Net Zero New Buildings

Evidence and guidance to inform Planning Policy

Revision	Version 1.3
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Issue date:	3rd December 2021

This document has been collated to support the development of planning policy in the South West of England. It is a summary of the local energy planning policy landscape in 2021 and collates recent evidence commissioned in support of net zero Local Plan policies in the region.

Where relevant, policy recommendations have been provided based on the conclusions of these studies.

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SOUTH WEST ENERGY HUB

1. Summary

In 2006, UK Government introduced the Code for Sustainable Homes, announcing that by 2016 all new development would be net zero carbon. In 2015 this move was scrapped, leaving the industry in a legislative limbo that continues to this day with building standards now 10 years old.

Today, approaching two decades since BedZED demonstrated net zero at scale, local planning authorities are increasingly taking the lead, setting planning polices proportionate to their climate emergency declarations.

If they are to succeed, policies set at a local level should be complimentary across the country and react to the many changes afoot in the market and in national policy. This report reviews the state of the market today (Autumn 2021) and the extensive local policy research that has been undertaken in recent years. It provides a suite of policy considerations to ensure a robust and practical transition to net zero energy buildings. All recommendations have been developed to dovetail as best as possible with recent industry guidance, other local plans across England and the Government's Future Homes Standard (FHS)/ Future Buildings Standard (FBS).

Context

In 2019, Government set out its intentions for the Future Homes and Buildings standards - flagship programmes that will level up construction practice across the country. Whilst both are welcomed, they are not without challenges. They will not come into force until 2025 at the earliest, are limited in their scope to reduce the performance gap (and therefore protect against high fuel bills) and will not in themselves meet net zero construction by 2030.[1]

In England and Wales last year, less than 2% of new buildings achieved best practice energy ratings (EPC A)[2]. If the region is to meet it's 2030 climate targets, the remaining 98% of buildings will face retrofit costs of between £15,000 and £25,000 each[3], a cost that could be avoided if additional planning policies are brought in earlier. Acting now will also save a skills cliff edge leading up the FHS/FBS implementation, instead positioning the region as a leader in low carbon goods and services.

The cost of this? Building better can deliver operationally net zero buildings for an average uplift of 2-4%[1]. This is equivalent to around two to four months of house price inflation[4] in return for comfortable, future proofed housing with significant opportunities for energy bill savings.

Policy Considerations

Modelling

A1 Provide clear targets that can be accurately modelled and monitored. For major developments, or where the risk of performance gaps are considerable (e.g. direct electrically heated buildings) this should go beyond Building Regulations compliance modelling.

A2 For minor development, request use of 'one click' SAP plugins to limit inaccuracies.

A3 Ensure approaches dovetail with national requirements (e.g. fabric and ventilation requirements of Building Regs.)

Operational Energy

B1 Implement policy that reflects a four-principal approach of no fossil fuels, space heating targets, energy use intensity targets and onsite renewable generation to (at least) match residual energy demand.

B2 Target the Committee on Climate Change recommendation of 15-20kWh/m^2/year limit for space heating by 2025 at the latest.

B2 Target LETI/RIBA Energy Use Intensity (EUI) targets by building type. Undertake local viability testing where transitional targets are required prior to 2025.

B3 Where non-standard non-residential buildings cannot meet EUI targets, require compliance with agreed alternative accreditation schemes suited to these typologies.

B4 Where BREEAM is used as a policy tool, consider targeting exemplary (unregulated energy and monitoring) Ene01 credits to drive performance gap reductions.

District Heating

C1 Connection to a district heating network should not allow exemption from onsite energy targets.

C2 Developments should make all reasonable efforts to achieve net zero onsite emissions prior to connecting to a DHN.

C3 Space heating and EUI targets should account for distribution losses in the DHN.

Embodied carbon

D1 Require an embodied carbon assessment using a RICS recognised tool (limited to a 'one-click' tool for minor developments) and reporting against industry benchmarks.

D2 Consider the introduction of embodied emissions targets for major developments (at costed levels or as a cost neural backstop), setting out how and when future targets will increase in scope

D3 Use data gathered through embodied carbon assessments to inform industry development of robust targets.

Existing Buildings

E1 Seek legal guidance on setting consequential improvements at a local level (typically this power sits with central Government).

E2 If amending policy, consider alignment with the consequential improvements requirements of Welsh Building Regulations or the LETI Climate Emergency Retrofit Guide.

Offsetting

F1 All efforts should be made to reduce onsite and embodied emissions prior to the consideration of offsetting. Offsetting should only be used to meet an energy generation shortfall after onsite renewables have been maximised; it should not be used as a mechanism to avoid energy use targets.

F2 Offsetting should only be permitted where it can provide credible additionality. The UK has a finite resource of cost viable renewable generation; using low hanging fruit to offset new development detracts from the ability to decarbonise harder to treat sectors.

F3 Offsetting schemes must ensure that the rate of savings equal the rate of emissions; delayed savings must account for balancing any accrued emissions prior to delivery of the offsetting project.

F4 Offsetting schemes should focus on either developer procured renewable energy supply at the point of planning and/or council collected payments with robust, transparent and accountable expenditure plans.

Monitoring

G1 Secure a process and resource for requiring, reviewing and monitoring energy demands through Planning Energy Statements and alignment with a post occupancy reporting scheme.

G2 Avoid policies that cannot easily be measured in the real world, or sole reliance on methodologies that will change within the timeframe of new policy (e.g. Building Regulations).

2. National Regulation

Heating and powering buildings currently accounts for 40% of the UK's total energy usage.[5] Although the demand from new development in isolation is a small proportion on this, the influence of the construction sector and its supply chains is significant, linked to almost half of all UK emissions. It is therefore the most important catalyst for the wider industry.[6]

The UK is a signatory to the 2015 Paris Agreement, an international treaty committing signatories to limit global warming to well below 2 °C, targeting 1.5°C. This commitment requires global emissions to be almost halved on 2010 levels by 2030. In 2019 UK Government committed to bring all greenhouse gas emissions to net zero by 2050, with some sectors including construction taking the lead well before this as part of the UK's system of carbon budgeting.

This document refers to climate mitigation i.e. the reduction of greenhouse gas emissions. Policies tackling climate resilience and climate adaptation are not covered here, however the co-benefits of healthy, resilient communities should not be underestimated,

Building Regulations

Nationally, the baseline for the energy performance of new buildings is set by Part L and Part F of the Building Regulations. This is made up of the following Approved Documents:

- L1A/B: Conservation of fuel and power in new dwellings / existing dwellings.
- L2A/B: Conservation of fuel and power in new buildings other than dwellings / existing buildings other than dwellings
- F – Ventilation

The Part L documents were published in 2010 and updated in 2013. Many of the requirements of these regulations are now widely considered outdated and out of step with current good practice (see section 5).

The Future Homes Standard (FHS)

In October 2019 the government launched the FHS consultation to be introduced in 2025 and require 'new build homes to be future-proofed with low carbon heating and world-leading levels of energy efficiency'. The consultation also considered the potential for interim changes to Part L to increase energy efficiency requirements before 2025. The following are key commitments made in response to the consultation:

2022 interim uplift: An interim uplift to Part L will come into force in June 2022 subject to the second Part L consultation. It will be legislated for in December 2021.

- This will only apply to new homes.
- An average home will produce 31% less CO_2 than homes constructed to the 2013 standards.
- Fabric Energy Efficiency Standard will be one of four performance metrics designed to ensure that developers adopt a fabric first approach.
- Natural gas boilers can still be installed.
- The transitional period will be one year (i.e. planning granted under old standards will have one year before being built to new standards) and will apply to individual homes rather than an entire development.
- Introduction of overheating standards
- No target for unregulated energy (see section 4).

2025 uplift: The technical specification for the FHS will be consulted on in 2023, legislated for in 2024 and implemented in 2025.

- New homes will not be built with fossil fuel heating (a performance-based standard will be used to deliver this commitment, rather than banning technologies).
- No further energy efficiency retrofit work will be necessary to enable homes to become zero-carbon as the electricity grid continues to decarbonise.
- Measures will be put in place to reduce the performance gap.
- An average home will produce at least 75% lower CO_2 than one built to current (2013) standards.
- A draft notional building specification has been published - this is not final and will be subject to further technical work and consultation.
- A full technical spec. will be consulted on in 2023.
- Existing homes will be subject to higher standards with a 'significant improvement' on the standard for extensions. Replacements and repairs will also have to be more energy efficient.
- No target for unregulated energy (see section 4).

The Future Buildings Standard (FBS)

The Future Buildings Standard consultation ran from January to April this year (2021). It builds on the FHS by setting out energy and ventilation standards for non-residential buildings and existing homes as well as including proposals to mitigate against overheating in residential buildings. Key considerations of the FBS consultation include:

2022 interim uplift for non-residential buildings:

- The Government's preferred option to uplift energy efficiency standards for new non-residential buildings in 2022 which is intended to deliver a 27% reduction in CO_2 emissions on average per building compared to the existing Part L 2013 standard.
- Improvements to the non-residential energy modelling methodologies
- Improvements to standards when work is carried out in existing non-residential buildings
- An expectation that the proposed increase in carbon and primary energy targets in the 2022 standard will drive a large proportion of developers to phase out fossil-fuels now, ahead of the introduction of the Future Buildings Standard.
- Introduce primary energy (total energy inclusive of upstream energy to get to a property) as the principal performance metric for new non-residential buildings, with the continued use of CO_2 as a secondary metric

2025 uplift for non-residential buildings:

- A vision for the Future Buildings Standard that will apply to new non-residential buildings from 2025 onwards. There will be further consultation on the full technical standard and recognition that there may be different timelines for implementation for different building types (i.e. this may not come in to force for all non-residential buildings in 2025)
- Performance-based standards will continue to be used rather than mandating or banning the use of any technologies. However, to make sure that new buildings are zero carbon ready, it is highly unlikely a new building will be able to meet the Future Buildings Standard without low carbon heating and very high levels of energy efficiency.

2025 uplift for residential buildings:

- Proposed improvements to standards when work is carried out in existing homes
- Reconsulting on the Fabric Energy Efficiency Standard, as well as other standards for building services in new homes and guidance on the calibration of devices that carry out airtightness testing
- A proposed requirement that when a whole wet heating system is replaced, including both the heating appliance (e.g. a boiler) and the emitters (e.g. radiators), that the new system is designed to run at 55°C.

Why not wait?

While both standards will reduce CO_2 emissions associated with new buildings compared to existing regulations, there are several reasons why Local Planning Authorities (LPAs) who have declared a climate emergency may need to take supplementary action.

