



TOWARDS A NEW LONDON PLAN

Evidence base for operational energy and carbon policies

September 2025 | P02

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We would like to thank the Greater London Authority for their leadership and guidance throughout the study. We are particularly grateful to the following individuals.

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Key operational energy definitions

Space heating demand

The amount of heat energy needed to heat a building over a year, measured in kWh/m²/yr (GIA). Design of building form, fabric and ventilation decisions affect space heating demand.

Energy use intensity

The total energy (regulated and unregulated) used by a building over a year, measured in kWh/m²/yr (GIA). Energy use intensity does not take into account any renewable energy generation.

Space cooling demand

The amount of energy required to cool a building over a year, to maintain internal comfort conditions, measured in kWh/m²/yr (GIA).

Fossil fuel free

When a building is not connected to the gas network and there is no use of fossil fuels on-site. A low carbon heating system must be used instead (e.g. heat pumps).

Heat network decarbonisation plan

A plan for transitioning an existing heat networks away from fossil fuel-based heat sources (gas boilers and/or gas Combined Heat and Power (CHP)).

Heat network zone

Formally designated geographical area where heat networks are expected to provide the lowest cost solution for decarbonising heat.

On-site renewable energy generation

The amount of on-site renewable energy generated in a year per sqm footprint of the building. This is influenced by the PV density, roof design, orientation, mounting and power output. It is measured in kWh/m²_{building footprint}/yr, this is shortened to kWh/m²_{fp}/yr in this report.

Energy balance

When the amount of renewable energy generated on-site over a year (kWh/yr) meets or exceeds the amount of energy used by the building over a year (kWh/yr).

Operational energy offsetting

When a development cannot achieve an operational energy requirement on-site (e.g. renewable energy generation), offsetting can be used as a planning mechanism through a contribution to an offset fund, transferring responsibility to the Local Authority to deliver the required operational energy requirement off-site.

Energy flexibility

When the building can shift its electricity demand in order to use electricity at times when it is cheaper/lower carbon.

Assured energy performance

Quality assurance process during design, construction and operation in order to deliver the predicted energy performance of the building with no or a reduced performance gap. This could be achieved through a quality assurance scheme (such as Passivhaus or Nabers) adopted during design and construction.

1.0

Operational and energy carbon requirements for new buildings in a streamlined, net zero compliant and just London Plan



This section introduces this evidence base in the context of the wider process and objectives of the London Plan update.

A streamlined, net zero compliant and just London plan

A wider London Plan development process

This document is part of a wider process: the development of a new London Plan which will run from adoption (currently scheduled for 2027) to 2050. A number of general objectives have informed the work summarised in this evidence base:

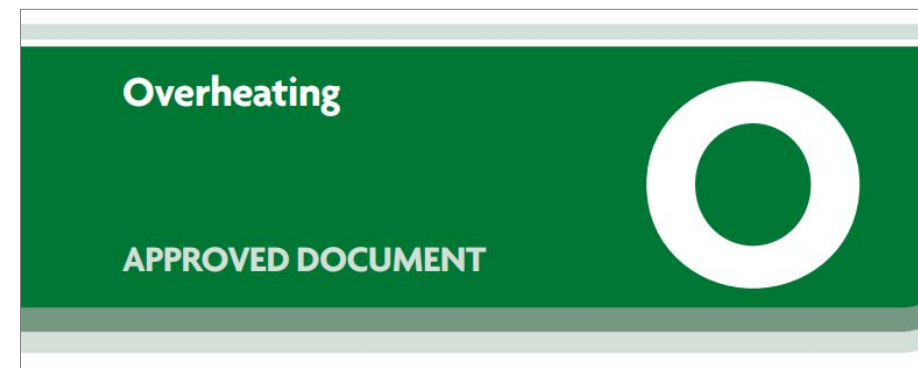
- **Environmental ambition:** the Mayor of London is committed to achieving Net Zero Carbon and the period 2027-2050 covers both the initial 2030 Net Zero objective and the 2050 horizon set by the Climate Change Act.
- **Just transition:** the London Plan should benefit Londoners and reduce inequality. New buildings should be high quality, affordable to heat, comfortable and healthy.
- **Viability and delivery:** planning requirements should not negatively impact the ability of London to deliver its housing objectives.
- **Streamlined process:** environmental outcomes should be achieved while reducing complexity for applicants.

Going beyond building regulations for clear reasons

The regulatory framework has evolved since the publication of the current London Plan and is continuing to change: Part O of the Building Regulations has been introduced in order to mitigate overheating risk in new homes; the Future Homes Standard and the Future Buildings Standard are scheduled to be published in Autumn 2025. Each section in this report considers whether the London Plan should go beyond the requirements of the Building Regulations and, when it does, seeks to clearly justify why.



The 'Towards a new London Plan' document has been published for consultation in June 2025



Part O (Overheating) forms part of the mandatory Building Regulations process



The Future Homes Standard is due to be published in Autumn 2025

Building an evidence base for operational energy and carbon requirements in the new London Plan

Helping the GLA make an informed decision

This evidence base has been developed in order to inform the GLA's policy development and decision making process. Therefore, it does not demonstrate the technical feasibility and identify the cost of a single set of policy requirements.

Instead, different levels of performance are articulated with varying benefits and cost implications. This is the case for example for space heating demand and Energy Use Intensity (EUI), or for renewable energy generation targets.

A number of 'PROs and CONs's pages have also been developed for a number of potential new policy areas (e.g. energy balance, demand flexibility).

Working closely with London Boroughs

The planning framework in London is set jointly by the London Plan and each borough's Local Plan. This evidence base seeks to build on the work completed by London boroughs.

Working with developers, housing providers and industry

Stakeholder engagement has informed the development of this evidence base. A number of developers, housing providers and industry specialists are already demonstrating that some of the requirements discussed in this evidence base are technically feasible and viable. This research is also based on their supporting evidence and in particular the work underpinning the UK Net Zero Carbon Buildings Standard (UK NZCBS).

Implementation: an opportunity to streamline the process

Policy implementation options provide an opportunity to streamline the planning process. Policy implementation is summarised in the last section.

Proposed policy requirement	Considerations for the GLA covered in this evidence base (including technical feasibility and costs)
1. Space heating demand (SHD) requirement	- Adoption of this energy metric for building fabric and ventilation efficiency - Three potential performance levels for all types of development: 30, 20 and 15 kWh/m².yr
2. Energy Use Intensity (EUI) requirement	- Adoption of this energy metric for total energy use - Three potential performance levels for residential development: 50, 40 and 35 kWh/m².yr - Three potential performance levels for non-residential development depending on building use - Specific exemptions for particular uses
3. Cooling	'Passive design test' for residential buildings - PROs and CONs for various energy-based metric and limit for non-residential buildings
4. Low carbon heat	- Low carbon heat appraisal focused on outcomes - Location-based approach for low carbon heat network and on-site low carbon heating systems
5. On-site renewable energy generation	- Adoption of a kWh/m²_{fp}.yr target for renewable energy generation - Two potential performance levels depending on building use: e.g. 45 and 75 kWh/m²_{fp}.yr for residential development
6. Energy balance requirement (including offsetting)	- PROs and CONs of an energy balance requirement - Associated role of offsetting for operational energy/carbon
7. Buildings and the wider energy system	- Consideration of energy flexibility requirements for new buildings - Early stage engagement with DNO
8. Assured energy performance and monitoring requirement	- Predictive energy performance modelling - Quality assurance - Energy monitoring requirements

Proposed operational energy and carbon framework

This document investigates policy options and implementation strategies that create a cohesive framework for policy requirements that drive down operational energy use and carbon emissions in new buildings.

The approach is consistent with the recommendations of the Climate Change Committee, UK Net Zero Carbon Buildings Standard, the Low Energy Transformation Initiative (LETI), the UK Green Building Council (UKGBC) and the Royal Institute of British Architects (RIBA).

Potential framework for Net Zero Carbon buildings

All new buildings must be designed and built to be Net Zero Carbon in operation. It relies on compliance with the following requirements:

1. Space heating demand (SHD)
2. Energy Use Intensity (EUI)
3. Cooling
4. Low carbon heat
5. On-site renewable energy generation
6. Energy balance requirement (if required)
7. Energy flexibility and electrical infrastructure
8. Assured energy performance and monitoring

Embodied carbon and whole life carbon policies are covered in a separate document.

Proposed policy requirement	Summary requirements	Page
1. Space heating demand (SHD) requirement	Meet selected SHD limit for typology (e.g. 20 kWh/m ² .yr for block of flats)	57
2. Energy Use Intensity (EUI) requirement	Meet EUI limit for typology (e.g. 50 kWh/m ² .yr for block of flats)	57
3. Cooling	'Passive design test' for residential buildings	68
4. Low carbon heat	Submission of a low carbon heat appraisal Location-based approach for low carbon heat network and on-site heating systems	81
5. On-site renewable energy generation	Meet selected renewable energy generation requirement for typology (e.g. 45 kWh/m ² _{fp} .yr for block of flats)	96
6. Energy balance requirement (including offsetting)	Potential requirement to achieve a balance between energy use and renewable energy generation (with offsetting if not possible on-site)	101
7. Buildings and the wider energy system	Consider energy flexibility measures (e.g. energy storage) Engage early with the electricity network DNO (Distribution Network Operator)	115 & 116
8. Assured energy performance and monitoring requirement	Undertake predictive energy performance modelling at RIBA stage 2/3, stage 4 and stage 6. Monitor and report actual energy use post-construction.	121

Implementation of policy | An opportunity to streamline submissions

Seeking outcomes

The principal purpose of updating policy is to continue to seek sustainable outcomes for London. However, the preconception is that updates to policy could be challenging and costly to adhere to while bringing more burden to applicants and the submission process. This need not be the case. Policy can be streamlined to work hand in hand with a submission process that:

- rewards **quality** and **clarity** over quantity
- uses guidance to apply policy **proportionately across development scales**.

Streamlining policy and process

As part of updates to the London Plan, there is an opportunity to review supplementary guidance and submission requirements, putting the focus on the need to achieve the desired policy outcomes while reducing the volume and types of information required to be submitted.

This could be done through the use of simple **proformas** (proportionate to the scale of development) to collect results from energy models, with the energy statement providing explanations.

The use of **predictive energy models** and a change to **energy-based metrics** would also help to focus on tangible and measurable outcomes, and potentially reduce the quantity of models to run and provide evidence of.

This would represent a different approach to the current one but we consider that this new approach will lead to more accurate performance assessments and therefore lead to improved design and better outcomes.

Current GLA position

- **Carbon based metrics** requiring a split of results across Be Lean, Be Clean and Be Green.
- **Multiple energy models** and iterations, producing a large quantity of results to satisfy the separate calculations for the energy hierarchy, all to be typed up into a GLA calculation tool.
- **Detailed energy reports**, with little guidance on expected content, resulting in long and unclear reports being submitted.

A streamlined position

- **Energy based metrics** for space heating demand, energy use intensity and renewable energy generation.
- **Fewer energy models** with one model producing all results required for the energy metrics summarised in a proforma proportionate to the scale of development.
- Guidance on expected content of **streamlined energy and carbon statements**, to reduce length and improve clarity and quality of outcomes.

How the proposed framework compares to the current London plan and industry practice

Proposed policy requirement	How it compares with the current London Plan	Industry definitions on Net Zero	Other comments
1. Space heating demand (SHD) requirement	- Delivers the same intent as the current London Plan, but with a metric which is likely to lead to more consistent outcomes and enable a streamlined and more helpful process for developers and design teams. Ability for a performance requirements to be tightened. - Replaces the % reduction at Be Lean and % reduction at Be Green.	- Performance level 2-3 are broadly in line with CCC recommendations. - Performance level 3 is in line with LETI targets and NZCBS limits	- Many progressive developers have their own SHD and EUI targets and track these metrics across projects. - Stakeholder engagement with local authorities, industry professionals and developers welcomed the introduction of these metrics.
2. Energy Use Intensity (EUI) requirement		Performance level 3 is broadly in line with LETI targets, RIBA 2030 targets and UK NZCBS limits	
3. Cooling	- Same overheating requirement but introduces an additional 'Passive design test' for residential buildings - Potential introduction of an energy-based metric and limit for non-residential buildings.	Most net zero definitions do not include overheating or cooling	Stakeholder engagement indicated that the introduction of the 'passive design test' would be welcomed.
4. Low carbon heat	- Similar heating analysis requirements, re-framed to focus on outcomes and enable a wider selection of low carbon heating systems to be considered. - Location-based approach to connecting to low carbon heat network.	Most Net Zero definitions ban fossil fuels being used. The exception is the UK NZCBS, that has an exemption for existing district heating networks (only until 2040), although the carbon content of heat must be still equivalent to a heat pump, and a fossil fuel free plan must be in place.	Stakeholder engagement showed that this would be welcomed by developers and industry professionals.
5. On-site renewable energy generation	Adds a minimum on-site renewable energy generation requirement (the current London Plan simply states that renewable energy generation should be maximised)	Performance level 1 is in line with UK NZCBS targets.	Stakeholder engagement indicated that the introduction of these requirements would be welcomed.
6. Energy balance requirement (including offsetting)	The current London plan, achieves regulated net zero carbon onsite through offsets. This framework could achieve net zero energy through an energy balance requirement	- Most net zero local plans have an energy balance requirement. - LETI targets a net zero energy balance - UK NZCBS does not require an energy balance.	Stakeholders generally felt that it was better to spend money on the building rather than energy offsets that would be required to meet an energy balance.
8. Assured energy performance and monitoring requirement	- Predictive energy performance modelling at RIBA Stage 2/3, Stage 4 and Stage 6. - Quality assurance. - Continuation of Be Seen.	- Many definitions advocate for assured energy performance, but most do not mandate it. - UK NZCBS is an in-use standard and therefore based on actual metered energy consumption, thus performance is inherently assured.	

Equalities impact summary | Operational energy and carbon

Proposed policy requirement	Potential equality impact	EDI (Equality, Diversity and Inclusion) outcomes compared to current London Plan	
1. Space heating demand	High ●●● this affects health and energy bills	Up	With the flexible nature of the % carbon emission metric, and the % Be lean having different outcomes on different typologies, the change of metrics to SHD and EUI means that energy use, and thus energy bills, are likely to be more consistently reduced.
2. Energy Use Intensity		Neutral or Up	Performance level 1 has similar energy use outcomes to the current London Plan. However, level 2 and level 3 will lead to lower energy usage, thus likely lower energy bills. Reducing energy use and energy costs for occupants and addressing fuel poverty. This will benefit single-parent households, young people, racialised people and disabled people, all of whom experience above average rates of fuel poverty.
3. Cooling	High ●●● this affects health and energy bills	Up	The 'Passive design test' for residential buildings means that all homes will need to be designed with an increased level of resilience. Energy bills associated with active cooling are likely to be lower and homes will be cooler when active cooling is not used. An energy-based metric to limit cooling in non-residential buildings will reduce cooling consumption in community buildings such as places of worship and community centres, supporting the affordable management of these spaces.
4. Low carbon heat	High ●●● this affects energy bills	Up	The proposed policy introduces the requirement to carry out a low carbon heat appraisal which considers running cost as a key driver in making decisions on heat system selection.
5a. On-site renewable energy generation	High ●● for single family homes, as the Solar PV has the potential to significantly reduce energy bills	Up	The flexible nature of the current London Plan policy leads to a wide variation in the amount of Solar PV installed on new homes. The introduction of on-site renewable energy generation requirements is likely to increase the amount and consistency of on-site renewable energy generation, which can help reduce energy bills.
6. Energy balance requirement (including offsetting)	Low ●	Up or Neutral	This will largely be met through energy offsetting, and therefore financial contributions away from the site. Offsetting funding could be used to support those in social deprivation, for example retrofit funding.
7. Buildings and the wider energy system	Medium ●● energy flexibility reduces energy bills	Neutral	Some populations with protected characteristics, such as older and/or disabled people and racialised people, may be unable to shift their energy use to lower their bills and may be charged higher prices for energy as a result. The proposed policies may result in more energy flexible homes, care must be taken that these energy flexible actions are accessible.
8. Assured energy performance	Medium ●●	Up	Assured energy performance will ensure that the desired policy outcomes are secured and that in-use energy use is lowered and on-site energy generation is maximised. It will ensure that new technology is operating as it should, identifying where energy use is exceeding the modelled expected use and supporting building managers to intervene and ensure that the benefits of lower energy bills are delivered to users.

Construction costs impact summary | Operational energy and carbon

This page provides an overview of the estimated cost impact ranges associated with the key policy elements, including space heating demand, EUI, cooling, renewable energy generation and energy balance (including offsetting) compared to a baseline London Plan-compliant specification. The purpose is to give to the GLA a clear sense of how different combinations of performance levels influence construction costs across representative building types.

Indicative impact on construction costs for two typologies

This evidence base covers many building typologies. The adjacent table focuses on two typologies to provide an example of the information available in this report: a mid-rise block of flats and an office building.

The results are based on the analysis that follows in the subsequent sections of the report, where individual policy areas are examined in more detail. For each measure, the cost impact is shown as a range to reflect variation across the levels of performance, e.g. Levels 1, 2, and 3, rather than a single fixed point. In some cases, modest savings are even achievable at lower levels due to simpler systems such as direct electric heating, while higher energy performance levels may result in additional construction costs linked to enhanced fabric, systems or design coordination.

This analysis does not promote a single optimal pathway or set of specifications. Each level of performance has associated merits and constraints that are explored in the report.

The aim of this analysis is to highlight these trade offs and to provide an evidence base to support the GLA in exploring which combination of performance levels is most appropriate to take forward into final policy. By presenting the full spectrum of options, alongside their indicative cost impacts, this approach enables a more informed and balanced policy decision-making process that takes into account technical feasibility, cost, and delivery.

Proposed policy requirement	Construction cost uplift range (depending on performance level)	
	Mid rise block of flat	Office
1. Space heating demand (SHD) requirement	-0.5% to +1.2% (-£12/m ² to +£56/m ²)	0% to 6.7% (£0/m ² to +£284/m ²)
2. Energy Use Intensity (EUI) requirement		
3. Cooling	None or negligible	None or negligible
4. Low carbon heat	Limited	Limited
5. On-site renewable energy generation	-0.1% to +0.1% (-£3/m ² to +3/m ²)	-0.1% to 0% (-£2/m ² to 0/m ²)
6. Energy balance requirement (including offsetting)	+1% to +2.2% (£34-£72/m ²)	+2.7% to +5.4% (£114-£229/m ²)
7. Buildings and the wider energy system	None	None
8. Assured energy performance and monitoring requirement	Assumed to be negligible due to HEM	+0.2%

Energy costs impact summary | Operational energy and carbon

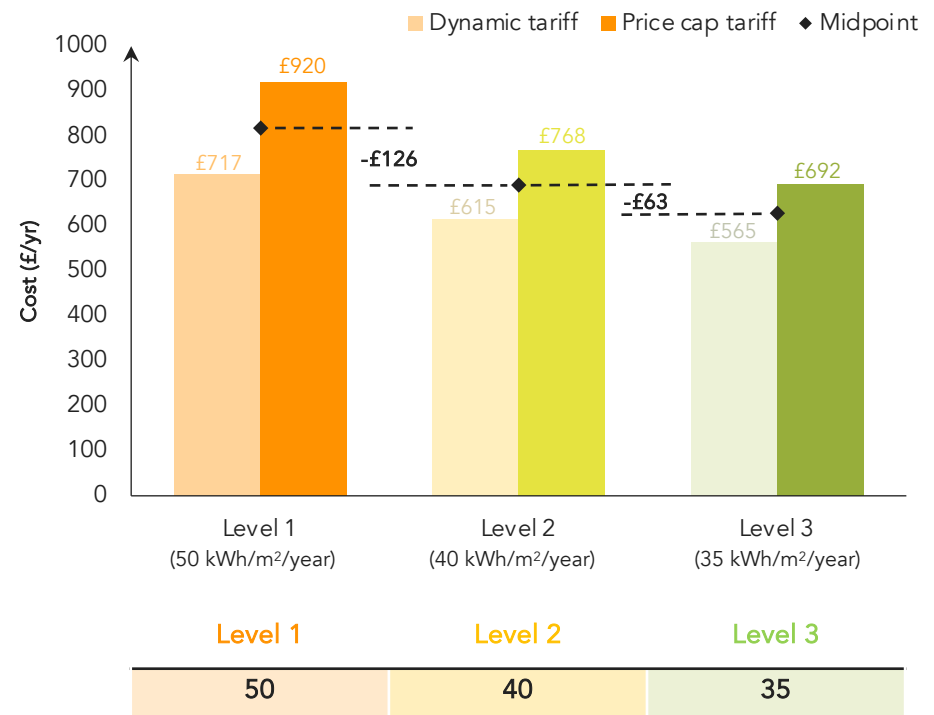
The adjacent graph represents estimated annual energy costs for a 60 m² flat in London built to the different levels of EUI (i.e. 50, 40 and 35 kWh/m².yr), using 2024 electricity pricing data from OFGEM and Octopus Energy. It shows two tariff types (price cap and dynamic) that represent a reasonable price range. The black dot on each pair of bars represents the midpoint (average) of the two tariff costs.

Cost reduction through energy efficiency

Based on this analysis for a 60 m² flat:

- Level 1 (50 kWh/m²/year) would be equivalent to annual energy costs of £817-920 per year.
- Level 2 (40 kWh/m²/year) would lead to a **saving of approximately £126 per year compared to Level 1 (i.e. 16%)**.
- Level 3 (35 kWh/m²/year) would lead to a **saving of approximately £190 per year compared to Level 1 (i.e. 23%)**

This demonstrates that the choice of performance level in the new London Plan (between Level 1, 2 or 3) will not only impact London's energy system and its carbon emissions, but the energy bill of every Londoner who will live in new buildings in London.



Estimated annual energy costs for a 60 m² flat in London across three energy performance levels under price cap and dynamic tariffs (using 2024 energy price data).

Cost impact for policy combinations | Mid-rise and high-rise residential | No energy balance

Assessing the overall impact on residential construction costs

This page summarises the cost impact of different 'Set menus' (i.e. specifications required to achieve set combinations of performance levels presented in this report). For construction costs, a set of good practice fabric specifications and a heat pump system are assumed to represent the baseline, as this is what is typically installed in London¹.

Key conclusions for mid and high rise residential

Set menu A is broadly equivalent to achieving the same level of energy performance as the London Plan, reframed using energy metrics, that drives a more consistent and helpful approach. Set menu A achieves a saving of 2-2.6% compared with the baseline as an ultra low energy building fabric with direct electric heating would meet the energy requirements.

Set menu C represents the most ambitious performance levels outlined in this report but only requires a <1% construction cost uplift, while delivering 28%-40% lower energy bills and 30% lower energy use and carbon emissions compared with Set menu A.

Set menu B sits between set menu A and C in terms of ambition, with lower construction costs than what is typically built under the current London Plan, while delivering 17%-20% lower energy bills and 20% lower energy use and carbon emissions compared with Set menu A.

Set menu D is a hybrid in terms of ambition, delivering 25-30% lower energy bills with lower construction costs than what is typically built under the current London Plan.

These Set menus are just examples. We suggest that other Set menus are also explored. It may be that different performance levels / Set menus are chosen for different typologies.

¹ For example for mid rise London Plan compliant baseline meets 11% carbon emission reduction at be lean and 50-60% carbon emission reductions at Be Green.

Mid rise residential									
		Set menu A		Set menu B		Set menu C		Set menu D	
Uplift on construction costs	SHD	Level 1	-1.5%	Level 2	+0.0%	Level 3	+1.2%	Level 2	+0.0%
	EUI	Level 1		Level 2		Level 3		Level 3	
	Solar PV	Level 1	-0.1%	Level 1	-0.1%	Level 2	+0.1%	Level 1	-0.1%
	Predictive modelling*	+0.0%		+0.0%		+0.0%		+0.0%	
	No carbon offset payment**	-0.4%		-0.4%		-0.4%		-0.4%	
	Total uplift	-2.0%		-0.5%		+0.9%		-0.5%	
Impact on energy bills		Energy baseline		-20%		-40%		-29%	
Impact on energy and carbon emissions				-20%		-30%		-30%	

Construction cost uplifts, the impact on energy bills and the impact on energy and carbon reductions for mid rise residential without the introduction of the energy balance policy.

High rise residential									
		Set menu A		Set menu B		Set menu C		Set menu D	
Uplift on construction costs	SHD	Level 1	-2.3%	Level 2	-1.7%	Level 3	+0.7%	Level 2	-1.1%
	EUI	Level 1		Level 2		Level 3		Level 3	
	Solar PV	Level 1	+0.0%	Level 1	+0.0%	Level 2	+0.0%	Level 1	+0.0%
	Predictive modelling*	+0%		+0%		+0%		+0%	
	No carbon offset payment**	-0.3%		-0.3%		-0.3%		-0.3%	
	Total uplift	-2.6%		-2.0%		+0.4%		-1.4%	
Impact on energy bills		Energy baseline		-17%		-28%		-26%	
Impact on energy and carbon emissions				-20%		-30%		-30%	

Construction cost uplifts, the impact on energy bills and the impact on energy and carbon reductions for high rise residential without the introduction of the energy balance policy.

*This assumes that HEM will be used for predictive modelling, if this is not the case additional 'process' costs associated with predictive modelling will need to be included.

**The policy option proposals do not include any carbon offset payments, whereas this is a requirement in the current London plan, thus there is a cost reduction, see Appendix for more information.



Cost impact for policy combinations | Office | No energy balance

Key conclusions for the office

Set menu A is broadly equivalent to achieving the same level of energy performance as the London Plan, reframed using energy metrics, that drives a more consistent and helpful approach. The costs differ from the London plan compliance for two reasons. The first is that costs are added as predictive energy modelling is required (0.2%) and 0.1% is taken away, as there is no carbon offset payment.¹

Set menu C represents the most ambitious performance levels outlined in this report and is estimated to be 7% more expensive to build than the current London Plan, whilst delivering roughly a 50% reduction on energy bills, energy and carbon emissions.

Set menu B sits in between Set menu A and C and is estimated to have a 3.3% additional construction costs than the current London Plan, whilst delivering an approximate 30% reduction on energy bills, and in terms of energy use and carbon emissions.

These Set menus are just examples. We suggest that other Set menus are also explored. It may be that different performance levels / Set menus are chosen for different typologies.

Office							
		Set menu A		Set menu B		Set menu C	
Uplift on construction costs	SHD	Level 1	+0.0%	Level 2	+3.2%	Level 3	+6.7%
	EUI	Level 1		Level 2		Level 3	
	Solar PV	Level 1	+0.0%	Level 1	+0.0%	Level 2	+0.1%
	Predictive modelling	+0.2%		+0.2%		+0.2%	
	No carbon offset payment*	-0.1%		-0.1%		-0.1%	
	Total uplift	+0.1%		+3.3%		+7.0%	
Impact on energy bills		Energy baseline		-32%		-50%	
Impact on energy and carbon emissions				-31%		-46%	

Construction cost uplifts, the impact on energy bills and the impact on energy and carbon reductions for office without the introduction of the energy balance policy.

**The policy option proposals do not include any carbon offset payments, whereas this is a requirement in the current London plan, thus there is a cost reduction, see Appendix for more information.*

Cost impact for policy combinations | Mid-rise, high-rise residential & Office | Including energy balance

This page explores the uplift on construction costs if the energy balance policy option is included.

The energy balance will typically be met by contributing into an offset fund managed by the LPA through s106. This would increase costs significantly without achieving significant benefits.

Mid rise residential					
		Set menu A-	Set menu B	Set menu C	Set menu D
Uplift on Construction costs	Total uplift without energy balance	-2.0%	-0.5%	+0.9%	-0.5%
	Energy balance	+2.2%	+1.6%	+1.0%	+1.3%
	Total uplift with energy balance	+0.2%	+1.1%	+1.9%	+0.8%

Construction cost uplifts with and without the introduction of the energy balance policy for mid rise residential.

High rise residential					
		Set menu A	Set menu B	Set menu C	Set menu D
Uplift on Construction costs	Total uplift without energy balance	-2.6%	-2.0%	+0.4%	-1.4%
	Energy balance	+2.4%	+1.9%	+1.5%	+1.6%
	Total uplift with energy balance	-0.2%	-0.1%	+1.9%	+0.2%

Construction cost uplifts with and without the introduction of the energy balance policy for high rise residential.

Office				
		Set menu A	Set menu B	Set menu C
Uplift on Construction costs	Total uplift without energy balance	+0.1%	+3.3%	+7.0%
	Energy balance	+5.4%	+3.7%	+2.7%
	Total uplift with energy balance	+5.5%	+7%	+9.7%

Construction cost uplifts with and without the introduction of the energy balance policy for office.

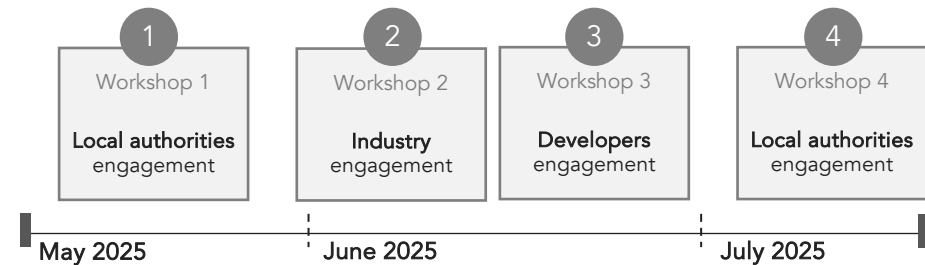
Stakeholder engagement summary | Operational energy and carbon

Between May and July 2025, four stakeholder engagement workshops were organised to inform the development of this evidence base. These workshops were with different groups of stakeholders: representatives from London boroughs, developers, housing providers and industry experts on operational energy/carbon as well as embodied carbon. In each session, the consultancy team presented the emerging approaches and initial findings, providing an opportunity to gather stakeholders' feedback. As well as the stakeholder engagement sessions summarised on this page, stakeholder engagement calls related to EDI were also undertaken and are described in the Appendix.

Summary of feedback

A high level summary of key views and outcomes on operational energy has been provided below, for more details see the Appendix:

- **Space heating demand and energy use intensity:** Strong consensus and support for the proposed metrics and general agreement on levels being considered.
- **Cooling demand:** Strong support for the 'passive design test'. The idea of a cooling metric was supported in principle, but further research is needed to determine which metric is most suitable.
- **Low carbon heat:** Broad agreement on the need for clearer guidance on when connection to a heat network is mandatory. Strong resistance to a 'blanket' expectation to connect in the future due to construction cost, uncertainty of the heat network ever becoming available and reduced heating requirements of new buildings. Strong support for assessing the affordability of heat but clear expectation for guidance on how to do it consistently.
- **Renewable energy:** Developers and industry representatives held mixed views on the need to set renewable energy generation requirements. In contrast, local authority representatives were supportive, viewing it as a positive way to encourage more renewable energy generation in London.



Stakeholder engagement timeline.

SHD and EUI performance levels

Space heating demand - kWh/m²GIA/yr

	Level 1	Level 2	Level 3
All typologies	30	20	15

Energy use intensity - kWh/m²GIA/yr

	Level 1	Level 2	Level 3
Residential	50	40	35
Office	115	90	70
Primary school	65	52	40
Industrial	40	35	30
Hotel	150	120	80
Student accommodation	80	65	50

Cooling discussion points

- Clear set of requirements promoting passive design
- Passive design test
- Cooling metric

Low carbon heat discussion points

- Heat network zones
- Comparing heating options
- Affordability of heat

Renewables performance levels

On-site renewable energy generation limits

- kWh/m²fp/yr

	Level 1	Level 2
Single family homes	80	100
Multi-residential	50	80
Industrial	80	100
Schools	50	80
Other	50	80

Energy balance -%

Early stage performance levels shared during stakeholder's engagement workshops across four operational energy themes. A more detailed summary of the discussions can be found in the Appendix.

Scope: New buildings, change of use and major refurbishments

This evidence base focuses on the operational energy performance of new buildings. It is assumed that major refurbishments and change of use applications which will be referable to the Mayor of London should be treated the same as new build for operational energy performance.

This is due to the likely scale of works required but also to the scale of opportunity: it is reasonable to assume that major refurbishments and change of use renovations coming forward during the period covered by the new London Plan will be the only such opportunity before 2050. It will therefore be the only opportunity to bring this building's performance in line with net zero.

Lighter refurbishments are not covered by this evidence base.

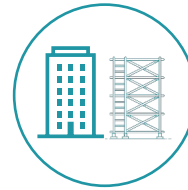
What is considered to be a major refurbishment?

The Code of Construction Practice classifies major refurbishments as:

Those which are of such a scale that the impacts are equivalent to those arising from a new build. For example, where there is extensive demolition and rebuilding or significant new construction behind a retained façade. The planning obligations required by a major refurbishment will also be determined by the length of construction programme extending over 12 months.

Building regulations defines 'major renovation' as 'the renovation of a building where more than 25% of the surface area of the building undergoes renovation.

The GLA could adopt or adapt one of these definitions. It is recommended that a definition be included in the London Plan for clarity regarding which schemes must comply with the targets.



New buildings



Major refurbishments



Change of use

Next steps | A robust evidence base for proposed policies

This page summarises the work required to develop this research into an evidence base that would be suitable to support the new London Plan at inspection. The purpose is to give to the GLA clarity on what needs to be added (or removed) once the intended policies are drafted.

Options and recommendations

This evidence base currently suggests different levels of performance, pros and cons of various potential policies and comparisons of different possible approaches and combinations of measures. The final evidence base should only evaluate the proposed policies, for clarity and to make sure the analysis is directly relevant.

Precedents and legal framework

References have been included in this evidence base to various other local plans and national standards which support the proposed options by demonstrating conformity with national policy or showing deliverability of a given approach. Once the proposed policies have been decided, the relevance of these references should be reviewed and either omitted or supplemented by other suitable precedents.

Draft policies and viability testing

We strongly recommend that whichever team is engaged to update this research evidence to the final evidence base and support the GLA at the EiP be given the opportunity to review the proposed policies before publication and also to engage with the viability consultants appointed, to understand how the cost uplifts in this work has been used in the viability work. This will enable a more consistent and robust set of documents to be presented at Examination.

Proposed policy requirement	Decisions which should be represented by the final evidence base
1. Space heating demand (SHD) requirement	SHD limit for each typology
2. Energy Use Intensity (EUI) requirement	EUI limit for each typology
3. Cooling	Inclusion of 'Passive design test' for residential buildings
4. Low carbon heat	Requirement and terms of a low carbon heat appraisal
5. On-site renewable energy generation	Renewable energy generation requirement for each typology
6. Energy balance requirement (including offsetting)	Requirement to achieve an energy balance and/or offsetting
7. Buildings and the wider energy system	Requirement or guidance
8. Assured energy performance and monitoring requirement	Requirements for predictive energy performance modelling at different RIBA stages. Monitoring and reporting policies.

Themes not covered by this document

The London Plan (2021) includes a Sustainable Infrastructure chapter, which includes policies with requirements for net zero, energy efficiency measures and the efficient supply of energy to new buildings: policies SI 2, SI 3 and SI 4).

This document provides policy options and recommendations addressing the majority of the themes in these existing policies.

However some elements covered by these policies are not covered by this evidence base. Broad recommendations are simply summarised below:

Policy SI 2 – Be seen

- Energy monitoring is fundamental to the success of the policy and should be continued.
- However, it is suggested that further work is carried out to review the implementation of the 'Be Seen' policy and improve it accordingly.

Policy SI 4 – Overheating analysis and future weather files

- This evidence base does not cover investigation of overheating analysis and compliance with DSY1 and/or DSY 2 and DSY3 weather files. It is suggested that further work is carried out on this to investigate whether compliance with future weather files should be a policy requirement.

- **Policy SI 2 – Minimising greenhouse gas emissions:** Introduces the energy hierarchy, the requirements for an energy strategy, the % be lean and % carbon emission reduction targets, the offset fund as well as Whole Life-Cycle Carbon Assessment.
- **Policy SI 3 – Energy infrastructure:** Development of energy masterplans, identifying energy infrastructure requirements, existing and future heating and cooling networks, the requirements for communal heating systems for Heat network priority areas and heat network requirements.
- **Policy SI 4 – Managing heat risk:** Development proposals to minimise urban heat island and reduce the potential for internal overheating and reliance on air conditioning systems.

A summary of the current policies included in the Sustainable Infrastructure chapter

2.0

Evidence of need

Introduction

This section summarises why the new London Plan should include requirements to minimise operational energy use and carbon emissions of new buildings.

Global and national commitments: Net Zero by 2050 and carbon budgets

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.

The Glasgow Agreement (2021)

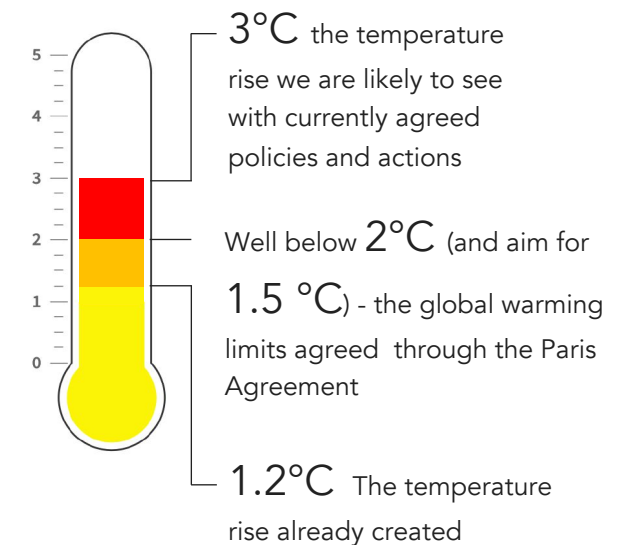
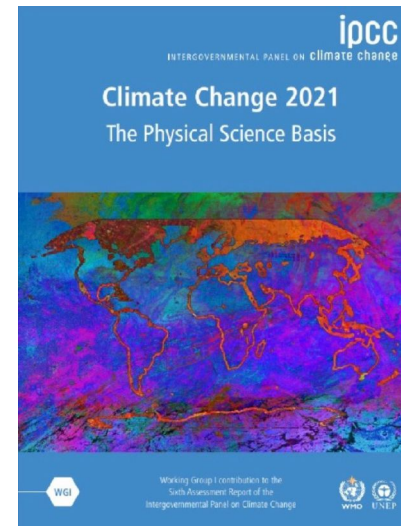
International negotiations on climate change are governed through the United Nations Framework Convention on Climate Change (UNFCCC). The most recent negotiations concluded with the Glasgow Agreement in 2021. Nations collectively agreed to work to reduce the gap between existing emission reduction plans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

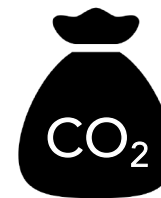
The concept of carbon budgets is absolutely critical to understand. Net Zero is not only about a destination; a very significant and fast required decarbonisation pathway is needed from now on.

The IPCC Special Report on 1.5°C has estimated the quantity of CO₂ that can be emitted globally and still be consistent with keeping global temperatures well below 2°C, with a chance of stabilising at 1.5°C. The report gives different budgets for different temperature rises and probabilities.

Recent work by Lamboll et al has indicated that at the start of 2023 the remaining global carbon budget for a 50% probability of keeping global warming to below 1.5°C was 250Gt CO₂. This budget will be consumed within under 6 years at current emission rates.



The IPCC has provided scientific evidence that global warming is happening and that greenhouse gas emissions must rapidly be reduced



250,000 MtCO₂

The **remaining global carbon budget** is 250,000 MtCO₂ (from January 2023) for a 50% chance of limiting temperature rises to below 1.5°C (Lamboll et al, 2023). Includes updates to climate models and incorporation of new knowledge on contribution from non-CO₂ emissions.



<6 years

It would take less than 6 years to **consume our entire global carbon budget** at current global emissions rates for a 50% chance of limiting temperature rises to below 1.5°C

The new London Net Zero 2030 pathway

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 of London has declared a climate emergency and has brought forward by 20 years the target for London to be Net Zero, which should now be achieved by 2030.

London Net Zero 2030: an updated pathway

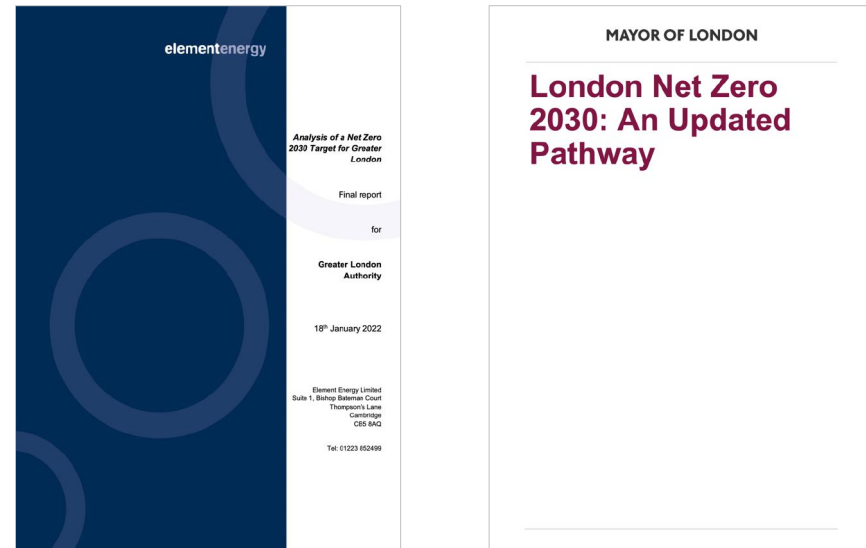
The GLA has commissioned experts at Element Energy to analyse pathways for London to reach Net Zero by 2030. Their report 'Analysis of a Net Zero 2030 Target for Greater London' was published in 2022 and explores four possible pathways that London could take. Based on this analysis, the Mayor of London has selected 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)

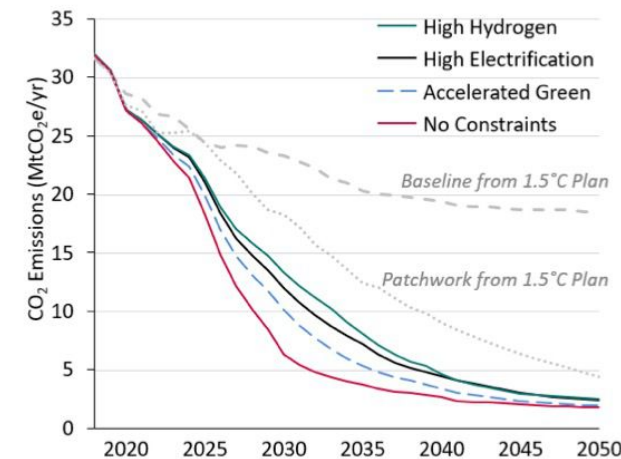
This pathway aims to reduce baseline emissions (30MtCO₂/yr in 2020) by more than 65% by 2030 down to 10MtCO₂/yr. Key features of this pathway for buildings include:

- 40% reduction in heat demand of buildings
- Gas boilers in new developments banned by 2025
- 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

The above objectives provide the scientific background to what the requirements discussed in this document seek to achieve.



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.

Why new buildings need to be compliant with climate change commitments from now on

New buildings must not add to the problem

There is a defined carbon budget for the built environment between now and 2050. This budget can be met through a range of scenarios but they all involve very significant carbon emission and energy consumption reductions between 2024 and 2050.

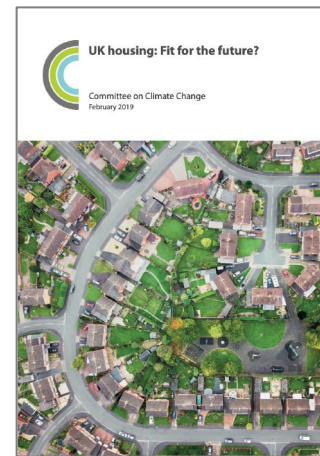
Operational carbon emissions associated with new buildings are still very significant. These new buildings are not energy efficient enough, some of them continue to use fossil fuels for heating and hot water (e.g. gas boilers), and they generate very small amounts of renewable energy. This effectively uses the carbon budget allowance, putting more pressure on existing buildings to decarbonise.

It costs five times more to achieve the same carbon reduction in existing buildings through retrofit than applying improvements to new buildings.

New buildings can be compliant with climate change commitments

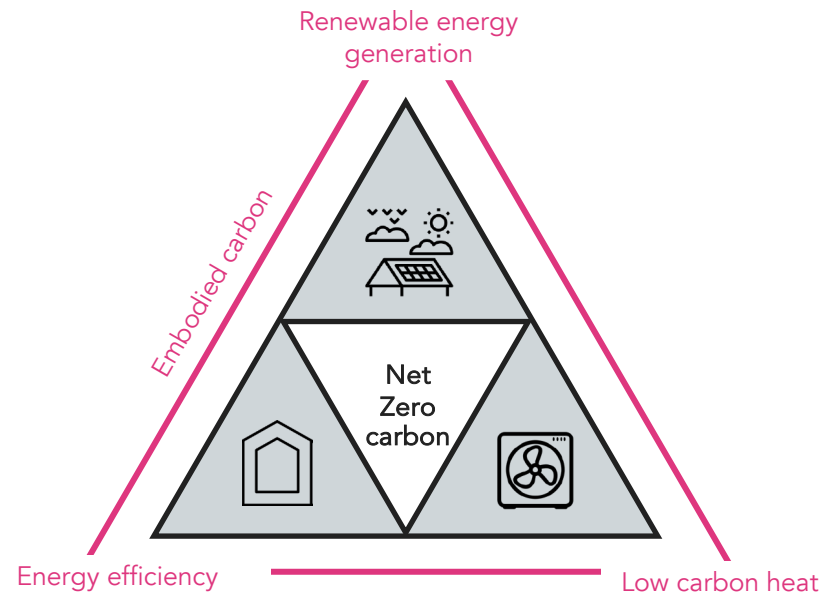
New buildings designed and built, today, with available and affordable skills, techniques and technologies can be compliant with climate change commitments. In their *UK housing: Fit for the future?* Report the CCC provides clear guidance on what should be expected from new buildings from now on and in particular:

- an ultra-low level of energy use (i.e. 15-20 kWh/m².yr space heating)
- a low carbon heating system.



"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.



For the Climate Change Committee, energy efficiency and low carbon heat represent two key pillars of future buildings compliant with our climate change commitments

Reducing energy bills for occupants

A growing concern

Energy costs have always been a concern for those affected by fuel poverty and it is now a major issue for many Londoners.

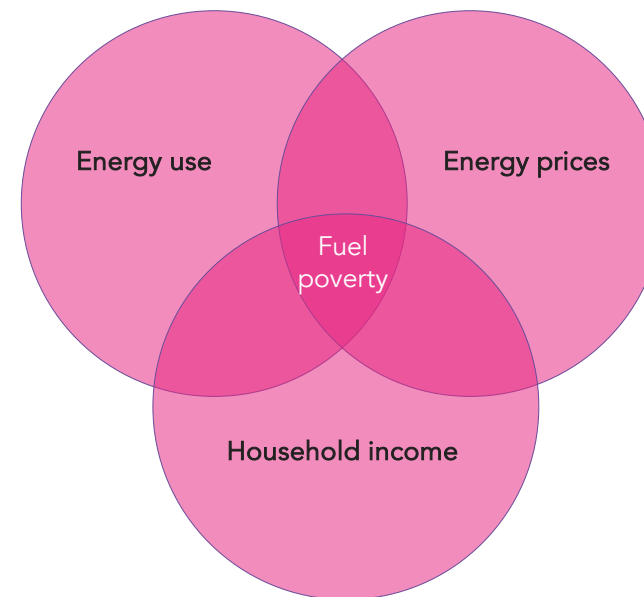
The role of new buildings

There are three factors contributing to fuel poverty: energy prices (set by the market/energy suppliers), the household income and the dwelling's energy demand. New buildings should use as little energy as possible and enable residents to make the most of flexible energy prices.

- An energy efficient dwelling will help to reduce energy demand which in turn would reduce energy bills.
- It would also make the temperature more stable, enabling a 'smart' heating system to make the most of flexible dynamic electricity prices. If electricity is used for heating and cooling, this benefit would be much more substantial with the use of 'Time of Use' tariffs.

The positive role of renewable energy generation on bills

PV generation can and should benefit residents. A solar PV system can generate significant cost savings when electricity is used by residents on-site, and some revenues through the export of electricity to the grid.



The dwelling's energy use is one of the three key factors contributing to fuel poverty. Delivering benefits for residents is key to ensure a 'just' energy transition across London.

3.0

Space heating demand, Energy Use Intensity (EUI) and cooling

3.0.1

The first sub-section sets out the different levels of space heating demand (SHD) and Energy Use Intensity (EUI) considered. It demonstrates their technical feasibility and summarises the construction cost associated with achieving them.

The second sub-section considers cooling.

Space heating demand, EUI and cooling | Summary of methodology and potential performance levels

A shift in metrics would be very positive

Assessing and reducing space heating demand (SHD) and Energy Use Intensity (EUI) helps design teams reduce the energy consumption of buildings and the associated energy bills for residents and occupants.

These metrics are supported by many in the industry including the Climate Change Committee, UK Net Zero Carbon Buildings Standard (UK NZCBS), Low Energy Transformation Initiative (LETI), UK Green Building Council (UKGBC) and the Royal Institute of British Architects (RIBA).

Comparing SHD and EUI targets requirements

Targets found in UK NZCBS, LETI and other local plans have been compared against the equivalent performance level of the current London Plan and Building Regulations. ¹

Development of performance levels

The technical feasibility of space heating demand and EUI limits has been tested and a range of performance levels that could be used by the new London Plan developed. This was carried out through energy modeling and energy data analysis from constructed buildings. A cost assessment of the performance levels was undertaken.

Reducing energy consumption related to cooling

It is recommended to introduce a 'passive design test' where buildings with proposed cooling to mitigate overheating are still required to meet the overheating criteria of non-cooled buildings, (under conditions that there are no acoustic constraints and the windows can be open). It could also be beneficial to introduce a metric that limits cooling demand and consumption and several options have been considered.

¹ The Future Homes and Buildings Standards are due to be released shortly after this research has been completed. As the specifications and tools used to calculate energy consumption are not currently available, a comparison to this standard has not been carried out.

kWh/m ² /yr (GIA)	Level 1	Level 2	Level 3
All typologies	30	20	15

Space heating demand - performance levels

kWh/m ² /yr (GIA)	Level 1	Level 2	Level 3
Residential	50	40	35
Office	130	90	70
Primary school	65	52	40
Industrial	40	35	30
Hotel	150	120	80
Student accommodation	80	65	50

Energy use intensity - performance levels

3.1

Space heating demand and energy use



Operational energy and carbon | Summary of requirements in the current London Plan

Use of a Part L approach and a focus on regulated carbon

After the introduction of the 'Merton Rule'¹ and its adoption by the GLA in the London Plan and Mayor's first Energy Strategy in 2004, planning policy in London has sought to mitigate the impact of new buildings on climate change. This has been done primarily through requirements for quantified improvements over Part L of the Building Regulations. The London Plan, through its successive iterations (2008, 2011, 2016 and 2021), regularly updated these requirements and adapted them to successive versions of Part L of the building regulations (i.e. Part L 2010, Part L 2013, now Part L 2021).

Current Policy SI 2: Minimising greenhouse gas emissions

The current London Plan policy requires all major developments to be 'net zero carbon' by designing to the following energy hierarchy:

Be Lean: Reduce energy demand through fabric efficiency measures and meet a minimum reduction in regulated carbon emissions against Part L 2021 baseline.

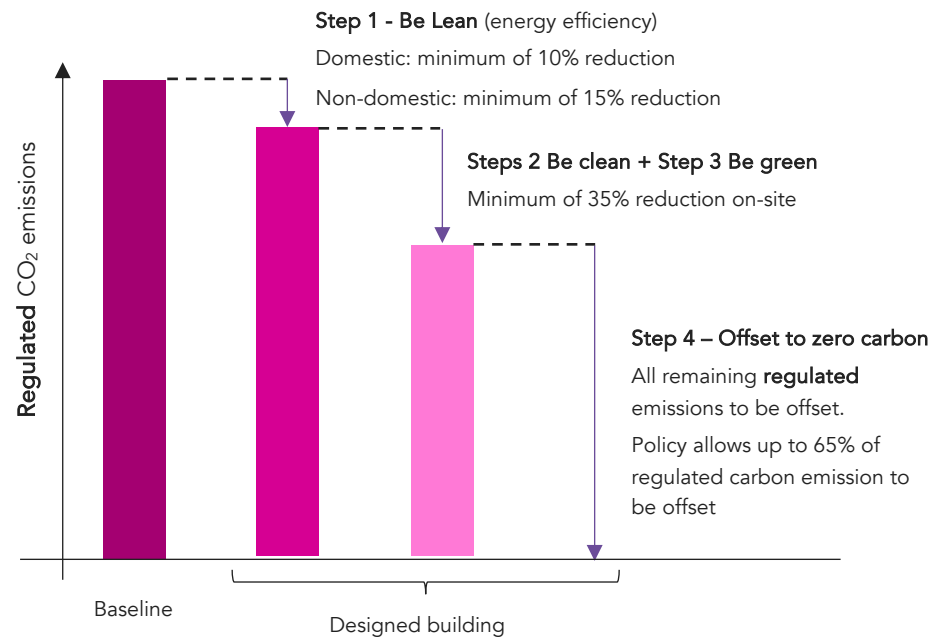
Be Clean and Be Green: Meet a minimum on-site reduction in regulated carbon emissions against Part L 2021 baseline through supplying energy efficiently and cleanly and maximise opportunities for on-site renewable energy generation.

Be Seen: Submit an energy performance monitoring plan to ensure alignment of actual energy consumption data with design predictions.

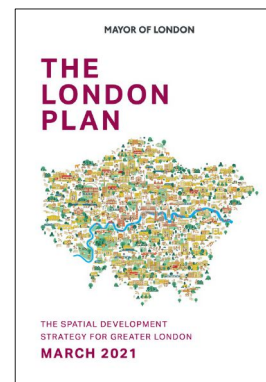
The 'Net Zero Carbon' definition used by the London Plan excludes 'unregulated' energy use and relies significantly on carbon offsetting, as illustrated by the adjacent diagram.

Since the publication of the Energy Guidance Assessment document in 2022, applicants are also required to report the Energy Use Intensity (EUI) and space heating demand of all major developments and compare them against given benchmarks.

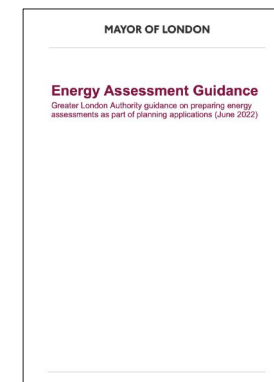
¹ The 'Merton Rule' was a pioneering planning requirement for new developments to generate at least 10% of their energy requirements from renewable energy sources.



The GLA Energy Assessment Guidance requires the above approach to carbon reduction for new buildings.



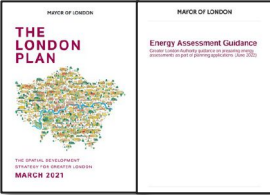
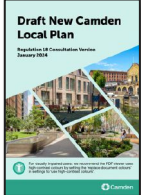
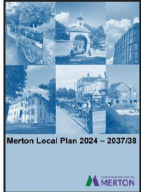
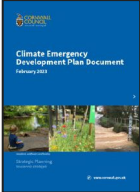
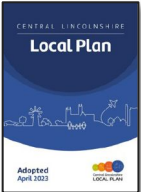
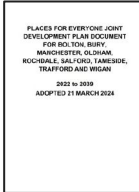
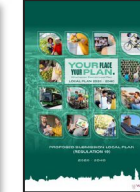
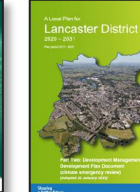
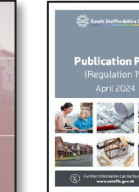
The London Plan's policy SI2 refers to Part L 2013 of the Building Regulations



The GLA Energy Assessment Guidance (2022) requires regulated carbon reductions targets against Part L 2021

Operational energy and carbon | Review of existing approaches

The table below summarises key sources that define existing approaches to reducing operational energy of buildings in the UK. The sources are categorised into two main areas: a) National building regulations and existing/emerging/draft local plans and b) industry guidance and best practice documents. They outline strategies for new and/or major refurbishments across various typologies, including residential and non-residential.

Operational energy	
Source	Document
National building regulations and existing/emerging/draft local plans	        
	Approved document L: Conservation of fuel and power Vol 1 & Vol 2 The Future Homes Standard 2023 consultation The London Plan 2021 and Energy assessment guidance 2023 Camden draft new local plan 2024 Tower Hamlets draft new local plan 2024 Ealing draft new local plan 2024 Enfield draft new local plan 2024 Kensington and Chelsea new local plan 2024 Newham draft new local plan 2024
Industry documents	         
	Merton local plan 2024-2037/38 Cornwall CEDP 2023 Central Lincolnshire updated local plan Places for everyone adopted plan 2024 Milton Keynes adopted plan 2019 Winchester Proposed local plan (reg19) 2020-2040 Lancaster district adopted local plan 2020-2031 Essex planning policy position South Staffordshire Local plan (examination) SPD Bath & North East Somerset sustainable construction checklist
Industry documents	    
	Climate Change Committee LETI climate emergency design guide UKGBC Net zero carbon buildings framework RIBA 2030 Climate Challenge UK Net Zero Carbon Buildings Standard

The case for using energy-based metrics (1 of 2)

The current London Plan requires the performance of building fabric and systems to be assessed using a set of relative metrics, primarily focused on the percentage improvement in regulated carbon emissions over compliance with building regulations. A Part L notional building is used as the baseline, and improvements demonstrated through the ‘Be Lean’, ‘Be Clean’ and ‘Be Green’ stages. While this approach aligns with national regulations, it has several limitations detailed below. By contrast, the energy-based metrics proposed in this study – Space Heating Demand and Energy Use Intensity - aim to provide a more accurate and holistic understanding of the building performance.

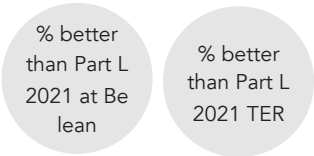
Validating performance

The notional building has the same shape, orientation and, up to a point, the same window proportions as the actual proposed building design. For clarity, the notional building is fictional and is created by the compliance tool and used only for building regulations purposes. The percentage improvement over a notional building is therefore an intangible requirement that cannot be measured in operation, whereas an absolute energy use target in kWh/m²/yr(GIA) can be checked against metered energy in the occupied building. This makes post-construction verification and learning from a feedback loop possible directly benefiting both buildings and future policy adjustments and development.

Incentivising good design

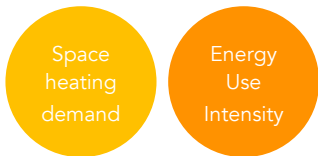
The carbon-based metric aggregates the influence of fabric and ventilation specifications as well as the heating system and on-site renewable energy generation. Therefore, one parameter may compensate for another, e.g. a poorly performing heating system can be compensated by a large PV array. Having a dedicated metric per objective helps to deliver a minimum performance for each objective and avoids ‘trading’ between them.

