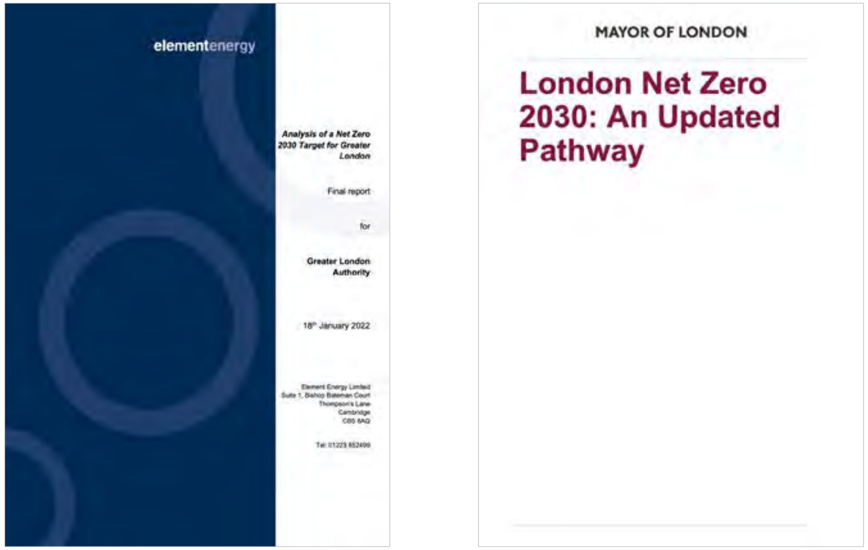
London Net Zero 2030: an updated pathway

The GLA has commissioned experts at Element Energy to analyse pathways for London to reach Net Zero by 2030. Their report '*Analysis of a Net Zero 2030 Target for Greater London*' explore four possible pathways that London could take. Based on this analysis, the Mayor of London's adopted the **Accelerated Green pathway** as the preferred pathway for London. It now replaces the previous trajectory in the 1.5°C Plan.

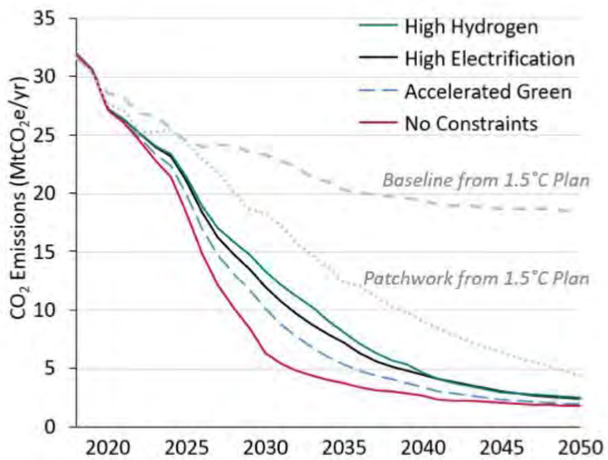
The new London Net Zero pathway (Accelerated Green)

This pathway will reduce baseline emissions (30MtCO_2/yr in 2020) by more than 65% by 2030 down to 10MtCO_2/yr. Key features of this pathway for buildings include

- 40% reduction in heat demand of buildings
- 200,000 homes retrofit each year, to achieve average EPC B or 65kWh/m^2/yr
- Gas boilers in new developments banned by 2025
- Gas boiler replacements banned by 2026 (with exceptions in areas expected to remain connected to the grid using biomethane)
- 2.2 million heat pumps by 2030, including 284,000 in 2028 alone, 60% of homes supplied with low carbon heat by 2030
- 1.5GW of PV generation by 2030 and 3.9GW by 2050



Element Energy report: 'Analysis of a Net Zero 2030 Target for Greater London' (2022) and the GLA's response to the report: 'London Net Zero 2030: An Updated Pathway' (2022)



Four pathways were considered by Element Energy and the Mayor of London adopted the 'Accelerated Green' pathway, shown above with a blue dotted line. It shows how decisive action is required over the next 10 years.

The Newham Local Plan must comply with local carbon reduction commitments

The Tyndall Carbon Budget for Newham

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

In summary, the report recommends the following:

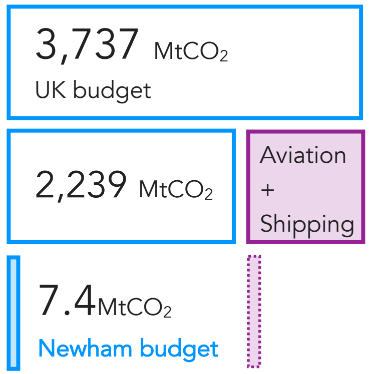
- The London Borough of Newham should stay within a maximum cumulative CO_2 emissions budget of 7.4 $MtCO_2$ for the period 2020-2100. If emissions continue at 2017 levels, the entire carbon budget for the area would be used within 7 years (from 2020), i.e. by 2027.
- Emission reductions should average -12.4% per year.
- Net zero should be achieved no later than 2041.
- Meeting the budget must not rely on carbon offsets.

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

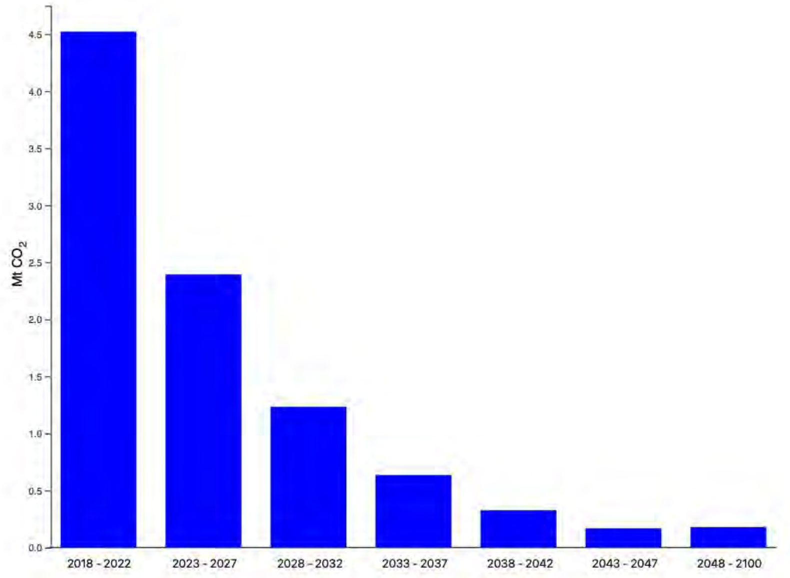
Comparison with other carbon budgets

The Tyndall Centre's carbon budgets are not directly comparable with the UK government's carbon budgets for a number of different reasons. The UK carbon budgets do no apply the equity principle* (as defined in the Paris Agreement); they include allowances from the EU emissions trading scheme (and therefore do not reflect actual carbon emitted by the UK); and budgets until 2032 were set on the basis of an 80% reduction in GHG emissions (not 100% as now required).

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



Tyndall Centre estimation of remaining carbon budget (from 2020) for Newham stay within 2°C temperature rise. Aviation and Shipping are regarded as a national overhead and not included in local budgets. Image not to scale.



5-yearly carbon budgets for the London Borough of Newham's total contribution, showing the pathway for staying within a 1.5°C temperature rise. Reductions in carbon emissions associated with buildings need to, at the least, mimic this trajectory. Data source: Tyndall Centre Carbon budgets report.

New buildings should now stop adding to the problem: they need to be part of the solution

New buildings are currently adding to the problem

Operational carbon emissions associated with new buildings (that meet current planning policy) are still very significant. They are not energy efficient enough, they continue to use of fossil fuels for heating and hot water, and they 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 London Borough of Newham's carbon budgets and that is not sustainable.

They create a future retrofit burden

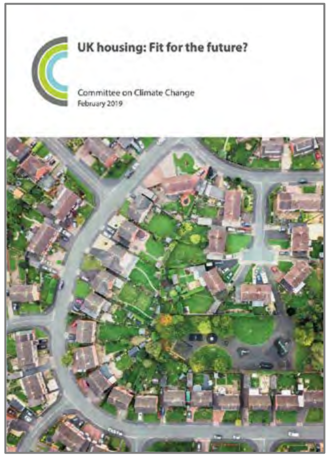
If new buildings continue to be designed and built to the current standards, they will need to be retrofitted in the next 10-30 years in order to reduce their carbon emissions. For example, their new gas boiler will have to be replaced with a low carbon heating system. This would be much more expensive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

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 climate change commitments. 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.

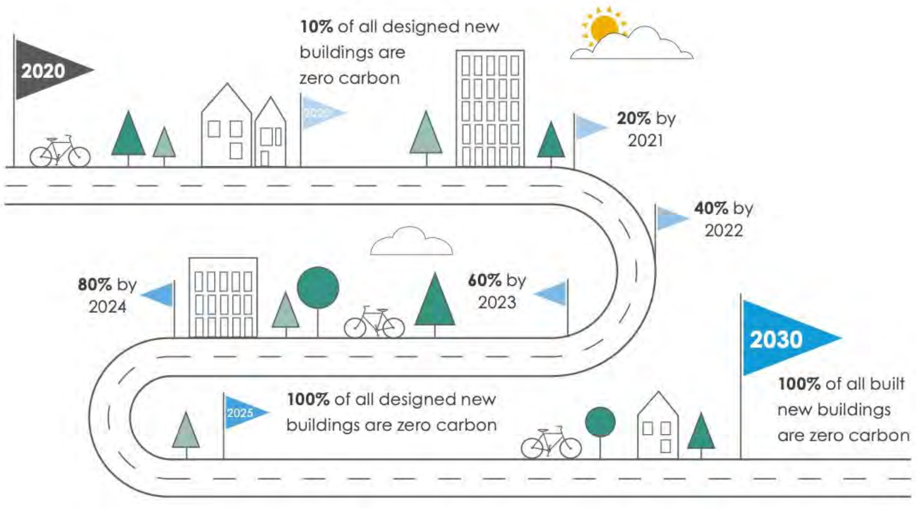
Beyond the issue of operational carbon: embodied carbon

In addition to operational carbon emissions, embodied carbon associated with new buildings must be reduced. Potential policies associated with embodied carbon are discussed in the 'Embodied carbon topic paper' prepared separately.



"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.

Another key benefit from Net Zero Carbon buildings: lower energy costs

A growing concern

Energy costs have always been a concern for those affected by fuel poverty. As Newham has the highest rate of fuel poverty in England, with nearly a fifth of households affected, it is a major issue for the Council. It is now becoming an even bigger concern with the current energy prices. It is affecting more those already in fuel poverty and pushing more people into fuel poverty. Energy costs are now a key issue for the majority of residents in Newham.

Investing in resolving the problem, not just helping with the consequence

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 by the Local Plan.

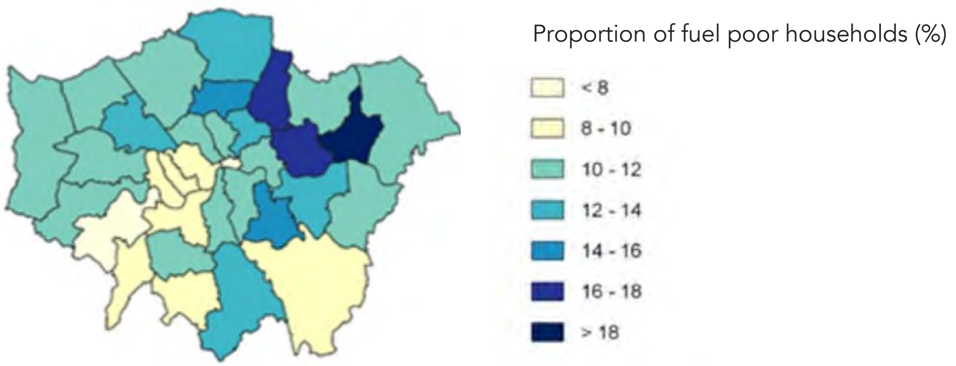
Historically however, most efforts to address fuel poverty have been directed at energy prices (e.g. introduction of a temporary cap) and the household income (e.g. temporary financial help). A more sustainable solution would be to reduce energy demand, and Net Zero Carbon buildings can help with this.

The two key benefits of energy efficiency

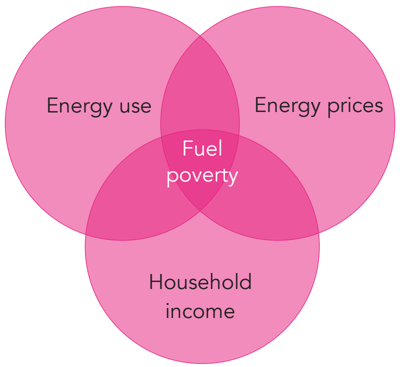
An energy efficient dwelling would help to reduce energy use in a sustainable way, which would mechanically reduce energy costs. It would also make the temperature more stable, enabling a 'smart' heating system to make the most of flexible dynamic electricity prices.

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 can reduce the amount of grid electricity used by over 40% and generate some revenues through the export of electricity to the grid.



The London Borough of Newham has one of the highest rates of fuel poverty in London and in the UK (Source: Department for Business, Energy & Industrial Strategy, Fuel poverty sub regional statistics for 2020)



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 Newham

2.0

Can the Local Plan introduce specific energy and carbon requirements?

This section demonstrates that the London Borough of Newham can (and should) introduce specific energy and carbon requirements in the new Local Plan.

It is possible for the London Borough of Newham to set their own energy and carbon requirements

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

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 plans to set "*reasonable requirements*" for new builds to comply with "*energy efficiency standards that exceed … building regulations*" and "*supply a proportion of their energy from nearby renewable or low carbon sources*".

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 s.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 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, 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, a very large number of local authorities, including the London Borough of Newham, declared a **climate and ecological emergency**.

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

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."

3.0

Definition of Net Zero Carbon buildings

This section explains the definition of Net Zero carbon buildings in operation and its key associated principles.

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).

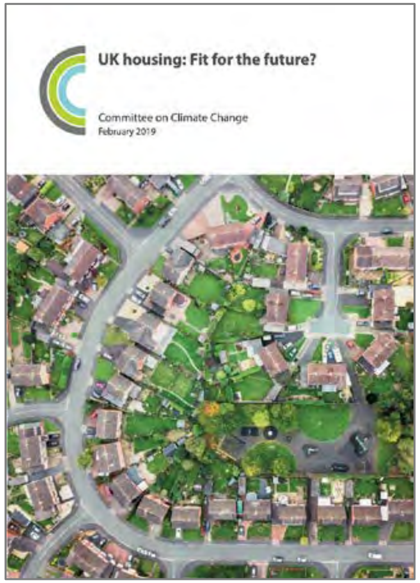
This work has led to an industry definition of a Net Zero carbon building in operation (see following page).

Different criteria form the definition

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

Future evolution of this definition

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



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

Net Zero Operational Carbon

Ten key requirements for new buildings

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

Low energy use

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

   For non-domestic buildings a minimum DEC B (40) rating should be achieved and/or an EUI equal or less than:
   - **65 kWh/m²/yr** (GIA) for schools[1]
   - **70 kWh/m²/yr** (NLA) or **55 kWh/m²/yr** (GIA) for commercial offices[1,2]

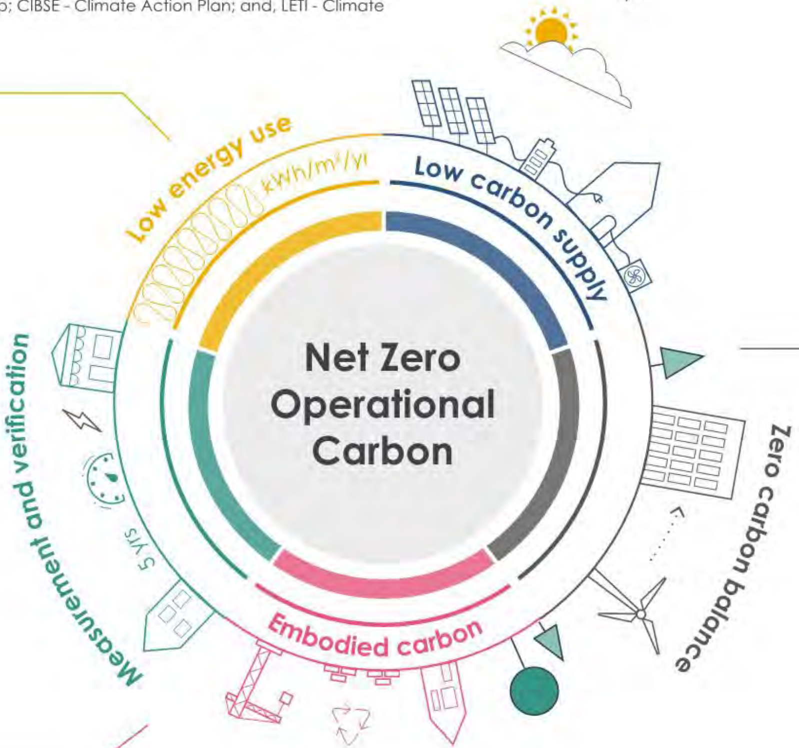
2. Building fabric is very important therefore space heating demand should be less than **15 kWh/m²/yr** for all building types.

Measurement and verification

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

Reducing construction impacts

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



Low carbon energy supply

5. **Heating and hot water should not be generated using fossil fuels.**
6. The average annual carbon content of the heat supplied (gCO_2/kWh) should be reported.
7. On-site renewable electricity should be maximised.
8. Energy demand response and storage measures should be incorporated and the building annual peak energy demand should be reported.

Zero carbon balance

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

Notes:

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

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

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

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

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

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

Ten key requirements for a Net Zero Carbon building in operation - A summary
Developed by LETI in collaboration with UKGBC and BBP, and supported by the Good Homes Alliance, RIBA and CIBSE

The principles of Net Zero Carbon in operation

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

1 - Energy efficiency

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

2 - Low carbon heat

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

3 - Renewable energy generation

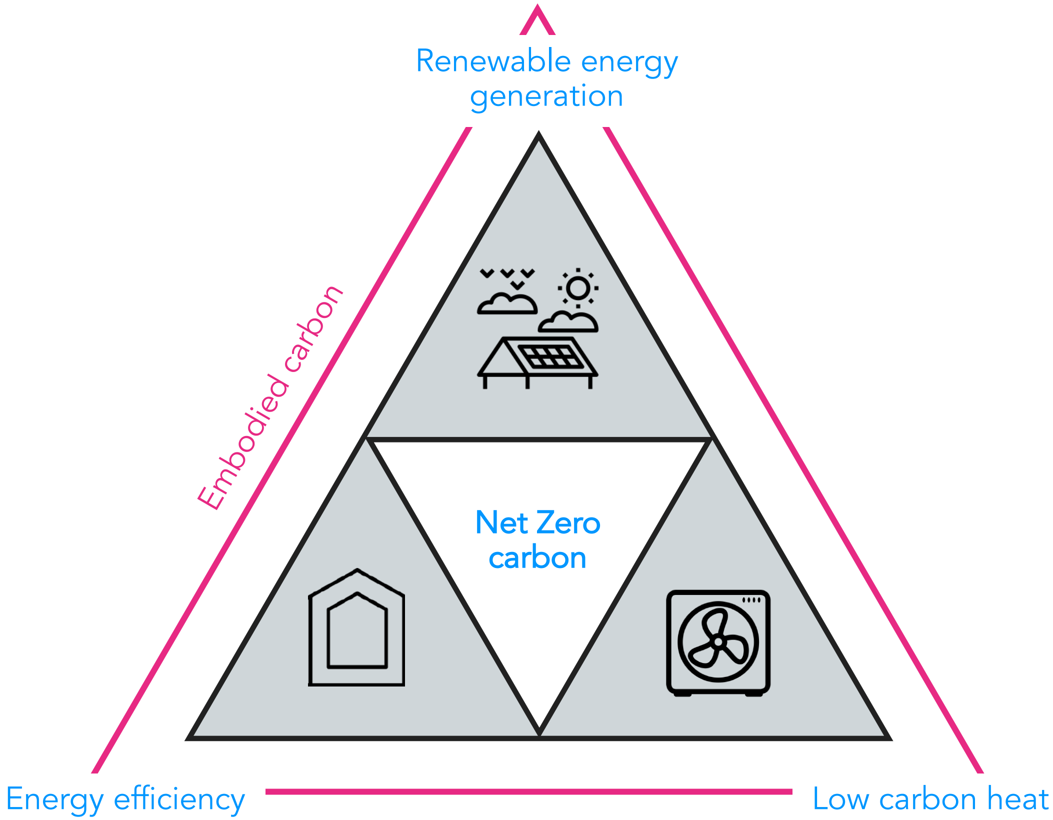
New buildings should seek to add at least as much renewable energy generation to the energy system as the energy they will use in an annual basis. In Newham, solar photovoltaic (PV) panels will be the renewable energy system to deliver this objective.

4 - Embodied carbon

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

No offsetting… or a very limited role for it

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



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

4.0

Current policy is not fit for purpose to deliver Net Zero Carbon buildings

This section explains why using the current approach to energy and carbon policy is not fit for purpose to deliver Net Zero Carbon buildings.

Summary of current energy and carbon policy

Current Newham Local Plan (2018)

The London Borough of Newham's current Local Plan addresses energy use and carbon emissions from buildings in **policy SC2 – Energy and Zero Carbo**n. In terms of targets and requirements this defaults to the London Plan.

The London Plan 2021 requirements

The London Plan requires a minimum of 35% reduction in regulated CO_2 emissions from Part L on-site. After that, the remaining regulated emissions to zero carbon (100% reduction) need to be offset through a contribution to the Council's carbon offset fund.

The energy hierarchy framework (be lean, be clean, be green, be seen) is used but there is only a minimum requirement to minimise regulated energy use: the 'be lean' element requires a 10% reduction in regulated CO_2 emissions from fabric efficiency measures for domestic applications, and 15% for non-domestic applications.

The be clean element requires that developments use energy efficiently, with an emphasis on connecting to district heating or creating communal heat networks and the be green element is about generating renewable energy, without quantitative targets.

Comment on the terminology 'Zero Carbon'

The London Plan's current policy (and therefore Newham's) requires new buildings to be "zero carbon". However, the definition of zero carbon used by the London Plan excludes 'unregulated' energy use and relies heavily on carbon offsetting. The diagram on the right explains how the policy works and how it heavily relies on carbon offsetting.

"All development will minimise and reduce carbon emissions by following the lean, clean, green energy hierarchy; all Major development will meet ***London Plan Zero Carbon targets****.*

…Major development will be required to commit to carrying out post-construction audits demonstrating compliance with CO_2 reduction targets and incorporate Smart Meters that deliver monitoring data to the Local Authority for a minimum period of 3 years post-occupation."

Extract from Newham Local Plan 2018 – Policy SC2

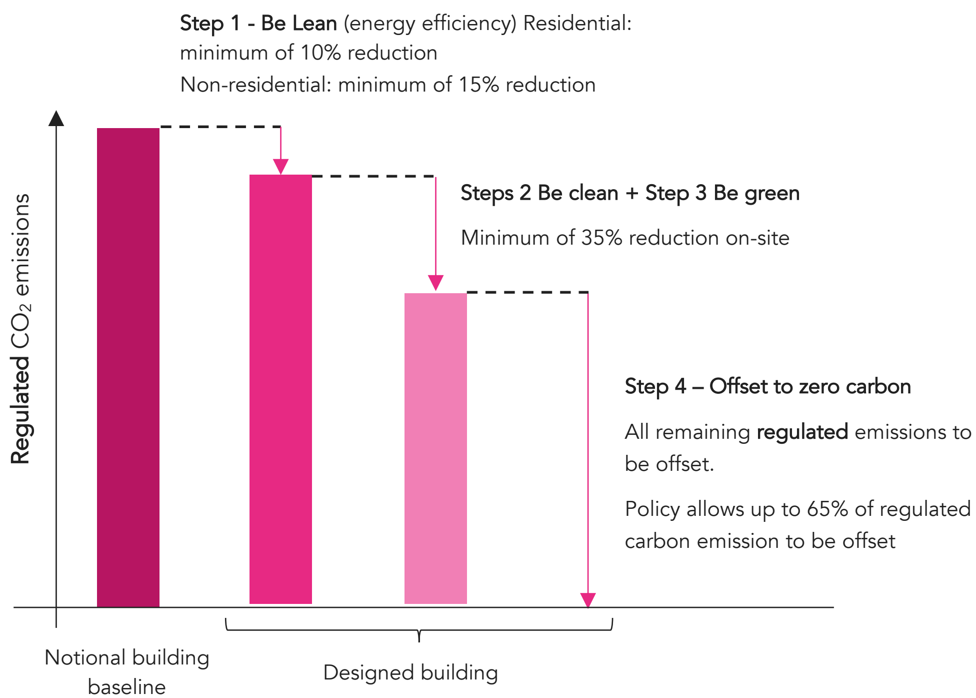


Diagram explaining how the London Plan's energy policy works.

% reductions are measured from a building regulations compliant baseline (the notional building), ***Important note:*** *calculations for this policy include regulated emissions only (they exclude equipment and appliances). This is an important discrepancy with the definition of Net Zero carbon.*

The current planning policy in Newham is not fit for purpose to deliver Net Zero new buildings

Newham's planning policy must move beyond national regulations and regional policy as they do not deliver Net Zero Carbon in practice. Issues can be broken down into three main categories: conflicts, missed opportunities and the performance gap.

Conflicts with Net Zero objective

If new buildings in the London Borough of Newham are to achieve Net Zero, it is important that the planning system prevents practices which are clearly conflicting with this objective. The best example of this type of conflict is the current ability to install gas boilers in new buildings, which is not compatible with Newham Council's climate change commitments. The reliance of carbon offsetting is another example: offsetting cannot be a central compliance mechanism.

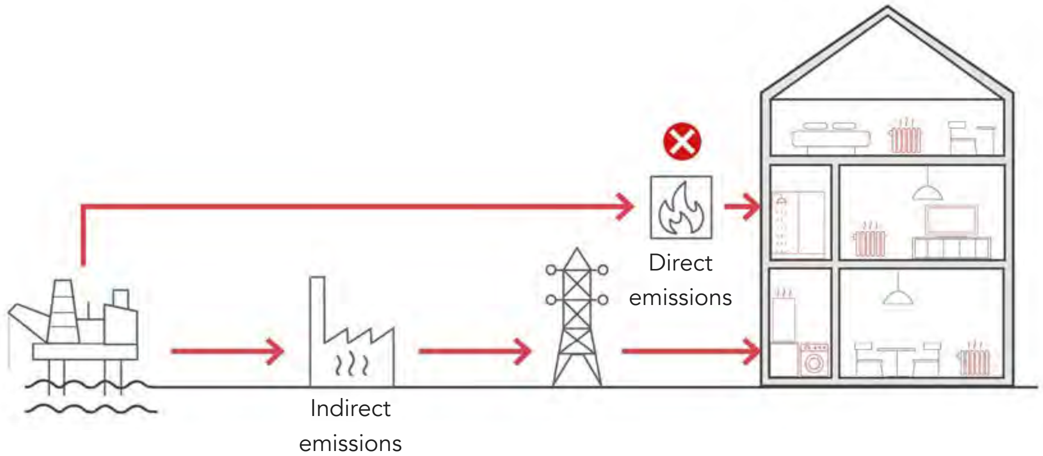
Missed opportunities

Planning policy does not specifically require any reduction in 'unregulated' energy use. This energy use must be addressed.

