Energy performance targets for commercial offices

The UKGBC *Net Zero Carbon Buildings Framework*[1] was published in April 2019 following an industry task group and extensive consultation process. The framework sets out high level definitions for net zero carbon buildings covering scopes for operational energy and construction emissions, with a whole life carbon approach to be developed in the future. It acts as guidance for achieving net zero and is being developed in consultation with industry to include detail and stricter requirements over. This will increase the level of ambition needed and challenge the industry to mainstream leading practice.

This paper sets out proposals for an energy performance target for commercial office buildings. This is intended as a minimum energy efficiency target for buildings seeking to achieve net zero carbon status for operational energy today, based on the performance levels that all buildings will be required to achieve by 2050.

This paper has been developed in collaboration with representatives of BBP, BPF (Iceni), Arup, Carbon Credentials, JLL, TfL and Verco. The proposals are being presented for stakeholder feedback up until **5pm on Friday 8 November** via an online survey at: https://forms.gle/JxWPtK4t2m1X8PQ49. If the reaction from stakeholders is positive, the aim is to integrate the targets into the net zero framework by the end of 2019.

Contents

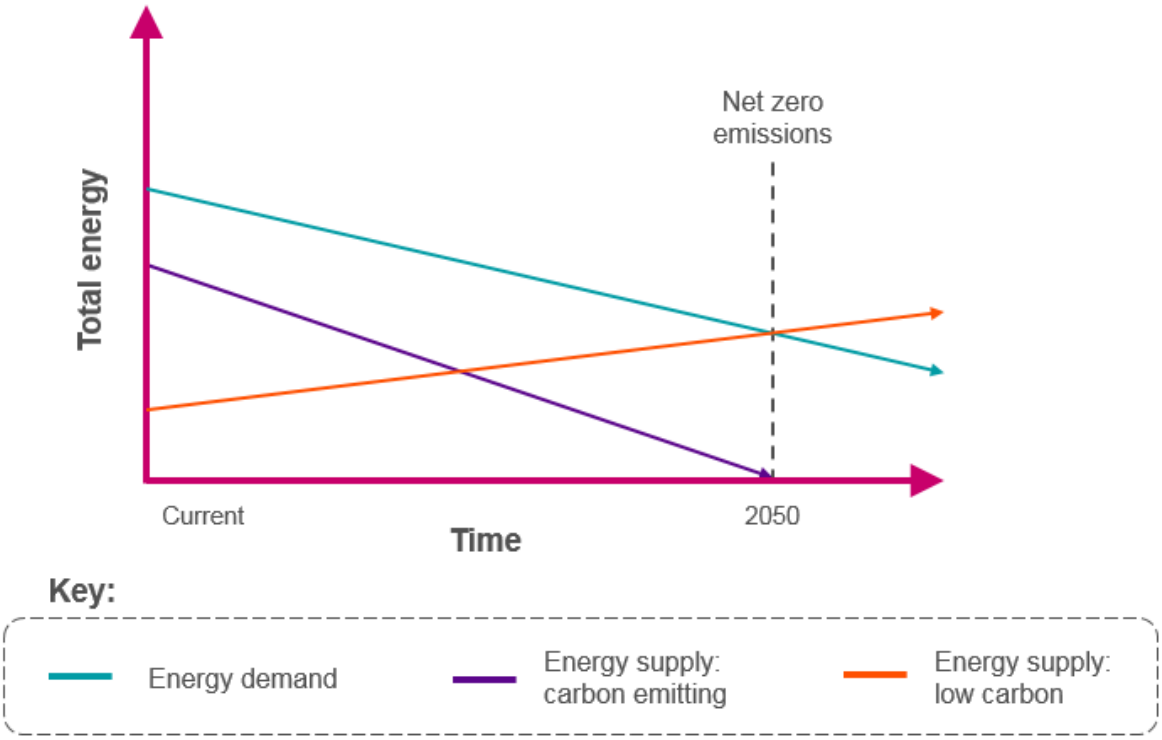
[1] UKGBC (2019), Net Zero Carbon Buildings: A Framework Definition: https://www.ukgbc.org/ukgbc-work/net-zero-carbon-buildings-a-framework-definition/