Current policy metrics (%)



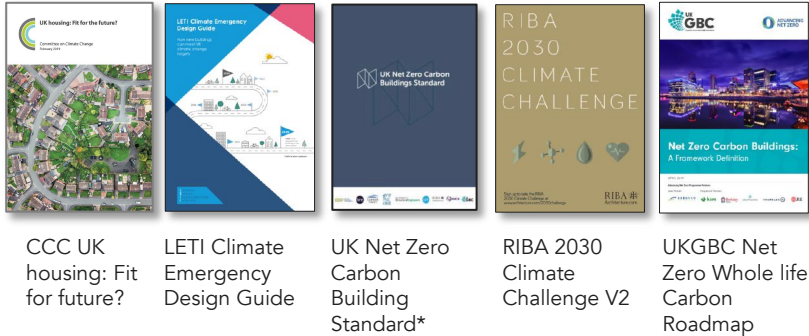
The TER (or Target Emission Rating) represents the regulated carbon emission limit set by Building Regulation)

Proposed policy metrics (kWh/m²/yr (GIA))



Industry supported metrics

Industry-led standards and guidance developed by experts in the built environment have been developed to further define net zero carbon buildings. They have been recommending Space Heating Demand and Energy Use Intensity as the main approaches for assessing fabric and energy efficiency in buildings and ensuring a successful pathway to net zero.



Space heating demand	✓	✓	✓		✓
Energy use intensity		✓	✓	✓	✓

Industry documents supporting SHD and EUI metrics.

*Unlike the other documents, UK NZCBS uses measured (not modelled) data, which do not account for the performance gap between predicted and actual use.

The case for using energy-based metrics (2 of 2)

Capturing total energy impact

Part L metrics cover only regulated energy use and not energy use from appliances, cooking and equipment. The energy use intensity metric accounts for regulated and unregulated energy use.

Supporting environmental design and understanding running costs

As the grid decarbonises, there is a risk that only considering carbon emissions will dilute the differences between buildings. A move towards energy-based metrics would ensure the ability to distinguish and support good environmental building design. In addition, carbon-based metrics influenced by carbon factors do not provide a reliable proxy for energy costs, whereas, energy use intensity can be related to energy cost.

Accuracy of calculation methodology and ease of implementation

Current regulatory calculation methodologies (SAP/ SBEM) used to check compliance with the carbon metric were not developed to predict energy use. They are generally low in accuracy and therefore increase the performance gap between design and completion¹. By contrast, predictive energy modelling, such as PHPP and TM54, assess energy use more accurately and provide absolute energy-based outputs. Predictive energy modelling can be used to reliably estimate energy use and drive suitable design and construction decisions, thereby helping to reduce the performance gap.

Predictive modelling is routinely carried out by many design professionals, and the current London Plan already has a requirement to undertake predictive modelling as part of 'Be Seen' for non-residential development. It is also anticipated that HEM will be a satisfactory methodology to predict energy use for residential developments.

¹ SAP is soon to be replaced with a new methodology when Part L 2025 (FHS) will be published. The FHS will still rely on comparison to a notional building, however the new regulatory tool (HEM) is likely to be more accurate than SAP at absolute estimates of SHD and EUI.

	Current policy metrics %	Proposed policy metrics kWh/m ² /yr (GIA)
	% better than Part L 2021 at Be lean	Space heating demand
	% better than Part L 2021 TER	Energy Use Intensity
Outcomes		
Consistent with current regulatory approach		
Government's preferred metric for planning policy		
Helps deliver energy use reductions		
Can be measured in-use and therefore reduce the performance gap		
Help delivers Net Zero according to industry's definition		
Used by industry experts, progressive local authority policy and developers		
Can be used to assess resident energy costs - aligned with Just Transition		
Robustness of evidence base (especially on viability) and meeting timelines of project		
Accuracy of calculation methodology		

Why should the new London plan go further than Buildings Regulations (Part L)?

Part L 2021, the Future Homes Standard and Building Standard

There is a huge range in space heating demand and energy use intensity of current building regulations, due to the methodology and approach. Although the final requirements of the Future Homes and Building Standard will not be confirmed and published until Autumn 2025, the proposals do not show a change in the metrics and approach to compliance. They also do not show a significant upgrade in building fabric performance.

Analysis carried out by the Net Zero Carbon Building Standard¹ shows that in order to meet the UK's energy and carbon budgets, energy consumption needs to be reduced beyond building regulations, including the latest proposals for the Future Homes Standard and Future Buildings Standard.

The adjacent figure show the space heating demand that meet the Part L 2021 regulations, the current London Plan and the performance level options developed for the new London Plan.

Energy costs

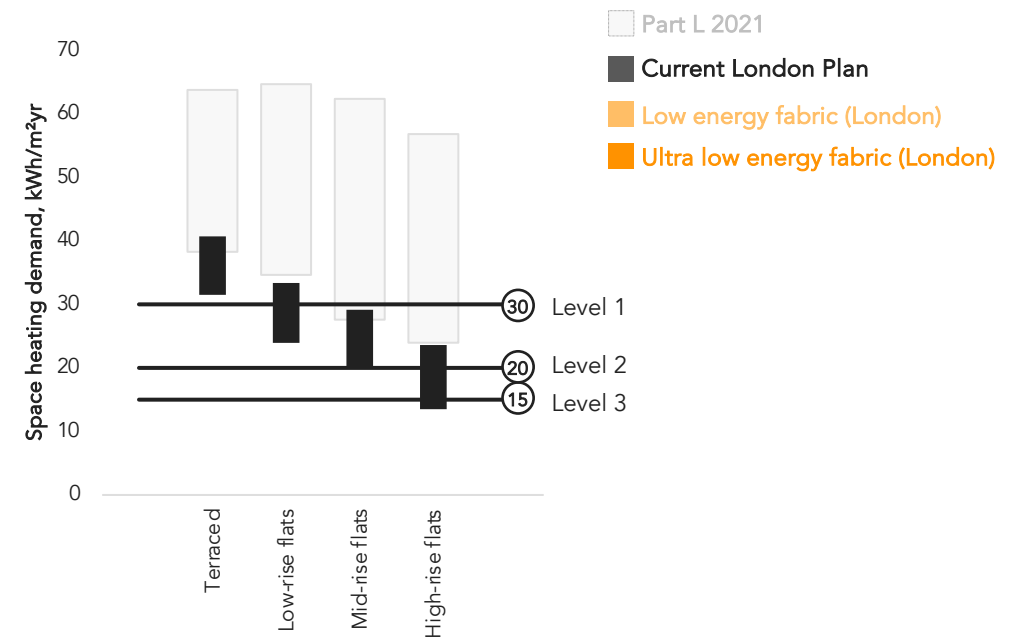
Energy costs are reduced by 15% when implementing the Level 2 and a 23% when implementing the Level 3 compared to Level 1. The metrics used in the current London Plan and building regulations do not enable a simple assessment of energy costs.

Meeting net zero

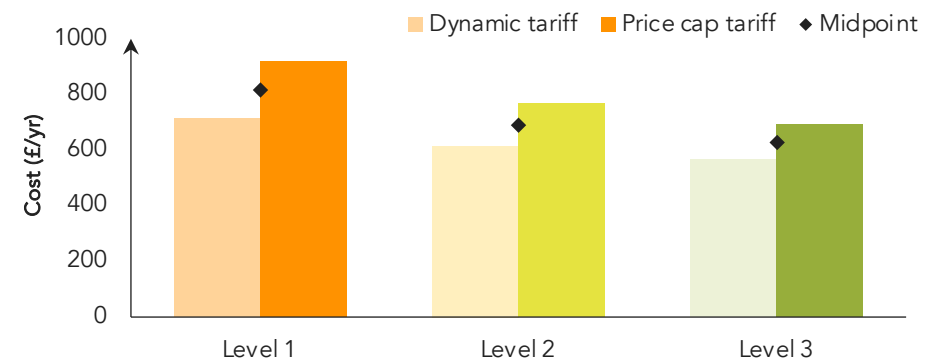
Carbon emissions are reduced, compared to Building Regulations. Level 3 aligns industry consensus on the requirements of net zero.

Performance gap is reduced

Energy metrics help reduce the performance gap. This means that the buildings are much more likely to perform as intended.



Space heating demand of Part L 2021 regulations, the current London Plan and the performance level options developed for the new London Plan. As Part L and the London Plan, does not use the metrics of space heating demand, the performance is shown as a range. For more details on the calculations, see pages on evidence of technical feasibility, modelled data.



Estimated annual energy costs for a 60 sqm flat

¹ Balancing the UK Stock Against a Net Zero Trajectory to Derive the Pilot Version Limits. May 2025 available at <https://www.nzcbuildings.co.uk/pilotversion>

Space Heating Demand (SHD) and Energy Use Intensity (EUI) | Performance levels: methodology

Performance levels have been developed for SHD and EUI, for various new build typologies in order to develop a range of performance suitable for the new London Plan, depending on viability constraints.

The SHD and EUI of a building depends on its form, orientation, window area, thermal performance, airtightness, heating, hot water and ventilation system types and efficiencies. Increasing the performance of some of these elements increases the construction costs of the development.

The levels represent:

- **Level 1:** Easily achievable for all building types. Loosely achieves cost parity with current London Plan
- **Level 2:** A low energy building, easily achievable for the majority of development types without significant restriction of form factor or orientation.
- **Level 3:** An ultra low energy building, most aligned with net zero, and achievable for the majority of development types without significant restriction of form factor or orientation. Lowest operational costs for the residents.

All of the levels are technically feasible.

Level 3 aligns with Net Zero Carbon

There is emerging consensus on the requirements of new buildings in order to achieve net zero, through the work of LETI, RIBA, UKGBC and the Net Zero Carbon Buildings Standard (NZCBS). The UK NZCBS energy limits are based on in-use data and reduce between 2025 and 2040. Level 3 is broadly aligned in most cases with the UK NZCBS, see the Appendix for more information.

The development of the performance levels

The performance levels have been developed by understanding the performance of:

- Part L 2021, the 2021 London Plan, the proposals for the Future Homes Standard and the Future Buildings Standard.
- Predictive energy modeling carried out for other local policy evidence bases.
- Bespoke predictive energy modeling for this project.
- A review of technical specifications and corresponding EUI and SHD levels for real projects in the design or construction phase.
- A review of in-use data from real buildings.
- A review of the LETI, RIBA and UK NZCBS limits and an understanding of their development.

3.1.1

Space heating demand and energy use

Residential



SHD & EUI | Residential | How the performance levels compare to others

Three performance levels for SHD and EUI

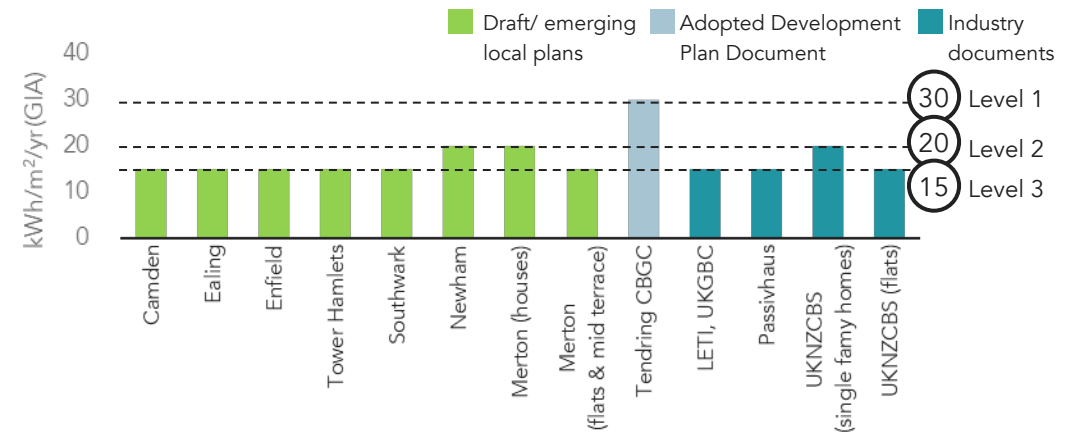
The graphs opposite demonstrate that all three proposed levels for residential SHD and EUI are supported by a range of sources (existing, draft and emerging local plans and industry documents), contributing to their technical feasibility.

Space heating demand

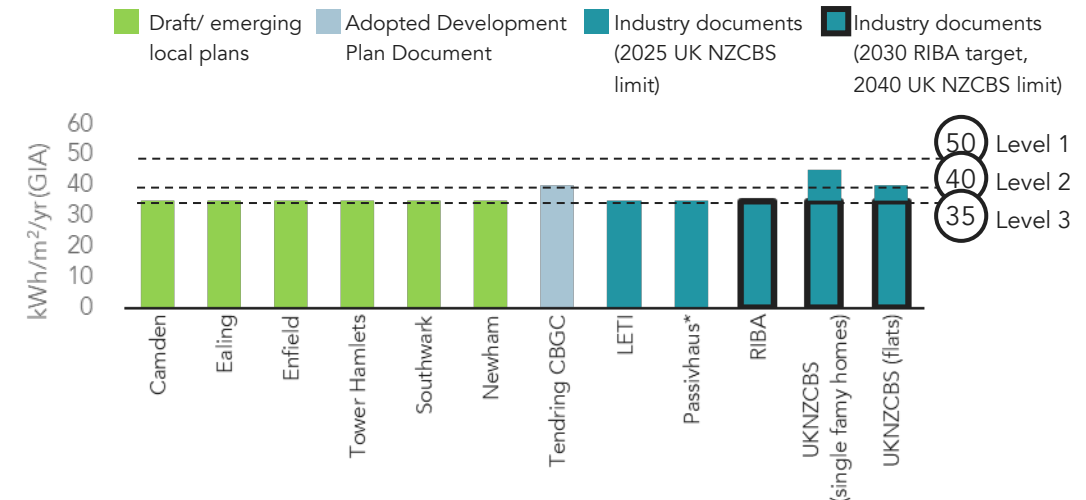
- **Level 1** - 30 kWh/m²/yr (GIA) - aligns with the recently adopted Tendring Colchester Borders Garden Community (CBGC) Development Plan Document (DPD) limit. However, it is above limit in emerging and adopted local plans and industry guidance on best practice.
- **Level 2** - 20 kWh/m²/yr (GIA) - is adopted by Newham's emerging local plans in London and appear in Merton's emerging policy as a performance level for houses. It also aligns with the **UK NZCBS** limit¹ for single-family homes.
- **Level 3** - 15 kWh/m²/yr (GIA) - reflects best practice and is consistent with 5 draft local plans targets in London and appear in Merton's emerging policy as a performance level for flats and mid terraces. It is also supported by **LETI**, **UKGBC** and **UK NZCBS** limit¹ for flats and is broadly equivalent to **Passivhaus**.

Energy Use Intensity

- **Level 1** - 50 kWh/m²/yr (GIA) - is above limit in emerging and adopted local plans and industry guidance on best practice.
- **Level 2** - 40 kWh/m²/yr (GIA) - aligns with the adopted Tendring CBGC's DPD limit, **UK NZCBS** 2025 limit for flats, and is slightly lower than **UK NZCBS** 2025 limit¹ for single family houses.
- **Level 3** - 35 kWh/m²/yr (GIA) - is proposed by 6 draft local plans in London. It is aligned with the **UK NZCBS** 2040 limit¹, the **RIBA 2030** target, the **LETI** target and is broadly equivalent to **Passivhaus**.



Residential SHD targets and limits from various sources, compared with the proposed performance level options.



Residential EUI targets and limits from various sources, compared with the proposed performance level options. The UK NZCBS limits are based on in-use energy data.

*Passivhaus doesn't have an EUI limit, however Passivhaus homes broadly meet an EUI of 35 kWh/m²/yr (GIA).

¹ While the local plans and industry documents rely on modelled/ predicted performance-based data, UKNZCBS uses measured in-use data, which accounts for the performance gap between predicted and actual use.

SHD & EUI | Residential | Evidence of technical feasibility | Modelled data

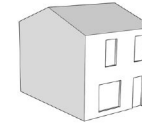
Residential Space Heating Demand (SHD) and Energy Use Intensity (EUI) have been explored across multiple policy projects, using energy models to represent many types of different residential dwellings as shown in the images to the right. These include the main residential typologies relevant to the London Plan, which can be found in minor, major and referable planning applications.

These energy models have been developed further for this evidence base.

Modeling methodology

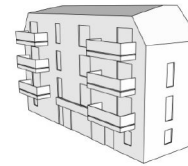
The space heating demand (SHD) and Energy Use Intensity (EUI) results, are based on modelling carried out using a predictive operational energy modelling tool: PHPP (10). When the graphs show the range of SHD and EUI corresponding to Part L and the London Plan, compliance modelling using SAP 10.2 (Elmhurst Design SAP 1.7.25) has also been carried out to understand which scenarios meet regulation or policy, and then using the corresponding SHD or EUI from the operational energy modelling results is presented.

Modelling results presented in this evidence base represent both previous work undertaken by Etude, Levitt Bernstein and Currie & Brown. Notably results from the Delivering Net Zero evidence base (DNZ) developed for 18 London boroughs and the Southwark Delivering Net Zero Technical Evidence Base evidence base have been used. Significant bespoke modelling has also been undertaken for this evidence base



Terrace houses

2 storeys (8 homes)
95 sqm



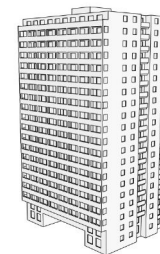
Low-rise

3/4 storeys
640 sqm



Mid-rise

5 storeys
3,200 sqm



High-rise

15 storeys
15,500 sqm

Examples of buildings used to develop the energy models for different typologies.

SHD | Residential | Evidence of technical feasibility | Modelled data

Where is the data from?

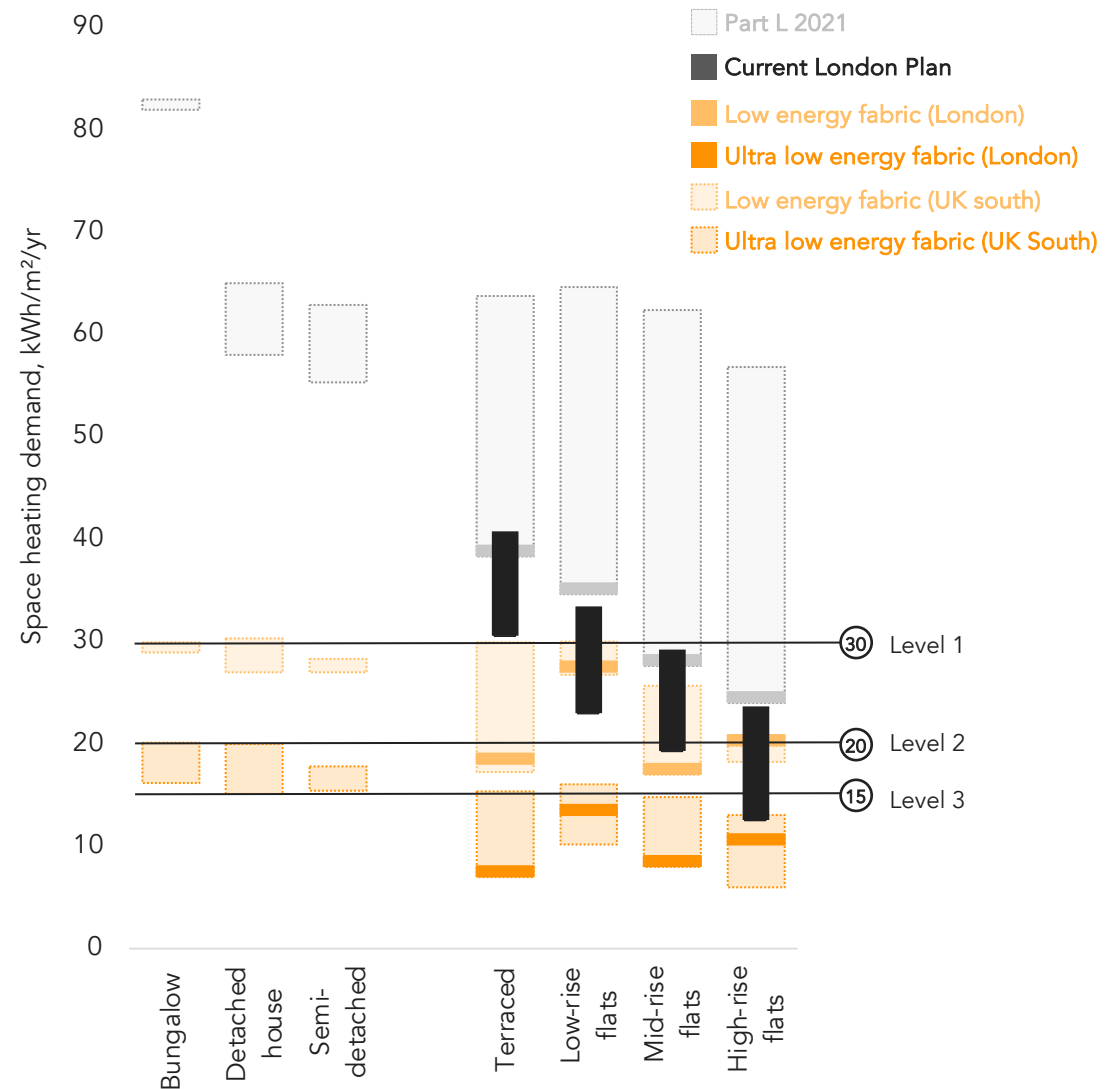
The bar chart to the right shows the space heating demand results from energy modeling conducted for a range of evidence bases. The results for the London Plan evidence base modeling are shown in bold with the dotted bars showing modelling for various evidence bases outside of London.

These are grouped into building fabric standards: **Ultra low energy** and **Low energy**.

The indicative space heating demand required to comply with the current Be Lean requirements (10% reduction in regulated CO₂ emissions over Part L 2021) of the London Plan and is indicated by the dark grey squares.

The modelling and the graph to the right shows that:

- All levels show a reduction in the space heating demand achieved by compliance with Part L 2021, which is more significant for the least dense typologies.
- Level 1, 30 kWh/m²/yr, is readily achievable for all typologies and likely achieves cost parity with meeting the current London Plan in most cases.
- Level 2, 20 kWh/m²/yr, is readily achievable for flats and terraces, and likely achievable for other house types, with smaller or more complex housing having to push further with building fabric efficiency. Some small bungalows may find this difficult depending on other constraints.
- Level 3, 15 kWh/m²/yr, is technically feasible for all tested typologies.



Ranges of space heating demand policy modelling results to date, undertaken using different climate files and for different purposes, with London Evidence base modelling shown in bold. Current London Plan maps the space heating demand range to achieve 10% CO₂ emissions over Part L 2021, this is based on one model per typology, testing a range of fabric options, with and without Waste water heat recovery (WWHR) WWHR affects % reduction at Be Lean but not space heating demand. An additional 10% has been added to the range, to account for the fact that only one typology was modelled thus the true range is likely to be larger. This is due to the fact that form factor will affect space heating demand and not % reduction.

EUI | Residential | Evidence of technical feasibility | Modelled data

This page gives further analysis of the impact on projects using different levels of fabric efficiency, with direct electric heating bottom right chart and without direct electric heating top right chart. The charts include other evidence bases from outside London. The table to the bottom shows the EUI results for the London plan modelling.

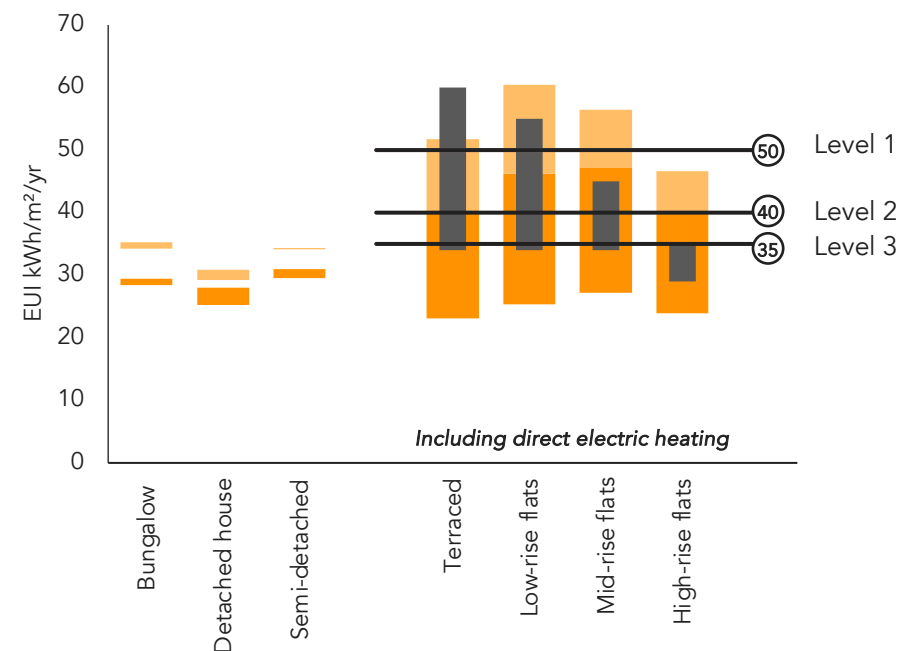
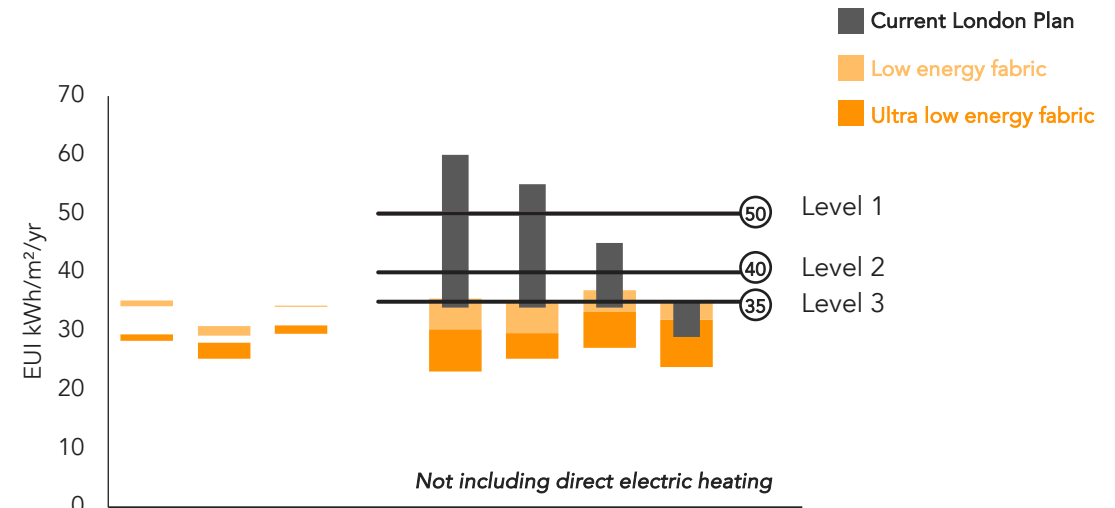
The modelling and graphs to the right show that:

- Level 1 is readily achievable for all scenarios for the four main typologies including those using direct electric heating if they have ultra low energy fabric, and for some cases when they don't.
- Level 2 is readily achievable for all scenarios using a heat pump, as well as ultra low energy homes using direct electric heating.
- Level 3 is achievable for all ultra low energy homes using heat pumps, and some using direct electric. Most low energy homes using a heat pump could also comply.

		FABRIC:			FABRIC:			FABRIC:		
		B	GP	ULE	B	GP	ULE	B	GP	ULE
		HEATING:			HEATING:			HEATING:		
		Direct electric			EAHP (terrace and low rise) HP - High temp loop (mid / high rise) (sCOP= 2.5/2.5)			ASHP (terrace and low rise) ASHP + ambient loop (mid / high rise) (sCOP= 3.9/3.4)		
Terraced		59.3	51.7	39.9	35.7	32.7	28.5	29.3	26.8	23.1
Low-rise flats		67.3	60.4	46.2	37.6	35.2	29.5	31.8	29.7	25.7
Mid-rise flats		63.1	56.4	47.1	39.9	37.0	33.3	36.3	34.0	31.1
High-rise flat		48.8	46.6	39.8	36.2	35.0	31.9	30.3	29.2	26.7

KEY: ■ Does not meet level 1 ■ Meets level 1 ■ Meets level 2 ■ Meets level 3

EUI results for London Plan Evidence modelling showing the combinations of fabric and heating system options for the four typologies modelled. B- Basic fabric, GP- Good practice fabric, ULE- Ultra low energy fabric. For residential the Basic fabric does not meet the FEES of Part L 2021, thus has not been included as part of any of the specifications that represent the performance levels.



Ranges of EUI policy modelling results to date including the London Plan Evidence base. **Top figure does not include direct electric heating and the bottom figure includes direct electric heating.**

EUI | Residential | Evidence of technical feasibility | Summary

Current regulations and benchmarks

The residential building modelled for the DNZ evidence base with specifications to meet Part L 2021 had an EUI of 45 to 95 kWh/m²/yr and 28 to 60 kWh/m²/yr with specifications to meet the current London Plan.

Industry standards and frameworks

UK NZCBS standard EUI limits are 45 and 35 kWh/m²/yr for 2025 and 2040 for flats, from stakeholder engagement at the time of development. The **RIBA 2030 target**, the **LETI target** is 35 kWh/m²/yr (Broadly equivalent to **Passivhaus**).

Adopted and emerging local plans

Tendering in Essex has an adopted AAP at 35kWh/m²/yr, and six London boroughs have emerging local plans at 35kWh/m²/yr.

Existing and emerging evidence base

The modeling resulted in EUIs ranging from 23 to 60 kWh/m²/yr. This range reduces to 23 to 37 kWh/m²/yr with at least low energy fabric and a heat pump. See previous page for more details. The analysis shows that there is a wide range of fabric and system options for all modeled typologies to achieve an EUI of 35 kWh/m²/yr.

Real buildings

649 homes meet and EUI of 35kWh/m²/yr Etude and Levitt Bernstein's portfolios, see Appendix for more information.

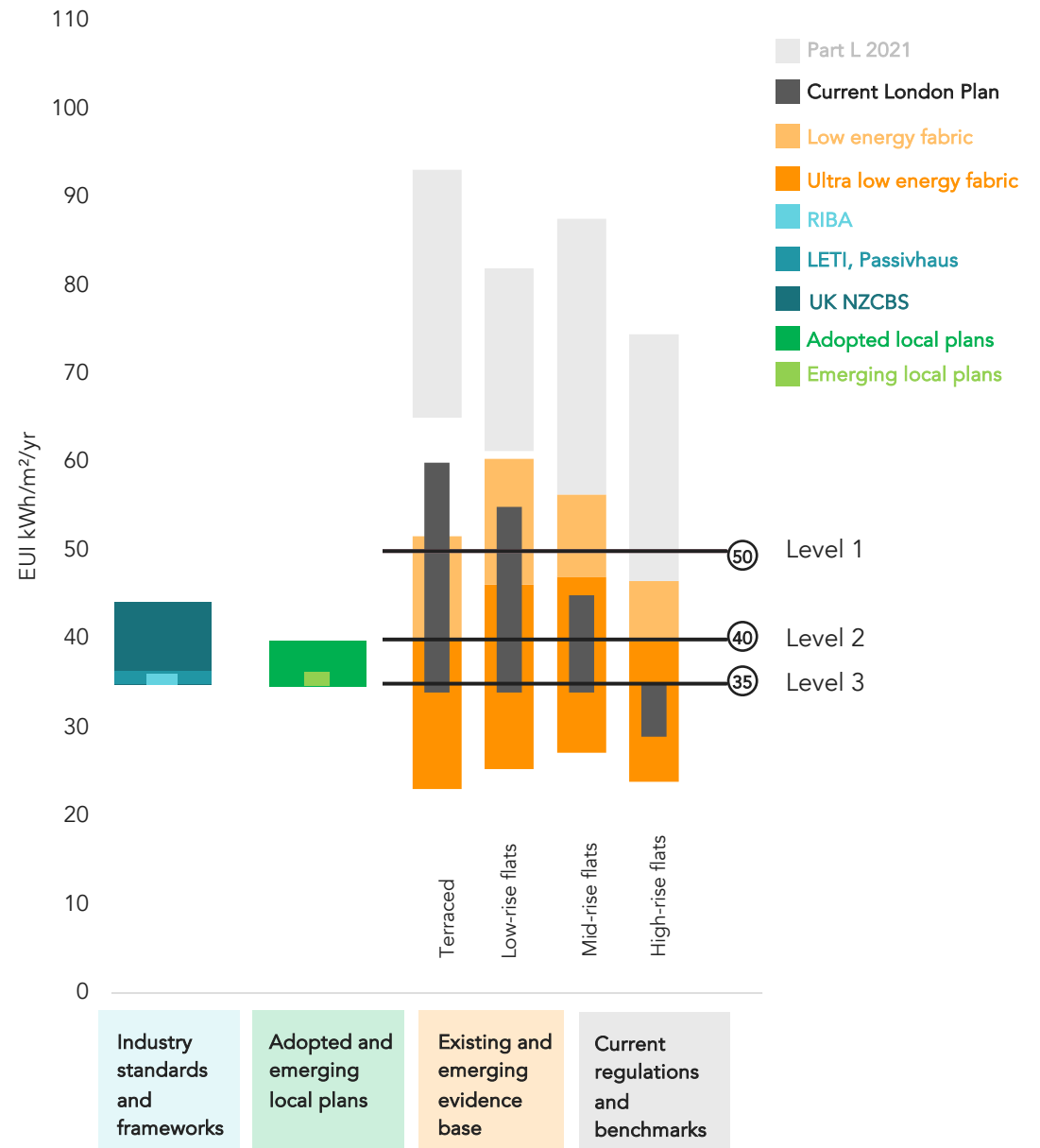
Recommended levels: 50, 40, 35 kWh/m²/yr

Level 1: Aligns broadly with current London Plan, can be achieved with low energy fabric and direct electric heating¹.

Level 2: Aligns with UK NZCBS 2025 limits for flats and is readily achievable for all scenarios using a heat pump, as well as ultra low energy homes using direct electric heating

Level 3: Aligns with UK NZCBS 2040 limits, LETI, RIBA 2030 limits, Passivhaus and the six London boroughs have emerging local plans that are introducing EUI limits.

¹ the high-rise flats can achieve this with worse fabric performance than 'low energy fabric'.



The graph shows EUI ranges for relevant Industry standards and frameworks, Adopted and emerging local plans, Existing and emerging evidence bases and the *policy modelling results related to meeting Part L 2021 and the London plan (35% reduction in CO₂ emissions over Part L 2021).*

SHD and EUI | Residential | Estimated impact of different performance levels on energy costs

Methodology

The tables opposite use the relative cost of each scenario compared to the baseline scenario which was assumed to have a Good Practice (GP) fabric and a heat pump for heating and hot water, which was shown to be broadly compliant with the current London Plan. Energy models were carried out with various building fabric and system options. The scenarios have been costed based on the specifications used in the energy modelling, choosing the the cheapest way of achieving the performance levels. The cost uplift is presented as an absolute cost per square metre uplift or decrease from this cost.

Details of the specifications used are found in the Appendix.

Analysis and comments

To meet Level 1 for SHD and EUI, the cost impact relative to the baseline ranges from cost savings of -3.4% for high-rise flats to -0.5% for low-rise blocks. These savings are primarily driven by the use of direct electric heating systems, which remain cost-effective at this performance level compared to air source heat pump-based baseline.

Achieving Level 2 for SHD and EUI results in a cost uplift from -1.7% for high-rise flats to +2.1% for low-rise flats. High-rise flats are able to achieve compliance with Level 2 with an ultra low fabric and direct electric.

Level 3 for both SHD and EUI which is the most rigorous is estimated to incur a cost uplift from +0.7% for high-rise flats to +2.1% for low-rise flats.

As well as pairing the SHD and EUI levels together, level by level. Different combinations were tested to understand how the cost uplift is influenced by the SHD or EUI element. This is shown in the lower table.

Process costs

Potential additional costs related to carrying out predictive energy modeling are presented in the page on estimated cost impact of policy page in the assured energy performance section.

Typology	Indicative all in construction benchmark cost (Baseline)	SHD Level 1 30 kWh/m ² /yr (GIA)	SHD Level 2 20 kWh/m ² /yr (GIA)	SHD Level 3 15 kWh/m ² /yr (GIA)
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	+0.0% (+£0/m ²)	+0.1% (+£2/m ²)	+2.7% (+£57/m ²)
Low-rise block of flats	£2,610/m ²	-0.5% (-£12/m ²)	+2.1% (+£56/m ²)	+2.1% (+£56/m ²)
Mid-rise block of flats	£3,340/m ²	-1.5% (-£50/m ²)	+0.0% (+£0/m ²)	+1.2% (+£40/m ²)
High-rise block of flats	£3,650/m ²	-2.3% (-£84/m ²)	-1.7% (-£61/m ²)	+0.7% (+£24/m ²)

Uplift costs from baseline for Levels 1, 2 and 3 for Space Heating Demand (SHD) and Energy Use Intensity (EUI). Relative costs (% or £/m²) of each case compared to the baseline scenario (Good Practice fabric and heat pump)

Typology	Indicative all in construction benchmark cost (baseline)	SHD Level 3 15 kWh/m ² /yr (GIA)	SHD Level 3 15 kWh/m ² /yr (GIA)	SHD Level 2 20 kWh/m ² /yr (GIA)
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	+0.1% (+£2/m ²)	+0.1% (+£2/m ²)	+0.0% (+£0/m ²)
Low-rise block of flats	£2,610/m ²	-0.5% (-£12/m ²)	+2.1% (£56/m ²)	+2.1% (+£56/m ²)
Mid-rise block of flats	£3,340/m ²	-1.5% (-£50/m ²)	+1.2% (+£40/m ²)	+0.0% (+£0/m ²)
High-rise block of flats	£3,650/m ²	+0.7% (+£24/m ²)	-1.7% (-£61/m ²)	+0.0% (+£0/m ²)

Uplift costs of different combinations of Space Heating Demand (SHD) and Energy Use Intensity (EUI). Relative costs (% or £/m²) of each case compared to the baseline scenario Good Practice fabric and heat pump)



SHD and EUI | Residential | Estimated impact of different performance levels on energy costs

Summary of methodology

The adjacent graph represents estimated annual energy costs for a 60 m² flat in London built to the different levels of EUI (i.e. 50, 40 and 35 kWh/m².yr), using 2024 electricity pricing data from Ofgem and Octopus Energy. It shows two tariff types (price cap and dynamic) that represent a reasonable price range. The black dot on each pair of bars represents the midpoint (average) of the two tariff costs. This graph highlights how both building performance and tariff choice interact to shape total energy cost, and should be viewed in the context of recent market volatility illustrated in a page in the Appendix.

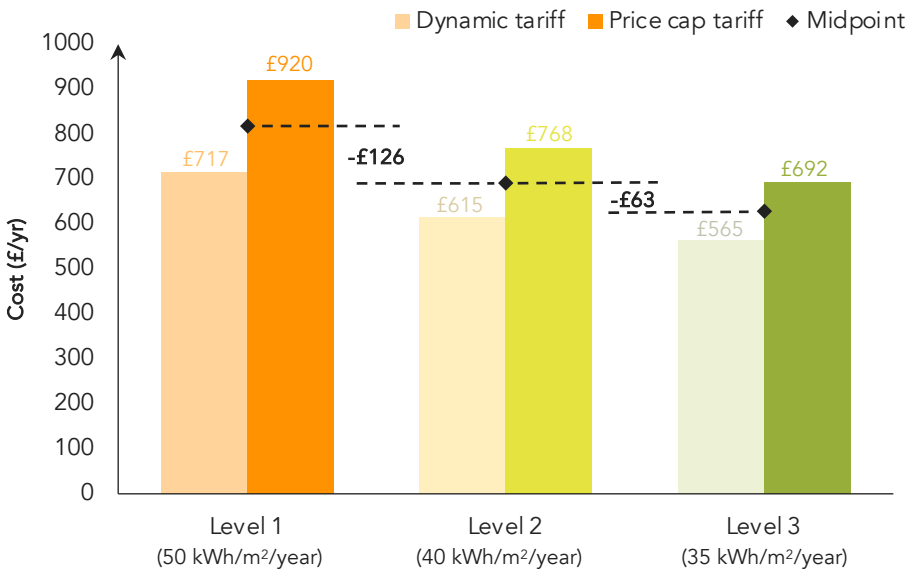
Cost reduction through energy efficiency

Based on this analysis for a 60 sqm flat,

- Level 1 (50 kWh/m²/year) would be equivalent to annual energy costs of £817-920 per year.
- Level 2 (40 kWh/m²/year) would lead to a **saving of approximately £126 per year compared to Level 1 (i.e. 16%)**.
- Level 3 (35 kWh/m²/year) would lead to a **saving of approximately £190 per year compared to Level 1 (i.e. 23%)**

Tariff selection

Tariff choice plays a critical role in shaping household energy costs, with dynamic tariffs offering average savings of around 20% compared to the price cap. The savings with a dynamic tariff are consistent across all energy performance levels, but only fully realised when households can shift usage to off-peak times. This is why this evidence base is proposing the introduction of new requirements in the London Plan to promote energy flexibility.



Estimated annual energy costs for a 60 m² flat in London across three energy performance levels under price cap and dynamic tariffs (using 2024 energy price data).

Assumption	Data
London flat size	60 m ²
2024 average dynamic tariff, with 2 hours peak avoidance	0.167 £/kWh
2024 average price cap	0.253 £/kWh
Estimated 2024 average standing charge for dynamic tariff	£214 per yr
Estimated 2024 average standing charge for price cap tariff	£160 per yr
Level 1 annual energy use	3,000 kWh/yr
Level 2 annual energy use	2,400 kWh/yr
Level 3 annual energy use	2,100 kWh/yr

List of key assumptions and data used to calculate annual energy costs for 2024 energy price data.

3.1.2

Space heating demand and energy use

Non-residential



EUI | Non-residential | Potential performance levels

The following pages give an overview of the various standards, targets, local plan limits and evidence base results for the five non-residential building typologies for EUI. These are either shown as ranges or values and the following notes to the right explain more context on each. The diagram below is an example of how the various levels and ranges are shown in the following pages.

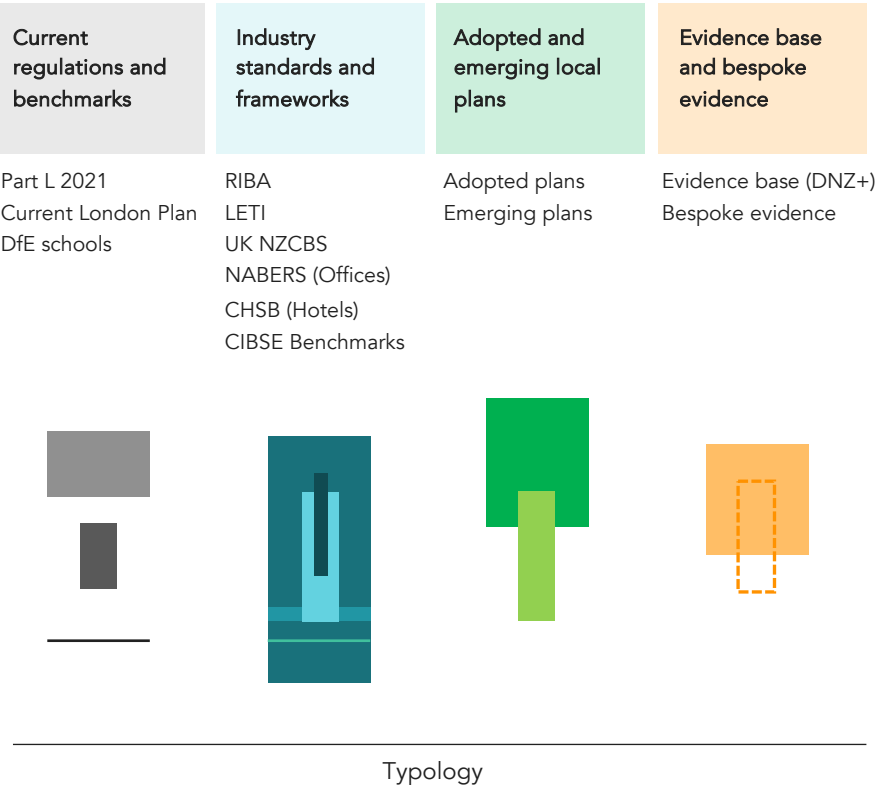


Diagram showing how the various regulations, industry standards and frameworks, adopted and emerging local plans and evidence bases and bespoke evidence are presented over the next few pages.

- Part L 2021:** Figures are based on modelling undertaken for the DNZ evidence base, and represent the SHD or EUI range resulting from various scenarios meeting Part L.
- Current London Plan:** These figures are based on modelling undertaken for the DNZ evidence base, and represent the SHD or EUI range resulting from various scenarios meeting the current London Plan.
- DfE OS for schools:** The Department for Education’s Output Specification for schools in England defines an EUI requirement and elemental limits for U-values and airtightness.

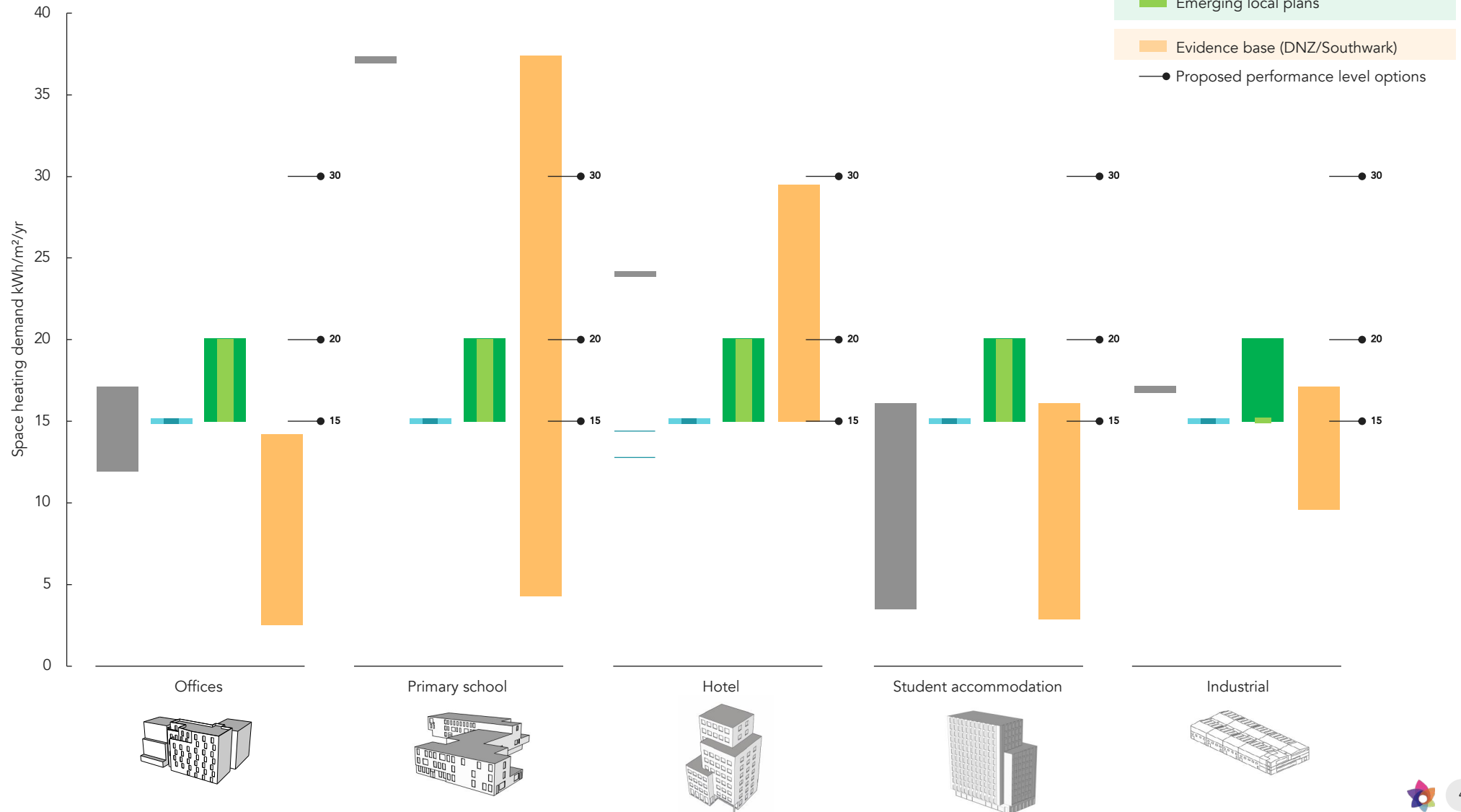
- RIBA:** EUI targets as part of RIBA's 2030 Climate Challenge. A range is shown representing the 2025-2030 targets.
- LETI:** SHD and (some) EUI targets developed as part of the Climate Emergency Design Guide. These have raised the ambition across the sector.
- UK NZCBS:** EUI limits developed for the UK Net Zero Carbon Buildings Standard for various building typologies, based on broad industry engagement at the time of development. A range is shown representing 2025-2040 targets.
- NABERS (Offices):** National Australian Built Environment Rating System is a performance-based rating system for Offices. EUI range shown is approximately equivalent to star ratings 4.5 to 5.5, but these do vary per building.
- CHSB (Hotels):** Cornell Hotel Sustainability Benchmarking Index 2024 global benchmarking tool showing energy performance for a range of hotel types in London.
- CIBSE Benchmarks:** These are based on energy use for different types of existing building, separated by fuel type and ‘typical’ and ‘good practice’.

- Adopted local plans:** there are numerous precedent local plans to refer to, from local authorities in different parts of the country.
- Emerging local plans:** there are also several plans in development and going through examination that can also be referred to.

- Evidence base (DNZ+):** The results from analysis carried out as part of the Delivering Net Zero evidence base, as well as some additional modeling undertaken for other projects.
- Bespoke evidence:** Evidence calculated or collected as part of this project. Either data from real buildings or predictive modeling for real buildings.

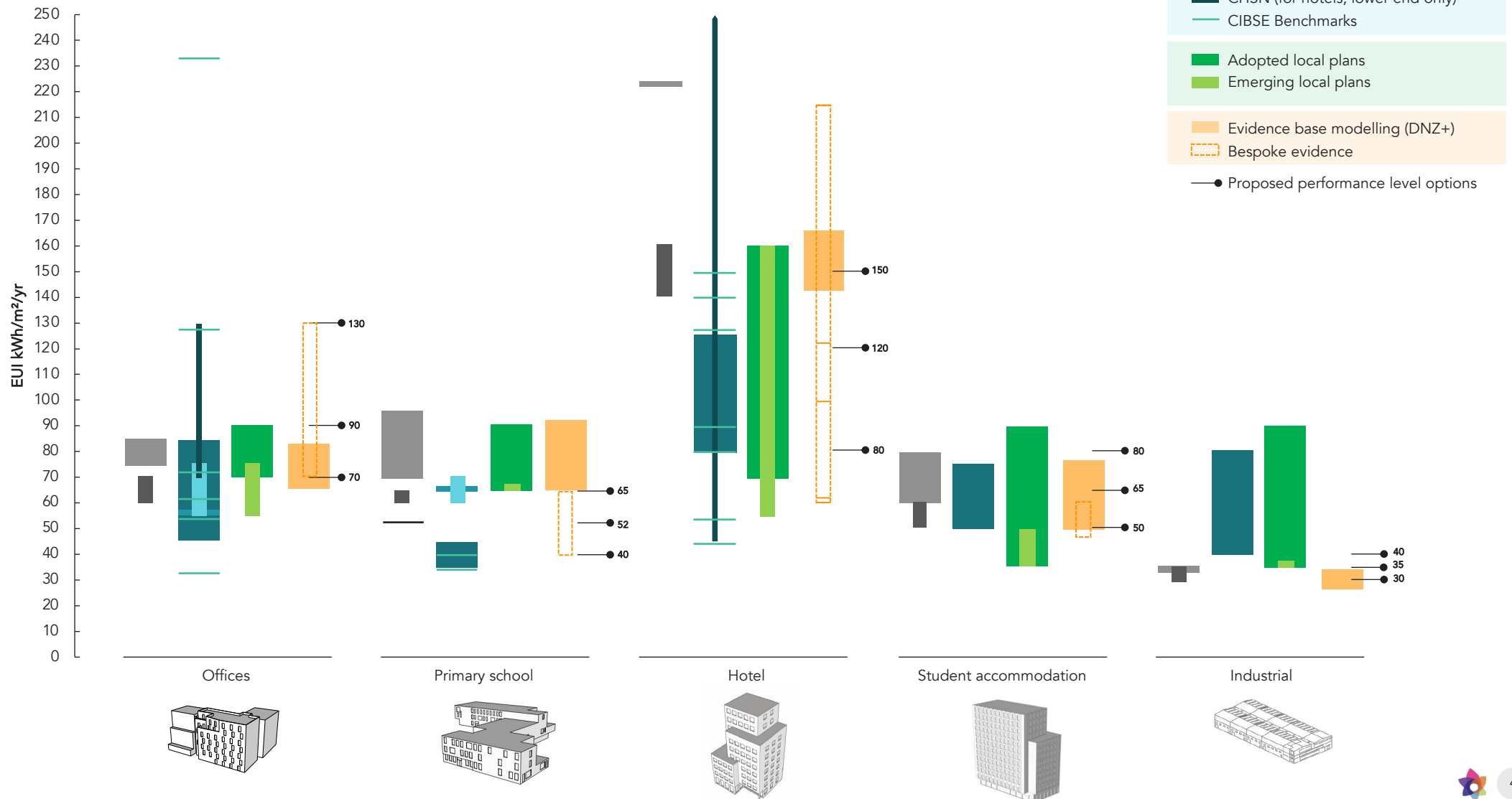
SHD | Non-residential | Evidence of technical feasibility | Modelled data

This page gives an overview of the various standards, targets, local plan limits and evidence base results for non-residential Space heating demand. **Please note that the orange bars include energy models targeting different levels of space heating demand using various specifications to enable cost effective routes to be found to meet those levels. Note that all typologies show a range that meets or goes below the proposed level 3 (15kWh/m²/yr).** This is also equivalent to the Passivhaus Standard limit, and there are numerous examples of buildings of different typologies which meet this Standard.

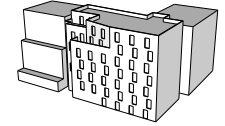


EUI | Non-residential | Evidence of technical feasibility | Summary

This page gives an overview of the various standards, targets, local plan limits and evidence base results for non-residential EUIs. The EUI evidence for non-residential typologies comes from a diverse range of sources created at different times. The proposed levels are based on our most up to date evidence. **The following pages explain the evidence for each typology in more detail.**



EUI | Non-residential | Evidence of technical feasibility | Offices



Current regulations and benchmarks

The office building modelled for the DNZ evidence base with specifications to meet Part L 2021 had an EUI of 75 to 85 kWh/m²/yr and 60 to 70 kWh/m²/yr with specifications to meet the current London Plan.

Industry standards and frameworks

UK NZCBS standard EUI limits are 85 and 45 kWh/m²/yr for 2025 and 2040, from stakeholder engagement at the time of development. The **RIBA targets** 75 and 55 kWh/m²/yr for 2025 and 2030, and the **LETI target** is 55 kWh/m²/yr. **CIBSE benchmarks** vary considerably according to the office type. The highest is "air conditioned, prestige" and lowest is "Naturally ventilated, cellular". The **NABERS Design for Performance** group have recommended that the performance levels are aligned with NABERS star ratings of 4.5, 5 and 5.5, corresponding to EUIs of 70 to 130 kWh/m²/yr as appropriate levels. (Star rating of 6 corresponds to 55 kWh/m²/yr but was deemed to hard to meet as a planning requirement).

Adopted and emerging local plans

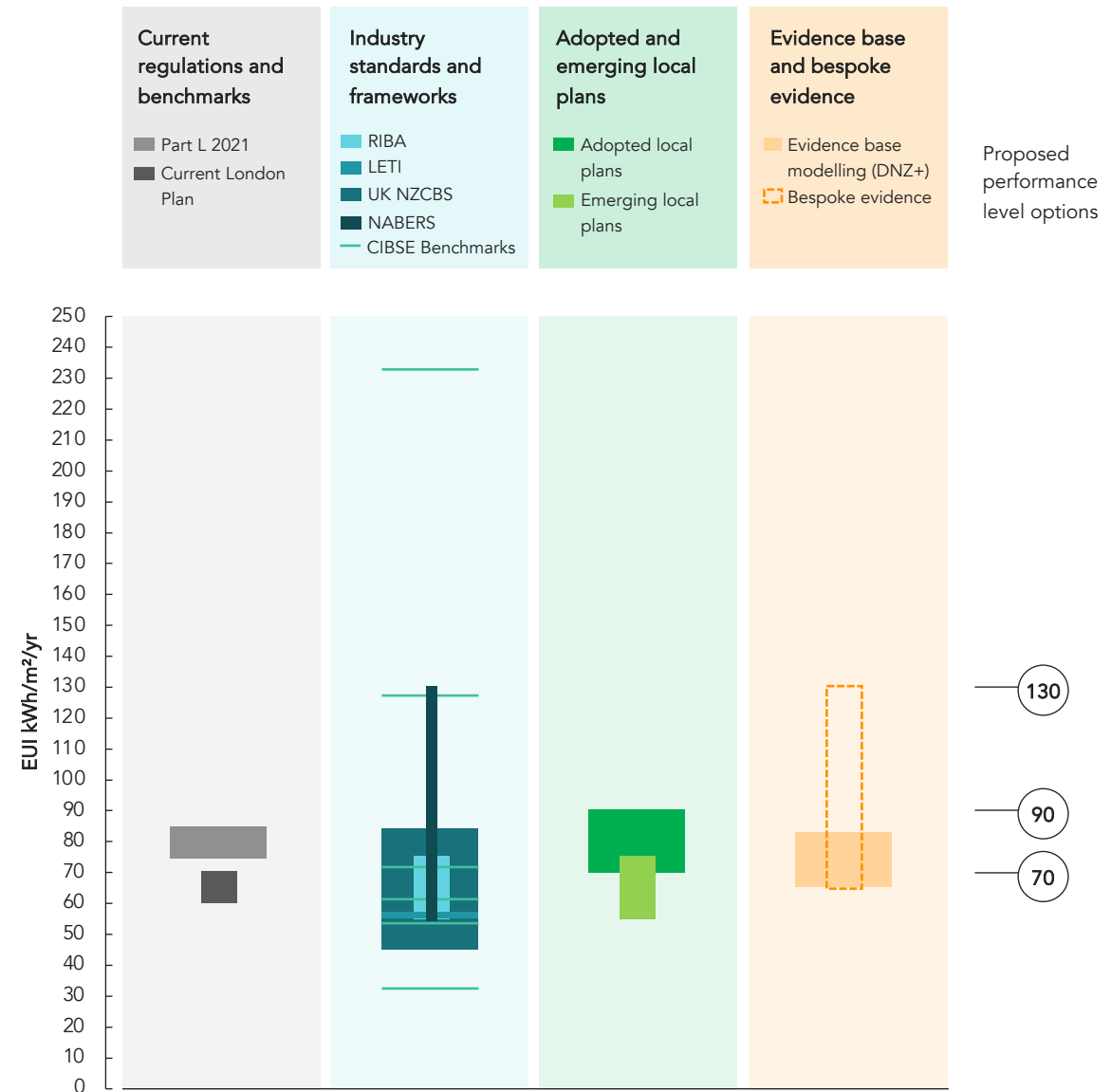
Central Lincolnshire has adopted a limits of 70 & 90 kWh/m²/yr, and Kensington and Chelsea have adopted a limit of 70 kWh/m²/yr. Five emerging local policies exist also propose a limit of 70 kWh/m²/yr. London borough of Newham proposes a limit of 55 and London borough of Southwark proposes a limit of 75 kWh/m²/yr.