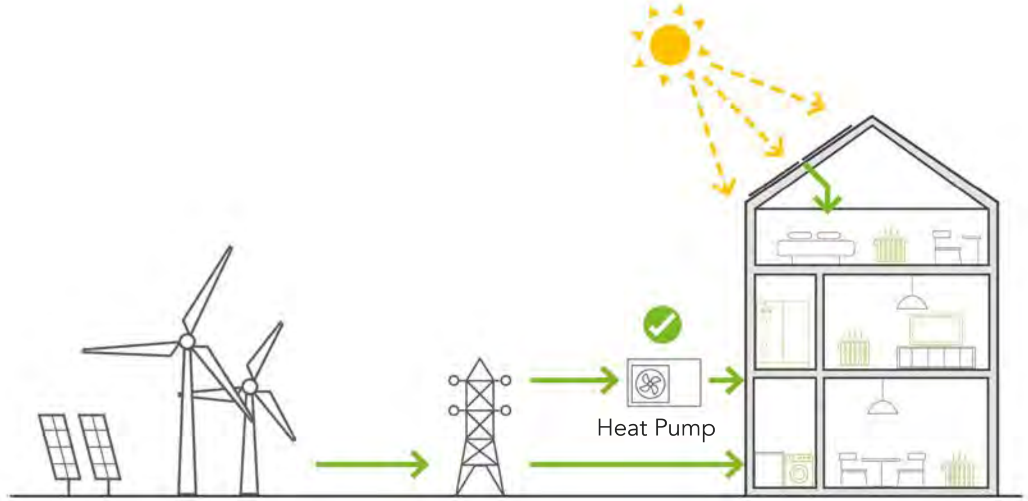
In order to decarbonise its electricity system the London Borough of Newham will also need to increase its solar generation capacity. Roofs are an ideal place to put PVs on, particularly as they can benefit residents and occupants. Unfortunately the current planning system does not maximise renewable generation as it enables trade-offs between energy efficiency, low carbon heat and PVs, which may end up with PVs not being required.

Failure to deliver

There is a significant amount of evidence that actual building energy use is much higher than the planning estimates. This is mainly due to inadequate energy modelling (tools and software used are actually not meant to predict energy use), poor quality of construction, commissioning and handover. The planning system put in place by Newham should seek to use the right metrics and tools pre-planning and ensure that the targeted energy performance will be delivered during detailed design and construction.



Current planning policy enables choices which are not compatible with Net Zero. *For example, gas boilers are a heating system which is still being allowed by building regulations and policy. Unfortunately they directly conflict with the London Borough of Newham's climate change commitments.*



Current planning policy does not require sufficient efforts in key areas. *For example, roofs of housing developments are generally ideal for solar PV panels. However, and aAlthough policy requires a small proportion of energy use to be generated from renewable energy on-site, is not mandated and very often not provided.*

The current planning metric (% improvement over Part L) is not fit for purpose for Net Zero buildings

Current requirements under the Local Plan Policy SC2

The carbon performance requirements of new developments in Newham's current Local Plan Policy SC2 is currently similar to the London Plan. It is expressed in terms of a percentage improvement over a 'notional building' defined by Part L and calculated for the purpose of Building Regulations.

Issues associated with the % improvement target

The % improvement over a notional building is an intangible, relative performance requirement that cannot be measured once a building is occupied. For clarity, the notional building is fictional and is used only for building regulations purposes.

This causes confusion and inability to compare the actual performance of different houses/homes. It also makes post-construction verification and learning from a feedback loop more complicated, for residents, for the Council and, more generally, for the whole supply chain.

Furthermore, current performance targets rely on carbon emission factors and primary energy factors that introduce additional complexity.

Issues associated with carbon factors

Carbon factors for electricity have changed very significantly over the last 10 years and will continue to change over the next 10 years. This in itself has an impact on the % improvement over Part L which could be misleading.

Moving to absolute metrics: a recommended focus on outcomes

Absolute, measurable targets (e.g. kWh/m^2/yr) are therefore recommended to consistently deliver Net Zero Carbon buildings.

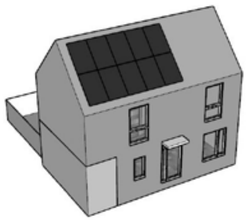
% improvement over notional building

- ✗ 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/m^2/yr at the meter (EUI)

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

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



Carbon Emission Reductions			
Building Regs	SAP 10	Sap 10.1	Lifetime
18%	59%	75%	88%

The table above shows the percentage improvement above the notional building for a terraced house with a heat pump. Each column is calculated using a different carbon factor for grid electricity to show how misleading this approach can be. A current building regulations calculation (Part L 2013) suggests heat pumps offer a modest improvement of only 18% in a typical new build. In reality when using lifetime carbon emissions, that take into account future decarbonisation of the grid, an 88% improvement is expected.

The relative performance approach is not fit for purpose for Net Zero buildings

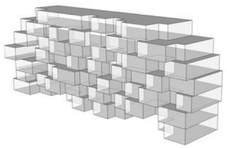
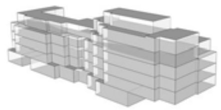
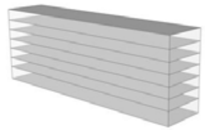
A more efficient building form is not incentivised

Planning policy is 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. Experience is showing that there are issues with this approach.

Improving the design of a building by reducing the extent of heat loss areas, the amount of junctions, and by optimizing 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.

Moving to absolute metrics: a recommended focus on outcomes

Again, absolute targets that are directly comparable across all designs are recommended to deliver Net Zero on a borough-wide scale.

		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.

In practice buildings do not need to exactly replicate the "low form factor' image above, but the form of the heated building area should be rationalised to a certain extent.

The current planning policy in Newham is not fit for purpose to deliver Net Zero new buildings

Energy, not CO_2, is the best metric

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

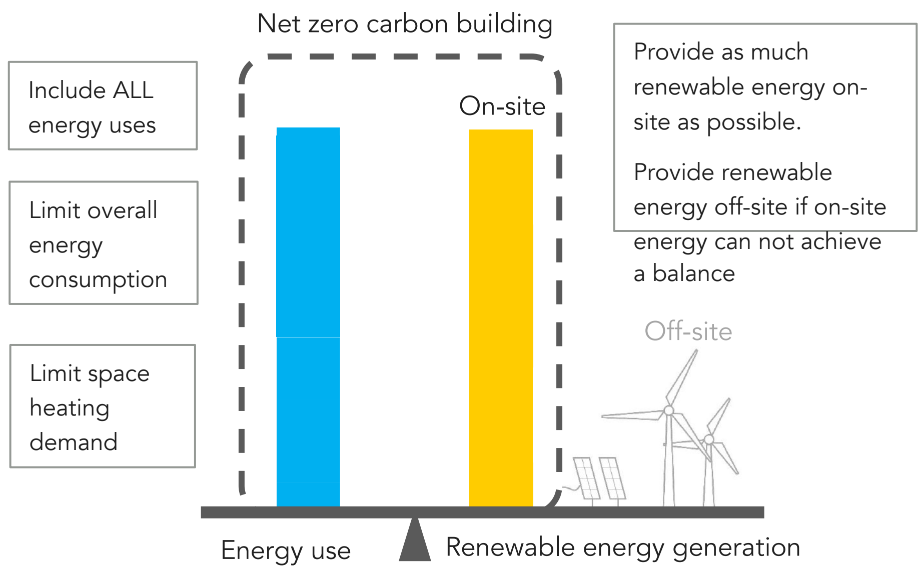
Planning policy methodology does not consider total energy use

The building regulations methodology which is used to show compliance with planning policy does not include energy consumption and CO_2 emissions from equipment and appliances. This represents approximately 50% of energy use in a low energy home.

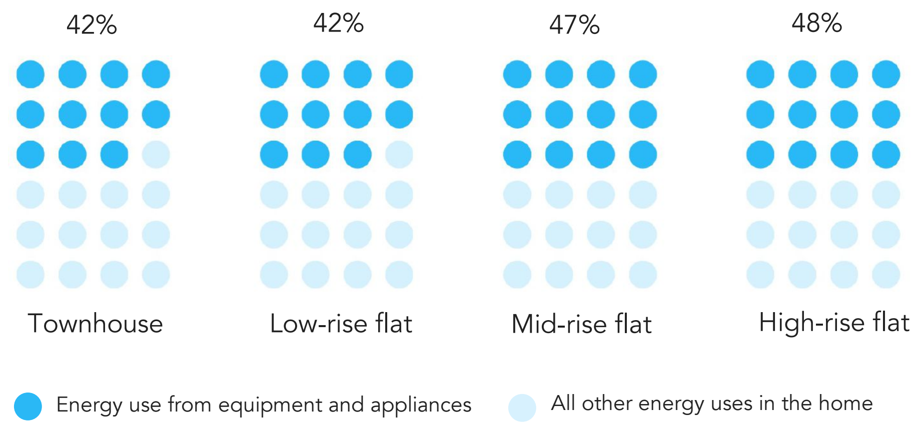
In summary, current policy:

- does not drive energy efficiency sufficiently (i.e. to the level recommended by the Climate Change Committee)
- does not cover unregulated energy use
- still allows gas boilers, a significant source of carbon emissions
- relies heavily on carbon offsetting, which does not remove carbon from the atmosphere and displaces the problem away from the applicant towards Newham Council
- does not facilitate closing the performance gap, leading to more emissions than were agreed at planning.

The following pages present information and evidence to support the above statements, through the modelling of typical typologies in Newham under different fabric and system scenarios.



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



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

The current planning policy is not appropriate: technical evidence (residential buildings modelled)

Typology selection

Energy modelling has been undertaken for four residential typologies. These typologies were selected as they represent the type of residential buildings expected to come forward over the next local plan period. The typologies have been based on recent planning applications, both in Newham and other London Boroughs. It was also important to model a range of building forms and sizes as dwelling density can impact energy efficiency and renewable energy generation. The typologies are:

- 3-bed townhouse
- Low rise block of 7 flats
- Mid rise block of 28 flats
- High rise block of 169 flats

For each typology, energy and cost modelling was undertaken on seven different scenarios:

1 – Current policy compliant*, gas boiler

2 – Current policy compliant*, individual heat pump

3 – Current policy compliant*, district heat network (gas)

4 – Future Home Standard**, individual heat pump

5 – Ultra-low energy, individual heat pump

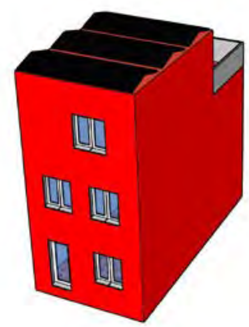
6 – Ultra-low energy, direct electric

7 – Ultra-low energy, district heat network (heat pump)

** To meet current London Plan energy requirements (as of May 2022) as well as the Part L 2021 notional dwelling specification*

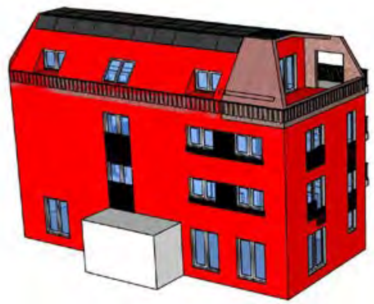
*** To align with the initial draft version of the Future Home Standard*

The results of the modelling were analysed and summarised in this evidence base to demonstrate why current planning policy is not fit for purpose to deliver Net Zero Carbon buildings.



3-bed Townhouse

GIA: 116m²

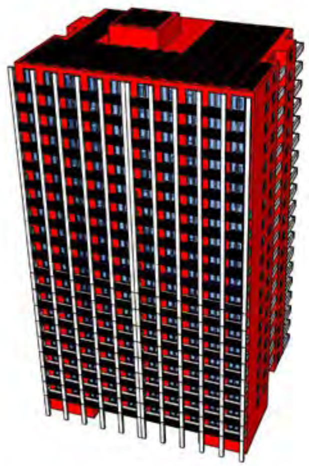


Low rise block (7 units)

GIA: 641m²

Mid rise block (28 units)

GIA: 2,1256m²



High rise block (169 units)

GIA: 15,541m²

The current planning policy is not appropriate: technical evidence (residential buildings modelled)

The table below summarises the scenarios modelled for the four different residential typologies.

SCENARIO	ENERGY EFFICIENCY	HEATING SYSTEM	RENEWABLE GENERATION
1 - Current policy compliant, gas boiler		Gas boiler	
2 - Current policy compliant, individual heat pump	To meet Part 2021 notional building and achieve 10% reduction over Part L 2013	Individual heat pump	To meet Part L 2021 notional building and achieve 35% reduction over Part L 2013
3 - Current policy compliant, district heat network (gas)		District network: gas boiler	
4 - Future Home Standard	To meet draft FHS specification	Individual heat pump	No PV
5 - Ultra low energy, individual heat pump		Individual heat pump	
6 - Ultra low energy, direct electric	15-20kWh/m^2 space heat demand target	Direct electric	To meet total annual energy consumption OR on-site maximise generation
7 - Ultra low energy, district heat network (heat pump)		District network: heat pump	

The current planning policy is not appropriate: technical evidence (non-residential buildings modelled)

Typology selection

Energy modelling has been undertaken for two industrial typologies. The main criteria for selection was to be representative of both current industrial development in Newham and that which is expected to come forward over the next local plan period. It was also important to model a range of building sizes as that can impact energy efficiency and the ability to match on-site energy renewable generation with on-site consumption.

The typologies have been based on recent planning applications, both in Newham and other London Boroughs.

The typologies are:

- **Large industrial unit**
- **Small industrial unit**

For each typology, energy and cost modelling was undertaken on four different scenarios:

1 – Current policy compliant*, gas boiler

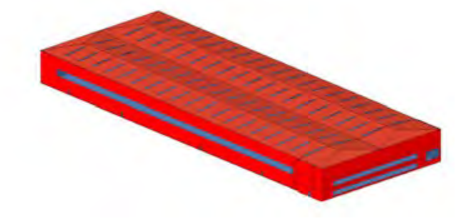
2 – Improved fabric, gas boiler

3 – Current policy compliant*, individual heat pump

4 – Improved fabric, individual heat pump

** To meet current London Plan energy requirements (as of May 2022) as well as the Part L 2021 notional dwelling specification*

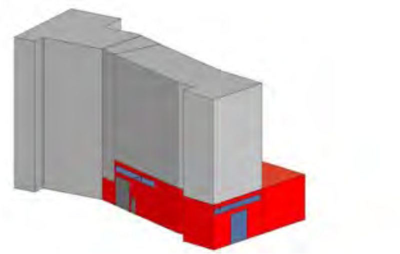
The results of the modelling were analysed and summarised in this evidence base to demonstrate why current planning policy is not fit for purpose to deliver Net Zero Carbon buildings.



Large Industrial Unit

GIA: 12153m²

- *Warehouse space: 10,324m²*
- *Open plan office: 660m²*
- *Other spaces including circulation, WC, plant deck: 1169m²*



Small Industrial Unit

GIA: 466m² (4 small units)

(Resi above- shown in grey)

- *4 small industrial units with a shared WC core. Each unit is composed of a warehouse space on ground level and office space on mezzanine level.*
- *Each industrial unit 60-80 m²*

The current planning policy is not appropriate: technical evidence (non-residential buildings modelled)

The table below summarises the scenarios modelled for the four different industrial typologies.

SCENARIO	ENERGY EFFICIENCY	HEATING SYSTEM	RENEWABLE GENERATION
1 - Current policy compliant, gas boiler	To meet Part 2021 notional building and achieve 15% reduction over Part L 2013 at Be Lean	Gas boiler	To meet Part L 2021 notional building and achieve 35% reduction over Part L 2013 at Be Green
2 – Improved fabric, gas boiler	Improved Building Fabric	Gas boiler	
3 - Current policy compliant, air source heat pump	To meet Part 2021 notional building and achieve 15% reduction over Part L 2013 at Be Lean	Air source heat pump	Various PV options modelled
4 – Improved fabric, air source heat pump	Improved Building Fabric	Air source heat pump	Various PV options modelled

Evidence that the current planning policy does not drive energy efficiency sufficiently

Ultra-low energy specifications are not required to comply with the London Plan and policy SC2 requirements

Current policy requires a minimum of 35% reduction in CO_2 emissions from Part L on-site, and only 10% due to energy efficiency measures for residential developments.

The problem is that this level of ambition is not consistent with the Climate Change Committee recommendation that new buildings should achieve ultra low energy efficiency levels, equating to a space heating demand of 15-20 kWh/m^2/yr, or the space heating demand criterion in the definition of Net Zero Carbon buildings: 15 kWh/m^2/yr.

This is illustrated by the adjacent bar chart: all four space heating demand results for the current policy compliant typologies are comprised between 25 and 60 kWh/m$^2_{GIA}$/yr, well in excess of the Climate Change Committee limit and the Net Zero Carbon space heating demand criterion.

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

Will the Future Homes Standard solve this issue?

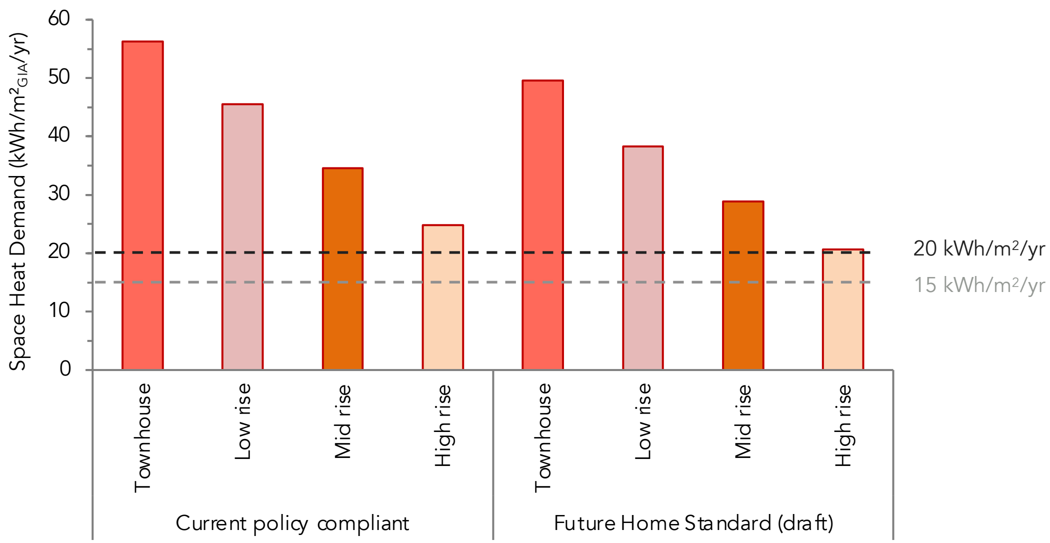
The forthcoming Future Homes Standard is unlikely to deliver the scale of improvement required, with energy modelling demonstrating space heating demands between 21-50 kWh/m$^2_{GIA}$/yr, still in excess of the Climate Change Committee limit and the Net Zero Carbon space heating demand criterion.

Conclusion

This results in buildings that are less efficient, use more energy overall, are not able to achieve an energy balance on site and are more reliant on carbon offsetting. These buildings are also less able to be flexible in the types of heating system they can accommodate in the future and they place an additional burden on energy supplies from the national electricity grid.

Energy efficiency scenario	Target	Townhouse	Low rise	Mid rise	High rise
Current policy compliant (scenarios 1-3)	10%	20% ✓	11% ✓	11% ✓	10% ✓
Future Home Standard (scenario 4)		29% ✓	14% ✓	12% ✓	10% ✓

On-site regulated carbon reduction over Part L 2013 – via energy efficiency measures (with SAP 10 carbon factors).
The building fabric and ventilation specifications modelled are sufficient for all typologies to meet or exceed current energy efficiency planning policy requirements (i.e. 10% carbon reduction over baseline due to energy efficiency measures alone)



Predicted space heating demand from PHPP modelling of all residential typologies.
This graph shows that with current policy compliant and likely Future Home Standard energy specifications, the space heating demand would be significantly higher than the Climate Change Committee recommendation of 15-20 kWh/m².yr and the Net Zero Carbon space heating demand requirement of 15 kWh/m².yr

Evidence that the current planning policy does not prevent fossil fuel heating systems

High carbon heating system can comply

Current policy does not stipulate which type of heating systems can or cannot be used for space heating and hot water generation. Therefore, as long as the minimum on-site carbon reduction policy requirement can be achieved, gas boilers can be used.

The CO_2 emissions of a gas boiler over its lifetime are very high though and will not reduce over time. This is why the use of gas for heating and hot water is not compatible with Net Zero Carbon buildings. At a time when we know that gas boilers are going to be phased out, and that buildings built today with gas boilers will need to remove them before the end of their life, it does not make sense to include them in new development.

On the other hand, heat pumps or other heating systems powered by electricity will see their carbon emissions reduce as the electricity grid decarbonises with more renewable energy contributing to it.

Residential

Our energy modelling of four typical residential building types in Newham shows that under current policy new homes with gas heating systems are able to meet planning policy (i.e. a minimum 35% carbon reduction over the Building Regulations baseline).

Non residential

Similarly, for both industrial typologies, our modelling suggests that developments with a gas heating system can meet planning policy (i.e. a minimum 35% carbon reduction over the Building Regulations baseline).

Heating scenario	Target	Townhouse	Low rise	Mid rise	High rise
1 - Current policy compliant, **gas boiler**	35%	41%	35%	35%	24%
3 - Current policy compliant, **district heat network (gas)**		35%	33%	-5%	-11%

Residential buildings: on-site regulated carbon reduction over Part L 2013 *(SAP 10 carbon factors)*
Residential buildings using gas for space heating and hot water can comply with current planning policy. They are not compatible with Net Zero Carbon buildings though: planning policy should not enable their use.

Heating scenario	Target	Large Industrial	Small Industrial
1 – Current policy compliant (BAU fabric), **gas boiler**, PVs (20% of building footprint area)	35%	56%	40%
2 – Improved fabric, **gas boiler**, PVs (10% of building footprint area)		59%	40%

Industrial buildings: on-site regulated carbon reduction over Part L 2013 *(SAP 10 carbon factors)*
Current planning measures do not prevent gas heating systems from being installed. For the typologies modelled; the small and large industrial unit can meet London Policy requirements with a gas boiler with a small amount of PV.

Evidence that the current planning policy does not drive enough renewable energy generation

Trade offs are possible so there is no clear renewable requirement

There is no quantified planning requirement to deliver a certain amount of renewable energy generation on site and it is often more convenient or cheaper to meet the minimum 35% reduction on-site and offset the remainder of regulated CO_2 emissions instead of reducing on-site emissions further with more on-site solar PVs.

There is however a consensus that achieving our climate goals and Net Zero Carbon will require a large and rapid increase in renewable energy capacity. Buildings are a great opportunity for PV generation in Newham, and locating them where electricity is consumed can directly reduce energy bills for occupants, a key advantage.

Requirements can be met with very little or no PVs

As is demonstrated by our energy modelling, current planning requirements can be achieved with much less PVs than the building is capable of accommodating, which is a significant missed opportunity.

- **Residential:** modelling of Scenarios 2 and 4 (both with a heat pump) demonstrate that all four residential typologies can meet the current on-site planning carbon requirements with no PV panels or a number well under the potential.
- **Non-residential:** the large industrial unit represents a significant opportunity to install an extensive PV system. Unfortunately, the current planning requirements will not make this happen as the on-site carbon reduction requirement can be met without PVs.

The current planning policy requirement can be met with limited or even without on-site renewable generation, which means there is no incentivisation for installation of PVs, particularly as it is cheaper and easier to offset the regulated emissions.

	Potential number of panels	2-Current policy compliant, individual heat pump	4-Future Home Standard
Townhouse	18	7	0
Low rise	70	10	0
Mid rise	92	35	0
High rise	330	96	0

Residential - Number of PV panels required to meet current policy, compared to potential

For scenario 2, PV numbers are based on meeting the Part L 2021 notional building specification and achieving at least a 35% reduction over Part L 2013. No PV is assumed under scenario 4, however all typologies surpass the 35% reduction target.

	Potential number of panels	1-BAU fabric, gas boiler	2-Improved fabric, gas boiler
Large Industrial	4,377	432	0
Small Industrial	62	21	7

Industrial - Number of PV panels required to meet current policy, compared to potential

For scenario 2, PV numbers are based on meeting the Part L 2021 notional building specification and achieving at least a 35% reduction over Part L 2013. For scenario 4 (and scenario 2 of the large industrial unit) the 35% reduction target has been already met without PVs.

Evidence that the current planning policy relies heavily on carbon offsetting

Current planning policy gives a significant role to carbon offsetting

The minimum on-site performance (35% lower regulated carbon emissions than the baseline) is relatively easy to achieve, particularly with a heat pump system. Although planning policy sets this level of on-site carbon reduction as a 'minimum', most applicants comply with this level or go a bit further; there is not a planning incentive to go much further. The consequence is that up to two thirds of regulated emissions are relying on a carbon offset mechanism, and obviously unregulated emissions are not even offset. A payment is made to the Local Authority, shifting the responsibility of carbon savings away from new buildings and applicants to other sources of carbon emissions and the Council.