Paris Proof concept

This project is seeking to develop energy use intensity targets based on the 'Paris Proof' concept developed by the Dutch Green Building Council.[2] This is based on the scenario in which a net zero carbon economy in 2050 is fully powered by low carbon energy supplies, including renewable energy and nuclear energy. This can only be achieved when the required energy demand is met by the available supply. Current low carbon energy supply projections predict that there will be a shortfall, unless energy efficiency measures are applied to reduce overall demand.

This paper sets out the expected magnitude of energy efficiency improvements required by 2050 and how this translates to the office building sector.

Figure 1: *In 2050, the UK's total energy demand will need to be supplied by low carbon energy*

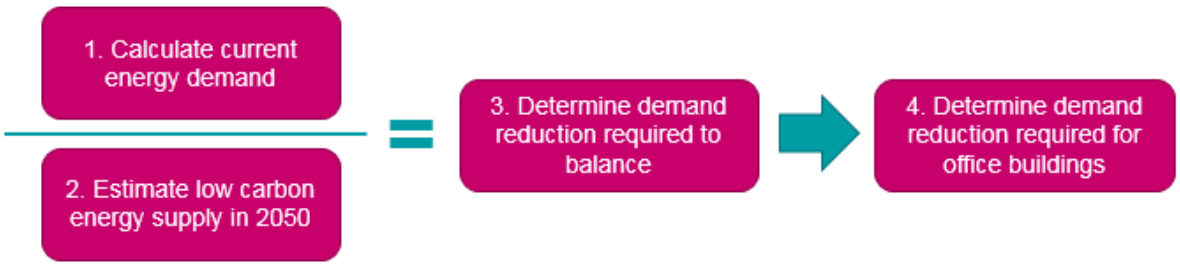


The Paris Proof approach uses a top-down calculation based on the estimated capacity of low carbon energy supply available in 2050 and the allocation of this capacity to different economic and built environment sectors. The 'fair share' of energy can then be allocated at an individual building level to determine an energy use intensity target - a building's maximum annual energy consumption relative to its floor area. This target can also be translated into an equivalent energy performance rating to provide a more robust measure tailored to different types of office buildings.

In this way, the Paris Proof concept has the potential to offer simple and clear targets for individual buildings that are aligned with the transition to a net zero carbon economy. The Paris Proof method involves four steps, set out below.

[2] Dutch Green Building Council (2019), Paris Proof: https://www.dgbc.nl/themas/paris-proof

***Figure 2**: Paris Proof methodology*



There are clearly a number of variables and uncertainties in using this approach. These include the amount of low carbon energy supplies available to the UK in 2050, changes made to remove current decentralised use of fossil fuels for heating buildings and transport, and other trends and changes in the demand for energy across the economy.[3] Nevertheless, for organisations seeking today to demonstrate their internal climate policies are consistent with the net zero target for 2050, it is possible to make reasonable assumptions which allow plausible targets to be set for different types of buildings.

The power of this approach is its clarity in showing how energy efficiency is a critical component of any net zero scenario for countries not blessed with surpluses of low carbon energy supplies, and that it quantifies plausible targets at the individual building level. It aims to square the circle between net zero carbon and "nearly zero energy", dealing simultaneously with the notorious rebound effects[4] which can sabotage energy efficiency efforts.

Whilst the focus of this project is on developing targets for commercial offices, the Paris Proof methodology will also provide insights into the development of energy use intensity targets for buildings in other sectors. If the approach is successful for the offices sector, this could provide the basis for developing further energy use intensity targets for other sectors that can be then integrated into the Net Zero Carbon Buildings Framework in the future.

The following sections in this paper set out the Paris Proof methodology, based on the four steps above.