Evidence base and bespoke evidence

The specification options for office building modelled for DNZ resulted in EUIs ranging from 66 to 82 kWh/m²/yr. We have not referred to any other EUI data except the indicative specification for NABERS star ratings and the corresponding EUI levels.

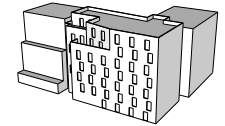
Recommended levels: 130, 90, 70 kWh/m²/yr

The levels correspond to NABERS star ratings 4.5, 5 and 5.5, and represent a good range of potential limits.



More detail on the existing evidence of technical feasibility for offices. The CIBSE benchmarks relate to the 'Good practice electricity' levels for (with EUIs in kWh/m²/yr): Naturally ventilated, cellular (33), Naturally ventilated, open plan (54), Local government office (62), Central government office (72), Air conditioned, prestige (234), Air conditioned, standard (128). Note that CIBSE benchmarks relate to existing buildings rather than new buildings.

EUI | Non-residential | Evidence of technical feasibility | Offices



Recommended levels

Our approach to setting the EUI levels has been influenced by the range of evidence from compliance-based modelling, benchmarking, industry standards and frameworks, adopted and emerging local plans and EUIs derived from the DNZ evidence base. On balance the EUI equivalents for the NABERS* star ratings of 4.5, 5 and 5.5 have been selected, following engagement with the NABERS Design for Performance group. This is the most detailed and robust methodology available for assessing final energy use in offices.

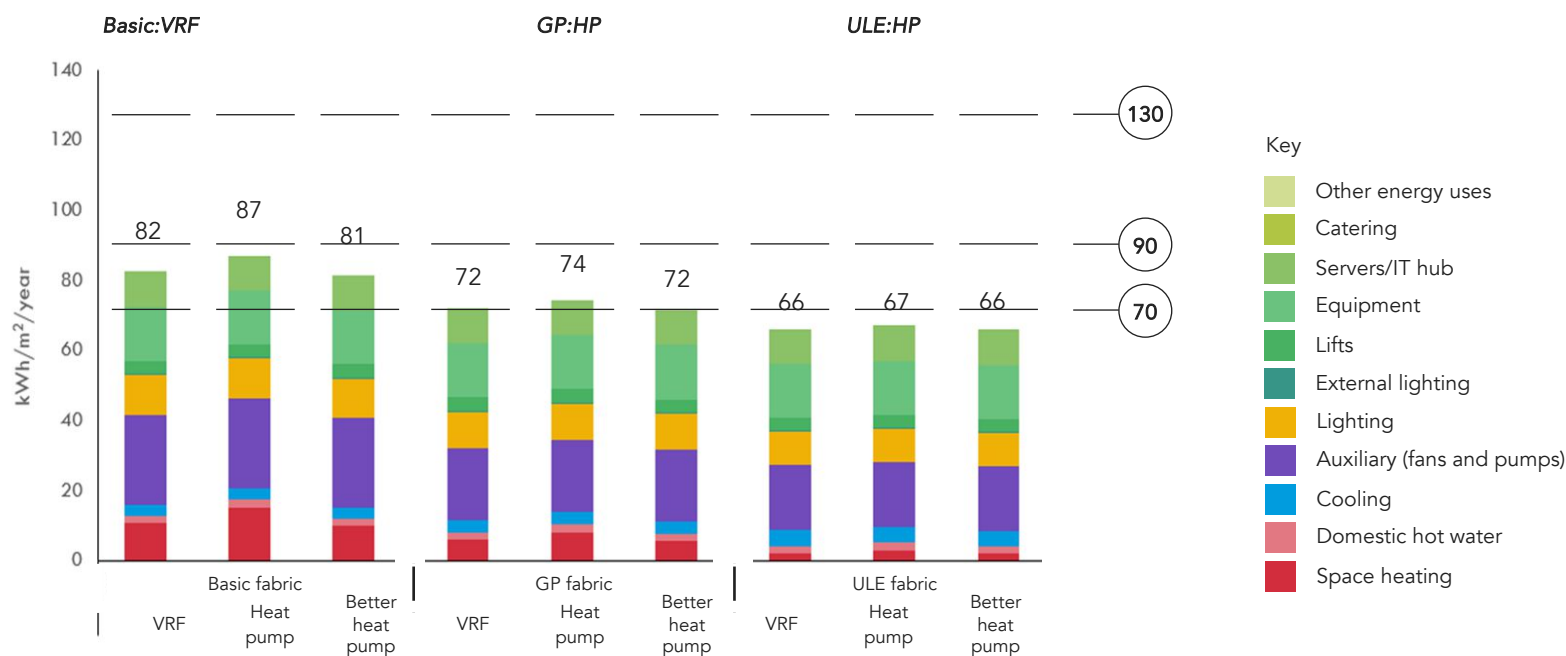
What is costing based on?

A costing exercise was carried out for DNZ, for the EUI levels 90, 70 and 60kWh/m²/yr, and the specification shown in Appendix. As the recommended EUI levels do not align with the levels for the DNZ cost exercise some additional analysis has been undertaken to update the costs.

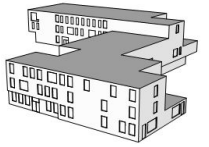
The NABERS Design for Performance group have provided typical specification for offices targeting star ratings of 4.5, 5 and 5.5 (corresponding to EUIs of 130, 90 and 70kWh/m²/yr). Any improvements in specification compared to the cost exercise originally undertaken have been identified and a cost uplift added.

What other data is available?

- More modelling results and data may be available from the NABERS Design for Performance group and other industry respondents.



EUI | Non-residential | Evidence of technical feasibility | Schools



Current regulations and benchmarks

The school building modelled for DNZ evidence base with specifications to meet Part L 2021 had an EUI of 70 to 96 kWh/m²/yr and 60 to 65 kWh/m²/yr with specifications to meet the current London Plan. The **Department for Education's Output Specification (OS)** for schools in England defines gives an EUI requirement of 52kWh/m²/yr as well as defining elemental limits for U-values and airtightness.

Industry standards and frameworks

UK NZCBS standard EUI limits are 45 and 35 kWh/m²/yr for 2025 and 2040 derived from stakeholder engagement at the time of development. **The RIBA targets** are 70 and 60 kWh/m²/yr for 2025 and 2030, and the **LETI target** is 65 kWh/m²/yr. The CIBSE benchmarks for Primary school "Good practice electricity" and "Typical practice electricity" are much lower, at 34 and 41 kWh/m²/yr.

Adopted and emerging local plans

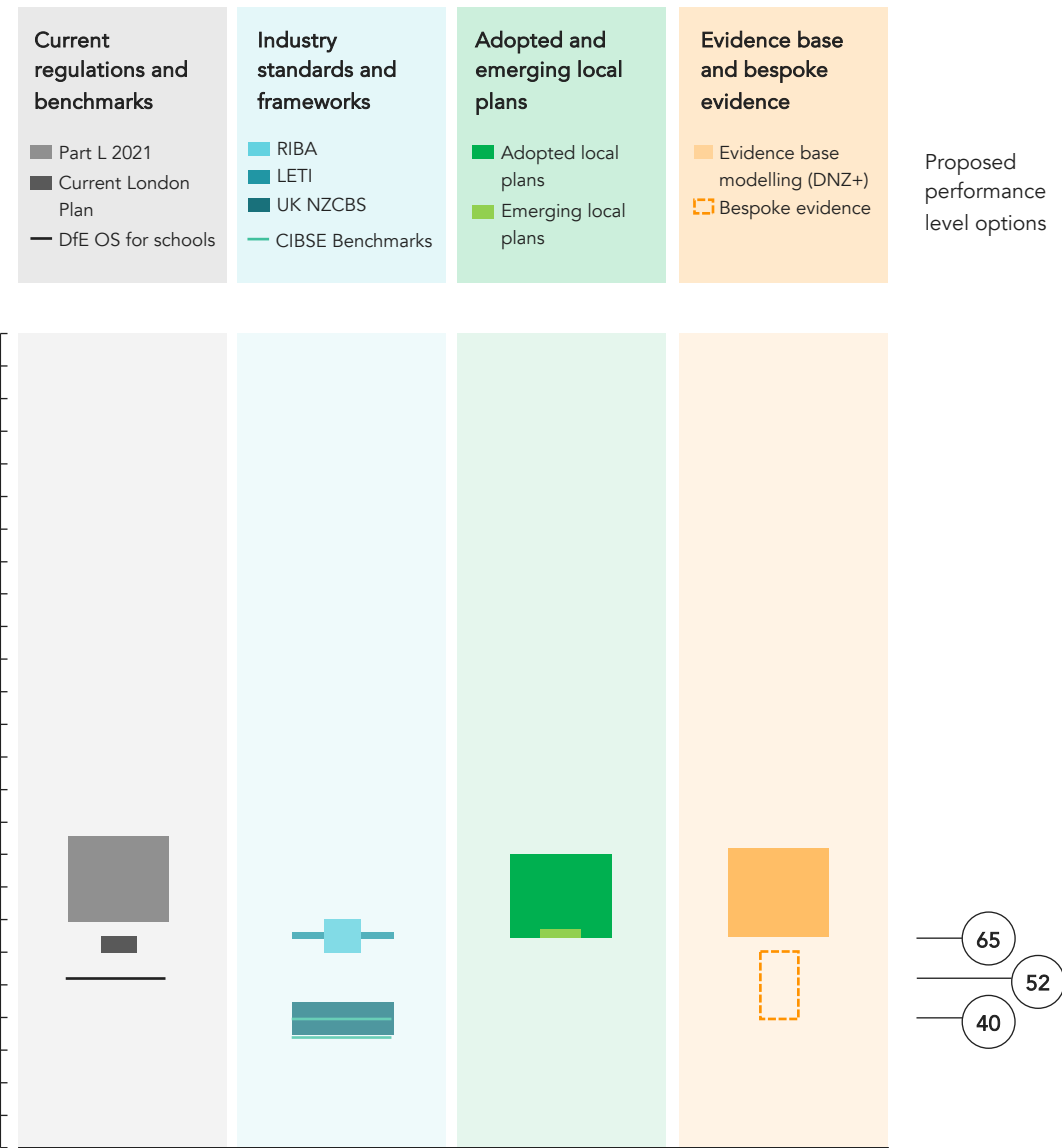
Central Lincolnshire has adopted limits of 70 & 90 kWh/m²/yr, and Kensington and Chelsea have adopted a limit of 65 kWh/m²/yr. Seven emerging local policies also propose a limit of 65 kWh/m²/yr.

Evidence base and bespoke evidence

The specification options for the school building modelled for DNZ resulted in EUIs ranging from 65 to 95 kWh/m²/yr. However, bespoke evidence provided examples of schools achieving much lower EUIs for modelled buildings and for in-use energy.

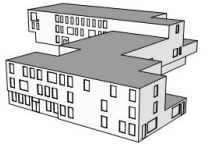
Recommended levels: 65, 52, 40 kWh/m²/yr

These levels align with adopted local plans, and current London plan (Level1), DfE Output Specification EUI limit (Level 2), and UK NZCBS limits based on industry engagement (Level 3).



More detail on the existing evidence of technical feasibility for schools. The CIBSE benchmarks relate to the for (with EUIs in kWh/m²/yr): 'Good practice electricity' level for Primary schools (34), 'Typical practice electricity' level for Primary schools (41).

EUI | Non-residential | Evidence of technical feasibility | Schools



Recommended levels

Our approach to setting the EUI levels has been influenced by the range of evidence shown on the previous page. There is a difference in the levels indicated by previous modelling and adopted and emerging local plans compared to more recent evidence collected as part of the UK NZCBS industry engagement. There is a growing consensus that lower EUIs are possible.

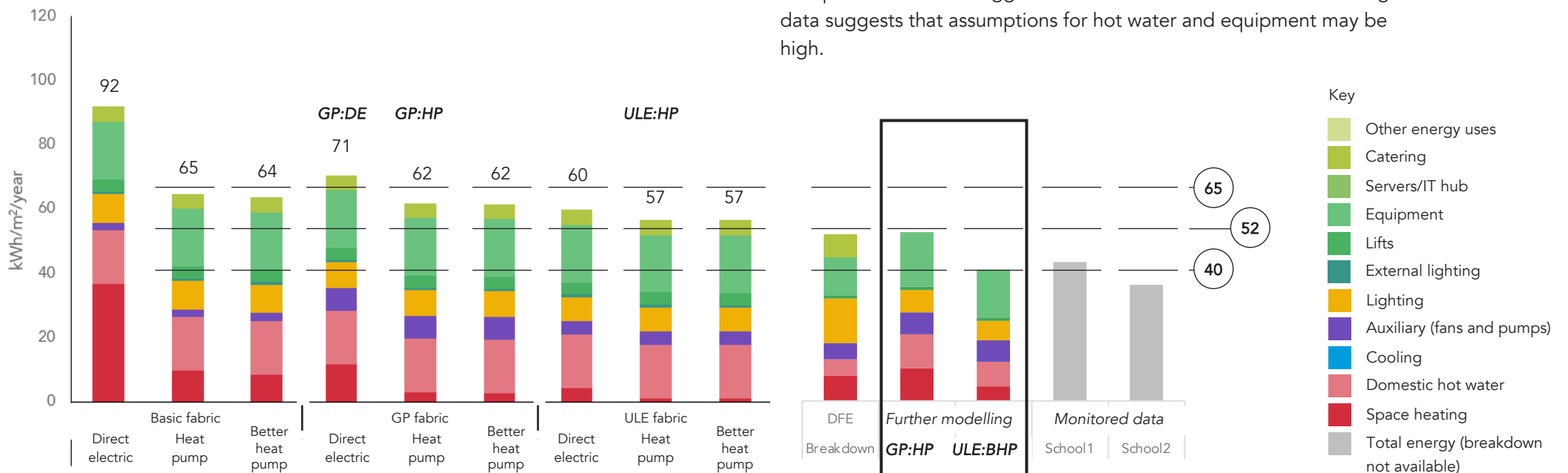
The DfE Output Specification for schools also states an EUI limit of 52kWh/m²/year as well as Fabric Efficiency Standards which limit U-values and air permeability.

What is costing based on?

A costing exercise was carried out for DNZ, for the EUI levels shown below and set out on the previous page, and the specification shown in Appendix. As the recommended EUI levels do not align with the levels for the DNZ cost exercise some additional analysis has been undertaken to update the costs. This is more difficult as the new EUIs are lower than the costed EUIs. Improvements in specification compared to the cost exercise originally undertaken have been identified by using some updated modelling, and a cost uplift added. The key differences are to the fabric specifications, U-values and airtightness assumptions have been improved.

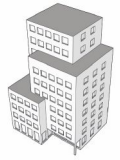
What other data is available?

- Some monitored data has been provided for schools currently achieving and EUI of approximately 40kWh/m²/yr. These schools were found to perform similarly to the energy model results.
- Comparison with DfE suggested EUI breakdown and other modelling data suggests that assumptions for hot water and equipment may be high.



EUI results for the cost exercise based on DNZ modelling.

EUI | Non-residential | Evidence of technical feasibility | Hotels



Current regulations and benchmarks

The hotel building modelled for the DNZ evidence base with specifications to meet Part L 2021 had an EUI of 222 kWh/m²/yr and 140 to 160 kWh/m²/yr with specifications to meet the current London Plan.

Industry standards and frameworks

UK NZCBS standard EUI limits are 125 and 80 kWh/m²/yr for 2025 and 2040 derived from stakeholder engagement at the time of development. CIBSE benchmarks range from 80 to 150 kWh/m²/yr. **Cornell Hotel Sustainability Benchmarking (CHSB) Index 2024**, which is more up to date than CIBSE benchmarks gives ratings according to facilities for a range of hotels in London. However, the EUI ranges are large and include examples up to nearly 800 kWh/m²/yr (figure shows lower range). See Appendix for more details on the CHSB Index.

Adopted and emerging local plans

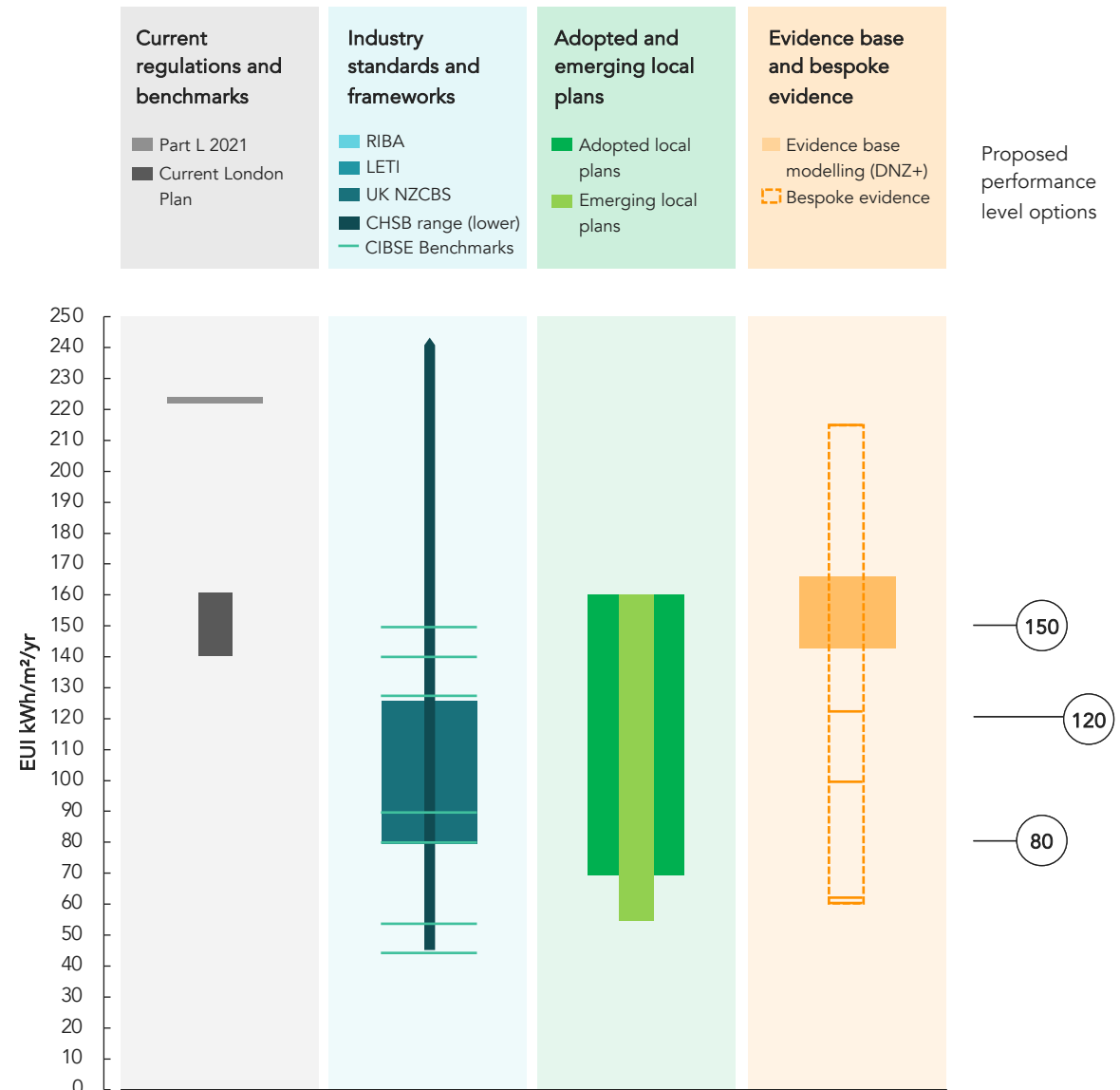
Central Lincolnshire has adopted limits of 70 & 90 kWh/m²/yr, and Kensington and Chelsea have adopted a limit of 160 kWh/m²/yr. Five emerging local policies for London boroughs also propose a limit of 160 kWh/m²/yr, and London borough of Newham proposes a limit of 55 kWh/m²/yr.

Evidence base and bespoke evidence

The specification options for the hotel building modelled for DNZ resulted in EUIs ranging from 142 to 174 kWh/m²/yr. Evidence from five hotel projects shows modelled EUI ranging from 60 to 215 kWh/m²/yr, depending on hotel type.

Recommended levels: 150, 120, 80 kWh/m²/yr

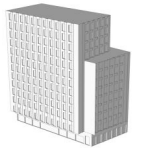
This aligns broadly with the sources referenced above including adopted and emerging local plans. **However, we recommend further investigation** due to the huge impact of facilities provided by the different types of hotel, e.g. swimming pools.



More detail on the existing evidence of technical feasibility for hotels. The CIBSE benchmarks relate to for (with EUIs in kWh/m²/yr): 'Good practice electricity' and 'Typical practice electricity' levels for 'Small' (80, 120), 'Holiday' (80, 140) and 'Luxury' (90, 150). The EUI range from CHSB is too large to show, so this only represents the lower end of the range.



EUI | Non-residential | Evidence of technical feasibility | Student Accommodation



Current regulations and benchmarks

The Student Accommodation building modelled for the Southwark evidence base (LBS) that met Part L 2021 had an EUI of 60-80 kWh/m²/yr and 50 to 60 kWh/m²/yr with specifications to meet the current London Plan.

Industry standards and frameworks

UK NZCBS standard EUI limits are 75 and 50 kWh/m²/yr for 2025 and 2040 derived from stakeholder engagement at the time of development. **There are no other specific EUI limits from industry standards and frameworks.** Neither the ANUK/Unipol National Codes nor the Universities UK National Codes publish or prescribe Energy Use Intensity (EUI) limits, focusing on statutory compliance and general quality standards.

Adopted and emerging local plans

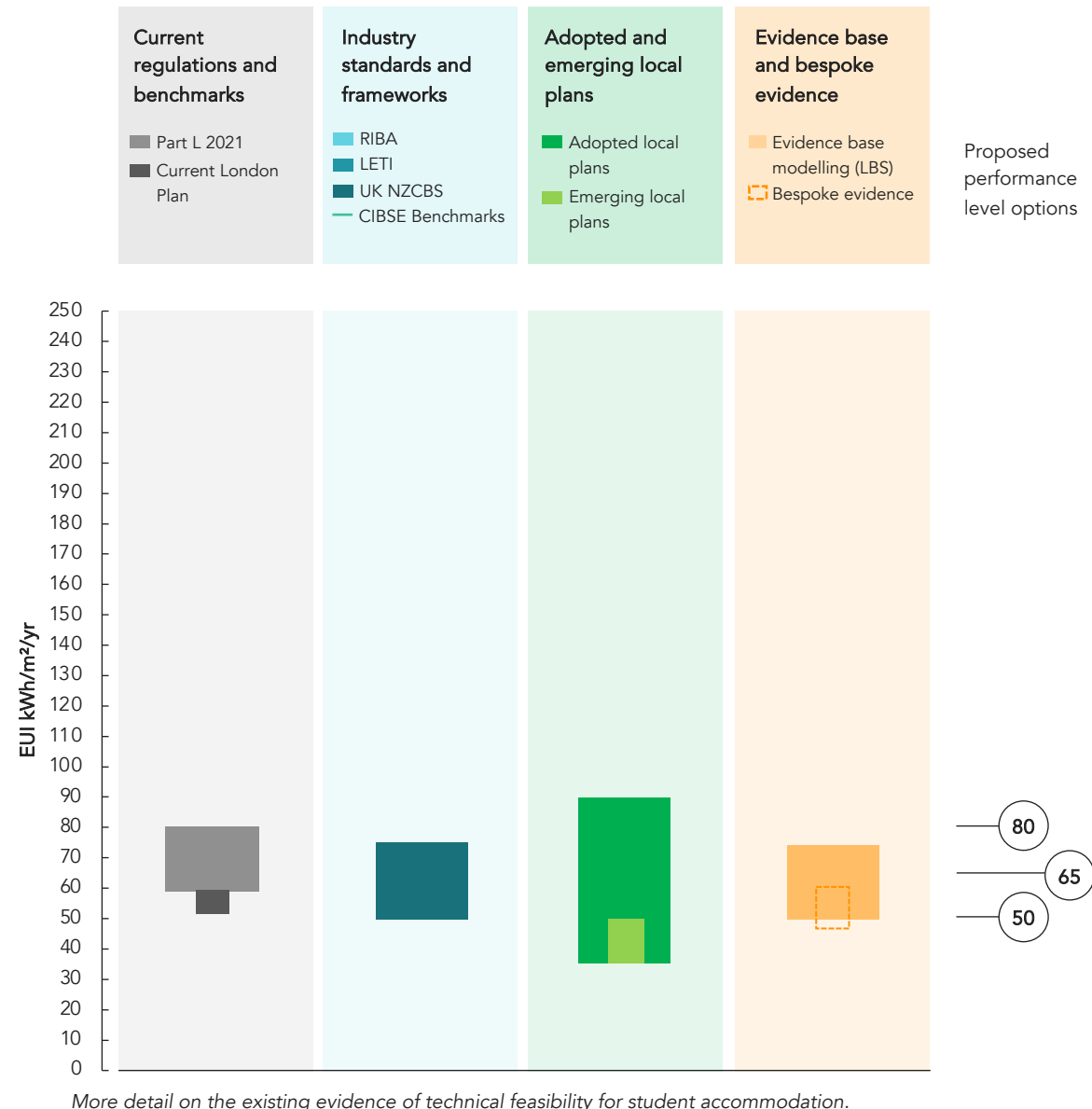
Central Lincolnshire has adopted limits of 70 & 90 kWh/m²/yr, and Kensington and Chelsea has adopted a limit of 35 kWh/m²/yr. Five emerging local policies for London boroughs also propose a limit of 35 kWh/m²/yr, and London borough of Southwark proposes a limit of 50 kWh/m²/yr.

Evidence base and bespoke evidence

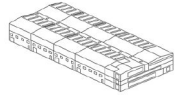
The specification options for the hotel building modelled for Southwark resulted in EUIs ranging from 49 to 82 kWh/m²/yr. Evidence from six Student Accommodation projects targeting Passivhaus shows modelled EUI ranging from 45 to 60 kWh/m²/yr. Other evidence may exist but has not been assessed in detail.

Recommended levels: 80, 65, 50 kWh/m²/yr

This aligns broadly with the sources referenced above, but with a tighter range compared to current adopted and emerging local plans.



EUI | Non-residential | Evidence of technical feasibility | Industrial



Current regulations and benchmarks

The Industrial building modelled for the DNZ evidence base with specifications to meet Part L 2021 had an EUI of 34 kWh/m²/yr as did the same model with specifications to meet the current London Plan.

Industry standards and frameworks

UK NZCBS standard EUI limits are 80 and 40 kWh/m²/yr for 2025 and 2040 derived from stakeholder engagement at the time of development. **There are no other specific EUI limits from industry standards and frameworks.** UK Government are consulting on a performance-based energy rating framework, which will eventually affect large industrial buildings.

Adopted and emerging local plans

Central Lincolnshire has adopted limits of 70 & 90 kWh/m²/yr, and Kensington and Chelsea has adopted a limit of 35 kWh/m²/yr. Five emerging local policies for London boroughs also propose a limit of 35 kWh/m²/yr.¹

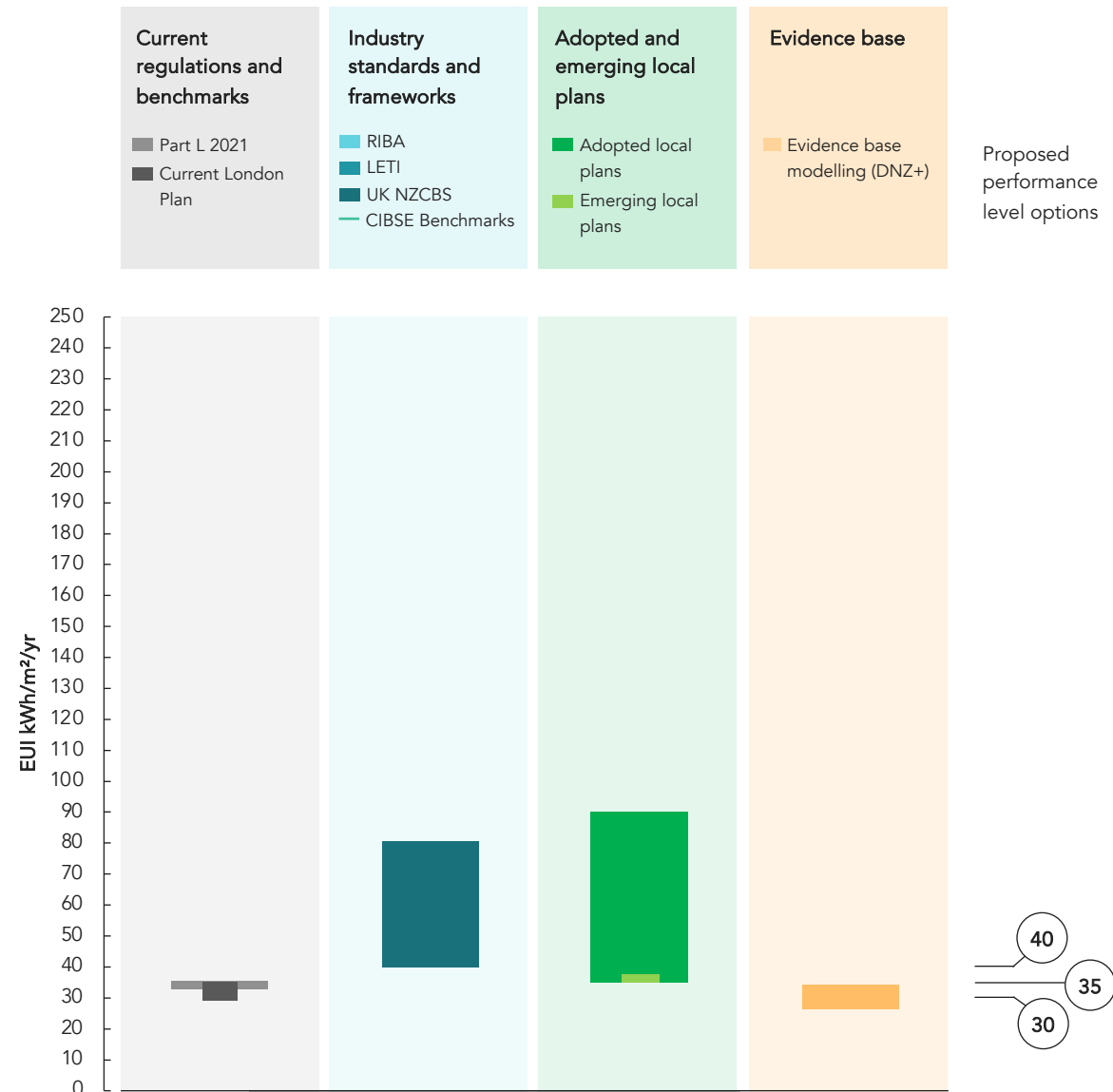
Evidence base

The specification options for the industrial building modelled for DNZ resulted in EUIs ranging from 27 to 34 kWh/m²/yr. Note that the assessment of EUI will be sensitive to assumptions on how much of the space is heated and to what temperature.

Recommended levels: 40, 35, 30 kWh/m²/yr

This aligns broadly with the sources referenced above, but with a tighter range compared to current adopted and emerging local plans.

¹ The London Borough of Newham proposes a limit of 100 - 120 kWh/m²/yr for industrial buildings, this has been removed from the graph, as these are for more intensive industrial buildings than assumed in this evidence base. (The modeling that underpins Newham's evidence base uses 5 W/m² for equipment and 5.6 W/m² for lighting, and the DNZ evidence base assumes 1 W/m² for equipment and 1.4 W/m² for lighting.



More detail on the existing evidence of technical feasibility for industrial.

SHD and EUI | Non-residential | Estimated cost impact of different performance levels

Methodology and calculation of the baseline build costs

The assumed baseline cost for the typologies vary and it is assumed to be a current London Plan compliant building. This was assumed to have a basic fabric and VRF for heating/cooling in the office and industrial typology. The Student accommodation typology was assumed to have a Good Practice fabric and direct electric for heating while the school was assumed to have a Good Practice fabric with heat pump for heating. These scenarios were used to represent a scenario assumed to comply, recognising that the actual specification can vary significantly and developers can select better energy efficiency measures to achieve a better performance for compliance with the London Plan. Details of the specifications used are found in the Appendix.

Analysis and comments

For the non-residential typologies, achieving SHD Level 1 and EUI Level 1 does not result in any cost uplift from the baseline scenario, as the baseline and level 1 reflect the same performance (current London Plan).

For more advanced levels, the cost uplift varies by typology. The office building experiences a notable increase of up to +6.7% (£284/m²) at SHD Level 3 and EUI Level 3, driven primarily by the enhanced building fabric and system requirements to meet higher performance thresholds.

By contrast, industrial buildings achieve a cost saving of -5.1% at this level. This is due to the effect of a higher fabric performance (i.e. Good Practice) that reduces the overall heating demand, which in turn enables a saving in the size and cost of the heating system. In this case significantly less VRF units are required.

Process costs

Potential additional costs related to carrying out predictive energy modeling are presented in the page on estimated cost impact of policy page in the assured energy performance section.

Typology	Indicative all in construction benchmark cost (baseline)	SHD Level 1	SHD Level 2	SHD Level 3
		EUI Level 1	EUI Level 2	EUI Level 3
Office	£4,220/m ²	+0.0% (+£0/m ²)	+3.2% (+£133/m ²)	+6.7% (+£284/m ²)
Primary School	£3,550/m ²	+0.0% (+£0/m ²)	+1.4% (+£50/m ²)	+2.4% (+£85/m ²)
Industrial	£1,360/m ²	+0.0% (+£0/m ²)	+0.0% (+£0/m ²)	-5.1% (-£70/m ²)
Student Accommodation	£3,340/m ²	+0.0% (+£0/m ²)	+1.9% (+£65/m ²)	+3.0% (£99/m ²)

Uplift costs from baseline for Levels 1, 2 and 3 for Space Heating Demand (SHD) and Energy Use Intensity (EUI).

Relative costs (% or £/m²) of each case compared to the baseline.

Note: Cost uplifts have not been provided for Hotels, as the data received as part of the research was not considered robust enough: it was very variable, and it was challenging to isolate 'specific' and significant energy uses such as catering and pools, so it was difficult to understand the specifications required to meet the limits without further work.

SHD and EUI | Non-residential | Running costs

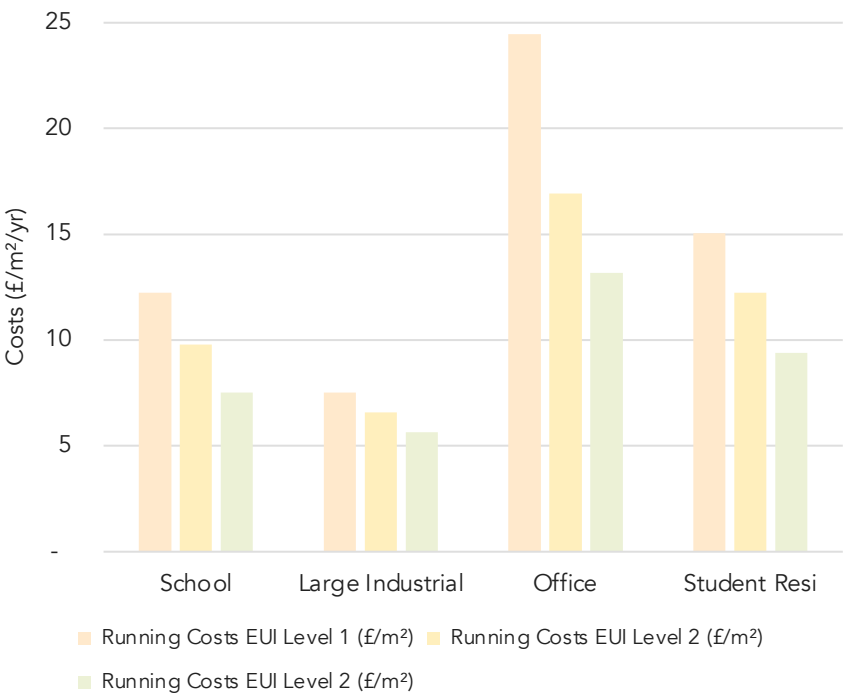
Methodology and calculation

The analysis of non-residential running costs has been carried out for the four representative typologies. The energy use for each building type has been calculated based on its gross internal area (GIA) and typical Energy Use Intensity (EUI) values for Levels 1, 2, and 3. Annual running costs are then derived by applying the Green Book 2025 central electricity price for commercial/ public sector of £0.188/kWh, with Level 1 used as the baseline for comparison. The results are presented in both absolute terms (annual £/yr) and relative savings (%) to show the impact of progressively lower EUIs on operational energy costs.

Analysis and comments

The results highlight the significant operational savings that can be achieved in non-residential buildings by improving energy performance. Offices show the greatest benefit, with running costs reduced by 31% at EUI Level 2 and 46% at EUI Level 3 compared to the baseline. Primary schools and student accommodation follow a similar trend, with cost reductions of around 20–38% at higher performance levels. Industrial buildings also achieve savings, though at a lower level (13–25%), reflecting their lower energy intensity.

Taken together, the results demonstrate that while the scale of savings varies by building type, all non-residential uses can achieve meaningful cost reductions through higher energy efficiency, showing how investment in fabric and systems can deliver long-term reductions in operational expenditure.



Estimated annual energy costs for non-residential typologies across the three energy performance levels under green book 2025 central electricity price for commercial/ public sector

	EUI Level 1	EUI Level 2	EUI Level 3
Office	n/a	31%	46%
Primary School	n/a	20%	38%
Industrial	n/a	13%	25%
Student Accommodation	n/a	19%	38%

Reduction in running costs from Level 1 (baseline) to levels 2 and 3

EUI | Non-residential | Other typologies

Some typologies require a different approach

Energy and cost modelling has been undertaken in this evidence base in order to cover a range of different types of buildings. This modelling has been used to inform the recommendation of appropriate Space Heating Demand (SHD), Energy Use Intensity (EUI) and PV generation requirements.

However, there are a few typologies for which this approach is unlikely to be appropriate, predominantly those in Planning use classes E and 'Sui generis'. Common uses in these groups include:

- **Retail** – variable spaces covering very different use types including display, food offers and professional services.
- **Sports and Leisure** – potentially covering spaces from small community fitness classes to highly conditioned gyms to swimming pools.
- **Science and research buildings** – large and energy intensive buildings including life science buildings and labs in general.

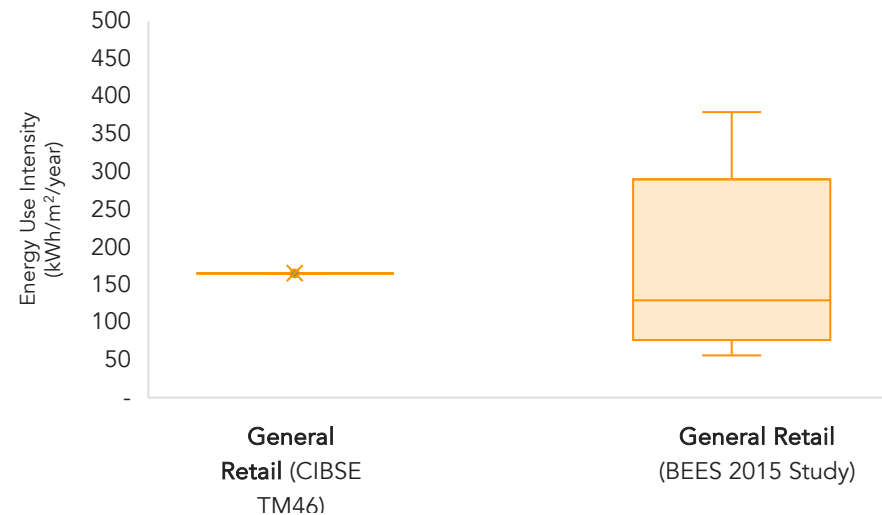
It is very challenging predict energy use for these spaces, particularly at planning stage

It is important that these buildings are designed to limit their energy consumption but due to the wide range of end uses with different energy consumption requirements, it is hard to predict the energy consumption of these typologies, and therefore a generic target level of energy use is unlikely to be appropriate.

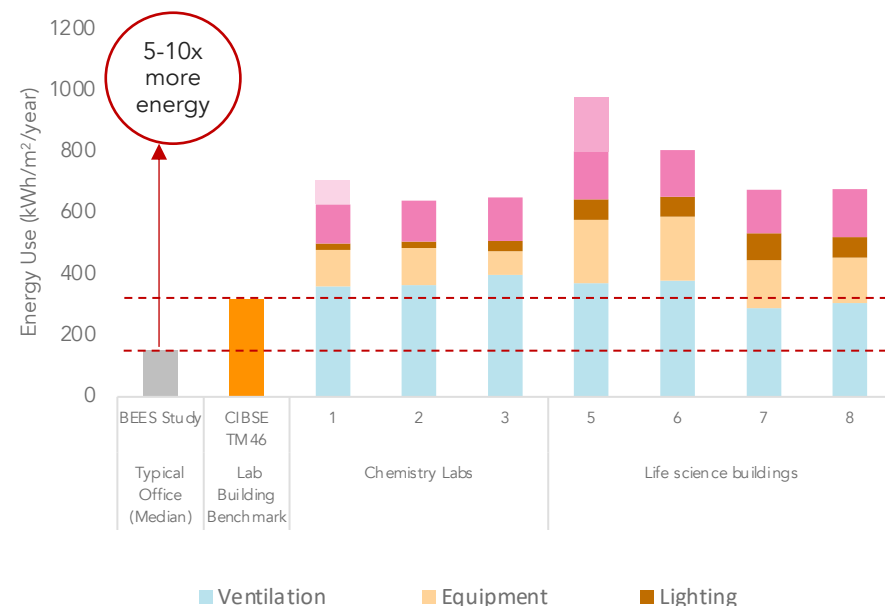
These typologies require a different approach.

There are 3 possible approaches to setting targets for these types of development, described in more detail on the following page:

- a bespoke target is agreed during the pre-application phase between the applicant and the Local Planning Authority.
- An elemental or phased approach.
- A set of default assumptions is developed to cover the varying component of their energy use.



BEES 2015 Study EUI results compared against the CIBSE TM46 benchmark for retail buildings. The BEES 2015 study presents the huge variance in EUI results emphasizing the difficulty in setting an EUI target for this typology.



Lab buildings energy consumption breakdown. Data from "Energy Consumption of University Laboratories: Detailed Results from S-Lab Audits"

EUI | Non-residential | Other typologies

The following 3 approaches to setting operational energy performance targets could be adopted for typologies that have not been modelled in this evidence base. Potentially all 3 have validity in different cases.

A bespoke target.

Where the end use is clearly defined at planning stage (e.g. faculty laboratories for a university or purpose-built community sports facility), reasonably detailed predictive energy modelling could be carried out and a bespoke performance target agreed between the applicant and the planning authority.

An elemental approach.

Where the intended occupier is not known at planning stage (e.g. small retail units as part of a multi-use scheme) the initial applicant could be asked to demonstrate that the space heat demand limit is met, but the EUI limit is not applied. If a further application is made at a later time for the fit out of an individual unit, the EUI limit can be considered using either a bespoke or default approach, as appropriate.

A set of default assumptions.

For typologies common to London, where the intended use is variable and often unknown at planning stage. Work could be undertaken to develop a set default assumptions, related to occupancy use, internal temperature set points, domestic hot water demand etc. A corresponding EUI limit can be developed, related to this standard set of assumptions, applicants are then asked to meet the EUI limit based on using these standardised set of assumptions.

Space heating demand and EUI | Potential policy framing

Why are we proposing this policy?

To promote energy efficiency and reduce energy consumption in buildings, using metrics that help the design team to understand and reduce space heating and energy use.

Space heating demand helps the design team to understand and reduce heat losses.

A low level of energy use intensity will reduce energy consumption and therefore energy costs. Energy use intensity has the significant advantage of being able to be measured (and therefore checked) post completion.

Space heating demand and energy use intensity limits

It is suggested that one of the performance levels that it presented in this report is chosen as a limiting requirement. See page 21 for the performance levels.

Should the London Plan adopt EUI limits, it is recommended that work is undertaken to define a suitable EUI limit for all types of buildings.

Our research suggests framing a policy with the following requirements and outcomes:

Space heating demand requirement

- *All domestic buildings to achieve a space heating demand measured in kWh/m²GIA/yr.*
- *All non-domestic buildings to achieve a space heating demand measured in kWh/m²GIA/yr.*

To get the desired result we would expect that applicants must undertake predictive energy modelling to demonstrate compliance.

Energy Use Intensity (EUI) requirement

- *All domestic buildings to achieve an Energy Use Intensity (EUI) measured in kWh/m²GIA/yr.*
- *All non-domestic buildings to achieve an Energy Use Intensity (EUI) measured in kWh/m²GIA/yr.*

To get the desired result we would expect that applicants must undertake predictive energy modelling to demonstrate compliance.

3.2

Cooling



Cooling | Summary of requirements in the current London Plan (1 of 2)

Policy SI4 Managing heat risk

London is already experiencing severe hot weather events which could ultimately worsen due to the growing population, urbanisation and the urban heat island effect. The current London Plan addresses heat risk management through Policy SI4. The policy is divided into two parts:

- **Part A** - requires all new developments in London to minimise their contribution to the urban heat island effect through thoughtful design choices, such as building's layout, orientation, materials, and green infrastructure. This aspect of the policy falls outside the scope of the current study, however the impact of designing for cooler surroundings on overheating and cooling demand should be examined in future research.
- **Part B** - requires all major new developments in London to demonstrate through their energy strategies how they will reduce both internal overheating risk and reliance on active cooling systems. This is done through the **cooling hierarchy** which prioritises passive design measures (e.g. fenestration design) and natural ventilation over active measures including mechanical ventilation and active cooling.

Assessment method to ensure compliance with cooling hierarchy

Compliance with Policy SI4 Part B is demonstrated through an overheating risk assessment undertaken as part of the scheme's planning application. This involves undertaking dynamic overheating modelling in line with in CIBSE TM59 (residential) /TM52 (non-residential), taking into account the associated Approved Document O requirements (only for residential). All developments must meet the CIBSE compliance criteria for the DSY1 weather scenario (2020s) and additional testing is required for the future weather scenarios. To support this, applicants are required to complete the Good Homes Alliance overheating risk assessment tool at the early stages of design.

Policy SI 4 Managing heat risk

A. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

- 1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure*
- 2) minimise internal heat generation through energy efficient design*
- 3) manage the heat within the building through exposed internal thermal mass and high ceilings*
- 4) provide passive ventilation*
- 5) provide mechanical ventilation*
- 6) provide active cooling systems.*

Extract of Policy SI4 Managing heat risk from the London Plan document (2021).

Overheating risk analysis

8.3. All developments are required to undertake a detailed analysis of the risk of overheating as part of the planning application. See the requirements set out in Table 6.

8.4. It is important to identify potential overheating risk in residential accommodation early on in the design process and then incorporate suitable passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan Policy SI 4.

Extract of Cooling and Overheating Guidance from the Energy Assessment Guidance document (June 2022).

Cooling | Summary of requirements in the current London Plan (2 of 2)

Guidance on active cooling for residential developments

According to the current London Plan, it is not expected that active cooling is proposed for residential developments as they should be able to mitigate overheating through passive design measures only. However, where site constraints exist - such as noise, air quality, or security concerns – relying on open windows to mitigate overheating may not be acceptable to comply with Part O of the Building Regulations, often leading to the need for active cooling.

In such cases, the Energy Assessment Guidance (EAG) requires applicants to test passive measures thoroughly and submit two overheating assessments: one with openable windows and one with windows assumed shut.

When active cooling is used, applicants must also report cooling demand, however the expected calculation approach is not specified.

Guidance on active cooling for non-residential developments

Non-residential building typologies must meet compliance with CIBSE TM52 overheating assessment criteria. However, the EAG allows for exemptions in exceptional circumstances where reducing cooling demand through passive measures is constrained. In these cases, applicants may be exempt from undertaking an overheating assessment, provided they can demonstrate that cooling demand has been minimised in line with the cooling hierarchy.

Although not explicitly defined, these exemptions likely apply to buildings that would have had active cooling from the outset due to their high internal heat gains (e.g. from equipment and high occupancy levels) and/or those requiring specific internal temperatures under the health and safety guidance (such as care homes) . Applicants must demonstrate that their cooling demand is reduced below that of the notional equivalent space. Data from BRUKL output report generated using Simplified Building Energy Model (SBEM) calculations should be used to demonstrate compliance.

Residential (including care homes and student accommodation)

[...]

8.10. For all residential dynamic overheating analyses, applicants should additionally adhere to the following guidelines:

[...]

- Limitations on openable windows: In instances where security, air quality or noise concerns pose limitations to the opening of windows, applicants will be required to demonstrate that all passive design measures have been thoroughly investigated. This should include technical and cost feasibility assessments of the following fixed shading devices; external shutters, external blinds, awnings and ventilated louvres. Should natural ventilation not be proposed due to opening limitations, applicants are required to submit two separate overheating analyses; one with openable windows and one with closed windows. This will ensure that passive measures have been maximised and the façade design has been optimised regardless of the constraints posed by the site’s location. [...]

Extract of Cooling and Overheating Guidance from the Energy Assessment Guidance document (June 2022).

	Area weighted average non-residential cooling demand (MJ/m²)	Total area weighted non-residential cooling demand (MJ/year)
Actual		
Notional		

Table 7 is the reporting template for cooling demand provided by the EAG document and must be completed for all non-residential spaces that use active cooling.

Cooling | Review of existing approaches

The table below summarises key sources that define existing approaches to reducing the need for cooling in buildings in the UK.

The sources are categorized into two main areas:

1. National and local regulations:

Approved Document O targets new residential buildings to mitigate overheating risk and avoid use of active cooling through limiting solar gains and ensuring sufficient heat removal. Compliance can be shown via a Simplified Method or Dynamic Thermal Modelling, while also addressing noise, safety, and pollution. There is currently no equivalent for non-residential buildings.

Other relevant regulations include Part L (2021), which focuses on energy efficiency and indirectly reduces cooling demand by improving fabric performance and limiting internal heat gains, though

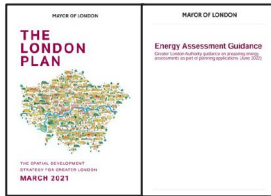
SAP/SBEM compliance modelling accuracy is limited. Part F (2022) also impacts cooling demand through its ventilation requirements.

The 2023 Future Homes and Building Standard consultation suggests tighter airtightness standards and enhanced mechanical ventilation, which may influence cooling demand. It also seeks evidence on Part O's effectiveness and considers extending its scope to building conversions.

2. Industry guidance and best practice documents:

The industry (and current London Plan) supports compliance with CIBSE TM59/TM52 overheating assessments, considering it as a sufficient method for reducing overheating risk. To supplement this at early stages of design the Good Homes Alliance overheating risk assessment tool can be a helpful starting point for designers.

The Passivhaus standard has a clear space cooling demand requirement of 15 kWh/m²/yr (TFA) that all new developments must not exceed.

Cooling demand	
Source	Document
National building regulations and existing/ emerging/ draft local plans	 Approved document L: Conservation of fuel and power V1 & V2
	 Approved document O: Overheating
National building regulations and existing/ emerging/ draft local plans	 Approved document F: Ventilation V1 & V2
	 Future Homes and Buildings Standard Consultation 2023
National building regulations and existing/ emerging/ draft local plans	 The London Plan 2021 and Energy assessment guidance 2023
Industry documents	 CIBSE TM59/ TM52 Overheating assessment
	 Good Homes Alliance Overheating in New Homes Tool and guidance
Industry documents	 Passivhaus

Cooling | Why should the new London Plan go beyond Building Regulations (Part L and Part O)?

While national regulations set minimum standards for energy efficiency and indoor comfort, they are not necessarily sufficient to drive the design of more climate resilient buildings, particularly in London's urban context. This is due to a number of limitations:

Part O (Domestic buildings only)

- The aim of Part O is to mitigate the overheating risk in new homes, not to minimise the use of active cooling.
- Applicants can turn to solutions like temperature looping or full comfort cooling to meet compliance. This reduces the motivation to prioritise passive design measures that could have reduced the cooling demand.
- Due the noise requirements in Part O, which requires adequate alternative means of cooling where background noise levels are deemed too high for openable windows (which affects a large number of new homes in London), active cooling is often included 'by default', discouraging the implementation of passive measures. This results to less resilient homes with increased energy consumption.
- Compliance with Part O is not required pre-planning, risking informing fundamental design changes too late, which can be costly and cause delays to the project.
- Two methods can be used in Part O. The simplified method can give misleading results for complex buildings, leading to poor design decisions.
- It does not consider future climate conditions which play a significant role in delivering resilient homes.

Part L

- For non-domestic buildings, the solar gains criterion (previously called criterion 3) aims to limit the use of active cooling by controlling summer solar gains through glazing. Given that compliance is typically demonstrated through SBEM – an imprecise building regulations compliance tool – the inaccurate results it produces can lead to misleading design decisions and missed opportunities to truly reduce cooling demand limit through passive solar design measures.

Noise

3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. 40dB LAeq,T , averaged over 8 hours (between 11pm and 7am).
- b. 55dB LAFmax , more than 10 times a night (between 11pm and 7am).

3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.

Extract from Approved Document O on noise criteria (June 2021).

Cooling | Suggestions to improve current London Plan policy | Residential developments

While the current London Plan's policy's objective is to reduce overheating risk and cooling demand of residential developments through mainly natural ventilation and passive design measures this is not effectively achieved in practice due to the following limitations:

- **Passive measures often 'skipped':** where limitations to the opening of windows are present, passive design measures are often 'skipped' and active cooling is directly applied. This is not in line with the intent of the policy, which is to encourage passive design measures to ensure the reduction of cooling demand.
- **Some passive measures prioritised over others:** lower glazing g-value and higher mechanical ventilation flow rates are often prioritised over more suitable overheating mitigation strategies (e.g. reduced window area, external shading). This could lead to unintended consequences such as increase energy costs for residents and compromised acoustic comfort.
- **Guidance gaps:** the GLA Energy Assessment Guidance (EAG) mentions the requirement for having two overheating assessments where limitations to openable windows are present and active cooling is proposed, is to *'ensure that passive measures have been maximised and the façade design has been optimised regardless of the constraints posed by the site's location'*. However, the EAG does not explicitly requires applicants to demonstrate compliance with both assessments and therefore does not ensure that passive measures have been incorporated even if they do not fully resolve overheating, to at least reduce cooling demand and increase climate reliance.
- **Accuracy issues in reporting cooling demand:** when active cooling is present, applicants are required to report cooling demand. The calculation tool to be used is not specified, often leading applicants to rely on the building regulations compliance tool (SAP) which is not very accurate at assessing cooling demand.

Recommendations

- **Strengthen policy wording:** restructure current cooling hierarchy to align with the two clear set of requirements in Part O: *'limiting unwanted solar gains'* and *'providing sufficient means to remove excess heat'*. This will simplify policy language and improve consistency with building regulations wording.
- **Request compliance with 'passive design test':** introduce a policy that the development must show compliance with CIBSE TM59 (2017) in a modelling scenario where there are no restrictions to openable windows. This will ensure that passive measures have been considered and implemented and will have the outcome that cooling demand has been reduced and climate resilience increased. (Even if these measures do not resolve overheating if windows are restricted when the homes are occupied due to security, noise and pollution, it will improve the situation. For clarity, refer to this as the 'passive design test'.

Note: CIBSE TM59 is due for an update. This requirement will need to be reviewed and potentially updated in the future.

- **Strengthening guidance:**
 - a) on sizing and specification of mechanical ventilation and active cooling (if present) to avoid oversizing which could potentially increase energy and construction costs and have noise and air quality implications.
 - b) on cooling controls and set points (e.g. set points should not be lower than 23 degrees).
 - c) request that g-value should be ideally not lower than 0.5 for homes. Lowering the g-value should be the lowest priority after other passive measures have been implemented, such as external shading, optimised window areas and maximised opening areas.
 - d) As per Part O, internal blinds and curtains should not be taken into account when demonstrating compliance with the overheating assessment.
- **Continue collecting space cooling demand data** using predictive energy modelling (PHPP) which potentially could inform a future space cooling demand limit.

Cooling | PROs and CONs of various cooling metrics

The primary objective of introducing a cooling metric is to recognise that cooling is becoming increasingly essential in London. A cautious approach should be undertaken to avoid unintended consequences, such as penalising or even making compliance unattainable for certain building types. The metric should be created to encourage good design; efficient equipment use and construction quality. However, it's important to note that some internal gains will be related to how the building is used and therefore may not be appropriate to address within the metric.

Three potential cooling reduction metrics have been evaluated:

Option 1: Limit on Space Cooling Demand

This metric would assess the total annual space cooling demand (in kWh/m²/year) across the whole building and could potentially be an extension to the space heating demand metric. An appropriate maximum limit could then be applied as part of policy.

Option 2: Limit on peak and summer aggregate solar gains

This metric would calculate the peak solar gain load across the building that as predicted by the energy model, including the total aggregated solar gains over the 6-month cooling period (e.g. 1st April to 30th September). These figures would then be normalised against the floor area to create a kW/m² and kWh/m² figure, respectively, with a limit potentially applied to both within policy.

Option 3: Limit on peak cooling capacity

This metric would assess the peak annual cooling load of the building in kW/m². This would likely correspond to the day with the highest external temperatures and solar gains.

Option 1: Space cooling demand requirement

PROS	CONS
✓ Energy-based metric holistically capturing all aspects of building physics (including heat losses and gains)	✗ Not widely used in the UK due to the primary need for heating rather than cooling
✓ Captures the extent that passive measures impact on cooling demand	✗ To date, not enough data to robustly enforce a limit
✓ Would be calculated using predictive energy modelling that is already required for the SHD and EUI metrics	✗ Unlikely to be practical for many non-residential buildings as cooling demand may be more affected by equipment, occupancy and internal gains rather than solar.
✓ Accounts for building services factors such as communal heating distribution losses through pipework and HIUs.	
✓ Accounts for external air temperature	

Option 2: Peak and summer aggregate solar gain

PROS	CONS
✓ Limiting peak and summer aggregated solar gains on a building-wide basis could help to reduce both cooling demand and plant size; lowering both operational and embodied carbon emissions.	✗ Could disadvantage shallow plan buildings and also reduce daylight performance.
✓ Implementing on a building-wide basis would be relatively simple and could complement the <i>Part L2A – Limit on summer solar gains criteria</i> .	✗ The calculation methodology and any solar gain limits would need to be created and tested to mitigate the risk of unintended consequences.
✓ Focusses on solar gains and therefore, avoids the complication of including other internal gains that may be inherent on the proposed building type or function.	✗ Doesn't incentivise natural ventilation or mixed-mode strategies.
	✗ Doesn't account for external air temperature
	✗ Ignores factors relating to building services

Cooling | PROs and CONs of various cooling metrics

Conclusions and recommendations

The simplest of the 3 proposed options is Option 2, which just assesses and limits building solar gains. This can be done by reducing glazing and introducing shading elements, which are two important tools building designers have for reducing cooling demand. However, it ignores other areas such as energy efficient equipment and building services, mixed-mode ventilation strategies and peak lopping. These other factors are accounted for in Options 1 and 3, however the main issue with these is that will also account for internal gains related to the use of the building, which may not be practical or possible to reduce, e.g. a datacentre.