- Interim uplifts fall short of or are only comparable to current best practice in the market and other local authority current practice.
- The technical specifications in the standards are only notional and may be changed.
- The implementation timeline is liable to slip.
- The current Part L modelling methodology leads to a large performance gap that cannot be monitored (there is a risk that energy bills may be high as a consequence).
- Placing a reliance on electricity grid decarbonisation can take renewable supply away from other harder to treat sectors.
- The FBS/FHS intend to cover the same scope as Building Regulations, this excludes key net zero scopes such as unregulated energy and embodied carbon.

Options for addressing these issues without losing the benefits of the FHS/FBS are explored in more detail throughout this document.

3. Legislative and National Policy Background

The legal background to local emissions legislation stems from a wide range of parent legislation not discussed here. A good reference point for this background context is the Royal Town and Planning Institute (RPTI) Climate Crisis Guide.

Historically there have been conflicting messages surrounding the ability of Local Planning Authorities (LPAs) to set energy and carbon targets beyond national requirements, in part as messaging has changed in recent years (see adjacent legal timeline).

The differences between national and local policy can be traced back in part to the UK Government's U-turn on zero carbon homes in 2015. This decision left a gap in policy, stagnating the market and supply chain. Some local policies already in draft (notably the 2016 London Plan) retained this commitment, in London's case enacting zero-carbon homes from 2016 and for all other buildings from 2019.

At the time of writing a national policy gap continues, with Government stating in its response to the FHS consultation that "new planning reforms will clarify the longer-term role of LPAs in determining local energy efficiency standards". To provide some certainty in the immediate term, this response has also signalled that it will not amend the Planning & Energy Act 2008 (see timeline) to restrict LPA action.

At the highest level, the Climate Change Act (2008) has a legally binding requirement to deliver net zero by 2050, delivered in step with the UK's carbon budgets. The evidence for meeting the sixth carbon budget (which has now been ratified by UK Government) suggests that in order to meet this goal, all new development should target net zero as soon as practically possible to avoid additional emissions and to catalyse wider decarbonisation required to hit 2050 targets.[7] This is the case regardless of whether or not climate emergencies have been declared or not at a local level.

At the time of writing, at least 17[8] local authorities have taken forward local policies related to energy and carbon in new developments that go beyond minimum national requirements. There have been no legal challenges to date.

What is undisputed is that the NPPF does expect planning to "shape places in ways that contribute to radical reductions in greenhouse gas emissions", but places equal evidence on deliverability, with policies underpinned by relevant and up-to-date evidence. Viability is therefore a key consideration in any policies being taken forward by LPAs.

Case study#1: Swale Borough Council

In May 2021 the Secretary of State rejected Swale Borough Council's attempts to impose stringent carbon reduction conditions on plans for 675 homes at Sittingbourne, Kent, ruling that the conditions were not reasonable because they 'went beyond current and emerging national policy'.

This decision went against the advice of the Planning Inspector, who argued that "the planning regime has a role to play and cannot leave climate change to other regimes to deal with, particularly when those regimes have not kept pace with the requirement to take urgent and material action". The "scale and urgency of the climate change emergency" was a material consideration that justified more stringent conditions, he advised.

Crucially, this example is a case where the Council looked to impose a requirement through guidance in absence of an underlying LPA policy. It demonstrates the importance of core policies related to the Climate Emergency. Where policies have been viability tested, consulted on and sit within Local Plans, there have been no such examples of similar challenges.

Timeline

2004 Planning and Compulsory Purchase Act sets out a duty to include in plans policies to tackle climate change.

2006 Zero Carbon Homes (ZCH) future policy announced by then PM Gordon Brown

2008 Planning and Energy Act allows Local Plans to include "reasonable requirements" for energy efficiency standards that exceed Building Regulations.

2012 National Planning Policy Framework (NPPF) states that the planning system should "secure radical reductions in greenhouse gas emissions" and that "Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change"

Mar '15 *In light of forthcoming ZCH standard a* Written Ministerial Statement (WMS) by Eric Pickles *[link] stated that Local Plans should not set out* technical standards or be expected to set policies above Code for Sustainable Homes Level 4, deemed equivalent to a 19% improvement on the Part L 2013 standard.

July '15 ZCH standard scrapped (set to be brought into law in 2016). As WMS was taken as a precursor to ZCH, significant uncertainty on how it should now be interpreted.

May '16 House of Lords attempts to reinstate ZCH standard for all new homes through an amendment to the Housing and Planning Bill. Amendment defeated by four votes. Government instead committed to a review of energy standards in current Building Regulations.

From '15 Some LAs go beyond requirements. A number of LPAs put into place local standards that are above Building Regs but equivalent to Code for Sustainable Homes (CfSH) Level 4. Some go further.

2018 Revised National Planning Policy Framework: Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

2018 Government statement on NPPF revision: "To clarify, the Framework does not prevent local authorities from using their existing powers under the Planning and Energy Act 2008 or other legislation where applicable to set higher ambition. Local Authorities are not restricted in their ability to require energy efficiency standards above Building Regulations.

Mar '19 Revised Planning Policy Guidance on Climate Change clarifies that different rules apply to residential and non-residential premises; with CfSH Level 4 limit being reinstated.

Jan '21 Government publishes FHS response - 86% of consultation respondents oppose the commencement to amend the Planning & Energy Act and were in favour of retaining local planning authorities' flexibility to set standards. As such the government clarified that:

> **" To provide some certainty in the immediate term, the Government will not amend the Planning & Energy Act 2008, which means that local planning authorities will retain powers to set local energy efficiency standards for new homes. "**

4. Building Regulations and measuring net zero

Building Regulations (Part L) require that the energy and carbon intensity of a building is measured using a National Calculation Model (NCM). This is most commonly done using UK Government's SAP and SBEM tools for residential and non-residential buildings respectively. This is the same methodology also used to generate Energy Performance Certificates (EPCs).

These tools generate a notional building design with standard features and compares these to the building design being considered. To pass, the Dwelling Emission Rate (DER) must be less than the Target Emission Rate (TER).

Benefits of SAP/ SBEM

- Ubiquitous: well understood by the industry and used for all new developments in the country
- Controllable: covers regulated emissions only; those that can be well estimated at the planning stage.
- Not overly onerous meaning it can be used early at the design stage and by large and small volume builders alike
- Backed by UK Government and currently under review – will continue to be used in the Part L 2021 update and the 2025 FHS.
- Ease of compliance checking owing to its simplicity
- Datasheets allow a range of metrics to be analysed beyond DER/ TER
- Sets clear requirements through the notional building methodology, supporting designers who are not low carbon experts.

Regulated energy *is related to controlled, fixed building services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps and indoor lighting. These uses are inherent in the design of a building and so can be more readily targeted.*

Unregulated energy *is energy that cannot be easily controlled at the design stage, typically reliant on occupant behaviour. It includes plug loads such as IT equipment and fridges, but also lifts, external lighting and cooking appliances. For some buildings such as offices, unregulated energy can be up to 50% of a building's energy demand.*

Limitations of SAP/SBEM

- Large performance gap. Tools use metrics that do not relate to how energy is used in real life. This can encourage a culture of false reporting and does not lead to best practice.
- Inaccuracies. SAP consistently underestimates heating demand for new build (typically half that of real life) and overestimates unregulated power use (as appliance efficiencies are outdated).[1]
- Post occupancy verification not possible as neither unregulated energy or absolute performance are assessed in SAP/SBEM.
- Efficient designs lack reward. The notional building has the same shape, orientation and, up to a point, the same proportions of glazing as the actual building (though not always the case for non-residential buildings).[9] This can neutralise the impact of improving thermal performance of a dwelling by reducing heat loss area, the number of junctions or by optimizing glazing layout. These are essential components of an energy efficient design. By excluding the benefits of these design components within SAP, inefficient designs can appear to be 'good' and better than they are in reality.

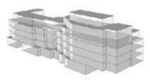
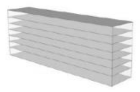
		Improvement over Part L (%) SAP	Space heating demand (kWh/m²/yr) PHPP
High form factor		35%	26
Medium form factor		35%	20
Low form factor		37%	13

Figure 1 Illustration of how similar SAP performance varies in real life[11]

- Zero carbon building cannot be modelled as unregulated energy is not fully included.
- Carbon emissions are inaccurate as the in-built electricity factors are outdated, reflecting a grid where power is supplied by far more coal than today. This underestimates the benefits of heat pumps versus gas boilers.

Alternative modelling comparison

There are many different modelling methods and software packages that can be used to calculate operational energy. Focussing on residential buildings, SAP 10.1 (the calculation that is likely to be adopted in 2021 Building Regulations) has been compared with:

- PHPP: the Passivhaus Trust's planning tool, an excel based tool often used for early stage modelling of low energy housing.
- IES: The leading dynamic simulation modelling software for demonstrating compliance against UK standards and guidelines (CIBSE TM54 in this example).

A modelling comparison for three different building designs in Cornwall[10] shows large variations in results for both space heating demand and total energy use. Recent work commissioned by BEIS supports this conclusion.[11]

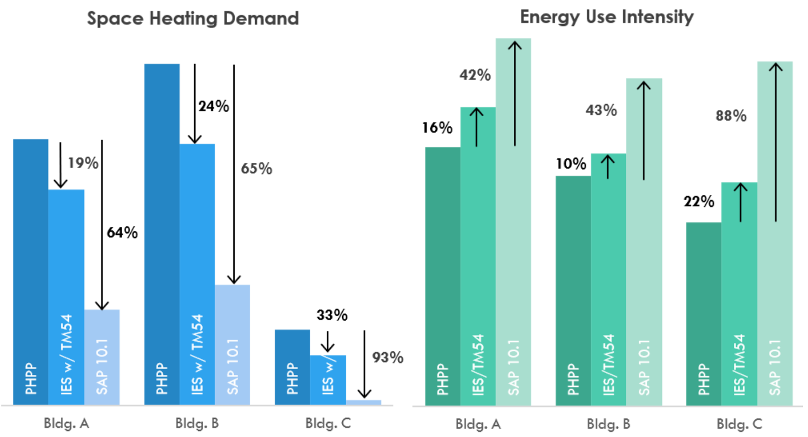


Figure 2 Software modelling comparisons for three buildings

In all cases, PHPP provides the highest estimate of space heating demand and is therefore the safest tool to use to not underestimate heat demand. It's higher estimate of electricity demands may be an overestimate, based on recent assessments of mid-range appliances.[12]

Not addressing the issue of SAP modelling could allow developers to avoid improving real life performance through a reporting loophole. Conversely, requiring minor developments to use third party modelling software may not be time or cost effective.

Work is ongoing to assess how these issues can be addressed through supplementary guidance, 'top-up' allowances and tools to map different software outputs against each other. This includes the development of a SAP Energy Adjustment Tool for early stage planning.

Non-residential energy modelling

For non-residential buildings it is also true that real world energy consumption is not well correlated with Part L modelling. It is not possible to account for all unregulated energy demands in a non-residential Part L, as well as having similar performance gap issues highlighted in Figure 2.

It is important that policy is designed to solve real life issues rather than modelling issues; modelling software is easier to update than policy and doing so pursues the right objectives. Where inaccurate modelling can have a severe impact on resident bills (such as the modelling of direct electric heating), policy should take a firmer line on accepted modelling practices to minimise the risk of unanticipated high fuel bills in operation.

Dovetailing with national requirements

Regardless of local policy, all new development is required to undertake Part L modelling and meet these minimum standards. In most cases better building design can be achieved by adding to, rather than conflicting with Part L requirements. This also keeps local policy agnostic to Building Regulation changes. A space heating target (for example) is not a requirement of Part L but a Part L assessment can provide the information needed to check this.

Policy Considerations

A1 Provide clear targets that can be accurately modelled and monitored. For major developments this should go beyond Building Regulations compliance modelling.

A2 For minor development, request use of 'one click' SAP plugins to limit inaccuracies

A2 Ensure approaches dovetail with national requirements (e.g. fabric and ventilation requirements of Building Regs.)

5. LETI Guidance

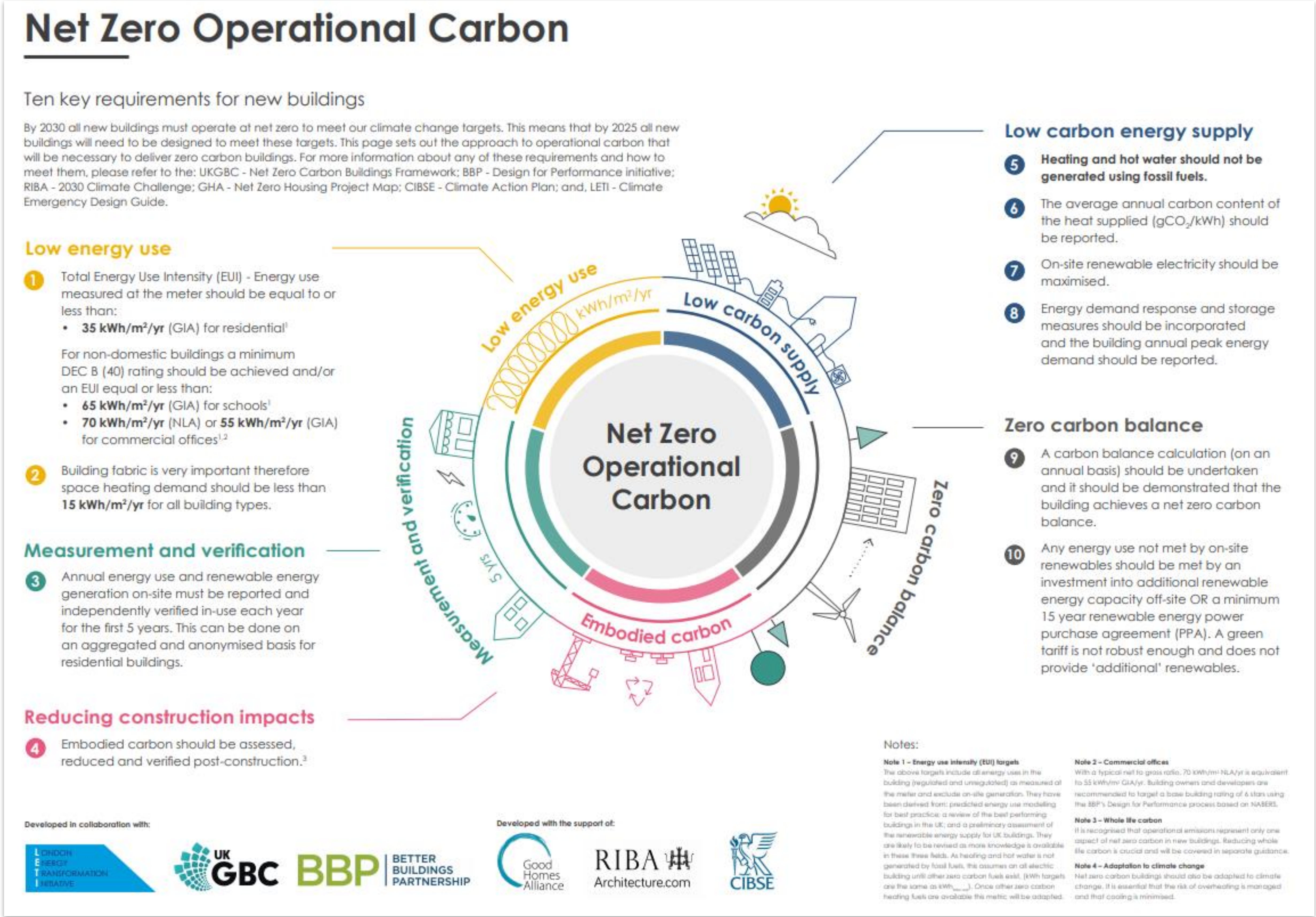
This figure is reproduced from www.leti.london/one-pager

Following diverging views on best metrics to drive net-zero carbon design, six industry bodies[13] across the built environment came together in 2019 to establish an agreed approach that would be resilient to changes in national policy. This work culminated in a 1-Page summary published by LETI[14] (adjacent) that has become a common goal across much of the industry. This has since been supplemented with other summary documents, all focussed on collaborative industry buy-in. These principles are reflected in prominent design guides including the UKGBC New Homes Policy Playbook and the RIBA 2030 Climate Challenge. The building fabric target is also reflected in the Committee on Climate Change evidence that underpins the UK's Sixth Carbon Budget.

Moving away from carbon. Predicting carbon emissions accurately is becoming hard as grid electricity becomes increasingly supplied by renewables. This causes the time of day and weather conditions to have a large bearing on emission levels, leading to complex carbon calculations that can risk masking poor underlying design principles. The LETI approach instead focuses on best practice energy demands limits that are applicable in any net zero ready building. As carbon is not assessed this also means the LETI principles can be followed alongside Part L and the Future Homes Standard without conflict; these metrics *do* calculate carbon use.

Unintended consequences. The LETI approach is dependent on all principles being followed as they are interrelated. Implementing an EUI target without a space heating target would risk high fuel bills, implementing both targets without an onsite fossil fuel ban would allow gas to be used to meet the other targets. It is also reliant on software which can model real life consumption accurately. **Energy Use Targets are not perfect; they do not specify elemental fabric standards and are highly dependent on the floor area of a building. They are designed to complement, and sense check national regulations until the point at which they are updated.**

Further guidance on best practice design is continuously evolving. At the time of writing a consortium of three local authorities have recently published a Net Zero Carbon Toolkit, reflective of the policies discussed here.



6. Operational energy targets: residential buildings

Following the discussion points in section 5 and subsequent LETI guidance, much LPA evidence since 2019 has focussed on implementing policy that follows four overarching principles.

1. No use of fossil fuels for heating
2. A kWh/m^2/yr. limit for operational energy use (EUI)
3. A kWh/m^2/yr. limit for space heating demand
4. Maximised onsite renewable generation

For net zero buildings the onsite renewable generation must at least match the energy use intensity (i.e. the annual energy use as measured at the meter) on balance over the year.

Timelines. Whilst there is broad agreement on aligned targets by 2030, there is divergence in opinion on the rate at which targets should come into force; this can present a challenge for authorities who must act now on policy positions that will last well into the future.

Table 1 Comparison of recent energy targets

Energy targets (kWh/m^2/yr.)	Space heating	EUI	Target referenced
	30	40	Cornwall Climate Emergency DPD
			B&NES Draft Local Plan Partial Update
	15-20	35	Central Lincolnshire Draft Local Plan
			Greater Cambridgeshire Draft Plan
			West Oxfordshire District Council AAP
			Committee on Climate Change
		70	UKGBC 'stretch target'
		60	RIBA Climate Challenge 2025
	15	35	LETI
			Better Buildings Partnership
			CIBSE
			RIBA Climate Challenge 2030
			Good Homes Alliance

Most relevant to the West of England authorities is Cornwall Council's Climate Emergency DPD, submitted for independent examination in November 2021 and expected to come into force in 2022. The underling evidence for this work found that a space heating target of 15 kWh/m^2/year and an EUI target of 35 kWh/m^2/year were viable, but that relaxing these to 30kWh and 40kWh initially would allow for a staged implementation. Other approaches for staged implementation are discussed in section 13.

Cost assessment

Table 2 summarises of cost uplifts calculated in support of the Cornwall Climate Emergency DPD for six housing typologies. The specifications of each building and £ values are set out in the associated evidence report[1]. The following target levels were compared:

- Part L 2013/21/25: typical levels of performance required for the 'notional building' in current regulations and draft notional building specification provided in the FHS consultation.
- Part L 2025 +PV: as above, with maximised roof mounted solar (Part L 2025 in itself does not require solar PV).
- UKGBC 2025: UKGBC stretch target (70 kWh/m2/yr. EUI and15-20 kWh/m^2/yr. space heating).
- Cornwall Council DPD: current draft policy requirements in Cornwall[15] and B&NES.[16]
- LETI target levels: 35 kWh/m^2/yr. EUI and15 kWh/m^2/yr. space heating).
-

These costs are presented relative to Part L 2021 minimum requirements as the minimum requirements in 2013 were considered an outdated baseline. For context, a cost uplift of 2-3% can be considered equivalent to several months house price inflation.

High rise flats (and some medium rise flats where solar insolation is less) may not be able to fully meet net zero energy use onsite. In restricted situations it may be necessary to offset this shortfall (see section 12) whilst maximising onsite renewables. Maximising renewables will vary on a site-by-site basis however as a guide,120 kWh generation per sqm of building footprint should be targeted.[17] Working is ongoing (by Bristol City Council) to update this evidence to include guidance on high rise flats.

Table 2 Indicative energy policy cost uplifts (Cornwall Example)[1]

	Semi-det. house	Terraced house	Bungalow	Dethatched house	Low rise flats	Medium-rise flats
PL 2013	-5.0%	-5.5%	-5.5%	-4.5%	-1.7%	-1.3%
PL 2021	baseline					
PL 2025	-2.4%	-2.0%	-2.4%	-2.0%	0.4%	0.4%
PL 2025 + PV	0.3%	1.3%	0.1%	0.1%	2.1%	1.6%
UKGBC 2025	3.4%	6.3%	5.5%	3.5%	4.3%	3.7%
CC DPD	0.8%	2.2%	1.2%	0.5%	2.2%	2.2%
LETI	2.7%	5.1%	4.1%	3.2%	3.7%	3.0%

Key	
	Not net zero compliant (gas boilers / poor fabric)
	Towards net zero compliance
	Net zero compliant

Regional variance

Costs in Table 2 have been calculated for indicative buildings in Cornwall – building designs and labour/ material costs will vary by region, as will levels of solar insolation.

Solar PV levels. Aside from flats, all buildings assessed complied with Cornwall policy levels without the need to fully maximise rooftop solar. Regional variance in insolation is not expected to reduce supply by more than 7kWh/m^2/year for any scenario, approximately equivalent to a maximum of three additional PV panels (based on 380W panels in the North East of England).[18]

Costs uplifts may be negligible where larger panels are specified. Where additional panels *are* required, this may increase overall spend by up to £600 in Bristol and £1,000 in Manchester (detached house example based on UK solar irradiance levels). These costs are conservative as they assume a degree of linear spend; in practice fixed costs (scaffolding, inverters etc) may not increase.

CASE STUDY #2 **The 2021 London Plan**

At 542 pages excluding supplementary guidance, the London Plan is the most in-depth spatial development strategy published in the UK. It contains a number of policies controlling energy and carbon limits for major developments across the city alongside detailed Energy Planning Guidance.

The London Plan approach is based on a ratcheted % improvements over building regulations. This is based on the methodology adopted in the Code for Sustainable Homes in 2006 and predates recent LETI/UGBC/CCC /CIBSE/RIBA work on alternative approaches. This approach has required updates to reflect changes in carbon emission factors and will require further updates when Building Regulations are changed in 2022 and 2025. As Building Regulations do not monitor unregulated energy, this is instead reported through the London Plan's 'Be Seen' policy (see section 13).

A call off contract between the GLA and consultants AECOM (supported by the BRE) is used to support and review major development policy compliance.

Policy Considerations

B1 Implement policy that reflects a four-principal approach of no fossil fuels, space heating targets, energy use intensity targets and onsite renewable generation to (at least) match residual energy demand.

B2 Target the Committee on Climate Change recommendation of 15-20kWh/m^2/year limit for space heating by 2025 at the latest.

B3 Target LETI/RIBA Energy Use Intensity (EUI) targets by building type. Undertake local viability testing where transitional targets are required prior to 2025.

7. Operational energy target: non-residential buildings

Whilst an energy metric for non-residential buildings holds the same appeal as for residential, it has much more variance on a case-by-case basis and is highly dependent on building design and fit-out after a development has passed through the planning system. Standardised driving conditions such as setpoints, hours of occupancy and occupancy density will always differ and be hard to predict fully at the planning stage. A one size fits all approach at a planning stage is therefore very challenging.

The performance gap

The performance gap can be particularly acute for non-residential buildings, especially at the planning stage. Building fit-out can be speculative at this point with a lack of control over tenant requirements. Building Regulation (Part L) modelling is not intended to model real-world energy use, exacerbating the issue. Using these modelling tools to measure EUI targets can be inaccurate in some cases.[19]

Space heating & cooling targets

Despite large sector variance, space heating can be less of a constraint for non-residential buildings and the CCC's overarching target of 15-20 kWh/m²/year may therefore be appropriate for all building types as suggested in section 5. As the cost of space heating and EUI targets has not been split out in recent non-residential evidence reports[20]; more empirical data may be required to justify this as a planning requirement. Likewise, cooling (a larger use in non-residential buildings) may merit inclusion alongside (or inclusive of) a heating target, but more evidence may be required to justify this.

EUI targets

Both RIBA and LETI set EUI recommendations for offices (55kWh/m²/year) and schools (65 kWh/m²/year) but acknowledge that such a target is tricky for other building typologies, instead recommending a Display Energy Certificate (DEC) of B. DECs are generated at the operational phase and based on metered energy use: although not a design stage tool, predictive DECs can be generated at the design stage where required.

The Evidence base for Greater Cambridge Local Plan[21] set out a range of EUI targets by planning class:

- Multi-residential/ Student accomm. - 35 kWh/m²/yr.
- Office/ Retail / Hotel - 55 kWh/m2/yr.
- GP surgeries/ HE Teaching facilities: 55 kWh/m²/yr.
- Schools – 65 kWh/m²/yr.
- Leisure – 100 kWh/m²/yr.
- Light industrial – 110 kWh/m²/yr.
- Research facility – 150 kWh/m²/yr.

The range of targets in this case highlights the extent at which building deigns can vary. Given this range it may be appropriate to allow some lenience around EUI targets for non-standard building types. Any lenience should only be granted where there are clear alternative metric in its place (examples below and in section 13, Table 9).

Even where not binding, EUI targets should still be reported against as an increasingly common metric, and for comparison against authorities where this is the overarching metric for non-domestic buildings (such as Greater Cambridgeshire).

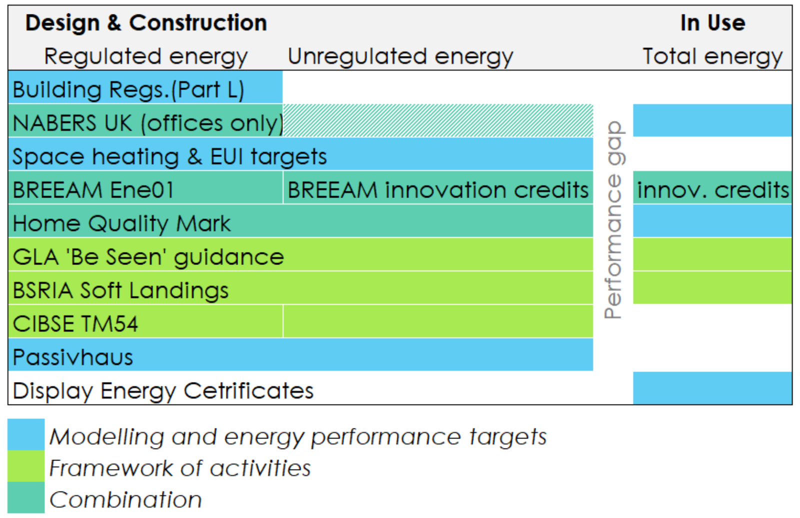


Figure 3 Design stage energy demands: accreditation schemes

Cost Assessments

A one size fits all cost assessments of non-residential buildings is not possible, cost evidence over time has been built up by several 'archetype' assessments. As part of the FBS Impact Assessment, UK Government has considered two options for its Part L 2021 update, the preferred of which (Option 2) delivers an average 27% improvement over Part L 2013 levels[22]. As with residential buildings, these costs are now considered a new baseline – many developers are already meeting these levels[23] which will become mandatory in the short term.

Table 3 Part L 2021 Option 2 - cost uplift over Part L 2013

	Cost inc. (£/m²)	% increase
Office: deep plan, AC	24	0.68%
Office: shallow plan, nat. vent.	29	1.14%
Hotel	40	1.32%
Hospital	23	0.51%
School (incl. sports)	36	1.20%
Retail Warehouse	75	4.15%
Distribution Warehouse	51	2.82%

Recent work by WSP[20] has assessed the cost uplift from this baseline towards net zero for two building types. These are:

▪ Office building: 3-storey, mechanically ventilated and cooled
▪ School: 2-storey, naturally ventilated with no cooling

A summary of this analysis is given below. It should be considered as towards net zero operational energy rather that true net zero as it permits a degree of regulated emissions offsetting (valued at £95/tCO_2/yr. for 30 years) and does not offset unregulated energy. It considers two fabric standards; those applied in Table 3 and a set of more stringent standards taken as current good practice.

Table 4 Cost uplifts - towards net zero

		Baseline	
		PL 2021 (Option 2)	Higher standards
Office	EUI (kWh)	82	78
	Cost uplift	0.9%	1.5%
School	EUI (kWh)	57	55
	Cost uplift	1.2%	2.8%

Further guidance

Beyond BREEAM, further details of these schemes covered in Figure 3 are not discussed in this report.

Guidance on modelling real world performance at the design stage is being published with increased frequency and alignment with external guidance can be a useful tool where core policy remains limited in its ability to keep up with changes in the market.

Examples and links to relevant guidance at the time of writing include:

- **CIBSE TM54** (operational energy design)
- **CIBSE TM52** (overheating design guidance)
- **BREEAM GN32** (prediction & post occupancy)
- **BSRIA Soft Landings** (implementation framework)
- **NABERS UK** (best practice for offices)

Policy Considerations

B4 Where non-standard non-residential buildings cannot meet EUI targets, require compliance with agreed alternative accreditation schemes suited to these typologies.

8. BREEAM

BREEAM is only one of many third-party accreditation schemes for non-residential buildings, however it is the most ubiquitous in the UK and referred to in the local plans of 193 authorities. Managed by the BRE, it is a credit-based framework across a range of sustainability criteria with a mix of mandatory and tradable credits.

In itself BREEAM does not mandate net-zero energy or carbon, however this can still be demonstrated and checked through a mix of compulsory and innovation credits. BREEAM also has credits relating to construction materials and embodied carbon.

BREEAM 'Excellent' is the most common level of performance referred to, both in planning policy and corporate strategies. Typical energy reduction of meeting this level of performance is approximately aligned to a 25% reduction over current Building Regulations[24], and like building regulations, does not consider unregulated energy as a minimum requirement. Beyond BREEAM Excellent, BREEAM Outstanding is the next highest level of accreditation.

Tackling the performance gap

BREEAM's calculation methods can rectify *some* performance gap issues that arise as the planning system is only involved at an early stage of design. The BRE maintain an oversight and audit role beyond planning, and provide periodic updates to procedures (e.g. alterative methodologies for SAP carbon factor fixes) whereas planning policy can be more fixed.

BREEAM's trading of credits between sustainability criteria also means that where an EUI target level is unobtainable, efforts must be made elsewhere under the set guidance of BREAM (including for embodied energy), rather than offsetting developer responsibilities, or replying on planning officers to decide where to draw the line on viability.

These principles also apply for the Home Quality Mark and NABERS UK schemes which are also overseen by the BRE.

Costs of BREEAM

Indicative BREEAM costs relate to overall performance; energy reduction alone cannot be isolated. Table 5 relates to BREEAM 2014 standards, however a more recent assessment (for an office) found that the impact of current BREEAM standards are similar[24].

In some areas (such as Bristol) BREEAM Excellent has been a standard requirement for major non-residential schemes since 2011 so the cost uplift of achieving Excellent is part of the baseline cost.

Table 5 Increase in BREEAM capital costs[25]

	Excellent	Outstanding
School	0.7%	5.8%
Industrial	0.4%	4.8%
Retail	1.8%	10.1%
Office	0.8%	9.8%
Mixed Use	1.5%	4.8%

The requirement to have a dedicated and accredited BREEAM assessor onboard throughout project development is a strength of the scheme but also carries a cost. For this reason, BREEAM is often only specified as a requirement in planning policy for major developments.

Beyond mandatory credits: net-zero

BREEAM Excellent requires at least 3 points to be scored in "Ene01" credits which cover reduction of emissions. Credits beyond this are not compulsory but often sought as an easier route to overall compliance than picking up more credits elsewhere. Whist there is not an explicit net-zero BREEAM standard, this would be met if achieving all exemplary credits under Ene01. Further exemplary credits can be achieved through maximising energy monitoring credits in criteria Ene02.

Requiring exemplary credits can be key to overcoming performance gap risks that cannot be controlled through planning as they include a commitment from the client/building occupier to pay for a post occupancy assessment of actual versus modelled energy data, then shared with the BRE and occupant.

Table 6 Ene 01 BREEAM credits (mandatory

<table>
<tr><th>Ene01 Criteria</th><th>Credits</th><th>Excellent</th><th>Outstanding</th><th>Net zero</th></tr>
<tr><td rowspan="9">Energy Performance</td><td>1</td><td rowspan="4">mandatory</td><td rowspan="6">mandatory</td><td rowspan="18">mandatory</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="5">additional</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td rowspan="3">additional</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td rowspan="4">Prediction of operational energy consumption</td><td>1</td><td rowspan="4">additional</td><td rowspan="4">mandatory</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td rowspan="3">Exemplary (unregulated emissions)</td><td>1</td><td rowspan="3">additional</td><td rowspan="3">additional</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td rowspan="2">Exemplary (monitoring)</td><td>4</td><td rowspan="2">additional</td><td rowspan="2">additional</td></tr>
<tr><td>5</td></tr>
</table>

Relation to EUI targets

Prediction of operational energy consumption can provide information needed for EUI targets and is part of BREEAM Ene01 if targeted, and mandator under BREEAM Outstanding (see Table 1). It is not recommended that BREEAM standards are used in lieu of any EUI reporting requirements, but both may be a compliance route where an EUI target cannot be met.

Policy consideration

To meet net zero emissions (including unregulated energy) through BREEAM would require all credits in Ene01 to be achieved. There is no known precedent for this and so the viability of this would need to be assessed, for a range of non-residential building designs.

Policy Considerations

B4 Where BREEAM is used as a policy tool, consider targeting exemplary (unregulated energy and monitoring) Ene01 credits to drive performance gap reductions.

9. District heating

Heating hierarchy's

Where the recommendations set out in this document are followed it may not be necessary to implement a heating hierarchy (i.e. a preferential order of heating technologies).
An agnostic approach leaves flexibility for the market to develop the best solutions within set parameters, however LPAs may still wish to set these parameters to promote more efficient heating systems (e.g. heat pumps over direct electric heating), discourage high embodied carbon technologies, or catalyse district heating where a wider infrastructure priority.

District heating EUI targets

Where district heating networks are promoted through policy, this should not be at the detriment of energy efficiency. Counting only heat "at the meter" into a building does not allow for energy used by the district heating system in generation, distribution and storage and would not be comparable with building based EUI accounting (where required) which does include heating system efficiencies. A district heating scheme may also use a range of energy sources rather than a single source, adding complexity to accounting.

Apportioning district heating energy use and savings to individual buildings is not new (it is commonplace to do this when demonstrating compliance with London Plan targets), however a methodology for doing this for EUI targets is more novel and should be clearly articulated in associated policy guidance.

Policy Considerations

C1 Connection to a district heating network should not allow exemption from onsite energy targets

C2 Developments should make all reasonable efforts to achieve net zero onsite emissions prior to connecting to a district heating network (DHN).

C3 Space heating and EUI targets should account for distribution losses in the DHN.

10. Embodied Carbon

Embodied carbon emissions are those associated with raw material extraction, manufacture and transport of building materials, construction, maintenance, repair replacements, dismantling, demolition and eventual material disposal (see Case Study #2). Combined with operational carbon emissions this is termed Whole Life Carbon (WLC). A WLC assessment provides a true picture of a building's carbon impact on the environment but is often not undertaken in detail as the embodied carbon element has not historically been assessed in planning.

An increasing importance

Around 10% of UK emissions are thought to be associated with the embodied carbon from new construction[26]. As operational emissions increasingly reduce, embodied emissions will make up a greater proportion of total carbon from the whole life of a building. Work carried out for RICS[27] suggests that embodied carbon currently makes up 35-51% of a building's total emissions, rising to 70% as operational energy decarbonises.

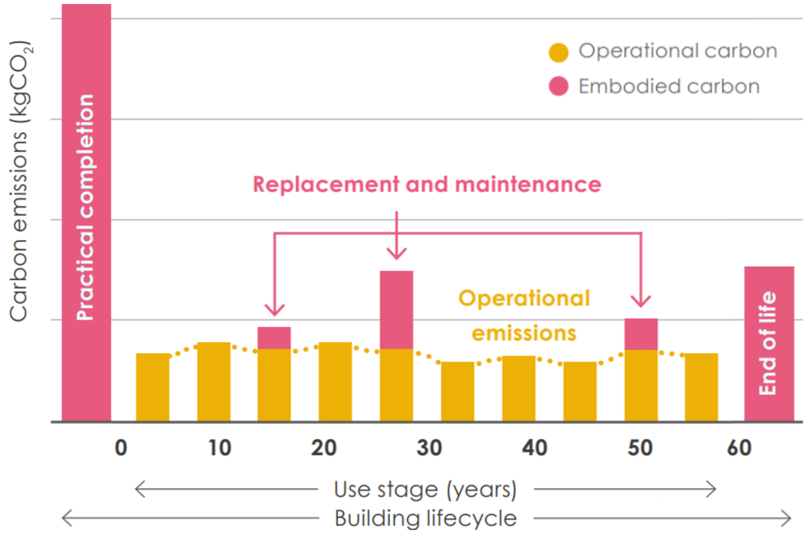


Figure 4 Emission breakdown of a building's life cycle, reproduced from LETI Embodied Carbon Primer[26]

A true net zero building is operationally net zero, made from 100% reused materials, and 100% of the materials can be reused again at the end of its life (if construction, transport and disassembly are carried out with renewable energy). In practice this is extremely hard to achieve in the current UK market and so some embodied emissions are unavoidable. Those remaining should be reduced as far as is possible through good design and planning, with accounting in place for those emissions that are unavoidable.

Existing requirements

National. There are currently no national Government requirements for embodied carbon assessments.

Industry. Embodied carbon is a key part of the RIBA 2030 Climate Challenge where there are targets for 2025 and 2030. LETI have also set design targets for 2020 and 2030 and have worked with the GLA who require a full assessment of embodied carbon for referable schemes[28]. UKGBC have published targets for embodied energy and have recently launched a Net Zero Whole Life Carbon Roadmap for COP 26. LETI have produced a helpful guide and reporting tool[29] for how these targets align, based on a A++ to G rating system.

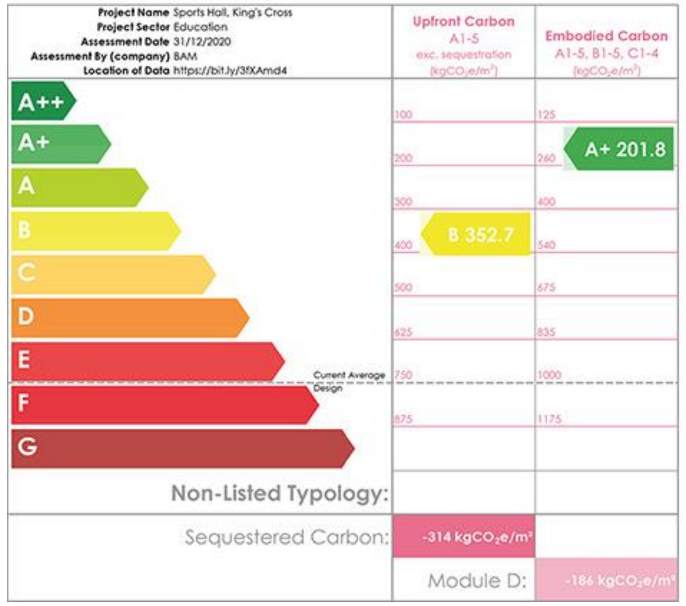


Figure 5 Emondied carbon reporting example, Bennetts Associates[30]

Local. Several local authorities include embodied carbon requirements in their local plans including:

GLA[31]: "*...should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions*" and;

GMCA[32] "*Include a carbon assessment to demonstrate how the design and layout of the development sought to maximize reductions in whole life CO_2 equivalent carbon emissions*".

In both cases the focus is on calculating embodied carbon emissions in a recognised way and then demonstrating how these will be reduced. Data gathered will serve as the basis for the introduction of carbon reduction targets in due course.

A number of Local Authorities are considering the introduction of embodied carbon benchmarking targets in the near future, with B&NES currently consulting on a minimum target of $900kgCO_{2e}/m^2$.[16] As targets in policy develop, the ongoing work by LETI and others on target alignment will be critical in setting well understood and measurable targets.

Cost implications

Significant reductions in embodied carbon can be achieved at no net additional cost[33]. This can be achieved through better design (including durability to replacements), better onsite management (to avoid wastage), better choice of materials (with lower embodied carbon) and though the removal of unnecessary finishes.

A recent study by WSP[34] for the WoE authorities and WECA has suggested that there would be no cost uplift to comply with the RIBA 2020 embodied carbon targets (for the four building typologies considered) aside from the modelled semi-detached house where a 3% cost uplift was estimated. For future standards (e.g. RIBA 2025/2030 and LETI 2030) a cost uplift of 7-15% was estimated dependant on the building typology.

CASE STUDY #3 **BS EN 15978: 2011 and the RICS Professional Statement (RICS PS)**

The framework for calculating lifecycle carbon emissions in the UK is set out in British Standard 15978, underpinned by RICS guidance as a practical guide to the technical details and calculation requirements of the standard.
The framework sets out four stages in the life of a typical project described as life-cycle modules.

For a true net zero assessment, each should be assessed separately and integrated into the design process from the outset.

In practice there is limited evidence to mandate or monitor all modules through the planning process. Much work to date is focussed on 'upfront' carbon, i.e. modules A1-A5.

Table 7 RICS life-cycle modules

Product	Raw materials	A1
	Transport	A2
	Manufacturing	A3
Construction	Transport	A4
	Process	A5
Use	Use	B1
	Maintenance	B2
	Repair	B3
	Replacement	B4
	Refurbishment	B5
	Operational energy use	B6
	Operational water use	B7
End of life	Deconstruction	C1
	Transport	C2
	Waste processing	C3
	Disposal	C4
Benefits and loads beyond the system boundary		D

Embodied carbon   Operational carbon

Although encouraging, it should be noted that the study did not include all elements of an embodied carbon assessment. It focussed on the Substructure (RICS 1), Superstructure (RICS 2) and Finishes (RICS 3) as WSP considered these to be the areas of highest carbon, the most commonly considered at an early design stage and with datasets which the consultant had available for modelling. This work did not include services, external works, fittings or stages B1 to B3 and B5 to B7 (see Case Study #3).

Any policy made in reference to the WSP findings cannot test the viability of emissions beyond those modelled. As cost evidence is limited in this sector it does however provide a basis for an initial policy which covers the largest element of footprint and the most readily available evidence. It also provides a mandate to request through planning more data on other scopes to inform future policy.

The WSP findings have been used as the underlying evidence for the 900kg$CO^2{}_e$/m^2 target referenced in the 2021 draft B&NES Local Plan Partial Update.

Policy Guidance

The introduction of targets is an important step in driving action over and above reporting alone. Where these are based on partial scopes due to available evidence, guidance should set out how the targets are aligned to the RICS methodology and other industry targets.

Although targets may be based on material properties, guidance should also set out how general design measures can have as big an impact on WLC. There are many online resources available for general deign principles for embodied carbon, such as the IStructE's Embodied carbon: structural sensitivity.

Reporting tools

There are a number of tools for carrying out planning assessments in line with BS EN 15978: 2011 and the RICS Professional Statement. The most popular of these are hosted by One Click LCA, including collaborations with, RICS, the GLA and the UKGBC to provide a number of tools through varying levels of detail.

For more limited assessments, UKGBC's One Click LCA Planetary tool[35] covers modules A1-A5 of the RICs methodology but can be used as a free tool to assess the impact of key construction materials.

Reporting and targeting of construction emissions is also covered in BREEAM requirements, under 'Materials' credits. This includes the need for a lifecycle assessment, designing for durability and resilience and the responsible sourcing of products. Although not directly overlapped with the RICS methodology, but assessments require similar input data.

The choice of accepted tools for demonstrating policy compliance should acknowledge the scale of development. The licence costs of full software that is RICSs compliant can be in the region of £3,000 per year with 3-4 weeks of time associated with an assessment.[34] Streamlined approaches may be required for small developments.

Circular Economy

Circular economy is a broader topic that embodied or whole life carbon, incuding the way that waste and water are used. Circular Economy Statements *including* emodied / whole life considerations may be appropriate as a requirement for minor developments, where separate reporting on a range of sustainability criteria in not considered approriate.

Product certification

Calculating embodied carbon becomes easier as the supply chain reacts to requirements from designers; products easier to report on gain a competitive advantage in the market. This is already commonplace with BREEAM where companies such as Kingspan align their products with the credit requirements of the scheme. Mitsubishi have also recently updated their product data sheets to report on embodied carbon in line with CIBSE's TM65 calculation methodology. Where new policy sets requirements for embodied carbon, it is highly likely that the market will react to make reporting easier – this also stresses the importance for aligned methodologies across the industry.

Policy options

The recommendations given should be considered in light of the best available evidence at the time of implementation, noting that the construction industry is making rapid advances in embodied carbon reporting. More viability evidence on embodied carbon is likely to promote stronger targets in the near future.

Policy Considerations

D1 Require an embodied carbon assessment using a RICS recognised tool (limited to a 'one-click' tool for minor developments) and reporting against industry benchmarks.

D2 Consider the introduction of embodied emissions targets for major developments (at costed levels or as a cost neural backstop), setting out how and when future targets will increase in scope.

D3 Use data gathered through embodied carbon assessments to inform industry development of robust targets.

11. Existing Buildings

80% of the buildings that will be in existence in 2050 are already built. This includes 2.5 million homes and 181,000 non-residential buildings in the South West alone[36,37]. Most of these are of poor energy efficiency standards, with 59% of recorded properties below an EPC band 'C'[38]. Most are fitted with fossil fuel based or inefficient electrical heating.

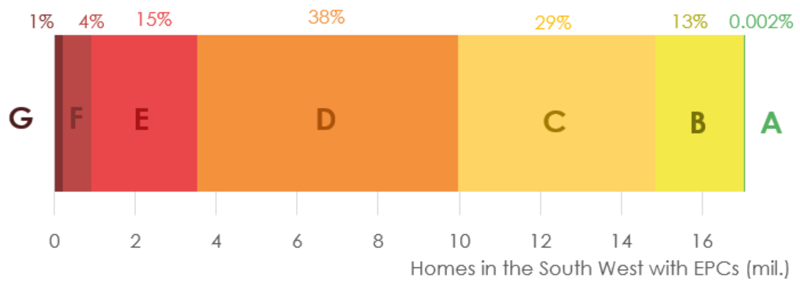


Figure 6 Homes in the South West by EPC rating[38]

In the context of planning policy, opportunities to improve existing buildings sit around:

- requirements to meet increased standards for extensions and conversions
- consequential improvements

Increased standards for improvements, extensions and conversions.

The Future Building Standard consultation has set out proposed changes to Part L1B and Part F to improve the standards for existing buildings in line with the wider interim updates to part L. While the fabric standards proposed are tighter than current requirements, they are relatively modest for new and replacement thermal elements and unchanged for renovating existing thermal elements (other than a tightening for flat and pitched roofs).

Many industry bodies[39] are already arguing that Government will need to take a more wholesale review and tightening of these standards in line with the timetable for the Future Homes Standard (i.e. by 2025) given the scale of the challenge in the existing stock. While it is recognised that building regulations will only be part of the solution for the existing stock, it has its part to play and the some of the wider issues that impact on new buildings (e.g. misleading metrics, embodied carbon and the performance gap) are also relevant here.

Arguments have been made that the proposed fabric standards should be higher as it is significantly more cost effective to achieve during normal element replacement than during separate energy retrofit. CIBSE, for example, have called for a 'whole building' approach to the existing stock and suggested that *"The Part F requirement that ventilation should be "no worse" than before the works is highly inadequate, as many homes are not well ventilated. The works should be "net zero ready"*, and a longer-term plan should be produced for the building, to reduce operational, embodied, and financial expenditure now and in the future. It is the approach promoted in PAS 2035, which regulations should build on."

Consequential improvements

Consequential improvements is the term used to describe additional energy efficiency improvements that should be undertaken when an existing building is extended or part of a building is converted. This ensures that alongside new building elements meeting energy and carbon standards, the remainder of the existing building is also brought up to a minimum target level.

A proposal to make this a requirement was made in the draft 2006 revision of Part L of the Building Regulations. However, the Government at the time chose to limit the provision to premises larger than 1,000m2 effectively restricting it in practice to large commercial premises. This is not the case in Wales, where the requirement was retained (see case study box).

In their response to the Future Homes Standard Government have currently clarified that 'For the purposes of improving the energy efficiency of existing homes, we do not intend to introduce new requirements or regulations into the Building Regulations through the 2021 Part L uplift beyond those that are set out in this consultation and the Future Homes Standard consultation, including extending where consequential improvements may apply. Improving the energy efficiency of the existing housing stock will be the subject of other government consultations.'

An opportunity remains for consequential improvements to be used as part of the wide range of tools to address the significant challenges in the existing stock - a strong case has already been made for a light touch version of this in Wales[40], with opportunities to go further as residential retrofit policies evolve.

Whilst consequential improvements can be an important mechanism to drive action in existing buildings, this is considered by many as beyond the reach of local authority planning powers in England. Reliance is instead put on central Government to bring such measures into force. Following the wave of local authority climate emergency declarations it has been included as a consideration for new policy, but the legality of bringing in such powers at a local level is yet to be tested.

Retrofit targets

This section is focussed on the relationship between planning policy are retrofit, not on retrofit targets themselves. LETI, the Passivhaus Trust, AECB, RIBA, CIBSE, Architects Declare and the UKGBC have come together to produce a jointly agreed set of retrofit targets which align with to the energy metrics referred to in section 5. These targets are summarised here.

Policy Considerations

E1 Seek legal guidance on setting consequential improvements at a local level (typically this power sits with central Government).

E2 If amending policy, consider alignment with the consequential improvements requirements of Welsh Building Regulations or the LETI Climate Emergency Retrofit Guide.

CASE STUDY #4 **Welsh Building Regulations**

In Wales the provision for consequential improvements is included within Building Regulations for all major works. This requires additional energy efficiency improvements to be undertaken when an existing building is extended or part of the building is converted to provide fixed heating in a previously unheated space, increasing the conditioned volume.

Required measures are limited to cavity wall insulation, loft insulation and hot water cylinder insulation to ensure that any required improvements are in proportion to the scale and cost of the triggering work. The below extract is taken from Approved Document L1B:

4.2.1 Where an existing dwelling is extended or converted, as a result increasing the habitable area by no more than $10m^2$, if there is no loft insulation or it is less than 200 mm thick, provide 250 mm of loft insulation or increase it to 250 mm.

4.2.2 Where an existing dwelling is extended or converted, as a result increasing the habitable area by more than $10m^2$, the following energy efficiency improvements should be undertaken:
a. if the dwelling has uninsulated or partially insulated cavity walls, fill with insulation where suitable (cavity wall insulation may not be suitable for sites exposed to driving rain); and b. if there is no loft insulation or it is less than 200 mm thick, provide 250 mm insulation or increase it to 250 mm; and
c. upgrade any hot water cylinder insulation as follows:
i. if the hot water cylinder is uninsulated, provide a 160 mm insulated jacket; or
ii. if the hot water cylinder has insulated jacket less than 100 mm thick, add a further insulated jacket to achieve a total thickness of 160 mm; or
iii. if the hot water cylinder has factory-fitted solid foam insulation less than 25 mm thick, add an 80 mm insulated jacket.

4.2.3 Where the consequential improvement to increase the thickness of the loft insulation to 250 mm is triggered by a loft conversion, the consequential improvement is still necessary as there are likely to be some areas of the loft floor remaining around the new heated volume, for example near the eaves.

12. Energy & carbon offsetting

Various forms of offsetting have been used by local authorities in the UK for over 10 years. These schemes have provided a mechanism to enable buildings that cannot technically achieve net zero carbon or a specified level of carbon reduction on site to be deemed compliant with planning policy.

Despite this, many existing offset mechanisms are not fit for purpose. The UK's total capacity for offsetting is already required for hard-to-treat sectors such as aviation and agriculture[41]; new development cannot add to this burden whilst remaining compatible with climate emergency declarations.

> "At their worst, carbon offset schemes can give us false comfort that development is zero carbon, whilst obscuring the more fundamental changes needed in our development model and potentially obscuring the extent of carbon saving from climate emergency action plans"[42]

In London, the GLA's carbon offset fund has successfully spent £13.8m since 2016, increasing as adoption spreads.[43] Whilst this is significant it remains a small percentage of total payments and the adoption curve and delayed expenditure must be weighed up against additional emissions generated since construction.

Figure 7 GLA Carbon offset spend: 2016-2020

Arguments for carbon offsetting

Whilst offsetting does have a high risk of double counting savings it is undeniable that some of the most decarbonised economies in the world have achieved their targets faster when subsidised by high carbon offsets. The benefits of offset schemes lie in their ability to catalyse action that would not have happened as quickly otherwise.

Rate of savings

It is important that offset schemes save energy or carbon at the same rate that it is emitted. Delays in savings must make up for demand prior to the delay. This is of particular importance when considering scheme such as tree planning (where carbon sequestration rates are not linear) or any scheme where administration can lead to delays. Figure 8 illustrates this concept: shaded areas above and below the axis must be equal.

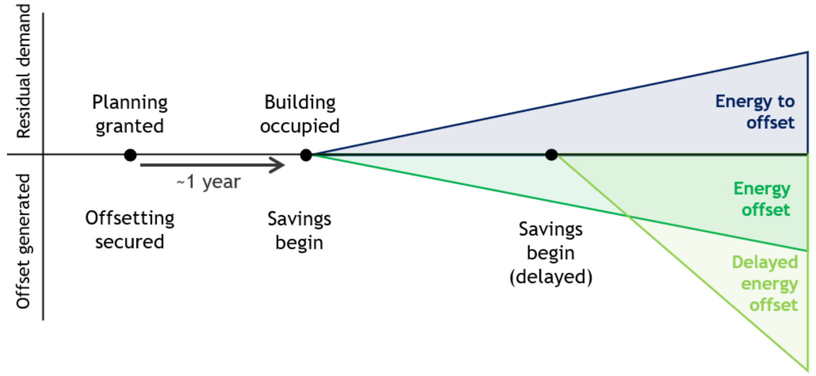


Figure 8 Rate of savings concept

Carbon vs. Energy offsetting

As with operational emissions, either energy or carbon can be used as the metric to demonstrate net zero emissions. There are pros and cons to each:

Carbon offsetting (typical approach)

A fixed price in £/tCO_2 is set based on the avoided cost of generating equivalent savings locally. This is usually set as the cost of solar PV installations or local retrofit.

Advantages
- A recognised metric by investors that can be linked to universal carbon pricing
- Easily compared (and therefore traded) between 3rd part schemes and non-energy projects e.g. peat restoration.
- Compatible with embodied carbon offsetting

Disadvantages
- Greater risk of sector leakage through trading
- Not directly comparable with energy use metrics
- Cannot account for changes in grid carbon
- Can delay action (CO2 from tree planting can take 20 years to materialise)

Energy offsetting

After maximising demand reduction, a kWh shortfall is matched with an equal kWh of 'credits' offsite.

Advantages
- Easy to check and monitor at the planning stage
- Agnostic to changes in UK grid decarbonisation
- No fixed cost associated, dependant on locality
- Less risk of carbon leakage
- Compatible with backstop kWh targets

Disadvantages
- Requires conversion if translated to £/tCO2
- Lack of fixed cost makes alignment with an LPA offset fund more complex
- Likely that low hanging fruit will be taken from other sectors
- Certification required to avoid double counting

Procurement vs. Payments

Procurement

The developer procures their own renewable energy supply and submits details with their planning application.

Advantages
- Easy to check at the planning stage
- Responsibility remains with developer
- Less risk of lag time; rate of savings more likely to match rate of emissions
- No fixed costs associated; reflects live market value

Disadvantages
- Commitment is virtual; developer rarely has long term interest in the site
- Minimal long-term accountability
- Incentivises low hanging fruit 'grab' for new development
- Agreements can be complex

Payments

The LPA collects payments into a fund and procures additional new renewable energy provision

Advantages
- Local authorities have long term interests at heart
- Can catalyse high social value projects
- Offset projects will be local, promoting transparency
- LPAs already handle such payments through CIL.

Disadvantages
- Sign off process can cause lag in installed measures
- Costs of measures must be kept updated
- Requires LPA resource / absolves developer responsibility
- New systems, checks and balances required

Responsible procurement

Whether procured by developers or local authorities, offsetting schemes must be accountable. The UKGBC provide a helpful guide on responsible procurement: Renewable Energy Procurement & Carbon Offsetting. This has been bolstered by recent work by CSE on options for offset mechanisms in the West of England.[42]

Setting offset prices

If using offset fund, prices must reflect the true costs of additionality to maximise onsite measures first. As an example, the offset cost of solar generation should be inclusive of an allowance for mobilisation, maintenance and mid-life inverter replacement, as all such costs would also be associated with on-site measures.

Backstop requirements

Where offsetting is permitted it is crucial that this is limited to very specific circumstances; if backstop conditions are not met it is likely that buildings will need further retrofit within the next decade. Backstop requirements should include space heating and energy demand targets set in planning policy, an embargo on onsite fossil fuels and maximised generation.

Embodied carbon offsetting

Offsetting all emissions from operation *and* construction is widely accepted as not yet cost viable; the industry has a way to go in reporting and reducing embodied carbon emissions as far as possible (see section 10) prior to offsetting being considered. This policy position is likely to progress in the next 3-5 years as embodied carbon moves more to the forefront of sustainable building design. Efforts should be made to protect the term 'net zero' to avoid greenwashing and reflect that true net-zero developments *would* include net zero embodied emissions.

13. Policy Implementation

Alternatives to conventional offsetting

It will almost always be preferable for a development to address its additional emissions directly rather than offset. In the current climate (where embodied carbon emissions remain significant), reducing construction and supply chain emissions beyond policy requirements can have advantages over offsetting as developers maximise their leverage on the market rather than invest in lower hanging fruit available elsewhere. Developers could be encouraged to go further on embodied carbon emissions where it can be demonstrated that savings are equivalent to conventional offsetting. To prove additionality this would require a set and transparent baseline and accounting methodology.

Policy Considerations

F1 All efforts should be made to reduce onsite and embodied emissions prior to the consideration of offsetting. Offsetting should only be used to meet an energy generation shortfall after onsite renewables have been maximised; it should not be used as a mechanism to avoid energy use targets.

F2 Offsetting should only be permitted where it can provide credible additionality. The UK has a finite resource of cost viable renewable generation; using low hanging fruit to offset new development detracts from the ability to decarbonise harder to treat sectors.

F3 Offsetting schemes must ensure that the *rate* of savings equal the rate of emissions; delayed savings must account for balancing any accrued emissions prior to delivery of the offsetting project

F4 Offsetting schemes should focus on either developer procured renewable energy supply at the point of planning and/or council collected payments with robust, transparent and accountable expenditure plans.

Effective implementation and monitoring of net zero policies is as important as policy itself – without this there is a high risk that otherwise progressive policies could further exacerbate existing gaps between reporting and reality. This can add to the burden for developers without making a meaningful difference to building performance.

Setting targets

It is important that targets in policy are set as part of a trajectory with clear implementation dates. If targets need to be staged due to viability, the dates and level at which all-encompassing policy will come into force should be stated. This gives confidence to the market over the trajectory, shows long term alignment across the industry and allows for a smooth transition from existing practice. The 2011 London Plan (and Plans since) are an example of where this ratcheting approach has been used to good effect. Policy was set 10 years in advanced with rachet levels given for 2010-2013, 2013-2016, 2016-2019 and 2019-2031.

Table 9 Example policy table - residential operational energy

Operational energy use (kWh/m²/year)		
From	Residential	
	Space Heating	Energy Use Intensity
1st Jan '21	*No target above Building Regulations*	
1st Jan '22	30	40
1st Jan '25	15-20	35
1st Jan '30	15	35

Transitional arrangements

Guidance should set out if transitional arrangements are required between existing and new policy; any such policy should be strict and time limited.

Skills training is a continual requirement of the construction industry and inevitable alongside ambitious new policies. New requirements may trigger skills uplifts for some, but this should not be used as an excuse for delays; net zero requirements for new buildings have been mooted by UK Government for over a decade, since 2006.

Table 8 Example summary reporting: non-residential buildings

Operational Carbon assessment		Building Regulations assessment	Operational Energy assessment	Justification where targets is not met
Modelling software			*see accredited list*	
Floor area (GIA m²)				
Space heating (kWh/m²)			*should target 15-20 and not exceed 30 kWh/m² heating*	*n/a if mandatory*
Space cooling (kWh/m²)				*n/a if mandatory*
Total energy use (kWh/m²)			*targets by archetype*	*n/a if mandatory*
Predicted DEC rating				
CO^2 savings	Demand reduction	*Part L linked targets where relevant*		*n/a if mandatory*
	Total			*n/a if mandatory*

Embodied carbon assessment	Upfront carbon [A1-5]	Embodied carbon [A1-5, B1-5, C1-4]	Justification where targets is not met
Emissions ($kgCO^2{}_e/m^2$)	*RICS recognised assessment tool*	*RICS recognised assessment tool*	*n/a if mandatory*
LETI Rating (A++ to G)	*LETI template*	*LETI template*	*n/a if mandatory*

Reporting non-binding targets

Where there is insufficient local evidence to mandate absolute targets at the time of Local Plan adoption (as may be the case for some embodied carbon and non-residential targets), targets should still be reported against and a clear justification made where they are not met. If the gap between the reported and target level is significant an application should be referred to Local Authority energy officers, the local Energy Hub or other support service for a technical review. Table 8 is indicative of the summary data that may be required for non-residential buildings, against a mix of binding and non-binding targets. Modelling and target requirements may differ for major and minor developments.

Collecting data

The collection and storing of data is crucial to the development of future policies, guidance and the monitoring of building energy performance in operation. Where developers report planning requirements via the Energy Hub reporting portal, this can be compared against practice across the UK and used as a tool to map development progress as it comes forward. The Energy Hub is also working with CIBSE to ensure that data collected through this portal is linked to CIBSE Energy Benchmarking Tool, for the measurement of subsequent energy demands during operation.

An example of data that may be reported is given in Table 9. While this may appear onerous, there is a large amount of repetition in the underlying energy modelling. Some aspects, such as a predictive DEC, can be generated without much more information than is required to generate a Part L model.

Performance checks & validation

Performance checks are crucial to ensure that responsibility is taken at the design stage to minimise the performance gap. Whilst this can go beyond the powers of a planning authority, some control can be levered either through planning conditions (See GLA 'Be Seen' example) or alignment with external accreditation schemes (e.g. BREEAM, Passivhaus, BSRIA Soft Landings) that administer post occupancy requirements in themselves. As a minimum, the LPA should take a role in collecting and publicly publishing data at the planning stage so that other organisations can hold developments to account during operational phases.

GLA ‘Be Seen’ Policy
The GLA’s ‘Be Seen’ guidance supports the London Plan energy policies and is the most detailed guidance produced by a planning authority to document and reduce the performance gap. It sets out requirements for data reporting at different stages of the design process (before and after planning), at practical completion and during the first 5 years of a building’s life. A template contract is provided alongside the guidance to ensure that commitments will remain binding where a building developer hands over the site to a third-party post construction.

Alternative compliance pathways

Alternative compliance pathways can be a tool to account for buildings that cannot meet a policy target but can demonstrate equivalence via another means. This approach gives space for the market to champion the best accreditation schemes and to develop these beyond the limitations of planning policy.

This practice is most commonly used to allow flexibility in policies that restrict electric heating. Although not inherently bad, electric heating combined with poor performing buildings can drive up fuel bills and emissions. Some authorities (such as Bristol City Council) allow electric heating *if* Passivhaus accreditation is demonstrated as an alternative compliance pathway. The use of alternative compliance pathways becomes increasingly relevant as operational carbon targets become more and more stringent relative to other sustainability criteria that can be less easily measured or enforced.

In allowing for alternatives it is crucial that backstops are set (see section 12) and that accredited schemes are checked for equivalence and for their ability to be checked and enforced. Developers should not be permitted to submit alternative approaches that have not been approved through planning guidance.

Example compliance pathways

Accepted alternative pathways will be dependent on accreditation schemes active at the time of writing and the exemption being sought by the developer. Examples may include BREEAM Whole Life Carbon level 3, Home Quality Mark 5 Stars, Passivhaus Plus, NABERS Base Build 6, PAS 2060.

Sub-regional priorities

Where policy priorities vary within a region, zoning can be used to set a boundary on where to apply different approaches. This is used to good affect through the London Plan’s Heat Network Priority Areas. Areas earmarked for heat networks require new development to facilitate connections; outside of these areas there is no such policy requirement. In this case an interactive map is used by planners and developers alike to determine the rules applied to a new applicant.

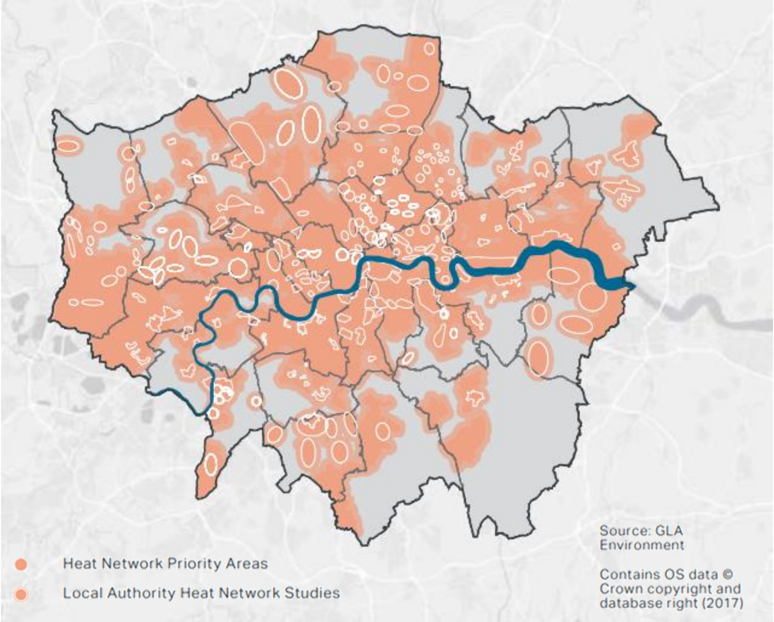


Figure 9 Policy zoning example - London Heat Network Priority Areas

Policy Considerations

G1 Implement a process for requiring, reviewing and monitoring energy demands through Planning Energy Statements and alignment with a post occupancy reporting scheme.

G2 Avoid policies that cannot easily be measured in the real world, or sole reliance on methods that will change within the timeframe of new policy (e.g. Building Regulations).

14. References

[1] Etude (2021). *Technical Evidence Base for Policy SEC 1 – New Housing*. Available at: https://bit.ly/3C5xDH9 [accessed 13/09/21]
[2] MHCLG (2021). *Energy Performance of Buildings Data: England and Wales.* Available at: https://bit.ly/31iGE2g [accessed 30/11/21]
[3] Currie & Brown (2019). *The costs and benefits of tighter standards for new buildings*. Available at: https://bit.ly/38RiJaT [accessed 09/09/21]
[4] *based on the long-term average from 1970 to 2019.*
[5] BEIS (2019). *The Grand Challenge missions.* Available at: https://bit.ly/3hvWQTr [accessed 03/11/21]
[6] BIS (2010). *Estimating the amount of CO_2 emissions that the construction industry can influence.* Available at: https://bit.ly/3Ef0CKy [accessed 14/09/21]
[7] Committee of Climate Change (2019). *The Sixth Carbon Budget. The UK's path to Net Zero.* Available at: https://bit.ly/3zb1EmQ [accessed 14/09/21]
[8] UKGBC (2021). *Interactive Policy Map*. Available at: https://bit.ly/3q47sho [accessed 03/11/21]
[9] It is generally lesser of 1.5m high window across full façade width or 40% of exposed facade area.
[10] Hydrock/ Etude (2021). *Modelling in support of the Cornwall Climate Energy DPD evidence base. [unpublished]*
[11] Etude (2021). *Making SAP and RdSAP 11 fit for Net Zero*. Available at: https://bit.ly/3r5wzRn [accessed 25/11/21]
[12] Etude (2021). *Technical evidence base for Policy SEC1*. Available at: https://bit.ly/393qJpx [accessed 29/11/21]
[13] LETI, UK Green Building Council, Better Buildings Partnership, RIBA, CIBSE, Good Homes Alliance
[14] LETI stands for the London Energy Transformation Initiative and is a voluntary network of over 1,000 built environment professionals. In was originally formed to give the industry a combined voice in response to the 2017 London Plan consultation. It's role since has been to continue to find and give a voice where there is consensus. More about LETI and its publications can be found here.
[15] Cornwall Council (2021). *Climate Emergency Development Plan Document Pre-Submission Consultation*. Available at: https://bit.ly/2XctKl7 [accessed 13/09/21]
[16] Bath & North East Somerset Council (2021). *Local Plan Partial Update (LPPU) - public consultation*. Available at: https://bit.ly/3ocabT5 [accessed 08/11/21]
[17] Based on Passivhaus Trust guidance for Passivhaus Premium buildings.
[18] South West Energy Hub (2021). *PPG Note SW001: Solar PV – regional variance.*
[19] A Part L DSM model can significantly underestimate the cooling demand of a mechanically ventilated and cooled space because fresh air is assumed to be supplied to the space at outside air temperature (see paragraph 47 of the NCM Modelling Guide).
[20] WSP (2021). Evidence base for WoE Net Zero Building Policy. Operation Carbon for Non-Residential Buildings.
[21] South Cambridgeshire District Council (2021). Greater Cambridge Local Plan: Net Zero Carbon evidence base. Available at: https://bit.ly/3xLZ1cn [accessed 02/12/21]
[22] MHCLG (2019). *The Future Homes Standard Impact Assessment*. Available at: https://bit.ly/3948FLZ [accessed 14/09/21]
[23] Buro Happold London plan report looking at applicant levels
[24] BRE(2020). Briefing Paper: Office Case Study. Available at: https://bit.ly/3hsRpV6 [accessed 14/09/21]
[25] BRE(2016). The Value of BREEAM. Available at: https://bit.ly/3w2drnX [accessed 27/10/21]
[26] LETI (2020). *Embodied Carbon Primer*. Available at: https://bit.ly/3ntOCPm [accessed 14/09/21]
[27] Based on a residential block: RICS (2017). *Whole life carbon assessment for the built environment*. Available at: https://bit.ly/3tDEXqx [accessed 14/09/21]
[28] London Plan Policy SI 2 sets out a requirement for developments to calculate and reduce WLC emissions. This requirement applies to planning applications which are referred to the Mayor, but WLC assessments are encouraged for all major applications.
[29] LETI (2021). Embodied Carbon Target Alignment. Available at: https://bit.ly/3C5Vuq0 [accessed 14/09/21]
[30] Bennetts Associates (2021). *Press release: LETI Embodied Carbon Ratings*. Available at: https://bit.ly/3wjC6nV [accessed 03/11/21]
[31] Greater London Authority (2021). The London Plan 2021. Available at: https://bit.ly/3nwRQ4L [accessed 14/09/21]
[32] GMCA(2020). *Greater Manchester Spatial Framework Publication Plan - Draft for Approval.* Available at: https://bit.ly/396OoW8 [accessed 14/09/21]
[33] Targeting Zero (2021). WoE Whole Life Carbon Policy – Draft Content.
[34] WSP (2021). Net Zero Buildings Policy – Embodied Carbon Study. Available at: https://bit.ly/3wsopmA [accessed 09/11/21]
[35] One Click LCA (2021). *One Click LCA Planetary*. Available at: https://bit.ly/30ahYJ9 [accessed 08/11/21]
[36] Office for National Statistics (2021). Household projections for England. Available at: https://bit.ly/3EG7lg2 [accessed 03/11/21]
[37] BEIS (2021). *Non-Residential National Energy Efficiency Data-Framework: geographical annex*. Available at: https://bit.ly/2ZJU4DU [accessed 03/11/21]
[38] South West Energy Hub (2021). Housing Energy Datasets. Available at: https://bit.ly/3EDORN2 [accessed 03/11/21]
[39] UKGBC (2018). *Letter to Secretaries of State*. Available at: https://bit.ly/3EGdkkL [accessed 14/09/21]
[40] Welsh Government (2014). *The Building Regulations 2010, Approved Document L1B*. Available at: https://bit.ly/3Ejb43N [accessed 14/09/21]
[41] Committee on Climate Change (2020). *The Sixth Carbon Budget. The UK's path to Net Zero*. Available at: https://bit.ly/3zb1EmQ [accessed 03/11/21]
[42] CSE (2021). *Carbon offsetting within an energy intensity policy framing - report to West of England Authorities*.
[43] GLA (2021). *Carbon Offset Funds: Monitoring Report 2020.* Available at: https://bit.ly/3md6kpk [accessed 26/10/21]