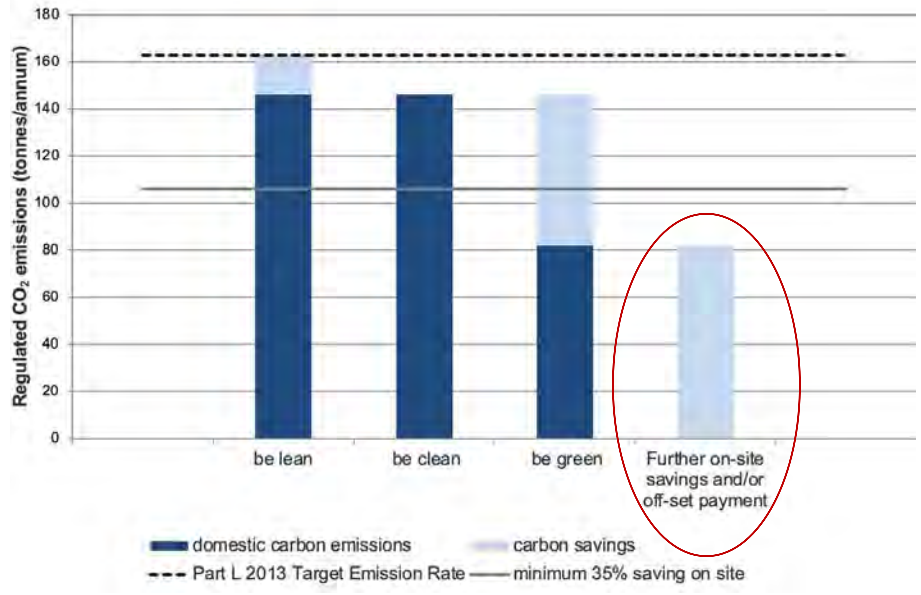
This goes against the recommendations of the Climate Change Committee, and is a challenge for Local Authorities

The Climate Change Committee only recognises limited forms of carbon offsetting and is clear that they should be reserved for the hard-to-treat sectors. New buildings are not considered a hard-to-treat sector. In addition to this, Local Authorities struggle to save carbon on other projects, and cannot save as much as they should as the carbon offset price (£95/tCO_2) is significantly too low.

This approach should end and new buildings should deliver much greater carbon savings on-site.

Further evidence

The 2020 report '*Towards Net Zero Carbon, Achieving greater carbon reductions on site: The role of carbon pricing*' undertaken for several London Boroughs recommends a move away from a carbon offsetting and, as a minimum, a higher and tiered carbon price to incentivise carbon reductions on-site over carbon offsetting.



Regulated carbon emissions for a policy compliant energy strategy for the high rise typology (assuming Scenario 2 – Current policy compliant, heat pump)

It illustrates that carbon offset payments play too large a role in current 'net zero' planning policy. In the above chart supposedly 50% of the reduction in regulated carbon emissions associated with the development will come from the offset payment. This ability to offset, and the relatively low cost of doing so, does not incentivise sufficient carbon reductions on site, and it ignores unregulated emissions.

Evidence that keeping the same policy and increasing the requirement would not be enough (residential)

The previous pages have demonstrated how current planning policy is not fit for purpose to deliver the key core principles of a Net Zero Carbon building.

It is very important to realise that the approach and the metric themselves are inadequate and that increasing the required regulated carbon reduction over the baseline will not be sufficient to solve this issue.

Changing the threshold will not be sufficient

Essentially, the current policy mechanism of setting a threshold over Part L is flawed. Energy policy cannot be made fit for purpose by simply setting a different, more demanding, threshold for compliance. The table to the right shows the modelled percentage reductions for the four residential typologies.

As scenarios 5, 6 and 7 which are compatible with Net Zero principles, are all above 60%, it could suggest that 60% could be a good target. However, applicants would not be incentivised to go further. In addition, Scenario 2 for the Townhouse would also comply, and it includes a relatively poor energy efficient envelope. Scenario 4 would too, and it does not have any renewable energy generation.

Furthermore, unregulated carbon emissions do not have any quantified requirement to achieve. And the actual performance of the building in operation against the planning commitments cannot be checked.

This final page confirms that new policy metrics are required, with appropriate methods of calculation. These metrics should drive transparency, learning and progress via comparison of measured to design data.

Scenario	Townhouse	Low rise	Mid rise	High rise
1 - Current policy compliant, gas boiler	41%	35%*	35%*	24%**
2 - Current policy compliant, individual heat pump	72%	53%	55%	50%
3 - Current policy compliant, district heat network (gas)	35%*	33%**	-5%**	-11%**
4 - Future Home Standard (draft)	61%	47%	53%	48%
5 - Ultra low energy, individual heat pump	104%	120%	82%	71%
6 - Ultra low energy, direct electric	108%	110%	68%	60%
7 - Ultra low energy, district heat network (heat pump)	116%	124%	83%	73%

Compliance with planning policy if the threshold for compliance was raised from 35% to 60% / improvement over baseline using SAP 10 carbon factors for different scenarios.

It shows that improving the target for compliance would not be satisfactory.

Red	<35% reduction over Part L
Yellow	<60% reduction over Part L
Light green	<100% reduction over Part L
Green	>100% reduction over Part L

* additional PV panels above the Part L 2021 notional specification included to meet the 35% threshold

** the maximum quantity of PV panels, as constrained by the design of the roof were included.

Evidence that keeping the same policy and increasing the requirement would not be enough (non-residential)

Non-residential buildings

For non residential, the NCM methodology is used for showing compliance with current policy and regulations. The same logic applies: a single threshold mechanism for on-site regulated carbon emission reductions allows for trade-offs, which could mask poor performing fabric or systems.

The table to the right shows the modelled on-site regulated carbon reductions for the typologies studied under the different scenarios.

The results in the table consider two PV arrangements; the first with 10% of building footprint area covered; and the second with the maximum PV area for the building (100% of the building footprint area for the large industrial building and 45% of the building footprint area for the small industrial building*). This demonstrates the potential on-site carbon reduction if PV area is maximised.

As can be seen by the results in the table to the right, the carbon emission reductions are a blunt instrument to demonstrate the difference between scenarios. Scenario 4 which represents an improved fabric and heat pump heating system does not have that much greater carbon emission reductions than scenario 2 or 3. It also shows the influence of PV panels, and the ability of PV panels to mask the poor performing fabric or systems.

*the maximum quantity of PV panels (45% of building footprint area), as half of the small industrial building sits under the residential block.

	Large industrial		Small industrial	
Scenario	PV 10% of footprint area	PV 100% of footprint area	PV 10% of footprint area	PV 45%* of footprint area
1 – BAU fabric (current policy compliant), gas boiler, PVs	35%	221%	30%	65%
2 – Improved fabric, gas boiler, PVs	59%	244%	40%	75%
3 – BAU fabric (current policy compliant), air source heat pump, PVs	61%	241%	45%	80%
4 – Improved fabric, air source heat pump, PVs	67%	247%	48%	83%

Compliance with planning policy if the threshold for compliance was raised from 35% to 60% / improvement over baseline using SAP 10 carbon factors for different scenarios.

It shows that improving the target for compliance would not be satisfactory

<35% reduction over Part L

<60% reduction over Part L

<100% reduction over Part L

>100% reduction over Part L

5.0

The current approach to energy modelling is not fit for purpose for Net Zero Carbon buildings

This section explains why the current approach to energy modelling required by planning policy may be satisfactory for demonstrating compliance with Building Regulations but is not fit for purpose to assist the delivery of Net Zero Carbon buildings.

Predictive energy use modelling is required

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 and (National Calculation Methodology) for non-domestic buildings through SBEM and Dynamic Simulation Modelling (DSM) tools.

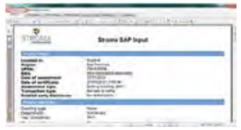
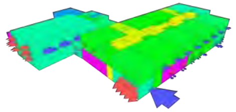
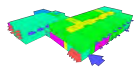
However, it is important to note that these Part L energy assessment methodologies were developed only to check compliance with Building Regulations. They were never meant to perform some of the functions that would be required to deliver Net Zero carbon buildings, and most importantly the prediction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

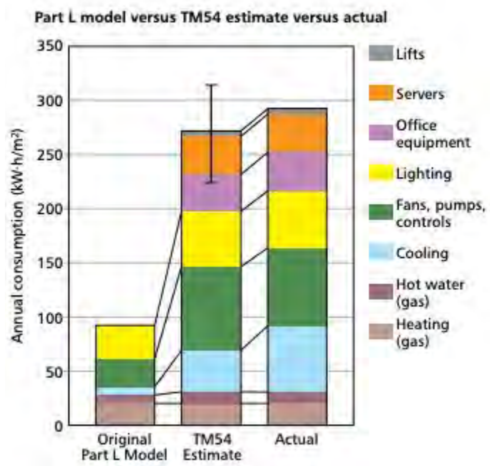
It seems that when these tools were mandated at planning stage approximately 15 years ago it was to minimise the burden on applicants and negate the need for a specific predictive energy use assessment. There is now a consensus in the industry that a different and better type of energy modelling is now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

Why predicting 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

Which methodology should be used to predict energy use for residential buildings?

The limitations of the SAP methodology

SAP is the calculation methodology and tool currently used in the vast majority of planning applications to demonstrate compliance with policy requirements. The main reason for this is that it is also required at a later stage to demonstrate compliance with building regulations and is relatively simple. However, it is important to note that SAP was originally designed with one key objective: to represent a standardised fuel cost to achieve comfort under given conditions (e.g. occupancy and location) that allows one dwelling to be compared with another and a value placed on energy improvement. It was never meant to perform some of the functions it is now being used for, including the prediction of future energy use.

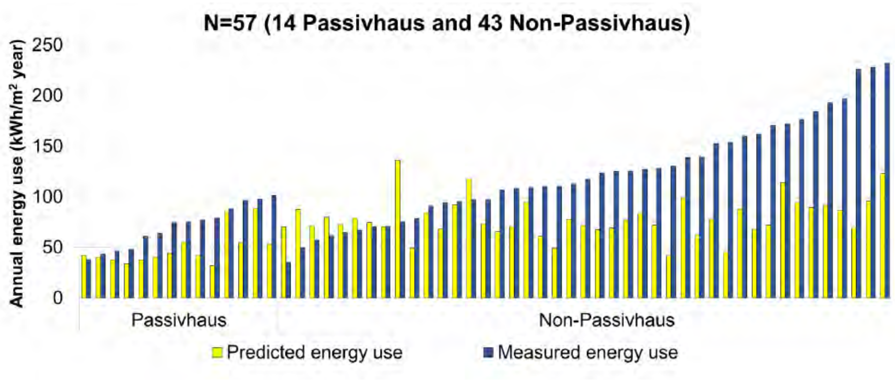
A proven methodology: the Passive House Planning Package (PHPP)

The PHPP methodology and excel based tool have been shown to predict energy use much more accurately than SAP. PHPP modelling is increasingly undertaken on UK projects both pre- and post-planning submission to better predict the energy performance and likely total energy use of new development. Our recommendation is that the London Borough of Newham mandates, or at least encourages, the use of PHPP on residential new build projects.

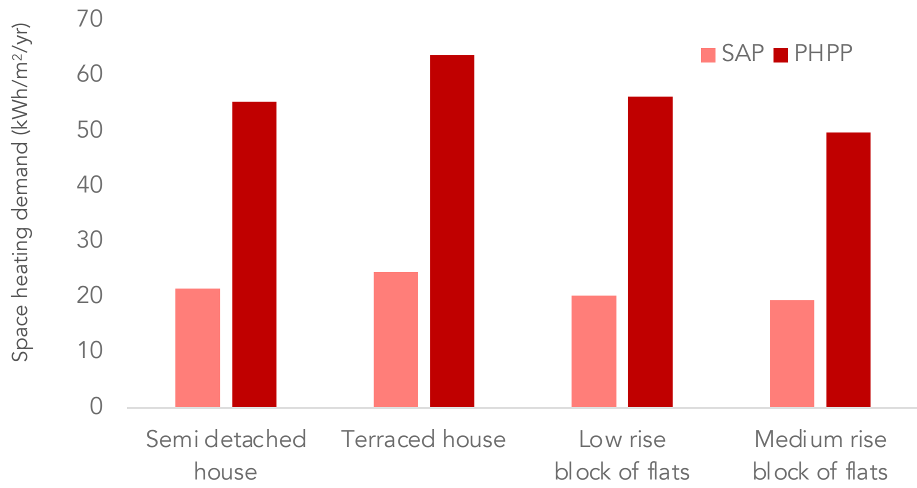
Comparison

Comparative SAP/PHPP modelling undertaken on different typologies suggest that SAP underestimates space heating demand by more than 50%. The under-estimation of space heating is detrimental as it leads to under-estimating the potential benefits of measures to reduce space heating demand (e.g. better U-values, triple-glazed windows, more airtight dwellings).

If SAP is continued to be used to demonstrate compliance with Net Zero policies, it is recommended that its outputs are corrected to better represent likely future energy use.



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



Comparison between space heating demand estimated by SAP vs PHPP for four housing typologies (assuming Part L 2021 compliant specifications). It can be seen that SAP tends to significantly underestimate space heating demand, which is a significant issue.

Which methodology should be used to predict energy use for non-residential buildings?

The limitations of the NCM

The National Calculation Methodology (NCM) is the calculation methodology used in non-domestic planning applications to demonstrate compliance with policy and Part L of the Building Regulations. The purpose of the NCM is not to predict the energy consumption of buildings and although it provides a figure for unregulated energy consumption it does not provide a framework for amending these figures so that they are bespoke to the building.

As a result, the NCM does not predict the actual building energy use with a satisfactory level of certainty and there is a huge difference between predicted energy performance in current planning applications and their actual energy performance.

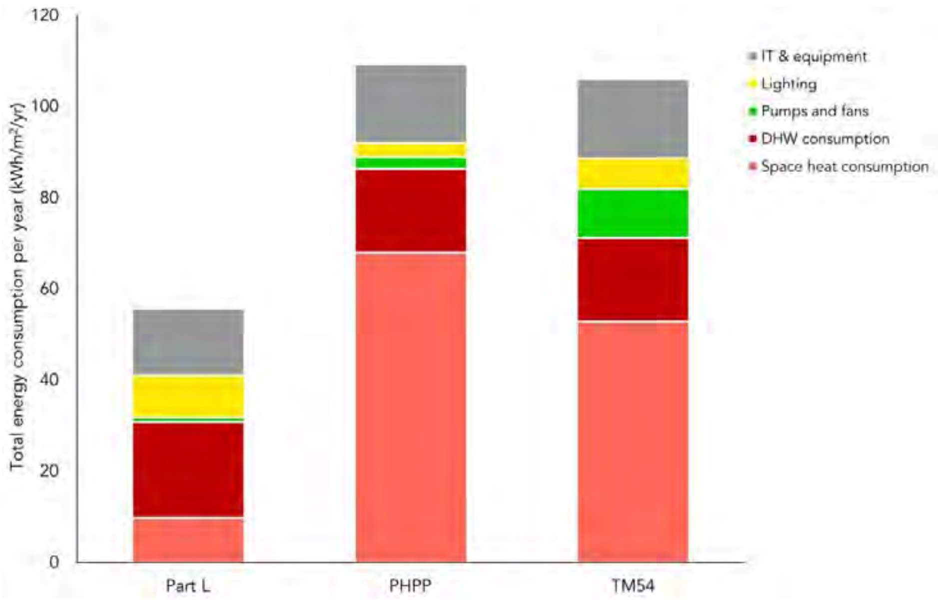
A better approach: Predicted Energy Modelling using CIBSE TM54

Predictive energy modelling using CIBSE Technical Memorandum 54 (TM54) allows to estimate the operational energy for all end uses of a building (regulated and unregulated) much more accurately. With TM54, more realistic operational scenarios such as the length of hours the building is used can be taken into account.

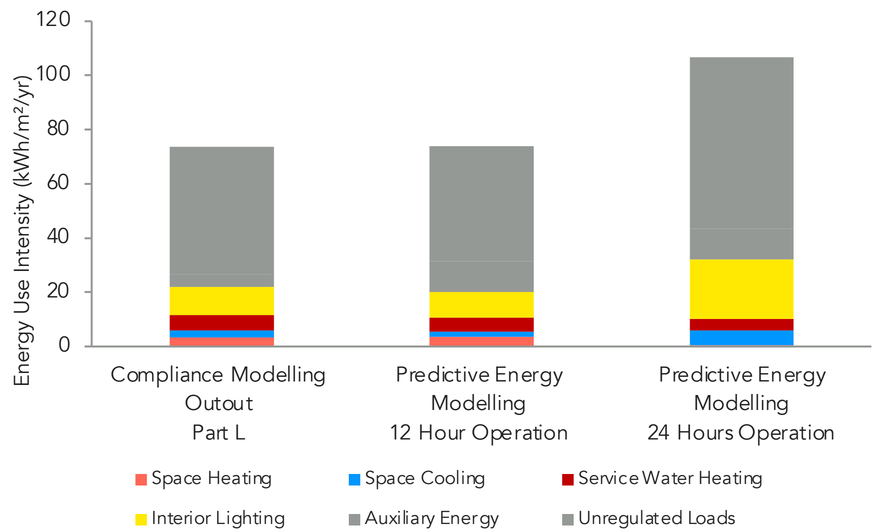
The London Borough of Newham should mandate, or at least encourage, the use of TM54 predictive energy modelling on non-domestic new build projects. IESVE, TAS and PHPP are three energy modelling packages that can be used to carry out TM54 assessments.

Two examples: schools and industrial buildings

The adjacent graphs show how inaccurate Part L modelling is at predicting energy use (top graph for a School building) and how inflexible it is: the bottom graph for industrial buildings show that considerations such as 12-hour vs 24-hour operation can be taken into account.



Comparison between Part L Modelling and Predictive Energy Modelling for a School



Comparison between Part L Modelling and Predictive Energy Modelling for a large industrial building

6.0

Proposed Net Zero Carbon new building policies for the London Borough of Newham's new Local Plan

This section sets out seven new proposed policies to help the new Local Plan deliver Net Zero Carbon new buildings.

Policy recommendations | Net Zero Carbon new buildings in operation

Introduction

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

Recommended policy 1 (overarching policy)

Net Zero Carbon new buildings

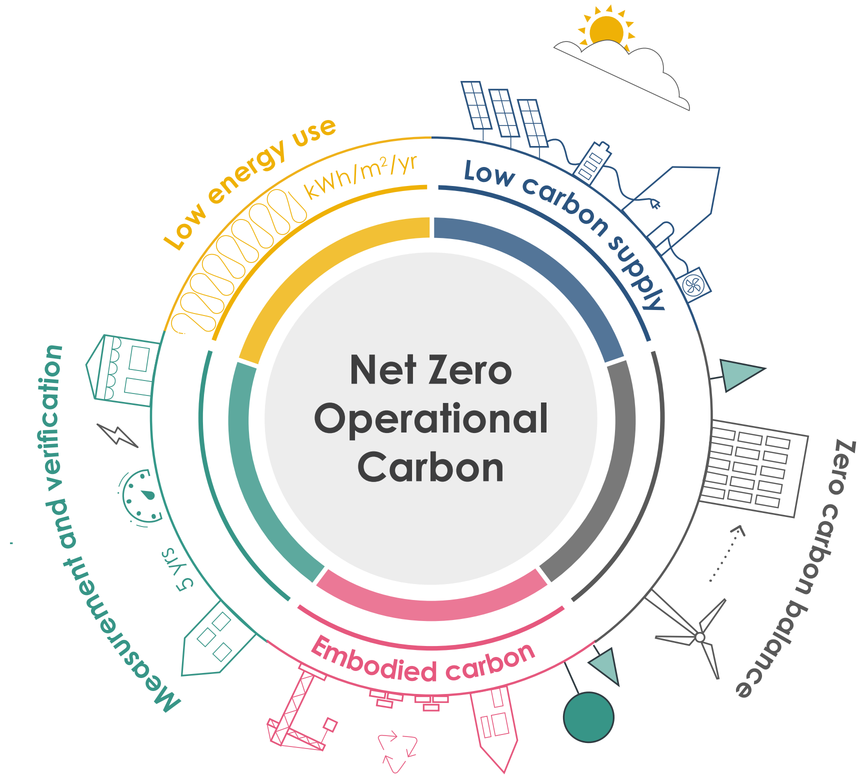
New buildings should be designed and constructed to Net Zero standards to enable the London Borough of Newham to stay within challenging remaining carbon budgets. This is also in line with the recommendations of the Climate Change Committee, the London Energy Transformation Initiative (LETI) and the Royal Institute of British Architects (RIBA).

Proposed policy wording

All new buildings should be designed and built to be Net Zero Carbon in operation. They should be ultra-low energy buildings, use low carbon heat, contribute to the generation of renewable energy on-site and be constructed with low levels of embodied carbon.

This is an overarching policy. Compliance with it relies on compliance with the following policies.

- Policy 2: Space heating demand
- Policy 3: Low carbon heat
- Policy 4: Energy Use Intensity (EUI)
- Policy 5: On-site renewable energy generation
- Policy 6: Assured energy performance
- Policy 7: Offsetting (as last resort)
- Embodied carbon policies (see separate document)



Extract from the current definition of Net Zero Carbon new buildings

Net zero operational carbon must cover all energy use within a building (both "regulated" and "unregulated").

Recommended policy 2

Net zero carbon new buildings: space heating demand

The space heating demand is the amount of heat energy needed to heat a home over a year and is expressed in kWh/m^2/yr. It is a measure of the thermal efficiency of the building elements.

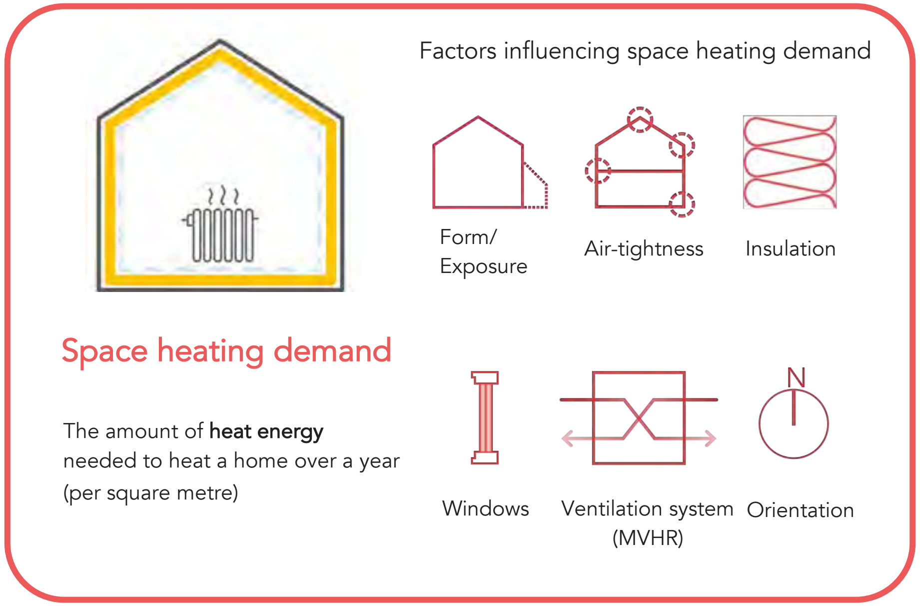
Various design and specification decisions affect space heating demand including building form and orientation, insulation, air-tightness, windows and doors and the type of ventilation system.

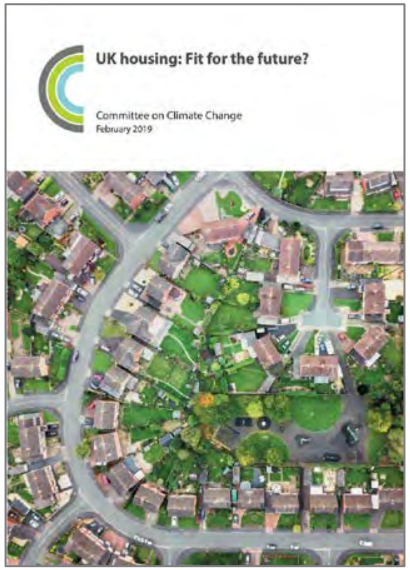
The Climate Change Committee recommends a space heating demand of less than 15-20 kWh/m^2/yr for new homes. This recommendation is also in line with the recommendations of the Royal Institute of British Architects (RIBA), the Low Energy Transformation Initiative (LETI) and the UK Green Building Council.

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

Proposed policy wording

- All dwellings should achieve a space heating demand of less than 20 kWh/m$^2_{GIA}$/yr.
- All non-domestic buildings except industrial buildings should achieve a space heating demand of less than 20 kWh/m$^2_{GIA}$/yr.
- Industrial buildings should achieve a space heating demand of less than 15 kWh/m$^2_{GIA}$/yr.





The Climate Change Committee has published a report in 2019 named 'UK housing – fit for the future?'. The report highlights the need to build new buildings with 'ultra-low' levels of energy use.

It makes a specific reference to space heating demand and recommends a maximum of 15-20 kWh/m2/yr for new dwellings.

For reference, Passivhaus requires 15 kWh/m^2/yr, and most new domestic buildings have a heating demand of 40-120 kWh/m^2/yr.

Recommended policy 3

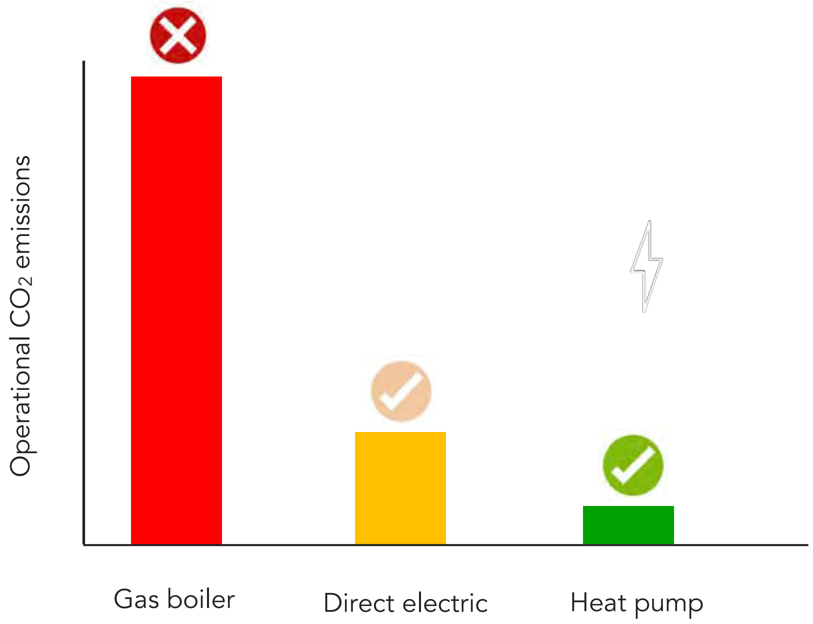
Net zero carbon new buildings: low carbon heat

New buildings cannot continue to burn fossil fuels for heating if the London Borough of Newham 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 250-300% for an Air Source Heat Pump.

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



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

Proposed policy wording

- No new developments shall be connected to the gas grid.
- Fossil fuels shall not be used on-site to provide heat.
- Heat shall be provided through low carbon fuels.