Option 3: Peak cooling capacity

PROS	CONS
✓ Limiting peak capacity could help to reduce cooling plant size, therefore lowering construction costs as well as operational and embodied carbon emissions.	✗ Physically limiting cooling capacity post-planning will be difficult, administrative and potentially risky.
✓ Could be modelled relatively simply by using the TM52 or TM59 overheating model.	✗ Unlikely to be practical for many non-residential buildings as peak cooling load may be more affected by equipment, occupancy and internal gains rather than solar.
✓ Captures the extent that passive measures impact on peak cooling load	✗ Peak cooling capacity may not always correlate to annual space cooling demand; therefore, it may not result in operational energy savings.
✓ Accounts for building services factors such as communal heating distribution losses through pipework and HIUs.	
✓ Accounts for external air temperature	

Cooling | Residential | Estimated cost impact of policy

The recommended measures primarily involve strengthening and clarifying existing policy wording and practice and therefore do not inherently introduce additional cost implications. The proposals are focused on refining policy language to better reflect existing practice and ensuring consistency across the compliance process.

Detailed assessment of recommendations

1. Strengthening Policy Wording

- **Cost Impact:** None.
- **Rationale:** This recommendation involves clarifying and simplifying existing policy wording to align with clearly defined requirements already outlined in Building Regulations Part O (limiting solar gains and providing sufficient means to remove excess heat). As these measures reflect stronger alignment with Part O which is already a requirement in the EAG document, no additional cost is introduced.

2. Compliance with 'Passive Design Test'

- **Cost Impact:** None.
- **Rationale:** This measure requires compliance with dynamic overheating assessments assuming no restrictions on openable windows. These assessments are already standard practice and embedded in current overheating analysis frameworks for referable applications. The recommendation ensures that the passive design would achieve compliance in the absence of external constraints and therefore the façade design is designed to mitigate overheating.

This recommendation is already partly reflected in the current London Plan energy assessment guidance, which advises that if window openings are restricted, applicants should submit overheating assessments for both open and closed scenarios to ensure passive measures and façade design are optimised despite site constraints.

3. Strengthening guidance on cooling design

- **Cost Impact:** Likely neutral or cost-saving.
- **Rationale:**
- **Avoiding oversizing cooling systems:** Specifying accurate sizing for mechanical ventilation and active cooling systems avoids unnecessary capital expenditure. Oversized cooling systems typically result in increased upfront costs, higher operational energy costs, and potential negative impacts on noise and air quality. Additionally, this is again part of the current compliance exercise performed by GLA energy officers together with the cooling control and set points.
- **Cooling control and set points:** Recommendation to avoid cooling set points below 23 degrees Celsius aligns with good practice and energy-efficiency standards, ensuring optimised system operation and energy cost savings rather than imposing new costs.

4. Continued collection of space cooling demand data

- **Cost Impact:** Minimal.
- **Rationale:** Using predictive energy modelling to collect cooling demand data will already be introduced for the collection of SHD and EUI for energy assessments. Such data collection helps inform potential future limits on space cooling, improving long-term strategic planning without introducing new immediate costs.

Cooling | Non-residential | Estimated cost impact of policy

The recommendations for non-residential developments are not expected to have any immediate cost implications. The proposed adjustment to policy wording simply brings non-residential developments in line with residential standards by recognising the importance of limiting internal gains, particularly in communal or district heat network scenarios. Similarly, the study does not propose a specific metric or enforceable limit at this stage; instead, it highlights the need for further work to determine the most appropriate metric and threshold. As such, this is a preparatory step focused on aligning policy structure and beginning data collection to support future decision-making. Additionally and similarly to the residential element, the predictive energy modelling that will already be introduced for the collection of SHD and EUI for energy assessments can also be used to collect data required related to a cooling metric.

Since no prescriptive requirements are being introduced at this stage, both recommendations are considered cost neutral at the moment. When the additional work on a cooling metric and limit is carried out, the estimated cost impact of policy should be reviewed

Cooling | Potential policy framing

Why are we proposing this policy?

To ensure that the overheating risk has been mitigated and to reduce energy consumption in buildings relating to space cooling and thus reduce energy bills. It requires design team to explore and implement natural ventilation strategies and passive design measures.

Selection of weather file

Compliance with future weather files would mean that the passive design test is impossible to pass without active cooling in place. An in-depth research of the impact of weather files should be examined in a future study. **Using metric to reduce cooling demand and setting a limit**

Further work is required for choosing the appropriate metric and the associated performance levels to limit cooling, particularly in various non-domestic building typologies where cooling is regularly installed. Suggestions include a limit on space cooling demand, solar gains or peak cooling load. Research on the metric and limit should also be extended to residential schemes, especially as cooling becomes more prevalent (as we experience hotter climate).

* 'Limiting internal gains' requirement applies to non-residential buildings, and communal areas of residential buildings served by a communal or district heat network.

** 'Effective external shading' refers to providing orientation-specific external shading: horizontal (e.g. brise-soleil) for south facades and vertical (e.g. shutters) for south, east and west. The overheating modelling carried out will demonstrate to applicants whether the external shading is effective at reducing solar gains.

Our research suggests framing a policy with the following requirements and outcomes:

Overheating and cooling demand requirement

All developments should mitigate the risk of overheating and reduce cooling demand by implementing the following passive design measures:

- **Limiting unwanted solar gains:** Through optimisation of the glazing design for orientation and introduction of effective** external shading.
- **Limiting internal gains*:** Through reduction in hot water pipe lengths, provision of adequate pipe insulation, reduction in hot water tank losses, and through zoning strategies (e.g. ventilation strategies suited to different zones of the building).
- **Removing excess heat:** Through inclusion of passive means (cross ventilation, generous openable window areas) for removing excess heat.

Major residential developments:

To get the desired result we would expect that compliance is demonstrated through dynamic overheating modelling in line with the most current version of CIBSE TM59. Where limitations to the opening of windows are present, and active measures (mechanical ventilation and active cooling) are unavoidable (e.g. due to security or noise restrictions), applicants must also demonstrate compliance through a **passive design test**. The passive design test requires applicants to demonstrate compliance with overheating criteria, through natural ventilation and passive design measures, assuming there are no restrictions to openable windows. This will ensure that even if active cooling is present, the cooling demand has been first reduced through passive measures.

Major non-residential developments:

To get the desired result we would expect that compliance is demonstrated through dynamic overheating modelling in line with the most current version of CIBSE TM52. [To ensure that cooling demand had been sufficiently reduced an energy-based metric with an associated limit is recommended to be used. To get the desired result we would expect applicants to then undertake predictive energy modelling to demonstrate compliance with the limit.]

4.0

Low carbon (and affordable) heat



This section considers how the London Plan can change in order to promote the most suitable low carbon heating system in different locations across London while ensuring that heating costs will be affordable to residents.

Low carbon heat | Summary of methodology, ideas and suggestions

A critical ingredient for Net Zero

Low carbon heat is one of the critical ingredients of a Net Zero carbon building alongside energy efficiency, renewable energy generation, demand flexibility and quality assurance. A number of important trends and changes in the last few years should be taken into account when considering how the new London Plan can help deliver low carbon and affordable heat to residents and occupants of new buildings in London.

In summary we recommend a more flexible approach for new buildings with a wider acceptance of on-site (fossil fuel free) electric solutions. Low carbon heat networks may play a role in the future within the framework set by DESNZ and heat network zones.

A wide range of low carbon on-site electric options

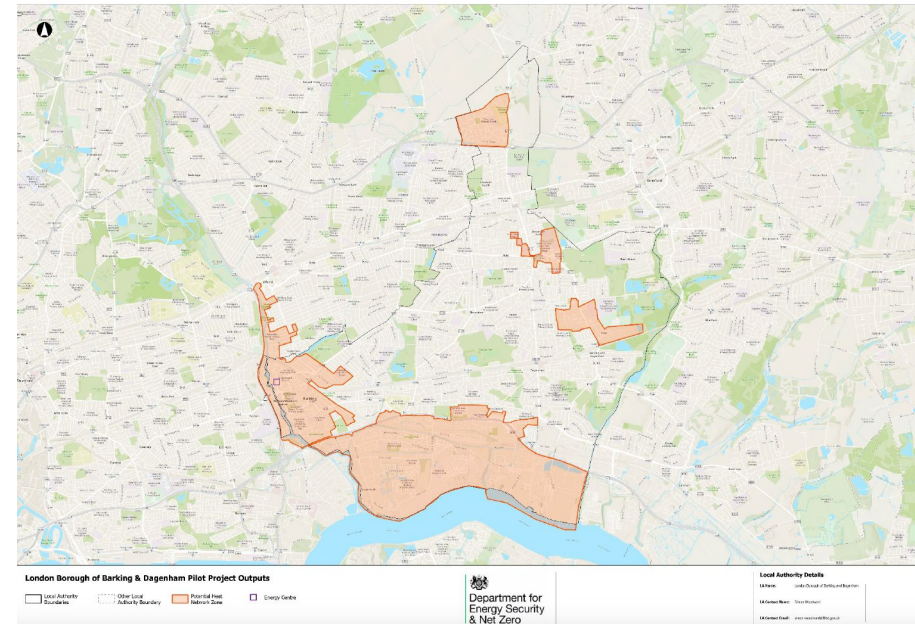
There is now a wide range of low carbon electric solution based on heat pumps and direct electric technologies available to applicants. The new London Plan should create a clear and consistent framework to assess and review them.

However, the energy cost crisis has identified the need for the costs to occupants to become an important consideration for applicants. This should therefore be one of the parameter appraised by applicants and reviewed by the GLA and London boroughs.

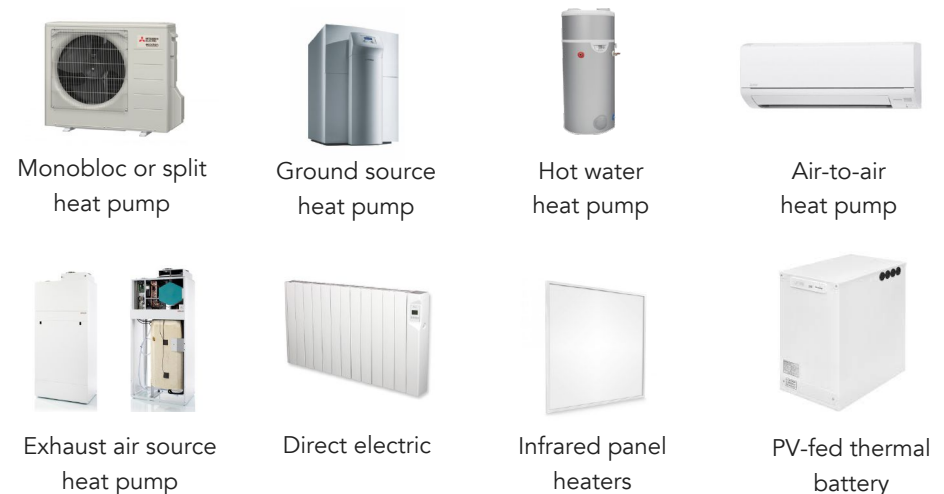
Heat network zoning and a location-based approach

DESNZ and the GLA are developing 'heat network zones' with a clear definition, i.e. 'zones where heat networks are the most economical way for buildings to decarbonise heat'. The 'counterfactual' on-site heating system is no longer a fossil-fuel system, e.g. individual or communal gas boiler, but instead an on-site heat pump system.

The 'heat network zones' will supersede the 'heat network priority areas' which were less clearly defined and therefore more extensive. This is likely to lead to heat network zones being less widespread. There will therefore be more situations where applications are outside of a heat network zone.



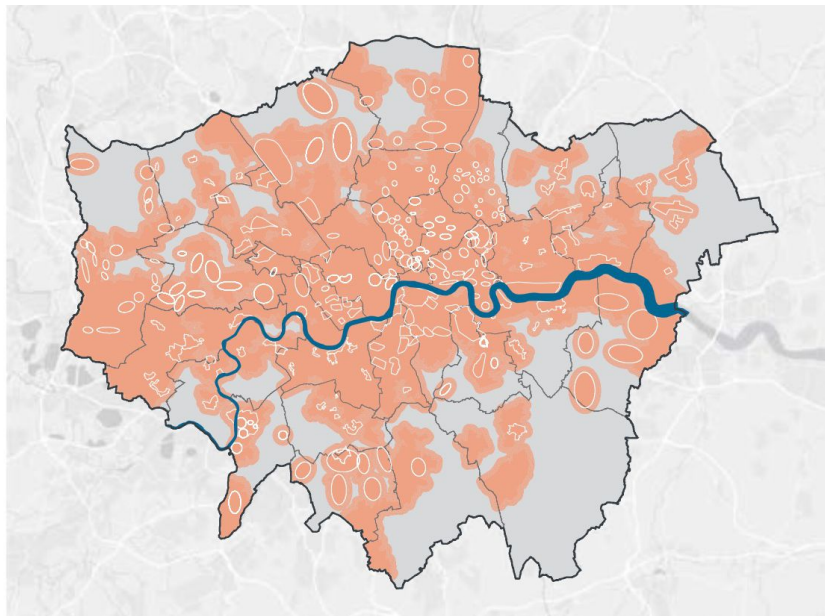
Potential heat network zone in the London Borough of Barking and Dagenham.



A wide range of low carbon electric heating and hot water systems are available

Heating | Summary of requirements in the current London Plan

The current London Plan has a specific policy on energy infrastructure: Policy SI 3 (see the adjacent extract). There is also a map of the heat network opportunity areas (see below).



- Heat Network Priority Areas
- Local Authority Heat Network Studies

Source: GLA
Environment
Contains OS data ©
Crown copyright and
database right (2017)

Heat network priority area in the current London Plan

It is clear that some elements of this policy will require changes:

- The concept of Heat Network Priority Areas (covering the majority of London) will be replaced with more clearly identified Heat Network Zones.
- Gas-fired CHP and gas boilers are not compatible with Net Zero and therefore should not be referred to.

Policy SI 3 Energy infrastructure

[...]

D. Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

- 1) *the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:*
 - a) *connect to local existing or planned heat networks*
 - b) *use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)*
 - c) *use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)*
 - d) *use ultra-low NOx gas boilers*
- 2) *CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality*
- 3) *where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.*

E. Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Heating | The importance of affordable and low carbon heat

Critical considerations for the London Plan

The London Plan has a key role to play in making sure that the planning process can positively influence the choice of heating systems by applicants in order to deliver the desired outcomes for Londoners. In particular, it is important for heating systems to be:

- affordable for future residents/occupants
- financially viable for applicants
- consistent with the Mayor of London net zero ambitions
- consistent with London's priorities in terms of infrastructure.

The ability of the London Plan to translate these overall ambitions into practical requirements for applicants will play a significant role in the ability to achieve them. A framework for decision making is likely to be more suitable than a hierarchy of heating systems.

Affordability of heat for Londoners

The proposed heating system should be affordable to use by residents and they should benefit from a clear and regulated level of protection as consumers.

Viability for applicants

Applicants should be able to consider the heating system impact on construction costs in their appraisal, particularly for social housing.

Consistency with Net Zero and environmental ambitions

The heat source should be consistent with Net Zero, and therefore not use fossil fuels or rely on processes which themselves are not consistent with Net Zero. It should also aim for a low level of embodied carbon have a limited environmental impact locally.

Consistency with London's strategic infrastructure development

Decisions on heating infrastructure should be the result of coordination with other infrastructure development priorities.

Affordability of heat for Londoners

Affordable warmth

- Cost of heat (per kWh)
- Maintenance costs
- Replacement costs
- Consumer protection
- Flexible tariffs

Viability

Viable for applicants

- Impact on construction costs

Consistency with Net Zero and environmental ambitions for London

Net Zero

- Consistency with climate change mitigation objectives
- Impact on local pollution (e.g. air quality, noise)
- Impact on public health (e.g. overheating risk)

Consistency with London's strategic infrastructure development

The right infrastructure investment for the future

- Electricity infrastructure
- Waste management
- Delivering low carbon heating for neighborhoods

Heating | Why should the London plan go further than Buildings Regulations?

The need for low carbon heating systems in new buildings is clear and is likely to be at least encouraged if not mandated by the Building Regulations framework in the future. It is therefore very important that any 'low carbon and affordable heat' requirement in the new London Plan has a clear purpose and is not effectively redundant.

Part L 2021

It is still possible under the current version of Part L of the Building Regulations to install a fossil fuel heating system. Therefore, until the Future Homes Standard and Future Building Standard are in force (and the inability to comply with them with fossil fuel heating systems confirmed), it should be assumed that the London Plan should have a set of low carbon and affordable heat requirements.

The Future Homes Standard and the Future Building Standard

Although the final requirements of the Future Homes Standard will not be confirmed and published until Autumn 2025, and in particular whether the ban of fossil fuel based systems will be explicit or implicit, it is likely that it will be extremely challenging for domestic developments to comply with a gas boiler system.

However, the efficiency of the heating system is unlikely to be significantly constrained as both the FHS and FBS are likely to rely on overall targets which can be traded off with each other, e.g. more PVs will enable a less efficient heating system (e.g. direct electric), so a specific requirement may still be useful as a way to ensure that the system is indeed efficient and low carbon.

Energy costs

Most importantly, the Building Regulations framework does not cover energy costs. Having a specific requirement for applicants to estimate the future energy costs for residents would clearly be additional and therefore bring significant value to the process.

Regulated carbon emissions (kgCO₂/m².yr)

Dwelling Emission Rate (DER) < Target Emission Rate (TER)

+

Regulated primary energy use (kWh/m².yr)

Dwelling Primary Energy Rate (DPER) < Target Primary Energy Rate (TPER)

+

Fabric energy efficiency (kWh/m².yr)

Dwelling Fabric Energy Efficiency (DFEE) < Target Fabric Energy Efficiency (TFEE)

=

Compliance with Part L of the Building Regulations

Summary of compliance criteria with Part L of the Building Regulations.

Energy costs is not one of the criteria. Therefore, if the GLA want to ensure that heat provided to new buildings is not only low carbon but also affordable for residents/users, a specific requirement in the London Plan would be necessary.

Low carbon heat | For a wider acceptance of on-site low carbon heating system

The heating revolution has started

15 years ago, the challenge of decarbonising heat was mainly about how to prevent individual gas boilers from being installed in new dwellings as it would effectively 'lock-in' fossil fuel use and high carbon emissions for at least 20-25 years.

The aggregation of heat loads in order to be able to install low carbon heating systems and the associated development of low carbon heat networks was considered to be essential to achieve this objective.

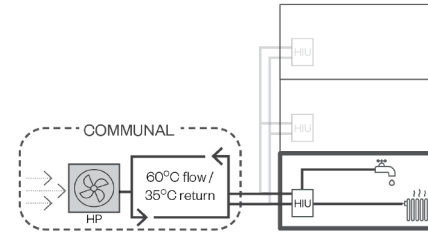
The underlying evidence behind this approach has now changed with the new heating revolution taking place in buildings: a much wider range of systems are available at the development level which can deliver low carbon heat. A selection of these systems are illustrated on the right-hand side.

Based on an assessment of how these systems would perform in terms of carbon emissions and energy costs, our recommendation is for the London Plan not to restrict the use of on-site electric (low carbon) heating systems through the London Plan.

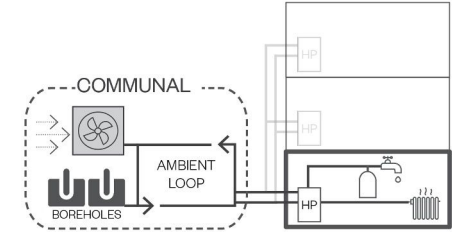
Focusing on outcomes: heat should be low carbon and affordable

In order to ensure that the system selected by the applicant does indeed provide low carbon and affordable heat to the residents, it is recommended that a 'low carbon heat appraisal' is required for all major planning applications.

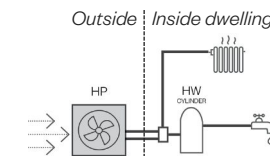
Communal air source heat pump
(55-60°C)



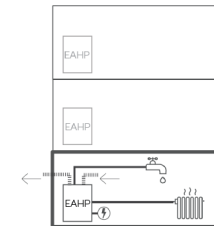
Communal ambient loop air source
heat pump (25 ° C)



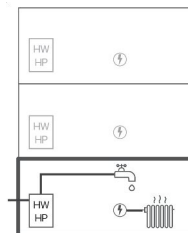
Individual air-source heat pump
(monobloc)



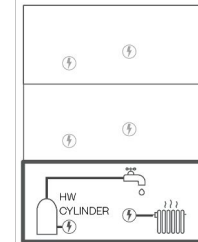
Exhaust air heat pump / Compact unit



Direct electric heating + hot water heat
pump



Direct electric heating panels and hot
water cylinder



Sample of low carbon heating systems which can be implemented at the development scale

Low carbon heat | From a heating system hierarchy to low carbon heat appraisals

A framework to guide heating system selection

As explained on the previous pages, it is unlikely that the future London Plan will be able to use a heating system hierarchy of technologies as there is not currently a robust and published evidence base which would justify one.

Instead, and in order for the most suitable system to be specified depending on the building typology, scale and context, a focus on outcomes is recommended. The '**low carbon heat appraisal**' is the recommended process that can be used to select the most appropriate heating system that delivers low carbon heat and low running costs outcomes.

It will enable the rationale for the heating system selection to be shared transparently with the London borough and the GLA, ensuring that applicants consider a range of parameters before they make a decision. The London borough and the GLA can challenge the decision if outcomes do not appear satisfactory, e.g. if there is a risk that residents could be left with a heating system which is not affordable in terms of energy, maintenance and replacement costs.

Proposed reporting framework

Indicators are recommended in the following areas:

- **Impact on residents/building users**
- **Net Zero and environmental performance**
- **Infrastructure development** (e.g. connection to low carbon heat network where applicable)
- **Viability**

A 'Low carbon heat appraisal' is recommended for all applications. However, the level of analysis and reporting expected will vary depending on the scale and location of the planning application. Guidance will need to be developed so that low carbon heat appraisals are carried out in a consistent way. A methodology for assessing energy costs would be particularly beneficial.

Performance area	Key indicator	Unit
Impact on residents/building users	1. Estimated energy costs for heating and hot water	£/yr
	2. Estimated maintenance costs	£/yr (annualised)
	3. Estimated replacement costs	£/yr (annualised)
	4. Additional operating costs compared with benchmark low carbon heating system including standing charge. ¹	+/- %
Net Zero and environmental performance	5. Fossil fuel use	yes/no
	6. Carbon content of heat	gCO ₂ /kWh of delivered heat
	7. Local pollution	description
Infrastructure development	8. Connection to low carbon heat network	yes/no
	9. Scale of application	m ² GIA
Viability	10. Capital cost of installing the system ²	£ per m ²

Proposed Indicators to be assessed in the low carbon heat appraisal

¹ Where a connection to a DHN is included in the comparison, the standing charge should be included, as some district heating network operators have lower connection costs, but then increase standing charge, if this is the case, this needs to be included.

² For systems that connect to district heating, this include the connection costs)

Low carbon heat | New buildings and heat networks

New domestic buildings are more efficient than existing buildings

The heating demand from new buildings, and particularly new domestic buildings, is considerably less than for existing dwellings:

- The average space heating demand for existing dwellings in London is around 150 kWh/m²/year.
- The average required space heating demand for new dwellings will be either 30 kWh/m²/year (Level 1), 20 kWh/m²/year (Level 2) or 15 kWh/m²/year (Level 3), depending on which 'level' the GLA opts for in the new London Plan.
- Passivhaus buildings in particular will achieve a much lower space heating demand, and it will be supported by a quality assurance scheme during design and construction.
- This represents an 80-90% reduction in space heating demand.

Distribution losses of heat networks are comparatively high

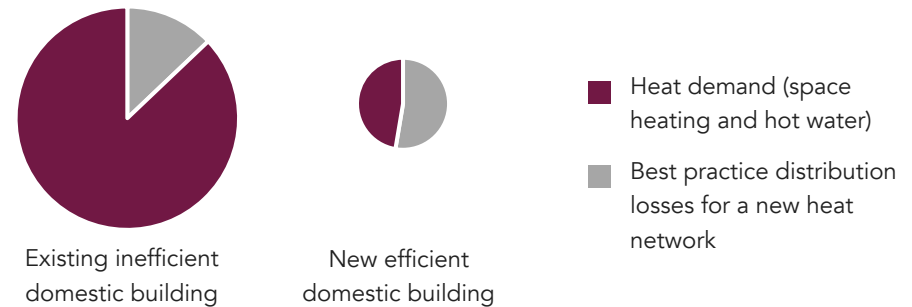
Distribution losses represent a significant source of energy wastage on existing heat networks. New heat networks can be designed to best practice (e.g. CP1) and seek to limit them, but as heat is distributed over long distance outside of the site boundary (primary losses) and within the site boundary), distribution losses are unavoidable when the temperature distribution is 50 degrees C or higher (and it is often much higher).

When compared against the heat demand of existing dwellings, these distribution losses may be considered acceptable but they are likely to be very significant in new buildings, potentially even exceeding space heating demand, see adjacent graph.

Impact on carbon emissions and energy bills

Accounting for distribution losses will lead to a significant increase in the system's actual carbon content of heat, which must be taken into account and may lead to a high carbon content of heat.

Residents will also have to pay for these distribution losses through their service charge.



As the heat demand of a building reduces, heat losses from distribution and standing losses can become disproportionately high. For new buildings with a space heating demand of 15-30kWh/m²/yr, distribution losses of heat networks may exceed space heating demand.

Low carbon heat | Low carbon heat networks and heat network zones

Heat network zones

A heat network zone is a “formally designated geographical area where heat networks are expected to provide the lowest cost solution for decarbonising heating.”

In the context of new buildings in London, this is assuming to mean that heat networks should be lower cost and lower carbon than an on-site communal air source heat pump system.

A significant amount of work on heat network zones has been undertaken by the Department for Energy Security and Net Zero (DESNZ) and the GLA.

The carbon requirement for heat networks within these zones is currently assumed to be lower carbon than an on-site communal air source heat pump system distributing heat to heat interface units.

The current assumption is that DESNZ and the GLA will finalise the identification of these zones in 2025, and that it will then be each London Borough’s responsibility, in conjunction with the GLA, to formally designate them as such. A Zone Coordinator (at the local authority or GLA level) will then have significant responsibilities and a key role to develop them.

OFGEM is also working with DESNZ on consumer protection and their work is expected to progress further in 2025.

The new London Plan and heat network zones

The legislative framework for heat network zones, the designation of heat zones by the respective London boroughs and consumer protection mechanisms are likely to be in place in 2026. Therefore, the new London Plan should use the concept of heat network zones rather than heat network priority areas which is not as robust.

This will enable low carbon heating requirements to be location based (see adjacent potential framework).

Example of a location-based approach to connections to low carbon heat networks

When the site is within 500m of an existing low carbon heat network

The existing low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be reviewed. Unless the applicant provides suitable justification*, the expectation is that the scheme will connect to the low carbon heat network.

When the site is within 500m of a planned low carbon heat network

The planned low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered. The applicant should liaise with the LPA to enquire about the likely development programme of the planned low carbon heat network. Unless the applicant provides suitable justification*, the expectation is that the scheme will install a communal heating system and enable future connection to the planned low carbon heat network.

When the site is in a low carbon heat network zone

A notional low carbon heat network with a carbon content of heat (delivered) equivalent to an on-site communal air source heat pump system should be one of the options being assessed. The applicant should then liaise with the LPA to enquire about the likelihood of a low carbon heat network being installed in the medium to long term.

When the site is in not in a low carbon heat network zone

The applicant does not have to consider any heat network option.

* A suitable justification is a technically robust and ‘fair’ analysis demonstrating that the low carbon heat network is higher carbon and/or higher cost than the proposed on-site low carbon solution.

Low carbon heat | Existing high carbon heat networks and fossil fuel use

The majority of heat networks are currently high carbon

The very large majority of existing heat networks operating in the UK (i.e. 91% of the 11,847 networks) use natural gas or oil as their primary fuel. A similar proportion is currently likely in London.

Decarbonising them is a challenge and mandating connection of new buildings is not a guarantee that this aim will be achieved, creating a significant risk of on-going use of high carbon heat.

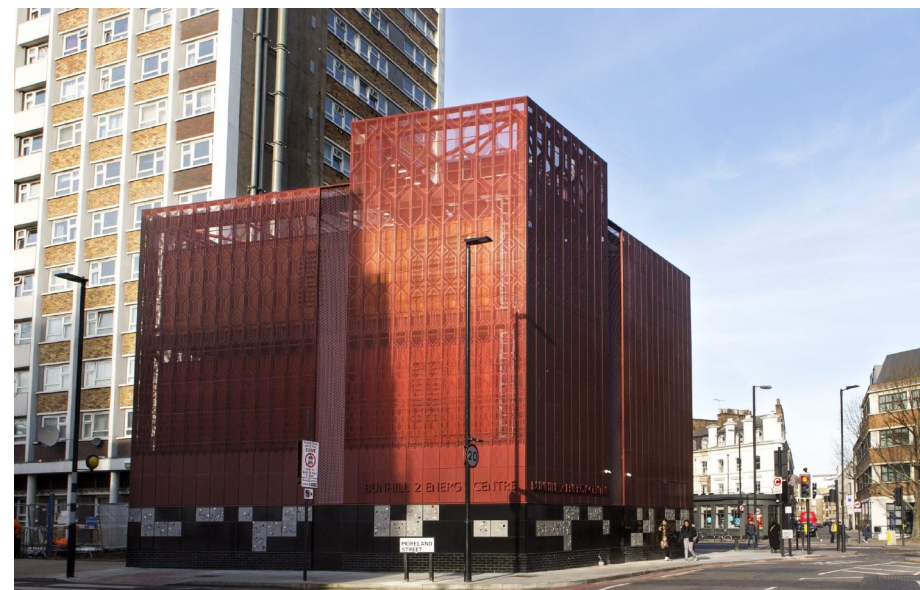
It is therefore recommended that new buildings should not be allowed, let alone encouraged, to connect to high carbon networks.

Conditions to allow connection to a high carbon heat network

Connection of a new building to a high carbon heat network should only be allowed when the specific network can:

1. demonstrate that a decarbonisation plan is available and can be verified by the applicant as well as the Local Authority and the GLA.
2. estimate the projected average carbon content of heat for the next 25 years and confirm that it will be lower carbon than an on-site communal air source heat pump system.
3. confirm that the decarbonisation plan is funded, at least partially.
4. indicate the implementation programme, key milestones and confirm that the heat network will be decarbonised by 2040.

It should be noted that GLA is working to reduce the carbon emissions of heat networks. Many of the above conditions are already implemented by the GLA including a decarbonisation plan that is reviewed by the GLA and the DNO.



The different phases of Bunhill heat network: transitioning away from fossil fuels

Low carbon heat | Estimated cost impact of policy (1 of 2)

The proposed recommendations suggest a shift away from fossil fuels with a location-based approach to connecting to low carbon heat network and a structured, appraisal-led approach to heating system selection. The estimated cost impact of these recommendations must be considered in the context of the existing requirements and the practical implications for developers and local planning authorities (LPAs).

Comparison to current London Plan

The current London Plan policy SI3 already necessitates active engagement with LPAs and a thorough assessment of heat network feasibility, which involves an associated communication and planning cost. The newly proposed structured low-carbon heat appraisal framework reinforces this existing requirement but adds clarity by establishing explicit evaluation metrics. Therefore, the additional cost impact is expected to be limited, primarily consisting of marginal increases in analysis depth and reporting.

From Heat Network Priority Areas to Heat Network Zones

The proposed policy adopts the concept of Heat Network Zones (HNZs), which are formally designated areas expected to offer the lowest-cost solution for decarbonising heating. These zones are based on coordinated assessments by DESNZ and GLA and are assumed to offer lower carbon and more cost-effective heat than on-site solutions such as communal air source heat pumps.

Unlike the generalised and wide-ranging Heat Network Priority Areas HNPAs, HNZs provide clearer signals to developers and planners about where connection to a heat network is genuinely viable and strategically encouraged. This increased specificity allows for more targeted infrastructure planning and better cost predictability, while also reducing the likelihood of speculative or infeasible connections being pursued. The cost implications are therefore more transparent and manageable, particularly once borough-level designation of zones will be complete in 2026.

Role of Low Carbon Heat Appraisals

The proposed shift from a heating hierarchy to a more flexible and context-sensitive "low carbon heat appraisal" framework provides a structured decision-making tool without significantly altering the cost landscape. While similar in principle to the existing hierarchy the appraisal framework introduces additional metrics, including energy cost, capital cost, maintenance, carbon intensity, and local air quality impacts. This deeper analysis is designed to ensure that heating systems are not only lower carbon but also viable and affordable across their lifecycle.

Though the appraisal adds some analytical overhead, this type of analysis is already usually already within the scope of a Stage 2 mechanical design report. Scope. Introducing the low carbon heat appraisal early in the planning process also reduces risks related to delays in determining planning applications, which are sometimes prolonged under the current system due to perceived non-compliance with the existing heating hierarchy. Importantly, it allows developers to present a broader range of technically and economically justified solutions, reducing the risk of poorly performing systems being installed under rigid policy interpretations.

Low carbon heat | Estimated cost impact of policy (2 of 2)

Cost considerations for connection to District Heat Networks (DHNs)

The cost of connecting to a DHN will vary and is not necessarily expected to introduce significantly higher costs compared to installing an onsite communal heating system. While DHN connections may involve upfront infrastructure such as plate heat exchangers and pipework and connection fees, these can typically be comparable to the capital costs associated with installing on-site heat pump systems that will be avoided.

Connection fee costs can be higher or lower than an onsite solution depending on wider economic factors. These include the business model of the DHN operator, the proximity and capacity within the network, the commercial terms of connection, and how capital and operating costs are shared between the network and the end user. For example, some DHNs recover a larger share of capital investment through long-term heat tariffs, while others may require higher upfront contributions from developers.

The variability in site-specific factors means that in some cases decentralised solutions may be more cost-effective, but overall, the cost implications are within the same order of magnitude. A developer has the option to identify such situations as part of the low carbon heat appraisal undertaken for each project.

If connection is not immediately available, space allocation for future DHN connections can be effectively managed through modular N+1 plantroom setups or replacement strategies, and transitional costs during off-peak periods remain minor relative to the total development cost.

Low carbon heat | Potential policy framing

Key policy aims

- To prevent the use of fossil fuels in new buildings.
- To require applicants to consider the outcomes of their heating system selection in terms of affordability of heat for residents/occupants, viability, carbon performance and infrastructure development.
- To propose a location-based approach when it comes to potential heat network connection.

Our research suggests framing a policy with the following requirements and outcomes:

Low carbon heat requirement

The most suitable heating system should be selected in order to deliver low carbon heat and low running costs for occupants. This outcome can be delivered through compliance the following requirements:

- A. New developments must not connect to the gas grid for any energy use (e.g. heating, hot water, cooking).
- B. All new developments should submit a Low Carbon Heat Appraisal (see separate guidance).
- C. The requirements for new developments in terms of immediate or future connection to a heat network will depend on the site location:

1. When the site is within 500m of an existing low carbon heat network*, the existing low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be reviewed. Unless the applicant provides suitable justification, the expectation is that the scheme will connect to the low carbon heat network.

2. When the site is within 500m of a planned low carbon heat network, the planned low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered. The applicant should liaise with the LPA to enquire about the likely development programme of the planned low carbon heat network. Unless the applicant provides suitable justification, the expectation is that the scheme will install a communal heating system and enable future connection to the planned low carbon heat network.
 3. When the site is in a low carbon heat network zone, a notional low carbon heat network with a carbon content of heat (delivered) of 100 gCO₂/kWh should be one of the options being assessed. The applicant should then liaise with the LPA to enquire about the likelihood of a low carbon heat network being installed in the medium to long term.
 4. When the site is in not in a low carbon heat network zone, the applicant does not have to include any heat network option in their Low Carbon Heat Appraisal.
- D. All communal or district heating schemes should comply with relevant planning stage Heat network technical assurance scheme (HNTAS) requirements

* A 'low carbon heat network' is assumed to be a heat network which is lower cost and lower carbon than an on-site communal air source heat pump system.

5.0

Renewable energy generation

5.0.1

This section considers how the London Plan could contribute to an increase in renewable energy generation on new buildings.

A potential additional 'energy balance'* requirement is also considered.

** Between annual energy use and renewable energy generation*

Renewable energy generation | Summary of methodology, ideas and suggestions

Renewable energy production is required to meet our net zero goals. In London, solar PV is the most appropriate form of renewable generation in most cases. It is much better use of space to install solar PV on rooftops where occupants can directly benefit from the power generated, rather than 'ground mounted' on land that could be used for food production.

The introduction of a minimum requirement of Solar PV

The current London Plan asks for onsite renewable to be maximized. It is recommended that a step further is taken and minimum requirements introduced. Setting a target that relates to building footprint area means that the target can be achieved by buildings with different heights so is more appropriate where many developments are high density.

Developing recommended performance levels

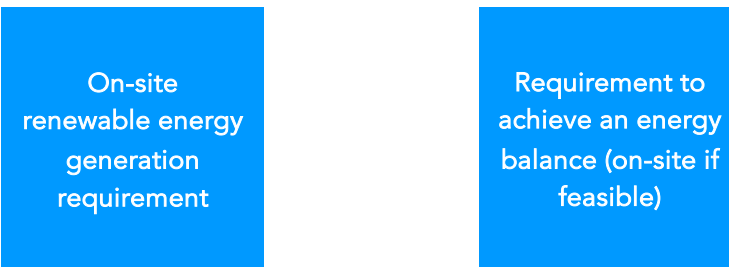
Analysis was undertaken to determine the quantity of PV panels that are technically feasible on a variety of typologies. Two levels have been developed, Level 1 represents the output possible in most cases where there are constraints and other uses required on roofs. Level 2 represents a layout optimized for PV, still allowing for expected other uses.

Are onsite renewables required for net zero?

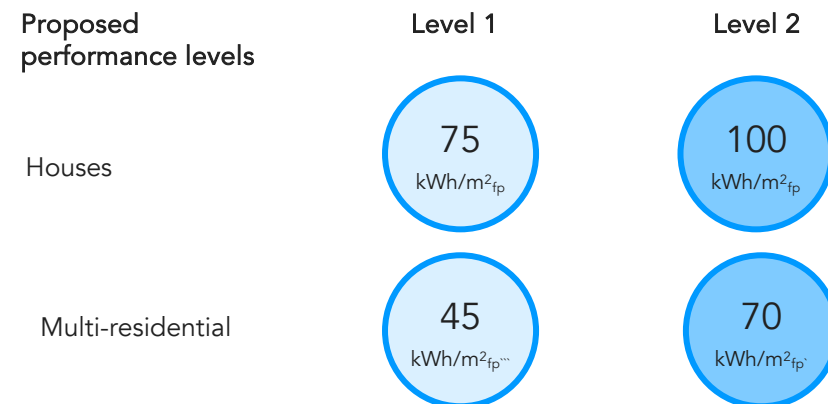
Meeting net zero within the boundary of the site, would mean installing enough renewables to achieve an energy balance over the course of a year. If an energy balance can not be achieved, energy offsetting can be used.

Competing roof requirements

Amenity space, area for mechanical plant, requirements for urban greening (UGF) all compete with PV for space at roof level. A policy balance particularly for UGF with PV is needed.



This section looks both at developing an on-site renewable energy generation target and achieving an energy balance



Example of onsite renewable energy performance levels for residential

Renewable energy generation | The importance of onsite renewable energy generation

Renewable energy production is required to meet our net zero goals. Although there are several forms of renewable energy generation, in a densely populated urban environment solar PV is the most appropriate form of renewable generation in most cases.

Electricity is needed by homes and businesses all year and there are simple, low-cost ways to convert electricity into stored energy (hot water storage via immersion heaters) to make use of surplus power.

MCS data suggests that around 50% of annual energy generated is typically used directly by residents in homes with modest sized PV arrays. In high density development, 'Solshare' or similar systems can give residents access to a share of the energy from a communal array, thereby allowing them to significantly reduce the amount of high-cost power imported from the grid. Simple design strategies and some behaviour changes, such as timing of the use of high energy appliances like washing machines, can maximise the use of energy 'behind the meter'. This directly impacts issues such as fuel poverty and helps to lower peak demands on the local infrastructure.

Other renewable energy generation

Solar thermal is technically feasible in London. These systems are comparatively high cost and high maintenance and less flexible in application than PV. They may be proposed in some specific applications.

Wind, anaerobic digestion and micro-hydro installations are unlikely to come forward in the city, being more suited to rural sites.

Waste heat

There are some low carbon sources of waste heat, such as sewerage systems and data centres. These will be major installations and very site specific so considered on their merits rather than factored into policy.

The following pages therefore focus on solar PV as the most generally applicable source of renewable energy in London.



Image source: Repowering London

Renewable energy generation | Summary of requirements in the current London Plan

The current London Plan doesn't have an explicit, absolute requirement for renewable energy generation. There is an expectation that renewables will be maximized on site, but this is not quantified.

There are competing priorities for roof space, particularly Urban Greening Factor (UGF) targets, MEP plant space, and amenity alongside the renewable energy needs.

UGF targets and plant space are generally seen as higher priority by developers, (UGF is prioritised because there is not a clear target or PV,) so PV is often relegated to the space that's left when other requirements have been satisfied.

The inclusion of on-site renewables contributes to the % on-site reduction in regulated carbon emissions against Part L 2021 baseline and can be offset.

The regional targets for renewable energy are not referenced in the current London Plan.

10. Renewable energy (Be Green)

10.1. Energy assessments should explain how the opportunities for producing, storing and using renewable energy on-site will be maximised, in line with Policy SI 2 of the London Plan. Within the main body of the energy assessment, detailed site specific analysis should only be provided for those renewable energy technologies considered feasible. Site-specific analysis for those technologies not considered feasible should be included in an appendix.

10.2. The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether the 35per cent on-site target has already been reached through earlier stages of the energy hierarchy. In particular, solar PV should be maximised on roof spaces.

10.3. Information required on renewable energy generation:

- An assessment of what is achievable and compatible with the measures already implemented in steps one and two of the energy hierarchy should be provided.
- Applicants should provide calculations to demonstrate that their chosen renewable system or systems will reduce CO2 emissions. The percentage CO2 reduction from renewable energy should be expressed relative to the Part L 2021 regulated energy baseline (as calculated in the carbon emissions reporting spreadsheet).
- High efficiency systems (e.g. state of the art PV panel models) and innovative technologies should be considered in the interest of maximising on-site CO2 reductions.
- If a number of renewable energy technologies are proposed, it will be important to demonstrate how they will work in tandem and, where applicable, how they will be integrated into a heat network (for heat generating technologies) and, again where applicable, also how they will integrate with a cooling system/strategy.

Extract from GLA Energy assessment guidance, June 2022

Renewable energy generation | The importance of solar PV generation and the case for building targets

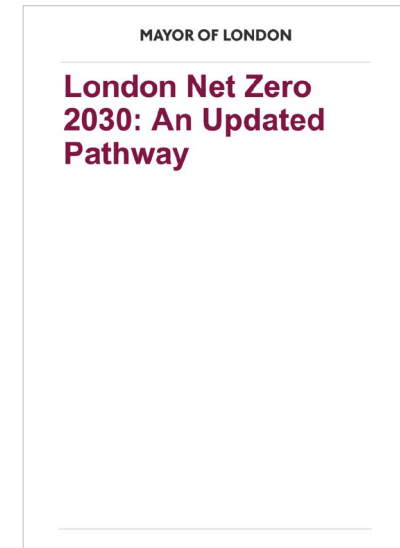
London Net Zero 2030: Accelerated Green Pathway

To support London's net zero ambitions, the new London net Zero (Accelerated Green) pathway outlines a significant increase in solar PV capacity, targeting 1.5 GW by 2030 and 3.9 GW by 2050. These figures highlight the scale of transformation required in the built environment. While these are London-wide targets, additional city-led initiatives such as Solar Together support the Mayor of London's ambition by installing solar PV on over 3,000 homes in London to date.

Achieving these targets will require a dual approach of retrofitting existing public buildings with solar PV and mandating PV installation on all new developments through the planning system. Local planning policy has a vital role to play in driving this transition. Embedding renewable energy generation targets expressed in kWh/m²fp/year can provide clear, measurable expectations that link building performance directly to wider energy and climate targets.

Local authorities have already adopted similar targets

Other local authorities have already adopted similar targets to help deliver their renewable energy and decarbonisation goals. These targets offer a practical mechanism to bridge the gap between national building regulations and local climate action plans. By following suit, London boroughs can strengthen their ability to ensure that new developments actively contribute to the city's long-term energy transition and net zero goals.



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)

Renewable energy generation | Why should the new London Plan go further than Building Regulations

Building regulations flexibility

The proposed renewable energy generation targets offer clear added value when compared to both existing and emerging national standards. Under Part L 2021, solar PV can currently be traded off as part of the overall energy strategy. Introducing specific kWh/m²fp targets removes this flexibility and ensures PV delivery is no longer optional, creating clearer expectations for developers and aligning with London's new pathway targets.

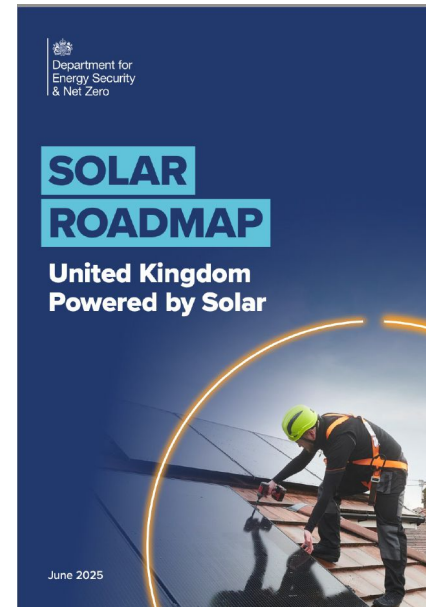
Future Homes Standard & Building Standard Approach

Looking ahead, the draft Future Homes Standard introduces a requirement for on-site solar PV's equivalent to 40% of a building's the ground floor area for new homes. The proposed methodology sets performance benchmarks for typical installation conditions but includes important flexibilities where full compliance is impractical due to roof design, shading, or other architectural constraints. While this is a significant step forward, the standard still allows developers to reduce provision where justified and does not set consistent energy output targets in kWh/m² across all housing types.

At present there doesn't appear to be a defined requirement for on-site renewable electricity generation in the Future Building Standard for non-residential buildings.

Added value of local targets

Our proposed approach builds on this by setting measurable, consistent renewable energy generation targets that apply regardless of minor design variations, thus avoiding the risk of under delivery. This can help ensure all residential and non-residential developments make a meaningful contribution to local and city-wide net zero goals, particularly where national regulation may not go far enough or apply uniformly across building types.



Regulations

Regulations - Future Homes Standard

As part of the Plan for Change, the Government has committed to build 1.5 million new homes over the course of this Parliament and introduce new standards that will ensure they are fit for a net zero future.

Action 6: UK Government will publish the Future Homes Standard this Autumn. The new Standard will ensure solar panels are installed on the vast majority of new build homes once it comes into force, saving households hundreds of pounds a year on their energy bills.

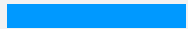
Including solar alongside low-carbon heating, such as heat pumps, and high levels of energy efficiency will cut people's energy bills and boost the nation's energy security with clean, homegrown power. Full details will be confirmed when the regulations are published this Autumn.

The Solar Roadmap published by DESNZ in June 2025 confirms that the new Future Homes Standard will ensure that solar panes will be installed on the vast majority of homes.

This will apply to all new homes in London and is therefore a very positive commitment. However, the associated details (e.g. minimum requirements, possible exemptions) have not been published yet. It is recommended to review this section of the evidence base when the details of PV requirements in the Future Homes Standard have been published.

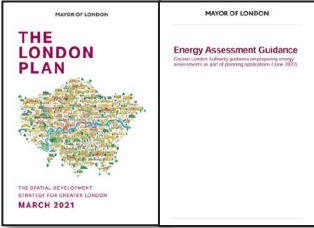
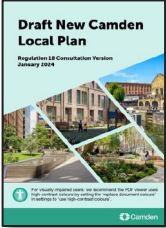
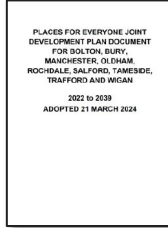
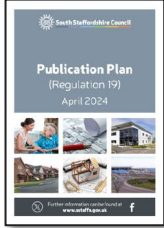
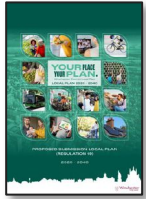
5.1

Renewable energy generation target



Renewable energy generation | Review of existing approaches

The table below summarises key sources that define existing approaches to address the renewable energy in buildings in the UK. The sources are categorized into three main areas: a) national and local regulations, b) industry guidance and best practice documents and c) certification standards. They outline strategies for new and/or major refurbishments across various typologies, including residential and non-residential.

Renewable energy	
Source	Document
National building regulations and existing/ draft local plans	 Approved document L: Conservation of fuel and power V1 & V2
	 The London Plan 2021 and Energy assessment guidance 2023
	 Camden draft new local plan 2024
	 Enfield draft new local plan 2024
	 Newham draft new local plan 2024
	 Places for everyone (GMCA) adopted plan 2024
	 South Staffordshire Local plan (under examination)
	 Winchester (reg19)
	 Essex planning policy position
Industry documents	 LETI Climate Emergency Design Guide
	 UKGBC Net Zero Carbon Buildings
	 RIBA 2030 Climate Challenge
	 UK Net Zero Carbon Building Standard

Renewable energy generation | Potential performance levels

A capacity study was undertaken for 9 typologies, to understand what range of solar PV requirements was feasible making appropriate allowances for roof mounted mechanical plant such as air source heat pumps, air handling equipment and smoke vents as well as lift overruns. See Appendix for the detail per typology.

The potential output from the PV arrays in different orientations (east//west or south facing) and if the layout were optimised for PV or based only on the unaltered roof design was quantified. These outputs were also compared to the NZCBS requirements.

Two performance levels have been developed and costed. Level 1 is feasible for most building arrangements in the typology with standard constraints and without alteration to the roof design and is therefore aligned with current practice for buildings conforming to the requirement to maximise PV on site with no explicit target performance. This level also **aligns with the NZCBS requirements**. Level 2 is feasible for most building arrangements in the typology if the roof is optimised for PV, e.g. avoiding stepped roofs and co-locating roof plant together so PV arrays can use more of the space. The modelling suggests there could be more ambitious targets for some typologies, but the **proposed levels are consistent with only two standards for simplicity** and clarity.

The expected target performance of the **Future Homes Standard** was also compared, based on the most recent consultation documents. This is a more ambitious target but is expected to be subject to exceptions so has been included for information, in the detailed pages in the appendix, but not reflected in the levels proposed.

Whichever level is chosen, **policy will need to allow derogations** where there is over-shadowing, amenity or urban greening factor requirements, or other issues constraining PV performance or layout. Energy offsetting could be used to maintain parity between developments. (See energy offsetting chapter for more information).

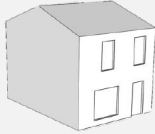
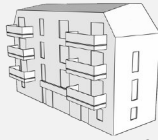
Performance levels options	Level 1	Level 2
Houses	75 kWh/m ² _{fp}	100 kWh/m ² _{fp}
Multi-residential	45 kWh/m ² _{fp}	70 kWh/m ² _{fp}
Industrial buildings	75 kWh/m ² _{fp}	100 kWh/m ² _{fp}
Schools	45 kWh/m ² _{fp}	70 kWh/m ² _{fp}
Other non residential	45 kWh/m ² _{fp}	70 kWh/m ² _{fp}

Renewable energy generation | Evidence of technical feasibility | Residential

A summary of the results of the renewable energy analysis for residential typologies are shown in the table to the right.

Based on the analysis, a policy target for multi-residential buildings could be 45 - 70 kWh/m²_{fp}/yr.

For a terrace house the PV requirements can be more ambitious, with achievable energy generations levels of 75 -100 kWh/m²_{fp}/yr.

Residential typologies		
	Good practice kWh/m ² _{fp}	Optimised for PV kWh/m ² _{fp}
 Terrace	75	150
 Low-rise block of flats	60	75
 Mid-rise block of flats	45	75
 High-rise block of flats	45	75

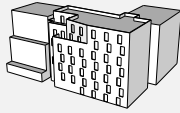
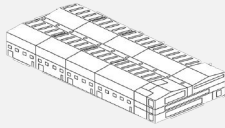
Onsite Solar PV generation potential for various residential typologies, based on analysis undertaken, see Appendix for details of this analysis.

Renewable energy generation | Evidence of technical feasibility | Non-Residential

A summary of the results of the renewable energy analysis for non-residential typologies are shown in the table to the right.

Based on the analysis, a policy target for most buildings ranges from 45 - 70 kWh/m²_{fp}/yr.

For industrial buildings there is potential for higher PV targets, with achievable energy generation levels of 75 -100 kWh/m²_{fp}/yr.

Non-residential typology		
	Good practice kWh/m ² _{fp}	Optimised for PV kWh/m ² _{fp}
 Office	45	75
 Hotel	50	80
 School	50	80
 Industrial	75	100
 Student Accommodation	45	75

Onsite Solar PV generation potential for various non-residential typologies, based on analysis undertaken, see Appendix for details of this analysis.

Renewable energy generation | Renewable energy generation vs UGF

Meeting Biodiversity Net Gain (BNG) is a regulatory requirement

In England, a BNG of 10% must be delivered by minor and major development (with some exceptions). This is mandatory under Schedule 7A of the Town and Country Planning Act 1990 (as inserted by Schedule 14 of the Environment Act 2021).

Meeting Urban Greening Factor is a London Plan requirement

Meeting the required Urban Greening Factor (UGF) is a local policy requirement and the methodology for its calculation is set out in London Plan Policy G5. Urban greening covers a wide range of options including, but not limited to trees, green roofs, green walls, and rain gardens.

UGF is an absolute measure of green cover over a site or area.

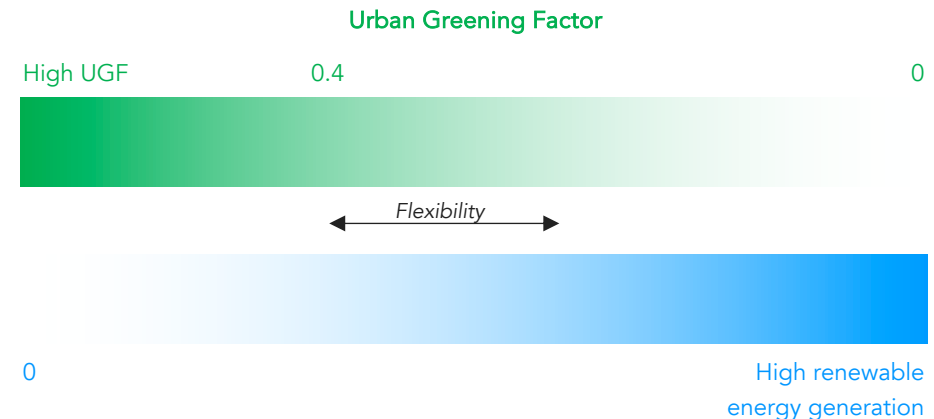
However, the requirements will also vary greatly on different schemes as the greening of the existing site affects the measure needed to be implemented (if existing greening is kept, it is counted towards the UGF). The policy requires that measures to improve UGF must be provided on site and can not be delivered offsite.

Balancing on-site renewable energy and UGF

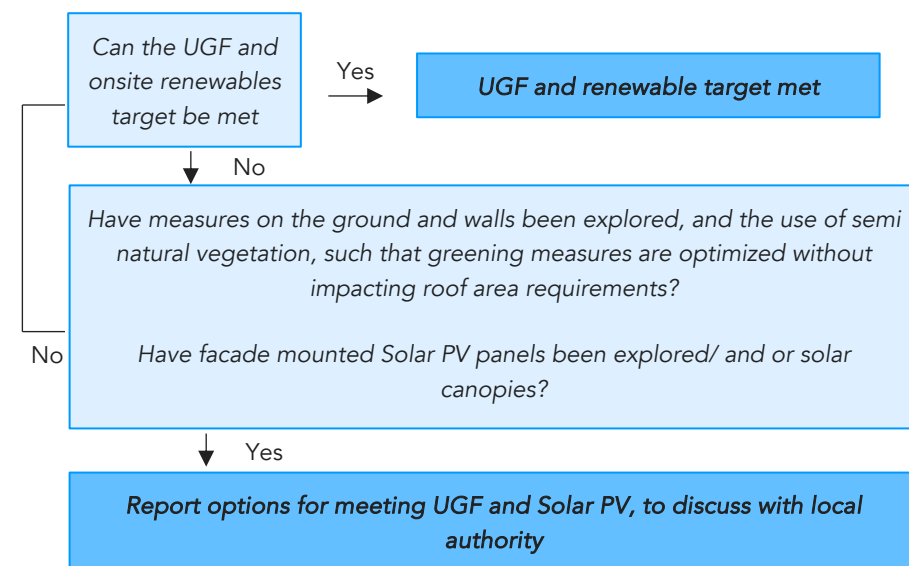
The extent of roof-mounted solar PV panels should be balanced with the need to meet the BNG and UGF requirements. Biodiversity efforts should ideally focus on ground-level measures - such as diverse surface treatments and high-scoring vegetation - before using the roof. As the requirements for Urban Greening Factor and on-site renewable generation (largely through solar PVs) will both be set by local policy rather than national regulations, balancing these two related London plan targets should be considered on a case-by-case basis as it is unlikely to be possible to meet both in some cases.

Combined approach

Combining PV and biodiversity could be a solution (e.g. Biosolar roofs). However, there may be concerns associated with fire risk of PV panels over green roofs.



Tension is likely on some schemes between the UGF and renewable energy generation targets. It is recommended that the balance is found at the local level depending on the context and that the UGF target (i.e. 0.4 and 0.3 respectively for domestic and non-domestic buildings) is not applied too rigidly.



A flow chart similar to the above could be developed to give guidance on a process for applicants if the UGF and solar PV target cannot both be met.

Renewable energy generation | Estimated cost impact of policy

This section summarises the additional construction cost impact of increasing photovoltaic (PV) energy generation requirements from the existing baseline, which already incorporates PV systems in line with current London Plan compliant approved applications. Thus, the cost figures presented here reflect only the incremental uplift from current practice. For more detailed information on the assumed baseline and Levels 1,2 PV capacity in kWp please see the Appendix.