[3] Further considerations also include diurnal and seasonal variations in demand requiring the use of energy storage. This will mean that the total supply will need to match the total demand plus inevitable storage losses.

[4] The rebound effect occurs when energy efficiency measures are put in place and, as a result, energy users increase their demand with the perception that their increased demand is made allowable by the efficiency measures. This typically results in more energy being used when compared to before the efficiency measures were put in place.

1. Calculate current total energy demand for the UK

The first step to assuming an economy fully-powered by low carbon energy is to convert the amount of energy currently consumed to electricity i.e. convert all current fossil fuel use to kilowatt hours of electricity equivalent (kWhe). Government sources for current energy consumption and conversion to kWhe are provided in Table 1 below.

***Table 1**: Total UK energy demand by use, 2017*

Energy carrier	TWh 2017	TWhe 2017	Statistical source
Gas consumption by final users	495	198	Energy Trends, ET_4.1
Electricity use	322	322	Updated energy and emissions projections, Annex J
All petroleum used by transport	684	274	Energy and environment: data tables, ENV0101
Other petroleum use	259	103	Energy and environment: data tables, ENV0101
Solid fuel	118	47	Energy Consumption in the UK, ECUK1.10
UK total		**944**	

To roughly calculate the kWh/kWhe conversion from current fossil fuel uses, fossil fuel energy is multiplied by 0.4 (as per column 3 above). A rationale for use of this metric is outlined in section 2.3 of the report *Issues considered in developing the LER*[5] developed by Verco for BBP.

These figures cover all current energy uses in the economy, including non-electricity uses. Using the Paris Proof methodology, it is assumed that all sectors in the economy will be electrified and powered by low carbon energy e.g. transport, industry, buildings.

Additionally, it is assumed that the proportion of energy currently available to each sector, including the office building sector, will remain the same between now and 2050. This is on the basis that any economic growth to 2050 will be compensated by energy efficiency through innovation in technologies. This addresses unknown future variables e.g. increase in office floor space due to economic activity, reduction in office floor space due to automation.

The current total energy demand for the UK economy is calculated as **944 TWhe.**

[5] BBP (2013), Issues considered in developing the LER: http://www.betterbuildingspartnership.co.uk/sites/default/files/media/attachment/Verco%20LER%20issues%20report%20Final.pdf

2. Estimate total low carbon energy supply in 2050

The next step is to estimate the amount of low carbon energy that will be available in 2050. There are two reliable sources for projections used in this paper:

- Committee on Climate Change (2019), Net Zero – Technical report; and
- BEIS (2018), Updated energy and emissions projections: 2017.

Committee on Climate Change

The Committee on Climate Change *Net Zero Technical Report* sets out a cost-effective route to net zero based on the likely demand for energy and meeting this through additional low carbon generation capacity. Low carbon generation includes renewables, nuclear, gas CCS as well as other minor sources such as BECCS. The projections also account for the electrification of a number of sectors, creating increasing demand on the electricity system.

The central scenario presented by the CCC estimates a total low carbon electricity supply of **645 TWh in 2050.**[6] This estimate is variable based upon the likely demand in 2050, but it nonetheless provides an indicative figure for the viable low carbon energy generation capacity.

However, while the CCC modelling represents a cost-effective route to net zero, it is also important to consider the risks associated with this projection. Specifically, there is a current policy gap which means the UK is not currently on track to achieve this level of low carbon energy generation by 2050.

BEIS

The BEIS publication *Updated energy and emissions projections: 2017*[7] Annex J provides total electricity generation by source from 2008 to 2035. Extrapolation of the trend for renewable energy generation predicts 261 TWh by 2050 from 192 TWh in 2035. In addition to this, the 2035 value for nuclear energy is 113 TWh (from 57 TWh in 2018). Assuming no increase in nuclear from 2035 to 2050, these figures suggest a total UK low carbon energy supply of **374 TWh in 2050**. This also assumes that the UK will not be a net importer of low carbon electricity.