Recommended policy 4

Net zero carbon new buildings: Energy Use Intensity (EUI)

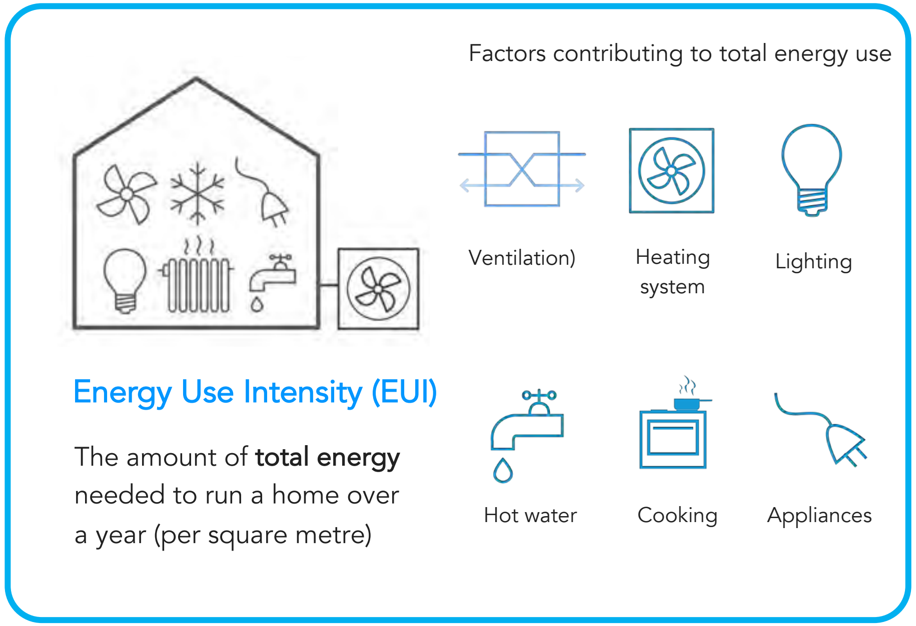
In order for new buildings to be compliant with our climate change targets, they need to use a total amount of energy which is small enough so that it can be generated entirely, on an annual basis, with renewable energy and nuclear energy. Reducing total energy use is also beneficial as it would directly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

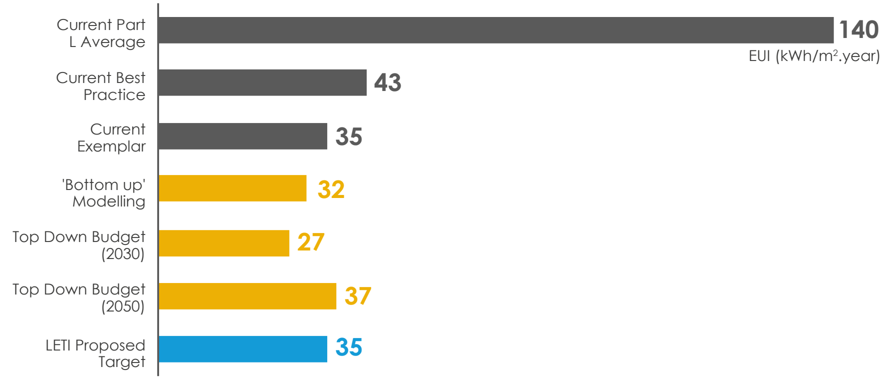
Energy Use Intensity (EUI), or metered energy use, is the total energy needed to run a home over a year (per square metre). It is a measure of the total energy consumption of the building (kWh/m²/yr). The EUI of a building covers all energy uses: space heating, domestic hot water, ventilation, lighting, cooking and appliances.

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.

Proposed policy wording

- **Residential** - All dwellings should achieve an Energy Use Intensity (EUI) of no more than 35 $kWh/m^2_{GIA}/yr$.
- **Non-residential** - Non-domestic buildings should achieve an Energy Use Intensity (EUI) of no more than the following (where technically feasible) by building type or nearest equivalent:
  - Student or keyworker accommodation – 35 $kWh/m^2_{GIA}/yr$
  - Offices, Retail, HE Teaching facilities, GP surgery, Hotel – 55 $kWh/m^2_{GIA}/yr$
  - Schools – 65 $kWh/m^2_{GIA}/yr$
  - Leisure, warehouses and light industrial units – 100 $kWh/m^2_{GIA}/yr$ + an additional 20 $kWh/m^2_{GIA}/yr$ budget for warehouses/industrial units that operate for 24 hours a day





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.

Recommended policy 5

Net zero carbon new buildings: 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.

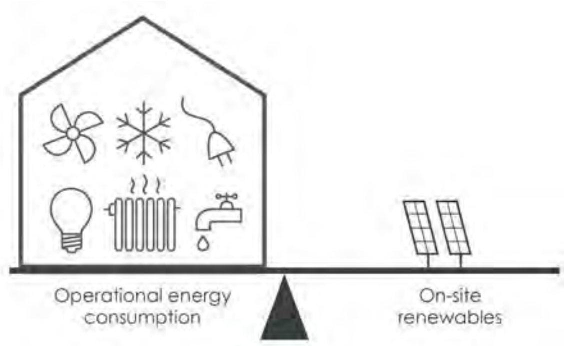
This would also have the advantage of generating 'free' electricity close to its point of use, helping to deliver significant energy cost savings for residents and building users.

Proposed policy wording

- Renewable energy should be generated on-site for all new developments.
- As a minimum, the amount of energy generated in a year must be:
  - at least 80 kWh/$m^2_{\text{building footprint}}$ per annum* for all building types
  - at least 120 kWh/$m^2_{\text{building footprint}}$ per annum* for industrial buildings

  (measured in per square meter of building footprint)
- The amount of energy generated in a year should match or exceed the predicted annual energy demand of the building, i.e. Renewable energy generation (kWh/m^2/yr) = or > EUI (kWh/m^2/yr).
- When this is not technically possible and suitably justified, the applicant should fund renewable energy generation (equivalent to the shortfall) elsewhere in the borough (see Policy 7).

** This evidence base shows that this level of generation is deliverable for typical new development whilst enabling some roof space to be used for other purposes.*

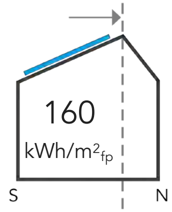


Energy balance

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

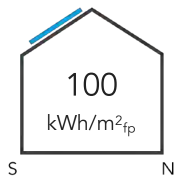
A key component of a net zero carbon building is achieving an energy balance – the amount of renewable energy generated in a year matches the energy used by the building in a year.

Pitched Roof



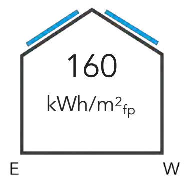
North South

Asymmetric pitch roof with a majority south facing roof



North South

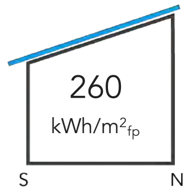
Pitch roof with a south facing roof



East West

Pitch roof with a majority east/west facing roof

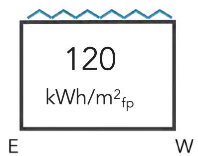
Monopitch Roof



North South

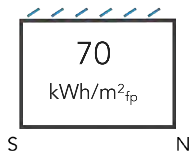
Monopitch roof with a majority south facing roof

Flat Roof



East West

Flat roof with a east/west concertina PV array



North South

Flat roof with an angled south PV array

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

Recommended policy 6

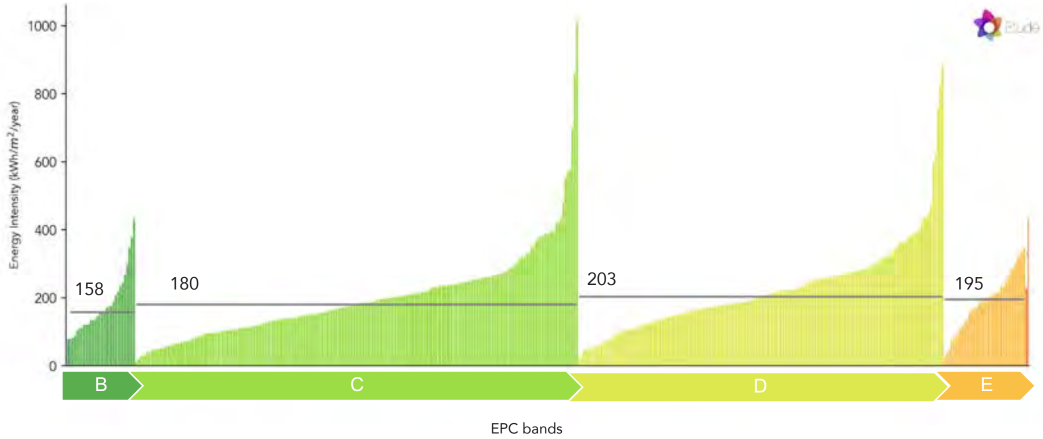
Net zero carbon new buildings: Assured energy performance

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. This can be achieved by energy performance construction quality assurance schemes such as the Passivhaus standard or the AECB Building standards.

Proposed policy wording

- All developments (domestic and non-domestic) must demonstrate and commit to the use of an assured performance method in order to ensure that the buildings' operational energy performance will meet the design intentions.
- All developments should monitor their total energy use and renewable energy generation and submit the annual figures to the London Borough of Newham for the first 5 years of operation.



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.

Good examples of insulation installed on site, showing methods to eliminate gaps (wedging and overfilling). Left: Goldsmith street © Etude, Right: © Green building store.

Recommended policy 7

Net zero carbon new buildings: Offsetting (as last resort)

The Climate Change Committee is clear: offsetting must have a very limited and defined role if we are to achieve Net Zero by 2050. Its role in the Local Plan as part of the Net zero carbon new buildings suite of policies 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 could be expressed in £/kWh instead of £/tCO_2. This would make it independent from carbon factor changes.

Proposed policy wording

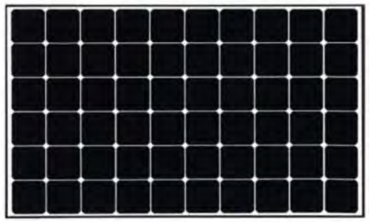
Offsetting will only be accepted as a means to achieving planning policy compliance a last resort if the building is compliant with all other Net Zero carbon buildings policies and in particular if the following conditions have been met:

1. The proposed building must not use fossil fuels on-site.
2. It must have a level of space heating demand and energy use intensity (EUI) compliant with levels set in the Local Plan.
3. On-site renewable energy generation (e.g. through PVs) has been maximised and achieves at least 80 kWh/$m^2_{building\ footprint}$ for all building types (and 120 kWh/$m^2_{building\ footprint}$ for industrial buildings).

In these circumstances, the applicant should establish the shortfall in renewable energy generation to enable the annual renewable energy generation to match the Energy Use Intensity in kWh. The applicant should 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 borough, which is able to generate a similar amount of energy.

Reduced operational energy consumption	**Achieve a Space Heating Demand and an Energy Use Intensity (EUI) lower than the levels required in the Local Plan** (e.g. 20 kWh/m^2_{GIA}/yr and 35 kWh/m^2_{GIA}/yr respectively)	✓
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	**Achieve a minimum electricity generation intensity compliant with the requirement in the local plan** (e.g. > 80-120kWh/$m^2_{building\ footprint}$/yr)	✓
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



£1.5 /kWh

Potential offset price (based on the energy balance shortfall)

Our recommendation is that the offset contribution is used to fund PV systems in the borough. The main reason for this is that the shortfall it is trying to compensate is a renewable energy generation shortfall. It is therefore clearer is funds are used for this purpose. It would also facilitate simplicity, transparency and accountability, which can be challenging when offset contributions are used for many different purposes. 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. Based on the current average price and performance of a PV system, a floor price of £1.25/kWh could be used. If a 20% project management fee was added, this would lead to an offset price of ***£1.5/kWh.***

The process takes time

The process of updating planning policy, creating the required evidence base to justify its need and technical feasibility, assessing its financial viability and going through the examination process takes months, if not years. That is why only a small number of Local Planning Authorities have already published their proposed policy and evidence base.

Local authorities leading the way

The list below includes the names of local authorities which have already published proposed policies and their evidence base:

- West Oxfordshire District Council (Salt Cross AAP)
- Greater Cambridge (Local Plan)
- Cornwall Council (Climate Emergency DPD)
- Central Lincolnshire (Local Plan)
- London Borough of Merton (Local Plan)

Net Zero carbon buildings

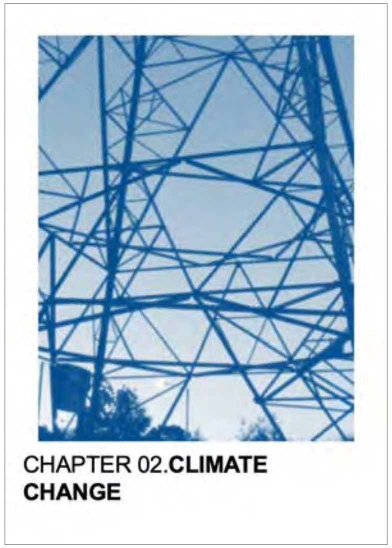
An important common theme between different local authorities, for which constraints and opportunities may be very different, is the introduction of a Net Zero carbon building policy.

A decisive move towards better metrics

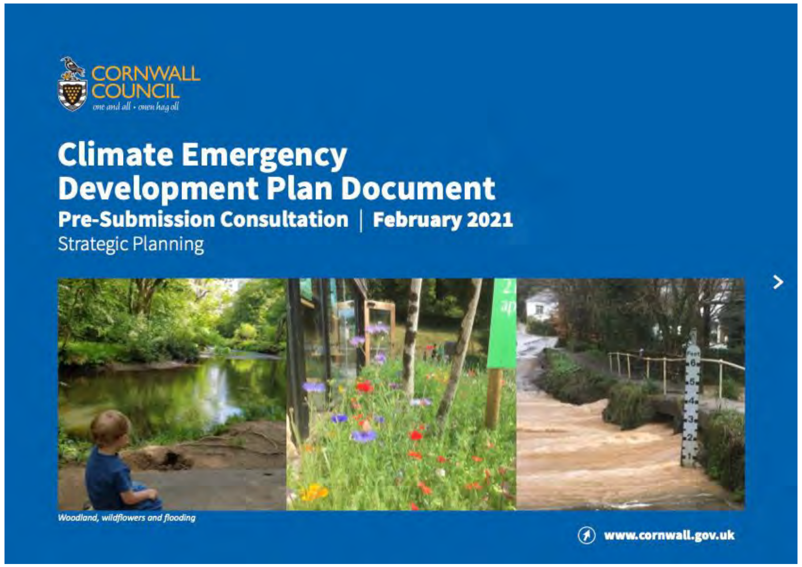
Along with the introduction of a Net Zero carbon building policy, most of these proposed planning requirements introduce a move towards better energy performance metrics in kWh/m^2/yr

1. Space heating demand
2. Energy use intensity (EUI)
3. Renewable energy generation
4. Net Zero balance.

Greater Cambridge New Local Plan
https://consultations.greatercambridgeplanning.org



London Borough of Merton Draft New Local Plan
https://www.merton.gov.uk/planning-and-buildings/planning/local-plan/newlocalplan



Cornwall Council Climate Emergency DPD and associated evidence base
https://www.cornwall.gov.uk/planning-and-building-control/planning-policy/adopted-plans/climate-emergency-development-plan-document/

7.0

Technical evidence base for residential planning applications

This section demonstrates that the seven recommended new policies are technically feasible for residential planning applications.

Typology selection

Energy modelling has been undertaken for four residential typologies.

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

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

The actual buildings selected all come from recent planning applications, either in Newham and other London Boroughs:

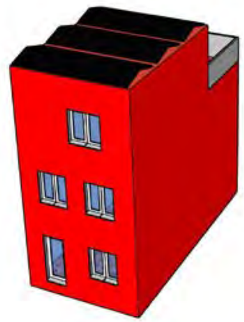
- 3-bed townhouse (terrace)
- Low rise block of 7 flats
- Mid rise block of 28 flats
- High rise block of 169 flats

For each typology, and in order to demonstrate that the proposed new policies are both feasible and viable, energy and cost modelling was undertaken for the scenarios below:

5 – Ultra-low energy, individual heat pump

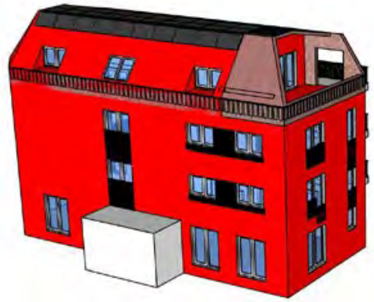
6 – Ultra-low energy, direct electric

7 – Ultra-low energy, district heat network (heat pump)



3-bed Townhouse

GIA: 116m²

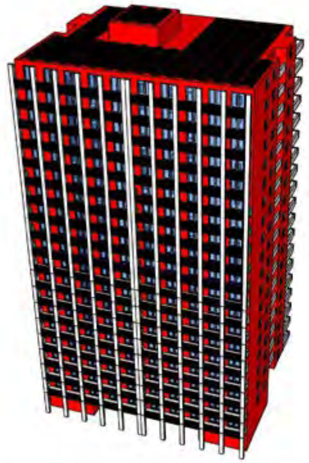


Low rise block (7 units)

GIA: 641m²

Mid rise block (28 units)

GIA: 2,125m²



High rise block (169 units)

GIA: 15,541m²

Proposed new planning policy: scenarios modelled (residential)

SCENARIO	ENERGY EFFICIENCY	HEATING SYSTEM	RENEWABLE GENERATION
5 - Ultra low energy, individual heat pump		Individual heat pump	
6 - Ultra low energy, direct electric	15-20kWh/m^2 space heat demand target	Direct electric	To meet total annual energy consumption OR at least 80 kWh/$m^2_{\text{building footprint}}$ per annum
7 - Ultra low energy, district heat network (heat pump)		District network: heat pump	

Energy efficiency | Specifications consistent with an 'ultra-low' level of energy efficiency

The scenarios modelled are all 'ultra-low energy': they are compatible with a net zero carbon future and are based on best practice levels of fabric efficiency. The building construction properties summarised on this page are the result of an iterative modelling process, using PHPP software, to meet a target space heating demand of 15-20kWh/m^2/yr.

Key energy efficiency specifications

- **U-values** range from good to best practice. For the larger typologies with improved form factors, construction U-values can be relaxed.
- All typologies are assumed to have **triple glazing**.
- All typologies are assumed to have Mechanical Ventilation with Heat Recovery (MVHR)
- **Airtightness** (<1.5 m^3/m^{2}h) for the ultra-low energy scenarios is a significant change compared to current business as usual applications in London (<3 m^3/m^{2}h). With good design this level of airtightness is not overly stringent though, and there are many examples of Passivhaus dwellings with air permeability rates measured post-completion at less than 1.0 m^3/m^{2}h. Achieving an airtight thermal envelope, which limits heat loss due to infiltration of cold outdoor air, can offer a very cost-effective way of reducing energy consumption.
- To reduce hot water demand Waste Water Heat Recovery (WWHR) units are included in these ultra-low energy scenarios. It is also included in the Part L 2021 notional building specification.

	TOWNHOUSE	LOW RISE	MID RISE	HIGH RISE
Floor U-value	0.10 W/m^{2}K	0.10 W/m^{2}K	0.10 W/m^{2}K	0.11 W/m^{2}K
Wall U-value	0.12 W/m^{2}K	0.13 W/m^{2}K	0.13 W/m^{2}K	0.15 W/m^{2}K
Roof U-value	0.10 W/m^{2}K	0.10 W/m^{2}K	0.10 W/m^{2}K	0.11 W/m^{2}K
Windows	Triple glazed windows U-value 0.8 W/m^{2}K g-value 0.55			
Ventilation	Mechanical ventilation with heat recovery (MVHR) >85% heat recovery efficiency			
Airtightness	1.5 m^3/m^{2}h			
Wastewater heat recovery	Instantaneous WWHR with 36% recovery efficiency All showers connected to a WWHR system			

Key energy efficient specifications applied to each typology

The scenarios modelled aim to be compatible with a net zero carbon future and each include a different low carbon heating system. These three heating systems are fuelled by electricity, drawn either from the grid or on-site photovoltaics. Hybrid approaches, such as direct electric radiators with domestic hot water from a heat pump system are possible, but have not been modelled.

Scenario 5 – individual heat pump

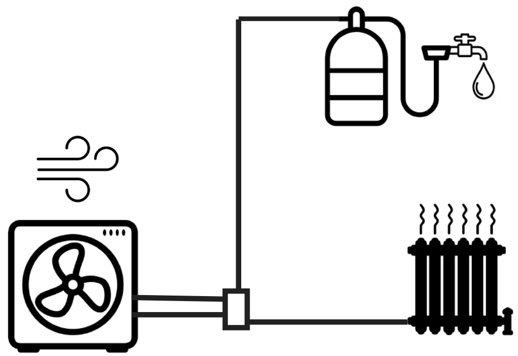
Heat pumps are currently the most viable technology to achieve widespread electrification of heat at scale while limiting overall demand on the electricity network. They are therefore a key technology whose use needs to be rapidly expanded. The energy modelling of scenario 5 assumes individual monobloc air source heat pumps, to be located generally on a roof, terrace or balcony.

Scenario 6 – direct electric

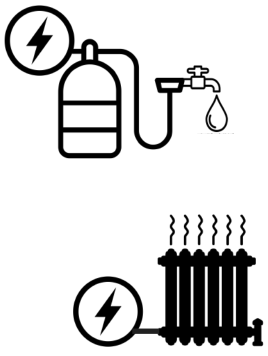
In ultra low energy dwellings direct electric systems may be viable due to significant reduction in energy demand compared to more standard new build homes. Scenario 6 is based on direct electric panels for space heating and an electric immersion hot water cylinder for domestic hot water.

Scenario 7 – heat network (heat pump)

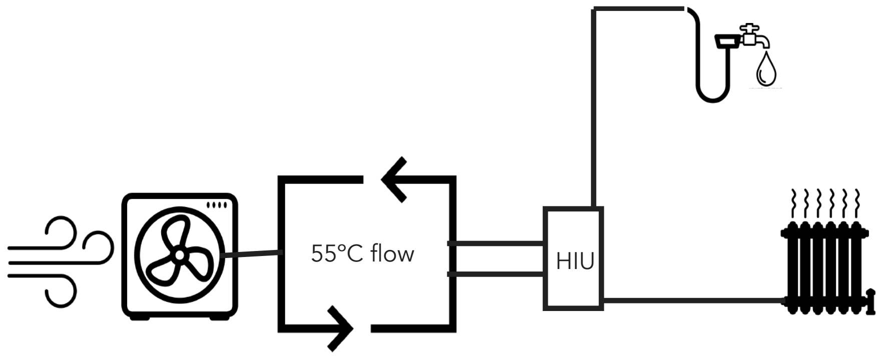
District or communal heating networks with centralised plant can take advantage of load diversity. If these networks are driven by a low carbon heat and minimise their energy losses, they can be compatible with a net zero carbon future. A heat network based on a centralised bank of air source heat pumps, with a flow temperature of 55°C, has been assumed for scenario 7.



Individual heat pump low carbon heating system ***(scenario 5)***



Direct electric low carbon heating system ***(scenario 6)***



Heat network low carbon heating system ***(scenario 7)***

PV arrangement

The images on this page show the PV arrangement used for each typology. The PV arrangements look to maximise renewable generation potential through either east-west concertina or pitched arrays, with some allowance for other uses (e.g. plant and/or amenity spaces and/or biodiversity).

Although extensive areas of the roofs can be used to increase biodiversity, there are other opportunities for this elsewhere (e.g. landscape design). Therefore, it was considered reasonable not to prioritise biodiversity over PVs.

All layouts shown here generate in excess of the 80 $kWh/m^2_{building\ footprint}$ requirement of Policy 5.

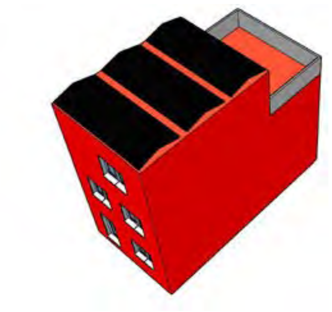
Additional PV potential through better roof design

The roof layouts have not been altered to optimise PV generation. With improvements to roof design, such as removing the terrace for the townhouse, or altering the roof angle of the low rise block to a mono pitch South facing roof, it would be possible to generate even more renewable energy generation on-site. Contrary to these four case studies, new developments can be designed with the consideration of how to optimise roof layout for renewable generation from the outset, which would enable them to achieve even greater levels of PV generation.

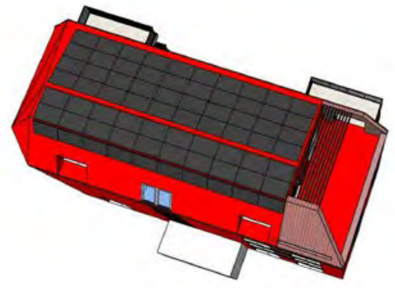
PV panel specifications

Renewable energy generation is based on solar panels with an efficiency of 380Wp. Monocrystalline panels, measuring approximately 1.8x1.0m, have been assumed.

Although this represents a reasonably high-performance specification, the solar PV market is continuingly evolving and PV panels with capacities of 400-420Wp are already available in 2022.