The additional cost associated with achieving PV Levels 1 and 2 primarily varies based on available roof area relative to the gross internal area (GIA). Terrace houses, experience the most notable uplift at Level 1 (+0.5%, £12/m²), increasing further to +1.1% (£25/m²) at Level 2. In contrast, blocks of flats, uplifts at Level 1 and Level 2 remain very modest or negligible (-0.1% to +0.2%, typically £2–£4/m²).

Non-residential typologies such as offices and student accommodation generally exhibit minimal incremental costs at Levels 1 and 2, largely due to the fact that the baseline has a similar amount of PV to the performance levels. Primary schools and industrial buildings experience slightly higher incremental costs (+0.9% for industrial). However, even in these cases, the cost uplift remains modest and manageable within overall development budgets.

Typology	Indicative all in construction benchmark cost (excluding PV)	Baseline PV cost	PV Level 1 kWh/m ² fp	PV Level 2 kWh/m ² fp
Terrace house	£2,110/m ²	£40/m ²	+0.5% (+£12/m ²)	+1.1% (+£25/m ²)
Low-rise block of flats	£2,610/m ²	£17/m ²	-0.1% (-£3/m ²)	+0.2% (+£4/m ²)
Mid-rise block of flats	£3,340/m ²	£11/m ²	-0.1% (-£2/m ²)	+0.1% (+£3/m ²)
High-rise block of flats	£3,650/m ²	£2/m ²	+0.0% (+£0/m ²)	+0.0% (+£2/m ²)

Uplift costs from baseline for Levels 1 and 2. Relative costs (% or £/m²) of each case compared to the baseline cost including PVs.

Typology	Indicative all in construction benchmark cost (excluding PV)	Baseline PV cost	PV Level 1 kWh/m ² fp	PV Level 2 kWh/m ² fp
Office	£4,220/m ²	£3/m ²	+0.0% (+£2/m ²)	+0.1% (+£4/m ²)
Primary School	£3,550/m ²	£14/m ²	+0.0% (+£1/m ²)	+0.3% (+£9/m ²)
Industrial	£1,360/m ²	£9/m ²	+0.5% (+£7/m ²)	+0.9% (+£12/m ²)
Student Accommodation	£3,340/m ²	£1/m ²	+0.1% (+£2/m ²)	+0.1% (+£4/m ²)

Uplift costs from baseline for Levels 1 and 2. Relative costs (% or £/m²) of each case compared to the baseline cost including PVs.

Renewable energy generation | Estimated impact of different performance levels on energy costs

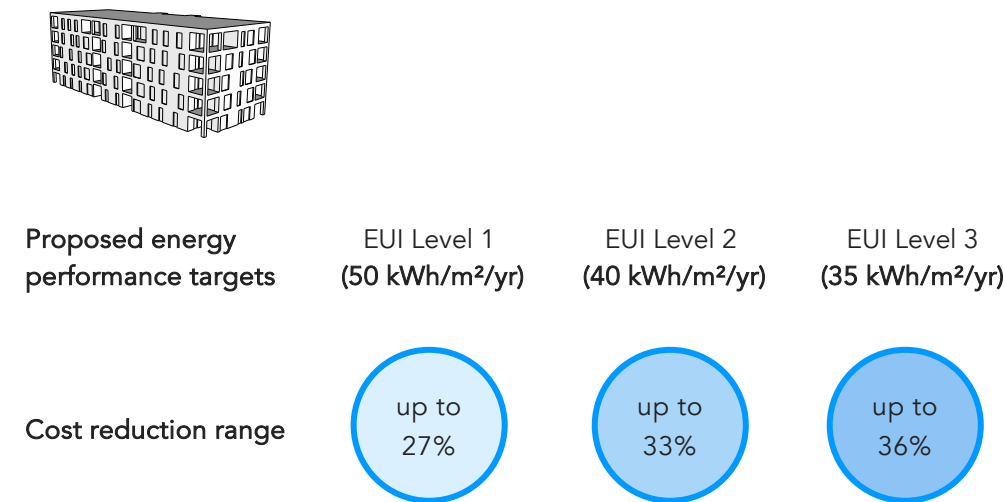
Summary of methodology

This page analyses the estimated annual energy costs for a 60 m² flat in London under three Energy Use Intensity (EUI) levels, as defined in section 3. It explores how the integration of two levels of PV renewable energy generation affects these costs. The analysis considers two self-consumption scenarios: 30%, which aligns with NEA and UKGBC guidance and represents a more realistic, easily achievable target; and 50%, which reflects a more ambitious benchmark aligned with MSC standards. Any surplus energy generated is assumed to be exported to the grid at a standard OFGEM tariff of £0.15/kWh, while imported energy is priced according to the 2024 average price cap. For detailed results see the appendix.

PV cost savings summary

The adjacent diagram summarises the analysis presented in the Appendix. Overall, the findings highlight the significant annual savings achievable through the installation of PV systems. The data consistently shows that reducing energy consumption and optimising PV generation and self-consumption can lead to substantial cost reductions. **The greatest savings, up to 36%, are achieved with an energy performance at Level 3 and a self-consumption rate of 50%, compared to the same flat without PV.** In contrast, at EUI Level 1, the potential savings are more modest.

Further information on energy costs savings for residential and non residential typologies is found in the appendix.



Energy cost reductions for each EUI level when PV panels are installed in a 60 m² mid-rise apartment block.

Renewable energy generation | Potential policy framing

Why are we proposing this policy?

To contribute to the Mayor's ambition in terms of renewable energy generation and be consistent with the Mayor's Accelerated Green Pathway.

To maximise the benefits of solar PV generation where it is used and help reduce occupiers' energy bills.

Minimum onsite renewable energy generation

It is suggested that one of the performance levels that it presented in this report is chosen as a limiting requirement. See page 93 for the performance levels.

Our research suggests framing a policy with the following requirements and outcomes:

Renewable energy generation requirement

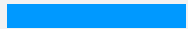
Renewable energy should be maximised on-site for all new developments.

Minimum requirements for onsite renewables should be set measured in kWh/m²_{fp}.

Where applicants demonstrate that this is not technically feasible energy offsetting should be used to compensate for the renewable energy generation 'gap'.

5.2

Energy Balance



PROs and CONs of a policy on an energy balance

Context

There are two possible approaches to setting a renewable energy target; as an absolute requirement (as shown in the previous sub-section) and/or as an energy balance. It is clear that the preference for the London Plan is to have an absolute requirement. The question is, should there be an energy balance requirement in addition to the absolute requirement.

Summary

An energy balance requirement will place a strong emphasis on Net Zero being delivered on every site.

Setting a target of an energy balance for every development makes a clear statement that the ambition is for every building to have net zero emissions, rather than relying on regional or national infrastructure to achieve this.

The majority of referred schemes will not be able to comply

Modeling shows that many high-density typologies can't technically comply. Given that the majority of schemes referred to the GLA will be high density, the soundness of a policy which most schemes can't meet could be challenged at examination.

The principle of a requirement to match the EUI with renewable energy generation requires a mechanism for meeting the policy where it isn't possible on site, so these developments would then offset the shortfall by paying for those PVs to be provided elsewhere. These funds need to be administered and used effectively.

Many Local authority adopted and emerging Net Zero Local plans include energy balance. This includes Cornwall council, Tendring, Essex model policy, Winchester local plan etc.

Energy balance requirement

Where technically feasible, the amount of energy generated in a year should match or exceed the predicted annual energy use of the building, i.e. Renewable energy generation (kWh/yr) equal or greater to predicted energy use (kWh/yr). Where this is not technically feasible energy offsetting should be used to compensate for the energy balance 'gap'.

If there is an energy balance requirement

PROS	CONS
✓ Consistent with 'Net zero on-site' policy (at a site level rather than UK scale)	✗ The majority of schemes in London will not be able to comply on-site – especially high-density development
✓ Low rise schemes will be able to achieve this balance on-site.	✗ These schemes will rely significantly on offsetting
✓ Simple and clear	✗ Potentially conflicts with the renewable generation policy (low density housing)
✓ Fair between typologies (e.g. same cost per residential unit between high-rise and low rise)	
✓ Further incentivises reduction of EUI	

If there is NOT an energy balance requirement

PROS	CONS
✓ Simpler policy structure	✗ Not consistent with 'Net zero on-site' policy (at a site level rather than UK scale)
✓ Less pressure on officers, determining where derogations apply (there will be many of them) and fewer negotiations on offsetting.	✗ Puts more pressure on setting the renewable energy generation requirements at the right level (they must be ambitious enough)
✓ Offsetting is not required	✗ There is no revenue from offsetting

Proportion of energy use met by renewable energy generation on-site

This page outlines the proportion of energy use met by renewable energy generation onsite, for various typologies. The table to the right is based on the assumption that an EUI limit and an onsite renewable energy generation target aligned with one of the performance levels in this report will be set and met for a development. It provides the proportion of energy use met by renewable energy generation onsite for various combinations of energy use and renewable energy generation performance levels.

The terrace house meets an energy balance for most of the combinations of performance levels (aside from Level 1 EUI and Level 1 PV).

Low, mid rise apartment blocks, schools and the industrial typology range from 21%-84% of energy use met by renewable energy generation onsite. This shows that a reasonable proportion of energy use can be generated onsite. For each of these typologies there is significant change of proportion of energy use that can be generated onsite from Level 1EUI: Level 1PV to Level 3 EUI: Level 2 PV.

For high-rise apartment blocks, offices and hotels, regardless of EUI and onsite renewable energy generation level, there is a very low proportion of energy use can be generated onsite (3-13%).

It is important to note that renewable energy generation level 2, feasible for most building arrangements in the typology if the roof is optimised, however some buildings will be able to achieve more than this, which means that a higher proportion of energy use met by renewable energy generation that the adjacent table could be met. See Appendix for detailed analysis on onsite solar PV for more information.



Energy Use Intensity (EUI)
(kWh/m²GIA/yr)

50

40

35



Renewable energy generation
(kWh/m²_{fp}/yr)

45

70

The proportion of energy over the course of a year that is generated by onsite renewables depends on the performance level chosen for energy use, and for onsite renewables. This means that there are six combinations for each typology. The above shows the targets for multi residential.

EUI level	Level 1 EUI		Level 2 EUI		Level 3 EUI	
Solar PV level	Level 1 PV	Level 2 PV	Level 1 PV	Level 2PV	Level 1PV	Level 2 PV
Terrace House	87%	116%	109%	145%	124%	165%
Low-rise apartment block	29%	46%	37%	57%	42%	66%
Mid-rise apartment block	21%	33%	27%	42%	31%	48%
High-rise apartment block	6%	9%	7%	11%	8%	13%
School	27%	41%	33%	52%	43%	67%
Large Industrial	47%	63%	54%	72%	63%	84%
Office	4%	6%	6%	9%	7%	11%
Hotel	3%	5%	4%	6%	6%	9%
Student accommodation	5%	8%	6%	10%	8%	13%

Proportion of energy use met by renewable energy generation on-site for all modelled typologies for the three EUI levels in combination with the two renewable energy performance levels



Quantification of energy offset required meet energy balance

If a policy is implemented that requires an energy balance to be met, this will require offsetting in the vast majority of cases. (If an EUI limit and an onsite renewable energy generation target aligned with one of the performance levels in this report will be set and met for a development.)

Detailed analysis for the cost of energy offset to achieve an energy balance for all of the EUI and Renewable energy performance levels is provided in the operational energy offsetting section. This page outlines the proportion of energy use met by renewable energy generation onsite and the energy offsetting cost for two EUI and on-site renewable energy generation combinations for the mid-rise apartment block and the office.

Mid-rise apartment

If an energy balance policy was implemented it is estimated that for the mid-rise apartments this would result in an energy offset payment of between £110,000-£250,000^{1,2} this results in an uplift of 1-2% on construction costs.

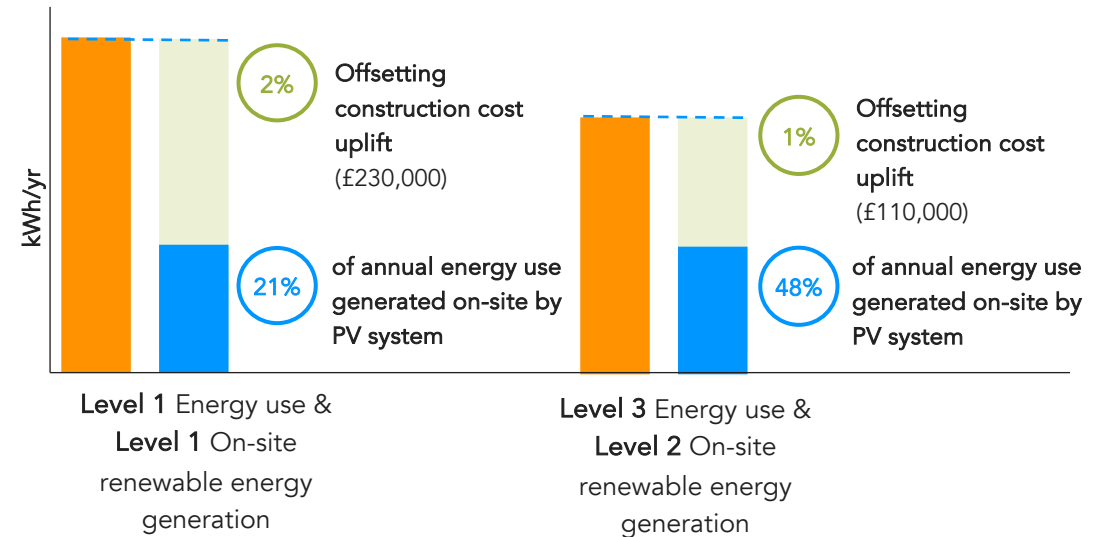
Office

If an energy balance policy was implemented it is estimated that for the office this would result in an energy offset payment of between £450,000-£900,000^{1,3} this results in an uplift of 3-5% on construction costs.

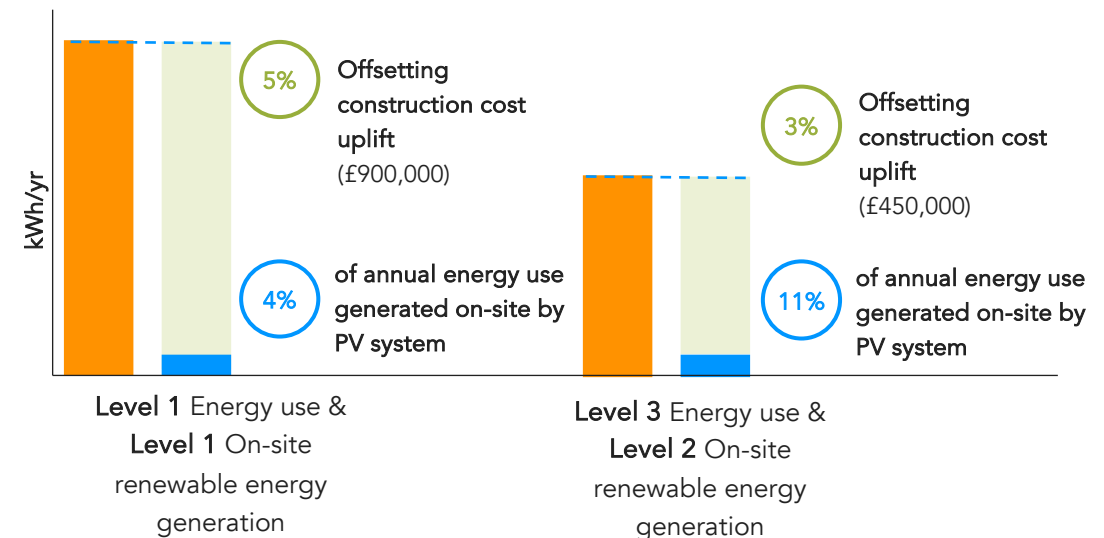
1 It is proposed that the offset price would be set at a higher price than installing solar PV panels onsite as it needs to include a charge for administering and managing the PV funding process. Due to this reason the capital cost uplift estimations assume that beyond meeting the On-site renewable energy generation the rest of the renewable energy generation is met by offsite by paying the energy offset payment. Developers could choose to install more Solar PV beyond the minimum required amount set by the onsite renewable target where there is available space, this would be cheaper than paying the offset payments. This means that the costs provided are conservative.

2 The price quoted is for the whole development (3200 m² GIA ,40 resi units)

3 The price quoted is for the whole development (4000 m² GIA)



Energy balance for **mid rise residential** for two combinations of EUI and renewable energy performance levels



Energy balance for an **office** development for two combinations of EUI and renewable energy performance levels

Energy balance | Potential policy framing

Why are we proposing this policy?

To see the translation at a building level the UK wide ambition of balancing energy use with renewable (and nuclear) energy.

Our research suggests framing a policy with the following requirements and outcomes:

Energy balance requirement

Where technically feasible, the amount of energy generated in a year should match or exceed the predicted annual energy use of the building, i.e.

Renewable energy generation (kWh/yr) equal or greater to predicted energy use (kWh/yr).

Where applicants demonstrate that this is not technically feasible energy offsetting should be used to compensate for the energy balance 'gap'.

6.0

Energy offsetting

Introduction

This section considers the potential role of offsetting in enabling applicants to comply with London Plan operational energy and carbon requirements.

Offsetting | Summary of methodology, ideas and suggestions

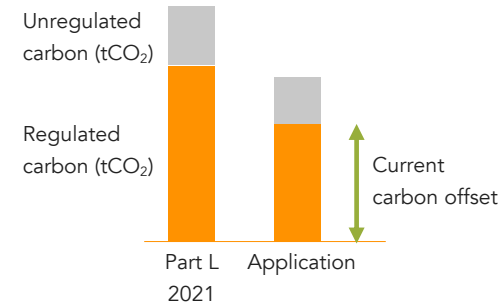
Offsetting: time to reflect

Carbon offsetting has been used extensively for new building's planning applications in London over the last 10 years. Firstly designed to introduce flexibility in how applicants could comply with policy when faced with technical challenges, its role has become more significant and led to some perverse outcomes with some applicants finding it cheaper to offset when it would have been possible to deliver a lower carbon development 'on-site'.

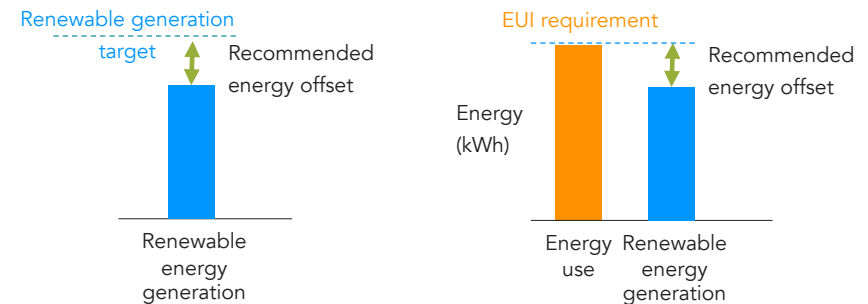
On the other hand many local authorities have made very good use of carbon offset funds, contributing to or unlocking the delivery of many projects which have saved carbon elsewhere in the borough. The new London Plan is the opportunity to take the time to reflect.

Potential issues and key questions

1. What are the PROs and CONs of introducing an updated energy offset? Should offsetting continue to play a significant role or should the London Plan restrict its role?
2. The use of offsetting to overcome technical feasibility could be considered acceptable in principle. However, the decision by applicants to pay into the offset fund as it is cheaper is clearly an issue. Operational energy and carbon emissions as well as energy bills will be higher than they should be.
3. Unregulated emissions are not currently offset as current planning policy focuses on regulated carbon emissions and requires only the residual regulated emissions to be offset. Should a new energy-based offset cover unregulated energy/carbon?
4. The responsibility of achieving the carbon savings currently shifts from the applicant to the Local Authority and delivering carbon savings off-site at for £95/tonne is extremely challenging. Which energy offset price would be both viable for the applicant and sufficient for the Local Authority?



Current approach to carbon offsetting



There are two potential alternative approaches to energy offsetting. Either using offsetting as a flexible mechanism to comply with renewable energy generation requirement. Or an applicant can offset if they are not meeting a target or as a mechanism to comply with energy balance requirement (applicants offset the remaining energy use, that is not generated onsite)

Offsetting | Summary of requirements in the current London Plan

Compliance with Policy SI 2 currently relies on offsetting

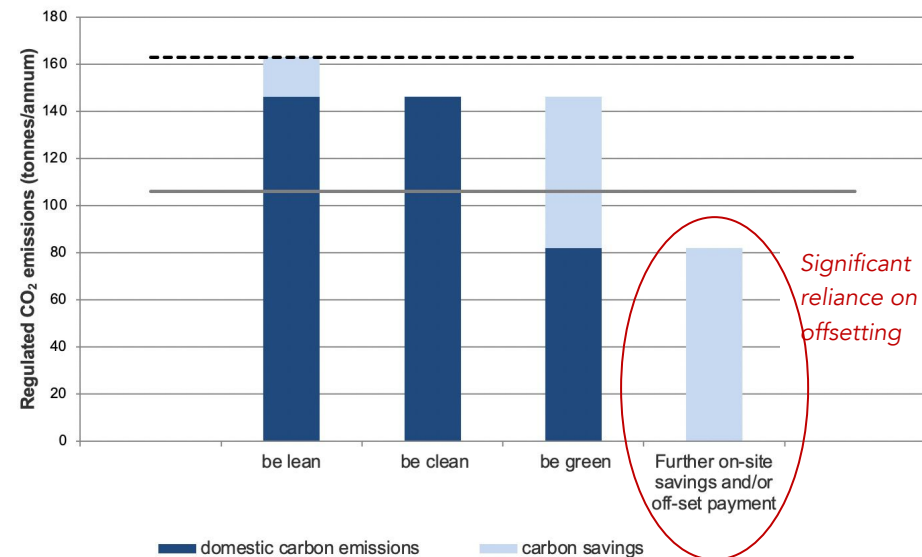
Although policy requires all buildings to achieve a 100% improvement over Part L, in most cases applicants use carbon offsetting:

- as it is not technically possible to achieve the required 100% requirement on-site and/or
- as it is cheaper to achieve a lower reduction on site (e.g. 35-60%) and offset the residual regulated emissions.

Policy SI 2 Minimising greenhouse gas emissions

[...]

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.



Regulated carbon emissions for a policy compliant energy strategy for a typical high rise development

It illustrates that carbon offset payments play a large a role in current 'net zero' planning policy. In the above chart 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 does not capture unregulated emissions.

Offsetting | Potential approaches and offset price

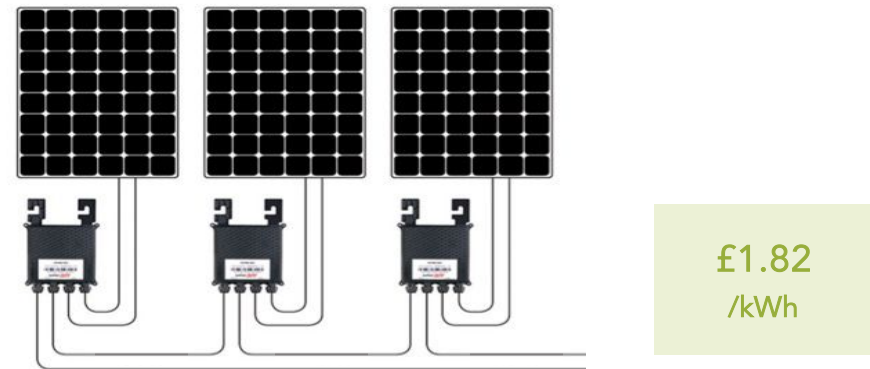
Moving towards energy offsetting

As the operational energy/carbon requirements in this evidence base are considering a move from carbon metrics towards energy metrics, it is logical for any potential offsetting mechanism to also change from carbon offsetting to energy offsetting.

Three options for energy offsetting

An energy offsetting mechanism could be used in any of the three situations below:

- 1. Flexible optional mechanism to achieve compliance with EUI requirement:** If a building exceeds its EUI target, offsetting could be used to offset the 'excessive' energy use. We strongly recommend that this is not included in policy as this introduce a risk of undermining a key policy,
- 2. Flexible optional mechanism to achieve compliance with renewable energy generation requirement:** If a building fails to achieve its renewable energy generation target, offsetting to be used to compensate for the renewable energy generation 'gap'.
- 3. Key mechanism to achieve compliance with energy balance requirement:** If a building fails to achieve a balance between predicted energy use and renewable energy generation, offsetting could be used to compensate for this energy balance 'gap'.



*If the energy offset price is to incentive more PVs on-site, it should be set at **more than £1.82/kWh**.*

The energy offsetting price has been based on the deployment of medium sized PV arrays (10-50 kW). The capital cost per kWp of installing PVs has been based on the government solar photovoltaic (PV) cost data ¹ (May 2024) and based on installations in the South of England. The calculations have been based on the median 10-50 kW installation cost of £1,376/kW for the year 2023/2024 and was adjusted for inflation for Q2 2025. The management cost for administering and managing the funding process has been assumed to be 10% of capital cost as typical practice.

These calculations are assuming a conservative electricity generation rate for the PV system of 850 kWh/kWp.

It is suggested that this price is reviewed every 3 years as the costs of Solar PV may change. It is important to note that energy offset price is much less sensitive to change than the current carbon offset price, which is sensitive both to cost changes and electricity grid intensity changes.

1. <https://www.gov.uk/government/statistics/solar-pv-cost-data>

A fair energy offset price for applicants

As the source of the energy offset is the renewable energy generation gap, its price should be set on the basis of the cost of PVs.

A viable energy offset cost for applicants

The approach above would ensure that offsetting does not impact viability as it would not add any additional cost on top of the renewable energy generation requirement.

PROs and CONs of a policy on offsetting

Context

The use of offsetting to provide flexibility within policy can be contentious as it is a way for an application to be deemed 'compliant' with a policy without necessarily meeting the intent of the policy.

Summary

The PROs and CONs of offsetting depend on its extent and particularly which policy it provides flexibility for. Based on our initial analysis:

- An offsetting mechanism/requirement associated only with the renewable energy generation requirement would be limited, bring flexibility and enable a simple offset price logic. It would introduce reduced risks of perverse outcomes. The offsetting mechanism provides flexibility on the renewable energy requirements, that may be needed (especially if Level 2 of the requirements are introduced).
- An offsetting mechanism/requirement associated with a potential energy balance requirement would also bring flexibility but would have a number of drawbacks including how extensive offsetting could become.

Recommendation

Our recommendation is to introduce an offsetting requirement, if the renewable energy generation requirement can not be met onsite. If the energy balance policy is also included, then our recommendations is to introduce offsetting if a building fails to achieve a balance between predicted energy use and renewable energy generation.

Operational offsetting (as last resort) requirement

This page considers two options for energy offsetting

- **Renewable energy generation offsetting:** If a building fails to achieve its renewable energy generation target, offsetting could be used to compensate for the 'renewable energy generation gap'.
- **Energy balance offsetting:** If a building fails to achieve a balance between predicted energy use and renewable energy generation, offsetting could be used to compensate for this 'energy balance gap'.

Renewable energy generation offsetting

PROS	CONS
✓ A flexible mechanism to comply with renewable energy generation requirement	✗ Revenues into offset funds would be much more limited
✓ As the cost is based on PVs, does not create perverse incentives to offset rather than install more PVs	
✓ As the cost is based on PVs, would be sufficient to fund PVs elsewhere in the borough	
✓ Would not cost anything on top of renewable energy requirement	

Energy balance offsetting

PROS	CONS
✓ A flexible mechanism to comply with energy balance requirement	✗ Offsetting contributions are likely to be very significant for large, dense and/or energy intensive buildings, particularly those with smaller roof areas for PVs, potentially affecting viability
✓ Significant revenues into offset funds	✗ Offsetting is likely to play a major role in enabling buildings to comply with the policy.

Offsetting | Residential | Estimated cost impact of policy

This page summarises the estimated construction cost impact associated with offsetting requirements for residential developments if energy offsetting is used to meet an energy balance.

The tables on the right illustrates these costs across the three EUI levels, combined either with on-site renewable generation at PV Levels 1 and 2.

In all cases, aside from EUI level 1 and PV level 1, **the terrace house requires no offset payment**, thus is shown as not applicable (N/A) as the development exceeds the energy balance target onsite. The negative value in grey highlights the extent to which energy performance surpasses the requirement.

For remaining residential typologies, the offsetting cost impact varies moderately based on building type and EUI performance. Low-rise blocks of flats have slightly higher offsetting costs (+2.5%, £65/m² at EUI Level 1), though these costs decrease notably as EUI improves (down to +1.4%, £37/m² at EUI Level 3). Mid-rise and high-rise blocks of flats display similar trends. (costs shown for PV level 1).

PV Level 2 reduces the cost of offsets as higher PV generation substantially reduces the energy shortfall that is required to be offset. This is most significant for the low rise block of flats.

Overall, the analysis illustrates that achieving higher EUI performance levels and higher PV generation levels substantially reduces or even eliminates offsetting costs.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 1	PV Level 1	PV Level 1
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	+0.6% (+£12/m ²)	N/A -0.3% (-£6/m ²)	N/A -0.7% (-£15/m ²)
Low-rise block of flats	£2,610/m ²	+2.5% (+£65/m ²)	+1.8% (+£46/m ²)	+1.4% (+£37/m ²)
Mid-rise block of flats	£3,340/m ²	+2.2% (+£72/m ²)	+1.6% (+£54/m ²)	+1.3% (+£44/m ²)
High-rise block of flats	£3,650/m ²	+2.4% (+£86/m ²)	+1.9% (+£68/m ²)	+1.6% (£59/m ²)

Uplift cost of offset to achieve energy balance from baseline assuming **Level 1 PV** will be met on site.
Relative costs (% or £/m²) of each case compared to the baseline.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 2	PV Level 2	PV Level 2
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	N/A -0.7% (-£14/m ²)	N/A -1.6% (-£33/m ²)	N/A -2.0% (-£42/m ²)
Low-rise block of flats	£2,610/m ²	+1.9% (+£50/m ²)	+1.4% (+£37/m ²)	+0.8% (+£22/m ²)
Mid-rise block of flats	£3,340/m ²	+1.8% (+£61/m ²)	+1.3% (+£44/m ²)	+1.0% (+£34/m ²)
High-rise block of flats	£3,650/m ²	+2.3% (+£83/m ²)	+1.6% (+£59/m ²)	+1.5% (£56/m ²)

Uplift cost of offset to achieve energy balance from baseline assuming **Level 2 PV** will be met on site.
Relative costs (% or £/m²) of each case compared to the baseline.

Offsetting | Non-Residential | Estimated cost impact of policy

This page summarises the estimated construction cost impact associated with offsetting requirements for non-residential developments if energy offsetting is used to meet an energy balance.

The tables on the right illustrates these costs across the three EUI levels, combined either with on-site renewable generation at PV Levels 1 and 2.

For non-residential typologies with baseline PV Level 1, the offsetting cost impact varies moderately depending on building type and targeted EUI performance. Offices experience the highest cost uplifts, starting from +5.4% (£229/m²) at Level 1 EUI and decreasing to +2.8% (£119/m²) at Level 3 EUI, reflecting reduced offset obligations as energy efficiency improves. Primary schools and student accommodation display similar but slightly lower cost impacts, initially experiencing moderate uplifts (+2.5% (£87/m²) and +4.2% (£139/m²), respectively) that decrease notably as EUI targets become more ambitious. Industrial buildings exhibit comparatively lower uplift across all EUI levels (+2.8% (£39/m²) to +1.5% (£20/m²), indicating lower relative offsetting costs due to their simpler building form and reduced baseline energy intensity.

Under baseline PV Level 2, offsetting costs are reduced across all typologies, demonstrating the benefit of higher onsite renewable generation.

Overall, the non-residential analysis reinforces that higher PV provision coupled with lower EUI standards significantly mitigates offsetting costs.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 1	PV Level 1	PV Level 1
		EUI Level 1	EUI Level 2	EUI Level 3
Office	£4,220/m ²	+5.4% (+£229/m ²)	+3.7% (+£156/m ²)	+2.8% (+£119/m ²)
Primary School	£3,550/m ²	+2.5% (+£87/m ²)	+1.8% (+£63/m ²)	+1.2% (+£41/m ²)
Industrial	£1,360/m ²	+2.8% (+£39/m ²)	+2.2% (+£29/m ²)	+1.5% (+£20/m ²)
Student Accommodation	£3,340/m ²	+4.2% (+£139/m ²)	+3.3% (+£111/m ²)	+2.5% (£84/m ²)

Uplift cost of offset to achieve energy balance from baseline assuming **Level 1 PV** will be met on site.
Relative costs (% or £/m²) of each case compared to the baseline.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 2	PV Level 2	PV Level 2
		EUI Level 1	EUI Level 2	EUI Level 3
Office	£4,220/m ²	+5.3% (+£224/m ²)	+3.6% (+£151/m ²)	+2.7% (+£114/m ²)
Primary School	£3,550/m ²	+2.0% (+£70/m ²)	+1.3% (+£46/m ²)	+0.7% (+£24/m ²)
Industrial	£1,360/m ²	+2.0% (+£27/m ²)	+1.3% (+£18/m ²)	+0.6% (+£9/m ²)
Student Accommodation	£3,340/m ²	+4.0% (+£135/m ²)	+3.2% (+£107/m ²)	+2.4% (£80/m ²)

Uplift cost of offset to achieve energy balance from baseline assuming **Level 2 PV** will be met on site.
Relative costs (% or £/m²) of each case compared to the baseline.



Operational energy offsetting | Potential policy framing

If offsetting is used as a flexible mechanism to comply with the renewable energy generation requirement

- This would be fair between applications which comply with the renewable energy generation (and therefore pay for it) and those which cannot for technical reasons.
- The responsibility for the installation of renewable energy systems would shift from applicants to London boroughs but assuming they can deliver them the overall solar generation in London would still be achieved.

If offsetting is used as a flexible mechanism to comply with the energy balance requirement

- This would be fair between applications which comply with the energy balance requirement, e.g. low density low energy developments (and therefore pay for it) and those which cannot, e.g. high density high energy developments.
- The scale of offsetting (and the associated responsibility of Local Authorities) would be much significant

Our research suggests framing a policy with the following requirements and outcomes:

If there is 'only' a renewable energy generation requirement

Operational energy offsetting (as last resort) requirement – Option 1

Where applicants demonstrate that it is not technically possible to achieve the required level of renewable energy generation on-site (and suitably justified), the applicant should determine the shortfall in renewable energy generation (in kWh/yr) and pay into the Council's offset fund a sum of money equivalent to it.

If there is 'also' an energy balance requirement

Operational energy offsetting (as last resort) requirement – Option 2

Where applicants demonstrate that it is not technically possible to achieve the energy balance between energy use and renewable energy generation on an annual basis (and suitably justified), the applicant should pay into the Council's offset fund a sum of money equivalent to this energy shortfall (in kWh/yr).

To get the desired result we would suggest that offsetting will only be accepted as a means to achieving compliance with the 'energy balance' policy as a last resort. The proposed development must :

- *Have a level of space heating demand and energy use intensity (EUI) compliant with levels set in the associated policies.*
- *On-site renewable energy generation (e.g. through PVs) has been maximised and is compliant with the renewable energy policy).*

7.0

Buildings and the wider energy system



This section considers how the London Plan can support a better integration of new buildings in London's electrical grid and particularly how they can help with energy flexibility.

Buildings and the wider energy system | How to build resilience and flexibility

Demand for electricity is increasing

The national move towards net zero inevitably will lead to a greater reliance on the country's electrical infrastructure. Buildings and transport together account for the vast majority of London's carbon emissions and electrification is the core strategy to address both.

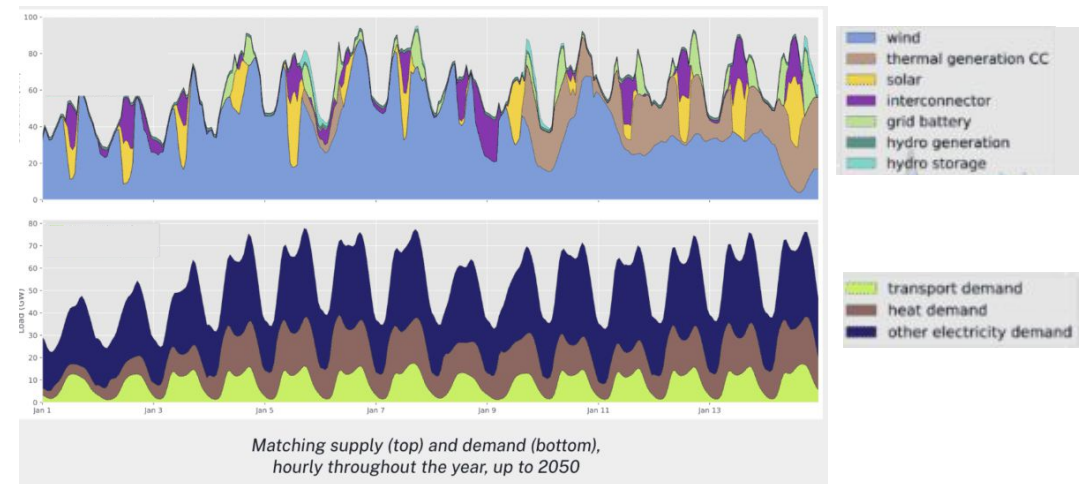
In dense urban areas, the demand for electricity is expected to rise rapidly and significant investment will be needed by the District Network Operator (DNO) to meet that demand.

Supply and demand both need to be considered

There are two issues to consider – supply and demand. The incorporation of PV generation on new and existing buildings potentially adds significant generation capacity, which is necessary, but the grid was designed around a small number of large generators, not dispersed small generation. The DNOs therefore need to reconfigure electricity networks and build in storage capability for times when there is high generation and low demand. At the same time, there needs to be demand management for times of low generation and high demand. This balancing of the system requires space as well as technology. New buildings are a relatively small part of the load increase, but new developments may offer good opportunities to introduce a local facility to support whole neighbourhoods.

Clear policies support investment in the network

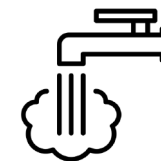
DNOs need certainty in order to build their investment plans. Using policy to ensure they have clarity on what is going to be needed will support the infrastructure development of the whole region.



The figure above from the Centre for Net Zero shows the two 'sides' of the electrical system: electricity supply at the top with different generation technologies (e.g. wind, solar) and electricity demand at the bottom with different uses (e.g. transport, heat). Matching supply (top) and demand (bottom) is very important. It will enable the UK to decarbonise quicker and more cost efficiently. Buildings have a key role to play © Centre for Net Zero



Building fabric



Thermal storage



Electrical storage

Energy can be stored in different ways in a building: in the building fabric, in hot water stores and in batteries.

PROs and CONs of a policy on energy flexibility

Context

Development of the electricity grid is essential for London as a whole. Building demand flexibility into new buildings could provide essential buffering capacity for the wider network operation, allowing better integration of renewable generation.

Summary

Introducing a clear policy highlights the issue

Requiring all developments to make provision for demand management and energy storage will build capacity in the network and raise the priority given to an issue which has not generally been considered by design teams.

Proportionality should be maintained

New buildings are a small contributor to the increase in demand, compared to existing buildings and transport. There is currently no metric to quantify how much storage is enough. Ensuring the requirement is applied fairly will place onus on officers to judge whether an applicant has complied with the policy.

Energy flexibility requirement (or guidance)

All developments should play their part to enable the electrical system in London to be managed with greater flexibility.

In order to do this, applicants must set out how their building's fabric, equipment, storage and controls systems will enable the building to be more flexible in terms of energy use and therefore better integrated in the electrical system.

In terms of storage, thermal storage should be given priority over chemical storage (batteries) due to their lower embodied carbon.

If there is an energy flexibility requirement

PROS	CONS
✓ Raises the priority of the need to address demand flexibility	✗ The policy can't deliver infrastructure upgrades directly
✓ Encourages energy storage which is a key element to allow the increase in renewable generation needed in London	✗ Policy is open-ended and cannot be costed at high level
✓ Allows a hierarchy of approaches to support simpler, lower impact solutions	✗ There is currently no metric which could be used to set an explicit target, so compliance is subjective

If there is NOT an energy flexibility requirement

PROS	CONS
✓ Avoids having an open-ended policy which requires officers to determine compliance	✗ Energy storage requires space. If policy doesn't mandate consideration, the DNO may have to rely on publicly owned land to accommodate storage
✓ New buildings will be a small component of the increase in demand – proportionality may be affected	

PROs and CONs of a policy on electrical infrastructure

Context

Interaction between developer and the District Network Operator (DNO) used to be a one-way process; the developer would apply for a new supply and the DNO would state a cost and space requirements for substations or other network equipment. With the increase in renewable generation in the grid and on developments, there's a need for more dialogue to ensure effective integration and operation of the local network and installed PV arrays.

Summary

Early dialogue can secure a better match between developments and infrastructure

For electrical infrastructure to efficiently incorporate renewable energy generation, both supply and demand need to be designed and managed. Neither developers nor DNOs can achieve this independently, so active coordination is essential. The earlier this happens in the planning process the better the outcomes for both parties.

An open-ended policy can't be costed as part of the plan testing

It is not possible to predict what the outcome of the discussions may be – the requirements will be site specific based on the both the planned development and the current configuration of the network locally and its ability to respond to the planned need. Therefore, this policy can't be costed, even notionally.

Electrical infrastructure requirement

- *Boroughs and developers should engage at an early stage with the Distribution network operator (DNO) to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.*
- *Development Plans should identify the need for, and suitable sites for, any necessary energy infrastructure requirements including upgrades to existing infrastructure.*

If there is an electrical infrastructure requirement

PROS	CONS
✓ Encourages an early dialogue and better planning for infrastructure development	✗ Policy is open-ended and cannot be costed at high level
✓ DNOs have clearer understanding of future needs in the locality	✗ There is no explicit target, so compliance is subjective
✓ Renewable generation in the development can be operational on the grid more quickly	

If there is NOT an electrical infrastructure requirement

PROS	CONS
✓ Avoids having an open-ended policy which requires officers to determine compliance	✗ Installed renewables may face prolonged delays for connection

Energy flexibility and electrical infrastructure | Estimated cost impact of policy

Energy flexibility

The proposed requirements on energy flexibility and electrical infrastructure do not introduce new formal obligations or enforceable metrics, and as such are not expected to result in direct cost implications. These recommendations reinforce principles already being implemented in many current developments, such as the inclusion of thermal storage systems, which are commonly integrated to support heat pump operations and reduce peak electricity demand. The energy flexibility requirement encourages applicants to demonstrate how buildings can support a more adaptable electricity system, largely through existing design measures related to fabric, controls, and storage.

Electrical infrastructure

The recommendation for early engagement with Distribution Network Operators (DNOs) reflects established best practice, particularly for large-scale or strategic developments. This engagement helps clarify grid capacity and infrastructure needs at the outset, avoiding costly redesigns or delays later in the planning process. Since these practices build on existing approaches and do not prescribe new infrastructure requirements, the associated cost impact is expected to be minimal.

Energy flexibility | Potential policy framing

To enable buildings to be designed with the wider energy system in mind, and for them to incorporate features which will enable the grid to use more renewable energy and for the cost to be cheaper to residents.

Our research suggests framing a policy with the following requirements and outcomes:

Energy flexibility requirement (or guidance)

All developments should play their part to enable the electrical system in London to be managed with greater flexibility.

To get the desired result we would suggest that applicants must set out how their building's fabric, equipment, storage and controls systems will enable the building to be more flexible in terms of energy use and therefore better integrated in the electrical system.

In terms of storage, thermal storage should be given priority over chemical storage (batteries) due to their lower embodied carbon.

Electrical infrastructure | Potential policy framing

To enable the electricity grid in London to be developed more strategically, and for new developments to play their part for a greener and more flexible grid.

Our research suggests framing a policy with the following requirements and outcomes:

Electrical infrastructure requirement

Boroughs and developers should engage at an early stage with the Distribution network operator (DNO) to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

To get the desired result Development Plans should identify the need for, and suitable sites for, any necessary energy infrastructure requirements including upgrades to existing infrastructure.

8.0

Assured energy performance

8.0.1

Although the London Plan focuses primarily on energy performance at the design stage, this section considers the role it may play in reducing the 'performance gap' and ensuring that actual energy use and carbon emissions are not significantly more than what was predicted at planning.

There is a performance gap leading to additional carbon emissions and energy costs

There is significant industry evidence¹ to suggest that buildings do not perform as well once they are completed and occupied as was anticipated when they were being designed. The difference between anticipated and actual performance is known as the performance gap, this leads to increased energy bills for occupants and carbon emissions.

Factors contributing to the performance gap

Studies have suggested that in-use energy consumption can be 5 to 10 times higher than design calculations. Factors contributing to this include:

- A lack of monitoring and feedback following occupancy.
- Design assumptions and compliance models do not reflect the in-use performance of buildings.
- Calculations for regulatory compliance do not account for all energy uses in buildings (regulated emissions only).
- Unregulated sources of energy consumption (such as small power loads, server rooms, fume cupboards and external lighting) are rarely considered at the design stage. Yet these can account for a significant amount of energy consumption.
- There are discrepancies between design specifications and the specification and quality of works as-built.
- There are rarely any consequences for designers, contractors and suppliers when energy consumption exceeds predictions.
- Site practices that may have been acceptable in the past, no longer meet the required standards for net zero carbon (e.g. airtightness).
- The design, installation and commissioning of building services is poor and there is a lack of smart metering.

¹ Reports on the performance gap include: Closing the gap between design and as-built performance, Evidence review report (Zero Carbon Hub), Building Performance Evaluation Programme (Innovate UK) and Closing the gap, Lessons learned on realising the potential of low carbon building design (The Carbon Trust).

Typical causes of the performance gap	Potential solution	Can this be resolved through planning system?
Predictive energy model (PHPP, TM54) was not carried out at stage 3, only a part L compliance model was carried out (excluding unregulated energy or poor prediction)	Require predictive modelling as part of the planning submission	✓ Planning policy
Predictive energy model (PHPP, TM54) was not updated at stages 4,5/6. Only Part L EPC produced	Require predictive modelling on completion, prior to handover	✓ Planning condition
Build quality is inconsistent and/or low quality – lack of supervision on site	Require use of an assurance scheme (e.g. Passivhaus)	✓ Planning policy (policy setting and monitoring & building control)
Differences in design specification and as-built specification	Improved ERs, performance specifications	✗ Client/contractor/ design team issue
Design assumptions not reflective of building in use, e.g. data not available to ensure a good prediction, skills of modelling team	Better data and guidance in industry	✗ Design team challenge
Commissioning of systems not carried out, detailed or effective	Regulation, requirement for performance in-use	? Regulation challenge
Lack of smart metering	Requirement for smart metering	✓ Planning policy
Occupant influence – Controls complicated for residents leading to increased energy consumption	Improved ERs, performance specifications	✗ Client/contractor/ design team issue
Occupant influence – lifestyle leading to use of more/less energy than expected	None	✗ Outside of planning and client/design team/ contractor control
No consequence for performance of building, little incentive to get it right, no requirement to get it right	Regulation or planning consequence	✓ Positively incentivise by implementing the suggested policy framing outlined.

Typical causes of the performance gap and potential policy solutions

Pros and cons of a policy on assured energy performance

Context

Assured energy performance requirements offer substantial benefits in closing the performance gap, supporting regulatory goals, and driving data-driven improvements, but they also introduce added costs, administrative complexity, and enforcement challenges that need careful management to ensure fairness and effectiveness.

Summary

Reduces the performance gap and encourages accountability

The collection of ‘Be Seen’ data has the potential to significantly improve design team and contractor understanding of performance and how decisions during decision and construction can impact on how a building performs. It also increases transparency and accountability across the sector.

Administrative burden and unclear remediation obligations

An assured energy performance policy puts additional responsibility on developers, as well as enforcement challenges for the GLA. Developers and building owners must invest time and resources into predictive energy modelling at multiple project stages, install and manage metering and monitoring systems, and handle complex data collection and reporting processes.

Recommendation

Include an assured energy performance requirement in the new London Plan.

Not having an assured energy performance requirement may reduce costs and increases flexibility in the short term, but it creates significant long-term risks, including poor energy performance, higher running costs, reduced market value, and difficulty meeting climate targets.

If there is an assured energy performance requirement

PROS	CONS
✓ Reduces the performance gap	✗ Administrative burden, especially relevant for smaller developers
✓ Encourages accountability	✗ Enforcement challenges
✓ Operational trouble shooting	✗ Unclear remediation obligations
✓ Financial savings for occupants	✗ Data collection and privacy concerns

If there is NOT an assured energy performance requirement

PROS	CONS
✓ Reduces administrative burden	✗ Greater risk of poor energy performance
✓ Increased flexibility and Innovation	✗ Missed opportunities for cost savings
✓ Lower upfront costs	✗ Difficulty meeting climate and regulatory goals
	✗ Reduced market transparency

Assured energy performance | Estimated cost impact of policy

The proposed assured energy performance policy introduces requirements for predictive energy modelling at key project stages and annual reporting of operational energy data. While these measures do involve some additional administrative effort and modelling work, the capital cost impact is expected to be modest.

Non residential

Predictive modelling is increasingly common in industry practice, particularly in non-domestic developments where CIBSE TM54 assessments are already routinely undertaken to support Whole Life Carbon Assessments. Moreover, the requirement to report operational data aligns closely with the existing 'Be Seen' reporting obligations in the current London Plan, meaning many projects already have the necessary systems in place. Carrying out the modelling at 3 stages rather than 1 may add some costs for some projects.

We have estimated the additional cost of the predictive modelling to be up to 0.2% of the construction cost.

Residential

For domestic schemes, the introduction of the Home Energy Model (HEM) may potentially help meet the predictive modelling requirement as part of the standard compliance process, minimising duplication and additional consultancy costs. In addition, most developers already carry out modelling work at pre-planning and pre-construction stages for sustainability assessments, so expanding this to include predictive performance analysis at completion would entail effectively updating the pre-existing models. Thus, this would not represent a significant uplift, particularly once incorporated into typical project workflows.

Assuming HEM is suitable for use as a predictive modelling tool, there would be no additional modelling costs incurred.

Although a short initial adjustment period may be needed for project teams to become familiar with the methodology and reporting processes, the overall capital cost impact is expected to be low. Once embedded, these requirements are likely to streamline compliance processes, improve energy performance outcomes, and reduce longer-term operational costs. As a result, the assured energy performance policy should be seen as a low-cost but high-value intervention that supports transparency, climate targets, and occupant trust in energy performance claims.

Assured energy performance | Potential policy framing

An assured energy performance policy is a key step in addressing and reducing the performance gap between predicted energy use at planning stage and actual energy use during operation.

While assured energy performance requirements do introduce additional administrative work and may, in the short term, increase upfront costs for developers and building owners, their benefits are substantial and far-reaching. The costs are expected to be limited and to become 'business as usual' within a short period of time.

These policies help close the gap between design and actual energy use, support climate targets, reduce long-term operational costs, and provide valuable transparency for buyers and tenants. The data-driven approach also encourages continuous improvement across the sector. Administrative challenges can be mitigated through streamlined processes and support mechanisms. On balance, implementing assured energy performance requirements is a proactive and responsible step that will deliver long-term value for building users, the environment, and the wider community.

Choice of schemes

Examples of quality assurance schemes include Passivhaus, AECB or NABERS adopted during design and construction. Each scheme has different performance targets for Space Heat Demand and Energy Use Intensity, not all of which align with the policy targets. Stipulating compliance with a specific scheme could therefore conflict with other parts of the Plan.

In principle, the requirement should be to:

- Use predictive modelling (which may include HEM in due course), carry out modelling at specified stages and show that results are compliant with policy targets.
- Implement on-site quality assurance practices to monitor construction which may use one of the quality assurance schemes cited as suitable.
- Report in-use energy performance and carry out remediation as necessary to deliver the designed performance.

Our research suggests framing a policy with the following requirements and outcomes:

Assured energy performance requirement

To get the desired result, for all development (domestic and non-domestic), it would be expected that the applicant would:

- *In design: carry out predictive energy performance modelling at RIBA stages 2/3 (as part of planning submission), pre-commencement and stage 6 (pre-occupation as part of planning condition discharge).*
- *After completion: monitor total energy use and renewable energy generation and submit the annual figures to the GLA 'Be Seen' portal for the first 5 years of operation.*

Assured energy performance guidance

To get the desired result, for all development (domestic and non-domestic), the applicant should:

- *During construction: 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. This could be through the adoption of a certified scheme such as Passivhaus, AECB or NABERS.*
Note: UKNZCBS and BREEAM do not currently include the necessary elements to be used as an assured performance scheme for design and construction stages.
- *After completion: Investigate and report on discrepancies between predicted and actual performance and carry out remediation where higher than forecast energy use or lower renewable generation result from building or system performance issues.*

9.0

Equalities impact



This section considers the complex question of the potential impact on these policies on Londoners and particularly on their impact on equality.

Key Equality, Diversity and Inclusion (EDI) definitions

Climate justice: Climate justice recognises that the effects of climate change are unequally distributed and disproportionately impact people who are marginalised due to their identities. A climate justice approach argues that those who have contributed the most to climate change have a responsibility towards those most affected by it.

Disability: Refers to a physical or mental impairment that has a substantial and long-term negative effect on a person's ability to do daily activities.

Equality: A human rights issue that refers to the equal rights, treatment, responsibilities and opportunities for all people.

Equity: Refers to equal outcomes, which may require specific interventions (such as benefits, opportunities and resources) for those who have historically been marginalised.

Ethnicity: A self-defined large group of people with shared identities such as culture, language, heritage or religion.

Gender: The socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse people. It influences how people perceive themselves and each other, how they act and interact, and the distribution of power and resources in society.

Intersectionality: A concept that describes how systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class and other forms of discrimination 'intersect' with one another to create unique dynamics and effects

Just Transition: Refers to a transition to a zero-carbon economy in a way that it is fair and inclusive for everyone.

LGBTQIA+: An abbreviation for Lesbian, Gay, Bisexual, Transgender, Queer (or Questioning), Intersex, Asexual. The plus at the end refers to the many other communities and gender/sexual identities that exist.

Marginalise: The act of treating a group as unimportant, insignificant or peripheral.

Pregnancy: Pregnancy is the condition of being pregnant or expecting a baby.

Racialise: The act of attributing social meaning to people's 'racial' identity.

Religion and religious belief: Religion refers to any religion, including a lack of religion. Belief refers to any religious or philosophical belief and includes a lack of belief.

Sex: A set of biological characteristics, primarily categorised as female or male, associated with physiological features including chromosomes, gene expression and reproductive anatomy. There is variation in the biological attributes that comprise sex and how those attributes are expressed in any given individual

Structural inequality: Refers to the biases in social structures such as businesses, social networks and public institutions, which produce advantages for some groups at the expense of others.

Systemic and structural racism: These terms describe the ways in which racism is embedded in systems, laws and other structures that perpetuate unfair treatment of people of colour.

Considering EDI in our approach to the research and developing the evidence base

Equity, diversity and inclusion (EDI) was considered in parallel to the development of the evidence base and policy proposals. A literature review and stakeholder engagement were carried out to understand the direct and indirect impacts net zero building policies could have on groups with protected characteristics or otherwise marginalised populations, such as low-income households. This baseline research informed a more detailed review of the potential impacts for each policy proposal. The chapter ends with a summary of what the equitable outcomes of each policy proposal should be, in order to support policy-makers to write policies that achieve these outcomes and support a Just Transition.

Both positive and negative potential impacts were identified. In most cases, the actual policy impacts will depend on the specific ways in which the proposed policies are enforced and adhered to by planning applicants. A series of questions and considerations were developed and posed to the consultant team to ensure that EDI was considered as the evidence base and policy recommendations were being compiled. These questions can be found in the Appendix and have informed the research as a whole.

It is important to acknowledge that any actions taken to reduce carbon emissions and mitigate climate change will be particularly beneficial to marginalised and disadvantaged communities, who may be at greater risk of experiencing the negative impacts of climate change. Likewise, many of the proposed policies will also support climate adaptation and improve the living conditions of those at greatest risk of experiencing overheating or fuel poverty. However, there is the potential risk that the cost of development rises as a result of these policies, making schemes less viable or less able to provide affordable housing or social amenities. Any consideration of EDI will have to balance these general benefits and potential risks.

Ensuring people with protected characteristics, and the organisations that support and advocate for their needs, are included in the development of policies and programmes can help to ensure that policy outcomes do not adversely impact marginalised groups.

Short interviews were carried out with the following organisations to understand and discuss the potential direct and indirect impacts of net zero planning policies on populations in London with protected characteristics:

- The Runnymede Trust
- The Young Foundation
- The Greater London Authority
- C40 Cities
- Citizens Advice

These organisations were selected as they have either conducted research or advised policy-makers about net zero policies for the built environment or because they research and advocate for policies to address inequalities and discrimination faced by people with protected characteristics. The transcripts from these calls can be found in the Appendix.

Supporting a just transition

Supporting a Just Transition

The concept of a Just Transition recognises that the pathway to net zero needs to be carefully managed to ensure that investments in new jobs, new construction materials warmer homes and cleaner energy distribute costs and benefits fairly across society. There is a risk that new policies and programmes exacerbate and worsen current inequalities, leaving marginalised communities paying more or benefitting less from the transition to net zero.

A focus on equity and justice will ensure that those who have contributed the least to emissions and who currently experience the most negative outcomes due to climate change see the most benefits from new policies and investments. Oxfam (2025) proposes four distinct approaches to secure a Just Transition:

Recognition justice: recognises existing inequalities and takes account these in policy decisions

Procedural justice: supports democratic and participative decision-making

Distributive justice: ensures that costs, benefits and climate actions are fairly distributed

Remedial justice: seeks fair and effective remedy for any harms related to the transition (or a failure to enact an effective transition)

The intention is that this work supports policy-makers to consider opportunities to support distributive and recognition justice. Further stakeholder engagement with advocacy groups will support greater procedural justice, ensuring that marginalised voices and the experiences of people with protected characteristics shape policy decisions. As policies are developed and consulted on, there will be further opportunities to ensure that any potential negative impacts are addressed. There are therefore future opportunities to support remedial justice as the new London Plan is drafted and adopted.

Distributive justice

A focus on distributive justice recognises that the costs and benefits of a transition to net zero will not necessarily be uniformly or equitably distributed. New jobs created by an energy transition may not be available to lower-skilled workers or may be concentrated in sectors that are disproportionately male-dominated for example (Oxfam, 2025).

Likewise, the cost and energy savings associated with better insulated homes, more flexible energy use and dynamic pricing may be more significant for higher income households, who may heat larger homes, are less likely live in overcrowded homes and find it easier to adjust energy use and take advantage of flexible energy pricing. The Joseph Rowntree Foundation (2014) predicted that “by 2020, the richest 10 per cent [of households] should see an average reduction of 12 per cent on their energy bills compared to a 7 per cent reduction for the poorest 10 per cent” due to the decarbonisation of energy and sustainable domestic energy production.

In their 2025 research on the barriers to retrofitting in London, The Young Foundation found that “energy schemes, home adaptation programmes and energy and home retrofit policies are often designed around the “average’ consumer, which misses adaptation necessary for households with protected characteristics and households with complexity around energy usage”. It is therefore important for policies that seek to improve the energy performance of buildings (reducing the energy needed to heat and cool buildings and reducing heat loss) to consider how these new buildings can meet the needs of households with protected characteristics.

Potential equalities impacts identified by protected characteristic (1 of 2)

Recognition justice

The table aside and on the next page summarises findings from a grey literature review of recent research exploring the implications of a Just Transition in the context of housing and the built environment.

It extracts findings and statistics that illustrate current inequities facing people with protected characteristics, as defined by the Equalities (2010) Act.

Although findings are split according to protected characteristics, it is important to note that these characteristics intersect with one another, and other factors outside of the list of protected characteristics such as income and housing tenure, to create unique, and in some cases stronger and more negative, effects.

Protected characteristics	Equalities considerations
Age	Overheating - Older people are at higher risk of heat-related death. - Young children (particularly babies) are at risk of health difficulties from poor sleep if bedrooms are too warm. - Some specific residential care settings, and safeguarding policies in these spaces such as window restrictors, may increase risks of overheating for residents.
	Flexible energy use Older and disabled people can face greater digital exclusion and are more likely to need to run medical equipment. This may result in less ability to access flexible tariffs or less flexibility in the timing of their demand for energy and so give less scope for them to benefit from bill savings.
	Accessible housing While poorer health is not inevitable as people age, one in five adults aged 65-69 need help with one or more activities of daily living – by the time people reach their 80s, this figure rises to more than one in two people. But as it stands, only one new accessible home is planned for every fifteen people over 65 by 2030.
Disability	Energy use Households with disabled adults typically have greater gas and electricity usage.
	Poor quality housing 91% of the existing housing stock does not provide the most basic accessibility features. - There are currently 104,000 disabled people on councils' waiting lists for accessible and adaptable homes in the UK and an estimated 400,000 wheelchair users in England are living in unsuitable accommodation. - On average, adapting a typical home costs up to five times more than making one adaptable at the design stage.
Religion or belief	Energy efficiency of religious buildings 7,375 out of 13,000 (57%) surveyed community buildings do not meet basic energy efficiency standards of EPC rating C, commonly suggested as the minimum required for sale or let.
Sex	Fuel poverty 14% of UK women were in energy debt between 2023 and 2024.
	Overheating Across Europe, an estimated 56% more heat-related deaths occur in women than men.
	Residential care Female care home residents aged 65 years and over outnumber men, with 23 female residents to every 10 male residents.

Potential equalities impacts identified by protected characteristic (2 of 2)

Protected characteristics (continued)	Equalities considerations (continued)
Gender reassignment	Unemployment The Census 2021 shows that adults in England and Wales whose gender identity does not match their sex registered at birth had higher rates of unemployment and economic inactivity.
Pregnancy/ maternity	Energy use Households with children typically have greater gas and electricity usage.
Race	Fuel poverty 16.6% of households with a household reference person (the person who fills in the Census on behalf of their household and typically owns or rents the property) of colour experienced fuel poverty between 2022 and 2023. Air quality - Communities of colour are over three times more likely to live in areas with very high levels of air pollution than their white counterparts. Housing - People from minority ethnic backgrounds are more likely to live in flats and multi-generational households. Flats and smaller homes have a higher risk of overheating as they are less able to dissipate heat, as do properties with more residents – especially if over-occupied. - Black people are three times more likely to experience statutory homelessness than their white counterparts. - In the UK, 36% of Bangladeshi people, 29% of Black African people and 27% of Pakistani people aged 50 and over are living in homes that are overcrowded, homes with no central heating or in shared accommodation, compared with 3.5% of White British people of the same age group. Higher tariffs and a lack of information - A London-based study found a high level of mistrust and disengagement with energy companies, with participants from ethnic minorities more likely to experience issues paying their energy bills and less likely to switch providers, leaving them on higher tariffs and vulnerable to overpaying or flexibility injustice. - Households of colour are less likely to switch energy providers. Reasons include a lack of time and trust, as well as the complexity of the switching process. People of colour are also overrepresented among those who seek help in dealing with bills, fuel debt and arrears, disconnections and government support.
Sexual orientation	Housing insecurity LGBTQ+ young people are twice as likely to experience hidden homelessness than heterosexual young people and 18% of LGBTQ+ people have experienced homelessness at some point in their lives.
Marriage/civil partnership	Fuel poverty - Lone parents experience a higher rate of fuel poverty (29%) than other populations. - Higher bills for single parents consumed 2.2% of disposable income in April 2022, a 56% faster rise compared to the average two-parent household, which will spend 1.4% of disposable income on energy bills. Poverty - After housing costs, 45% of single parents (90% of whom are women) were in relative poverty, compared to 22% of parents in a couple.

Additional potential equalities impacts and intersections with low-income

Low-income households

Although not a protected characteristic, there are specific risks to consider for low-income households. Some of the protected characteristics listed in the table above overlap closely with low-income populations. For example, women are more likely to experience low pay, part-time work and undertake unpaid work than men. After paying for housing costs, more than half (55%) of Bangladeshi and 47% of Pakistani households in the UK experience poverty. For Black African, Black Caribbean and Black British households, the rate is 40%. 34% of LGBTQ+ over-50s surveyed by Tonic have a household income below £15,000. Trans people are 81% more likely to be unemployed compared to cisgender peers.

These factors intersect to heighten risks such as overheating with warmer UK summer temperatures having an outsized impact on low-income households and low-paid workers. More than half (54 per cent) of the poorest fifth of English families, three-times as many as among the richest fifth (18 per cent), live in homes liable of getting too hot, while two-thirds of socially-renting households, six-in-ten of those with young children, and more than half of ethnic-minority families have the highest risk of their homes getting too hot as temperatures rise. Lower-income households, especially those in rental properties, are more than twice as likely to report regular overheating.

Having a low income also significantly shapes energy use and housing quality. Studies suggest the lowest income households have the highest price elasticity of demand for heat, meaning that they are most likely to reduce their heating if prices rise. Lower-income households are also more likely to be living in draughty, energy inefficient housing that cost more to heat.

Households living in poverty after paying for housing costs:

- **55%** of Bangladeshi or Bangladeshi British households
- **47%** of Pakistani or Pakistani British households
- **40%** of Black African, Black Caribbean or Black British households

22% of women have a persistently low income compared to **14% of men**

Trans people are **81% more likely to be unemployed** than cisgender people

After housing costs, **45% of single-parents** (of which 90% are women) are in relative poverty compared to **22% of parents in couples**

Equity impact identified for the proposed policies (1 of 4)

Policy review		
Policy	Potential impacts	Evidence
Space heating demand and EUI	Healthier homes <u>Co-benefits</u> The policies will lead to the design and development of better insulated homes. This will reduce heat loss, leading to warmer and healthier homes that are cheaper to heat and less at risk of being cold or damp and developing mould. This will benefit disabled and/or older people, who are at greater risk of negative health impacts from living in a cold home and younger people who are more likely to live in a non-decent home. People with low incomes (in the lowest 20% of incomes) are also more likely to live in homes with damp or mould, as are private sector renters. Racialised groups are more likely to be in the 20% of lowest incomes and are less likely to own their homes than white households and make up a disproportionate share of private sector tenants. These populations would all therefore benefit from access to better insulated homes. The policy will reduce the amount of energy needed to heat homes, reducing energy use and energy costs for occupants and addressing fuel poverty. This will benefit single-parent households, young people, racialised people and disabled people, all of whom experience above average rates of fuel poverty. <u>Risks</u> There is a risk that indoor air pollutants are less able to be removed in more airtight buildings with no adequate ventilation. It is therefore crucial that ventilation is appropriate and installed/commissioned properly. Beyond design and construction, there is a risk that MVHR systems may not be maintained properly which may negatively impact indoor air quality. Maintenance is very important.	<i>"51% of Bangladeshi, 45% of Pakistani and 38% of Black households in the UK are in the lowest fifth of the income distribution, compared with 18% of white British households."</i> Runnymede Trust (2025) <i>"29% of lone parents, 25% of individuals aged 16–24, 17% of minority ethnic groups and 17% of households with someone with a disability are in fuel poverty."</i> Committee on Climate Change (2025) <i>"In neighbourhoods with very high levels of air pollution, nearly half of the population are people of colour. This means that communities of colour are over three times more likely to live in highly polluted areas than their white counterparts."</i> Runnymede Trust (2025) <i>"More airtight building envelopes may have the unintended consequence of increasing exposure by reducing the rate of removal of indoor sourced air pollution, and can increase pollutant transmission between flats in buildings."</i> Ferguson et al (2021)

Equity impact identified for the proposed policies (2 of 4)

Policy review		
Policy	Potential impacts	Evidence
Cooling	Overheating <u>Co-benefits</u> Designing buildings to reduce their risk of overheating, through passive design measures, will benefit low-income households, social renters, families with young children and racialised populations, who are all more likely to live in homes at risk of overheating. Passive cooling and ventilation measures will mitigate the risks of overheating, which can be particularly dangerous for old people and children and which disproportionately impacts women. It will reduce the cost of cooling for households and support lower income households. The Passive Design Test, mandating that buildings where there may be restrictions on window opening and mechanical cooling is necessary are designed as if windows can be opened and according to overheating standards, will reduce the cooling demand of buildings and reduce energy use and costs. This will benefit low-income households and vulnerable residents of any type of supported living facilities where there may be restrictions on window opening. <u>Risks</u> There is a risk that the Passive Design Test does not significantly reduce cooling demand if the assumed (but infeasible) opening of windows alone allows the design to meet the cooling standards and other interventions to reduce solar gain are not explored as a result.	<i>"54 percent of the poorest fifth of English families, three-times as among the richest fifth (18 percent), live in homes liable of getting too hot. Two-thirds of socially-renting households, six-in-ten of those with young children, and more than half of ethnic minority families have the highest risk of their homes getting too hot"</i> Resolution Foundation (2023)

Equity impact identified for the proposed policies (3 of 4)

Policy review		
Policy	Potential impacts	Evidence
Low carbon heat	<u>Co-benefits</u> The policy will see a decrease in the number of households connected to heat networks and ensure that energy prices for households are considered in the selection of low carbon heat sources for new buildings. This may benefit low-income households, who are more likely to be connected to heat networks, and households in fuel poverty, where single parents, young people, older adults, racialised populations and disabled people are over-represented. These populations are currently more likely to be charged fixed standing and service charges, irrespective of energy use, which may lead to high and inflexible energy costs, regardless of energy use. Heat networks may also offer less ability for households to change their supplier. This can be further exacerbated by households who do not have an individual meter and therefore cannot benefit from price reductions to match their lower energy use, or who have their energy and rent bundled into a single payment, as is common for social housing tenants. In London, social housing tenants are disproportionately from racialised backgrounds with 54% of social tenants from Asian, Black or Minority Ethnic backgrounds and 52% of all Black households in London live in social housing. Heat networks may also offer less ability for households to change their supplier and seek out lower prices.	<i>"Heat network consumers are more likely to be in vulnerable circumstances, or to have lower income than other energy consumers"</i> Citizens Advice (2025) <i>"Price increases were worsened by unfair billing practices such as long-term back billing, and retrospective price increases. Both practices are banned in the mains gas and electricity sector. Some heat network consumers have their heat and housing costs 'bundled' together. For some of these households, falling behind on their heating bills led to threats of eviction."</i> Citizens Advice (2025) <i>"57% of heat network consumers don't have their own meter measuring how much energy they use. Being unmetered means a consumer can't control their energy usage, and reducing energy consumption doesn't necessarily save them money."</i> Citizens Advice (2025)
Renewable energy generation, energy balance and offsetting	Energy generation and offsetting <u>Co-benefits</u> The generation of on-site renewable energy may reduce energy costs, ensuring that a higher share of energy is consumed as it is produced. <u>Risks</u> The policy recognises that meeting on-site energy generation targets or an overall energy balance may be technically infeasible in higher density developments. These developments may then rely on offsetting to a greater extent than other types of development to provide energy generating infrastructure elsewhere and meet the energy balance. The potential benefits of on-site renewable energy provision (including cheaper energy bills) will therefore be less accessible for residents of these denser schemes.	

Equity impact identified for the proposed policies (4 of 4)

Policy review		
Policy	Potential impacts	Evidence
Energy flexibility	Flexible pricing	
	<u>Co-benefits</u> Energy flexibility will allow consumers to access cheaper energy at off-peak times, therefore leading to potential cost savings.	<i>"Without proactive initiatives to reach a more diverse audience, energy flexibility models are still only likely to reach people with fewer barriers - people on higher incomes, without vulnerable circumstances and with more flexibility capital."</i> Citizens Advice (2023)
	<u>Risks</u> Some households will be less able to be flexible with their energy use and are therefore less able to make cost savings by shifting their energy use to times when energy is cheaper. This includes people who need to run medical equipment, with older people and disabled people more likely to use medical equipment. Likewise, households with children may find it harder to shift their energy use. Flexible energy pricing may mean that these groups pay more on average for their energy use.	<i>"Without significant capital investment in things like home battery storage, households with a health-related need for high energy usage will struggle to access the value of models like smart time-of-use tariffs."</i> Citizens Advice (2023)
	Some workers are less able to work remotely or from home and may therefore find it harder to shift their energy use to off-peak hours during typical working hours. Minority ethnic groups are less likely to work from home than white workers and may therefore be disadvantaged. There is also a potential high upfront cost for the types of smart appliances that can automate or support households to make use of flexible pricing, which may be an additional barrier for low-income households to benefit from the potential energy cost savings.	<i>"Minority ethnic groups are more likely to live in multigenerational households and may be less able to run appliances in off-peak times, as they have previously been less likely to work from home."</i> Committee on Climate Change (2025)
Assured energy performance	Monitoring	
	<u>Co-benefits</u> The assured energy performance will ensure that the desired policy outcomes are secured and that in-use energy use is lowered and on-site energy generation is maximised. It will ensure that new technology is operating as it should, identifying where energy use is exceeding the modelled expected use and supporting building managers to intervene and ensure that the benefits of lower energy bills are delivered to users. Improved transparency about the actual energy use and costs of new builds will also support new occupiers and address knowledge gaps about new technologies experienced by older people, racialised people and low-income groups.	<i>"Without some form of outcome monitoring, there is a risk that measures installed in homes may not lead to the anticipated improvements in energy efficiency, health, or wellbeing."</i> National Retrofit Hub (2025) <i>"People taking part in the research said they find it difficult to access trusted information to help them to make informed decisions about their civic responsibilities. They cited a knowledge vacuum with a lack of government-led, trusted information in clear, accessible language about net zero, describing what it would involve at household and community level."</i> The Young Foundation (2024)

Steps to ensure policies deliver equitable and just outcomes

Proposed policy requirement	Steps to ensure policies deliver equitable and just outcomes
1. Space heating demand 2. Energy Use Intensity	The policy should ensure that new homes are as energy efficient as possible to reduce energy use and costs and maximise health benefits, such as improvements to indoor air quality and warmer homes that are not susceptible to damp or overheating.
3. Cooling	The policy should ensure that all buildings with restrictions on window openings are designed to be as cool as possible in real-world conditions (where the windows cannot be opened) before mechanical cooling or ventilation is designed to ensure cooling demand and costs are reduced as much as possible.
4. Low carbon heat	The policy should ensure that households can access affordable low-carbon heat. New households in multi-family housing should have their heat use individually metered. Systems should be chosen so that whole life costs (such as service charges) are lowered and that systems are affordable to maintain, thereby reducing maintenance fees that get passed onto consumers. Households should be given a choice of heat provider and contract type.
5a. On-site renewable energy generation	The policy should ensure that on-site renewable energy generation is maximised to reduce energy bills for households.
5b Energy balance	There are no EDI considerations for this policy.
6. Energy flexibility	The policy should not assume that all households are equally able to benefit from flexible energy prices. Where possible, flexible energy pricing arrangements should be as simple to opt-in and out of and should not unduly penalise people who consume energy at peak times.
7. Electrical infrastructure	There are no EDI considerations for this policy.
8. Assured energy performance	The policy should ensure that the desirable outcomes are realised and delivered and ensure that there are monitoring and enforcement mechanisms in place. The policy could go further and provide new households with clear expectations about energy costs to allow them to notify building managers when buildings aren't performing as assumed. Planning conditions could secure the delivery of simple tools for new households such as a new home starter guide to inform people about how new technologies in their homes should work and be maintained.
9. Offsetting	The policy should ensure that offsetting rates are set such that planning applicants are incentivised to deliver as much on-site renewable energy generation as possible. There is an opportunity to use offsetting funds to achieve outcomes, such as better insulated homes, elsewhere in the borough through a retrofit fund. The policy should outline how offsetting funds should be spent and managed to advance EDI outcomes.

10.0

Implementation and opportunities to streamline the process

10.01

This section covers implementation and identifies opportunities to make the requirements on applicants easier and less time consuming.

Operational energy policies | Streamlining the process

Streamlining planning submission requirements for operational energy will save the applicant and Local Authority/GLA time and resource. A simpler submission process will divert time away from the submission and back towards the quality of the analysis underpinning the submission.

To ensure transparency and delivery against the intent of policy, applicants should be required to submit predictive energy and carbon data (as a summary) with an explanation of how development has achieved the level of performance (in a standardised way).

Combining policy with efficient processes to achieve outcomes

With clear policy requirements that are proportional to the scale of development, the focus can be placed on guidance to achieve the desired outcomes through good environmental design and robust energy analysis. This guidance should make it clear what is expected of applicants and provide simple tools for submission.

Achieving quality

A well-thought through submission process can replace the need for vast amounts of data and onerous verification in the quest for quality. To achieve quality submissions and outcomes the GLA should consider:

- Providing updated guidance and tools covering:
 - How to design low energy buildings and what low carbon heating solutions should be considered where
 - Submission requirements including simplified tools/proformas.
 - Requirement for applicants to sign-off on quality of submission.
- Carrying out spot checks on energy calculations which require more detail to be shared with third parties for analysis.
- Building an expert London carbon panel to:
 - Review planning applications with an eye for what good and poor energy performance looks like
 - Provide a forum to discuss challenging applications with applicants in detail, to seek a balance between policy and outcomes.

Pre-app	Description	• Summary of efforts made to reduce space heating demand through environmental design and specification, reduce energy use intensity through provision and selection of low carbon heating, and increase the provision of renewable technologies.
	Format	• Short presentation at pre-app against a checklist of topics.
	Governance	• Unless a pre-app is made mandatory for all major projects then this will remain optional.
Planning submission	Description	Outline, full and reserved matters applications: • Predictive energy modelling carried out for a sample set • Operational energy limits set in planning to be met • Compliance with the 'passive design test' (full), or commitment to comply (outline).
	Format	Outline applications: • Commitment to achieve operational energy limits and use of predictive energy modelling. Demonstration of environmental design and how it will contribute to meeting operational limits. Full and reserved matters applications: • Energy and carbon proforma that collates and summarises the predictive energy modelling results. • Supplementary energy and carbon statement describing how a reduction in operational energy has been achieved, with appendices for detailed results from modelling. This should include a low carbon heat appraisal and outcomes of the cooling passive design test.
	Governance	• Refusal of permission or offsetting route if limits are not met.
Discharge of pre-commencement condition, required again as part of Discharge of pre-occupation	Description	• Updated predictive energy modelling carried out for all buildings. Confirmation that the SHD, EUI limits and Renewable energy targets submitted at planning have been followed through during construction.
	Format	• Resubmission of energy and carbon proforma • Confirmations statement of any amendments made since planning permission was granted.
	Governance	• Officer discretion with regards to actions to be taken in relation to compliance with policy or non-alignment with original planning application.

Operational energy policies | Simplified submission process

In order to make a submission process more simple and effective, it could be split into two parts:

- **Energy and Carbon Proforma** - A summary Excel tool for applicants to complete and submit as part of outline and full planning applications. This summary tool would simply require the entry of final results, rather than form part of the processing/calculation of data to generate results. The data entered into the proforma would be expected to be backed by further detail included in an Energy and Carbon Statement.
- **Energy and Carbon Statement** - An Energy and Carbon Statement using a standardised contents list to describe how a development meets the energy and carbon policies. It need not be more than a 20+ page report with appendices containing supplementary reports (overheating, embodied carbon and low carbon heat appraisals).

Bringing proportionality to policy and planning submissions

The scale of submission requirements should be proportionate to the scale of the development (minor/major/referable). Submission requirements should also vary depending on the stage/type of application (outline planning application or full/reserved matters application), and by sector.

Use of a simplified energy proforma

In our work for Greater Manchester Combined Authority we found the introduction of a simplified proforma, completed by the applicant, is a useful way to streamline the planning application process (for both applicants and local authorities). A series of residential and non-residential proformas brought proportionality to the submission for different scales of development. The proforma collects results on key metrics for each building/block that can be compared back to policy to determine compliance. Additional supporting data (such as form factor, U-value and efficiency of heating system) is also captured to give an indication of how plausible the results are.

Greater Manchester Combined Authority, Places for Everyone Energy and Carbon Proforma. Three residential and three non-residential proformas bring proportionality to submissions and have been provided for applicants to complete as part of their planning application.

Breakdown of development types and scales:

	Minor development		Major development	
	Small minor	Minor	Major	Large major
Residential	Single home and extra large extensions	2-9 homes	10-149 homes	+150 homes
Non-residential	<100m ²	100-999m ²	1,000-4,999m ²	+5,000m ²

Energy and Carbon Proforma requirement for type and scale of development:

	Minor development		Major development	
	Small minor	Minor	Major	Large major
Residential	Residential Small minor Proforma	Residential Minor Proforma	Residential Major Proforma	
Non-residential	Non-residential Small minor Proforma	Non-residential Minor Proforma	Non-residential Major Proforma	

Energy and Carbon Statement requirement for type and scale of development:

	Minor development		Major development	
	Small minor	Minor	Major	Large major
Residential	Design and access statement	Energy and Carbon Statement		
Non-residential	Design and access statement	Energy and Carbon Statement		

Operational energy policies | The energy modelling and results process could be simpler

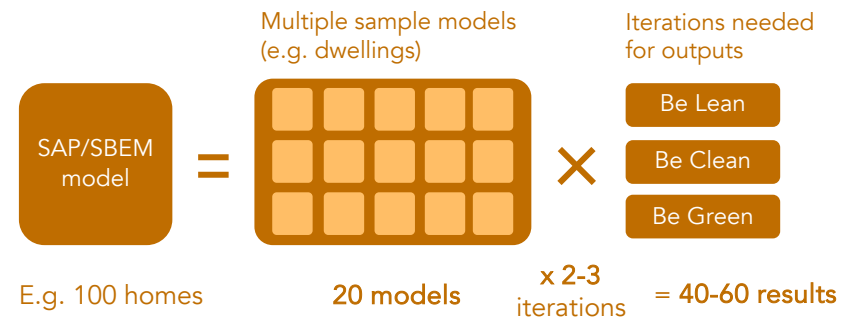
Current position

The GLA currently requires the completion of a Part L carbon emission spreadsheet, which takes raw SAP/SBEM data and provides an auto calculated summary to declare the Be Lean, Be Clean and Be Green results for policy compliance. Whilst this spreadsheet is relatively fool proof for applicants to complete, it can also be time consuming and prescriptive. The spreadsheet requires all sample dwellings and buildings to be entered individually; this includes their target and dwelling/building emissions for each step of the energy hierarchy. As a result, consultants are required to build multiple versions of the SAP and SBEM models (for each step of the hierarchy). This often results in them developing their own spreadsheets to pre-process data for copying and pasting into the GLA spreadsheet. For example: For a development with 100 homes across 2 blocks, with 40 representative models made, and all models iterated 3 times (for Be Lean, Be Clean, and Be Green results) - this totals 120 sets of results being included in the GLA spreadsheet.

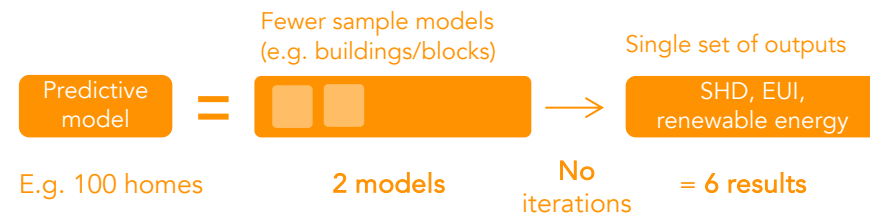
Reducing time and complexity through new metrics and fewer models

Using predictive modelling to generate space heating demand and energy use intensity means the results can be calculated in a single model for each building or block. Models do not need to be copied and edited/iterated to produce results for each stage of the hierarchy, instead the new metrics are collected for each building or block. For the same example as above, only 2 models would be required, with no iterations. Totalling 6 results being included in the submission to cover space heating demand, energy use intensity and renewable energy generation. Therefore, while it may feel more complex or unfamiliar to use predictive energy modelling, much less of it will be required than the current system.

Illustration of potential for reduced complexity through change of modelling methodology and updated operational energy metrics



Current GLA modelling methodology. It is familiar to applicants because it uses regulatory modelling methods, but it has increased complexity through the number of iterations required for Be Lean, Be Clean, and Be Green outputs (40-60 results).



Proposed modelling methodology. It is less-familiar as it requires predictive energy modelling, but it is less complex because far fewer models are required to generate the outputs.

Note where HEM is used, the modeling is per flat, thus there are still 20 models, GLA would receive block compliance data, so the reporting would still be 6 results.

Predictive energy modelling | Residential

Part L modelling – residential buildings

Standard Assessment Procedure (SAP 10.2) was developed to check compliance with Building Regulations. SAP was not developed to predict the energy performance of a home, and more importantly was not meant to predict future energy use accurately. This is a widely accepted fact, hence why the Government is developing a new energy modelling methodology for residential buildings: the Home Energy Model (HEM) and its Future Homes Standard (FHS) wrapper.

A move to predictive energy modelling

To influence the energy efficiency of the building design and improve performance outcomes, we must move to the use of predictive energy modelling (e.g. Passivhaus Planning Package (PHPP), or when complete and tested the future building regulations model – Home Energy Model (HEM)). Predictive modelling not only gives more accurate predictions of performance, but it can also better influence early design to ensure the thermal envelope and systems are better designed.

Predictive energy modelling for residential buildings

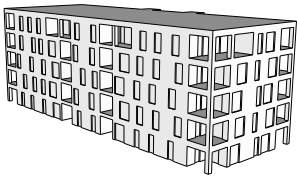
Benefits of using predictive modelling for new residential projects include:

- Greater accuracy (e.g. London weather file, more accurate shading assessment, ventilation duct heat losses taken into account)
- Inclusion of unregulated energy (e.g. cooking and appliances)
- Ability to assess the benefit of better building orientations, building form and window sizes early during the design.

Applicants should summarise their key modelling assumptions to make it easier for the local planning authority to review them.

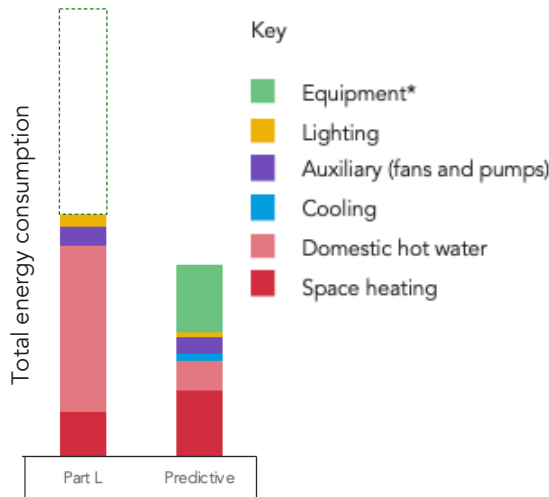
The use of PHPP is independent of meeting Passivhaus standards and certification.

Part L modelling	Predictive modelling	HEM
SAP 10.2	PHPP	HEM:FHS
Used to check compliance with Part L 2021	Used to predict space heating demand and energy use (it is also used to check compliance with Passivhaus Standard)	Will be used to check compliance with Future Home Standard
To be replaced by HEM in 2025/2026	Agnostic of building regulation methodology changes	From 2025/2026
Least accurate • UK standard weather file • Underestimates space heating and overestimates domestic hot water and appliances	Most accurate • Specific weather conditions and location used • As-built performance predicted more accurately	To be determined



There is a significant difference between Part L modelling currently used to demonstrate compliance with building regulations and predictive energy use modelling which should be used to demonstrate compliance with the proposed policies.

(Source: Delivering Net Zero Study, 2023)



SAP doesn't account for unregulated emissions, over estimates hot water energy consumption, while under-estimating space heating.

Predictive energy modelling | Non-residential

Part L modelling – non-residential buildings

The NCM (National Calculation Methodology) is the calculation methodology used on new non-residential buildings and is used through the Simplified Building Energy Model (SBEM) and Dynamic Simulation Modelling (DSM) tools in order to demonstrate compliance with Part L of the Building Regulations. However, this methodology was never meant to perform key functions that are required to assess Net Zero Carbon buildings, and most importantly they were not meant to predict future energy use accurately. This is why the use of predictive energy modelling is required to demonstrate compliance with Net Zero requirements.

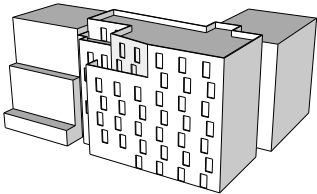
Predictive energy modelling for residential buildings

For non-residential buildings, PHPP methodology (an excel based tool) has also been shown to predict energy use accurately. The methodology set out in CIBSE Technical Memorandum 54 (TM54) can also be followed for DSM models. Benefits of using predictive modelling on new non-residential building projects include:

- Ability to model opening/working hours and occupancy patterns specifically.
- Inclusion of unregulated energy (e.g. IT and equipment).
- Possibility to compare predictive performance against benchmarks for similar buildings.

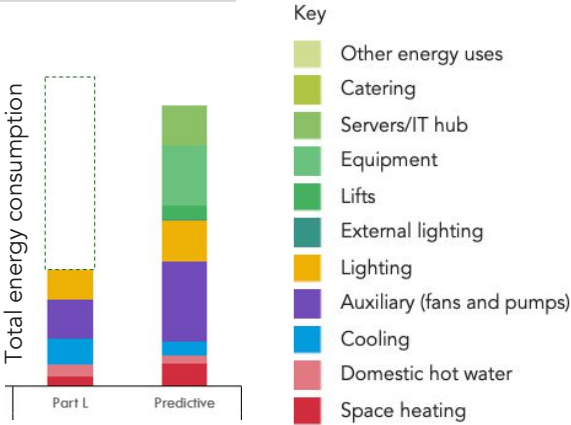
Applicants should summarise their key assumptions to make it easier for the local planning authority to review them.

Part L modelling	Predictive modelling
SBEM and DSM for Part L (e.g. IES , TAS)	DSM for CIBSE TM 54 (e.g. IES , TAS), PHPP, DfP NABERS modelling
Used to check compliance with Part L 2021	Used to predict space heating demand and energy use (PHPP is also used to check compliance with Passivhaus Standard)
No planned updates	Agnostic of building regulation methodology changes
Least accurate • High level of standardisation • Underestimates space heating and overestimates domestic hot water and equipment (incl. IT)	Most accurate • As-built performance predicted more accurately



There is a significant difference between Part L modelling currently used to demonstrate compliance with building regulations and predictive energy use modelling which should be used to demonstrate compliance with the proposed policies.

(Source: Delivering Net Zero Study, 2023)



SBEM doesn't account for unregulated emissions, and grossly under estimates energy consumption, especially related to improvements to the building fabric.

Next steps to consider | Predictive modelling guidance for non residential buildings

Standardisation of predictive energy modelling

There are various approaches to carrying out predictive energy modelling. If an EUI limit is incorporated into policy then it is important that guidance is produced for applicants on how to carry out this energy modelling. Without some level of standardisation, results could vary significantly between applicants, similar to the inconsistencies observed in Whole Life Carbon assessments. This poses a risk of unfairly penalising applicants who use more accurate methods compared to those who don't. This guidance can be drawn from various sources that already exist, such as CIBSE TM54, the LETI Operational energy modelling guide, RICS Whole life carbon assessment guidance for the built environment and NABERS design for performance modelling guidance.

Standardisation/ guidance can be light touch or more detailed.

Options are listed below, with pros and cons opposite:

1. Predictive energy modeling - with no template assumptions

Guidance on the steps required, level of detail required to be carried out as well as the outputs.

2. Standardised predictive energy modeling - with template assumptions (this could be called performance modelling).

Providing default assumptions on inputs such as occupancy density, operating hours and temperature set points. (as well as the guidance mentioned in Option 1)

3. A two-step process, where first a performance model using template assumptions is developed and then for buildings where the assumptions are significantly different from the template, assumptions are updated and to create a predictive model.

If there is predictive energy modeling - with no template assumptions

PROS	CONS
✓ Model is highly bespoke to the building	✗ For some building types the intended occupier is not known at planning stage (e.g. small retail units as part of a multi-use scheme) or the intended use is variable (e.g. industrial, science and tech). This means that energy modelers will have to use their own default assumptions, depending on what they use it will be easier or harder to meet the SHD and EUI limits.
✓ The design team can fully understand the energy reduction benefits of various fabric and system efficiencies	
✓ Provides an accurate prediction of the energy consumption	
✓ In-use energy consumption results from the Be Seen policy can be compared to the results	✗ For a more typical building, like a home, not having standardised assumptions means greater variance in modelling results even though they should be consistent. Making it difficult to understand why a dwelling may be performing better or worse than the SHD and EUI limits.

If there is standardised predictive energy modeling - with template assumptions

PROS	CONS
✓ Easier for limits to be met as there is more consistency	✗ Does not predict the energy use as accurately as the bespoke approach above (unless Stage 5 energy modelling is completed with bespoke assumptions).

If there is a two-step process

PROS	CONS
As this has both model types, it has all of the pros of the predictive energy model and the performance model	✗ This process requires to versions of the energy modelling for buildings the assumptions on how the building is used are significantly different from the template assumptions.

Low carbon heat appraisal

Planning has a key role to play in the selection of the best low carbon heating system. In our previous work we have found the introduction of a low carbon heat appraisal as part of the planning submission to be beneficial.

Selecting the most suitable low carbon heating system

In order to enable applicants to select the most suitable low carbon heating system and to facilitate the GLA and local authorities' appraisal of their proposal, the following KPIs are recommended:

Impact on residents: estimated energy, maintenance and replacement costs and additional cost compared to a 'benchmark' low carbon heating system (e.g. (on-site air source heat pump)).

Impact on viability: estimated capital costs of selected heating system and additional cost compared to a 'benchmark' low carbon heating system (e.g. (on-site air source heat pump)).

Environmental performance: whether the system uses fossil fuels or not, its predicted carbon content of heat and whether it will create any local pollution issues. Embodied carbon/whole life carbon as an optional KPI.

Infrastructure development: whether the scheme is proposing to connect to the local low carbon heat network or not with suitable justification for exemption if required.

A 'Low carbon heat appraisal' is recommended for all applications

It is recommended that all planning applications include a Low Carbon Heat Appraisal and that the most suitable low carbon heating system is proposed. However, the level of analysis and reporting expected will vary depending on the scale and location of the planning application.

Performance area	Key indicator	Unit
Impact on residents/ building users	1. Estimated energy costs for heating and hot water	£/yr
	2. Estimated maintenance costs	£/yr (annualised)
	3. Estimated replacement costs	£/yr (annualised)
	4. Additional operating costs compared with benchmark low carbon heating system including standing charge. ¹	+/- %
Net Zero and environmental performance	5. Fossil fuel use	yes/no
	6. Carbon content of heat	gCO ₂ /kWh of delivered heat
	7. Local pollution	description
Infrastructure development	8. Connection to low carbon heat network	yes/no
	9. Scale of application	m ² GIA
Viability	10. Capital cost of installing the system ²	£ per m ²

Proposed Indicators to be assessed in the low carbon heat appraisal

¹ Where a connection to a DHN is included in the comparison, the standing charge should be included, as some district heating network operators have lower connection costs, but then increase standing charge, if this is the case, this needs to be included.

² For systems that connect to district heating, this include the connection costs)

How to support London boroughs implementing the policies

The policies in the new London plan will be implemented by London boroughs, as well as the GLA. There is a varying amount of resources and skills London boroughs, therefore it is important that they are supported so that they can implement the policies effectively and consistently. At the stakeholder engagement workshop with London boroughs, there was general support of the proposed policy options, for more information see the Appendix. Various items below were discussed in the workshop:

Supporting streamlining and time efficiency

- A simple proforma with all of the headline information on if policies are met or not. Yes/ no answers with references to the application reports to avoid contradictions which sometimes occur. This is similar to the 'Simplified submission process' described in the beginning of this report section.

Standardisation and consistency

- Guidance developed for policy officers that shows how to assess the proforma, and whether the results are acceptable or not, and what questions to ask the applicants.
- Centralised London wide database that the applicant uploads to via a portal that all boroughs use. Publicly accessible so it is clear if applicants are not meeting their obligations.¹
- Relevant S106 conditions be standardised and shared and used by all boroughs.

¹ It would be very beneficial if the proforma upload would negate the need for boroughs to submit an annual monitoring report, as they could be automatically generated.

LLDC 1.5°C Future Reporting Proforma Residential developments

Version 1.0

Date:

Project Name:
Project Phase:
RIBA Stage:

HFL Collaboration Programme summary reporting table (auto-calculated)																	
RIBA stage	No. of buildings on site	Area (m ² GIA)	Minimum no. of storeys in development	Maximum no. of storeys in development	Space heating demand (kWh/m ² /yr) area weighted	Energy use intensity (kWh/m ² /yr) area weighted	On-site fossil fuels (kWh/m ² /yr) area weighted	On-site renewable energy generation (kWh/m ² /yr) area weighted	Energy balance (%) whole site	Upfront embodied carbon (kgCO ₂ e/m ²) area weighted	Life cycle carbon (kgCO ₂ e/m ²) area weighted	Overheating assessment - using Part O/TM59 (pass/ fail)	Urban Tree Canopy Cover (%)	Biodiversity Net Gain (%)	Urban greening factor	Water consumption (litres/ person/ day)	
-	0	0	0	0	0	0	-	0	0%	0	0	-	0	0	0	0	
Ref. name																	
No. dwellings																	
No. storeys																	
Area (m ² GIA)																	
Target values	Building 1	Building 2	Building 3	Building 4	Building 5	Building 6	Building 7	Building 8	Building 9	Building 10	Building 11	Building 12	Building 13	Building 14	Building 15	Building 16	Building 17
Calculation methodology used to calculate operational energy and confirmation that this covers all homes/blocks	PHPP																
Space heating demand (kWh/m ² GIA/yr)	Target: ≤15																
Energy use intensity (kWh/m ² GIA/yr)	Target: ≤35																
Electricity generation intensity (kWh/m ² pl/yr)	Target: ≥120																
Calculation methodology used to calculate embodied carbon and confirmation that this covers all homes/blocks	RICS Whole life carbon assessment Professional Statement 2nd edition																
Upfront embodied carbon A1-A5 (kgCO ₂ e/m ² GIA)	Benchmark: ≤500																
Life cycle carbon A-C - B6 & B7 excluded (kgCO ₂ e/m ² GIA)	Reporting only																
Whole life carbon A-C - B6 & B7 included (kgCO ₂ e/m ² GIA)	Reporting only																
Overheating assessment - using Part O/TM59 (pass/ fail) - all sample homes/buildings tested are expected to pass	Pass both Part O and CIBSE TM59																
Water demand - meet AECB standards	Good Practice																
Additional metrics required to be reported by the HFL Collaboration																	
On-site fossil fuels	No																
Urban Tree Canopy Cover (%)	N/A																
Biodiversity Net Gain (%)	N/A																
Urban greening factor	N/A																

LLDC development team has a reporting proforma for the design team to complete for each new development. This also brings together headline information at the top of the spreadsheet relating to the GLA Group's four development organisations: GLA Land and Property Ltd (GLAP); London Legacy Development Corporation (LLDC); Transport for London -Places for London; and Old Oak and Park Royal Development Corporation (OPDC). This allows for efficient collation and reporting back to the GLA Group Board as part of Homes for Londoners reporting.

11.0

Appendices



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Construction cost assessment | Methodology

Proposed approach for costing:

construction cost analysis was undertaken by Currie & Brown to benchmark the likely construction cost for the typologies under the modelled specifications for complying with the proposed performance levels.

Costing approach

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

The costs are based on Q2 2025 prices and reflect a London cost base.

Costs were developed for each affected element to identify the variance in price between the baseline London Plan-compliant specification and the enhanced specifications for SHD Levels 1-3, EUI levels 1-3, renewable energy levels 1 and 2. Those elements that are not materially affected by the energy efficiency / low carbon technology options, e.g., substructure, roof coverings, kitchen and bathrooms, etc, were not costed in detail. Instead, these costs were incorporated within the 'balance of construction' cost estimated by reference to a typical whole building construction cost per m² for the building type in question. This whole building cost was then adjusted for each option based on the variance in the elements costed in detail to determine the overall percentage impact on construction costs.

Calculation of the baseline build costs

A benchmark £/m² cost is estimated for each building type based on Currie & Brown's experience of helping deliver residential developments across London and represents an average citywide figure. These benchmark figures are deemed more representative of current development costs in London than other benchmark datasets which typically take voluntarily reported data from a range of development types across the UK.

The benchmark costs assume a medium specification recognising that 'discretionary' build costs can vary significantly dependent on design and specification choices to reflect target market requirements.

It should be noted that for the SHD, EUI and offsetting cost estimated cost impact PV panels were not included in the estimation as the analysis for the on-site renewable energy generation is undertaken as a separate item within this report.

Effects of scale of development on construction costs

In most instances the impact of development scale (larger or smaller development area) on the cost uplift associated with carbon policies is relatively linear, ie the cost is similar per m². This assumes a broadly similar form factor and equivalent use / target market. Exceptions to this include:

Photovoltaics where the building height and consequential footprint to gross internal area ratio will be key in determining the cost PV cost per m² of developed area.

Airtightness, where higher levels of airtightness are typically easier to achieve in larger buildings

Where development scale or design materially changes the building form factor it is likely that targets linked to heat loss will become more expensive to achieve where the external envelope to internal area ratio increases, this might be a result of reduced building size or change in shape – for example a terrace of houses linked on the shorter rather than the longer side.

Construction cost assessment | Renewable energy assumptions for costing

In order to develop the cost model to estimate the construction cost for installing solar PV onsite that meets the two performance levels for assessed typologies a solar PV generation calculation was carried out corresponding to the levels of performance.

Worst case (most costly) panel arrangements were assumed. On the terrace house it was assumed that the array faced East/West and on the remaining typologies a 15 degree East/West concertina arrangement was assumed.

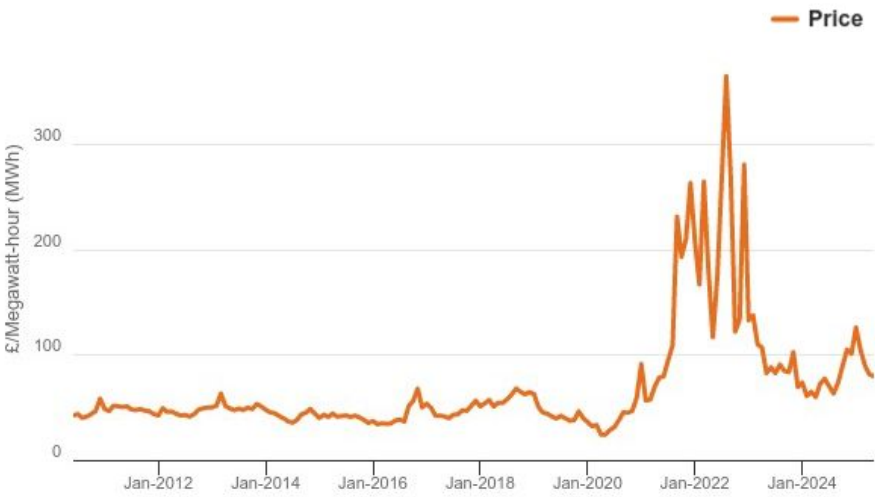
In the costing exercise, the cost of achieving the levels of performance is compared with a current London Plan baseline. The kWp for the current London Plan was calculated based on the solar PV installed on approved applications. For the non-residential developments, this was calculated by grouping information on approved applications by typology.

	Solar PV generation						
	Panel generation efficiency	Baseline		Level 1		Level 2	
	kWh/kWp	kWp	kWh	kWp	kWh	kWp	kWh
Terrace House	787	4	2,855	5	4,125	7	5,500
Low-rise apartment block	827	14	11,460	11	9,450	18	14,700
Mid-rise apartment block	827	50	41,580	41	34,290	64	53,340
High-rise apartment block	827	47	39,050	54	44,595	84	69,370
School	827	119	44,250	126	104,040	196	161,840
Large Industrial	827	119	66,410	206	170,625	275	227,500
Office	827	13	29,525	24	19,800	37	30,800
Hotel	827	Not calculated as cost assessment not carried out for hotel		21	17,190	32	26,740
Student Accommodation	827	13	53,095	36	29,790	56	46,340

Energy costs | Historical energy crisis, costs, and tariffs

Understanding the risks behind energy price volatility

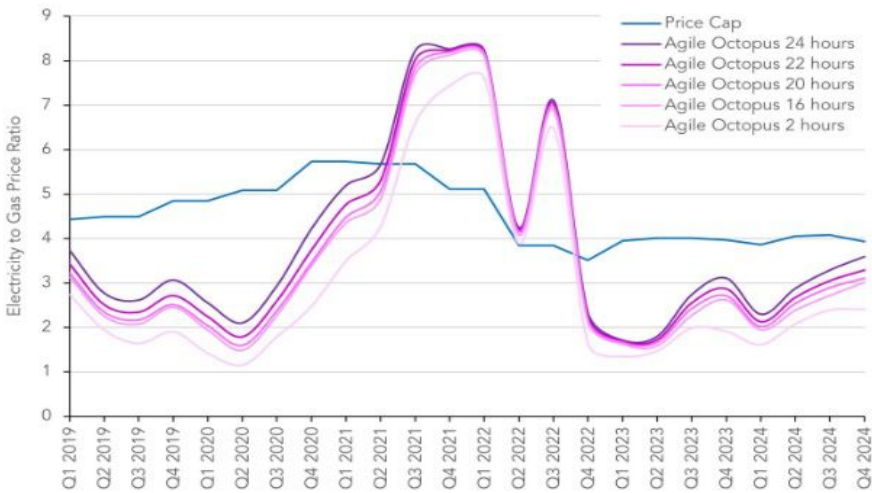
In 2022, the UK faced a severe energy crisis driven by global gas shortages, geopolitical instability, and record-high wholesale prices. Household energy bills soared, prompting government intervention through price caps and emergency support. While prices have since fallen, the structural risks remain. The UK continues to rely heavily on imported gas and is exposed to global market volatility. Future crises could be triggered by extreme weather, supply disruptions, or geopolitical tensions. As London transitions to a low-carbon energy system, short-term volatility may persist. Understanding how household energy use and tariff selection influence exposure to these risks is increasingly important. The impact of different performance levels on energy costs slide outlines how these factors interact and how energy performance decisions can help reduce vulnerability to future price shocks in line with the London Plan’s objectives.



Historical electricity prices (£/MWh) using monthly averages (OFGEM, 2025)

Pricing trends and tariff structures in domestic electricity

As energy markets evolve, understanding domestic electricity pricing has become increasingly important for households seeking to manage costs. Over recent years, electricity prices have shown notable volatility, as illustrated in the adjacent graph, which compares electricity-to-gas price ratios across standard and dynamic tariffs. The price cap tariff (blue line) shows a general upward trend, with sharp peaks in early and mid-2022. In contrast, Agile Octopus tariffs (pink lines) offer lower average prices during selected off-peak hours. These savings are most accessible when households can shift their energy use to off-peak periods, typically achievable only with technologies such as PV battery storage. Without such systems, the benefits of dynamic tariffs may be overstated for the average household.



Electricity to gas price ratios for price cap tariff vs Agile Octopus tariff. Pink lines show the quarterly average prices for the cheapest, 2, 16, 20, or 22 hour periods.

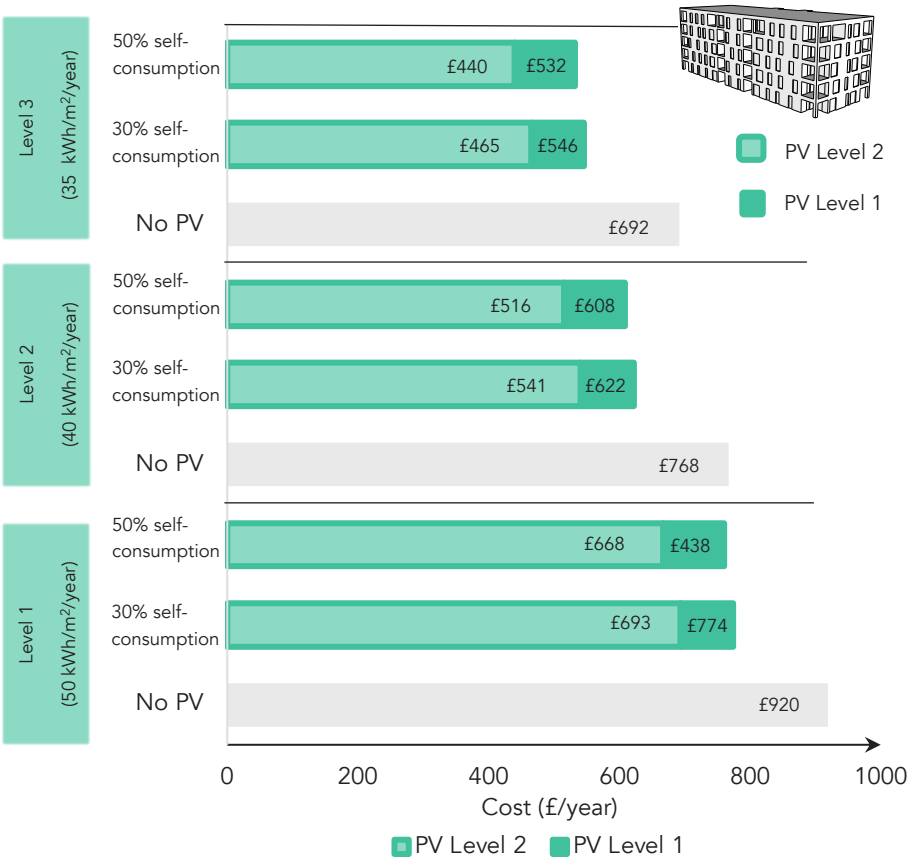
Energy costs | Savings from renewable energy | Residential

The estimated annual energy costs were calculated by combining imported energy charges with savings from photovoltaic (PV) generation. For each scenario, the total energy consumption was based on the flat’s EUI level (50, 40, or 35 kWh/m²/year) multiplied by the flat’s area (60 m²). PV generation was modelled for two system sizes (Level 1 and Level 2, with annual outputs per flat of 1,106 kWh and 1,720 kWh respectively)

Two self-consumption rates were applied: 30% and 50%. The portion of PV energy not consumed on-site was assumed to be exported to the grid at a fixed rate of £0.15/kWh. The export tariff was selected with reference to the [Solar Energy UK’s league table of export tariffs](#), which shows a range of recent Smart Export Guarantee (SEG) tariffs. A conservative mid-range value of 0.15 £/kWh was chosen to reflect a realistic but cautious assumption that avoids overstating avoiding both the very high and very low outliers.

Export revenue was calculated by multiplying exported energy by this rate. Avoided grid import costs were determined by multiplying the self-consumed PV energy by the 2024 price cap of £0.25/kWh.

Total savings for each scenario were the sum of export revenue and avoided import costs. Net annual energy cost was then calculated by subtracting these savings from the baseline cost of grid-supplied energy. This method allows for a consistent comparison across energy performance levels and PV configurations, highlighting the energy cost impact of onsite solar PV and EUI level.



Estimated annual energy costs (£/year) for a 60 m² mid-rise flat in London, based on 2024 energy prices. The analysis compares three energy performance levels and two levels of photovoltaic (PV) generation. Self-consumption rates of 30% and 50% are considered.

Tariff Type	Unit price (£/kWh)	Standing charge (£/yr)
Price cap	0.25	159.72
Fixed rate export tariff	0.15	-

2024 average tariffs used for PV cost reduction calculations

Energy costs | Savings from renewable energy | Non-residential

Summary of methodology

Annual energy costs for non-residential typologies have been modelled across three EUI levels with and without on-site PV. Savings are calculated using the Green Book 2025 central electricity price for commercial/ public sector (0.188 £/kWh) and an export tariff of 0.15 £/kWh. The export tariff was selected with reference to the [Solar Energy UK's league table of export tariffs](#), which shows a range of recent Smart Export Guarantee (SEG) tariffs. A conservative mid-range value of 0.15 £/kWh was chosen to reflect a realistic but cautious assumption that avoids overstating avoiding both the very high and very low outliers. A self consumption rate of 50% was assumed in the calculations

PV energy cost savings summary

The table opposite demonstrates that PV can deliver substantial reductions in annual energy costs across most non-residential typologies, with the greatest benefits seen at higher EUI levels.

Primary schools achieve savings of up to 61% at PV Level 2 with EUI Level 3, while industrial show the largest relative reductions, ranging from 43% to 76% depending on performance level due to large roof areas (compared to floor area) enabling high PV application. Office buildings see the lowest benefits (3–10%) and student accommodation achieves more modest savings (5–12%) due to the limited roof-to-floor area ratio, which constrains available PV capacity.

Typology		Annual energy cost (£/yr)			Reduction in running costs from having no PV installed	
		No PV	PV Level 1	PV Level 2	PV Level 1	PV Level 2
Office	EUI Level 1	97,866	94,518	92,657	3%	5%
	EUI Level 2	67,753	64,405	62,545	5%	8%
	EUI Level 3	52,697	49,349	47,489	6%	10%
Primary School	EUI Level 1	73,399	55,806	46,032	24%	37%
	EUI Level 2	58,719	41,126	31,352	30%	47%
	EUI Level 3	45,169	27,575	17,801	39%	61%
Industrial	EUI Level 1	67,753	38,900	29,283	43%	57%
	EUI Level 2	59,284	30,431	20,813	49%	65%
	EUI Level 3	50,815	21,962	12,344	57%	76%
Student Accommodation	EUI Level 1	108,405	103,368	100,569	5%	7%
	EUI Level 2	88,079	83,042	80,243	6%	9%
	EUI Level 3	67,753	62,716	59,917	7%	12%

Technical specifications

The following pages outline the technical specifications that were used in the energy modeling, in order to understand the impacts of building fabric and systems on to meet space heating demand and EUI.

These are set out by typology, starting with residential, and for each typology the specification is split into **Fabric and Ventilation** and **Building services**.

Combinations of the the building fabric and systems, that represented the cheapest way of meeting the performance levels were then used in the cost analysis.



Mid rise apartment building | Fabric & Ventilation



This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios.

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m ² K)	0.13	0.10	0.08
External wall U-Value (W/m ² K)	0.18	0.15	0.13
Roof U-Value (W/m ² K)	0.15	0.12	0.10
Soffit U-Value (W/m ² K)	N/A	N/A	N/A
Windows U-value (W/m ² K) Window g-value	1.40 0.4	1.20 0.5	0.80 0.5
External doors (W/m ² K)	1.40	1.20	1.00
Thermal bridging (W/m ² K)	Good practice (e.g. y-value = 0.1 W/m ² K)	Better practice (e.g. y-value = 0.07 W/m ² K)	Best practice (e.g. y-value = 0.04 W/m ² K)
Air Permeability (m ³ /m ² /hr)	<3	<3	<1
Ventilation system and design	Good quality MVHR Long ducts to outside	High quality MVHR Long ducts to outside	High quality MVHR Short ducts to outside
MVHR heat recovery efficiency	85% (77% when coupled with System B)	85% (77% when coupled with System B)	90% (77% when coupled with System B)
MVHR specific fan power	0.8 W/l/s (SAP) 1.75 W/l/s (PHPP)	0.7 W/l/s (SAP) 1.25 W/l/s (PHPP)	0.6 W/l/s (SAP) 0.85 W/l/s (PHPP)

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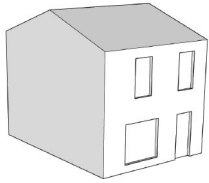
Mid rise apartment building | Building services



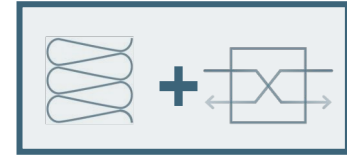
This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Direct electric	B Communal heat pump serving residential unit via HIU (baseline system for cost analysis)	C Ambient loop
Description	Direct electric and individual hot water cylinder	Communal heat pump with high temperature loop	Communal heat pump with ambient loop serving water to water heat pumps
Communal heating distribution and Distribution Loss Factor (DLF)	N/A	Flow and return temperature 65°C/50°C. Assumed DLF = 1.5	Flow and return temperature 45°C/30°C. Assumed DLF = 1.2
Heating emitters	Direct electric panel radiators	LTHW radiators fed by HIU	LTHW radiators fed by water to water heat pump
Hot water system	A 150L hot water store in each unit	HIU provides instantaneous hot water	A 180L hot water store in each unit
Heating and hot water seasonal efficiency	100%	250% space heating 250% water heating Flow temperature 50°C	300% space heating 300% water heating Flow temperature 45°C
Showers	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each
Waste Water Heat Recovery	No WWHR assumed	No WWHR assumed	No WWHR assumed
Internal lighting	10 light bulbs @ 5W and 95W	10 light bulbs @ 5W and 95W	10 light bulbs @ 5W and 95W

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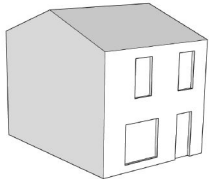


Terrace House | Building fabric

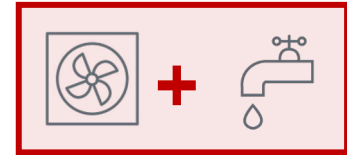


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.11	0.10	0.08
External wall U-Value (W/m²K)	0.18	0.15	0.11
Roof U-Value (W/m²K)	0.13	0.12	0.10
Soffit U-Value (W/m²K)	N/A	N/A	N/A
Windows			
U-value (W/m ² K)	1.40	1.20	0.80
Windows g-value	0.6	0.6	0.6
External doors (W/m²K)	1.6	1.4	1.2
Thermal bridging (W/m²K)	Good practice (e.g. γ -value $\approx$ 0.08 W/m ² K)	Better practice (e.g. γ -value $\approx$ 0.05 W/m ² K)	Best practice (e.g. γ -value $\approx$ 0.04 W/m ² K)
Air Permeability (m³/m²/hr)	3	2	<1
Ventilation system and design	Good quality MVHR Long ducts to outside	Good quality MVHR Long ducts to outside	High quality MVHR Short ducts to outside
MVHR heat recovery efficiency	85% (77% when coupled with System B)	85% (77% when coupled with System B)	90% (77% when coupled with System B)
MVHR specific fan power	0.8 W/l/s (SAP) 1.75 W/l/s (PHPP)	0.7 W/l/s (SAP) 1.25 W/l/s (PHPP)	0.6 W/l/s (SAP) 0.85 W/l/s (PHPP)



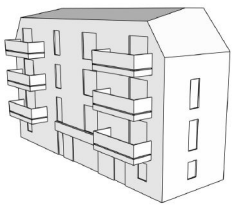
Terrace House | Building services



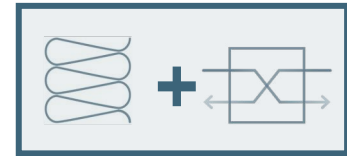
This table summarises the different heating system assumptions modelled based on the four different scenarios.

* New input for SAP 10.2

	A Direct electric	B Heat Pump (baseline system for cost analysis)	C Exhaust air heat pump	D Efficient Heat Pump System
Description	Direct electric and individual hot water cylinder	Individual air source heat pump serving each domestic unit	Exhaust air source heat pump serving each domestic unit	Individual air source heat pump serving each domestic unit
Communal heating distribution and Distribution Loss Factor (DLF)	N/A	N/A	N/A	N/A
Heating emitters	Direct electric panel radiators	LTHW radiators fed by individual heat pump or warm air	LTHW radiators fed by individual heat pump or warm air	LTHW radiators fed by individual heat pump or warm air
Hot water system	A 150L hot water store in each unit	A 180L hot water store in each unit	A 180L hot water store in each unit	A 200L hot water store in each unit
Heating and hot water seasonal efficiency	100%	270% space heating 210% water heating <i>Blended efficiencies for SAP models 1/2/3: 253% /245% / 235%</i> <i>Flow temperature 45°C</i>	247% space heating 193% water heating <i>Flow temperature 45°C</i>	348% space heating 361% water heating <i>Flow temperature 45°C</i>
Showers*	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each
Waste Water Heat Recovery	No WWHR assumed	No WWHR assumed	No WWHR assumed	No WWHR assumed
Internal lighting	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW



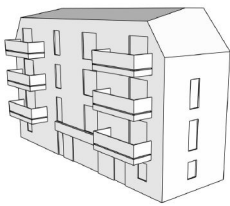
Low rise apartment building | Fabric & Ventilation



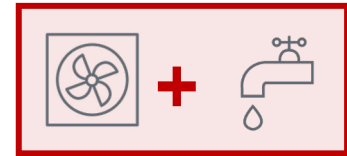
This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios.
The SAP Calculations assume a 5 story building.

* New input for SAP 10.2

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.13	0.10	0.08
External wall U-Value (W/m²K)	0.18	0.15	0.13
Roof U-Value (W/m²K)	0.15	0.12	0.10
Soffit U-Value (W/m²K)	N/A	N/A	N/A
Windows U-value (W/m ² K) Windows g-value	1.40 0.6	1.20 0.6	0.80 0.5
External doors (W/m²K)	1.40	1.20	1.00
Thermal bridging (W/m²K)	Good practice (e.g. γ -value $\approx$ 0.1 W/m ² K)	Better practice (e.g. γ -value $\approx$ 0.07 W/m ² K)	Best practice (e.g. γ -value $\approx$ 0.04 W/m ² K)
Air Permeability (m³/m²/hr)	<3	<3	<1
Ventilation system and design	Good quality MVHR Long ducts to outside	High quality MVHR Long ducts to outside	High quality MVHR Short ducts to outside
MVHR heat recovery efficiency	85% (77% when coupled with System B)	85% (77% when coupled with System B)	90% (77% when coupled with System B)
MVHR specific fan power	0.8 W/l/s (SAP) 1.75 W/l/s (PHPP)	0.7 W/l/s (SAP) 1.25 W/l/s (PHPP)	0.6 W/l/s (SAP) 0.85 W/l/s (PHPP)



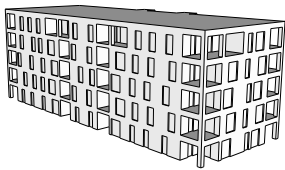
Low rise apartment building | Building services



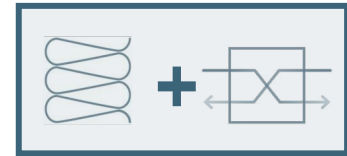
This table summarises the different heating system assumptions modelled based on the four different scenarios.

* New input for SAP 10.2

	A Direct electric	B Heat Pump (baseline system for cost analysis)	C Exhaust air heat pump	D Efficient Heat Pump System
Description	Direct electric and individual hot water cylinder	Communal air source heat pump supplying heat interface units in all flats	Exhaust air source heat pump serving each domestic unit	Individual air source heat pump serving each domestic unit
Communal heating distribution and Distribution Loss Factor (DLF)	N/A	Flow and return temperature 65°C/50°C . Assumed DLF = 1.5	N/A	N/A
Heating emitters	Direct electric panel radiators	LTHW radiators fed by HIU	LTHW radiators fed by individual heat pump or warm air	LTHW radiators fed by individual heat pump or warm air
Hot water system	A 150L hot water store in each unit	HIU provides instantaneous hot water	A 180L hot water store in each unit	A 200L hot water store in each unit
Heating and hot water seasonal efficiency	100%	190% space heating 210% water heating <i>Blended efficiencies for SAP models 1/2/3: 200% /201% / 204%</i>	247% space heating 193% water heating <i>Flow temperature 45°C</i>	348% space heating 361% water heating <i>Flow temperature 45°C</i>
Showers*	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each
Waste Water Heat Recovery	No WWHR assumed	No WWHR assumed	No WWHR assumed	No WWHR assumed
Internal lighting	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW



Mid rise apartment building | Fabric & Ventilation

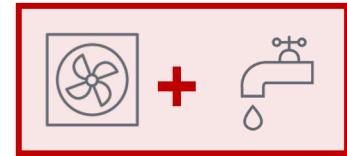


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios.

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.13	0.10	0.08
External wall U-Value (W/m²K)	0.18	0.15	0.13
Roof U-Value (W/m²K)	0.15	0.12	0.10
Soffit U-Value (W/m²K)	N/A	N/A	N/A
Windows U-value (W/m ² K) Windows g-value	1.40 0.4	1.20 0.5	0.80 0.5
External doors (W/m²K)	1.40	1.20	1.00
Thermal bridging (W/m²K)	Good practice (e.g. ψ -value $\approx$ 0.1 W/m ² K)	Better practice (e.g. ψ -value $\approx$ 0.07 W/m ² K)	Best practice (e.g. ψ -value $\approx$ 0.04 W/m ² K)
Air Permeability (m³/m²/hr)	<3	<3	<1
Ventilation system and design	Good quality MVHR Long ducts to outside	High quality MVHR Long ducts to outside	High quality MVHR Short ducts to outside
MVHR heat recovery efficiency	85% (77% when coupled with System B)	85% (77% when coupled with System B)	90% (77% when coupled with System B)
MVHR specific fan power	0.8 W/l/s (SAP) 1.75 W/l/s (PHPP)	0.7 W/l/s (SAP) 1.25 W/l/s (PHPP)	0.6 W/l/s (SAP) 0.85 W/l/s (PHPP)

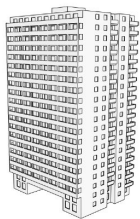


Mid rise apartment building | Building services

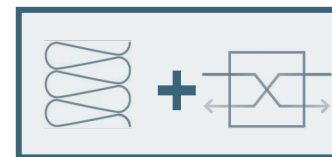


This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Direct electric	B Communal heat pump serving residential unit via HIU (baseline system for cost analysis)	C Ambient loop
Description	Direct electric and individual hot water cylinder	Communal heat pump with high temperature loop	Communal heat pump with ambient loop serving water to water heat pumps
Communal heating distribution and Distribution Loss Factor (DLF)	N/A	Flow and return temperature 65°C/50°C . Assumed DLF = 1.5	Flow and return temperature 45°C/30°C . Assumed DLF = 1.2
Heating emitters	Direct electric panel radiators	LTHW radiators fed by HIU	LTHW radiators fed by water to water heat pump
Hot water system	A 150L hot water store in each unit	HIU provides instantaneous hot water	A 180L hot water store in each unit
Heating and hot water seasonal efficiency	100%	250% space heating 250% water heating Flow temperature 50°C	300% space heating 300% water heating Flow temperature 45°C
Showers	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each
Waste Water Heat Recovery	No WWHR assumed	No WWHR assumed	No WWHR assumed
Internal lighting	10 light bulbs @ 5W and 95lW	10 light bulbs @ 5W and 95lW	10 light bulbs @ 5W and 95lW

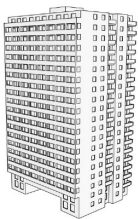


High rise apartment building | Fabric & Ventilation

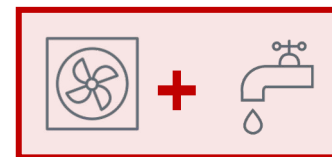


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios.

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.13	0.10	0.08
External wall U-Value (W/m²K)	0.18	0.18	0.15
Roof U-Value (W/m²K)	0.15	0.12	0.10
Soffit U-Value (W/m²K)	N/A	N/A	N/A
Windows			
U-value (W/m ² K)	1.40	1.20	0.90
Windows g-value	0.4	0.5	0.5
External doors (W/m²K)	1.40	1.20	1.00
Thermal bridging (W/m²K)	Good practice (e.g. γ -value $\approx$ 0.15 W/m ² K)	Better practice (e.g. γ -value $\approx$ 0.08 W/m ² K)	Best practice (e.g. γ -value $\approx$ 0.06 W/m ² K)
Air Permeability (m³/m²/hr)	<3	2	<1
Ventilation system and design	Good quality MVHR Long ducts to outside	High quality MVHR Long ducts to outside	High quality MVHR Short ducts to outside
MVHR heat recovery efficiency	85% (77% when coupled with System B)	85% (77% when coupled with System B)	90% (77% when coupled with System B)
MVHR specific fan power	0.8 W/l/s (SAP) 1.75 W/l/s (PHPP)	0.7 W/l/s (SAP) 1.25 W/l/s (PHPP)	0.6 W/l/s (SAP) 0.85 W/l/s (PHPP)

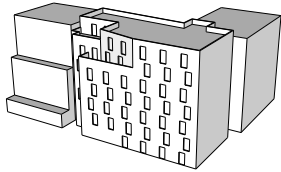


High rise apartment building | Building services

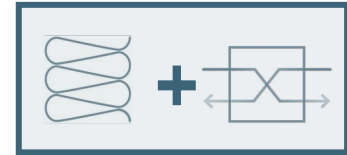


This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Direct electric	B Communal heat pump serving residential unit via HIU (baseline system for cost analysis)	C Ambient loop
Description	Direct electric and individual hot water cylinder	Communal heat pump with high temperature loop	Communal heat pump with ambient loop serving water to water heat pumps
Communal heating distribution and Distribution Loss Factor (DLF)	N/A	Flow and return temperature 65°C/50°C . Assumed DLF = 1.5	Flow and return temperature 45°C/30°C . Assumed DLF = 1.2
Heating emitters	Direct electric panel radiators	LTHW radiators fed by HIU	LTHW radiators fed by water to water heat pump
Hot water system	A 180L hot water store in each unit	HIU provides instantaneous hot water	A 180L hot water store in each unit
Heating and hot water seasonal efficiency	100%	250% space heating 220% water heating Flow temperature 50°C	300% space heating 300% water heating Flow temperature 45°C
Showers	2 showers – 8 l/min each	2 showers – 8 l/min each	2 showers – 8 l/min each
Waste Water Heat Recovery	No WWHR assumed	No WWHR assumed	No WWHR assumed
Internal lighting	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW	10 light bulbs @ 5W and 95IW

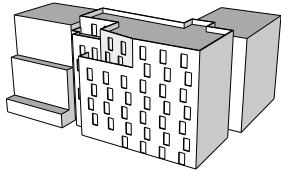


Office building | Fabric & Ventilation

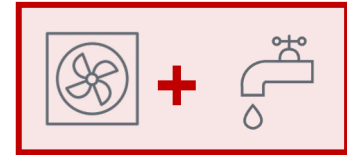


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios. Modelling was carried out for a 7-storey office of 4000m² GIA.

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.15	0.12	0.09
External wall U-Value (W/m²K)	0.25	0.18	0.13
Roof U-Value (W/m²K)	0.15	0.13	0.10
Windows			
U-value (W/m ² K)*	1.60	1.40	0.80
Windows g-value	0.40	0.40	0.40
External doors (W/m²K)	2.0	1.5	1.5
Thermal bridging (W/m²K)	Good practice (5% of losses)	Better practice (3% of losses)	Best practice (1% of losses)
Air Permeability (m³/m²/hr)	5	3	1
Ventilation system and design	Standard quality AHU	Good quality AHU	Best practice AHU
AHU heat recovery efficiency	75%	80%	90%
AHU specific fan power	1.8 W/l/s 0.3 W/l/s (FCU terminal units)	1.6 W/l/s 0.3 W/l/s (FCU terminal units)	1.2 W/l/s 0.3 W/l/s (FCU terminal units)
Demand Control Ventilation	No	Yes - CO ₂ sensors with speed control	Yes - CO ₂ sensors with speed control
Internal Lighting (lm/W)	95	105	115
Lighting Control	PIR Presence Detection + Daylight Dimming in Offices only	PIR Presence Detection + Daylight Dimming in Offices only	PIR Presence Detection + Daylight Dimming in Offices only

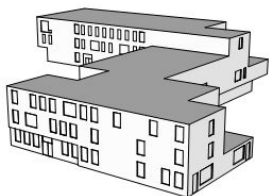


Office building | Building services

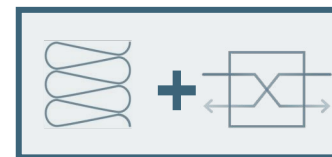


This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Gas boiler	B VRF (baseline system for cost analysis)	C Less efficient Heat Pump System <i>Communal heat pump</i>	D More Efficient Heat Pump System <i>Communal heat pump</i>
Description	Gas boiler serving a heating system with flow and return temperature 70°C/50°C	VRF unit	Heat pumps serving a heating system with flow and return temperature 65°C/50°C	Heat pumps serving a heating system with low flow and return temperatures 45°C/40°C fed from ambient loop.
Heating emitters	LTHW Fan Coil Unit fed by Gas Boiler	Fan Coil Unit fed by VRF	LTHW Fan Coil Unit fed by Heat Pump	LTHW Fan Coil Unit fed by Heat Pump
Hot water system	Direct electric hot water to toilets A 400L hot water store for the showers fed by gas boiler	Direct electric hot water to toilets A 400L hot water store for the showers fed by heat pump	Direct electric hot water to toilets A 400L hot water store for the showers fed by heat pump	Direct electric hot water to toilets A 400L hot water store for the showers fed by heat pump
Heating and hot water seasonal efficiency	95% for heating and hot water	350% for heating 300% for hot water	220% for heating and hot water	400% for heating 300% for hot water
Waste Water Heat Recovery (WWHR)	No WWHR assumed	No WWHR assumed	No WWHR assumed	No WWHR assumed
Cooling seasonal efficiency	3.5 EER 5.0 SEER	3.5 EER 5.0 SEER	3.5 EER 5.0 SEER	3.5 EER 5.0 SEER
Controls				More control zones than C, thus 10% more FCU's and 10% more control points

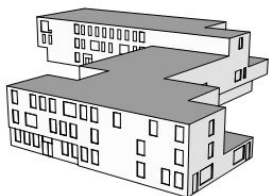


Primary school building | Fabric & Ventilation

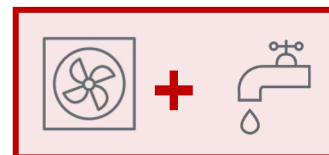


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios. Modelling was carried out for a 3/4-storey primary school of 6000m² GIA.

	1 Basic	2.1 Good Practice 1	2.2 Good Practice 2	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	Additional modelling was carried out on a different school, and an additional scenario developed (the differences in bold)	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m ² K)	0.15	0.12	0.119	0.09
External wall U-Value (W/m ² K)	0.20	0.18	0.13	0.10
Roof U-Value (W/m ² K)	0.15	0.13	0.12	0.09
Thermal bridge performance*	25% added to the U-values	25% added to the U-values	25% added to the U-values	25% added to the U-values
Windows				
U-value (W/m ² K)*	1.40	1.20	0.94	0.78
Windows g-value	0.50	0.50	0.50	0.50
External doors (W/m ² K)	1.6	1.6	1.13	0.93
Air Permeability (m ³ /m ² /hr)	5	3	1	0.6
Ventilation system and design	Fan assisted ventilation	Good quality MVHR	Best practice MVHR	Best practice MVHR
AHU heat recovery efficiency	0%	70%	85%	80%
AHU specific fan power	0.5 W/l/s	1.6 W/l/s	1.6 W/l/s	1.2 W/l/s
Demand Control Ventilation	No	No	Yes - CO2 sensors with speed control	Yes - CO2 sensors with speed control
Internal Lighting (lm/W)	95	105	105	115
Lighting Control	PIR Absence Detection + Daylight Dimming in Teaching and Offices only PIR Presence Detection in Circulation, Toilets, Stores, Kitchen, Dining, Server and Changing	PIR Absence Detection + Daylight Dimming in Teaching and Offices only PIR Presence Detection in Circulation, Toilets, Stores, Kitchen, Dining, Server and Changing	PIR Absence Detection + Daylight Dimming in Teaching and Offices only PIR Presence Detection in Circulation, Toilets, Stores, Kitchen, Dining, Server and Changing	PIR Absence Detection + Daylight Dimming in Teaching and Offices only PIR Presence Detection in Circulation, Toilets, Stores, Kitchen, Dining, Server and Changing

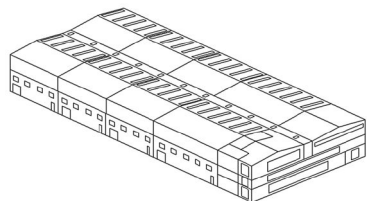


Primary school building | Building services

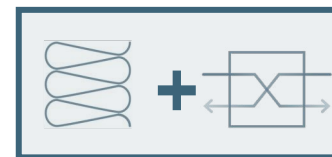


This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Gas boiler	B Direct electric	C Less efficient Heat Pump System <i>Communal heat pump</i> (baseline system for cost analysis)	D More Efficient Heat Pump System <i>Communal heat pump</i>
Description	Gas boiler serving a heating system with flow and return temperature 70°C/50°C	Direct electric panel radiators providing heating	Heat pumps serving a heating system with flow temperature 65°C	Heat pumps serving a heating system with low flow temperature 45°C fed from ambient loop
Heating emitters	LTHW radiators fed by gas boiler	Direct electric panel radiators	LTHW radiators fed by heat pump	LTHW radiators fed by heat pump
Hot water system	A 2500L hot water store	Direct electric point-of-use hot water to bathrooms	Direct electric point-of-use hot water to bathrooms	Direct electric point-of-use hot water to bathrooms
Heating and hot water seasonal efficiency	95% for heating and hot water	100% for heating and hot water	400% for heating* 100% for hot water	450% for heating* 100% for hot water
Waste Water Heat Recovery (WWHR)	No WWHR assumed	No WWHR assumed	No WWHR assumed	No WWHR assumed
Cooling seasonal efficiency	No cooling assumed	No cooling assumed	No cooling assumed	No cooling assumed
Distribution efficiency (heating, cooling and DHW)	95%	95%	95%	95%



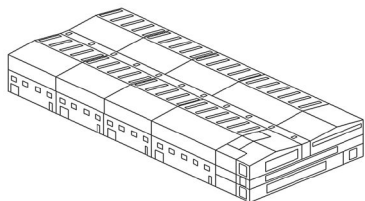
Industrial building | Fabric & Ventilation



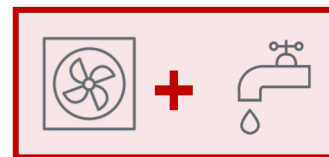
This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios. Modelling was carried out for a 2-storey industrial building of 9000m² GIA.

 New input for Part L 2021

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.18	0.15	0.13
External wall U-Value (W/m²K)	0.26	0.18	0.14
Roof U-Value (W/m²K)	0.16	0.13	0.11
Windows/Rooflights U-value (W/m ² K)* Windows g-value	1.60 / 2.00 0.40 / 0.50	1.40 / 1.60 0.40 / 0.50	1.20 / 1.40 0.40 / 0.50
External doors – Pedestrian / Vehicle (W/m²K)	2.0 / 1.3	1.5 / 1.3	1.5 / 1.3
Thermal bridging (W/m²K)	Good practice (5% of losses)	Better practice (3% of losses)	Best practice (1% of losses)
Air Permeability (m³/m²/hr)	5	3	2
Ventilation system and design	Industrial offices: AHU with HR Industrial warehouses: Exhaust only	Industrial offices: AHU with HR Industrial warehouses: AHU with HR	Industrial offices: AHU with HR Industrial warehouses: AHU with HR
AHU heat recovery efficiency	Industrial offices: 75% Industrial warehouses: NA	Industrial offices: 80% Industrial warehouses: 80%	Industrial offices: 80% Industrial warehouses: 80%
AHU specific fan power	Industrial offices: 1.6 (0.2 for terminal units) Industrial warehouses: 0.5	Industrial offices: 1.4 (0.2 for terminal units) Industrial warehouses: 1.4	Industrial offices: 1.2 (0.15 terminal units) Industrial warehouses: 1.2
Demand Control Ventilation 	No	No	Yes - CO ₂ sensors with speed control only in offices
Internal Lighting (lm/W) 	100	110	115
Lighting Control	PIR Presence Detection + Daylight Dimming in offices only	PIR Presence Detection + Daylight Dimming in offices only	PIR Presence Detection + Daylight Dimming in offices only

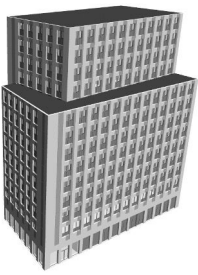


Industrial building | Building services

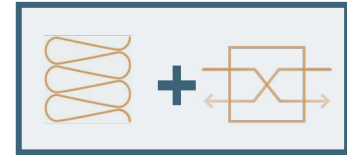


This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Gas boiler	B VRF (baseline system for cost analysis)	C Less efficient Heat Pump System <i>Four pipe chiller</i>	D More Efficient Heat Pump System <i>Central heat pump</i>
Description	Gas boiler serving a heating system with flow and return temperature 70°C/50°C	ASHP serving the warehouse spaces and VRF system for the office spaces.	Four pipe chiller which does simultaneous heating and cooling	Heat pumps serving a heating system with low flow and return temperatures 45°C/40°C fed from ambient loop.
Heating emitters (Workshop)	Radiant panels	Radiant panels	Radiant panels	Radiant panels
Heating seasonal efficiency (Workshop)	95%	300%	300%	350%
Heating emitters (Office)	FCU	FCU	FCU	FCU
Heating seasonal efficiency (Office)	95%	450%	300%	350%
Hot water system	Direct electric	Direct electric	Direct electric	Heat pump
Hot water seasonal efficiency	100%	100%	100%	300%
Cooling seasonal efficiency (Office spaces)	3.5 EER 5.0 SEER	3.5 EER 5.0 SEER	3.0 EER 4.0 SEER	3.5 EER 5.0 SEER

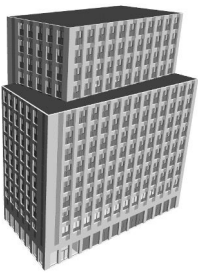


Student residential building | Fabric & Ventilation

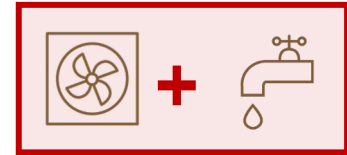


This table summarises the different energy efficiency assumptions modelled based on the three different fabric and ventilation scenarios. Modelling was carried out for a 14 storey student accommodation block with 264 bedrooms, ground floor facilities and 7200m² GIA. A concrete frame with lightweight external walls was assumed.

	1 Basic	2 Good Practice	3 Ultra Low Energy
Description	This scenario represents what has typically been built over the last 10 years	This scenario represents the type of energy efficiency performance most applicants are used to deliver.	This scenario represents a feasible best practice level of performance
Floor U-Value (W/m²K)	0.13	0.10	0.08
External wall U-Value (W/m²K)	0.18	0.18	0.15
Roof U-Value (W/m²K)	0.15	0.12	0.10
Thermal bridge performance*	30% added to the U-values	20% added to the U-values	10% added to the U-values
Windows			
U-value (W/m ² K)	1.40	1.20	0.90
Windows g-value	0.4	0.4	0.4
Air Permeability (m³/m²/hr)	5	3	1
Ventilation system and design	MVHR to each cluster	MVHR to each cluster	MVHR to each cluster
MVHR heat recovery efficiency	70%	70%	80%
MVHR specific fan power	1.6 W/l/s	1.4 W/l/s	1.2 W/l/s
Demand Control Ventilation	No	No	No
Internal Lighting efficacy (lm/W)	95	105	115
Lighting Control	Manual on/off and daylight controls are assumed for all kitchens. PIR presence detection in corridors and stairwells. Manual controls in all bedrooms.	Manual on/off and daylight controls are assumed for all kitchens. PIR presence detection in corridors and stairwells. Manual controls in all bedrooms.	Manual on/off and daylight controls are assumed for all kitchens. PIR presence detection in corridors and stairwells. Manual controls in all bedrooms.



Student residential building | Building services



This table summarises the different heating system assumptions modelled based on the four different scenarios.

	A Gas boiler <i>SH & DHW = Gas Boilers</i>	B Direct Electric <i>SH & DHW = Direct Electric</i> (baseline system for cost analysis)	C Mixed <i>SH = Direct electric</i> <i>DHW = basic heat pump (central)</i>	D More Efficient Heat Pump <i>SH = Heat pumps (450%)</i> <i>DHW = Heat pumps (300%)</i>
Description	Communal gas boiler heating system with flow and return temperature 70°C/50°C	Direct electric space heating and centralised direct electric hot water cylinders	Direct electric space heating Communal air source heat pumps serving DHW.	Communal air source heat pumps Flow and return temperature 35°C/30°C
Heating emitters	LTHW radiators	Direct electric panel radiators	Direct electric panel radiators	LTHW radiators
Hot water system	A central 8000L hot water store fed by gas boilers	Direct electric local 40-50 no. 200l cylinders	A central 8000L hot water store but fed by ASHP	A central 8000L hot water store but fed by ASHP
Heating and hot water seasonal efficiency	95% for heating and domestic hot water	100%	100% for space heating 250% for domestic hot water	450% for space heating 300% for hot water
Waste Water Heat Recovery (WWHR)	No WWHR assumed	No WWHR assumed	No WWHR assumed	No WWHR assumed
Cooling seasonal efficiency	No cooling	No cooling	No cooling	No cooling
Distribution efficiency (heating, cooling and DHW)	95% DHW 90%	100% DHW 95%	100% DHW 90%	95% DHW 95% (improved)

Construction cost assessment | Combinations of specifications

In order to develop the cost model to estimate the construction cost for meeting the performance level options, the combinations of building fabric and system scenarios that provide the cheapest way (of the scenarios tested) of meeting the SHD and EUI levels where chosen, these are shown in the table aside, and below

Typology	Baseline	SHD Level 1 EUI Level 1	SHD Level 2 EUI Level 2	SHD Level 3 EUI Level 3
Terrace house	Fabric: GP System: HP	Fabric: GP System: HP	Fabric: ULE System: DE	Fabric: ULE System: EAHP
Low-rise block of flats	Fabric: GP System: HP	Fabric: ULE System: DE	Fabric: ULE System: EAHP	Fabric: ULE System: EAHP
Mid-rise block of flats	Fabric: GP System: HP	Fabric: ULE System: DE	Fabric: GP System: HP	Fabric: ULE System: HP
High-rise block of flats	Fabric: GP System: HP	Fabric: GP System: DE	Fabric: ULE System: DE	Fabric: ULE System: HP
Office	Fabric: B System: VRF		Fabric: GP System: HP1	Fabric: ULE System: HP2
Primary School	Fabric: GP System: HP		Fabric: GP2 System: HP	Fabric: ULE System: HP2
Industrial	Fabric: B System: VRF		Fabric: B System: VRF	Fabric: GP System: VRF
Student Accommodation	Fabric: GP System: DE		Fabric: GP System: Mix	Fabric: GP System: HP

Fabric key:

B: Basic

GP: Good practice

GP2: Good practice 2

ULE: Ultra low energy

Systems key :

GB: Gas boiler

DE: Direct electric

VRF: Variable refrigerant flow

HP1: Less efficient heat pump

HP2: More efficient heat pump

EAHP: Exhaust air heat pump

Mix: Direct electric space heating with heat pump for space heating

Typology	Baseline	SHD Level 3 15 kWh/m ² /yr (GIA)	SHD Level 3 15 kWh/m ² /yr (GIA)	SHD Level 2 20 kWh/m ² /yr (GIA)
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house		Fabric: ULE System: DE	Fabric: ULE System: DE	Fabric: GP System: HP
Low-rise block of flats		Fabric: ULE System: DE	Fabric: ULE System: EAHP	Fabric: ULE System: EAHP
Mid-rise block of flats		Fabric: ULE System: DE	Fabric: ULE System: HP	Fabric: GP System: HP
High-rise block of flats		Fabric: ULE System: DE	Fabric: ULE System: DE	Fabric: GP System: HP

Tables illustrating the combinations of fabric and systems specifications that provide the cheapest way (of the scenarios tested) of meeting the SHD and EUI performance level options



Choosing models that best represent the current London Plan (1 of 2)

When choosing the scenarios that best represented the current London Plan, the Be Lean and the Be Green results from compliance analysis was reviewed. Where possible and relevant models were chosen that best aligned with meeting the be lean and be green policy requirements.

It should be noted that for the office and the primary school even the ultra low energy scenario does not meet the 15% Be Lean target, thus the scenarios chosen were based largely on the Be Green results.

Typology	% Carbon emission reductions at Be Lean		
	Basic	GP	ULE
Terrace house	-2%	18%	40%
Low-rise block of flats	-8%	7%	28%
Mid-rise block of flats	-1%	11%	27%
High-rise block of flats	-5%	6%	14%
Office	-43% (Heat pump/VRF baseline)	-26% (Heat pump/VRF baseline)	-22% (Heat pump/VRF baseline)
Primary School	-11% (Heat pump baseline)	-34% (Heat pump baseline)	-10% (Heat pump baseline)
Industrial	-4% (VRF baseline)	0% (VRF baseline)	7% (VRF baseline)
Student Accommodation	6% (Direct electric baseline)	15% (Direct electric baseline)	35% (Direct electric baseline)
	5% (Mixed)	18% (Mixed)	37% (Mixed)
	35% (Heat pump baseline)	27% (Heat pump baseline)	41% (Heat pump baseline)

A table illustrating the Be Lean results from compliance analysis. Values in Bold show the fabric specification that was chosen to represent the current London Plan.

Waste water heat recovery was not included in the modelling. If waste water heat recovery were included for residential typologies then it would increase the % Be lean by 6-8% for residential typologies.

Choosing models that best represent the current London Plan (2 of 2)

When choosing the scenarios that best represented the current London Plan, and thus the baseline scenario, the Be Lean and the Be Green results from compliance analysis was reviewed.

It should be noted that none of the scenarios corresponded exactly with the 35% carbon emission reductions, however and relevant models were chosen that best aligned with meeting the be lean and be green policy requirements. Refer to the Delivering Net Zero evidence base (DNZ) for details of the % carbon emission reductions at all of the building fabric and system scenarios.

Typology	Baseline scenario	% Carbon emission reductions at Be Green (no PV)	% Carbon emission reductions at Be Green (with PV)	PV assumption
Terrace house	Fabric: GP System: HP	62%	98%	<i>PV area of 36% of the building footprint</i>
Low-rise block of flats	Fabric: GP System: HP	48%	75%	<i>PV area of 50% of the building footprint</i>
Mid-rise block of flats	Fabric: GP System: HP	49%	62%	<i>PV area of 33% of the building footprint</i>
High-rise block of flats	Fabric: GP System: HP	52%	65%	<i>PV area of 21% of the building footprint</i>
Office	Fabric: Basic System: VRF	-47%	13%	<i>PV area of 50% of the building footprint</i>
Primary School	Fabric: GP System: HP	-34%	40%	<i>PV area of 25% of the building footprint</i>
Industrial	Fabric: Basic System: VRF	-10%	41%	<i>PV area of 20% of the building footprint</i>
Student Accommodation	Fabric: GP System: DE	-9%	10%	<i>PV area of 50% of the building footprint</i>

A table illustrating the Be Green results from compliance analysis (SAP 10.2) based this is first shown with no PV and then with PV.

EUI | Residential | Evidence of technical feasibility | Data from case studies

12 case study projects representing 967 homes from Etude and Levitt Bernstein's portfolios have been analysed. The schemes were selected as our best practice performing homes from three typologies:

- Terraced housing
- Mid-rise housing
- High-rise housing

These schemes demonstrate the level of performance possible and achievable for new residential schemes. These schemes are all live and progressing and therefore deemed viable.

The projects range in their progression, from RIBA stages 2-6, with:

- 490 at RIBA stages 2-3
- 380 at RIBA stage 4
- 97 at RIBA stage 6 (completed)

The space heating demand and energy use intensity has been derived from the predictive energy models (PHPP).

SHD and EUI metrics are both important

For energy use intensity, the projects meeting level 3 are designed with air source heat pumps for heating and hot water. Where an element of direct electric has been used, either for heating or both heating and hot water, level 3 EUI becomes challenging and in most cases unachievable.

As part of the data analysis it was found that when space heating demand is low the use of direct electric heating and/or hot water has less impact on the resultant energy use intensity and therefore residents' energy bills. This demonstrates the importance of the use of both metrics, to understand the contribution of the fabric and heating systems separately.

12 case study projects representing 967 homes from Etude and Levitt Bernstein's portfolios:



713 homes
meet Level
3 SHD

713 homes meet an SHD of 15 kWh/m²/yr or lower, this corresponds to performance level option 3



649 homes
meet Level
3 EUI

649 homes meet an EUI of 35 kWh/m²/yr or lower, this corresponds to performance level option 3

London-based case studies | Residential developments

Ultra-low energy buildings have been delivered in London for a while now. The London-based residential case studies below meet or perform better than SHD Level 3 (15 kWh/m²GIA) and where data is available, developments meet or perform better than EUI Level 2 (40 kWh/m²GIA). Where SHD is reported per TFA it is overestimated and in reality if their SHD was reported per GIA, it would be even lower.



Image source: Levitt Bernstein

Plashet Road, Newham

Building typology: 4-5 storeys block of flats
Architect: Levitt Bernstein
Total number of dwellings on site: 65
Completion: 2024

Fabric and energy performance:

Form factor: 1.53
Exterior wall U-value: 0.15 W/m²K
Ground floor U-value: 0.11 W/m²K
Roof U-value: 0.10 W/m²K
Window U-value: 1.16 W/m²K
Window g-value: 0.53
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: communal air-sourced heat pumps, supplemented by direct electric heating system in each home as a back-up.

SHD: 15
kWh/m²GIA/yr

EUI: 39
kWh/m²GIA/yr



Image source: Architype

Agar Grove (Phase 1), Camden

Building typology: 2-7 storeys block of flats
Architect: Hawkins/Brown, Architype
Total number of dwellings on site: 38
Completion: 2018

Fabric and energy performance:

Form factor: 1.6
Exterior wall U-value: 0.17 W/m²K
Ground floor U-value: 0.25 W/m²K
Roof U-value: 0.09 W/m²K
Window U-value: 0.78 W/m²K
Window g-value: 0.46
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: Gas-sourced communal low temperature hot water heating system

SHD: 13
kWh/m²TFA/yr



Image source: Levitt Bernstein

Melfield Gardens, Lewisham

Building typology: 4-6 storeys block of flat
Architect: Levitt Bernstein
Total number of dwellings on site: 32
Completion: 2025

Fabric and energy performance:

Form factor: West block 2.00, East Block 2.27
Exterior wall U-value: 0.14 W/m²K
Ground floor U-value: 0.10 W/m²K
Roof U-value: 0.11-0.17 W/m²K
Exposed first floor: 0.21 W/m²K
Window U-value: <0.80 W/m²K
Window g-value: >0.50
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: direct electric

SHD: 15
kWh/m²GIA/yr

EUI: 46
kWh/m²GIA/yr

Awaiting PH
Certifications

Renewables: 7
kWh/m²GIA/yr



Image source: Levitt Bernstein

Ashley Road, Haringey

Building typology: 4-13 storeys block of flats
Architect: Levitt Bernstein
Total number of dwellings on site: 272
Completion: 2025

Fabric and energy performance:

Form factor: 1.30-1.89
Exterior wall U-value: 0.13 W/m²K
Ground floor U-value: 0.10 W/m²K
Roof U-value: 0.08-0.17 W/m²K
Window U-value: 0.8 W/m²K
Window g-value: 0.50
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: communal air-sourced heat pumps,

SHD: 10
kWh/m²GIA/yr

EUI: 26
kWh/m²GIA/yr

Awaiting PH
Certifications

Renewables: 8
kWh/m²GIA/yr

London-based case studies | Residential developments

Ultra-low energy buildings have been delivered in London for a while now. The London-based residential case studies below meet or perform better than SHD Level 3 (15 kWh/m²GIA) and where data is available, developments meet or perform better than EUI Level 2 (40 kWh/m²GIA). Where SHD is reported per TFA it is overestimated and in reality if their SHD was reported per GIA, it would be even lower.



Image source: Levitt Bernstein

South Gardens, Elephant and Castle

Building typology: 3 storeys terrace houses
Architect: Maccleanor Lavington
Total number of dwellings on site: 15
Completion: 2017



Image source: Cartwright Pickard

Sulgrave Gardens, Shepherd's Bush

Building typology: 4 storeys – mix of houses, apartments and maisonettes
Architect: Cartwright Pickard
Total number of dwellings on site: 30
Completion: 2013

Fabric and energy performance:

Exterior wall U-value: 0.10 W/m²K
Ground floor U-value: 0.10 W/m²K
Roof U-value: 0.10 W/m²K
Window U-value: <0.77 W/m²K
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: gas boilers and solar panels



Image source: Levitt Bernstein

Goldsmith St, Norwich

Building typology: 2-3 storeys terrace houses
Architect: Mikhail Riches
Total number of dwellings on site: 93
Completion: 2019

Fabric and energy performance:

Exterior wall U-value: 0.11 W/m²K
Ground floor U-value: 0.08 W/m²K
Roof U-value: 0.10 W/m²K
Window U-value: 0.92 W/m²K
Window g-value: 0.51
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: gas combi boilers



Image source: Levitt Bernstein

Purdown View UWE student accommodation, Stoke Gifford

Building typology: 6 storeys student accommodation
Architect: Stride Treglown
Total number of bedrooms on site: >900
Completion: 2024

Fabric and energy performance:

Form factor: 1.30-1.40
Exterior wall U-value: 0.18 W/m²K
Ground floor U-value: 0.13 W/m²K
Roof U-value: 0.16 W/m²K
Window U-value: 0.93 W/m²K
Airtightness (n50): ~0.30 ac/h
Ventilation: MVHR
Heating and hot water: direct electric and ASHP

SHD: 15
kWh/m²TFA/yr



SHD: 15
kWh/m²TFA/yr



SHD: 13
kWh/m²TFA/yr



SHD: 14
kWh/m²TFA/yr



Renewables:
36 kWh/m²TFA/yr

London-based case studies | Educational buildings

Ultra-low energy buildings have been delivered in London for a while now. The London-based educational case studies below meet or perform better than SHD Level 3 (15 kWh/m²GIA). Where SHD is reported per TFA it is overestimated and in reality if their SHD was reported per GIA, it would be even lower. Currently, there are no EUI data available for the case studies below.



Image source: Architype

Hackbridge, Sutton

Building typology: 2-storey primary school
Architect: Architype
Total number of dwellings on site: 65
Completion: 2020

Fabric and energy performance:

Exterior wall U-value: 0.13 W/m²K
Ground floor U-value: 0.14 W/m²K
Roof U-value: 0.09 W/m²K
Window U-value: 0.92 W/m²K
Window g-value: 0.52
Airtightness (n50): 0.54 ac/h
Ventilation: MVHR
Heating and hot water: ground source heat pump with bore holes and gas fired hot water storage heater.

SHD: 15
kWh/m²TFA/yr

Certified
Passivhaus

REG: 70
kWh/m²/yr



Image source: Rivington Street Studio

Stebon, Tower Hamlets

Building typology: 2-storey primary school
Architect: Rivington Street Studio
Completion: 2015

Fabric and energy performance:

Exterior wall U-value: 0.13 W/m²K
Ground floor U-value: 0.13 W/m²K
Roof U-value: 0.13 W/m²K
Window U-value: 0.6 W/m²K
Airtightness (n50): 0.60 ac/h

SHD: 15
kWh/m²TFA/yr

Certified
Passivhaus

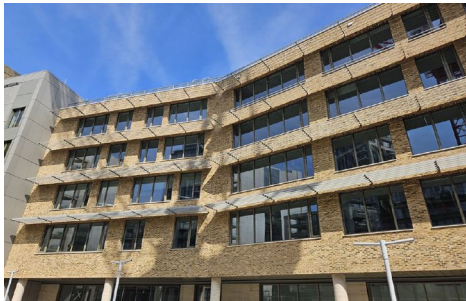


Image source: ARch8itype

Mulberry academy, Shoreditch

Building typology: 4-5 storeys secondary school
Architect: Architype
Completion: 2024

Fabric and energy performance:

Form factor: 1.53
Exterior wall U-value: 0.15 W/m²K
Ground floor U-value: 0.09 W/m²K
Roof U-value: 0.15 W/m²K
Window U-value: 0.87 W/m²K
Window g-value: 0.46
Airtightness (n50): 0.20 ac/h
Ventilation: Centralised MVHR
Heating and hot water: Air-sourced heat pumps

SHD: 12
kWh/m²TFA/yr

Certified
Passivhaus

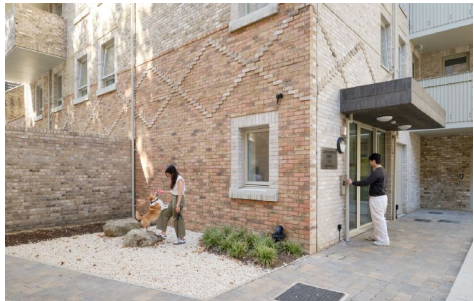


Image source: Levitt Bernstein

Plashet Road Nursery, Newham

Building typology: 1 storey nursery
Architect: Levitt Benrstein
Completion: 2024

Fabric and energy performance:

Form factor: 1.53
Exterior wall U-value: 0.15 W/m²K
Ground floor U-value: 0.11 W/m²K
Roof U-value: 0.10 W/m²K
Window U-value: 1.16 W/m²K
Window g-value: 0.53
Airtightness (n50): 0.60 ac/h
Ventilation: MVHR
Heating and hot water: communal air-sourced heat pumps, supplemented by direct electric heating system in each home as a back-up.

SHD: 10
kWh/m²TFA/yr

EUI: 45
kWh/m²GIA/yr

Certified
Passivhaus

Renewables:
36 kWh/m²TFA/yr

Cornell Hotel Sustainability Benchmarking (CHSB) Index 2024

Cornell Hotel Sustainability Benchmarking (CHSB) Index 2024:

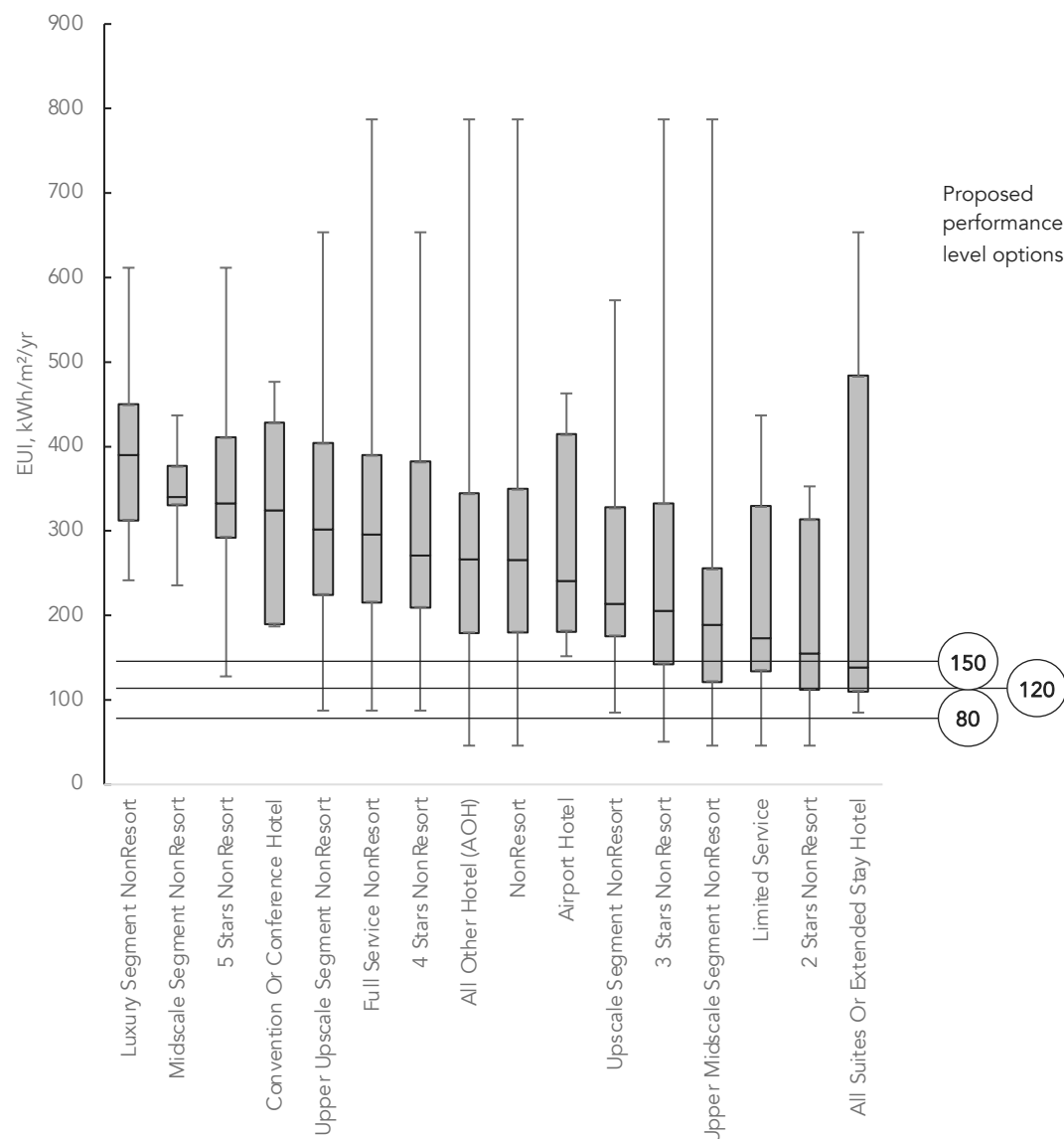
Ratings by Facilities

The Cornell Hotel Sustainability Benchmarking (CHSB) Index 2024 is a comprehensive, global benchmarking tool for measuring hotel energy, water, and carbon performance. It is recognized as more up to date than the industry-standard CIBSE (Chartered Institution of Building Services Engineers) benchmarks, providing granular, facility-specific data and insights.

However, there is no data on build date (or retrofit date), so it isn't possible to check on the EUI range for the newest buildings, which would be most relevant to deciding on EUI limits.

Cornell - Hotels in London	Count	Low	Lower Quartile	Mean	Median	Upper Quartile	High	SD
Luxury Segment NonResort	17	242	312	391	390	450	612	105
Midscale Segment NonResort	15	236	331	347	340	377	437	50
5 Stars NonResort	21	128	292	358	332	411	612	112
Convention Or Conference Hotel	6	187	189	319	324	429	477	116
Upper Upscale Segment NonResort	48	87	224	307	302	404	653	120
Full Service NonResort	103	87	215	311	296	390	787	124
4 Stars NonResort	69	87	209	302	271	382	653	116
All Other Hotel (AOH) NonResort	130	46	179	276	267	345	787	125
Airport Hotel	155	46	180	278	266	350	787	127
Upscale Segment NonResort	14	152	181	286	241	415	463	118
3 Stars NonResort	30	85	175	250	214	328	573	107
Upper Midscale Segment NonResort	51	51	142	240	205	333	787	128
Limited Service	42	46	121	205	189	255	787	126
2 Stars NonResort	52	46	134	215	173	330	437	109
All Suites Or Extended Stay Hotel	14	46	112	185	155	314	353	104
	5	85	110	265	139	484	653	234

The table shows the metered EUI data for hotels in London published by Cornell
Data and guidance available from <https://greenview.sg/resources/chsb-index/>



The graph shows the metered EUI data for the different categories of hotels in London and compares this to the proposed performance level options.

Renewable energy generation | Evidence of technical feasibility | Residential | Terrace house

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a terrace house. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

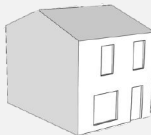
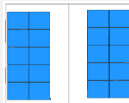
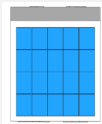
Two types of roof extent and shapes were considered:

- Pitched roof angled at 35°.
- A south-facing mono-pitched roof angled at 20°.

PV arrangements

Three types of PV arrangements were considered:

- When the building is assumed to be oriented north–south, a south-facing PV arrangement is assumed. The PV panels are assumed to be installed at a 35° tilt in-line with the roof slope.
- When the building is assumed to be oriented east–west, an east-west PV arrangement is assumed with panels at 35° tilt in line with the roof slope.
- When the building is assumed to have a south facing mono-pitched PV roof. The PV panels are assumed to be installed at a 20° tilt in-line with the roof slope.

Terrace house				
		Roof area m ²	Annual generation kWh/m ² fp	More than 40% of building footprint? ¹
 South facing pitch	N ⊕	68	77	✗ (36%)
 East/ West pitch	N ⊕	68	120	✓ (71%)
 South facing mono-pitch	N ⊕	73	149	✓ (71%)

Summary of PV energy generation for the Terrace house

¹ The current proposals for the Future Homes Standard (FHS) are that new homes will be required to install an area of Solar PV equivalent to 40% of the footprint of the building (ground floor area). However, there are various exemptions to this including if rooflights, dormers, HVAC plant and its maintenance access routes or architectural features preclude the installation of sufficient panels. For this reason, and as the final requirements of the FHS have not been published yet, a detailed study has not been carried out if each of the PV arrays modelled would comply with the FHS. However an indication is given if the 40% of building ground floor area is met with the panel arrangement. In most cases meeting 40% of building ground floor area is equivalent to 60-90 kWh/m²_{fp}.

Renewable energy generation | Evidence of technical feasibility | Residential | Low-rise block of flats

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a low-rise residential block of flats. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

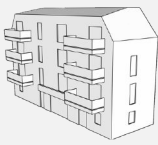
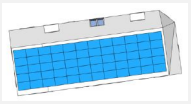
Three types of roof extent and shapes were considered:

- A multi-pitched roof with varying angles and a flat accessible terrace.
- An extended multi-pitched roof with varying angles.

PV arrangements

Two types of PV arrangements were considered:

- The PV arrangement on the flat portion of the roof is assumed to be an East/ West concertina. The PV panels are assumed to be installed at a 10° tilt.
- The PV arrangement on the pitched segments of the roof is assumed to be South-facing. The PV panels on the pitched roofs are assumed to be installed at a 12° and 53° tilt in-line with the slope of the roof.

Low-rise block of flats			
	Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint? ¹
 South	248	51	✗ (28%)
 South-facing & East/ West concertina	248	81	✓ (52%)
 South facing	248	114	✓ (62%)

Summary of PV energy generation for the low rise block of flats

¹ The current proposals for the Future Homes Standard (FHS) are that new homes will be required to install an area of Solar PV equivalent to 40% of the footprint of the building (ground floor area). However, there are various exemptions to this including if rooflights, dormers, HVAC plant and its maintenance access routes or architectural features preclude the installation of sufficient panels. For this reason, and as the final requirements of the FHS have not been published yet, a detailed study has not been carried out if each of the PV arrays modelled would comply with the FHS. However an indication is given if the 40% of building ground floor area is met with the panel arrangement. In most cases meeting 40% of building ground floor area is equivalent to 60-90 kWh/m²_{fp}.

Renewable energy generation | Evidence of technical feasibility | Residential | Mid-rise block of flats

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a mid-rise residential block of flats. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

Three types of roof extent and shapes were considered:

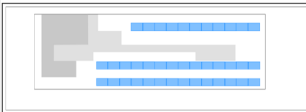
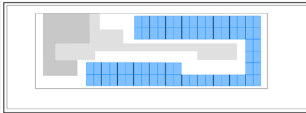
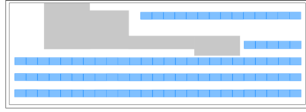
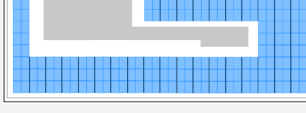
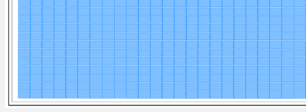
- A reduced flat roof (or 'two-tier roof') assuming that the top floor is set back from the main building perimeter).
- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.
- A south-facing mono-pitched roof assuming that the roof extends to the building perimeter and is angled at 20 degrees.

PV arrangements

Two types of PV arrangements were considered:

- When the building is assumed to be oriented north-south, a south-facing PV arrangement is assumed. The PV panels are assumed to be installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- When the building is assumed to be oriented east-west, an east-west concertina PV arrangement is assumed with panels at 15 degrees tilt.

¹ The current proposals for the Future Homes Standard (FHS) are that new homes will be required to install an area of Solar PV equivalent to 40% of the footprint of the building (ground floor area). However, there are various exemptions to this including if rooflights, dormers, HVAC plant and its maintenance access routes or architectural features preclude the installation of sufficient panels. For this reason, and as the final requirements of the FHS have not been published yet, a detailed study has not been carried out if each of the PV arrays modelled would comply with the FHS. However an indication is given if the 40% of building ground floor area is met with the panel arrangement. In most cases meeting 40% of building ground floor area is equivalent to 60-90 kWh/m²_{fp}.

Mid-rise block of flats			
	Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint? ¹
 South facing (two-tier roof)	262	21	✗ (22%)
 East/ West concertina (two-tier roof)	262	33	✗ (12%)
 South facing (levelled roof)	637	51	✗ (29%)
 East/ West concertina (levelled roof)	637	76	✓ (51%)
 South facing mono-pitched canopy	762	167	✓ (93%)

Summary of PV energy generation for the mid rise block of flats

Renewable energy generation | Evidence of technical feasibility | Residential | High-rise block of flats

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a high-rise residential block of flats. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

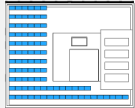
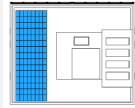
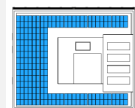
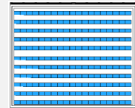
Two types of roof extent and shapes were considered:

- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.
- A south-facing array assuming that the roof extends to the building perimeter.

PV arrangements

Two types of PV arrangements were considered:

- South-facing PV arrangement is assumed with the PV panels are installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- East-West concertina PV arrangement is assumed with panels at 15° tilt.

High-rise block of flats				
		Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint? ¹
 South facing	N ⊕	991	36	✗ (37%)
 East/ West concertina	N ⊕	991	42	✓ (51%)
 East/ West concertina (max PVs)	N ⊕	991	70	✓ (86%)
 South facing (no plant area)	N ⊕	991	86	✓ (90%)

Summary of PV energy generation for the high rise block of flats

¹ The current proposals for the Future Homes Standard (FHS) are that new homes will be required to install an area of Solar PV equivalent to 40% of the footprint of the building (ground floor area). However, there are various exemptions to this including if rooflights, dormers, HVAC plant and its maintenance access routes or architectural features preclude the installation of sufficient panels. For this reason, and as the final requirements of the FHS have not been published yet, a detailed study has not been carried out if each of the PV arrays modelled would comply with the FHS. However an indication is given if the 40% of building ground floor area is met with the panel arrangement. In most cases meeting 40% of building ground floor area is equivalent to 60-90 kWh/m²_{fp}.

Renewable energy generation | Evidence of technical feasibility | Non-Residential | Office

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a mid-rise residential block of flats. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

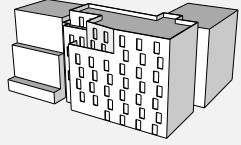
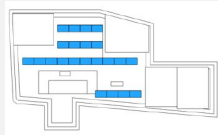
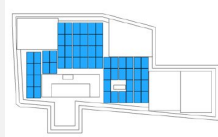
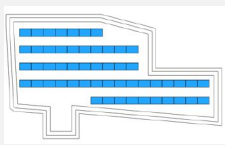
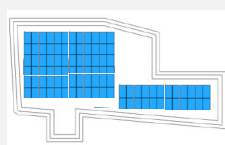
Three types of roof extent and shapes were considered:

- A reduced flat roof (or 'two-tier roof') assuming that the top floor is set back from the main building perimeter).
- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.

PV arrangements

Two types of PV arrangements were considered:

- South-facing PV arrangement is assumed with the PV panels are installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- East-West concertina PV arrangement is assumed with panels at 15° tilt.

Office				
		Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint?
 South facing	N ⊕	413	20	N/A
 East/ West concertina	N ⊕	413	46	N/A
 South facing (no plant area)	N ⊕	413	49	N/A
 East/ West concertina (no plant area)	N ⊕	413	76	N/A

Summary of PV energy generation for the office building

Renewable energy generation | Evidence of technical feasibility | Non-Residential | Hotel

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a Hotel. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

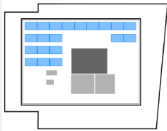
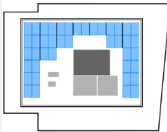
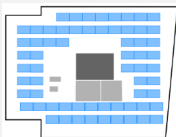
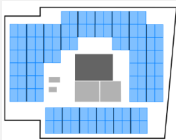
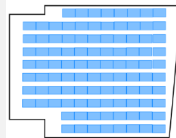
Three types of roof extent and shapes were considered:

- A reduced flat roof (or 'two-tier roof') assuming that the top floor is set back from the main building perimeter).
- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.
- A south-facing array assuming that the roof extends to the building perimeter.

PV arrangements

Two types of PV arrangements were considered:

- South-facing PV arrangement is assumed with the PV panels are installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- East-West concertina PV arrangement is assumed with panels at 15° tilt.

Hotel				
		Roof area m ²	Annual generation kWh/m ² fp	More than 40% of building footprint?
	N	262	21	N/A
South facing (two-tier roof)				
	N	262	39	N/A
East/ West concertina (two-tier roof)				
	N	637	54	N/A
South facing (levelled roof)				
	N	637	92	N/A
East/ West concertina (levelled roof)				
	N	762	77	N/A
South facing (no plant area)				

Summary of PV energy generation for the hotel building

Renewable energy generation | Evidence of technical feasibility | Non-Residential | School

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a school. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

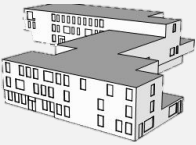
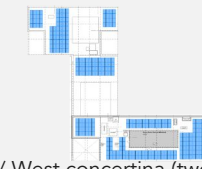
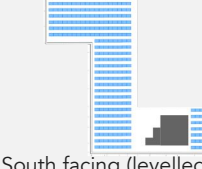
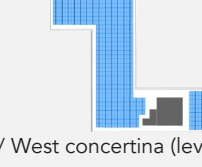
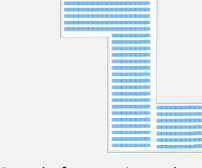
Three types of roof extent and shapes were considered:

- A reduced flat roof (or 'two-tier roof') assuming that the top floor is set back from the main building perimeter).
- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.
- A south-facing array assuming that the roof extends to the building perimeter.

PV arrangements

Two types of PV arrangements were considered:

- When the building is assumed to be oriented north-south, a south-facing PV arrangement is assumed. The PV panels are assumed to be installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- When the building is assumed to be oriented east-west, an east-west concertina PV arrangement is assumed with panels at 15 degrees tilt.

School			
	Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint?
 South facing (two-tier roof)	2065	22	N/A
 East/ West concertina (two-tier roof)	2065	45	N/A
 South facing (levelled roof)	2312	58	N/A
 East/ West concertina (levelled roof)	2312	94	N/A
 South facing (no plant area)	2312	74	N/A

Renewable energy generation | Evidence of technical feasibility | Non-Residential | Industrial

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a mid-rise residential block of flats. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

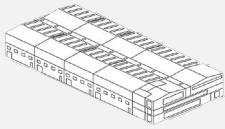
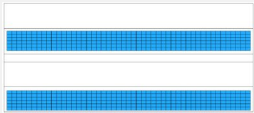
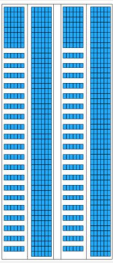
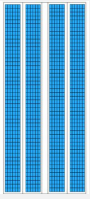
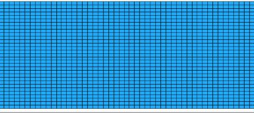
Three types of roof extent and shapes were considered:

- Roof with two pitches.
- Roof with two pitches and rooflights.
- A south-facing mono-pitched roof assuming that the roof extends to the building perimeter and is angled at 20°.

PV arrangements

Two types of PV arrangements were considered:

- When the building is assumed to be oriented north–south, a south-facing PV arrangement is assumed. The PV panels are assumed to be installed at a 10° tilt.
- When the building is assumed to be oriented east–west, an east–west facing pitched PV arrangement is assumed with panels at 10 degrees tilt.

Industrial			
	Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint?
 South facing pitch	3354	68	N/A
 East/ West (roof lights accounted for)	3354	100	N/A
 East/ West (no rooflights)	3354	123	N/A
 South facing mono-pitch	3354	175	N/A

Summary of PV energy generation for the industrial building

Renewable energy generation | Evidence of technical feasibility | Non-Residential | Student Accommodation

This page summarises the estimated renewable energy generation (in kWh/m²_{fp}) which can be achieved by different PV layouts and for different roof arrangements for a student accommodation. Although this analysis was only done for an example, it is useful to inform the development of potential renewable energy generation targets.

Roof extent and shapes

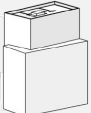
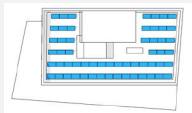
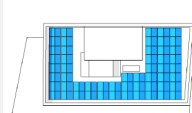
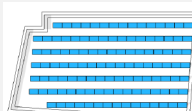
Two types of roof extent and shapes were considered:

- A reduced flat roof (or 'two-tier roof') assuming that the top floor is set back from the main building perimeter).
- A full flat roof (or 'levelled roof') assuming that the roof extends to the building perimeter.

PV arrangements

Two types of PV arrangements were considered:

- South-facing PV arrangement is assumed with the PV panels are installed at a 20° tilt, with 2.5 metres of spacing between rows (centre to centre) to minimise shading and maintain performance.
- East-West concertina PV arrangement is assumed with panels at 15° tilt.

Student Accommodation			
	Roof area m ²	Annual generation kWh/m ² _{fp}	More than 40% of building footprint?
 South facing (two-tier roof)	465	41	N/A
 East/ West concertina (two-tier roof)	465	58	N/A
 South facing (levelled roof & no plant area)	465	75	N/A

Summary of PV energy generation for the student accommodation building

Carbon offsetting | Establishing the cost baseline for the current London Plan

The current London Plan has a policy requirement to achieve 100% regulated carbon emission reductions, where this is not delivered onsite a carbon offset must be paid. In order to evaluate the uplift in price of the policy options compared to the current London Plan, the cost of achieving this policy requirement has been estimated for the assessed typologies. This is based on a carbon offset price of £95 per tonne of carbon for 30 years.

Two options are shown in the tables to the right, the first if 35% carbon emission reductions are met onsite (the minimum policy requirement for onsite reductions), the second option (67% onsite reduction for residential 47% for non residential) relates to the average carbon emission reductions of the applications submitted to the GLA in 2024.

Results

For the residential typologies that achieve a 35% carbon emission reduction onsite, this represents a 0.6 -1% construction cost uplift. When the onsite reduction is increased to 67% then the cost of offset reduces to 0.3-0.5%.

For the non-residential typologies that achieve a 35% carbon emission reduction onsite, this represents a 0.1 - 0.5% construction cost uplift. When the onsite reduction is increased to 47% then the cost of offset reduces to 0.1-0.4%.

Typology	Indicative all in construction benchmark cost	Cost of offset over 30 years		Construction cost uplift due to offset	
		35% carbon emission reductions onsite	67% carbon emission reductions onsite	35% carbon emission reductions onsite	67% carbon emission reductions onsite
Terrace house	£2,110	£15,737	£7,990	1.0%	0.5%
Low-rise apartment block	£2,610	£11,979	£6,082	1.0%	0.5%
Mid-rise apartment block	£3,340	£63,716	£32,348	0.7%	0.4%
High-rise apartment block	£3,650	£278,559	£141,422	0.6%	0.3%

Residential carbon offset costs in order to achieve the current London Plan requirements of 100% regulated carbon emission reductions at £95 per tonne for 30 years presented in total £ and construction cost uplift.

Typology	Indicative all in construction benchmark cost	Cost of offset over 30 years		Construction cost uplift due to offset	
		35% carbon emission reductions onsite	47% carbon emission reductions onsite	35% carbon emission reductions onsite	47% carbon emission reductions onsite
School	£3,550	£37,055	£30,214	0.2%	0.1%
Large Industrial	£1,360	£56,913	£46,406	0.5%	0.4%
Office	£4,220	£22,702	£18,511	0.1%	0.1%
Student resi	£3,340	£52,494	£42,803	0.3%	0.2%

Non-residential carbon offset costs in order to achieve the current London Plan requirements of 100% regulated carbon emission reductions at £95 per tonne for 30 years presented in total £ and construction cost uplift.

Offsetting (option for limited offsetting to 50%) | Residential | Estimated cost impact of policy

An option to reduce the cost of offsetting

In the section on energy balance, a potential policy requirement of achieving a 100% energy balance between energy use and on-site solar PV generation is considered.

When it is not possible to achieve this balance on-site (e.g. through limited roof space), it is suggested that energy offsetting can be used to achieve the 100% energy balance.

If it is deemed too costly to introduce a policy on energy balance two options are possible:

- Omit the requirement to achieve an energy balance on-site.
- Reduce the requirement to one which would be less costly, e.g. 50% energy balance. The adjacent tables show the uplift in construction cost of doing this. Please note that this is not a recommendation but that it has been provided as a potential scenario.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 1	PV Level 1	PV Level 1
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	N/A -1.6% (-£34/m ²)	N/A -2.0% (-£43/m ²)	N/A -2.2% (-£47/m ²)
Low-rise block of flats	£2,610/m ²	+0.7% (+£19/m ²)	+0.4% (+£10/m ²)	+0.2% (+£5/m ²)
Mid-rise block of flats	£3,340/m ²	+0.8% (+£26/m ²)	+0.5% (+£17/m ²)	+0.4% (+£12/m ²)
High-rise block of flats	£3,650/m ²	+1.1% (+£40/m ²)	+0.9% (+£31/m ²)	+0.7% (£27/m ²)

Uplift cost of offset to achieve 50% reduction of the energy balance from baseline assuming Level 1 PV will be met on site. Relative costs (% or £/m²) of each case compared to the baseline.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 2	PV Level 2	PV Level 2
		EUI Level 1 50 kWh/m ² /yr (GIA)	EUI Level 2 40 kWh/m ² /yr (GIA)	EUI Level 3 35 kWh/m ² /yr (GIA)
Terrace house	£2,110/m ²	N/A -2.9% (-£60/m ²)	N/A -3.3% (-£69/m ²)	N/A -3.5% (-£74/m ²)
Low-rise block of flats	£2,610/m ²	+0.1% (+£4/m ²)	N/A -0.2% (-£5/m ²)	N/A -0.4% (-£10/m ²)
Mid-rise block of flats	£3,340/m ²	+0.5% (+£15/m ²)	+0.2% (+£6/m ²)	+0.0% (+£2/m ²)
High-rise block of flats	£3,650/m ²	+1.0% (+£38/m ²)	+0.8% (+£28/m ²)	+0.7% (+£24/m ²)

Uplift cost of offset to achieve 50% reduction of the energy balance from baseline assuming Level 2 PV will be met on site. Relative costs (% or £/m²) of each case compared to the baseline.

Offsetting (option for limited offsetting to 50%) | Non-Residential | Estimated cost impact of policy

An option to reduce the cost of offsetting

In the section on energy balance, a potential policy requirement of achieving a 100% energy balance between energy use and on-site solar PV generation is considered.

When it is not possible to achieve this balance on-site (e.g. through limited roof space), it is suggested that energy offsetting can be used to achieve the 100% energy balance.

If it is deemed too costly to introduce a policy on energy balance two options are possible:

- Omit the requirement to achieve an energy balance on-site.
- Reduce the requirement to one which would be less costly, e.g. 50% energy balance. The adjacent tables show the uplift in construction cost of doing this. Please note that this is not a recommendation but that it has been provided as a potential scenario.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 1	PV Level 1	PV Level 1
		EUI Level 1	EUI Level 2	EUI Level 3
Office	£4,220/m ²	+2.6% (+£110/m ²)	+1.7% (+£73/m ²)	+1.3% (+£55/m ²)
Primary School	£3,550/m ²	+0.8% (+£28/m ²)	+0.4% (+£16/m ²)	+0.1% (+£5/m ²)
Industrial	£1,360/m ²	+0.1% (+£2/m ²)	N/A -0.2% (-£3/m ²)	-0.5% (-£7/m ²)
Student Accommodation	£3,340/m ²	+2.0% (+£66/m ²)	+1.6% (+£52/m ²)	+1.1% (+£38/m ²)

Uplift cost of offset 50% reduction of the energy balance from baseline assuming Level 1 PV will be met on site. Relative costs (% or £/m²) of each case compared to the baseline.

Typology	Indicative all in construction benchmark cost (excluding PV)	PV Level 2	PV Level 2	PV Level 2
		EUI Level 1	EUI Level 2	EUI Level 3
Office	£4,220/m ²	+2.5% (+£105/m ²)	+1.6% (+£68/m ²)	+1.2% (+£50/m ²)
Primary School	£3,550/m ²	+0.3% (+£10/m ²)	N/A -0.1% (-£2/m ²)	N/A -0.4% (-£13/m ²)
Industrial	£1,360/m ²	N/A -0.7% (-£10/m ²)	N/A -1.0% (-£14/m ²)	N/A -1.4% (-£19/m ²)
Student Accommodation	£3,340/m ²	+1.8% (+£61/m ²)	+1.4% (+£48/m ²)	+1.0% (£34/m ²)

Uplift cost of offset 50% reduction of the energy balance from baseline assuming Level 2 PV will be met on site. Relative costs (% or £/m²) of each case compared to the baseline.



Equalities impact | Key questions to consider

In the context of new planning policies that seek to significantly increase the minimum energy efficiency standards of new buildings, it is important to ascertain if the benefits of these policies will be limited to, or higher for, high income populations. It is similarly important to identify any risks or costs that may disproportionately impact people with protected characteristics.

The following questions are worth considering:

- Will energy savings be dependent on shifting when energy consumption takes place, thereby unduly penalising people who cannot or do not shift their energy consumption habits?
- Will maintenance costs or service charges be higher than for new builds that currently don't meet these standard?
- Will London have enough people with the right skills to maintain these buildings?
- Will building occupiers have agency over their choice of energy supplier?
- Will it be more difficult to meet the space heating demand target in larger spaces that support multi-generational living, address over-crowding or meet accessibility standards? Conversely, will the policies to reduce space heating demand incentivise the delivery of smaller housing that is more prone to overheating and overcrowding?
- Will risks associated with overheating be mitigated, particularly in residential care settings and other specialist housing for vulnerable adults where there may be restrictions on window openings?
- Will developments in areas with poor external air quality that rely on natural ventilation lead to worse indoor air quality?

- What impact will building fabrics, systems, batteries and energy flexibility have on energy bills for residents?
- Are there any pitfalls relating to technologies likely to be implemented that achieve operational energy standards, for certain communities such as the potential misuse of MVHR?
- To what extent can on-site renewable energy reduce energy bills, especially in blocks of flats?
- What are the trade offs between mitigating noise and naturally ventilating homes? There is likely to be a greater need for cooling in homes located in noisy locations. Affordable homes are often sited in these locations and are more likely to have vulnerable residents who will be more exposed to risks of fuel poverty and the health impacts of overheating.
- How might offsetting funds be used to support those in social deprivation, for example through a retrofit fund

Equalities impact | Stakeholder engagement summary (1 of 3)

Jon Emmet | London Sustainable Development Commission

- Impacts are often indirect and disproportionately negative outcomes for some populations. These impacts can be personal and felt at an individual scale. For example, research conducted by the Young Foundation for the LSDC showed that some groups find it more challenging to invite tradespeople into their homes.
- It is important to note the potential to address energy inequalities. Increased energy efficiency reduces energy bills, which will address fuel poverty. Warmer homes are healthier as cold and damp homes impact elderly people and people with health conditions. There is however a risk that warmer, better insulated homes may, if poorly built, lock in damp and mould problems. This is particularly an issue for people living in the private rental sector who have less control over their home environment.
- There is a lack of disaggregated and intersectional data to help us have nuanced conversations. This is a particular issue when talking about disability and conflating groups with very different needs such as neurodiverse people or people that are visually impaired. We need to disaggregate this data if possible.
- Climate adaptation is maybe a bigger issue to consider than net zero. We need to consider the impacts of extreme weather, especially on the poorest and most marginalised. This will be an increasing source of disparities. Who will be able to afford air conditioning? How effective will passive cooling be for those who live in a flat without windows that can open? Exposure to heat will depend on the orientation and height of buildings and flats.
- The big trade-off to consider is if these policies make housing more expensive. This can make developments non-viable and raise house prices, keeping them out of reach of low-income groups. It is not always clear what the evidence is to back this claim up. Developers talk about risks and the potential costs, especially if meeting several new policies at once.

Nannette Youssef | Runnymede Trust

- The University of Manchester has done research about energy inequality through a racialised lens. They found that people of colour are more likely to be in bill arrears, less likely to shop around for different energy providers, more likely to encounter language barriers. These all mean people of colour are less likely to find value for money in the energy sector.
- There is scope to conduct more primary research and data collection about people's experiences of net zero policies and their homes – how do people interact with new technologies? How are they communicated?
- Social housing allocation a key process for racialised groups, who are less likely to own their homes, more likely to live in non-decent housing that does not meet energy efficiency standards. Lower income groups are less able to afford upgrades to their homes and may not have control as renters.
- In general, climate policies don't consider the needs of people of colour, who are often not included in the policy-making process to the extent that they should be.
- Environmental sector focuses on sticking plaster policies that don't tackle the structural underpinnings of the inequalities we see. We need a broader, more holistic approach. There is a lack of joined up thinking about how policy areas relate to one another. It is important to be visionary and to ask what needs to accompany technical policies for this to be fair and promote fairness. Lots of new-build housing is inaccessible to marginalised groups, through location, cost and design.

Equalities impact | Stakeholder engagement summary (2 of 3)

Julie McLaren | The Young Foundation

- Research into net zero policies needs to be much more cross-cutting and holistic. Links between energy efficiency and health for example need to be communicated, researched and explored. Retrofitting social housing for example may be informed or led by a desire to improve health outcomes rather than through just a sustainability lens. Is there an opportunity to factor in green roofs or growing spaces into masterplans? Could this be required of developers to meet multiple policy objectives at once?
- There is no one size fits all for issues like retrofitting and refurbishment. A lot of people don't just experience one protected characteristic and there are intersections between them that shape how people may be treated. People want to be involved in the design of homes and developments to ensure their needs are met. Is there a risk of new policies locking people out of certain decisions they would like to make about their homes or reducing the flexibility or adaptability of those spaces?
- Affordability is the primary concern. Will these additional policy requirements come with additional costs? And even if the initial outlay is recouped over years in lower bills, do landlords and building owners have the right incentive as they typically don't see those savings? Likewise, if a home is a commodity to be resold, will homeowners not see the long-term benefits of their investments? These could be issues for more transient, less stable populations (or those displaced for any reason).
- Increased participation is one mitigation strategy for addressing any identified risks or negative impacts of policies. Hear from people about how the policies might impact them and how they would address those impacts.

Dan Daley | C40 Cities

- There is an issue of the costs of retrofitting being passed onto tenants and renters. This can be a barrier to retrofitting in places with rent controls as there is little incentive for landlords to shoulder retrofit costs if these cannot be recouped by higher rent. Likewise, these policies carry a risk of renovations and adding green premiums for tenants.
- C40 cities is pushing cities to think holistically about where climate and justice issues intersect to consider equitable policy outcomes. It is about writing policies that layers in what other departments are doing and what their priorities are to create holistic policies.

Betty Owoo | GLA Design Unit

- There is a knowledge and cost gap for these new net zero building technologies. Language is technical and people need real-life, costed examples of the types of outcomes and benefits they could see from retrofitting their homes. The benefits aren't always clear to people and they don't always make connections to other issues such as health and energy costs. There is a lot of misinformation about these topics.
- Some installations, such as loft insulation, may result in homes reducing their overall floor area. In older properties, there is a risk of sealing in damp issues. You may lose heritage features in some homes.
- There is no good government messaging on net zero building policies. There needs to be a digital campaign to help fight misinformation. Is there scope for a new home starter guide to teach people about new systems such as MVHR systems?
- Post-occupancy reviews are needed to know how homes are performing in real-world conditions. It would be very powerful if this was written into policy with clear guidelines about who this data is reported to. There is currently a lack of oversight and it is not clear what happens when schemes are not compliant.

Equalities impact | Stakeholder engagement summary (3 of 3)

Cara Holmes | Citizens Advice

- It is likely that people with Protected Characteristics will be missing out and inequalities will worsen. Access to flexible prices is how many of the benefits of net zero are accessed. It is the only way you can get cheaper energy. There are barriers to flexibility in the equipment and technologies people have in their homes. There are also problems around how people choose which tariffs will actually save them money. People don't understand how it works and how to navigate different offers. It is not always clear what the actual cost savings are for flexible energy use. A lot of people end up being penalised for not being flexible with their energy use or don't have smart appliances. People don't have the time to think about this and some people's energy use is inelastic. Flexibility is forced onto many people where this is not the appropriate solution.
- It is important to take, as much as possible, a building by building approach to retrofit. Not all solutions are appropriate for all places but there is a one size fits all approach and incentives to put in the cheapest measures. It is important to ensure we also have buildings that keep cool and to consider climate resilience and adaptation.
- There is a scenario where wealthy people get all of the benefits and when gas boilers are phased out, the people who can't afford a heat pump or solar panels are reliant on expensive plug-in electric space heaters. Net zero technologies work best when people have all the technologies working together such as on-site energy generation, batteries, electric vehicles and heat pumps. These represent a very significant upfront outlay. People need to be supported to invest in the right products to achieve a transition to net zero. There is a risk that this reduces people's ability to sell their homes if they can't invest in the right technology.
- Where heat networks do switch to greener energy sources, customers end up paying more for the upgrades and costs are passed on. The implications of moving into a property with a heat network are not always clear to new residents.
- Policies can mitigate these risks by having a focus on outcomes. Many schemes are about inputs and don't test or check the outcomes of these policies. Bake-in outcome and post-occupancy checks for new builds. EPC outcomes need to be measured not modelled. Quality assurance is key as some insulation, if not properly installed, can cause damp and mould. Policies need strong enforcement. Policies should be framed more holistically as being about health and safety in homes. This focus would encourage a different way of building.

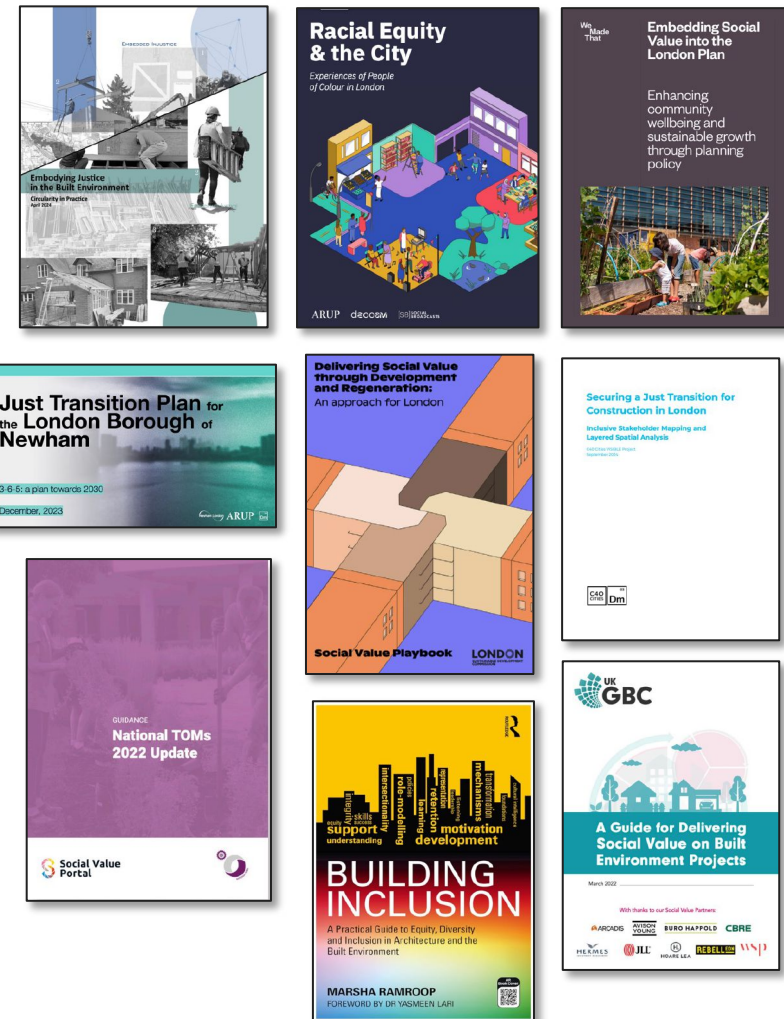
Equalities impact | Review of document relevant to EDI

A review of relevant documents was carried out. An over-arching challenge was identified that the effects of climate change are not distributed evenly: climate change compounds poverty and structural disadvantage.

While the report 'Securing a Just Transition for Construction in London' has not been released publicly it serves as a useful background to some of the systemic challenges with achieving high performance and social value within the current built environment and planning system. For example, 'Newham's Just Transition Plan' highlighted that lower-income and other disadvantaged groups contribute least to climate change; but are likely to be the most impacted by it. The 'Racial Equity and the City' corroborated this finding. Usefully, the Newham report identified interdisciplinary co-benefits in support of climate related policy.

The 'Embodying Justice in the Built Environment' guide is focussed on the Circular Economy but the wider framework for defining justice could be a useful reference point for wider issues related to the impacts and co-benefits of climate policy.

One mechanism to achieve greater equality and justice is through Social Value mechanisms and measurements. Nationally, the TOMs system allows the measurement of social value and includes the impact of carbon reductions. The 'Embedding Social Value into the London Plan' report highlights that Policy S1 2 (Minimising greenhouse gas emissions) and Policy SI 3 (Energy infrastructure are relevant to embedding social value into the London Plan.



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Equalities impact | References

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Stakeholder engagement summary | Overview

Between May and July 2025, four stakeholder engagements were held to support the development of this evidence-base. The workshops were also attended by representatives of the GLA London Plan team and the consultant team. The workshops aimed to gather early feedback on the emerging ideas to support the new London Plan evidence-base.

	Workshop 1	Workshop 2	Workshop 3	Workshop 4
Stakeholder group	Local authorities	Wider industry (built environment)	Property development companies	Local authorities
Date	7 th May 2025	23 rd June 2025	25 th June 2025	10 th July 2025
Location	Online meeting	Currie & Brown offices	Currie & Brown offices	Hybrid - London Councils/Online
Duration	1 hr	2 hrs	2 hrs	2 hrs
Attendees	Katherine Frost & Nicola Tulley (Camden), Joe Penn (City of London), Vera Vajda (Enfield), Minerva Anderson (Essex County Council), Kat Scott (Hackney), Baker Paul (Hammersmith & Fulham), Suzanne Kimman (Haringey), Jill Warran (Havering), Duncan Mckane (Hounslow), Preeti Gulati & Jonathan Wade (Kensington and Chelsea), Katie Dowle & Luisa Brotas (Kingston), Jennifer Cairns & Thomas Davies (Lambeth), Tom Ardron & Laura Keay (Merton), James Scantlebury & Jane Custance (Newham), Joanna Hill (Richmond & Wandsworth), Lauren Wilkinson (Southwark), Patrick Whitter (Sutton), Jonathan Taylor & Charlotte Norris (Tower Hamlets), Carolyn Seymour (Waltham Forest), Hrabrina Nikolova, Aidan Nyman, Paolo Balice & Marika Gabbianelli (Westminster)	Aazraa Pankan, Margarita Chorafa & Steve Edge (Introba), Adam Lane & Lewis Knight (Bioregional), Bertie Dixon (Inside Outside), Chris Twinn (independent), Christian Dimbelby (White Arkitekter), David Kingston & Rahul Grover (Buro Happold), Duncan Cox (Thornton Tomasetti), Fabrizio Varriale (RICS/ UK NZCBS), Greg Jones (Hoare Lea), Joel Callow (Beyond Carbon), Kristen Haggart (Waugh Thistleton), Lizzie Oreily (KLH), Louisa Tredwell (Elliot Wood), Louise Wille & Tom Kordell (XCO ₂), Mat Edis (SCS Partnership), Matthew Mapp (Sweco), Michelle Sanchez (RSHP), Olga Koumaditou (ARUP), Philip Exton (AECOM), Phoebe MacDonald (RIBA), Rodrigo Garcia Priego (Greengage), Susie Diamond (Inkling)	James Parker (Latimer/Clarion), Attzaz Rashid (Barratt), Harry Knibb (Oxford Properties), Robin Palmer (Peabody), Joe Jack Williams (By water properties), Victoria Herring (Grosvenor), Dan Rafferty (Stanhope)	In person: Eleanor Grace (Westminster), Nicola Tulley (Camden), Vera Vajda (Enfield), Ashwin Patel (London councils), Rachel Weaver (Hackney), James Scantlebury (Newham), Luisa Brotas (Kingston), Joe Penn (City of London), Tom Davis (Lambeth), Alice Leach (Barnet) Online: Adam Derham (Essex County Council), Amber Fahey (Be First), Paolo Balice, Hrabrina Nikolova-Laxness, Orlaigh McComish & Marika Gabbianelli (Westminster), Biplav Pageni (Haringey), Carlos Gonzalez- Martos (Lambeth), Carolyn Seymour (Waltham Forest), Chin Chin Lam (Camden), Ryan Clark (Greenwich), Alex Fish (Southwark), Rhoda Hayashi (Bexley), Huw Trevforrow (Havering), James Delamere (Waltham Forest), Jane Custance (Newham), Jennifer Cairns & Robert O'Sullivan (Lambeth), Jill Warren (Haringey), Joanna Hill (Richmond and Wandsworth), Kat Scott & Seonaid Carr (Hackney), Katie Dowle (Kingston upon Thames), Dominique Hill, Laura Keay & Tom Ardron (Merton), Lydia Brown (Islington), Partick Whitter (Sutton), Tessa Devreese (ReLondon), Vera Vajda (Enfield)

Stakeholder engagement summary | Overview

The workshops aimed to gather early feedback on the emerging ideas to support the new London Plan evidence-base. Seven key themes – shown on the table opposite – were presented, and participants shared their experiences, challenges and support for these topics. Some participants also followed up with additional evidence from research or projects in support of or to supplement the findings as part of this evidence base.

Embodied carbon was also discussed, and feedback is summarised in the *'Embodied carbon and whole life carbon'* report. Feedback on operational energy is summarised on the following pages.

Key research topics	Points discussed
Space heating demand & Energy use intensity	Performance levels - Proposal of three levels of performance for SHD and EUI per building typology to support the introduction of policy targets/limits relating to energy metrics. Calculation method - Use of predictive energy modelling (PHPP/TM54) for greater accuracy as opposed to building regulations compliance tools (SAP/SBEM).
Cooling	Identified gaps in current policy - Skipping of passive measures for buildings which propose active cooling. Ensuring implementation of passive measures - Simplification of existing cooling hierarchy. - Compliance of residential schemes with 'passive design test'. - Meeting a cooling demand limit for non-residential typologies.
Low carbon heat	Three key approaches - Adoption of key zones. - Incorporation of low carbon heating options. - Conducting affordability analysis.
Renewable energy	Performance levels - Proposal of two levels of performance for on-site renewable energy generation per building typology to support the introduction of policy targets. Energy balance - Adoption of energy balance (which would likely require energy offsetting).
Lean design	Incentivising lean design and material efficiency for low embodied carbon outcomes through policy
Upfront embodied carbon	Performance levels Proposal of two levels of performance for upfront embodied carbon limits for residential developments and offices to support the introductions of policy targets/limits.
Whole life carbon	Reflection on current policy - Scope of reporting and submission. - Policy administration and enforcement.

Summary of themes presented at the workshops



Stakeholder engagement summary | Local authorities workshop 07/05/2025

This workshop was an introductory engagement session with the local authorities to gather insights on their own experiences in producing evidence and implementing specific policies related to operational energy and embodied carbon within their local plans. In so doing, the consultant team aimed to gain insights, avoid duplicating existing evidence, understand where others have faced challenges when developing and implementing certain policies, and how to streamline planning processes.

Addressed questions

- 1 For those implementing SHD, EUI, specific renewable requirements, energy offsetting and embodied carbon limits. Where are you in the process?
- 2 Do you have useful evidence that we can use, especially evidence that is not in the public domain/ we might not be aware of?
- 3 Have you had any representations for or against any of your draft policies? Have they impacted your draft policies?
- 4 Have you encountered difficulties that you would like to share? Did you develop any helpful solutions?
- 5 How have you considered equality, diversity and inclusion (EDI) in plan making, and do you have ideas on how it could be integrated into London plan making. Do you know of any good examples, either within or outside of London? Are you working with any external partners on this, or know of any good work in this area?
- 6 Do you have any advice on evidence preparation?
- 7 Do you have any advice on viability?
- 8 Do you have any advice on streamlining?
- 9 Any other comments on the research questions and/or our approach?
- 10 Further questions for the GLA (and/or comments and assorted views/recommendations)

1. For those implementing SHD, EUI, specific renewable requirements, energy offsetting and embodied carbon limits. Where are you in the process?

Local authorities are at different stages in plan making. With most authorities in the process of implementing at least some of these metrics and limits. A few report not yet being in the process of implementing operational energy and embodied carbon metrics and limits while others report having fully implemented metrics and limits. Each local authority has developed their own evidence base or deferred to current GLA policy to support their emerging or adopted policy. However, many have chosen common metrics (SHD and EUI) and shown support for WLC. For more details see the existing approaches report produced as part of this research.

Stakeholder engagement summary | Local authorities workshop 07/05/2025

2. Do you have useful evidence that we can use, especially evidence that is not in the public domain/ we might not be aware of?

A few useful documents and evidence packs were suggested, these are summarised in the table below:

Local authority	Evidence / observations
	Observation: WLC being used to justify demolition
Camden	Basement extensions impact on EC: https://www.camden.gov.uk/documents/d/guest/embodied-carbon-impact-of-basement-extensions
City of London	Spreadsheet: major developments, EC (>2022).
Hammersmith & Fulham	Viability assessment for local carbon offset price
Merton	Workshop (by Arup & Uni of Sheffield) on EC and CE
	Have EC from planning submissions. Internal work on Science-based targets and benchmarking.
Westminster	Internal paper on carbon pricing https://committees.westminster.gov.uk/ieDecisionDetails.aspx?ID=2114 (and documents therein)
Richmond	Net Zero Carbon Study, 2023 https://www.richmond.gov.uk/media/rpjb4t4xh/psed_05_richmond_cof_report_v11.pdf
Kensington & Chelsea	Etude study (Towards Net Zero Carbon, 2023)
Sutton	Suggest Southwest Local Energy Plan

3. Have you had any representations for or against any of your draft policies? Have they impacted your draft policies?

A few local authorities report having received representations. The majority of these questioned the viability of specific policies or limits. An important identified gap in implementing some of the policies is the lack of information or references about specific uses or building typologies.

The main topics questioned by representations were:

- Missing considerations for specific building typologies (Camden – exempted lab-enabled buildings; City of London – tall buildings, hotels; Kensington & Chelsea – Care homes; Newham – exception made for a specific industrial use)
- High carbon offsetting costs (Kensington & Chelsea; Richmond – did not change policy; Westminster – dialled back)
- Consistent GLA and local authority policy alignment (City of London – case by case benefits where GLA WLC is not achieved)
- Local requirements are going beyond national regulations
- Resistance to mandatory heat network connections
- Viability of energy balance on site
- WLC RICS v2 seen as too challenging
- Achievability of NABERs 5 stars in retrofit (City of London – policy adapted to 4 stars)

Stakeholder engagement summary | Local authorities workshop 07/05/2025

4. Have you encountered particular difficulties that you would like to share? Did you develop any helpful solutions?

Some of the concerns and difficulties were expressed by the participants:

- Concerns were raised about the rapidly changing policies and how best to future-proof them.
- Despite carbon offsetting mechanisms becoming more common, there is still a need for clarity, particularly when policies consider both embodied and operational carbon. For instance, if policy addresses both forms of emissions, can one offset the other?
- Some authorities, especially smaller ones, are concerned about the lack of in-house expertise, resources and/or tools that enable them to efficiently assess applications or develop more ambitious policy.
- Retrofit versus new build policies are being questioned due to the inherent limitations that these impose on the integration of more ambitious environmental improvements.
- Recent requirements mandating the need for producing a WLCA to evidence the request for demolition of dwellings was pushed back by applicants.
- There's a concern about the viability of managing overheating through passive measures alone in many circumstances and building types.
- Some are concerned by the incorporation of scarce resources (e.g., cement replacement/GGBS, recycled aluminium, etc.) to claim better project sustainability outcomes when this is known to make no difference in reduction of carbon emissions globally.

5. How have you considered equality, diversity and inclusion EDI in plan making, and do you have ideas on how it could be integrated into London plan making. Do you know of any good examples, either within or outside of London? Are you working with any external partners on this, or know of any good work in this area?

The majority of participants report doing just enough to satisfy the Equality Act, by conducting Equalities Impact Needs Assessment or the Public Sector Equality Duty.

There is a general acknowledgement that the Equality Act duties and the Sustainability Appraisal framework have some overlapping purposes and objectives.

When viability testing has been conducted it has generally shown that new policies tend to have a bigger impact in deprived areas

Some of the local authorities claim having implemented further elements in favour of EDI in their policies, namely:

- Haringey – New Local Plan and all policies considered EDI. Safe, healthy, resilient buildings are key.
- Hackney – Fairness strongly considered in Climate Action Plan. Fair and just transition to net zero.
- Camden – Have an EDI statement in plan. Resist active cooling, direct electric heating, ASHP without thermal efficiency measures.

6. Do you have any advice on evidence preparation?

The quality of evidence is seen as key to substantiate the policies, particularly when suggesting limits. It is thus essential to produce more quantitative data, instead of generic or qualitative outputs. Ideally, this should be backed up and tested with built projects.

Some participants recommend starting at a very ambitious level, with the assumption being that it will all be watered down during consultations.

The use and reference to RICS v2 in evidence gathering, with the assumption that that is the recommended methodology to follow, has been flagged as challenging to some developers.

Recommendations for considering grid spacing in benchmark buildings (aligned with BCO standards) and the impact of basements on baselines for smaller buildings.

7. Do you have any advice on viability?

Policies tend to be particularly scrutinised when they exceed the current London Plan in terms of viability and cost (both direct and process costs). Both cost and value for money are perceived as essential (considering also the cost for inaction).

Planning inspectors generally want to understand the impacts of net zero policies when in combination with other policies. For instance, Kensington & Chelsea's Local Viability Plan (2022) has demonstrated that net zero for major development is still viable.

There's a lack of evidence showing if smaller developments are more challenging and economically unviable in commercial typology.

Allowing for credits in embodied carbon against energy offsets has been shown to improve viability for major schemes.

8. Do you have any advice on streamlining?

There was a general agreement that using proformas and simplifying submission and analysis of information is essential to improve efficiency and reduce repetitions. Ensuring that the data is collected in a usable form is fundamental, particularly to help inform future policy.

9. Any other comments on the research questions and/or our approach?

Policies need to be considered holistically and work together (environmental, social, economic). For instance, concerns were raised in the relationship between raising overheating risk and other policies, such as daylighting.

A clear implementation guidance is essential to support both planning officers and developers. Ideally, a wider range of development scales, building types and uses should be covered by evidence and policies.

Developing robust post-occupancy performance monitoring and reporting mechanisms is important to ensure projects are meeting targets (or subject to fines for non-compliance). This should go along with updated carbon offsetting costs.

10. Further questions for the GLA (and/or comments and assorted views/recommendations)

Further comments encompassed topics such as: making it harder to remove mature trees; doubling-down on unoccupied properties; considering requirements for external blinds; setting limits to cooling demand; developing guidance around compatibility of VRF systems with DHN; stricter façade design guides/limits (e.g., glazing ratios).

Stakeholder engagement summary | Local authorities workshop 10/07/2025

Generic comments:

- Policy requirements to address both minor and major developments, and clear guidance to be covering more building typologies.
- Participants raised the need to future proof performance levels in order to stay relevant within the whole timeframe of the new London plan.
- There were requests to analyse how the new recommended approaches are likely to impact the application process.
- There were requests to provide more clarity on accreditations that can support the policy outcomes – BREEAM, NZCBS, Passivhaus, NABERs etc – not to become mandatory but to offer Assured Performance for planners and reduce the burden.

Comments on policy implementation:

- There were requests to simplify collection of data and the review application process for DM officers.
- A suggestion was to standardise S106 conditions for all boroughs to use.
- Suggestions were made to provide clear guidance on the consequences of an application not meeting a target.
- Suggestion to standardise data submission through a unified legal proforma across all boroughs to eliminate the need for annual monitoring reports. Clarify process and responsibility for the data updates. Suggestion to upload this and additional project specific data on a London-based publicly available database, ensuring transparency and promoting learning from each other's projects.
- Additional guidance to support DM officers interrogate the performance levels and supporting data.
- There was a suggestion to verify a number of projects (random selection) rather than all of them to reduce cost and incentivise thorough checking.

Space heating demand and energy use intensity:

Metrics approach: all participants were positive and familiar the SHD and EUI metrics. Some are already adopted or planning to adopt them through their emerging local plans.

SHD and EUI levels: there were requests that performance levels should cover a wider range of typologies, such as co-living spaces and student accommodations. Participants requested for clarity on the performance levels, and whether these are based on design or as-built performance. A participant suggested to request applicants to report the percentage of cooling consumption within the total EUI of the building, to understand impact of cooling in the total energy consumption of a building per typology.

Cooling:

Suggestions to improve the current policy:

- Great support on the suggested approach.
- There was a suggestion to have a limiting internal gains requirement for both residential and non-residential developments.
- Concerns were raised on the current policy's conflict between dual aspect and space restrictions. Participants requested clearer guidance for reducing cooling demand for buildings that are more likely to have single-aspect dwellings/ living spaces (e.g. student accommodation and co-living).
- There was a concern regarding the passive design test's relevance, as it appears similar to the existing guidance in GLA 2022 paragraph 8.10, which is reportedly not being followed. Clarification is needed on how the new proposal differs / how it will change in this issue and be specific on which building typologies does it affect (e.g. are HMO's included?).
- External shading remains a challenge - developers often resist due to maintenance and design concerns. There's need for a plan that more strongly promotes its adoption.

Stakeholder engagement summary | Local authorities workshop 10/07/2025

Low carbon heat:

- Participants requested for more clarity on when buildings should or not connect to the district heating networks, what additional infrastructure is required if connection is needed and what physical or regulatory boundaries need to be considered?
- Suggestion to consider the embodied carbon impact of the additional infrastructure needed to connect to the DHN. Concerns were raised regarding the lifespan of heat sources, if they are only operational for 40 years, what happens to the infrastructure afterward?
- There was a suggestion for affordable heat analysis to use gas as a baseline - heat source to be acceptable if a slightly more expensive than gas.
- There was a suggestion that District heating lead to perverse outcomes. For example when there are energy sharing from datacentres etc, this doesn't incentivise energy reductions
- Participants agreed that clearer guidance on when different types of low carbon heating systems are allowed. Exhaust air heat pumps is a frequent chosen option in London.
- Strong agreement that connecting to DHN should not be mandatory, especially where ultra low energy standards are met (e.g. Passivhaus certification). Requiring future connection was seen as a viability issue and not in the best interest of residents.

Renewable energy:

Renewables guidance & PV policy:

- there should be clearer guidance on what qualifies as 'renewables'. Current definitions are too narrow, and guidance should go beyond just PVs, even if broader definitions are harder to quantify. A simplified methodology or framework would help incentivise broader adoption.
- General agreement that PV deployment should be maximised wherever possible. Further guidance on where to prioritise PVs over other conflicting roof elements (e.g. amenity space) and how to address constraints in conservation areas.
- that PVs should not be encouraged only on the roof but on balconies and car parks as well.
- There were discussions on setting Level 2 as a requirement but with level 1 as a onsite backstop and energy offsets being paid between level 1 and 2, if level 2 can't be achieved onsite.
- PVs should be mandated on single family houses.
- Participants agreed that a clear derogations process is needed.

Energy balance & viability:

- Participants agreed that more analysis is needed on the current viability of energy balancing strategies. How do today's costs compare to the long-term costs of climate risk? They suggested exploring this trade-off to support more sustainable long-term planning.
- There was broad agreement that the focus should be on incentivising on-site renewable energy generation and reduction of operational energy over relying on offset payments, with a exception of low-rise residential buildings where achieving energy balance is more possible.

Stakeholder engagement summary | Wider industry workshop 23/06/2025

Space heating demand and energy use intensity:

Performance levels approach: there was a strong consensus in favour of the proposed performance metrics and levels approach for SHD and EUI by typology.

SHD levels: the feasibility of achieving more ambitious levels was noted to depend on the building typology. For example, high-rise buildings with efficient forms were seen as capable of achieving level 3, whereas low-rise buildings with a higher form factor (semi-detached and terraced houses) were generally considered to be able to achieve levels 1-2.

EUI levels: participants noted that proposed EUI levels appeared more ambitious for hotels and student accommodation. There was agreement that these targets may only be achievable if bespoke spaces, such as spas, swimming pools and commercial kitchens, are excluded from the EUI levels.

Calculation methodology: there was consensus that predictive energy modelling is the most appropriate method for SHD and EUI.

Implementation:

- Participants agreed that clear implementation guidance is essential to ensure accurate and comparable results. This includes clarity on what should be included or excluded from calculations, as well as standardised assumptions for occupancy profiles and weather files.
- There was also a general understanding of the challenges in implementing third-party verification of models and in using in-use data to validate predicted results.
- A proposed approach involved using predictive energy modelling with standardised template assumptions to assess compliance with SHD and EUI. If a building is unlikely to follow the template, the model would be updated to develop a predictive EUI, which would then be compared to in-use data. The majority of the participants supported this approach, while a few preferred the use of predictive model only or the template-based model only.

Cooling:

Existing GLA heat risk policy: there was a general view that the current cooling hierarchy is ineffective in enforcing passive measures. Some disagreed with existing policy's current stance of penalising active cooling, rather than accepting that it will be inevitable due to future warmer weather, while everyone agreed that requiring passive measures will ensure that cooling demand has been minimised.

External shading: there was strong support for the requiring of external shading regardless of active cooling presence. Suggestions included requiring external shading as a default, unless applicants could provide robust evidence proving that it is not essential due to the sufficient implementation of other passive measures.

Passive design test approach: there was full support for applying the 'passive design test' to mechanically cooled residential developments.

Cooling demand limit approach: participants supported a metric to understand and reduce cooling demand. However no participants supported the introduction of a cooling demand metric (kWh/m²/yr). Opinions were split between using peak solar demand (W/m²) and peak cooling load (W/m²) as alternative metrics. A suggestion was also made on introducing wall-to-glazing ratio as a supporting metric. Overall participants agreed that there is currently a lack of evidence to define appropriate limits for any of the cooling metrics.

Overheating analysis: there was an agreement that when applying a cooling metric, the choice of weather files is critical to ensure the delivery of future warmer weather resilience buildings.

Stakeholder engagement summary | Wider industry workshop 23/06/2025

Low carbon heat:

Heat network zones approach: participants generally agreed that the current heat maps are too loose and requirements to connect are not backed by a firm plan for expansion of district heat networks. There was resistance to requiring provision for future heat network connections, since the network is unlikely to be delivered and the connections are costly.

Low-carbon heating options approach: the majority were opposed to banning certain heating systems (e.g. direct electric). There was strong support for clearly defining which systems are acceptable and under what circumstances. For example, could schemes be exempt for connection to a heat network when they are Passivhaus certified, due to low heat loads on the development? Participants supported flexibility to allow systems like direct electric (such as in low space heat demand/Passivhaus certified schemes) or exhaust air heat pump where appropriate.

Affordability approach: the majority agreed that applicants should report on the affordability of systems, energy performance of building and embodied carbon impact of MEP systems as part of a low carbon heat appraisal. In addition, it was widely supported that the baseline heating system should be an on-site ASHP, as opposed to a gas boiler.

Renewable energy:

Performance level approach: A range of opinions were expressed on the inclusion of a renewable energy metric.

- Some participants were supportive of the approach and levels, felt that a clear target for on-site renewable energy is necessary and found the term 'optimising' used in current policy too weak.
- There was consensus that energy generated should be ideally benefit the residents.
- Others questioned the added value of going beyond the renewable energy requirements suggested by FBS/ FHS.
- Everyone acknowledged the tension between installing PVs on the roof and meeting competing metrics such as biodiversity net gain (BNG), urban greening factor (UGF), amenity space, plant space and fire/insurance considerations. A prioritisation hierarchy was strongly supported to guide applicants.
- There were suggestions to locate PVs on marginal land instead of rooftops due to lower costs.

Energy balance: There were differences of opinions for introducing or not an energy balance requirement.

Batteries: There were suggestions to prioritise battery storage over rooftop PVs, particularly given the future projections to decarbonise the grid. Most participants were in favour of investigating battery storage, which could work well with PV farms and enhance energy flexibility. An additional recommendation was for new schemes to provide detailed analysis as to whether battery storage would be beneficial.

Stakeholder engagement summary | Developers workshop 25/06/2025

Space heating demand and energy use intensity:

Metrics approach: all participants were familiar, comfortable and supported using these metrics. One had already rolled out Passivhaus levels of performance as standard (similar to level 3 for resi).

SHD and EUI levels: there was caution around setting the most ambitious SHD level (level 3) for low-rise residential buildings and that the proposed EUI level 3 for offices was seen as unachievable. Suggestions were made for applying different SHD levels to different building scales and revise the EUI levels for offices to ensure that they are all viable.

Calculation methodology: there was agreement that the accuracy of regulation compliance tools (SAP/SBEM) are low and that more reliable predictive energy tools are needed.

Cooling:

Suggestions to improve the current policy:

- Participants agreed that passive measures are often skipped when active cooling is introduced.
- There was strong support for strengthening the current policy to ensure indoor comfort and resilience, either through passive design or cooling solutions.
- Additional suggestions included: systems be considered early in the process, for both heating and cooling, and provision of rules of thumb for window sizes and shading on orientations.

Experience with passive measures: participants demonstrated strong understanding of how passive measures can influence comfort. Examples shared included installation of external shading, ceiling fans and an understanding the impact of thermal mass.

Implementation: concerns were raised that the current Part O methodology is not future-proofed and that weather files should reflect peak temperatures already occurring in London. Additionally, ensuring that design stage measures are delivered in practice was seen as crucial to minimise the performance gap.

Low carbon heat:

Heat network zones: there was strong agreement that connecting to DHN should not be mandatory, especially where ultra low energy standards are met (e.g. Passivhaus certification). Requiring future connection was seen as a viability issue and not in the best interest of residents.

Low-carbon heating options approach: all participants opposed banning specific heating systems. There was a general agreement that connecting to DHN increases costs for residents and schemes with good fabric performance should be allowed to use more viable and effective alternatives (e.g. EAHP).

Affordability approach: there was general consensus that heating costs should be assessed as part of a low carbon heating appraisal. It was strongly supported that there should be clear guidance and a standardised methodology, including the consideration of management fees and maintenance costs.

Renewable energy:

Performance level approach:

- Participants expressed concerns that rooftop PV systems are competing with factors like UGF, BNG and amenity, making it hard to meet the current building regulations, let alone the suggested more ambitious levels.
- Many felt that the proposed levels were unrealistic and suggested that emerging FHS requirements may be sufficient for residential.
- Several noted that residents do not see direct benefits on their energy bills and suggested that a more cost-effective alternative could be that PVs are installed off-site, allowing for roof space to be used as residents' amenity.

Energy balance: it was noted that this metric shouldn't just be measuring how much energy is generated on-site but also how much is actually utilised vs exported to the grid.

EUI | Review of UK NZCBS levels & Engagement with UK NZCBS

A comprehensive review was carried out of Industry standards and frameworks especially the UK NZCBS, as well as current regulations and benchmarks, adopted and emerging plans and existing and emerging evidence bases to develop the performance level options.

The UK NZCBS is a voluntary standard and verification is based on in-use measurement. The UK NZCBS limits were developed based on in-use data collected by the project, and an energy and carbon balancing exercise, to understand what is required in order for the UK carbon emission targets to be met. The EUI limits for new buildings reduce from building that have commenced onsite between 2025-2040.

EUI performance level options, developed as part of this evidence base have been developed in a different way. In order to develop an evidence base, it needs to be shown that the EUI levels are technically feasible for building applying for planning permission from 2028 and financially viable. This means that data needs to be published in this report that shows that the EUI levels can be met (using predictive energy modeling), and the performance specifications are of the buildings that meet these levels, as well as the performance specifications required to meet the current London Plan, so that a cost assessment can be carried out.

Comparison on the performance level options and the UK NZCBS

- Level 1, which is based on the performance of the current London plan is a little higher than level 2025 NZCBS limit
- It was felt that the 2040 NZCBS EUI limits align in most cases with best practice buildings currently being designed and built, thus it was felt reasonable for Level 3 to be aligned with the 2040 NZCBS EUI limits, (this has the added benefit of consistency.)
- For residential, hotels and student accommodation level 2 is similar to the 2030 NZCBS limit.

	EUI Level 1	EUI Level 2	EUI Level 3	UK NZCBS pilot EUI limits		
				2025	2030	2040
Residential	50	40	35	45 (homes) 40 (flats)	42 (homes) 39 (flats)	35 (homes) 35 (flats)
Office	130	90	70	85	72	45
Primary school	65	52	40	45	42	40
Industrial warehouse (conditioned)	40	35	30	35 (unconditioned) 80 (conditioned)	30 (unconditioned) 67 (conditioned)	20 (unconditioned) 40 (conditioned)
Hotel	150	120	80	125	110	80
Student accommodation	80	65	50	75	67	50

Table comparing the EUI performance level options with the EUI limits in the NZCBS. It shows that the level 3 performance level option is aligned in most cases with the 2040 NZCBS limit, aside from the offices limit.

Offices: An EUI of 45 kWh/m²/yr aligns with NABERS 6 stars. There are very few examples of NABERS 6 star offices being designed or in-operation in London, hence this level is too ambitious for policy implemented from 2028. There are examples of 5.5 star office buildings (aligned with EUI of 70 kWh/m²/yr), thus this is why this level of performance was chosen for Level 3. (These conclusions were based on industry engagement with members of the NABERS IDR panel, some who were also part of the NZCBS sector group.

Schools: The NZCBS limits for schools have a very small difference between 2025 and 2040. Level 1 and Level 2 is larger than the 2025 and 2030 NZCBS limit, this is based on modeling that shows that 65 kWh/m²/yr is broadly in line with the current London plan today, and level 2 (52 kWh/m²/yr) is based on the DfE EUI limit.

Industrial: The industrial warehouse typology for the London Plan evidence base is conditioned. Level 1 is already position at the NZCBS 2040 limit. This is due to the results from the energy modeling, showing that this is already at the level of the current London Plan.

Explanation of why certain typologies where the performance level options are different from the NZCBS limits



Stakeholder engagement summary | Offices sector workshop 09/06/2025

Purpose of the engagement

Over the past 5 years, NABERS rating system has been increasingly used to design and operate office buildings in London. For buildings in the design phase there is a design for performance process that involves an independent review, carried out by someone from the independent design review (IDR) panel. There is therefore a pool of experts that understand the energy performance of offices in London. It was thought that engaging with and learning from these experts from the IDR panel that work on offices in London, as well as other experts on office energy performance, would strengthen the research.

Development of EUI performance levels:

Performance levels articulated in this report follow EUI equivalent levels¹ to NABERS star ratings. The levels were chosen based on this engagement workshop, see table aside. It was concluded by the group that 4.5 stars was equivalent to what was achieved by office building in London with ambitions of just complying with the London Plan. That they knew of a sufficient number of 5.5 star buildings in design or construction in London, that would make it a reasonable limit for Level 3.

Development of SHD performance levels:

It was agreed by the group that the SHD levels that were proposed, could be easily achieved by the equivalent NABERS star rated building and that they are set at a level that doesn't really drive heating consumption reductions. Some in the group thought that this was a good thing, as offices are cooling dominated, thus pushing beyond the SHD presented is not cost effective. Others disagreed and thought that the initial levels should be improved upon (L1:20, L2:15 L3:10). It was decided to keep the SHD levels as they were, so that there was consistency with other non-residential typologies.

Workshop Attendees:

Claire Das Bhaumik (Inkling), Jennifer Elias (Atelier Ten), Robert Cohen (Verco), Simon Wyatt (Cundal), Stephen Hill (Arup)

Scope	Metric	Interim Targets			Paris Proof Target
		2020-2025	2025-2030	2030-2035	2035-2050
Whole building energy	kWh _e /m ² (NLA) / year	160	115	90	70
	kWh _e /m ² (GIA) / year	130	90	70	55
	DEC rating	D90	C65	B50	B40
Base building energy	kWh _e /m ² (NLA) / year	90	70	55	35
	kWh _e /m ² (GIA) / year	70	55	45	30
	NABERS UK star rating	4.5	5	5.5	6
Tenant energy	kWh _e /m ² (NLA) / year	70	45	35	35

NLA = net lettable area GIA = gross internal area

Extract from the UKGBC report: Energy performance targets for net zero carbon offices: Technical report and summary of consultation responses, June 2020

	Level 1	Level 2	Level 3
Office - Whole build EUI	130	90	70
Equivalent star rating	4.5	5	5.5
Office -Base build EUI	70	55	45

Levels of performance agreed at the workshop

¹ As articulated in the UKGBC report: Energy performance targets for net zero carbon offices: Technical report and summary of consultation responses, June 2020

Stakeholder engagement summary | Offices sector workshop 09/06/2025

Specifications of a 4.5, 5, 5.5 star office building

Much of the conversations at the workshop were around the minimum specifications required to meet 4.5-5.5 stars, this informed the construction cost calculation carried out in this report. Ratings can be achieved in a variety of ways, the group sought to develop the lowest cost minimum specifications requirements.

It was agreed that VRF systems are the cheapest system used for heating and cooling on 4.5-5 star buildings and 4 pipe fan coil units for 5-5.5 star buildings. It was agreed that mixed mode ventilation is required for a 6 star building, and some 5.5 star building have some kind of mixed mode ventilation, but this is not a minimum requirement, and building can meet 5.5 stars without mixed mode. (Thus the cost assessment for Level 3 does not need to include opening windows).

The adjacent table presents the identified construction cost increases and savings in the workshop.

	From 4.5-5 stars	From 5-5.5 stars
Cost increase	• Systems FCU not VRF • Enhanced heat pump efficiency • Enhanced SFP's and HR efficiency • Enhanced fabric • Space take risers	• Systems FCU not VRF • Enhanced heat pump efficiency • Enhanced SFP's and HR efficiency • Enhanced fabric • Space take from risers • Smaller control zones, thus higher cost for controls? (point count increase by 10%, + more FCU)
Cost saving		• Reduction in chiller size/ system size. (15%?)

Summary of the identified construction cost increases and savings in the workshop

Stakeholder engagement summary | Offices sector workshop 09/06/2025

Other comments by participants

The rules set by GLA should include commitment to keep model going through stages 3 to 5 as well as commitment to rate. Otherwise this becomes lip service to comply just to get planning. Point is if they don't, they will never achieve the target rating.

To follow the design for performance route, at the IDR the modelled energy performance must be at least 25% below the maximum level for the star rating being targeted. This seeks to account for the performance gap. It was raised in the workshop that as the London Plan EUI limits will be at planning stage they should be 25% lower than stated in this report.

The detailed design for performance modelling is usually undertaken at Stage 4, post planning. Rather than requiring the modelling to be undertaken earlier as part of planning, the new London Plan could have a pathway, where the developer commits to achieving a certain NABERS rating and following the Design for performance process, with a pre-commencement planning condition that the IDR is carried out and licence is given by the IDR to promote the 'target' rating and a further condition to achieve a NABERS rating in use. In the city of Sydney there is a planning route similar to this for central tower clusters and a policy ¹ in New South Wales for offices with NLA>1000m², hotels with more than 100 rooms, and serviced apartments with at least 100 apartments.²

It was noted that matching the EUI rating to a NABERS rating only works under a standardised set of conditions. Depending on the usage intensity of the building, temperature set points etc. It is important that a set of standardised assumptions are developed, for energy modellers to use when developing the energy models required for planning. It is suggested that a good starting point is the DfP modelling guidance on assumptions. Although the planning EUI limit is a whole building target, if a standard set of operating conditions are used in the energy model. It effectively means that at planning stage the focus is the base build performance.

¹ <https://legislation.nsw.gov.au/view/html/inforce/current/epi-2012-0628> (Part 7, Division 4, clause 7.25A)

² <https://www.nabers.gov.au/sites/default/files/2024-04/Fact%20Sheet%20-%20NSW%20Sustainable%20Buildings%20SEPP.pdf>