This figure does not represent a viable net zero scenario for 2050, but the significant difference between the CCC scenario and current policy projections highlights the inherent risks of using modelling of the future to inform decisions today. It is therefore sensible from a precautionary perspective to take into account both the CCC scenario and the current policy projections from BEIS in order to develop Paris Proof targets for UK buildings.

[6] Committee on Climate Change (2019), *Net Zero – Technical report* p.21 https://www.theccc.org.uk/publication/net-zero-technical-report/

[7] BEIS (2018), *Updated energy and emissions projections: 2017* https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2017

3. Ratio between predicted supply in 2050 and total demand today

Using the calculated estimates above, it is possible to determine the ratio by which the economy will need to reduce energy demand by 2050. These are summarised in Table 2 below.

Based on the CCC projections (645 TWh in 2050), low carbon electricity capacity will be able to meet only 68.3% of energy demand today. This implies that all sectors of the economy, including the office buildings sector, will on average need to **reduce its energy demand by just over 30%** to ensure it is using its 'fair share' of low carbon supply by 2050.

However, using the BEIS projections (374 TWh in 2050) implies that low carbon electricity capacity will only be able to meet 39.6% of current demand across the economy. This implies that the office buildings sector will need to **reduce its energy demand by around 60%**, requiring double the efficiency savings compared to the CCC scenario.

***Table 2**: Summary of 2050 supply and demand ratios*

Total current energy demand	**944 TWh**	
Total low carbon energy supply in 2050	CCC projections: **645 TWh**	BEIS projections: **374 TWh**
Percentage in energy demand reduction required	(944 - 654) / 944 = 31.7% **30% (rounded)**	(944 - 374) / 944 = 60.4% **60% (rounded)**

4. Determine energy use intensity reduction required for offices

The final step in this methodology is to determine a reasonable level of energy demand reduction required for offices, given the aggregated energy demand reduction required across the entire economy. Given the significant variation in the level of energy reduction required across the economy, this paper sets out three different options for the Paris Proof targets for commercial offices. These each represent different levels of ambition for the sector and involve different levels of risk

The three options are expressed as a percentage reduction in line with the ratios outlined above and have also been translated into Display Energy Certificates (DEC) ratings, NABERS star ratings and indicative whole building energy use intensity targets for Net Lettable Area (NLA) and Gross Internal Area (GIA).

***Table 3**: Options for Paris Proof targets for commercial offices*

	Option A (from CCC data)	**Option B** (from BEIS data)	**Option C** (compromise proposal)
Percentage energy reduction	30%	60%	50%
DEC rating (whole building)[8]	C70	B40	B50
NABERS rating[9]	4 stars	5.5 stars	5 stars
Energy use intensity, for: **kWhe/m^2 (NLA) / year** **kWhe/m^2 (GIA) / year**	 125 100	 72 57	 90 72

Option A (30% reduction) represents the most straightforward interpretation of the Paris Proof concept, basing the targets solely on the CCC cost effective scenario for net zero, and presenting total energy reductions needed across the sector. But it also represents the lowest ambition for energy savings of the three options and the highest relative level of risk for investors because it does not account for future unknown variables e.g. relative increases in floorspace by 2050.

Option B (60% reduction) represents a more conservative estimate based on BEIS projections up to 2035 and extrapolation of these figures out to 2050. These projections were not originally intended to offer a vision for a net zero scenario for 2050 but they do indicate the current level of policy ambition. This option therefore represents the lowest relative level of risk for investors.

Option C (50% reduction) is proposed as a compromise target between the CCC scenario and extrapolation of the BEIS projections as well as taking into account other investment and policy considerations. The Climate Bonds Initiative (CBI) assesses the climate resilience of investments

[8] A DEC rating of D100 represents, in principle, the median whole building energy performance rating of the existing building stock. As DECs use a linear scale, a percentage reduction across the existing building stock will result in an equivalent shift in the median DEC rating e.g. a universal 30% reduction would reduce the median to C70.