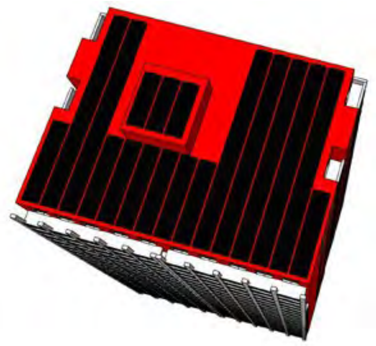


Townhouse
18 x 380 kWp panels
102 $kWh/m^2_{footprint}$



Low rise block
70 x 380 kWp panels
105 $kWh/m^2_{footprint}$

Mid rise block
92 x 380 kWp panels
88 $kWh/m^2_{footprint}$



High rise block
330 x 380 kWp panels
109 $kWh/m^2_{footprint}$

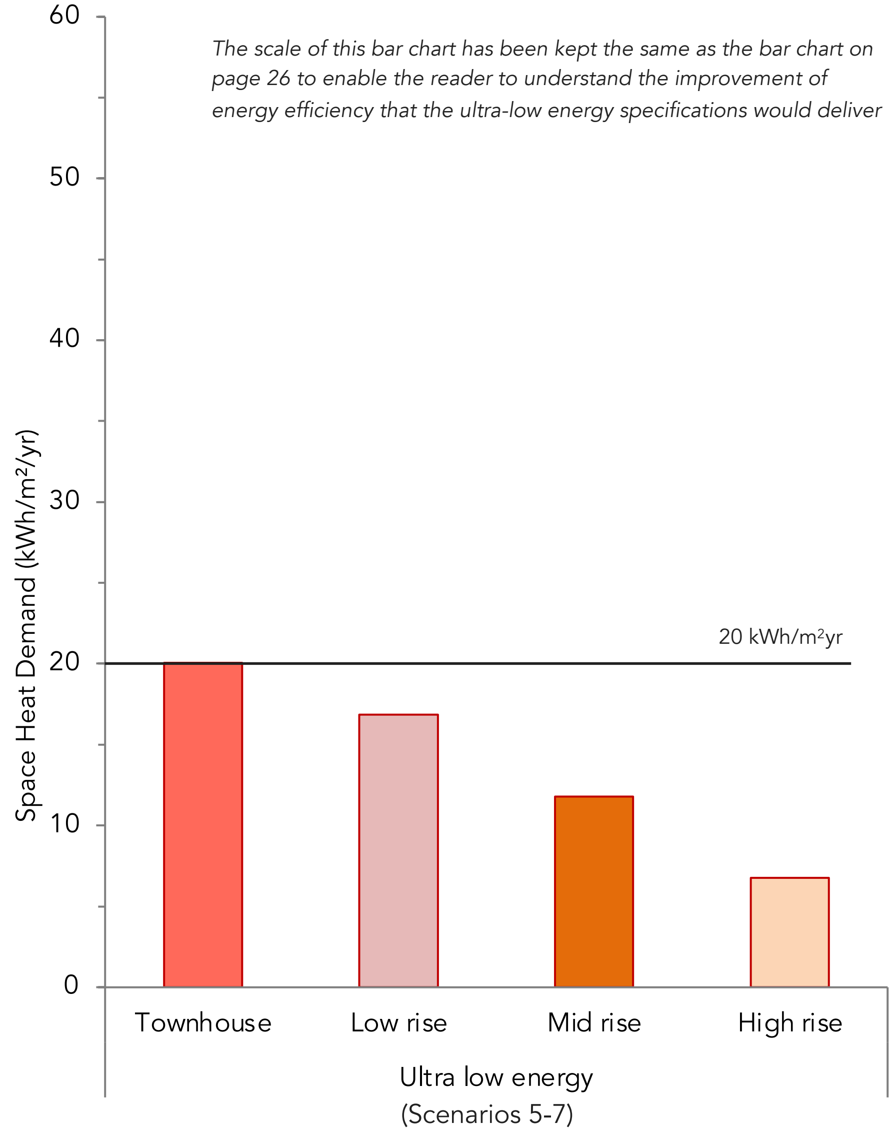
Policy 2 requires all dwellings to achieve a space heating demand of less than 20 kWh/m²/yr.

Technical feasibility

Energy modelling using PHPP software was carried out for the four residential typologies. The ultra low energy specifications summarised on page 47 enable all typologies to achieve a space heating demand of less 20 $kWh/m^2_{GIA}/yr$, while avoiding any onerous individual element requirements. The resulting ultra low energy space heating demands, for the four typologies, are shown to the right.

Conclusion

Based on the energy efficiency specifications shown on previous pages, all typology dwellings achieve compliance with the Policy 2 requirement. Therefore, it can be concluded that Policy 2 is technically feasible for domestic buildings



Space heating demand of all typologies using ‘ultra low energy’ specifications

Technical feasibility of recommended Policy 3 | Net zero carbon new buildings: low carbon heat

Policy 3 requires that:

- No new developments shall be connected to the gas grid.
- Fossil fuels shall not be used on-site to provide heat.
- Heat shall be provided through low carbon fuels.

Technical feasibility

This policy offers flexibility. There are many types of heating systems available that do not use gas, such as those shown on this page.

Heat pumps

Heat pumps are technically feasible in all building types. This is demonstrated by the number of successful heat pump installations currently in the UK, which is growing year-on-year.

There were more than 200,000 Air Source Heat Pumps and 27,000 Ground Source Heat Pumps installed in the UK as of 2019 (source: Statista) and annual heat pump installations doubled between 2019 and 2021, from 35,000/yr to almost 70,000/yr (source: The Heat Pump Association). Some European countries have a much higher uptake of heat pumps than the UK. The northern European countries of Norway, Sweden and Finland have 4-5 times more heat pumps per capita than the UK.

Direct electric

Direct electric solutions can be considered (subject to compliance with the other policies). Hybrid technologies that combine heat pump technology and direct electricity use could also be viable options.

Heating system	Scale suitability		
	Individual	Communal	District
Direct electric			
Air to water heat pump			
Air to air heat pump			
Exhaust air heat pump			
Ground source heat pump			

There is a variety of low carbon heating systems, suitable for domestic buildings. Some are also suited to communal and district scale heating.

Communal rooftop air source heat pumps (Source: Mitsubishi electric)

Electric radiators can be sourced in a variety of shapes, styles and colours (Source: BestHeating)

Individual heat pump in each dwelling (Source: Dimplex)

Hot water heat pump (Source: Dimplex)

Technical feasibility of recommended Policy 4 | Net zero carbon new buildings: Energy Use Intensity (EUI)

Policy 4 requires all buildings to achieve an Energy Use Intensity (EUI) of no more than 35 kWh/m²/yr.

Technical feasibility

Energy modelling using PHPP software was undertaken to estimate the total energy consumption for the different residential typologies. Total energy use (both regulated and unregulated) can be divided by the floor area (GIA) to arrive at an Energy Use Intensity (EUI) figure.

For each of the four typologies three low carbon heating options were compared:

- Individual heat pump
- Direct electric
- District network: heat pump

These correspond to scenarios 5-7 (see page 46 for further details).

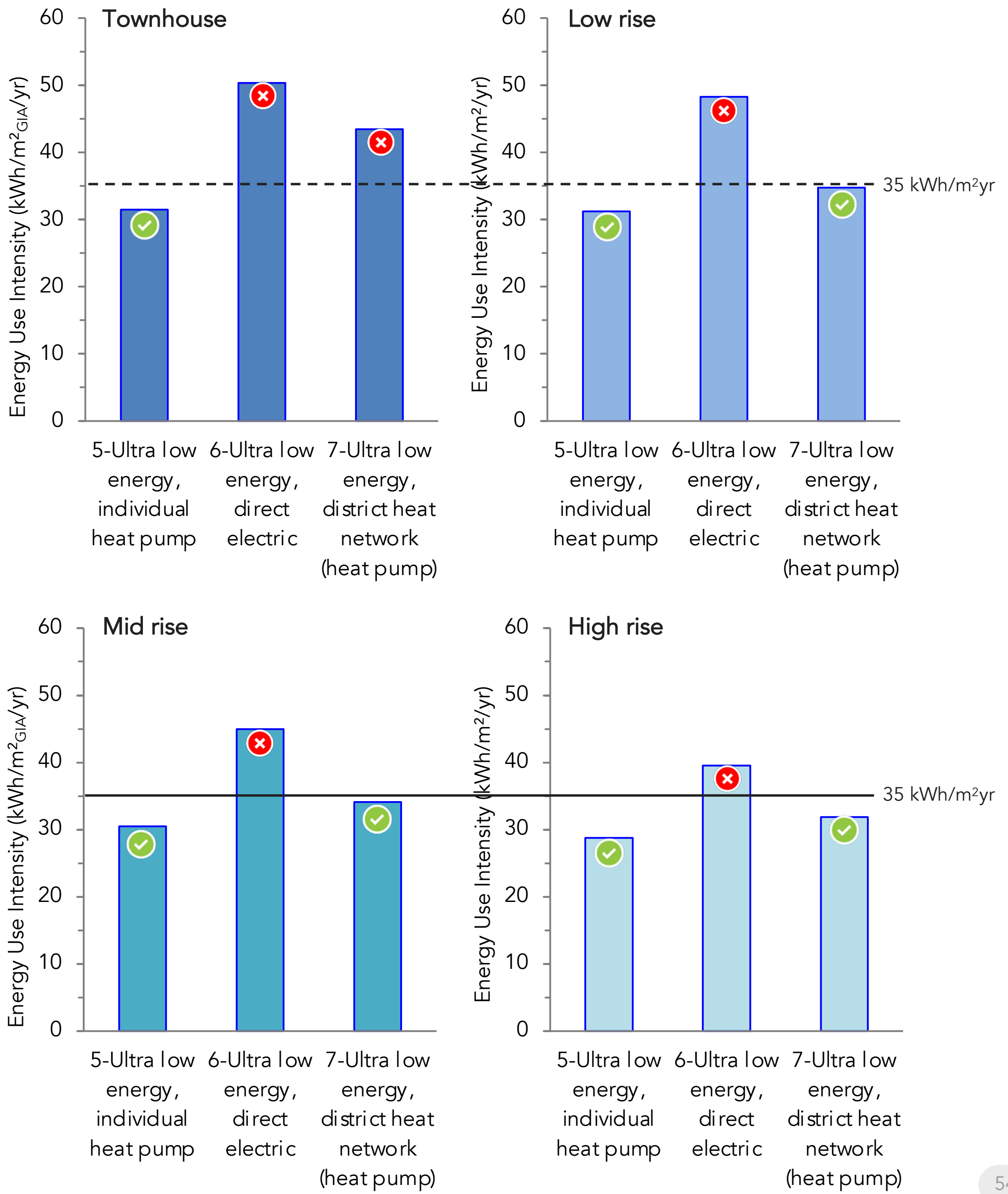
The resulting Energy Use Intensities (EUIs), for the four typologies, are shown to the right.

Conclusion

Seven out of twelve of the low carbon heating options were able to achieve the required 35kWh/m²GIA/yr target, demonstrating the policy is feasible and still allows designers some flexibility in system choice. The direct electric scenario did not meet the target for any of the typologies*.

**** Note on Policy 4 and direct electric heating***

If the objective of the Local Plan is to enable Direct Electric heating systems to go through, it would be necessary to relax the EUI threshold and set it at a higher level (e.g. 50kWh/m² instead of 35kWh/m²). This cause of action could be considered in the future if deemed necessary.



Technical feasibility of recommended Policy 5 | On-site renewable energy generation

Policy 5 requires that:

- Renewable energy should be generated on-site for all new developments.
- As a minimum, the amount of energy generated in a year must be: at least 80 kWh/$m^2_{\text{building footprint}}$ per annum* for all building types (measured in per square meter of building footprint)
- The amount of energy generated in a year should match or exceed the predicted annual energy demand of the building, i.e. Renewable energy generation (kWh/m^2/yr) = or > EUI (kWh/m^2/yr).
- When this is not technically possible and suitably justified, the applicant should fund renewable energy generation (equivalent to the shortfall) elsewhere in the borough (see Policy 7).

Technical feasibility

Energy modelling using PHPP software was carried out for the four residential typologies; this included both a prediction of total annual energy use (EUI) and a calculation for annual renewable generation. In each case, annual generation has been divided by the building's footprint area to check compliance with the second part of policy 5.

The graphs to the right show the balance between the renewable generation vs the total energy consumption (EUI) for the four typologies. This shows that it is feasible for the townhouse and the low-rise block to achieve a balance on-site.

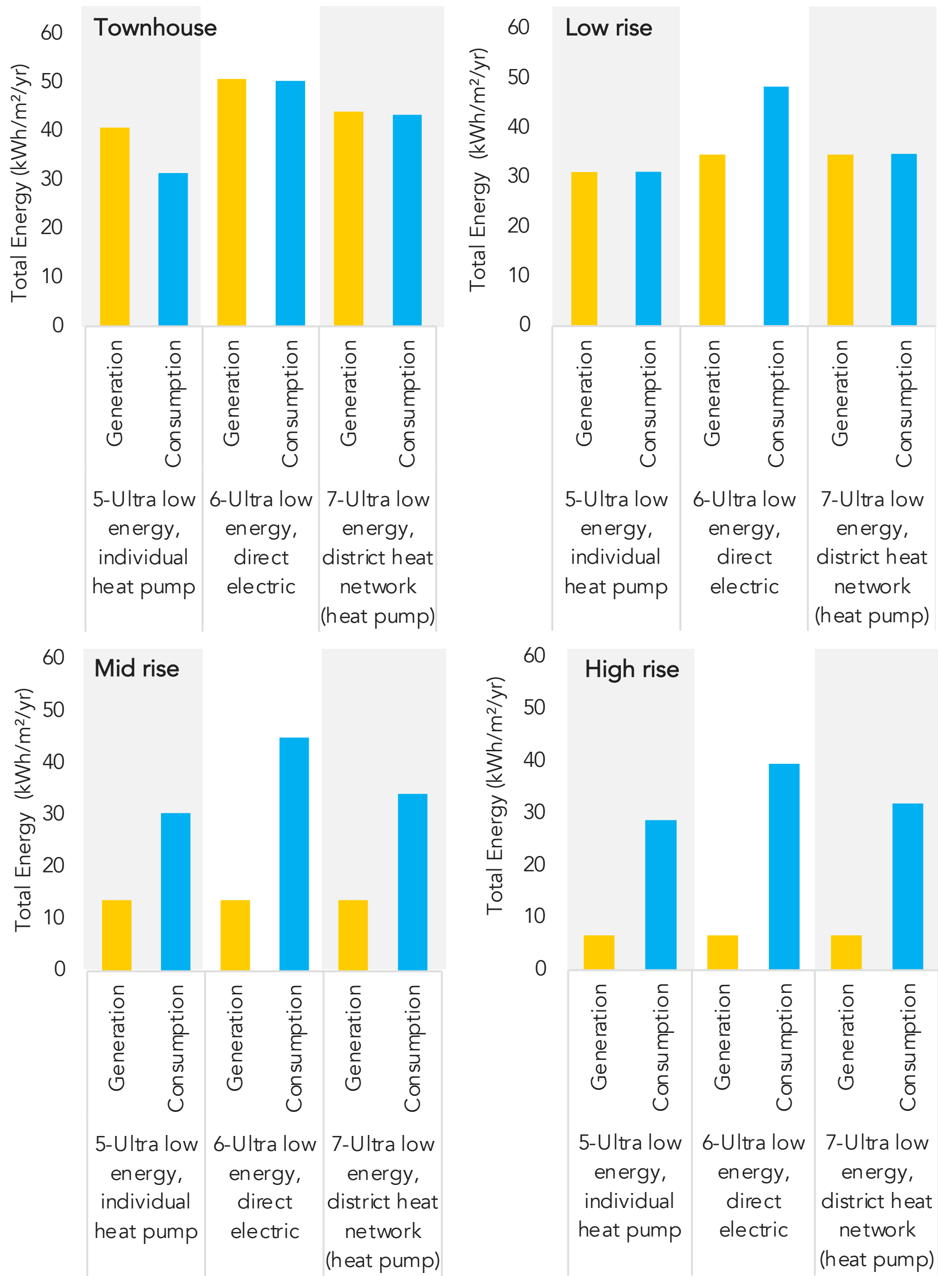
When it is not possible (e.g. mid-rise and high-rise), a minimum of 80kWh/$m^2_{\text{footprint}}$ must be achieved, which is technically possible.

On-site renewable energy generation potential
(kWh/$m^2_{\text{building footprint}}$)

Townhouse	Low rise	Mid rise	High rise
102 ✓	105 ✓	88 ✓	109 ✓

Conclusion

All residential typologies are able to comply with policy 5.



Policy 6 requires that:

- all developments demonstrate use of an assured performance method in order to ensure that the buildings' operational energy performance reflects design intentions.
- all developments should monitor their total energy use and renewable energy generation and submit the annual figures to the London Borough of Newham.

Technical feasibility

Assured energy performance standards

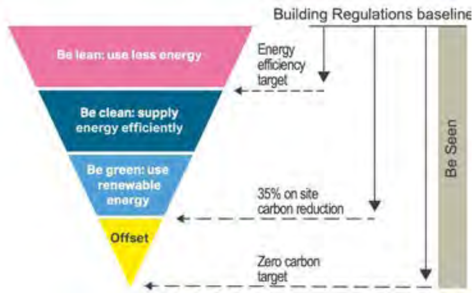
There are several existing performance standards, including the Passivhaus Standard, the AECB Standard and BEPIT, that offer an assured performance methodology to deliver energy efficient homes. These performance standards are now well established in the UK.

As of January 2022 the Passivhaus Trust estimates that there are more than 1,900 residential units built to the Passivhaus standard and 7,000 under development.

Monitoring of energy

The requirements to monitor and report operational energy in use is already incorporated in London Policy. The London Plan "Be Seen" policy requires major development to report on energy performance for at least five years following completion, with online guidance and a data reporting spreadsheet available. This can be extended to all new developments in Newham.

Energy performance standards can help deliver construction quality. Examples of established performance standards used in the UK include the Passivhaus Standard, BEPIT and the AECB Building Standard



9.2.10 The move towards zero-carbon development requires comprehensive **monitoring of energy demand and carbon emissions** to ensure that planning commitments are being delivered. Major developments are required to monitor and report on energy performance, such as by displaying a Display Energy Certificate (DEC), and reporting to the Mayor for at least five years via an online portal to enable the GLA to identify good practice and report on the operational performance of new development in London.

The London Plan 2021 includes a requirement to monitor and report on energy performance, under the "Be Seen" element of the energy hierarchy.

Technical feasibility of recommended Policy 7 | Offsetting (as last resort)

Policy 7 requires that offsetting be used only a last resort, provided that the building is compliant with all other Net Zero carbon buildings policies.

The applicant should establish the shortfall in renewable energy generation to enable to annual renewable energy generation to match the Energy Use Intensity in kWh.

Technical feasibility

Energy modelling using PHPP software was carried out to compare renewable energy generation to total energy consumption for the four residential typologies, under different heating system scenarios. This enabled a shortfall in annual generation to be calculated.

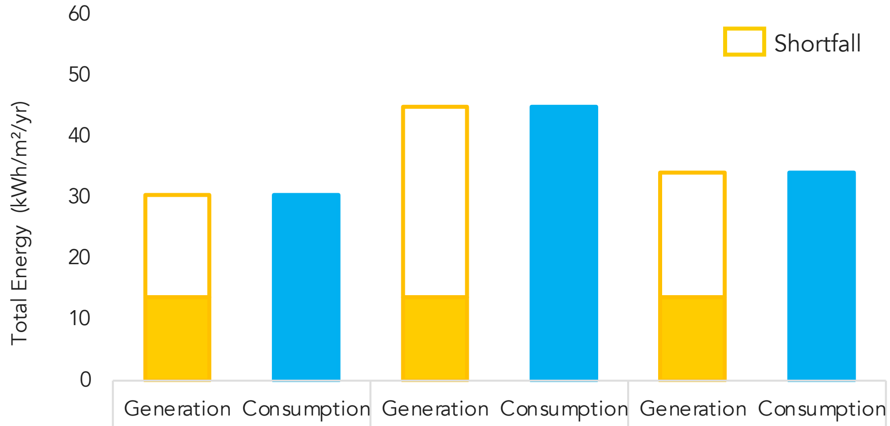
The townhouse and low-rise block were able to generate sufficient renewable energy (on an annual basis) to match their total consumption, this analysis focused on the mid-rise and the high-rise buildings. Their resulting renewable energy shortfalls are shown to the right.

Based on the current average price and performance of a PV system, our initial recommendation for the offset price would be £1.5 /kWh. For the Mid and High rise scenarios studied the resulting payment would represent between 1.2-2.3% of total build cost.

Conclusion

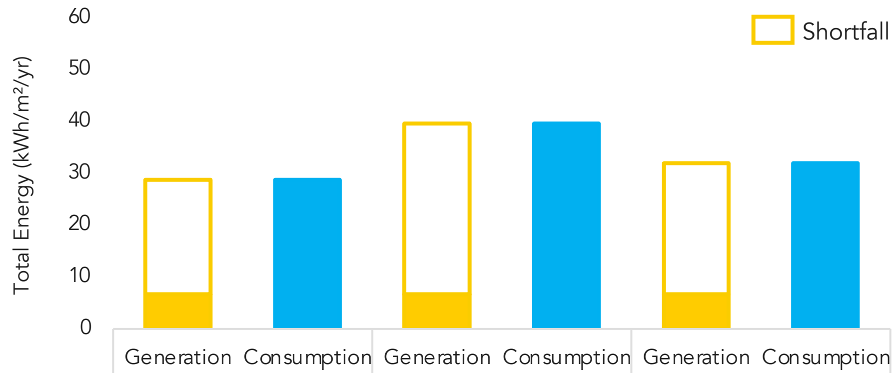
It is likely that mid to high rise residential blocks compliant with the recommended net zero carbon policies will be unable to generate sufficient on-site renewable energy to meet operational annual net zero. In this case, the applicant should pay into the Council's offset fund a sum of money equivalent to funding a PV renewable energy system elsewhere in the borough able to generate the shortfall amount of energy. This is technically feasible. The impact on construction cost in considered in the cost chapter.

Mid rise, GIA: 2,125 m² (28 units)



	5-Ultra low energy, individual heat pump	6-Ultra low energy, direct electric	7-Ultra low energy, district heat network (heat pump)
Shortfall (kWh)	35,670	66,460	43,340
Payment per unit (£)	1,274	2,374	1,548

High rise, GIA: 15,541 m² (169 units)



	5-Ultra low energy, individual heat pump	6-Ultra low energy, direct electric	7-Ultra low energy, district heat network (heat pump)
Shortfall (kWh)	342,383	510,545	391,540
Payment per unit (£)	2026	3021	2317

Technical feasibility of recommended Policy 1 | Resulting carbon emissions

Policy 1 stipulates that new buildings should be designed and built to be Net Zero Carbon with immediate effect.

This is recommended as an overarching policy that will be delivered in practice via compliance with policies 2-7.

Technical feasibility

Energy modelling using PHPP provided a baseline projection of total energy use for the different residential typologies under each scenario.

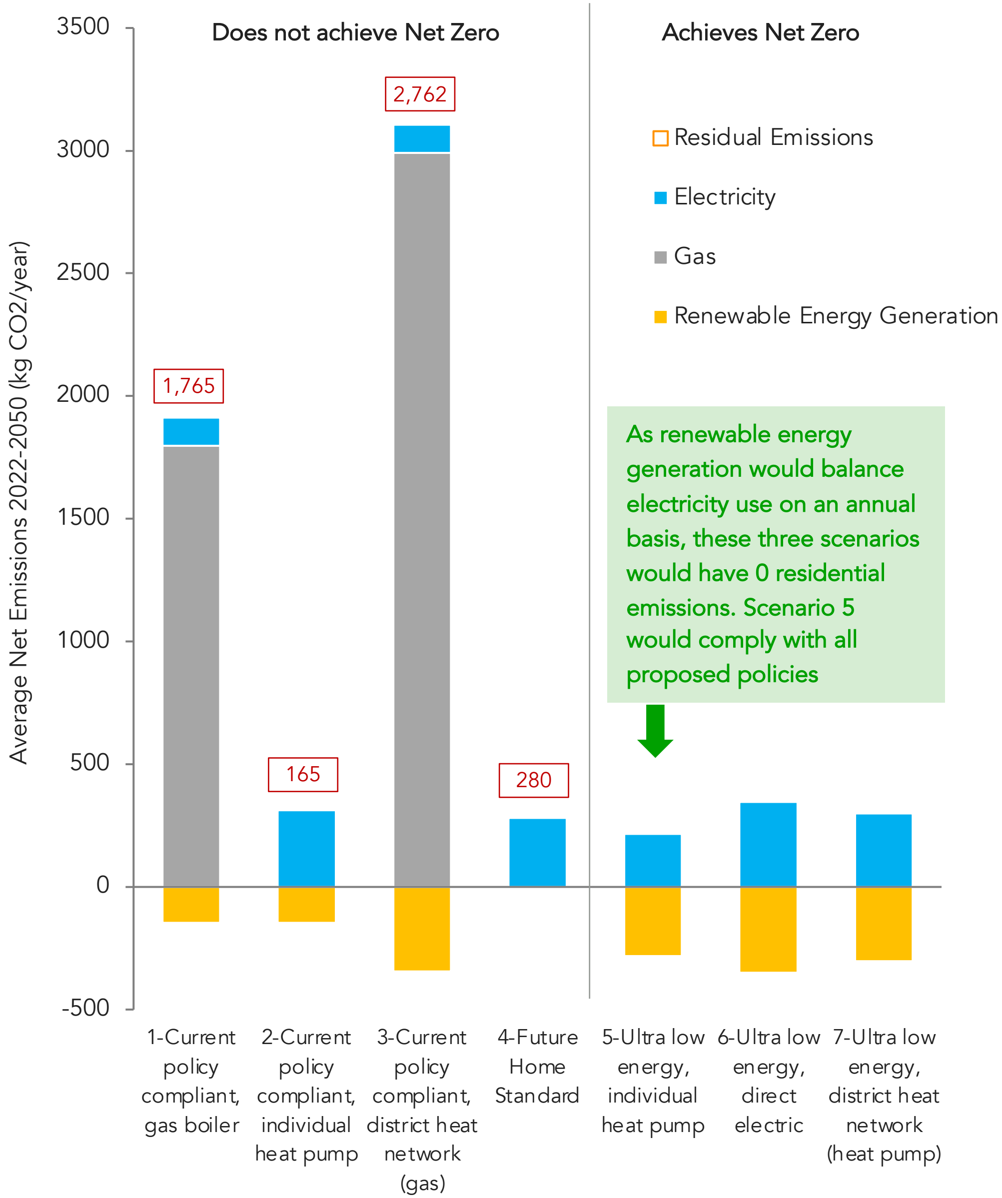
Carbon factors were then applied to gas and electricity consumption, and solar PV generation. The carbon factor for gas is taken from SAP 2012 as it is not expected to change significantly. Annual carbon factors for electricity from 2022-2050 are taken from HM Treasury Green Book domestic consumption-based grid average figures. These figures are also used to calculate savings from solar energy generation.

The resulting average annual carbon emissions for the Townhouse, are shown to the right. It is evident from the graph how current policy scenarios (1-3) and the Future Home Standard (4) are not compliant with Net Zero Carbon, as there are significant residual emissions remaining.

Net zero carbon can be achieved with the proposed policies (scenarios 5-7). This relies on the use of an energy efficient fabric, low carbon heating and on-site renewable energy generation to meet the energy used onsite.

Conclusion

The energy and carbon modelling in PHPP, using projected carbon emission between 2022-2050, confirms that the proposed policies will help residential development reach net zero carbon on-site.



Townhouse– average annual net carbon emissions per dwelling

8.0

Technical evidence base for non-residential planning applications

This section demonstrates that the seven recommended new policies are technically feasible for non-residential planning applications.

Proposed new planning policy: technical evidence base (non-residential)

Typology selection

Energy modelling has been undertaken for two industrial typologies. The main criteria for selection was to be representative of both current industrial development in Newham and that which is expected to come forward over the next local plan period. It was also important to model a range of building sizes as that can impact energy efficiency and the ability to match on-site energy renewable generation with on-site consumption.

The typologies have been based on recent planning applications, both in Newham and other London Boroughs.

The typologies are:

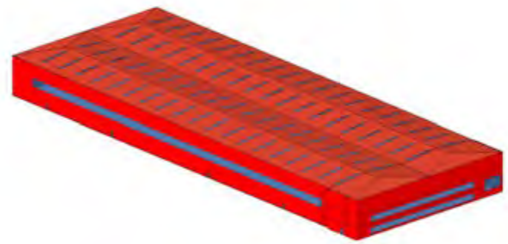
- **Large industrial unit**
- **Small Industrial unit**

For each typology, energy and cost modelling was undertaken on the following scenario:

4 – Improved fabric, individual heat pump

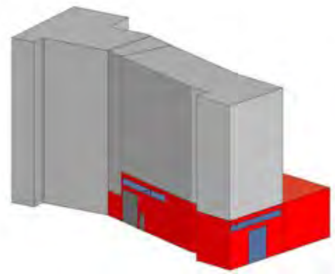
For the large industrial typology, an additional study was undertaken on the following scenarios:

6- Limiting fabric , unheated warehouse space, individual heat pump



Large Industrial Unit

GIA: 12153m²



Small Industrial Unit

GIA: 466m² (4 small units)

(Resi above- shown in grey)

SCENARIO	ENERGY EFFICIENCY	HEATING SYSTEM	RENEWABLE GENERATION
4 – Improved fabric, air source heat pump	Improved Building Fabric	Air Source Heat Pump	120 $kWh/m^2_{building\ footprint}$ per annum

Energy efficiency | Fabric modelled

Energy efficiency specification

The table on the right lists the building construction properties of an 'Improved' fabric efficiency.

The 'Improved' fabric efficiency is a stepped improvement over the current policy compliant 'BAU' fabric and is the results of an iterative modelling process to meet the target space heating demand of 15kWh/m^2/yr for both typologies.

	Improved Fabric	Limiting Fabric (Current policy limiting fabric – used for unheated spaces)
Floor U-value	0.13 W/m^{2}K	0.25 W/m^{2}K
Wall U-value	0.14 W/m^{2}K	0.35 W/m^{2}K
Roof U-value	0.11 W/m^{2}K	0.25 W/m^{2}K
Glazing	Double glazing U-value 1.3 W/m^{2}K g-value 0.4 Light Transmittance: 60%	Double glazing U-value 1.6 W/m^{2}K g-value 0.55 Light Transmittance: 70%
Doors	Entrance Door: 2.0W/m^{2}K Opaque Door: 1.6W/m^{2}K Vehicle Door: 1.3W/m^{2}K	Opaque Door: 2.2W/m^{2}K Vehicle Door: 1.5W/m^{2}K
Airtightness	3 m^3/m^{2}h	5 m^3/m^{2}h
Ventilation	Natural Ventilation	Natural Ventilation
Wastewater heat recovery	No	No

The Newham policy offers flexibility in the heating system choice but has a firm "no gas" requirement.

Scenario 4 modelled aims to be compatible with a net zero carbon future and include a low carbon heating system, which is fuelled by electricity, drawn either from the grid or on-site photovoltaics.

The following explains the systems modelled in the modelling scenario:

Scenario 4 – individual heat pump

Heat pumps are currently the most viable technology to achieve widespread electrification of heat at scale while limiting overall demand on the electricity network. They are therefore a key technology whose use needs to be rapidly expanded.

For the Large Industrial typology, the air source heat pump scenario assumes that all the internal spaces are heated, and that cooling is provided in the open plan office area only.

For the Small Industrial typology, the air source heat pump scenario assumes that all the internal spaces are heated and that no cooling is provided anywhere.

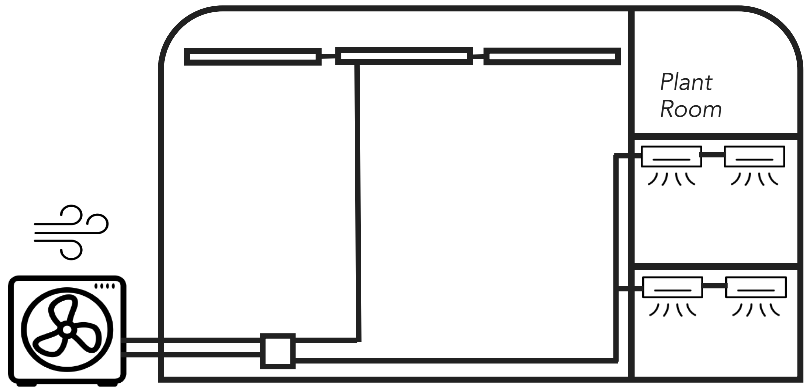


Diagram to present the individual heat pump low carbon heating system ***(scenario 4)***

Warehouse Space – Radiant Panels

Other Spaces – Fan Coil Units

Domestic hot water – Direct Electric

Policy 2 requires all industrial buildings to achieve a space heating demand of less than 15 kWh/m²/yr.

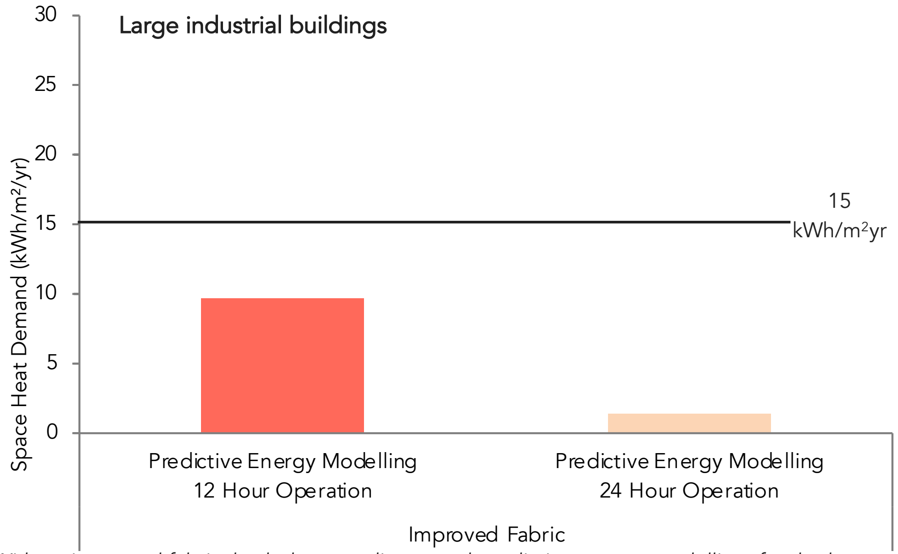
Technical feasibility for industrial buildings

Predictive energy modelling should be used for large industrial buildings. Predictive modelling using the IESVE software was carried out for the large industrial typology under two scenarios; a 12 hours operation unit and a 24 hours operation unit. This included the consideration of bespoke profiles to represent proposed internal gains and heating/cooling setpoints, rather than relying on generic NCM profiles that are used for Part L compliance only modelling. Bespoke dynamic simulation profiles and inputs have been established and are listed in the Appendix.

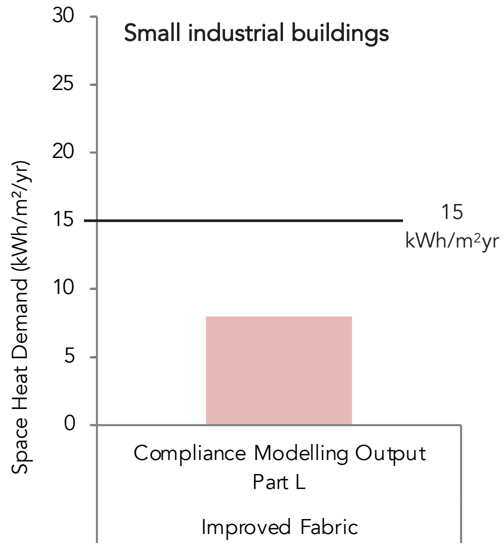
The resulting predictive and Part L modelling space heating demands, for the large and small industrial units respectively, are shown to the right.

Conclusion

Based on the energy efficiency specifications shown on previous pages, all typology achieve the Policy 2 target of 15kWh/m²/yr. Therefore, it can be concluded that Policy 2 is technically feasible for industrial buildings.



With an improved fabric, both the compliance and predictive energy modelling for the large industrial unit have a space heating demand of under 15 kWh/m²yr.



With an improved fabric the space heating demand of the small industrial unit is under 15 kWh/m²yr.

Policy 3 requires that:

- No new developments shall be connected to the gas grid.
- Fossil fuels shall not be used on-site to provide heat.
- Heat shall be provided through low carbon fuels.

Technical feasibility

This policy offers flexibility. There are many types of heating systems available that do not use gas, such as those shown on this page.

Many non-domestic buildings are already built without gas boilers as heat pumps are effectively the same technology as chillers. Buildings which have both a heating and cooling demand, have been using heat pumps / chillers for years.

Heat pumps are technically feasible in all building types. This is demonstrated by the number of successful heat pump installations currently in the UK, which is growing year-on-year.

Other alternative all-electric heating systems (e.g. electric radiant heating panels) would also comply with this policy

Commercial scale Air Source Heat Pump systems have been used for years in many types of non-domestic buildings (e.g. offices, hotels, etc.)

Commercial scale Ground Source Heat Pump systems have also been used for years in many types of non-domestic buildings

Policy 4 requires 12-hour operation industrial buildings to achieve an Energy Use Intensity (EUI) of no more than 100 kWh/m²/yr, and 24-hour operation industrial buildings to achieve an Energy Use Intensity (EUI) of no more than 120 kWh/m²/yr.

Technical feasibility for industrial buildings

Predictive energy modelling using IESVE software was carried out for the large industrial typology under two scenarios; a 12-hour and a 24-hour operation unit, to estimate the total energy consumption, and to compare the EUI between predictive energy modelling and Part L compliance modelling. The resulting energy use intensities of the different scenarios, for the large typology, are shown to the right.

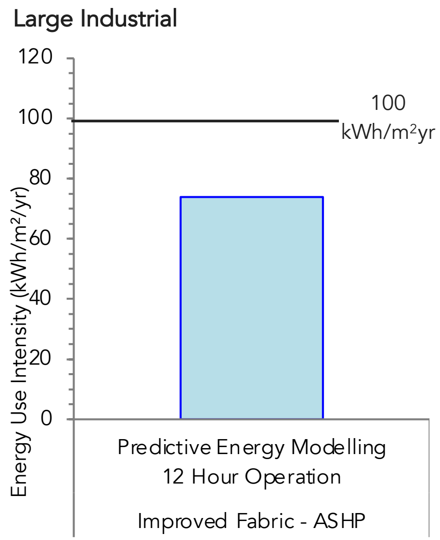
Conclusion

For the small industrial unit, the proposed scenario was able to achieve the required 100 kWh/m² target under Part L compliance modelling outputs.

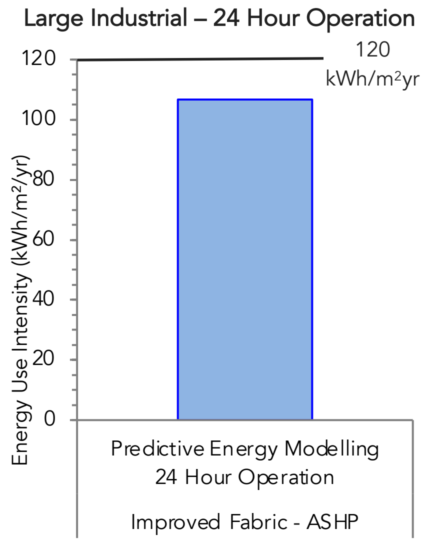
For the Large Industrial unit, the 12-hour operation predicted modelling scenario was able to achieve the required 100 kWh/m² target and the 24-hour operation predicted modelling scenario was able to achieve the required 120 kWh/m² target , demonstrating that the policy is technically feasible.

Comment on other non-modelled non-domestic typologies

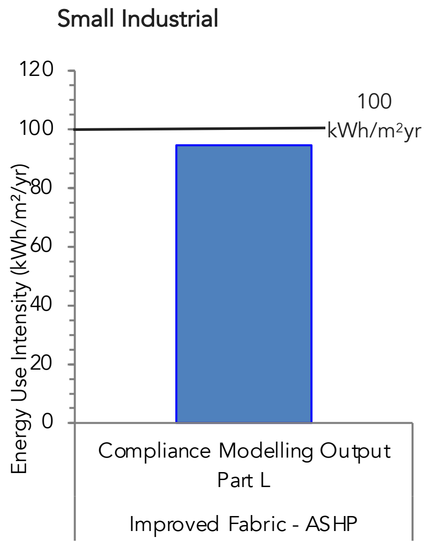
This evidence base has focused on the industrial typology. The EUI of 35 kWh/m²/yr for the student or keyworker accommodation was chosen as this typology is similar to residential. The school and office target is based on the LETI targets (www.leti.London/CEDG). Retail, HE teaching facilities, GP surgery and hotel are seen to be similar to offices and thus the office target was deemed reasonable.



The modelling scenario shown above meet the proposed EUI target of 100 kWh/m²yr.



The modelling scenarios shown above meet the proposed EUI target of 120 kWh/m²yr for industrial buildings that operate for 24 hours.



The modelling scenarios shown above meet the proposed EUI target of 100 kWh/m²yr for small industrial units.

Policy 5 requires:

- Renewable energy should be generated on-site for all new developments.
- 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

  (measured in per square meter of building footprint)
- The amount of energy generated in a year should match or exceed the predicted annual energy demand of the building, i.e. Renewable energy generation ($kWh/m^2/yr$) = or > EUI ($kWh/m^2/yr$).

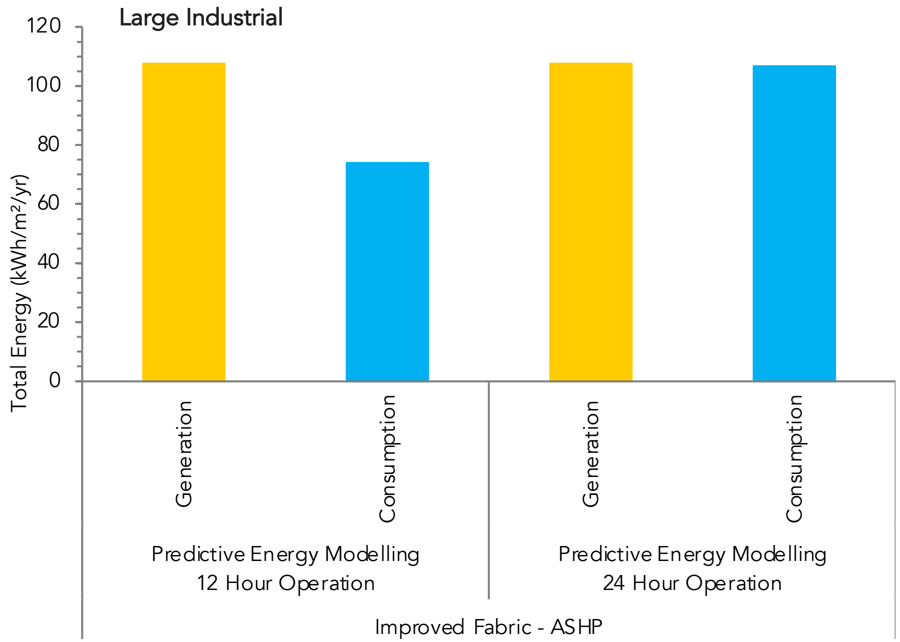
Technical feasibility for industrial buildings

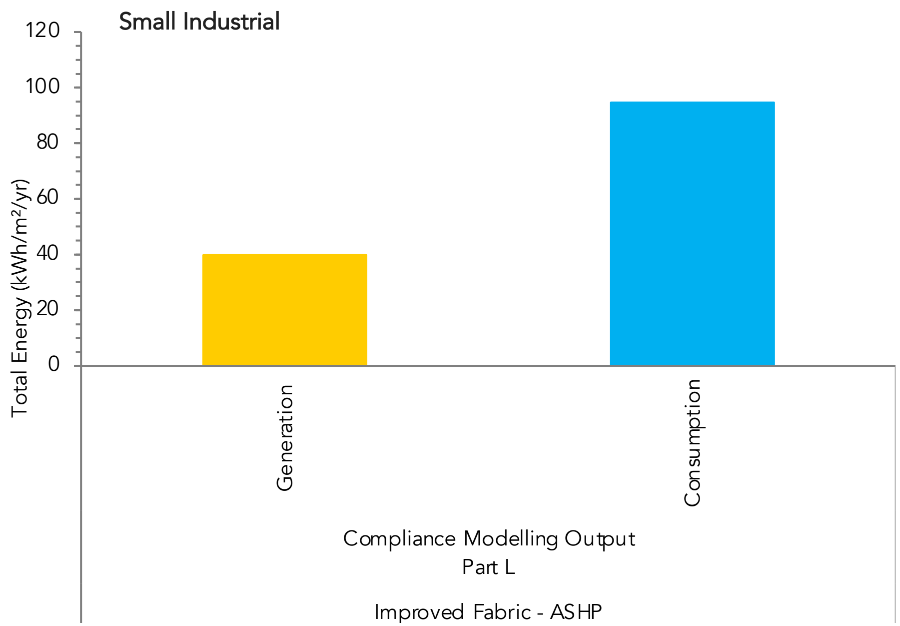
Energy modelling using IESVE software was carried out; this included a prediction of total annual energy consumption and a calculation for annual renewable generation. In each case, annual generation has been divided by the building's footprint area to check compliance with policy 5.

The renewable energy generation requirement of 120 $kWh/m^2_{building\ footprint}$ is achieved for the large industrial typology (which also equates to 108 kWh/m^2_{GIA}, as indicated in the graph on the right).

As it only has a the limited roof area, the small industrial typology cannot achieve the required on-site renewable energy generation requirement of 120kWh/m^2 footprint, meaning that a renewable energy offset will be required.

The graphs to the right depict the renewable generation and energy consumption values for both industrial typologies, in the Improved Fabric with ASHP scenario (4).





Technical feasibility of recommended Policy 7 | Offsetting (as last resort)

Policy 7 requires that offsetting be used only a last resort, provided that the building is compliant with all other Net Zero carbon buildings policies.

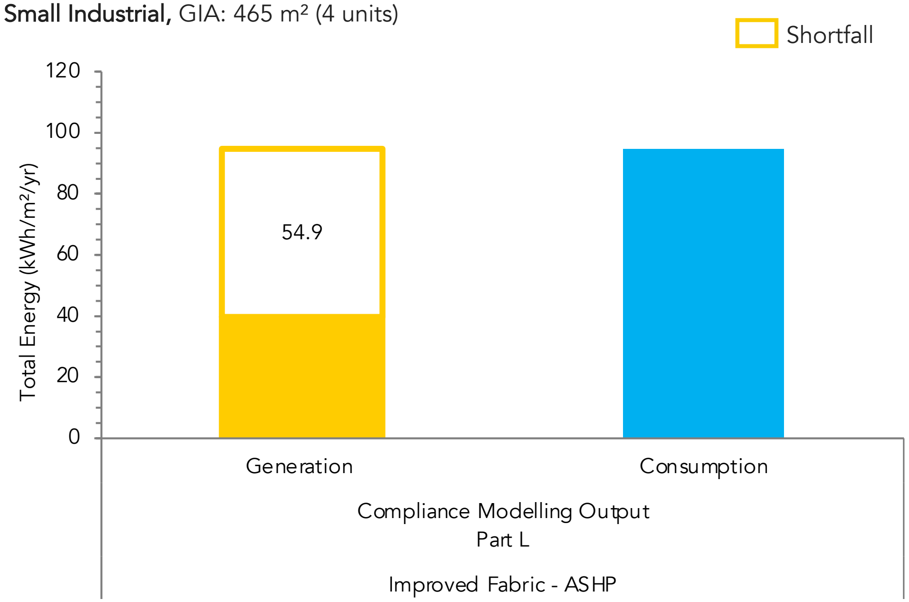
The applicant should establish the shortfall in renewable energy generation to enable to annual renewable energy generation to match the Energy Use in kWh.

Technical feasibility for industrial buildings

The resulting renewable energy shortfalls, for the Small Industrial unit under the Improved Fabric – ASHP scenario, is shown to the right. The Large Industrial unit scenarios were able to generate sufficient renewable energy (on an annual basis) to match their total consumption. .

Due to the fact that the small industrial unit has limited roof space, it will be unable to generate sufficient on-site renewable energy to meet operational annual net zero. In such cases, the applicant will be expected to pay into the Council's offset fund a sum of money equivalent to funding a PV renewable energy system elsewhere in the borough. This system should be able to generate the shortfall amount of energy.

Small Industrial, GIA: 465 m² (4 units)



Shortfall (kWh)	25,542
Payment per industrial unit (£)	9,578
Payment per development (£)	38,312

Technical feasibility of recommended Policy 1 | Resulting carbon emissions

Policy 1 stipulates that new buildings should be built to be net zero carbon with immediate effect.

This is recommended as an overarching policy that will be implemented in practice via adherence to policies 2-7. To help assess whether new development is aligned to net zero the correct metrics should be used during predictive energy modelling.

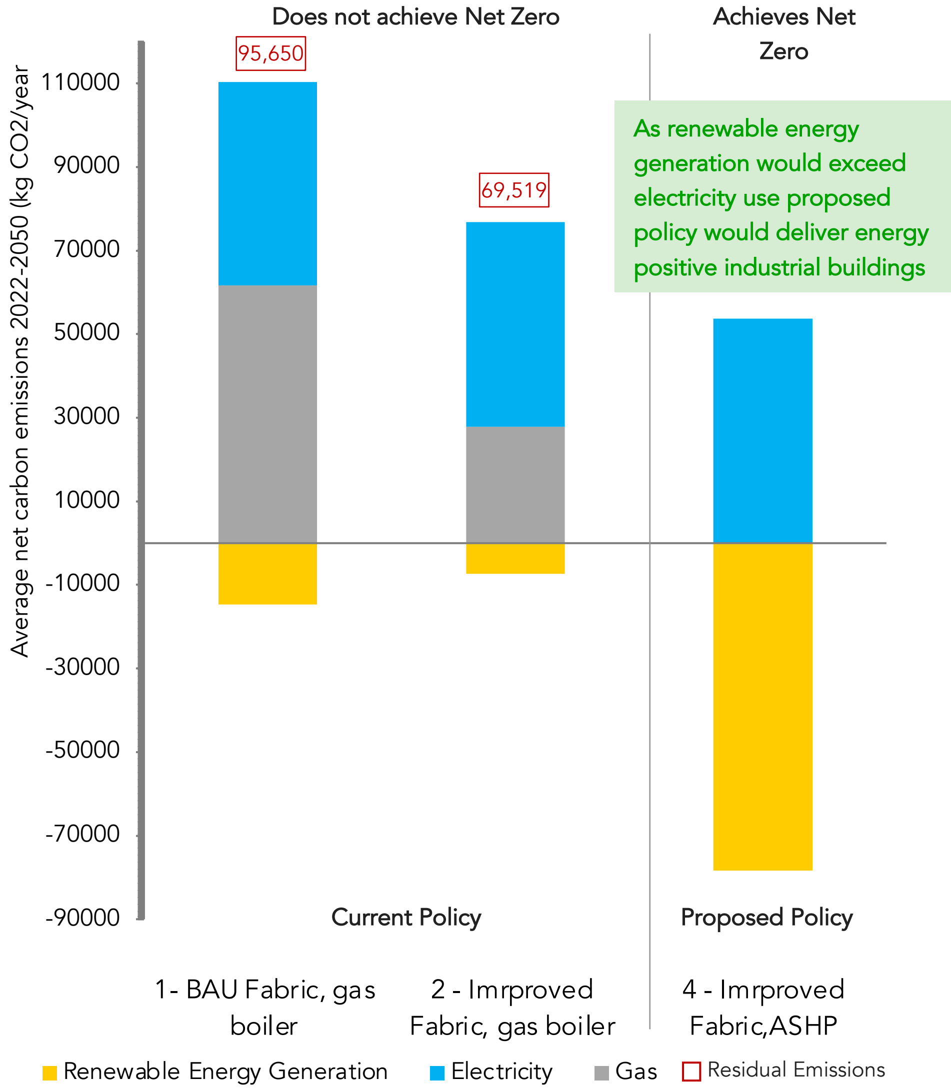
The proposed policy meets net zero carbon

The estimated carbon emissions, for the Large Industrial typology, are shown to the right. Scenarios 1 and 2 are compliant with current policy, and it is evident from the graph how current policy is not compliant with net zero carbon, as there is a large amount of residual emissions remaining. Scenario 4 represents a large industrial building that meets the proposed policy. It demonstrates that net zero carbon can be achieved with the proposed policies. This includes the use of an energy efficient fabric, low carbon heating and on-site renewable energy generation to meet the energy used.

Conclusion

The energy and carbon modelling using projected carbon emission between 2022-2050, confirms that the proposed policies will help the development reach net zero carbon on-site.

Large Industrial – average annual net carbon emissions



**The carbon factor for gas is taken from SAP 2012 as it is not expected to change significantly. Annual carbon factors for electricity from 2022-2050 are taken from HM Treasury Green Book domestic consumption-based grid average figures. These figures are also used to calculate savings from renewable energy generation.*

Technical analysis on unheated warehouse conversions

The particular case of unheated warehouses

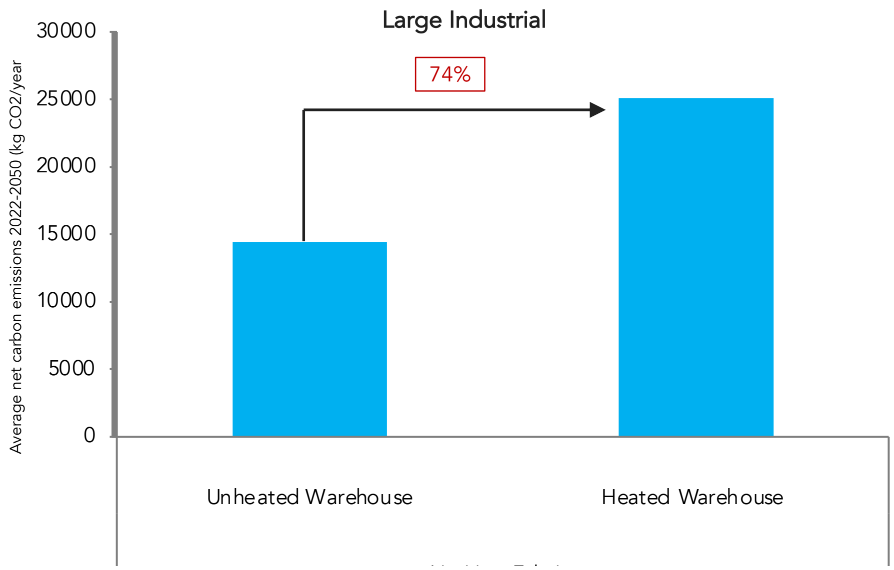
Energy modelling was carried out for the large industrial typology to compare the increase in energy use intensity and space heating demand from changing an unheated warehouse space to a heated space. For each scenario, two different levels of energy efficiency specifications were modelled, which are the 'Improved Fabric' and the 'Limiting Fabric'.

An industrial building with 'Limiting Fabric' has a space heating demand of 33 kWh/m^2/yr (73% higher than if it had 'Improved Fabric'). This results in a 74% increase in average net carbon emissions if it changed from an unheated to a heated warehouse space.

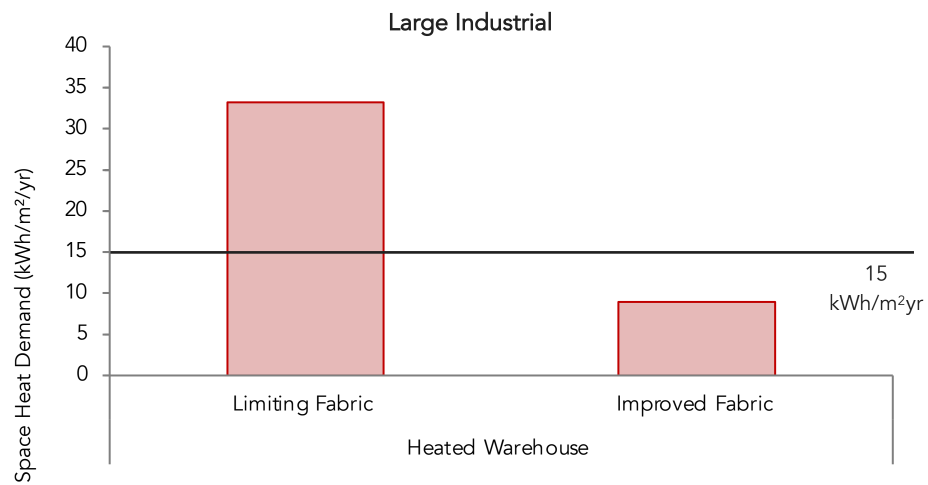
It is therefore important that the planning system does not enable these poor standards to affect future building performance when a non-heated warehouse is turned (without the need for planning permission) into a heated space. Hence, we suggest that policy is implemented that even unheated warehouse spaces meet the space heating demand requirement of 15 kWh/m^2/yr if they were to be heated.

Suggested addition to policy 2

Policy 2 should require unheated spaces to be subject to the same energy efficiency requirements as heated spaces, and meet the space heating demand requirement of 15 kWh/m^2/yr. This avoids significant increases in the space heating demand, energy use and carbon emissions if an unheated space is converted to a heated space.



Th graph shows the percentage increase in average annual carbon emissions when an unheated warehouse is turned into a heated warehouse (assuming limiting fabric)



Space heating demand of a heated warehouse space under different fabric efficiencies

9.0

Capital cost evidence base to inform viability testing

This section reports on the additional construction costs and offset costs associated with the seven recommended policies

Introduction to cost analysis

Sections 7 and 8 demonstrate that for the four dwelling typologies and the two industrial typologies it is feasible to achieve the Newham policies outlined in section 6 of this document. The next step is to demonstrate whether the policies are financially viable.

High level capital cost analysis was undertaken by Currie & Brown to benchmark the likely build cost for the typologies under the different specification scenarios. The ultra low energy scenario build costs can be compared to a baseline build cost to assess financial viability.

General approach to cost analysis

The residential costs presented in this report are current for Q42021 for a medium sized developer, building several hundred to a thousand homes a year, or for non-domestic buildings, for an experienced specialist developer.

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

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

How were the baseline costs calculated

The assumed baseline cost is based on Scenario 2 of this study, that is the current policy compliant, heat pump case. This scenario uses the Part L 2021 notional building specification and does not look to surpass demands of current carbon policy. Scenario 2 was selected as the most relevant baseline as this scenario not only meets policy being introduced currently but also aligns with Future Home Standard requirements and the move away from gas heating systems.

A benchmark £/m2 cost is estimated for each building type. This reflects our current experience of building costs for these developments and is drawn from Currie & Brown's experience of a wide range of relevant developments across London. Overall baseline capital cost will vary according to the level of external and internal finishes, fittings etc. Our benchmark costs assume a medium specification.

Residential build cost – Townhouse

Cost uplift

The percentage uplift in total build cost for the compliant ultra low energy scenarios fell between: 4.2% – 5.2%*. The graph to the right outlines the total build cost for theses Townhouse scenarios 5 & 7. This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV. Building to net zero can also introduce cost savings, indicated by the decrease in the cost of heating system compared to the baseline. These savings arise from the reduced scale and extent of heating distribution systems that are enabled by the high-performance fabric. Developers might choose to provide 'standard systems'. However, this would be for marketing purposes rather for technical reasons. Cost changes for each intervention are outlined in the table.

The additional costs of fabric efficiency measures are split into approximately 55% for improved insulation, thermal bridging and airtightness, 30% for MVHR systems and 15% for triple glazing.

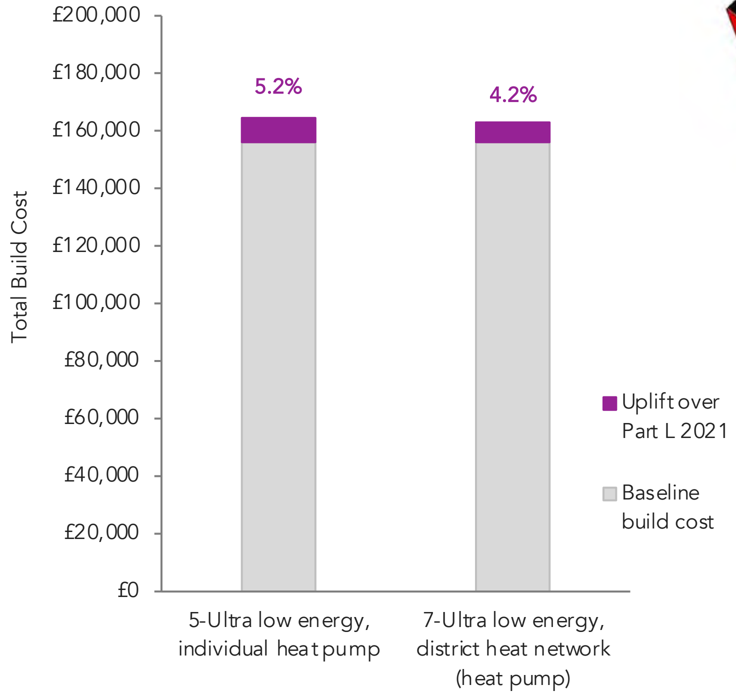
Offset

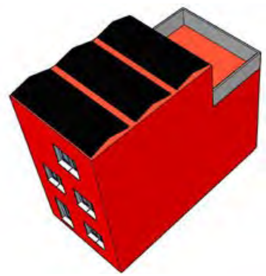
No offsetting is required for the Townhouse ultra-low energy scenarios 5 & 7 as they achieve net zero balance. By comparison, the carbon offset payment required for the baseline Scenario 2, based on current policy practice of £95 per tonne for 30 years, is £834.

Conclusion

The additional build cost of achieving a net zero compliant townhouse development, following the policies recommended in this report, are modest, ranging from 4.2% to 5.2%. An additional 0.5% of cost saving (compared to baseline build cost) is likely via avoided carbon offset payment.

* costs associated with heat network connection will vary based on the proximity of the development to existing networks and the level of pre-existing capacity in the network (costs included here are for within building systems only and exclude connection costs)





GIA: 116 m^2

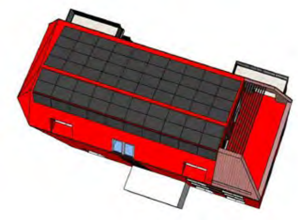
External envelope to floor area ratio: 2.7

Total build cost for the Townhouse scenarios 5 & 7 showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars. This proportional cost uplift decreases for the larger typologies.

	5-Ultra low energy, individual heat pump, PV	7-Ultra low energy, district heat network (heat pump), PV
Fabric efficiency	£7,242	£7,242
Heating system	-£463	-£2,538
PV	£1,658	£2,152
Above: the impact of the ultra-low energy measures on costs compared to the baseline Below: impact of the solar energy offset on the offsetting cost per sqm, compared to the baseline (scenario 2) carbon offset payment		
Solar energy offset	-£7.2	-£7.2

Townhouse build cost - £/m² change compared to Part L 2021 (Scenario 2)

Residential build cost – Low-rise



Low-rise block

4-storeys, 7 units

GIA: 641 m^2

External envelope to floor area ratio: 2.0

Cost uplift

The percentage uplift in total build cost for the policy compliant ultra low energy scenarios fell between: 3.4% – 4.3%.

The graph to the right outlines the total build cost for the Low-rise scenarios 5 & 7. This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV. Building to net zero can also introduce cost savings, indicated by the decrease in the cost of heating system for the ultra-low energy scenarios compared to the baseline. Cost changes for each intervention are outlined in the table.

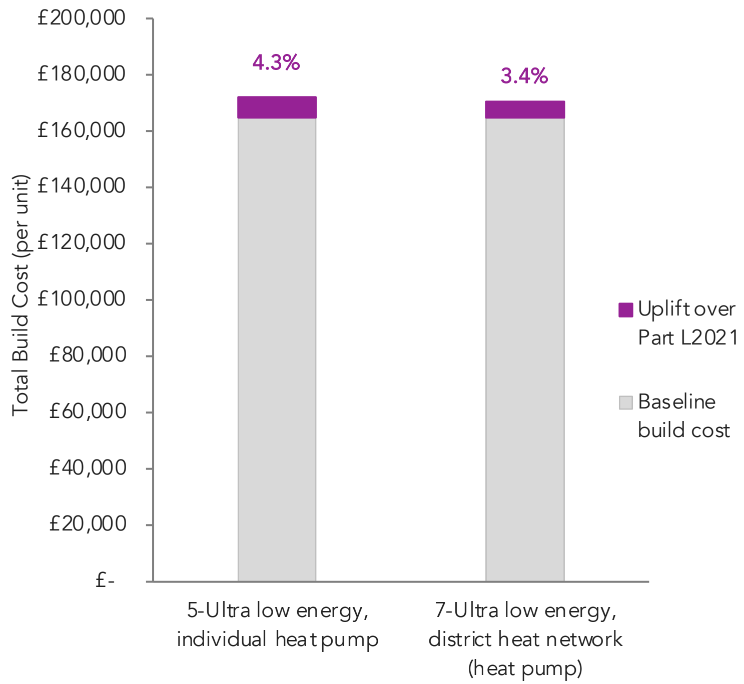
The additional costs of fabric efficiency measures are split into approximately 1/3 for MVHR systems, 1/3 for triple glazing and 1/3 for improved insulation and airtightness.

Offset

No offsetting is required for the Low-rise ultra-low energy scenarios 5 & 7 as they achieve net zero balance. By comparison, the carbon offset payment required for the baseline Scenario 2, based on current policy practice of £95 per tonne for 30 years, is £6,194.

Conclusion

The additional build cost of achieving a net zero compliant low-rise development, following the policies recommended in this report, are modest, ranging from 3.4% to 4.3%. An additional 0.5% of cost saving (compared to baseline build cost) is likely via avoided carbon offset payment.



***Total build cost per unit for the Low-rise scenarios 5 & 7** showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars..*

	5-Ultra low energy, individual heat pump, PV	7-Ultra low energy, district heat network (heat pump), PV
Fabric efficiency	£5,731	£5,731
Heating system	-£405	-£2,205
PV	£1,870	£2,117
Above: the impact of the ultra-low energy measures on costs compared to the baseline Below: impact of the solar energy offset on the offsetting cost per sqm, compared to the baseline (scenario 2) carbon offset payment		
Solar energy offset	-£9.6	-£9.6

Low-rise build cost - £/m² change compared to Part L 2021 (Scenario 2)

Residential build cost – Mid-rise

Mid-rise block

8-storeys, 28 units

GIA: 2,125 m²

External envelope to floor area ratio: 1.4

Cost uplift

The percentage uplift in total build cost for the policy compliant ultra low energy scenarios fell between: 3.1% – 3.7%.

The graph to the right outlines the total build cost for the Mid-rise scenarios 5 & 7. This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV. Building to net zero can also introduce cost savings, indicated by the decrease in the cost of heating system for the ultra-low energy scenarios compared to the baseline. Cost changes for each intervention are outlined in the table.

Nearly ¾ of the additional costs linked to fabric efficiency are a result of triple glazing (50%) and MVHR systems (25%).

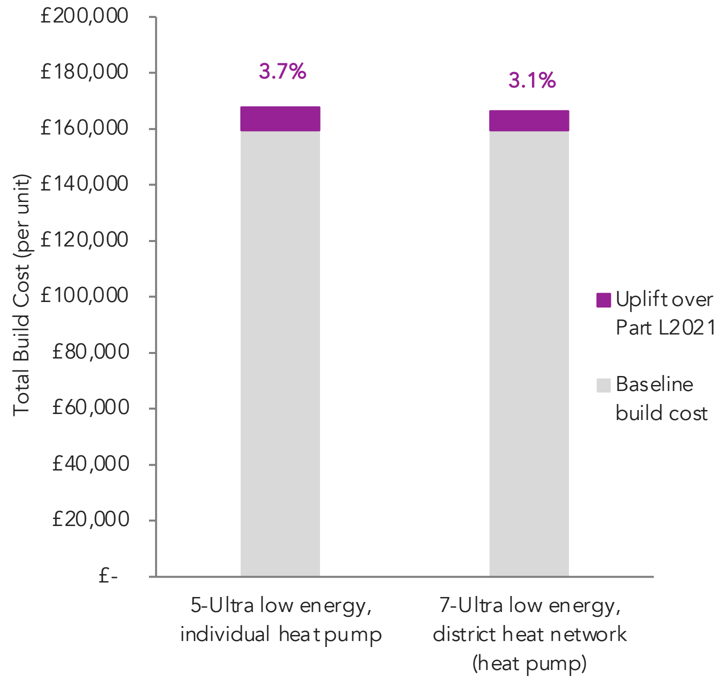
Offset

To comply with the proposed Newham policy, a solar energy offset is required for the Mid-rise ultra-low energy scenarios. Using a price of £1.5/kWh this offset would total between £53,505 and £65,010 for the development.

By comparison, the carbon offset payment required for the baseline Scenario 2, based on current policy practice of £95 per tonne for 30 years, is £22,556.

Conclusion

The additional build cost of achieving a net zero compliant mid-rise development, following the policies recommended in this report, are small, ranging from 3.1% to 3.7%. An additional 0.8% cost increase is likely due to increased offset payment.

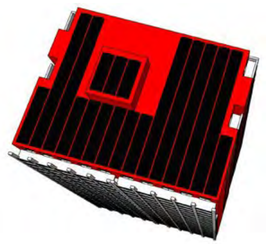


Total build cost per unit for the Mid-rise scenarios 5 & 7 *showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars..*

	5-Ultra low energy, individual heat pump, PV	7-Ultra low energy, district heat network (heat pump), PV
Fabric efficiency	£8,135	£8,135
Heating system	-£396	-£1,887
PV	£699	£699
Above: the impact of the ultra-low energy measures on costs compared to the baseline Below: impact of the solar energy offset on the offsetting cost per sqm, compared to the baseline (scenario 2) carbon offset payment		
Solar energy offset	£14.6	£20.0

Mid-rise build cost - £/m² change compared to Part L 2021 (Scenario 2)

Residential build cost – High-rise



High-rise block

20-storeys, 169 units

GIA: 15,541 m^2

External envelope to floor area ratio: 0.7

Cost uplift

The percentage uplift in total build cost for the policy compliant ultra low energy scenarios fell between: 1.7% – 2.7%.

The graph to the right outlines the total build cost for the High-rise scenarios 5 & 7. This includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV. Building to net zero can also introduce cost savings, indicated by the decrease in the cost of heating system for the ultra-low energy scenarios compared to the baseline. Cost changes for each intervention are outlined in the table.

Over 80% of the additional fabric efficiency costs are linked to triple glazing and to MVHR systems.

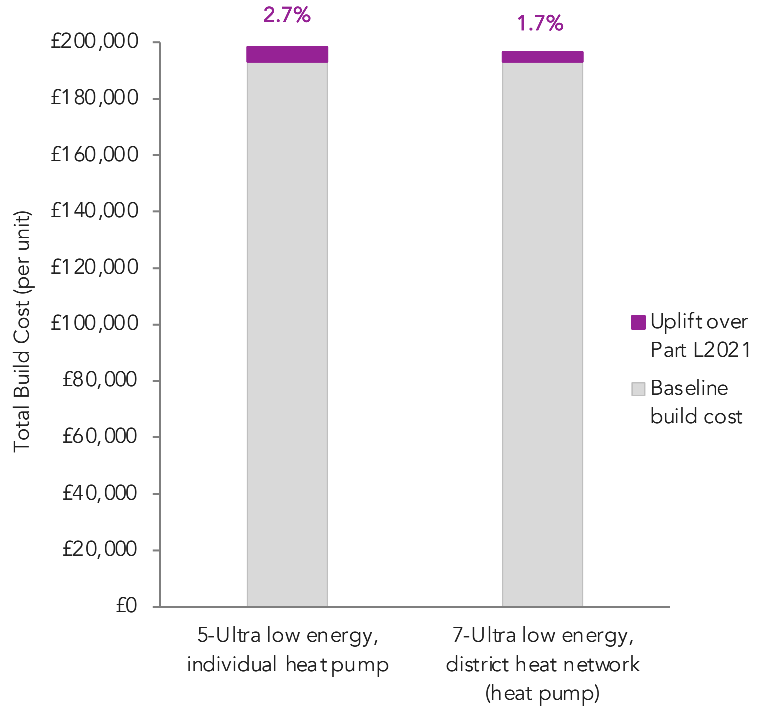
Offset

To comply with the proposed Newham policy, a solar energy offset is required for the High-rise ultra-low energy scenarios. Using a price of £1.5/kWh this offset would total between £513,574 and £587,310 for the development, i.e. approximately 1.5-1.8% of baseline build cost.

By comparison, the carbon offset payment required for the baseline Scenario 2, based on current policy practice of £95 per tonne for 30 years, is £136,032.

Conclusion

The additional build cost of achieving a net zero compliant high-rise development, following the policies recommended in this report, are small, ranging from 1.7% to 2.7%. An additional 1.3% cost increase is likely due to increased offset payment.



Total build cost per unit for the High-rise scenarios 5 & 7 *showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars..*

	5-Ultra low energy, individual heat pump, PV	7-Ultra low energy, district heat network (heat pump), PV
Fabric efficiency	£4,947	£4,947
Heating system	-£71	-£1,871
PV	£342	£342
Above: the impact of the ultra-low energy measures on costs compared to the baseline Below: impact of the solar energy offset on the offsetting cost per sqm, compared to the baseline (scenario 2) carbon offset payment		
Solar energy offset	£24.3	£29.0

High-rise build cost - £/m² change compared to Part L 2021 (Scenario 2)

Residential cost summary

The cost analysis demonstrates that for an additional 5% or less to the cost a Part L 2021 compliant home with an ASHP it is possible to achieve an ultra high fabric specification with space heat demand of 20kWh m2 and significant onsite generation.

Uplift costs are linked to higher specification, glazing, MVHR systems, insulation and airtightness and PV arrays. For the town house uplift costs are dominated by insulation, airtightness and thermal bridging (totally c.55%) whereas for low rise flats homes this portion falls to around 1/3 and in medium and high rise flats the costs of enhanced insulation fall to around 10% or below of the overall uplift. This reflects the improved form factor (ie external envelope to internal floor area ratio) of apartments compared to housing. In flats, glazing and MVHR systems become the most important sources of additional costs.

Cost trends

It would be hoped that more airtight construction with reduced thermal bridges will become less expensive overtime as construction teams become more experienced and as new build methods and offsite manufactured systems become more widespread.

Further, the costs of MVHR systems are likely to see cost reductions as these become a more mainstream part of the home specification. Significantly lower cost systems are already becoming available in the UK, albeit with a reduced level of heat recovery efficiency. It would be expected that the costs of MVHR units will continue to fall perhaps by 25-30% in current cost terms over through to 2030 with further associated reductions in the costs of installation as designers become more experienced at efficiently integrating these systems into home designs.

Build cost - percentage increase over Part L 2021 (scenario 2)

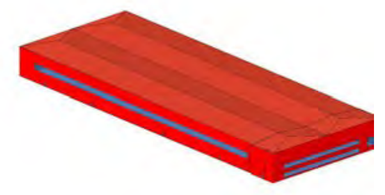
	5-Ultra low energy, individual heat pump	6-Ultra low energy, direct electric	7-Ultra low energy, district heat network (heat pump)
Townhouse	5.2%	3.7%	4.2%
Low rise	4.3%	2.4%	3.4%
Mid rise	3.7%	2.4%	3.1%
High rise	2.7%	0.9%	1.7%

Summary of the ultra-low energy scenario cost uplifts over the baseline scenario

Heat pump systems are already based on highly mature technologies but there are additional costs incurred in the UK due to the relatively generic nature of the products and the relatively high costs of installation due to the low existing installer base. It would be expected that heat pump units will be developed that are better sized for high efficiency homes and there are already some innovative ducted heat pump units on the market that do not require an external unit, these have the potential to further reduce cost where heat demand is low. Internal ducted systems will be easier to deploy in flats and terraced housing.

Despite the over 85% reduction in the capital cots of photovoltaic arrays in the last 15 years, further savings of around 25-30% in the current cost of this technology are anticipated by 2030.

Industrial build cost – Large industrial unit



Large industrial unit

GIA: 12153 m^2

Cost uplift

The percentage uplift in total build cost for the large industrial unit scenario 4, which would comply with the recommended policies, is estimated to be: 0.3%*

The graph to the right outlines the total build cost for the large industrial unit (scenario 4). The table under the graph includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV.

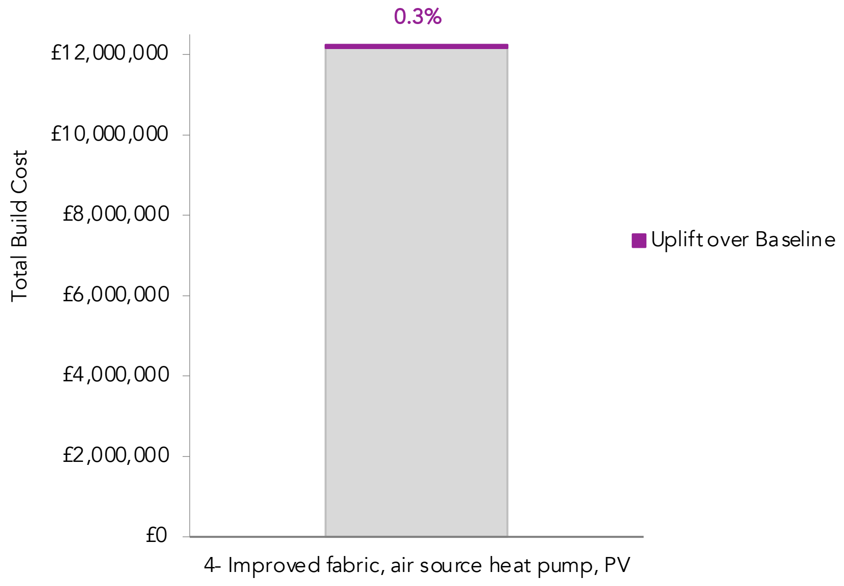
Offsetting costs

No offsetting is required for the large industrial unit as it will comply with the 120 kWh/m$^2_{footprint}$/yr criteria and exceed the net zero balance. By comparison, the carbon offset payment required for the baseline Scenario 3, based on current policy practice of £95 per tonne for 30 years, is £240,974.

Conclusion

The additional build cost of a large industrial development compliant with the recommended policies is modest, i.e. approx. 0.3%. An additional 2% of cost saving (compared to baseline build cost) is likely to be achieved via avoided carbon offset payment.

**This conclusion is true assuming a baseline heating system comprising of wet radiant panels fed by air source heat pumps. Cheaper alternative baseline options are available but have not been modelled at this stage.*

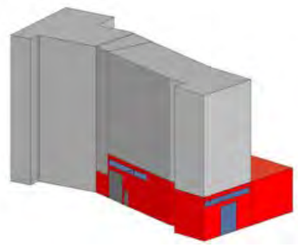


***Total build cost for the large industrial unit** showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars.*

	4-Improved fabric, air source heat pump, PV
Fabric efficiency	£33
Heating system	-£34
PV	£6.7
Above: the impact of the ultra-low energy measures on costs per sqm, Large Industrial typology Below: impact of the solar energy offset on the offsetting cost per sqm, compared to Scenario 3 carbon offset payment	
Solar energy offset	-£19.8

Build cost - £/m² change compared to Part L 2021 (assumed to be Scenario 3)

Industrial build cost – Small industrial unit



Small industrial unit

GIA: 466 m^2

Cost uplift

The percentage uplift in total build cost for the small industrial unit scenario 4, which would comply with the recommended policies, is estimated to be: 4.1%.

The graph to the right outlines the total build cost for the small industrial unit (scenario 4). The table under the graph includes a breakdown of the baseline cost versus the net uplift due to improved fabric, changes in heating system and additional PV.

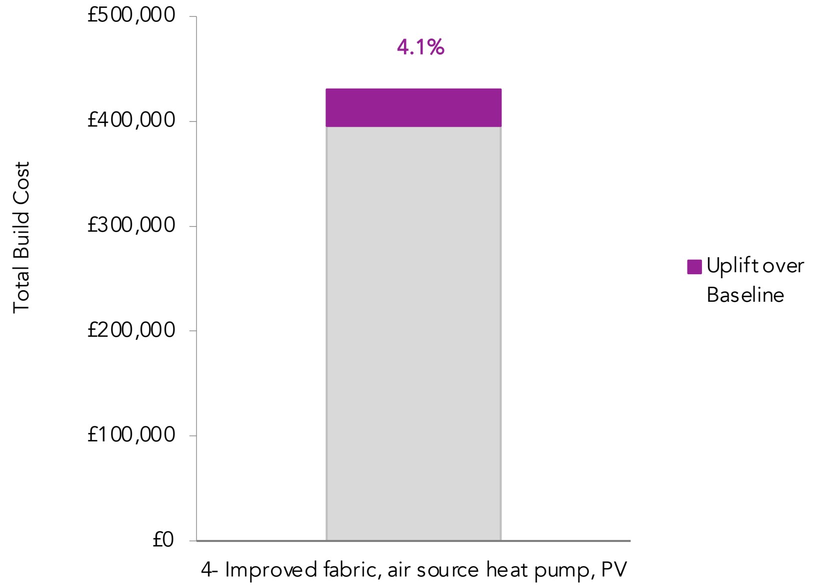
Offsetting costs

Offsetting is required for the small industrial unit as it will not comply with the 120 kWh/m$^2_{footprint}$/yr criteria or the net zero balance.

An energy offsetting contribution of £38,312 is required. By comparison, the carbon offset payment required for the baseline Scenario 3, based on current policy practice of £95 per tonne for 30 years, is £16,702.

Conclusion

The additional build cost of a large industrial development compliant with the recommended policies is modest, i.e. approx. 4.1%.



Total build cost for the small industrial unit *showing the net uplift over the baseline cost due to improved fabric, heating system and renewable generation measures. The percentage increase over the baseline cost is indicated above the bars.*

	4-Improved fabric, air source heat pump, PV
Fabric efficiency	£35
Heating system	-£39
PV	£78
Above: the impact of the ultra-low energy measures on costs per sqm, Small Industrial typology *Below: impact of the solar energy offset on the offsetting cost per sqm, compared to Scenario 3 carbon offset payment*	
Solar energy offset	£46.4

Build cost - £/m² change compared to Part L 2021 (assumed to be Scenario 3)

10.0

Appendices

10.1

Guidance on how to assess ‘unregulated energy use’ in buildings

Total energy use requirements need to include an allowance for all electricity uses in a building. A suitable methodology is required to determine an appropriate allowance, and to provide applicants with the means to consistently assess performance of their buildings against the requirement. If the allowance is too low, applicants will struggle to comply with policy. If the allowance is too high the total energy use requirement will be too easy to achieve and could fail to deliver the policy objectives.

Passivhaus Planning Package (PHPP)

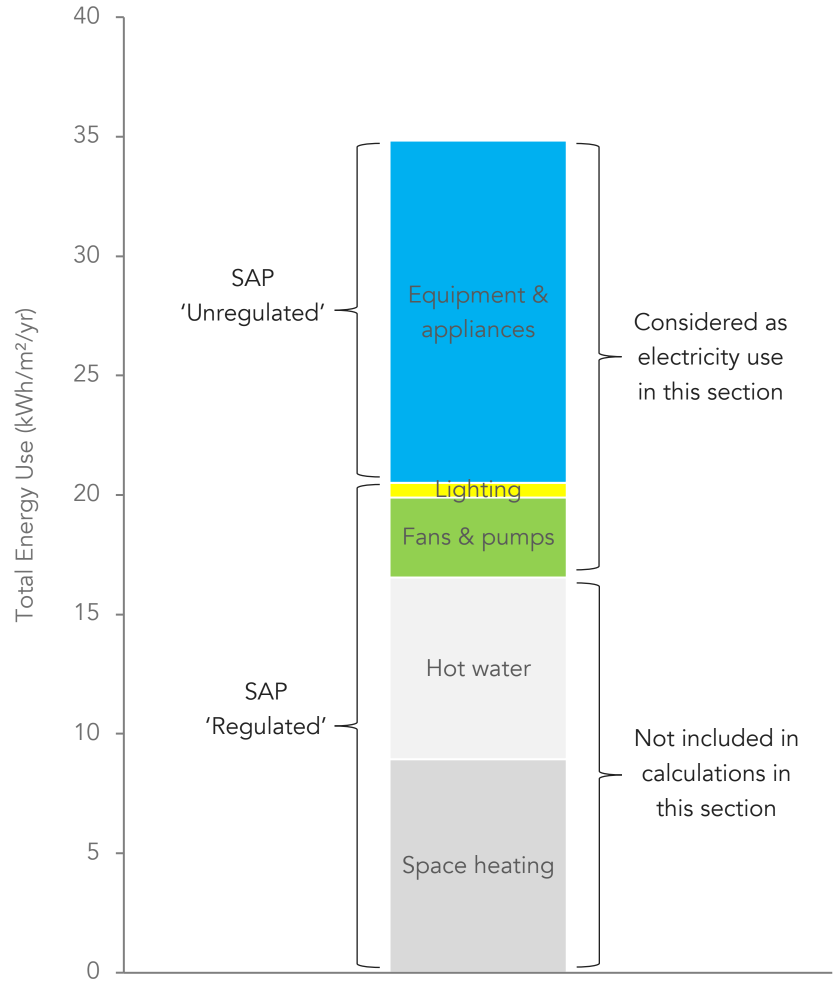
The total energy use requirements used in this report are based on assessment of electricity use using the Passivhaus Planning Package software, which calculates electricity use in detail based on several attributes of the building: the number of occupants, size of the building, ventilation system, appliances, and lighting systems. As the user is allowed to input up to date information on product efficiency, these calculations typically provide a realistic baseline prediction of electricity use.

SAP

Another methodology to calculate electricity use is to use Part L/SAP calculations. These divide energy use into 'regulated' and 'unregulated', as shown in the graph opposite, splitting electricity use in two. Electricity used for lighting, fans and pumps is classed as 'regulated' and included in standard SAP calculations and outputs. Electricity used for appliances and other equipment is classed as 'unregulated'. It is calculated in Appendix L, and is available as a supplementary output from SAP, but it is not provided as a standard output or factored into cost and carbon calculations.

Limitations of modelling

In practice, electricity use will vary from what has been modelled due to differences in occupancy, user behaviour and appliance efficiency, relative to what was assumed in the model. Accepting these limitations, energy modelling can still indicate the typical baseline levels of electricity use that can be expected for a new dwelling in a consistent and repeatable way, which enables the use of total energy requirements to deliver more effective policy.



Graph of total energy use for a typical net zero carbon house. This considers both 'unregulated' energy use and lighting, fans, and pumps, which SAP classes as 'regulated' energy use. PHPP calculates all these energy uses and does not differentiate between them. Note that equipment and appliances is typically the largest end use of electricity and is therefore critical to setting total energy use requirements.

Occupancy and Electricity Use

The number of occupants in a building has a strong influence on the amount of electricity used for equipment and appliances, and to a lesser extent electricity used for lighting, fans and pumps. This is reflected in the table to the right, which qualitatively ranks the impact of occupancy on different end uses of electricity.

Occupancy in PHPP and SAP calculations

As shown by the adjacent diagram, the 2020 Labour Force Survey produced by the Office for National Statistics estimates that the average occupancy of a UK home is 2.38.

PHPP calculates a default occupancy based on floor area. This is 2.12 for a 94m^2 home. While this is slightly below the ONS average, the occupancy level in PHPP is used to calculate electricity use for appliances, lighting and ventilation. This increases the accuracy of PHPP calculations for electricity. PHPP occupancy can also be overridden, so it is possible to use the ONS average occupancy to test the accuracy of PHPP against top-down data sets.

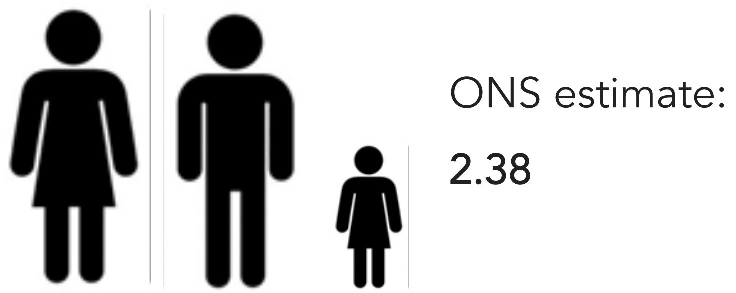
SAP calculates a default occupancy level of 2.76 for the average size UK home. While this is above the ONS average and therefore conservative, the Appendix L calculation for energy consumed by appliances does not take occupancy into account. Appendix L calculations only use dwelling floor area as an input.

Occupancy in design

Design for policy compliance should use default or average occupancy levels when comparing to the energy use target. This provides a fair and consistent method. When monitoring compliance of a new development the average unit should meet the energy use target. In reality for some developments or dwellings actual energy use may be higher than predicted due to higher levels of occupancy. If this is the case then actual occupancy levels may be used to explain the discrepancy.

Electricity End Use	Impact of Occupancy
Dishwashing	*****
Clothes Washing	*****
Clothes Drying	*****
Refrigeration	**
Consumer Electronics	*****
Small Appliances	****
Cooking	*****
Lighting	***
Fans and Pumps	*

Ranking of the impact of occupancy on residential electricity use



The Office for National Statistics estimated in their 2020 Labour Force Survey that the average UK occupancy was 2.38. For Newham, the average household is likely to have closer to 3.1 occupants.

General approach

The aim of modelling electricity use is to determine the baseline level of electricity that is required to provide an acceptable standard of living. This is straightforward to achieve and has recently become easier as products have become more efficient, which has reduced the impact of user behaviour on energy consumption.

A typical basket of services that are required to provide a good standard of living includes cooking, refrigeration, laundry, ventilation, lighting, and an allowance for consumer electronics.

Advantages of modelling electricity use

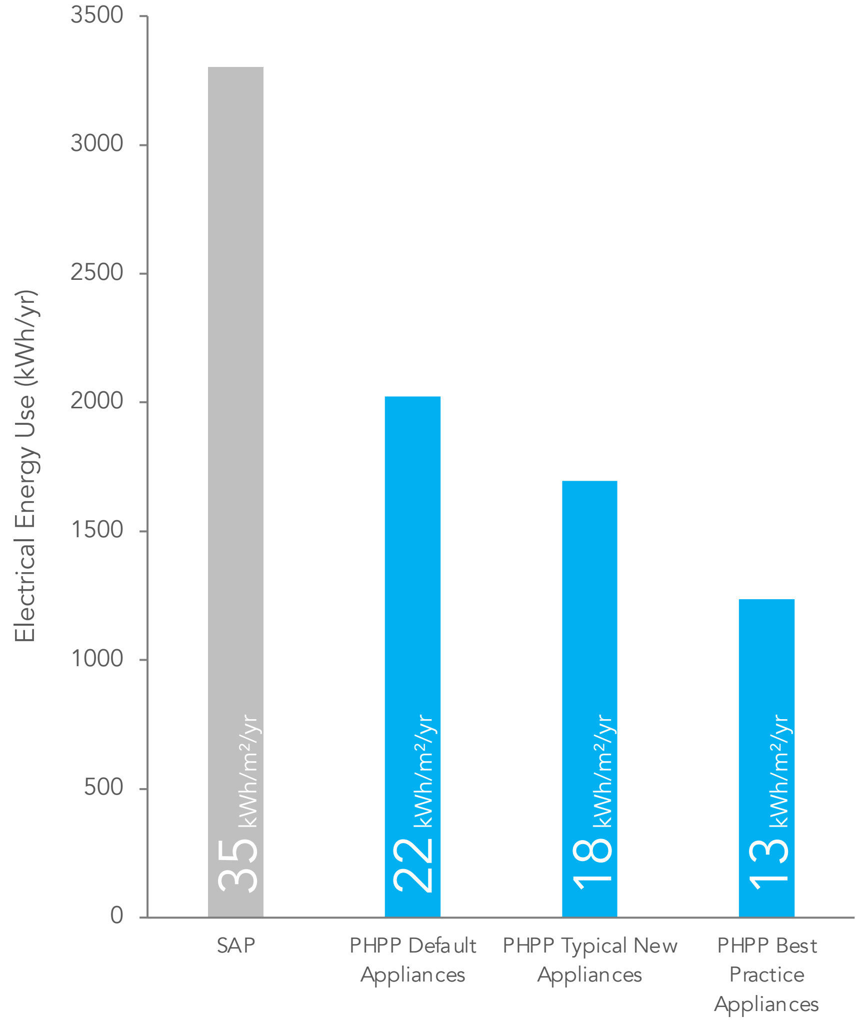
By including the actual performance of electrical devices such as appliances and lighting in energy calculations, it places a value on energy efficiency. This creates an incentive, in some cases, for applicants to ensure lighting and appliances are energy efficient as well as the building's fabric and services. In a net zero home the appliances may be one of the biggest end uses of energy, so this is a significant advantage. If an applicant does not know what devices will be used, conservative assumptions can be used in place of actual performance data, ensuring a route to compliance is always available.

Part L / SAP

The current version of SAP was originally released in 2012, it is based on use of older less efficient technologies. As a result, electricity use calculated by SAP is typically about twice as high as that calculated by PHPP using up to date data, as shown in the adjacent graph.

Appliance efficiency

The energy efficiency of household appliances and lighting products has significantly increased over the past decade. PHPP calculations are able to capture these improvements, as shown in the adjacent graph. Electricity use in a typical new home is likely to be about 15% lower than assumed by PHPP's default levels of efficiency, and could be up to 30% lower if using the most efficient products currently available on the market.

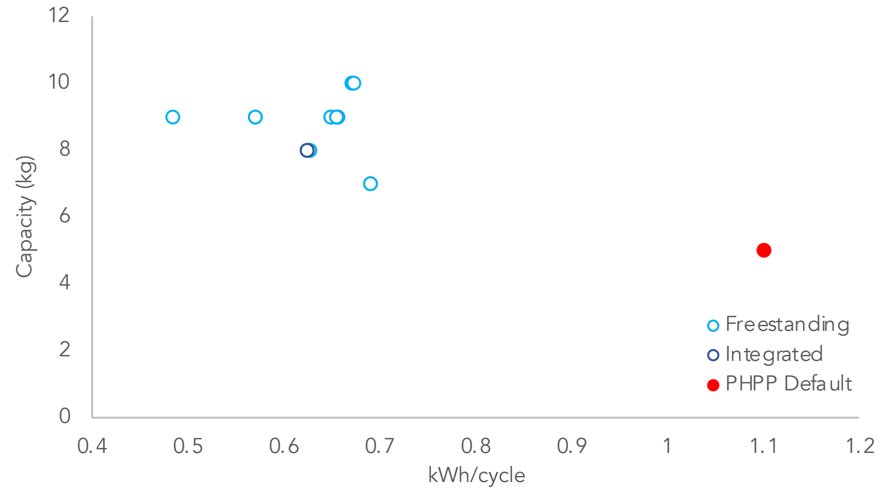


Electrical energy use calculated by SAP and PHPP for appliances, lighting, fans and pumps. Assumes a dwelling with the UK average floor area of 94m². PHPP modelling assumes the UK average occupancy of 2.38 estimated by the Office for National Statistics. Energy consumption for 'typical new appliances' and 'best practice appliances' is based on an April 2021 survey of Bosch appliances.

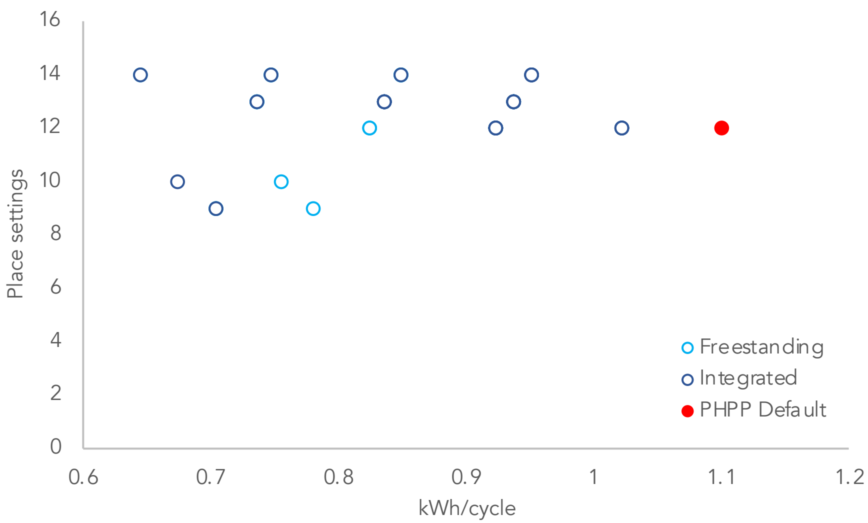
PHPP default values in context

Etude have surveyed the efficiencies of all types of white goods modelled in PHPP that are currently available from one mid-range supplier, Bosch, as of April 2021, based on EU Energy Label data. The graphs on this page show that the default values in PHPP 9.6a are significantly more conservative than even the least efficient appliances currently on the market from this supplier. Spot-checks of other leading manufacturers indicate similar levels of efficiency.

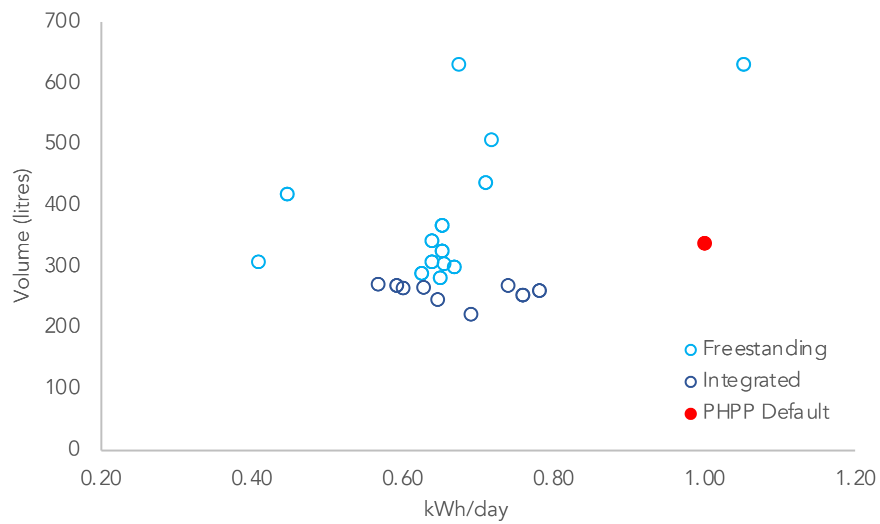
As the previous pages have shown, SAP is even more conservative than PHPP. Even when accounting for higher occupancies and using conservative default efficiencies, calculations of unregulated energy use in PHPP suggests that values of 12-20kWh/m2/yr are plausible.



Energy use of all clothes washers currently available from Bosch, compared to PHPP default value. The PHPP default value is more than twice as high as most clothes washers currently on the market.



Energy use of all dishwashers currently available from Bosch, compared to PHPP default value.



Energy use of all fridge-freezers currently available from Bosch, compared to PHPP default value. As PHPP does not provide a stated volume, an indicative volume is shown, based on the average of all appliances surveyed.

10.2

Predictive energy modelling assumptions for the large industrial unit

Predictive Energy Modelling | Large industrial unit - bespoke predictive modelling inputs

The following table lists the bespoke profiles and inputs for the warehouse space of the large industrial unit for the predictive energy modelling scenario.

		Warehouse space bespoke predictive modelling inputs	
		Predictive Energy Modelling 24-Hour Operation	Predictive Energy Modelling 12-Hour Operation
Heating	Heating Set Point	18C	18C 12 C night time set back
	Heating Profile	on continuously	6am - 6pm operation 6pm-6am night-time setback
Ventilation	Auxiliary Ventilation Flow (l/s.m^2)	10 l/s/p	10 l/s/p
	Auxiliary Vent Profile	on continuously	6am - 6pm
Lighting	Lighting Max Illuminance (lux)	150	150
	Efficacy	90	110
	Maximum Sensible Gain (W/m^2)	5.6	5.6
	Lighting Profile	on continuously	100% from 6am-6pm 0% for rest of the day
People	People Density (m^2/person)	60	20
	Occupancy Profile	on continuously	100% from 6am-6pm 0% for rest of the day
Miscellaneous	Miscellaneous Power Consumption (W/m^2)	5	5
	Miscellaneous Profile	on continuously	100% from 6am-6pm 5% for rest of the day

Predictive Energy Modelling | Large industrial unit - bespoke predictive modelling inputs

The following table lists the bespoke profiles and inputs for the office space of the large industrial unit for the predictive energy modelling scenario.

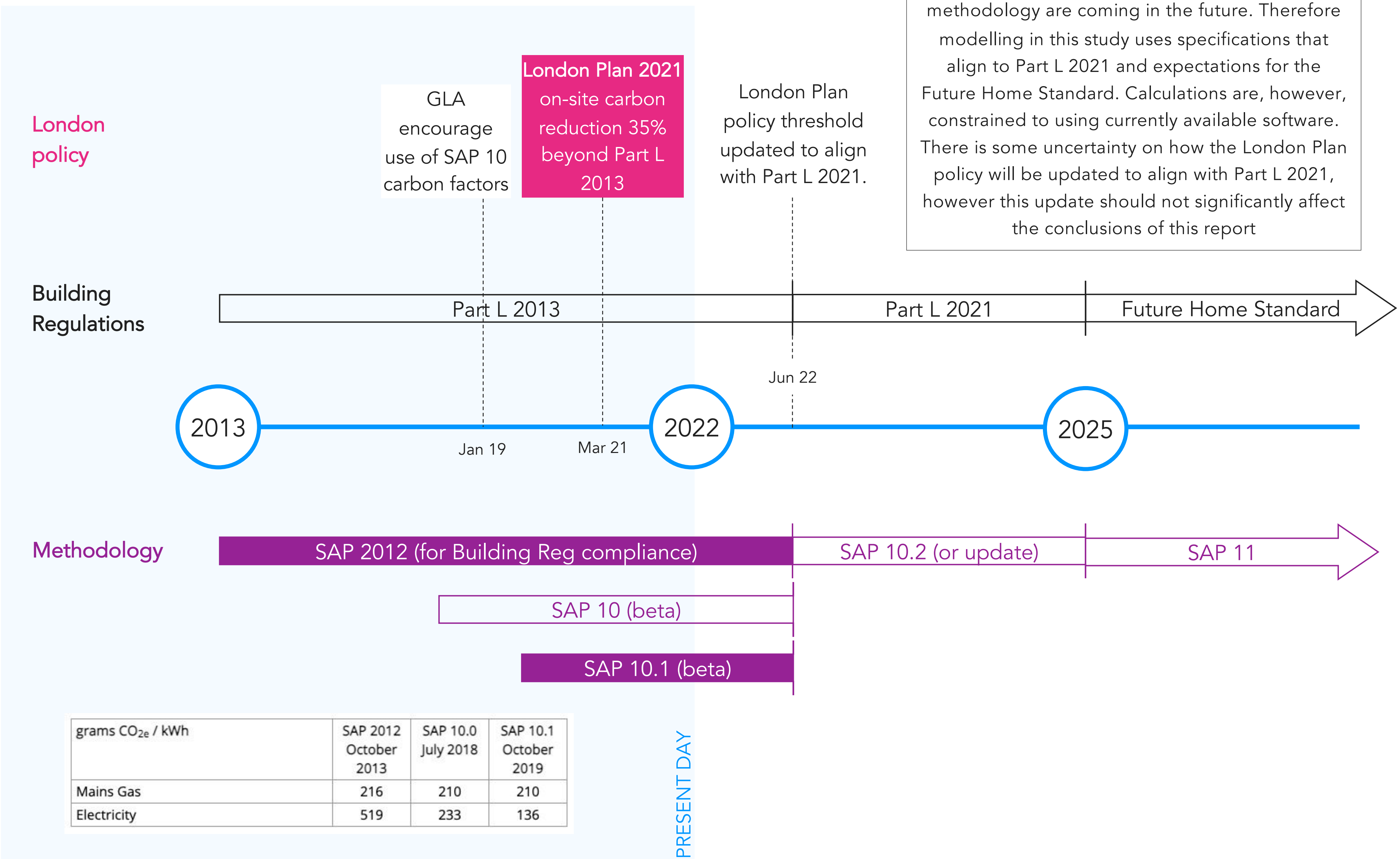
		Office space bespoke predictive modelling inputs	
		Predictive Energy Modelling 24-Hour Operation	Predictive Energy Modelling 12-Hour Operation
Heating	Heating Set Point	22C 12C night time set back	22C 12 C night time set back
	Heating Profile	6am - 6pm operation 6pm-6am night-time setback	6am - 6pm operation 6pm-6am night-time setback
Cooling	Cooling Set Point	24C	26C
	Cooling Profile	6am - 6pm 100% operation 6pm – 9pm 50% operation 9pm-6am off	6am - 6pm operation 6pm-6am off
Ventilation	Auxiliary Ventilation Flow (l/s.m^2)	10 l/s/p	10 l/s/p
	Auxiliary Vent Profile	100% from 6am-6pm 0% for rest of the day	100% from 6am-6pm 0% for rest of the day
Lighting	Lighting Max Illuminance (lux)	400	400
	Efficacy	90	110
	Maximum Sensible Gain (W/m^2)	15	15
	Lighting Profile	on continuously	100% from 6am-6pm 0% for rest of the day
People	People Density (m^2/person)	15	8
	Occupancy Profile	on continuously	100% from 6am-6pm 0% for rest of the day
Miscellaneous	Miscellaneous Power Consumption (W/m^2)	15	15
	Miscellaneous Profile	on continuously	100% from 6am-6pm 5% for rest of the day

10.3

Timeline of changes to Building Regulations

National policy timeline

Updates to National policy and the SAP methodology are coming in the future. Therefore modelling in this study uses specifications that align to Part L 2021 and expectations for the Future Home Standard. Calculations are, however, constrained to using currently available software. There is some uncertainty on how the London Plan policy will be updated to align with Part L 2021, however this update should not significantly affect the conclusions of this report



grams CO_{2e} / kWh	SAP 2012 October 2013	SAP 10.0 July 2018	SAP 10.1 October 2019
Mains Gas	216	210	210
Electricity	519	233	136

10.4

EUI and District heating

Energy Use Intensity and district heating

District heating

District heating systems, and their associated energy consumption and carbon emissions, can vary significantly. This is due not only to the energy source (i.e. gas boiler, CHP, heat pump, etc) but also factors such as the length of the network's pipework and the flow & return temperatures. Two district heat network options have been included in this study:

- Scenario 3 – based on a 'typical' existing heat network driven by gas boilers, with a flow temperature of 85°C
- Scenario 7 – based on a heat network driven by heat pumps, with a flow temperature of 55°C

For both only heat losses within the site boundary have been considered. This is akin to a communal heat network serving a single apartment block.

The resulting energy use intensities, for the four typologies, are shown to the right, in comparison to the ultra-low energy individual heat pump scenario. It is evident that gas networks running at higher flow temperatures (scenario 3) are extremely energy inefficient.
In both cases, if the energy centre was not based on site there would be a higher proportion of energy loss, and a higher EUI, due to lengths of pipework outside of the site boundary.

Conclusion

It has been shown that district (and communal) heat networks driven by heat pumps can meet the policy 4 EUI target of 35kWh/m^2_{GIA}.
However, if networks are not well designed, and distribution losses are not managed, the system would likely fail to meet this target.
Therefore, this report proposes to introduce an EUI target of 35kWh/m^2 which will be an incentive for new heat networks to be well designed and energy efficient. It is also an incentive for existing heat networks to be updated to support low carbon heat.

Total on-site energy consumption per m^2 GIA for the districting heating scenarios, in comparison to the ultra low energy individual heat pump scenario (middle)