[9] The NABERS rating system assumes the current commercial office stock median rating is approximately 3 stars.

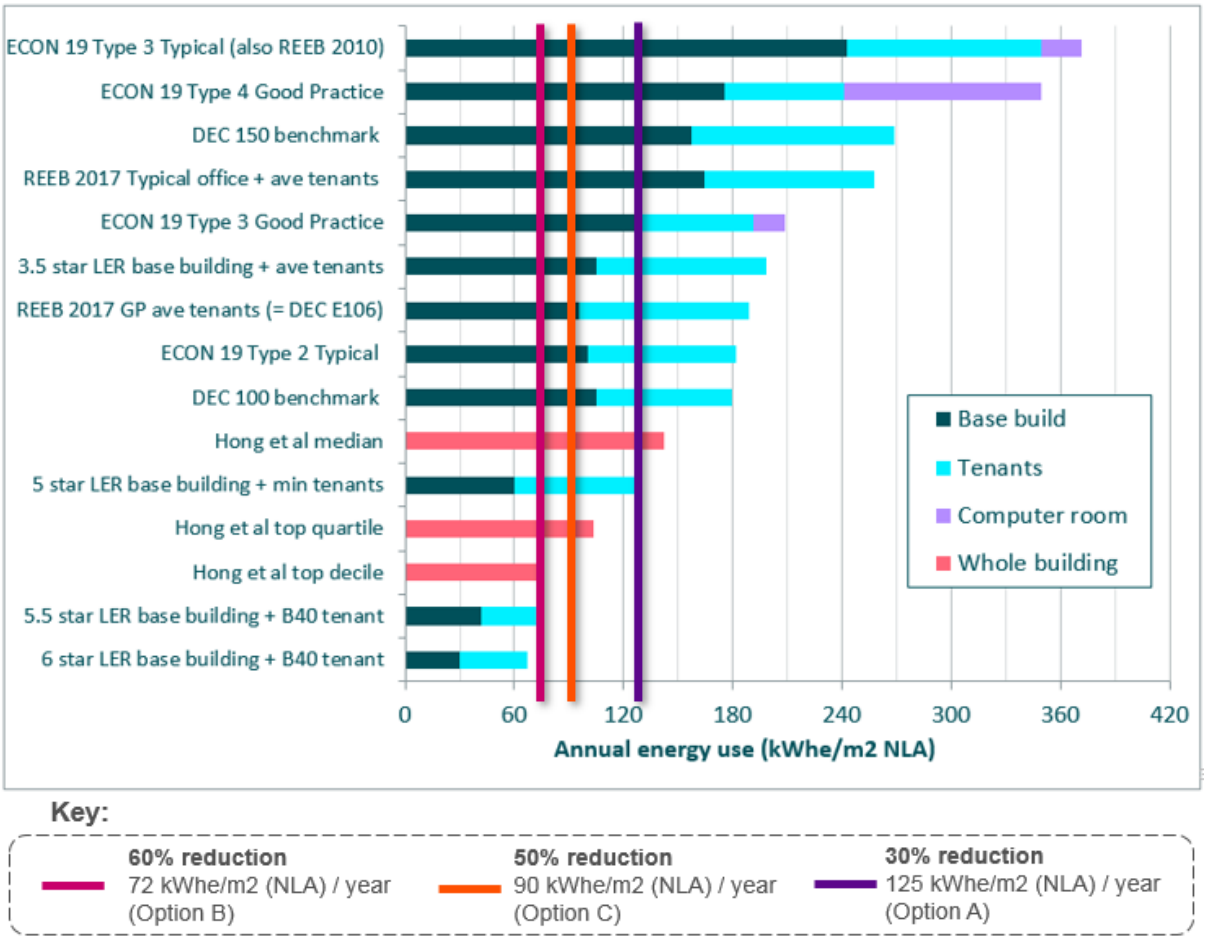
and commonly uses the top 15% of a particular market as a proxy for best practice. A 50% reduction in energy use broadly reflects the top 10-15% of the current commercial offices market in terms of energy performance, and so is therefore consistent with the approach of the CBI. These levels of energy reduction also align with the Government's Clean Growth Grand Challenge Mission to halve the energy use from new buildings by 2030.[10]

[10] UK Department for Business, Energy & Industrial Strategy (2019), The Grand Challenge Missions: https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/missions

Implementation of targets for commercial offices

The expectation is that commercial offices should seek to achieve the approved target in order to claim to be net zero carbon for operational energy. The graph below indicates that the most ambitious proposed target of DEC B40 (Option A, 60% reduction) whole building rating is possible with a 6-star LER base building and B40 tenants rating.

Figure 3: *Comparison of proposed targets with relevant benchmarks*



Key:

60% reduction 72 kWhe/m2 (NLA) / year (Option B)	**50% reduction** 90 kWhe/m2 (NLA) / year (Option C)	**30% reduction** 125 kWhe/m2 (NLA) / year (Option A)

It is noted that commercial office whole building energy intensity has been declining since ECON 19 was first published in 1990 when a Typical Type 4 office consumed 421 kWhe/m^2 NLA / yr excluding its computer room. In 2010 the REEB median was 372 kWhe/m^2 NLA / yr and by 2017 this had fallen to 258 kWhe / m^2 NLA / yr. REEB Good Practice in 2017 is down to 189 kWhe / m^2 NLA / yr almost the same as the DEC 100 benchmark (179 kWhe / m^2 NLA / yr unadjusted for hours of use).

While it is strongly recommended that office buildings should meet the chosen Paris Proof target and aim for net zero carbon, the target could also be interpreted differently for various circumstances. For example, the separate responsibilities that landlords and tenants have for base building and tenant energy use respectively is recognised in the use of NABERS ratings. The target base building rating is therefore seeking to encourage landlords to target a net zero carbon base building as well as engaging with tenants to achieve the standard for the whole building.

At the same time, it could also be argued that new buildings should aim to exceed the Paris Proof target wherever possible to reduce the need for costly retrofitting on older buildings in the transition to a net zero economy. Complementary initiatives such as the RIBA 2030 Challenge[11] and the upcoming LETI design guidance on net zero[12] could also be used by developers and designers seeking to maximise the potential of new office buildings.

Finally, older buildings that are harder to improve may use the Paris Proof target as an end goal with interim steps to ensure they become Paris Proof ahead of 2050. Tools such as those developed by the CRREM[13] project could also be used alongside the Paris Proof target to inform a longer-term improvement strategy for older buildings.

[11] RIBA 2030 Climate Challenge: https://www.architecture.com/about/policy/climate-action/2030-climate-challenge
[12] Guidance due to be published in late 2019: https://www.leti.london/
[13] Climate Risk Real Estate Monitor: https://www.crrem.eu/about-crrem/

Feedback on the proposals

UKGBC is inviting input from relevant stakeholders on the proposals outlined here for Paris Proof targets for commercial offices. We welcome feedback on the proposed methodology and assumptions, the target itself and the routes offered for demonstrating achievement of the target.

Feedback is requested by the consultation deadline of **5pm on Friday 8 November 2019.** Please provide your feedback using the online Google survey which can be accessed at: https://forms.gle/JxWPtK4t2m1X8PQ49.

If there is shown to be broad support from stakeholders for the Paris Proof approach and for a specific target option, UKGBC will seek to integrate the targets into the Net Zero Carbon Framework by the end of 2019.

Please contact ANZ@ukgbc.org if you have any questions.

Acknowledgements

With thanks to Verco for leading the drafting of this paper and to Arup, Better Buildings Partnership, British Property Federation/Iceni, Carbon Credentials, JLL UK and TfL for their close collaboration on the development of the proposals.

This consultation is being run under the UKGBC Advancing Net Zero programme. With thanks to the UKGBC Advancing Net Zero programme partners:

Lead Partner:

Programme Partners: