UK Net Zero Carbon Buildings Standard

Technical Update & Consultation

14 June 2023

Hello!

Through the determination and hard work of members of our task groups, sectors groups, and data providers we have been able to meet our next important milestone. On behalf of the team, I am delighted to report that we are now at the stage where we can provide you with a Technical Update & Consultation, which forms our second Quarterly Update.

This consultation document describes the technical fundamentals behind the Standard, sharing the metrics that buildings will be assessed against to demonstrate that they are aligned with what is required for the UK built environment to achieve Net Zero Carbon.

It then describes the work that has been undertaken to gain an understanding of the current operational energy and embodied carbon performance levels that will provide the context of technical feasibility for various sectors. This is the main focus of the consultation.

Finally, the consultation outlines the approach being taken to determine relevant budgets for carbon and energy, which inform the limits that will follow in later stages of work.

I also wanted to take the time to thank you for being involved in our consultation – and helping to shape the future definition of a Net Zero Carbon building.

This is an extremely important initiative that I am hugely passionate about. We have a lot of people giving up their time on this and I am grateful for all their hard work.

By completing our questionnaire, you can make a real difference to sustainability across the built environment, so I ask that you take the time to do so.

Thank you again for being a part of our consultation and I hope you find our Technical Update useful.

Clara Bagenal George

Chair, Technical Steering Group

UK Net Zero Carbon Buildings Standard

Contents

UK Net Zero Carbon Buildings Standard

Purpose of this Technical Update & Consultation

We want your views on:

- **The overall technical proposals for the Standard**
- **The achievability of the new build performance levels**
  - These levels will be used to inform the final NZC limits

Aims

The team developing the Standard have spent the last 9 months developing its **technical basis**, and establishing **new build performance levels** for a wide range of sectors.

We are sharing this Technical Update & Consultation document to allow the wider industry to review the proposals and performance levels, and provide us with feedback.

The performance levels do not represent the energy and embodied carbon limits that buildings would have to meet. They provide the context of technical feasibility for the various sectors and provide a summary of the data received in the call for evidence.

Who should respond?

We are interested in the views from across all built environment stakeholders, and interested we have broken the consultation into various themes.

Glossary: *Performance levels: These levels provide the technical evidence on what can be achieved by the individual sectors, based on benchmarking, case studies and modelling. They are not limits or targets, but will be used to inform the NZC limits and targets in the next stage of work.*

How to engage with the consultation

Responding to the consultation

There are a series of talking points raised within this document which are posed as questions in our **online survey**. Please submit your responses to these for our consultation.

Given the technical nature of certain sections of the consultation document, it is expected that not all stakeholders will want to respond to all sections.

We are expecting a high volume of responses to this consultation. Please ensure you use the online survey for your comments to ensure we are able to process and incorporate your feedback.

The team will also be conducting a webinar at **12pm on Monday 10 July 2023** to provide industry with answers to pertinent issues raised throughout the consultation. You can sign up **here**.

Consultation period

Please submit your views on the consultation between

Wednesday 14 June - Thursday 31 August 2023.

Data and performance levels

We are particularly interested to get your feedback on the performance levels which have been provided in answer to our Call for Evidence, for both operational energy and embodied carbon, and we encourage responses from those who have an understanding of technical achievability for these levels.

Please also note that we are collecting more embodied carbon data – please refer to **6. New Build Embodied Carbon Performance Levels** for more information.

These levels provide technical evidence for what is currently being achieved by individual sectors within the built environment, based on benchmarking, case studies and modelling.

They are not intended to be limits or targets, but will be used to inform the NZC limits and targets in the next stage of our work.

1. Background

Origin, principles, and progress

Origins of the Standard

In May 2022 a cross-industry Steering Group, representing stakeholders across the built environment, joined together to develop a Standard for verifying UK buildings as Net Zero Carbon (NZC).

The UK Net Zero Carbon Buildings Standard, or "The Standard", will enable our industry to robustly verify that our built assets are Net Zero Carbon, and in line with our nation's climate targets.

What will the Standard cover?

The Standard will set out metrics by which net zero carbon performance is evaluated, and provide performance targets and limits.

The Standard will be science-based, aligned with delivering a Net Zero Carbon UK by 2050 and a 78% reduction by 2035 in the UK in order to limit global warming to 1.5°C.

The Standard will incorporate targets and limits that have been derived from an analysis of the UK's Sixth Carbon Budget and from data gathered across different sectors within the built environment.

Who is it for?

The Standard is for developers, contractors, asset owners and managers, occupiers, investors, financiers and funders, consultants, building industry professionals, building managers and product/material manufacturers, suppliers, and distributors.

It is for anyone who wants to either fund, procure, design, or specify a Net Zero Carbon building and anyone wanting to demonstrate that their building is Net Zero Carbon in accordance with an industry-agreed Standard.

Principles of the Standard

Overall principles

- Providing clear, consistent definitions and trajectories for Net Zero Carbon (NZC) buildings and the built environment. This will make it simpler to specify and deliver NZC, and also prevent unfounded “NZC” claims
- Driving market transformation through industry engagement, uptake and support
- Ensuring that the Standard is easy to understand and use, with achievable but stretching requirements
- Aligning asset-level requirements with the system-level changes needed for a NZC UK.

Technical Principles

- Creating a Standard which is science-based
- Including both operational and embodied carbon
- Prioritising energy efficiency and eliminating the performance gap
- Prioritising the reuse of existing buildings and assets
- Adopting a whole life carbon approach
- Enhancing renewable energy generation
- Ensuring that buildings are responsive to electricity grid fluctuations

More detailed explanations of these principles can be found in our April Quarterly Update.

Application of the Standard

The approach will be applicable to both existing and new buildings.

To start with, the focus will be on the most common building typologies, especially those for which industry stakeholders have already robust performance data available to inform the setting of performance targets.

The Standard is seeking to develop performance targets and limits for the following typologies.

Homes	Sport and Leisure	Hotels
Offices	Retail	Commercial Residential
Schools and Further Education	Culture and Entertainment	Logistics / Warehouses
Healthcare	Heritage	Datacentres
	Science and Technology	

The people behind the Standard

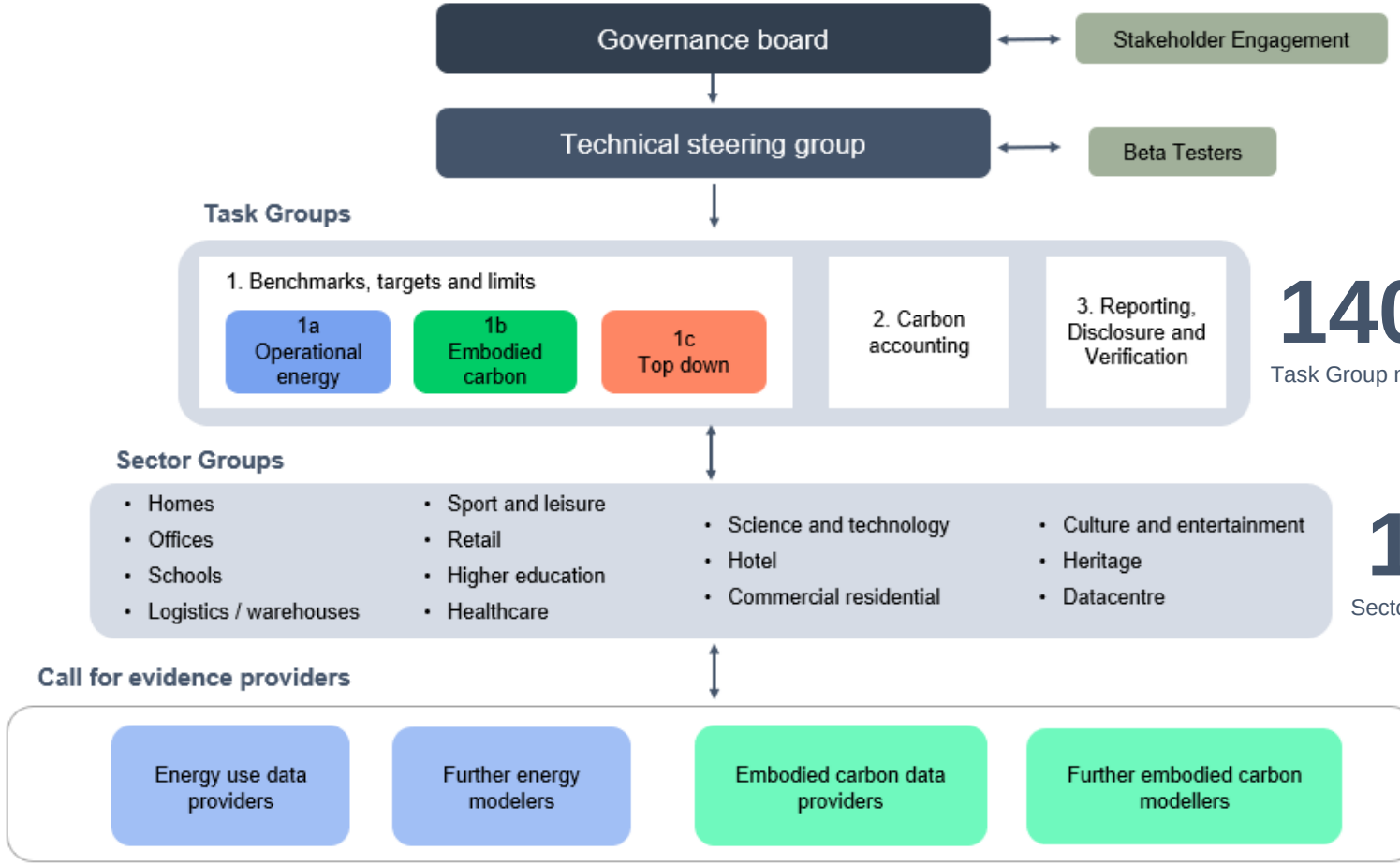
The Standard's project team is made up of more than 350 voluntary experts from all parts of the built environment industry.

The **Governance Board** oversees the development of the Standard, leads on stakeholder engagement, and secures resources for the Standard.

The **Technical Steering Group** (TSG) oversees the specification, design and development of the Standard. The TSG is supported by a series of Task Groups and Sector Groups.

The **Task Groups** develop the technical basis for the Standard alongside the TSG, and will draft parts of the Standard.

The **Sector Groups** provides expertise on the decarbonisation of that sector, by identifying sources of data, processing data from the call for evidence, producing sector-specific information such as metrics and benchmarks, and supporting the development of performance levels.



More information on these groups can be found in our April Quarterly Update.

Developing Net Zero Carbon Limits

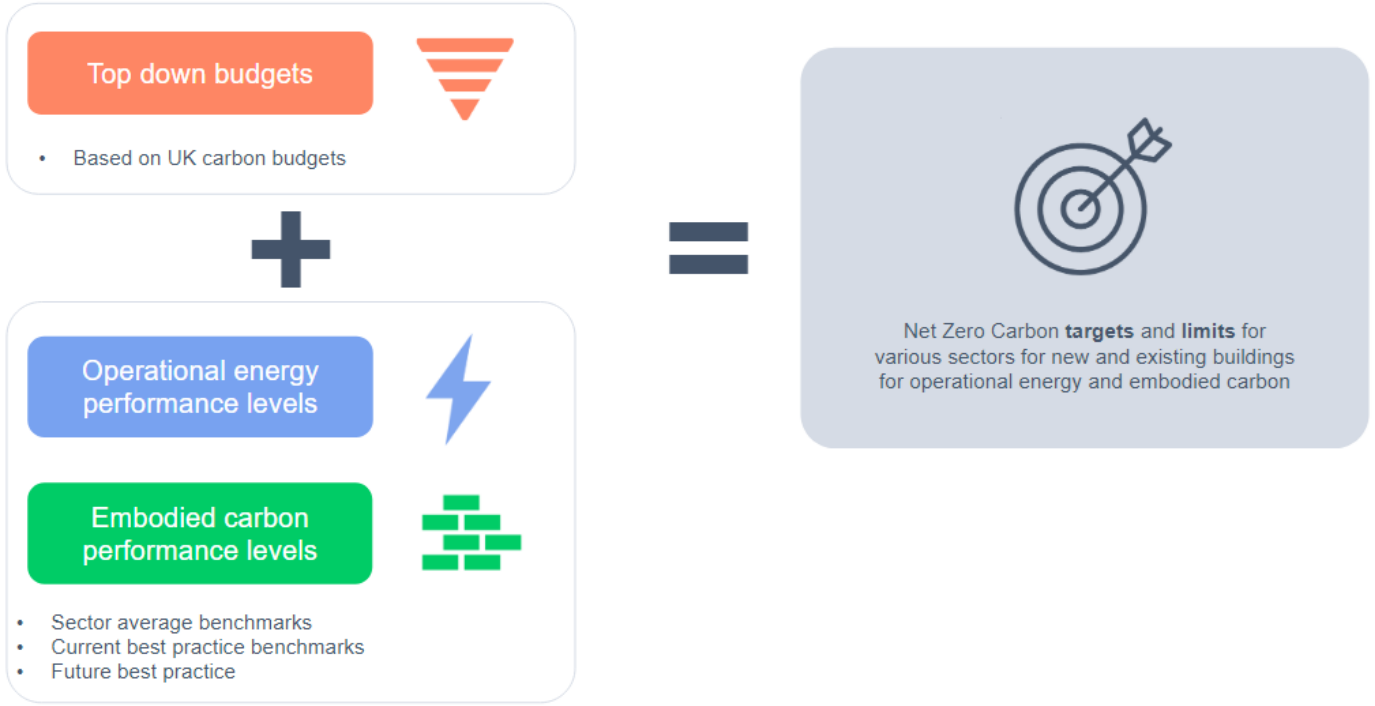
Two key principles for the Standard are that it should be stretching but achievable, and also that is should be science-based.

To reconcile these aims, two workstreams have been established to develop the Net Zero Carbon limits.

The **bottom-up workstream** will use benchmarking, case studies and modelling to create Levels of Performance.

The **top-down workstream** will establish the relevant national carbon 'budgets' which show what the industry needs to achieve to play its part in a NZC UK.

The outputs from these workstreams will then be combined to create NZC limits and targets for the Standard.



This consultation issue relates to the New Build Performance Levels, which are not the final NZC limits. More information on the development of limits can be found in our April Quarterly Update.

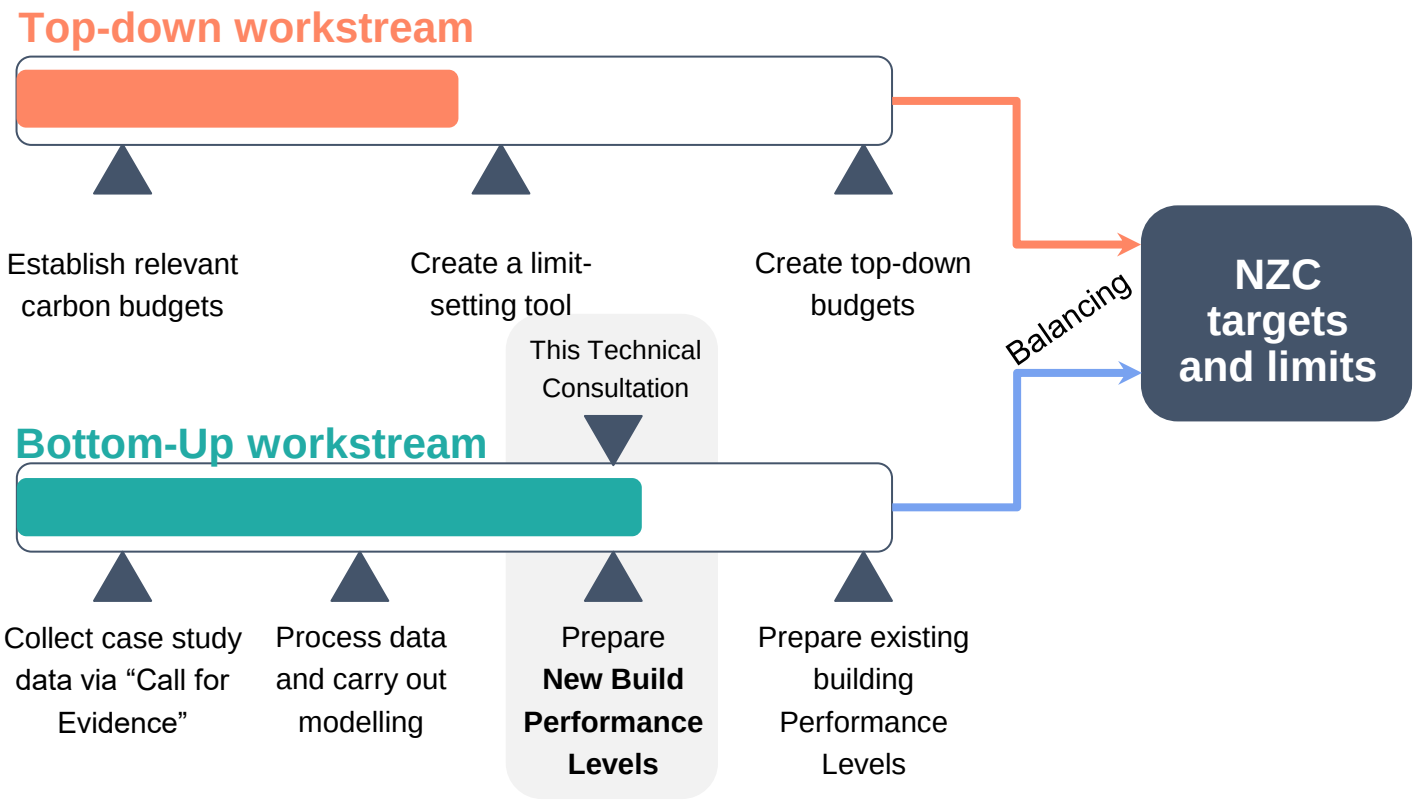
Glossary: *Performance levels: These levels provide the technical evidence on what can be achieved by the individual sectors, based on benchmarking, case studies and modelling. They are not limits or targets, but will be used to inform the NZC limits and targets in the next stage of work.*

Progress towards NZC Limits

The major milestone reached at the time of publication of this document is the development of bottom-up **New Build Performance Levels** for operational energy and embodied carbon**.**

Alongside technical fundamentals for the Standard, these New Build Performance Levels are a key focus of this consultation.

The Performance Levels represent what can be achieved at an individual building level. They are not the final NZCBS limits, which will be produced once the top-down budgets are available



Glossary: *Performance levels: These levels provide the technical evidence on what can be achieved by the individual sectors, based on benchmarking, case studies and modelling. They are not limits or targets, but will be used to inform the NZC limits and targets in the next stage of work.*

Call For Evidence - Thank You!

The Standard issued a Call for Evidence to obtain case study data from the real estate and built environment industry. This data is critical to ensure that the Standard is inclusive, and reflective of the best available evidence.

Metered energy data from individual project submissions from best-in-class buildings for over 200 projects has bene combined with data from predictive energy models to inform the performance levels.

Embodied carbon modelled data was submitted from 836 projects. Over half of the assessments were carried out between RIBA Design Stage 4-6, which provides a suitably robust assessment.

836
Projects embodied carbon data

3,200
Projects metered operational energy data
- from large data sets

200+
Projects metered operational energy data
- from individual projects

A huge thank you to everyone who responded to the Call for Evidence and contributed data:

AECOM
AEW
AHMM
AHR
Anne Thorne Architects LLP
Architype Ltd.
Argent LLP
Arup
Atkins
Bam
BDP
BE Design
Big Yellow Group
Bouygues
Bruntwood
Bryden Wood
Buro Happold
BWB Consulting
Certified
Chapman bdsp
City of London
Commercial Services Group
Cundall
Curtins
Cushman and Wakefield
Davies Maguire
dRMM
DEFRA
Eckersley O'Callaghan Engineers
Fiera Real Estate
Focus Consultants
Galliford Try
Glenn Howells Architects
Hawkins Brown
Haworth Tompkins
Hilson Moran
Hoare Lea
Introba (formerly Elementa Consulting)
ISG Ltd.
JLL
Kirsty Maguire Architect
Knight Frank Investment Management
Lamington Group
Landsec
LEAP
Lendlease
London Legacy
Longevity Partners
Mace Group
Martin Ingham
Max Fordham LLP
Method Consulting
New River
Nigel Dutt
Nottingham Trent University
Pilbrow and Partners
Price & Myers
Purcell
QODA Consulting
Ramboll
Renaissance Associates Ltd
Ridge
RPS
Savills
SD Structures
Sir Robert McAlpine
Smith and Wallwork
Staffordshire University
Sustainable Construction Services
Swansea Council
Swansea University
Timber Development
Tooley Forster
Treveth Holdings LLP
Turley
Turner & Townsend
University of Liverpool
University of Reading
Walsh
Wates Group
Welsh School of Architecture
Whitby Wood
Wilkinson Eyre
Willmott Dixon Holdings Ltd.
Woolgar Hunter
Workman
WSP
XCO2

2. Technical Fundamentals

Definitions

UK Net Zero Carbon Buildings Standard

Fundamentals - Introduction

Net zero carbon - what do we mean?

This section defines how the Standard will be applying for buildings to demonstrate that they are Net Zero Carbon in line with Climate Science to mitigate global average temperature increase within 1.5°C.

Limits and other requirements

This section identifies the specific carbon sources that needs to be limited and outlines other requirements that need to be met in order to demonstrate that a building meets the Standard

New build, retrofit and existing buildings

The standard will apply to new build, retrofit and existing buildings. Targets and limits will be treated differently depending on which category the building sits. A retrofit is defined as where more than 25% of the building envelope undergoes renovation, or a substantial replacement of building services occurs. For or intensive refurb projects where more than 50% of the existing slab area is demolished, the building will be classed as new build.

Heritage

We have assembled a working group looking specifically at the challenge of applying a net zero Standard to historic buildings or those with heritage aspects. It is our intention that heritage buildings will form part of the Standard, but that they will need a parallel approach that takes routine account of conservation principles, as well as energy and carbon. This approach will be developed by the Heritage sector group.

We are exploring an approach that involves incorporating energy and carbon issues routinely into the scope of Conservation Management Plans used for buildings of special significance. The limits and targets developed within the Standard may need to be applied with some flexibility to heritage buildings, with a consideration of listed status and an ‘Assessment of Significance’.

As this work is ongoing, this consultation does not explicitly focus on these buildings.

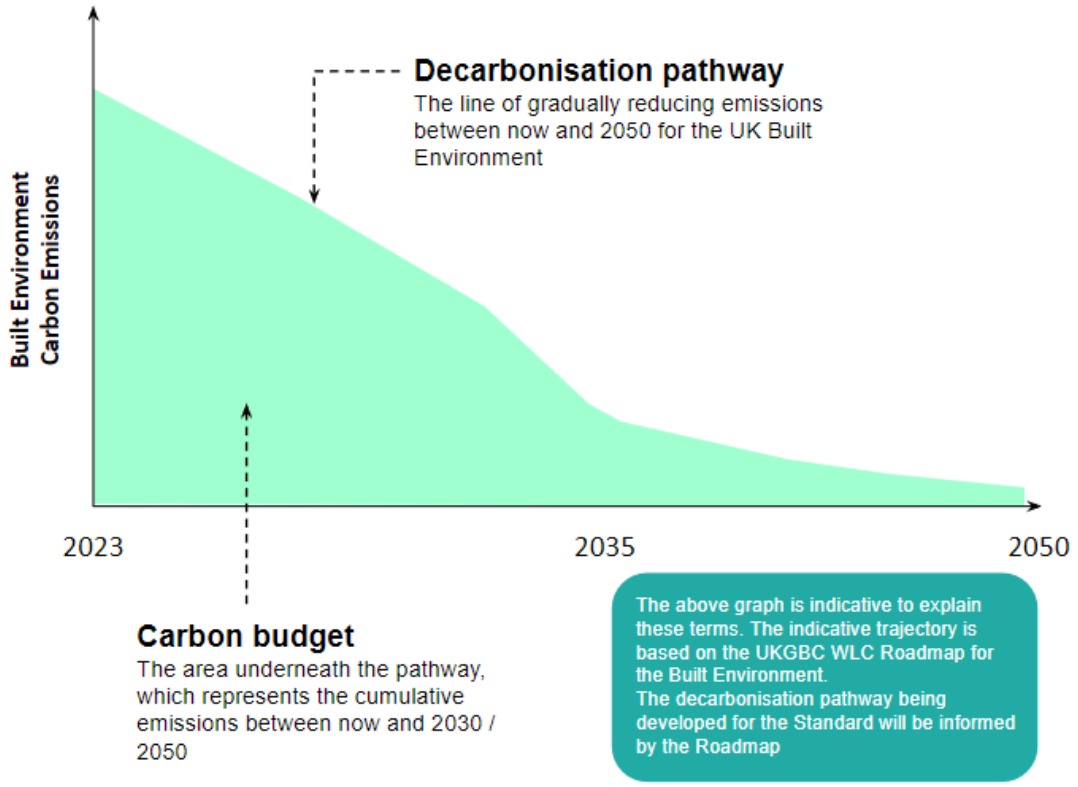
Net Zero Carbon - What do we mean?

Net zero carbon means achieving a balance between the greenhouse gases emitted into and removed from the atmosphere. In order to mitigate the worth impacts of climate change on humanity and natural ecosystems, climate science has shown that we need to **limit global heating to 1.5°C** over pre-industrial levels. In order to stand a reasonable chance of doing so, we need to **achieve net zero carbon globally by 2050 and limit cumulative emissions between now and then to within the remaining 'carbon budget'.** To achieve net zero carbon, all sectors in all countries must reduce their emissions as far as possible, and any 'residual' emissions will need to be removed (refer next page).

Accordingly, for the Standard we propose to **limit emissions** including both embodied carbon emissions and the emissions associated with energy use. Limits will be based on what is necessary to enable the cumulative emissions from the UK built environment between now and 2050 to stay within its share of the UK's **carbon budget.** The method to determine this proportion is currently being developed. Energy use intensity limits will be set, and targets for other metrics associated with supporting the full decarbonisation of the UK energy system are being considered. The Standard will therefore be geographically bound to the UK.

A "**decarbonisation pathway**", is being developed to show how the UK built environment's emissions could reduce, limiting them to within the remaining carbon budget. The shape of the decarbonisation pathway will be informed by what is anticipated to be possible and by when, based on data and modelling for each sector, and will ultimately be aligned to the budget identified.

The decarbonisation pathways will be delineated between operational carbon/energy and embodied carbon to show their separate trajectories.



The role of offsetting

The Standard will include embodied carbon and operational energy limits that support the decarbonisation of the built environment in a manner consistent with not breaching the limit of 1.5°C.

In addition to achieving these limits, Net Zero Carbon at an asset level is typically taken to involve the balancing of emissions through some form of offsetting. This is often talked about as either removal offsets (taking carbon out of the atmosphere), or reduction/avoidance offsets (reducing someone else's emissions).

An important discussion during the development of the Standard has been around whether or not the Standard should mandate the offsetting of emissions. There are reasons for and against requiring this, which are summarised to the right.

We are exploring whether offsetting should be mandated, optional (as a separate route to compliance), or excluded from the Standard due to the reasons "against" given on the right. It is acknowledged that excluding offsetting from the Standard entirely would be a shift in focus away from asset-level net zero.

The argument <u>for</u> including offsetting
"we must 'net' our emissions!"

- **Resilience.** If assumptions behind the Standard's limits and targets change at a later date, buildings that comply with the Standard will have still contributed to decarbonisation by offsetting their own emissions.
- **Language.** An asset is not "Net Zero" unless its emissions have been balanced with offsets, and therefore this would not be a Net Zero Carbon Building Standard without offsets. An alternative naming for the Standard may need considering if offsetting is not included.
- **Something is better than nothing.** Offsetting will always lead to greater decarbonisation progress when compared with not investing at all in carbon removals, reductions or avoidance. Mechanisms could be explored such as setting a carbon price and investing into a portfolio of measures to drive emissions reduction.
- **Convention.** Many developers are already offsetting their emissions to claim "net zero", and some existing standards require this.

The argument <u>against</u> including offsetting
"offsetting isn't necessary at an asset level!"

- **Systemic net zero.** Research by the CCC shows that Net Zero is a systemic issue, with no need for individual assets to 'net' their own emissions, provided these are aligned with a 1.5°C trajectory.
- **Removals availability.** The UN, IPCC and SBTi only specify removal offsets (and not reductions or renewables) in their definitions of Net Zero Carbon– but it is unlikely that there will be enough removal credits available to meet demand.
- **Integrity concerns.** Carbon offsets are market transactions where you are buying the right to claim carbon savings that were made in other industries. It is inherently difficult to demonstrate that offsetting claims are additional, permanent and robustly quantified with no double counting, and the market for doing this is still immature and poorly regulated.
- **Costs.** Offsetting introduces costs that don't directly benefit building owners/users, and may dissuade people from wanting to meet the Standard. It could be argued that this money would be better spent on reducing the assets' emissions.

Survey Talking Points

Complete the survey

Throughout the document, there will be a number of talking points (as below), which are questions in the consultation survey. Please provide responses to our talking points by completing the survey **here** or look out for the following icon to submit your thoughts.

Talking Points - The Role of Offsetting

7. Which of the following approaches to offsetting do you think the Standard should take?

- **A) Offsetting mandatory:** The Standard should only recognise assets that have met carbon and energy limits, and then purchased offsets to 'net' these emissions
- **B) Offsetting optional:** The Standard should not mandate the purchasing of offsets, but should recognise when a project has purchased offsets to 'net' the asset's emissions
- **C) Offsetting not required:** The Standard should recognise assets that have met carbon and energy requirements without mandating the requirement to purchase offsets

A Note on Energy Procurement

The way in which buildings procure energy can help accelerate the decarbonisation of the energy system. Whether the Standard considers a building's energy procurement strategy when accounting for emissions associated with operational energy consumption is currently being discussed.

Whole Building Approach

We recognise that *building* is most commonly used to refer to a single structure, but in the case of multi-tenanted buildings there are also single 'demises' or 'hereditaments' within a structure. We recognise that in tenanted buildings, it will be necessary for owners and occupiers to collaborate in order to achieve a net zero carbon building.

We are proposing that the Standard **adopts a 'whole building' approach; to support emissions reductions across scope 1, 2 and 3; align with investor reporting tools/mechanisms; and drive owner-occupier engagement.**

We recognise there are good reasons for being able to delineate and assess different parts of a building:

- **Data**: enabling more granular data that owners/occupiers can use to drive improvements in performance.
- **Practicality**: enabling owners and occupiers to allocate the costs of achieving net zero appropriately.
- **Reporting:** the ability separate Scope 1,2 and 3 emissions for reporting purposes.
- **Accountability:** to ensure that clear accountability for emissions can be established and that owners/occupiers of buildings are neither unfairly rewarded or penalised for emissions that they do not control.

At this stage of the development of the Standard, delineating and creating a Standard for different parts of tenanted buildings across a range of different asset types introduces significant complexities. The Standard also needs to consider whether this complexity should be incorporated within the Standard, or left to the market to resolve.

We propose that the the Standard will require addressing all energy uses and embodied carbon for the whole building. We welcome views on this approach. We understand that separation based on accountability may be important for some sectors such as offices or retail, hence we are seeking views on this in this consultation and will take these views into consideration to inform the next stages of the Standard's development.

Talking Points overleaf

Whole Building Approach

Talking points

Accountability for delivering a net zero carbon building is an important consideration when developing the Standard. Some sectors have indicated that they would like the Standard to consider separating out the building according to accountability, making it possible to verify different parts of the building as net zero carbon (e.g. owner-controlled or tenant spaces). We are seeking views on this through this consultation.

8. Do you agree with the proposal put forward that the Standard will only apply to a whole building, with no separation of landlord and tenant activities and no ability to verify part of a building (e.g. base build only, or a single tenant demise)?

9. If yes, do you think the Standard should seek to explore owner/occupier accountability and building delineation in future Versions of the Standard?

10. If no (i.e. you think version 1 of the Standard should delineate between owner/occupier), do you think the Standard should seek to:
- **Establish a common set of rules for delineation**
- **Develop rules for delineation specific to each sector**

[NB: IF a majority of respondents to the consultation would like to see delineation – either in Version 1 or subsequent versions of the Standard, this may have significant implications for the development of the standard going forward in terms of complexity and timescales].If you think the Standard should seek to delineate owner/occupier accountability either in Version 1 or future versions of the Standard, then...

11. Should individual occupier demises or the owner controlled areas within a building be able to attain net zero status?

12. Should individual occupier demises or the owner controlled areas within a building be able to retain their net zero status even if the whole building cannot?

3. Technical Requirements

Metrics and Limits of the Standard

UK Net Zero Carbon Buildings Standard

Technical Requirements

Contents

Overview of Metrics

The Standard will set requirements within each of the following areas to define what is needed for a NZC building. The specific numerical targets and limits will vary by sector, and in some cases by sub-sector.

Operational Energy Limits will be set that define a building's required operational energy performance, to be demonstrated in operation.

Upfront Embodied Carbon (A1-A5)* limits will be set, defining a building's required embodied carbon performance in $kgCO_2e/m^2$ GIA.

Lifecycle embodied carbon emissions (A1-A5, B1-B5, C1-C4*) will be required to be reported, but will not be limited in this version of the Standard. The metric will be $kgCO_2e/m^2$ GIA over the building's Reference Study Period (default being 60 years, in according with the RICS Professional Statement).

Fossil fuel free New buildings with on-site plant will be required to be fossil fuel free, with certain exceptions. This will also be the end goal for existing buildings.

Demand management No limits or targets will be set with regards to demand management / flexibility, however the standard will require reporting of peak demand and time of peak. The embodied carbon of all demand management solutions, including batteries will be counted as part of the overall building's embodied carbon

Onsite renewables

All buildings will be required to report on renewable electricity generated by on-site systems, how much is used on site and how much is exported $kgCO_2e/kWp$. New buildings are required to meet a target for provision of on-site renewables, measured in kWh/m^2 of building footprint/yr. The embodied carbon of onsite renewables will not be counted within the A1-A5* total, but will be subject to separate limits, measured in $kgCO_2e/kWp$.

Renewable procurement & offsetting

If these form part of the Standard, acceptable forms of renewable procurement and offsetting will be defined. This will be steered by Industry guidance including the UKGBC's current update to their renewable procurement and offsetting guidance.

Refrigerant & Leakage Refrigerant emissions will be accounted for within embodied carbon. A limit will be set for Global Warming Potential (GWP), aligning with F gas regulations and EU taxonomy. In addition, the Standard will require refrigerant leak detection to be installed, and for refrigerant leakage to be reported

*lifecycle stages

Proposed Requirements

Carbon emission sources	Limits/ targets	Reporting and disclosure	Offsetting
Upfront carbon	Meet Embodied carbon limits	Measure and report emissions after PC	Offset EC after PC
Life cycle embodied carbon (A-C ex B6-7)		Measure and report emissions after PC	
Operational energy	Meet Operational Energy limits	Measure and report emissions annually	Offset OE annually
Operational water		Measure and report emissions annually	Offset annually
Fugitive refrigerant gases	Meet GWP limits	Measure and report emissions annually	Offset annually
Demand Management		Measure and report annually	
Onsite renewables	Meets minimum onsite target and embodied carbon limit	Measure and report annually	
Reportable (significant) in use embodied carbon		Measure and report emissions annually	Offset annually
Embodied Carbon of fit outs (offices, hotels and retail)	Meet EC limits for fit out (if data is available and provided to the standard))	Measure and report emissions annually	Offset annually

Talking points

13. In general do you agree with the proposals put forward for the metrics for the Standard?

Embodied Carbon Limits

Embodied carbon limits will be set, defining a building's required embodied carbon performance in $kgCO_2e/m^2$ GIA. These limits will be set based on both top-down budgets and bottom-up performance levels, the same approach as operational energy.

Upfront Embodied Carbon (A1-A5) limits will be set, defining a building's required embodied carbon performance in kgCO2e/m2 GIA.

Lifecycle embodied carbon emissions (A1-A5, B1-B5, C1-C4) will be required to be reported, but will not be limited in this version of the Standard. The metric will be kgCO2e/m2 GIA over the building's Reference Study Period (default being 60 years, in according with the RICS Professional Statement).

The reporting for A1-A5 will require measured, as-built quantities. Product-specific EPDs are to be used where available - where not, the standard will set out the hierarchy of other carbon factor options that can be used instead.

Both the material quantity and embodied carbon will need to be reported for each building element. Additional reporting on material efficiency will be required to be completed and published to encourage designs to meet A1-A5 limits through efficient use of material.

A1-A5 limits will decrease over time, as materials are expected to decarbonise and material efficiency will increase. The limit applied to a specific project will be that in place during the year the project was completed. Therefore, adherence with the standard will be based upon the submission year for the data and the current limits in place within the Standard.

No further requirements are to be placed on material flows or circularity for the first version of the Standard.

Embodied Carbon Limits

Whilst the approach to reporting and limiting embodied carbon for a new-build project is clear (see previous page), the requirements on reporting and limiting embodied carbon in other circumstances will depend on the extent of the work. The following approach is proposed on reporting and limiting for different levels of intervention:

- **In existing buildings verified to the Standard:**
  - **Non-reportable works:** For the most minor works, (e.g. changing a single lightbulb), embodied carbon does not need to be measured, reported or limited.
  - **Reportable works (most sectors):** Where work is more substantial than the cut-off limit <level tbc>, embodied carbon is to be measured and reported, but is not limited.
  - **Reportable works (office, retail and hotels only):** For these sectors, the ambition is also to set embodied carbon limits if enough data can be found to substantiate these.
- **In retrofit or new-build projects looking to meet the Standard:**
  - **Retrofit:** If more than 25% of the building envelope undergoes renovation, or if a substantial replacement of building services occurs, then embodied carbon must be measured and reported, and '*Retrofit'* embodied carbon limits met.
  - **New-build:** For a building that is clearly a new-build, and for intensive reuse projects where more than 50% of the existing slab area is demolished, embodied carbon must be measured and reported, and '*New-build'* embodied carbon limits met.
  - **Mixed new/retrofit:** Where less than 50% of the existing slab area is demolished, and the building is extended, a floor area weighted average limit may be set based on the equation below, where GIA_{total} is the combined Gross Internal Area (GIA) of the completed building project including all retained areas and extensions.

$$[\ ((GIA_{total} - GIA_{existing}) \times limit_{EC,newbuild})\ +\ (GIA_{existing} \times limit_{EC,retrofit})\ ]\ \ /\ \ GIA_{total}$$

Embodied Carbon Limits

Talking points

14. What are your views on the approach to limiting embodied carbon?
Do you have any comments on the proposed approach?

15. We are only able to work on setting upfront embodied carbon (A1-A5) limits at this time, due to the data we received. What is your opinion on this?

16. The embodied carbon limits will be set for 2024 based on current levels of performance (before ratcheting down in the future). How would you expect to see the initial starting point for the limits set?

Embodied Carbon Retrofit Limits

Approach to limit-setting

Setting retrofit limits is complex as the level of intervention varies significantly between projects. The priority of the Standard is to encourage retrofitting where possible, whilst avoiding overly carbon-intensive works to take place.

Various options were considered for setting such limits. The options are shown here, with the middle (bold) option selected as the way in which limits will be set going forwards.

Final limits will be reviewed against the retrofit data submitted in the call for evidence, to check for achievability.

Approach considered	Advantages	Disadvantages
Limits are the same as new build.	Simplest option. Promotes retrofit-first approach.	Limits likely to be too easy to meet, so serve little purpose and thus doesn't incentivise efficient retrofit design.
Limits are sector-specific, based on a % of new-build, calculated for a reasonable allowance for typical replacements required by retrofit projects.	**More stringent than new build limits.** **Incentivise efficient design for larger retrofit schemes.** **Still simple for the user.**	**Very easy to meet for lighter-touch retrofit schemes.** **'Reasonable allowance' is subjective and must be well-reviewed.**
Bespoke limits for every project based on the nature of retrofit and elements replaced, developed using a formula provided.	If done well, creates stringent limits for all retrofits, so most effective way of minimising embodied carbon.	Most complicated option for the user. Open to manipulation, requires careful management / implementation. Limits may change as design progresses.

Embodied Carbon Retrofit Limits

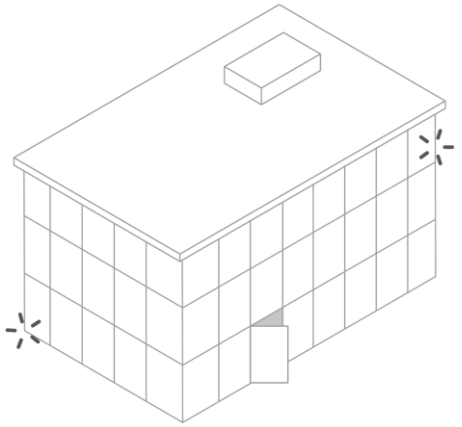
Applying the limit-setting approach

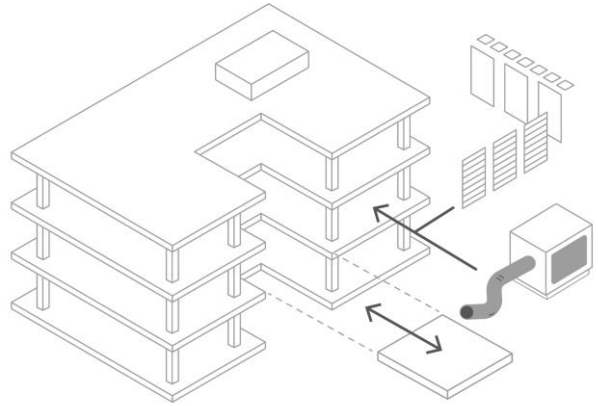
These figures demonstrate how the approach outlined on the previous page will be applied, once new-build limits have been set for each sector.

For each element (substructure, facade, etc) within each sector, a Retrofit Factor (RF) will be determined for that element, based on the typical replacement scenarios during retrofit works. The RF represents expected upper-bound emissions during retrofit, as a proportion of original emissions for an equivalent new-build.

For example, the RF for facades in the Office sector might be 1.0 (complete replacement) but for Single-Family Homes might be 0.5 to represent the addition of insulation and replacement of the doors and windows.

New-build limits are prorated down to give elemental limits based on typical % split between elements. RFs are applied to these, before summing the factored elemental limits, to give a total retrofit limit for each sector.





New-build$_{office}$

$$Limit_{EC} = \sum_{Total} \left[Limit_{structure} \; Limit_{MEP} \; Limit_{etc...} \right]$$

Individual limits based on element performance levels and sector embodied carbon budget

Retrofit$_{office}$

$$Limit_{EC} = \sum_{Total} \left[RF \times Limit_{structure} \; RF \times Limit_{MEP} \; RF \times Limit_{etc...} \right]$$

Retrofit Factors based on expected upper-bound emissions during retrofit, as a proportion of original emissions for an equivalent new-build

Refit Embodied Carbon

Need for consideration

Whilst the Standard is being created solely for setting out Net Zero requirements across whole buildings, it is recognised that the cumulative embodied carbon footprint of regularly refitting buildings can be significant.

The Office, Retail and Hotel sectors have been identified as having exceptionally high materials turnover and high wastage for fit-out (typically Cat B, in the case of offices).

As such, we wish to understand whether sufficient refit embodied carbon data exists, to enable a decision to be made as to whether this should be limited within buildings that have been verified against the Standard.

Talking Points

17. To set Embodied Carbon limits in retrofits, we intend to follow the process outlined in the consultation document, creating bespoke targets for each sector based on typical retrofit interventions. What is your opinion of this?

Do you have any other comments regarding the retrofit limit-setting process?

18. Whilst the Standard is being created solely for setting out Net Zero requirements across whole buildings, it is recognised that the cumulative embodied carbon footprint of regularly refitting buildings can be significant, particularly in the Office, Retail and Hotel sectors.

Do you believe that the Standard should include refit limits (for buildings already certified to the Standard) for these sectors?

Refit Embodied Carbon

Call for data

To help us make the decision as to whether or not refit embodied carbon limits should be set, we are researching to find existing data covering the refit of these sectors during a building's life.

If you have refit data from UK projects in the Office, Retail or Hotel sectors, please get in touch by emailing TG1b@NZCbuildings.co.uk.

Thank you!

Operational Energy Limits

The Standard will set limits for the operational energy use of buildings.

Rationale

The limits will be informed by both UK-wide carbon budgets (i.e. the Top Down modelling) and by an assessment of what is achievable (i.e. the Bottom-Up performance levels), aiming to strike a balance between both.

Performance levels have been produced for some sectors, on which we are inviting feedback. In other sectors, they are not yet available and their development is on-going. See details in Operational Energy Performance Levels section. Once performance levels and UK carbon budgets are available, a balancing exercise will be carried out to determine the limits.

Verification based on actual outcomes

Verification will require evidence of metered energy use and associated information (e.g. parameters such as occupancy hours or density of use, as relevant to each sector) , to demonstrate the Operational Energy limits have been met in operation. Other actions will be required for verification.

Talking Points

19. What are your views on the approach to verification of operational energy based on actual outcomes?

20. Do you have any comments on the rationale?

Scope of energy uses covered

In general, all electrical and thermal energy uses are covered by the Standard. However, a small number of exceptions apply:

Electric vehicle charging is excluded.

Heavy process loads may be excluded in some cases:

- By default, they will be included and covered by energy use limits (either as part of the overall energy use limit, or treated as an additional special end use with its dedicated limit)
- Some process loads may be excluded and not covered by energy use limits, **if** the carbon emissions from these processes are already managed as part of that industry's carbon emissions and do not come under the 'built environment' heading. It is not sufficient for carbon to be *counted* elsewhere in an industry: such exceptions will only apply where there is evidence that the relevant industry is actively managing and enforcing reduction limits.

Emissions from refrigerants use

These are considered in-use **embodied carbon** emissions for the purpose of carbon accounting. Refer to the section on refrigerant leakage for more information.

Operational Energy Limits

New build limits

New build limits will be set at an ambitious level. This will avoid the need for future re-works and provide more flexibility to the existing stock, where deep operational carbon savings are more costly, both financially and in embodied carbon terms.

Limits for new buildings applying for certification may be revised over time as part of the Standard's regular reviews, but on a given building they will not change over time: a building certified as "NZC New Build" will retain the same limit in future years (it will just need to regularly show it continues to meet that limit).

Existing building and retrofit limits

A number of considerations apply when setting limits for existing buildings and retrofit:

- Feasibility due to technical or other constraints e.g. heritage
- Whole life carbon impacts: energy use reduction is needed across the stock, and energy efficiency works will bring other important benefits (e.g. longevity, comfort for occupants), but a balance needs to be struck between operational carbon and other benefits (e.g. comfort), and the embodied carbon expenditure of the works.

The current proposals are that Operational Energy (OE) limits for existing buildings and for retrofits should be the same. Therefore if an OE limit can be met with more limited works, this should be encouraged. This does not apply to buildings already verified as NZC New Build - in that case, the limits will remain those of a new building. *A number of options are available for how these limits will be set, and we are seeking views on this - see consultation question.*

Talking Points

21. Should the end point (2050) limits be the same for new and existing buildings & retrofits?

22. Should the operational energy limits for existing buildings & retrofits tighten over time?

Fossil Fuel Free

New and existing buildings with on-site plant

Buildings with on-site plant (e.g. heating, cooking, generator) will be required to be **fossil fuel free**, with the exceptions of:

- Energy uses that are not covered by the Standard
- Emergency and back-up: see right.

This includes plant serving several users, but within a single owner site e.g. hospital campus, university campus, block of flats with communal heating, commercial centre with central heating or cooling.

Talking Points

23. Do you agree with the proposed exemptions for 'fossil- fuel free' requirements? Please select all that you agree with:

- **Emergency and life safety uses** i.e. back-up power in healthcare sector, or specific uses in other sectors where they are critical to health and safety (e.g. fire fighting and evacuation lifts)
- **Back-up to essential functions in buildings and sites "of vital importance for civil protection"** i.e. Class IV in BS EN 1998:2004+A1:2013 e.g. hospitals, fire stations, power plants"
- **Back-up power in datacentres**, on the condition that reliance on fossil fuels has been minimised.
- Other

Exceptions for emergency and back-up

Fossil fuel plant will only be allowed for the following uses:

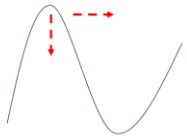
- **Emergency and life safety uses** i.e. back-up power in healthcare sector, or specific uses in other sectors where they are critical to health and safety (e.g. fire fighting and evacuation lifts)
- **Back-up to essential functions in buildings and sites defined of critical importance.** For example, this could apply to Class IV buildings as defined in BS EN 1998:2004+A1:2013 ("buildings whose integrity during earthquakes is of vital importance for civil protection e.g. hospitals, fire stations, power plants etc").
- **Back-up power in datacentres**, on the condition that reliance on fossil fuels has been minimised. An approach to this is proposed in the Datacentre Sector Group report.

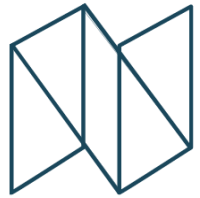
This is an area that will be regularly reviewed as part of the Standard development to incorporate opportunities for fossil fuel free solutions, while ensuring life safety and critical functions are maintained where satisfactory fossil fuel free alternatives do not exist.

Buildings connected to district heating or cooling

For information on this, go to Page 41.

Demand Management / Flexibility





Rationale

The Standard recognises that buildings cannot be viewed in isolation from the wider system, and that they must play their part to support grid decarbonisation. There are three ways in which buildings can do this:

- Reducing annual energy use: this is at the core of the approach to operational carbon. Measures that reduce annual energy use will also usually reduce peak demand.– see page 32 on operational energy limits.

- Contribution to the generation of zero carbon energy, through on site renewables (see pages 37-39) or offsite renewables.

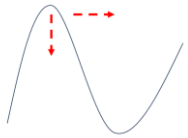
- Reduce the burden on the grid at times of high demand, which are also often times when grid electricity is higher carbon. This can be achieved through reducing peak demand both through passive and efficiency means, and through management, or flexibility, solutions e.g. smart controls, thermal storage, and electrical storage.

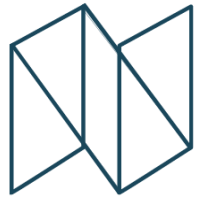
Performance metrics

The Standard team are developing a view on what the best metrics for demand management should be. Metrics considered include:

- Peak demand, and time of that peak; possibly differentiating between summer and winter
- Proportion of the peak that can be shifted
- Thermal or electrical storage, in absolute (e.g. kWh/m2) or relative terms (e.g. % thermal load)
- More qualitative approaches e.g. “smart readiness indicator”

Demand Management / Flexibility





The Standard team will continue to engage with built environment professionals and the industry, as well as consulting those in the wider system, including CCC and National Grid, to ensure the Standard best supports system-level decarbonisation. In the meantime, the following requirements are proposed:

Requirements – Operational energy and carbon

No limits or targets will be set with regards to demand management and/or flexibility but they may be proposed in some sectors.

Reporting against a range of metrics will be required, to support the ongoing review and future development of the Standard. As a minimum, this will require reporting of peak demand and time of peak. Other metrics may apply at least in some sectors.

Requirements – Embodied carbon

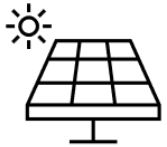
The embodied carbon of all demand management solutions, including batteries will be counted as part of the overall building's embodied carbon i.e. demand management solutions such as batteries will not be provided a dedicated allowance or limit, and instead be considered altogether as part of the building's overall embodied carbon limit.

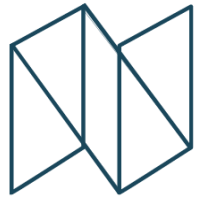
Talking Points

24. What is your view on the approach to Demand Management / Flexibility?

Do you have any further comments on the proposed approach?

Onsite renewables





Rationale

Renewable electricity generation needs to be encouraged in order to support grid decarbonisation and ensure a sufficient supply of nationwide zero carbon electricity. However, the embodied carbon of creating such electricity must be considered, and so the standard must set embodied carbon limits on such electricity-generating equipment.

Renewable electricity generating systems

Operational Energy

Reporting requirements for all buildings

All buildings (new **and** existing / retrofits) will be required to annually report on renewable electricity generated by on-site systems, how much is used on site and how much is exported.

Provision of renewable electricity generation on new builds

In addition, the Standard proposes that **new buildings should be required to provide on-site renewable electricity systems**.

The renewable electricity generation requirement would be expressed as a target (i.e. minimum), in annual kWh/m^2 of building footprint/yr.

For indication, the target is currently proposed to be within the following range, to be confirmed with further analysis:

- at least 150-200 (tbc) kWh/m2 building footprint per year for 1- or 2-storey industrial buildings
- at least 80-120 (tbc) kWh/m2 building footprint per year for all other building types
- A smaller provision would be allowed, if this was sufficient to meet all the building's energy uses on an annual basis. This may be the case for houses and some low rise buildings.

Flexibility would be provided in the following conditions, with evidence:

- **Planning or legal constraint preventing on-site renewables e.g. heritage building or conservation area**: this would not be a blanket relaxation for all heritage buildings or all buildings in conservation, but would need to be evidenced as a constraint applying to that specific building or conservation area
- **Impractical to provide generation:** The available area has suitable solar exposure, but is very limited and only very small or impractical systems could be installed.
- **Target cannot be met due to practical constraint:** The area is suitable in its solar exposure, but limited so that even systems maximising the use of the available area cannot meet the target.
- **Poor conditions for generation**: The available area may be large, but is not optimum for PV generation (e.g. northern UK, overshadowed), so annual output from PVs would be small.

Onsite renewables

Renewable electricity generating systems

Alternative metrics for setting onsite renewable generation targets have been explored, but are not currently preferred:

- kWh/sqm of site footprint/yr: this would place unduly large requirements on sites with external areas used for valuable purposes such as sports and leisure, biodiversity etc
- % of annual energy use: this has the benefit of encouraging reductions in annual energy use (since the required renewable energy system is then smaller), but does not necessarily reflect a building's potential e.g. a low rise and high rise buildings with the same area of roofs would have different requirements, when in fact the rooftop area available for PVs is similar.

These proposals are based on an initial review of precedents (e.g. technical feasibility studies for local authorities including Greater Cambridge, Cornwall, and Newham).

Further work is required to finalise the approach and numerical targets.

Feedback is sought on this - see consultation question.

Please share with us any research about the embodied carbon implications of onsite PV, and the efficiency of PV over wind in Northern England and Scotland. We are currently reviewing if it is appropriate that any targets for on-site renewable energy generation be varied across geographical regions of the UK (to reflect the regional availability of solar and wind, for example), or should a single set of targets be applied?

Talking Points

25. Do you agree that a requirement for onsite renewables should be set for new builds?

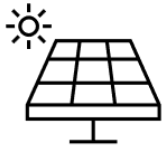
26. For this requirement, do you agree that kWh/sqm building footprint/yr is the right metric?

27. Do you think the proposed target ranges for onsite renewable generation are broadly right i.e. ambitious but reasonable?

28. Do you have comments on the proposed flexibility conditions for onsite renewable generation, where the target would not have to be met?

29. Do you have any other comments on the proposed approach?

Onsite renewables



Renewable electricity generating systems

Embodied Carbon

The embodied carbon of renewable electricity-generating systems (including all additional structure / fixture / fittings / technology, but excluding batteries) will not be counted within the A1-A5 total when proving that a building meets embodied carbon limits, but will be subject to separate limits of their own.

The metric for these EC limits will be $kgCO_2e/kWp$, based on preventing the use of the poorest-performing electricity-generating systems out there. This metric is considered the simplest to use. Efficiency of installation is encouraged through the Standard's approach to operational energy limits.

The Standard hasn't yet determined whether on-site renewable heat-generating systems will be treated the same as electricity-generating ones, or as non-renewable heat-generating systems.

Renewable heat-generating systems

Operational carbon

They will be treated as other heat-generating systems.

Embodied carbon

The Standard hasn't yet determined whether on-site renewable heat-generating systems will be treated the same as electricity-generating ones, or as non-renewable heat-generating systems.

Electricity Storage

See page 35 on Demand Management / Flexibility.

Talking Points

30. What is your view on the approach to embodied carbon of renewables

Do you have any further comments on the proposed approach?

Refrigerant & leakage

Rationale

As we move towards more refrigerant based systems, emissions from Module B1 grow in proportion to others. Poorly managed refrigerant systems can produce greater emissions than gas-based heating system. Therefore the Standard will place limits on refrigerants.

Refrigerants will be accounted for within embodied carbon calculations. This is because operational energy is being measured on EUI basis, and it is not possible to measure refrigerant-related emissions in this way.

The Standard will place a limit on the Global Warming Potential (GWP) of refrigerants. A GWP limit is universally applicable across system types and aligns with BREEAM. The F-gas regulations and EU taxonomy also refer to the GWP of refrigerants.

Limits will be selected based on their GWP, as well as their current availability on the market. It is not the intention to preclude VRF systems that could disadvantage smaller projects and budgets.

Performance metrics

The initial proposal for the GWP limit is based on R32: 675 GWP. The Standard will also require the GWP of refrigerants to match the most recently published IPCC publications, as per the RICS Professional Statement on Whole Life Carbon Assessment for the Built Environment.

In addition to a limit on the GWP of refrigerants, the Standard will also require the following:

- Refrigerant leak detection to be installed
- Refrigerant leakage to be reported

Talking Points

31. What is your view on this approach?

Do you have any further comments on the proposed approach?

District Heating & Cooling Networks

“District” network is used here to encompass schemes serving several buildings (e.g. a multi-block residential development, a mixed-use scheme), except if all buildings are within a site owned and occupied in large majority by a single party (e.g. university campus, hospital campus).

An “existing” network follows a similar definition to Building Regulations, i.e. a scheme that is either in operation or under construction, meaning any of: the building to house the energy centre has been constructed; there is a heat (or coolth) offtake agreement signed between the network and a third party; excavation for pipework has been completed.

Operational performance of the district networks

Operational emissions from district energy networks will need to be considered in the building’s emissions (i.e. overall carbon content of heat or coolth, in kgCO2 / kWh of supplied heat or coolth measured at the user interface). *We are seeking views on this, and whether to set a limit to the carbon content of heat - see consultation question.*

There would not be performance requirements on individual elements, such as distribution losses (other than what may be required in the future through other means e.g. the government’s upcoming Heat Networks Technical Assurance Scheme). This is consistent with the overall approach of the standard i.e. focusing on performance outcomes rather than individual design elements. *We are seeking views on this - see consultation question.*

Talking Points

32. Do you think there should be a limit on the carbon content of heat from district energy schemes?

- No: schemes should just report the carbon content of heat, and buildings would account for emissions as they would for on-site plant.
- Yes, there should be a limit, no worse than an on-site air source heat pump
- Yes, there should be a limit, no worse than a district scheme served by air source heat pump and with CP1 “Best Practice” distribution losses
- Yes, there should be a limit, but a different one than the options above: please specify what you think it should be

33. For the above, do you think the limit should be the same for new and existing schemes?

- Yes
- No
- Don’t know / not sure

34. Do you think there should be performance requirements on the district energy scheme, beyond carbon content of heat?

- Yes, as per CP1 “Best Practice”
- Yes, other - please specify
- No

District Heating & Cooling Networks

Fossil Fuels

Buildings connected to a **new** district heating or cooling scheme will only be able to certify if the scheme is fossil fuel free.

Buildings connected to an **existing** district heating or cooling scheme using fossil fuels may be able to certify, ***if*** :

- The scheme has a decarbonisation plan in place, and
- There is a limit to the contribution from fossil fuels.

We are seeking views on this approach - see consultation question.

The scheme's **decarbonisation plan** should include :

- Future plant, distribution efficiencies, operating temperatures, storage plant requirements etc, and associated design implications.
- Calculations for the resulting carbon content of heat, showing that the network will then meet the limit carbon content of heat
- Commitment by the network or the building to cover renewable energy and offset requirements.
- Incorporation in the network's business model (including how capitals will be made available, future revenue streams, impacts on energy bills and other implications for energy consumers).
- Commitment to implementation.
- Timeline for implementation. At this stage, a deadline of 2030 is being considered i.e. no reliance on fossil fuels after 2030, but this will be reviewed as part of the balancing of carbon budgets.

Talking Points

35. Do you agree that buildings connected to an existing district network using fossil fuels could qualify as Net Zero, if the network has a decarbonisation plan compatible with UK Net Zero and there is a limit on fossil fuel contribution (you can comment on the detail of these conditions in the next questions) **?**

- No, if networks burn fossil fuels then buildings connected to them should not Scotland. We qualify as Net Zero.
- Yes, but only if connection to a network is a legal / planning requirement
- Yes, as proposed i.e. with decarbonisation plan and limit on fossil fuel contribution
- Yes, but only requiring a decarbonisation plan
- Yes, but only requiring a limit to fossil fuel contribution
- Yes, but with different conditions - please specify
- Don't know / Unsure

36. Do you have comments on the proposed decarbonisation plan conditions?

37. What should be the limit to fossil fuel contribution to the district scheme?

- No specific limit: this should simply be covered by the overall limit to carbon content of heat, as for all networks whether or not they use fossil fuels
- A limit on the proportion of heat (%) produced from fossil fuels, compared to the total heat produced by the network - if so, please specify that limit (%)
- Other - please specify.

District Heating & Cooling Networks

Energy-from-Waste

We are seeking views on how to approach Energy-from-Waste schemes (i.e. the burning of waste, where heat is used to feed into a network) - see consultation question.

Biomass

We are seeking views on how to approach networks burning biomass - see consultation question.

Energy sharing, and energy from waste heat

The carbon impacts will be allocated following standard accounting rules, to avoid double counting e.g. in the case of a district scheme utilising heat rejected by a datacentre or supermarket cooling plant:

- the energy use and associated emissions by the datacentre supermarket's cooling plant are allocated to the supermarket .
- That rejected heat is counted as "zero emissions" energy source by the district energy scheme - but energy use and associated emissions to utilise that heat (i.e. in a heat pump, in distribution etc) is allocated to the district scheme.

Talking Points

38. How do you think that heat networks that recover energy from waste should be treated from an energy and carbon perspective?

- They should be treated as networks using fossil fuels *(rationale: there is a lot of plastic, i.e. fossil fuel based materials, in the waste being burnt)*
- Their carbon content of heat should be accounted for, as for all networks, but they should not be treated as fossil fuel networks *(rationale: they make use of waste which may otherwise end in landfill or other detrimental routes).*
- Don't know / not sure

39. How do you think that heat networks that burn biomass should be treated from an energy and carbon perspective? Tick all that apply

- Their carbon content of heat should be accounted for, as for all networks
- There should be criteria on sustainable sourcing of the biomass fuel
- There should be criteria on air quality emissions
- Other - please specify
- Don't know / not sure

District Heating & Cooling Networks

Performance of buildings connected to district networks

Buildings connected to a district heating or cooling network will be subject to the same energy performance limits as buildings with on-site systems, accounting for all energy uses in generation, distribution and storage (as for buildings with on-site systems).

There are precedents for this accounting of the network's energy use within a building's energy performance limit, for example in NABERS and in options being explored by some local authorities.

This could be done by a simple apportionment of the network's energy use to each user on the basis of the heat delivered annually to that user, or in more sophisticated ways for example to account separately for secondary and primary losses, using metering at heat sub-stations.

An alternative would be to apply adjusted energy performance limits to the buildings (i.e. electrical uses + thermal energy demand), alongside a carbon content of heat requirement applying to the network. This is not the preferred option at this stage, as it is considered this would not be sufficient to encourage energy efficient networks.

The team developing the Standard will liaise with BEIS and the Department for Energy Security and Net Zero (DESNZ) on this issue, and particularly the Heat Network Technical Assurance Scheme, to provide guidance on compatibility of performance and reporting requirements.

Talking Points

40. Do you agree with this approach to energy performance limits?

- Yes, energy performance limits for buildings should be the same as with on-site systems, including energy used by the network
- No, the limits should be adjusted to stop "at the heat meter" (with separate requirements on the performance of the network)
- No, another approach should be taken - please specify
- Don't know / not sure

41. Do you have further comments, for example on how you think that network energy use should be apportioned across users (e.g. how metering arrangements could work, whether to apportion to something else than annual kWh, such as kWp or floor area)?

District Heating & Cooling Networks

Embodied carbon impacts of the network

The embodied carbon related to creating the district heating and cooling network will need to be reported as part of Standard.

However, it hasn't yet been concluded as to the format of this. The working assumption is that the approach of the Standard will align with the approach outlined in the consultation version of the updated RICS Professional Statement on Whole Life Carbon Assessments in the Built Environment whereby the embodied carbon of the district network is included in B6, with and embodied carbon factor/ kWh of heat.

Talking Points

42. Do you have an opinion on how district heating and cooling networks should be treated from an embodied carbon perspective?

- Yes, I think the Standard should follow whatever is agreed in the updated RICS PS
- Yes, but I think something else - Please specify
- No
- Don’t know / Unsure

4. Carbon Accounting

UK Net Zero Carbon
Buildings Standard

Carbon Accounting

The following building related carbon emissions must be measured and reported:

Post Construction

applies to new construction and retrofit - **one off** measurement.

- **Embodied upfront carbon** - carbon emissions calculated from bills of quantities and LCA tools
- **Embodied life cycle carbon** - This includes upfront, in use and end of life carbon with operational energy use based on energy predictions. These embodied calculations take account of decarbonisation of the grid and construction products

Talking Points

43. Do you agree with the approach to carbon accounting?

Do you have any comments on the proposed approach?

In use

applies to all buildings - annual measurement.

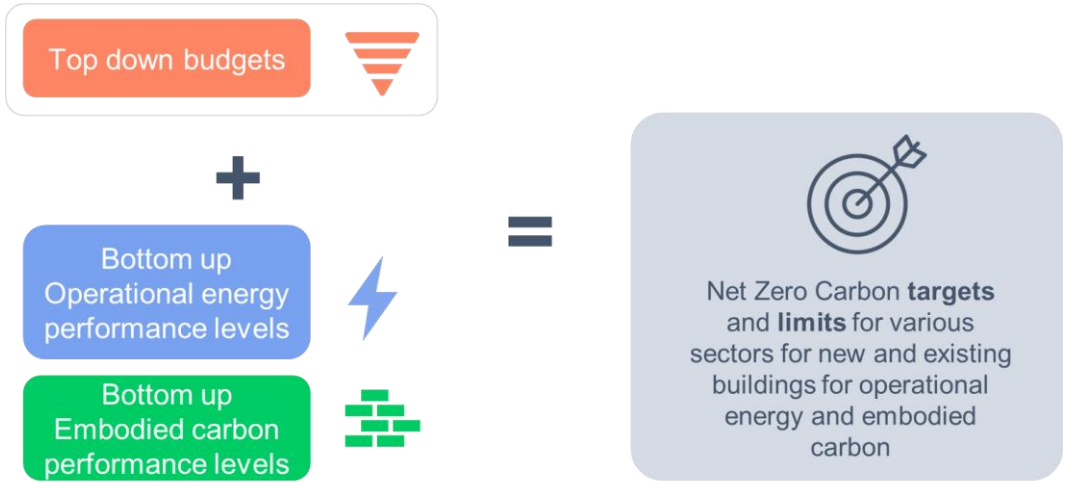
- **Operational energy** - calculated from measured consumption data and calculated using the most recent UK Government conversion factors for the relevant fuels for annual data
  - For electricity, where time of use metering data is available, national time of use emission factors may be used instead of annual factors
  - For district heating and cooling and cogeneration, system specific carbon emission factors should be used
- **Operational water** - calculated from measured consumption data and calculated using the most recent UK Government conversion factors for the relevant fuels for annual data.
- **Operational refrigerants** - calculated from refrigerant leakage and refrigerant GWP (global warming potential)
- **In-use embodied carbon** - This does not cover legacy embodied carbon, but is limited to reportable carbon impacts from in-use works and maintenance e.g., fit out, HVAC system replacement carbon emissions calculated from bills of quantities and LCA tools

5. Bottom Up Performance Levels

Bottom Up Performance Levels

Overview

The bottom-up workstream has been working over the last six months to use benchmarking, case studies and modelling to create Performance Levels that provide the context of technical feasibility for the various sectors. The next phase of work over the summer of 2023 will be for the top-down workstream to establish the relevant national carbon 'budgets' which show what the industry needs to achieve to play its part in a net zero carbon UK. The outputs from these workstreams will then be combined to create relevant limits and targets for the Standard.



The performance levels represent what can be achieved at the individual building level. **They do not represent the final NZCBS limits**, since these limits will be determined as part of the process of Bottom Up & Top Down analysis, to represent what is required to meet the UK's carbon budgets as well as what is expected to be achievable, taking account of:

- How much zero carbon energy is expected to be available
- How efforts are shared across sectors
- How efforts are shared between buildings in a sector e.g. to represent different types and levels of constraints on some buildings.

The performance levels are one part of the process for defining the net zero limits.

What the Performance Levels represent

Operational Energy

The operational energy performance levels result from the assessment of what can be achieved at the asset level in individual sectors and sub-sectors, based on benchmarking of the existing stock (median and best practice), metered data from case studies, and energy performance modelling. Two types of performance levels have been developed:

- Best Practice Today
- Future Exemplar.

The purpose of these 2 levels is to assist the balancing of carbon budgets: depending on how much effort is required across sectors to meet UK-wide carbon budgets, the Net Zero limits will be set more closely towards Best Practice Today or, if more efforts are required, towards Future Exemplar.

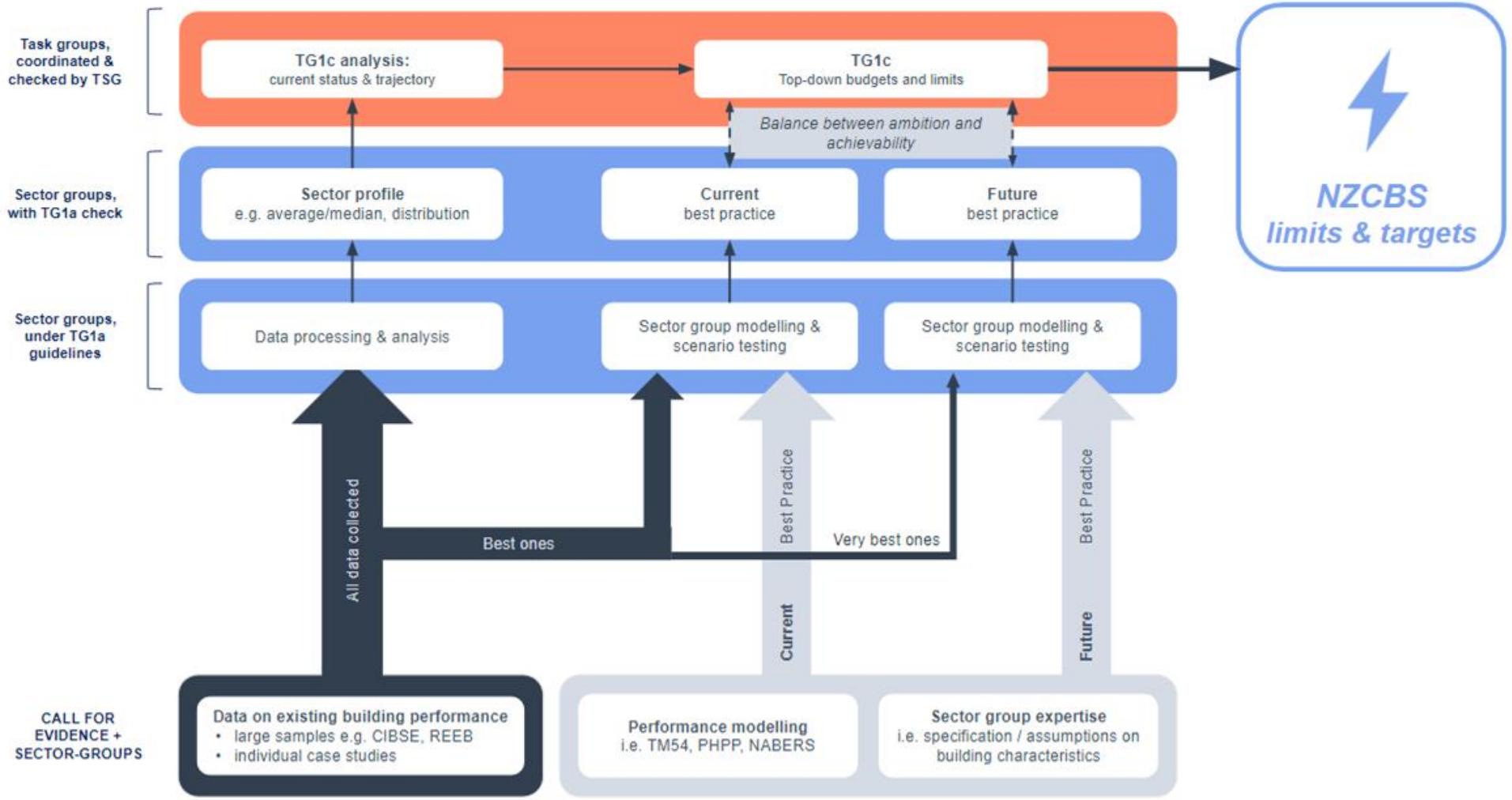
Embodied Carbon

For the embodied carbon performance levels, we are assuming that the data submitted lies somewhere between mean performance and current best practice, as embodied carbon calculations have historically only been undertaken on projects with strong sustainability agendas. We have also not yet differentiated between best practice and future exemplars, the latter of which is based largely on material decarbonisation and can only be driven a little by today's design decisions.

For that reason, embodied carbon performance levels are articulated solely in terms of the range of data received today - percentiles and median/mean values.

Creation of the Performance Levels

We have completed this step for new buildings



6. New Build Embodied Carbon Performance Levels

New Build Embodied Carbon Performance Levels

Contents

New Build Embodied Carbon Performance Levels

Executive summary

The embodied carbon of nearly 500 UK-based new-build projects has been analysed for the Standard, to understand what levels of performance are currently achieved on our projects. This section of the report explains what data was received, how it was interpreted, and what performance levels were derived from it.

It should be noted that there was a lack of usable data in four sectors (retail, data centres, hotels and sports & leisure), and most sectors did not provide sufficient life-cycle embodied carbon data to allow analysis for modules A-C. This section therefore focuses on upfront embodied carbon (modules A1-A5) for the nine remaining sectors only.

We also comment on the next stages of work for embodied carbon: predicting future possible performance levels, and setting limits for new-build and retrofit projects.

The consultation questions for this section of the report focus on whether the consultees support the approaches taken to analysing data so far, and whether there is support for the proposed approaches to be taken as next steps.

New Build Data Collection and Analysis Processes

New Build Embodied Carbon Data Collection

Data format

Embodied carbon data was collected from several sources, including the beta version of the Built Environment Carbon Database (BECD). Project data was also submitted using the LETI proforma, and OneClick downloads.

Multi-project datasets were submitted by the Greater London Authority, Future Homes Hub, and both Price & Myers and Smith & Wallwork shared their in-house structural embodied carbon datasets.

Scope (modules)

All building lifecycle modules could be submitted, across modules A-C and D. Sequestered biogenic carbon could be reported, but was to be reported separately to the fossil emissions modules.

Scope (elements)

Using the element categories provided by the RICS Professional Statement on WLCA in the Built Environment, most submissions concentrated on elements 1 through 5, meaning that facilitating works and external works were omitted from submission.

This means that the Standard team focussed on the analysis of the data submitted for:

- Substructure (1)
- Superstructure (2.1-2.4)
- Facade (2.5-2.6)
- Cat A fitout (2.7-3)
- FF&E (4)
- Building services/MEP (5)

Very few datasets included all six elements shown on this page; many were structure-only (1-2.4).

For office submissions, it was assumed that all data provided was Shell & Core plus Cat A only, unless specified otherwise in the submission. This means that no embodied carbon allowances have been made for tenant installations and modifications.

We note that the forthcoming updates to the RICS Professional Statement increases the scope as to minimum reporting requirements, as referred in the RICS Professional Statement v2.

New Build Embodied Carbon Data Analysis

The primary role of the embodied carbon Task Group was to consolidate the various data sources, and ensure that they were comparable in scope to one another.

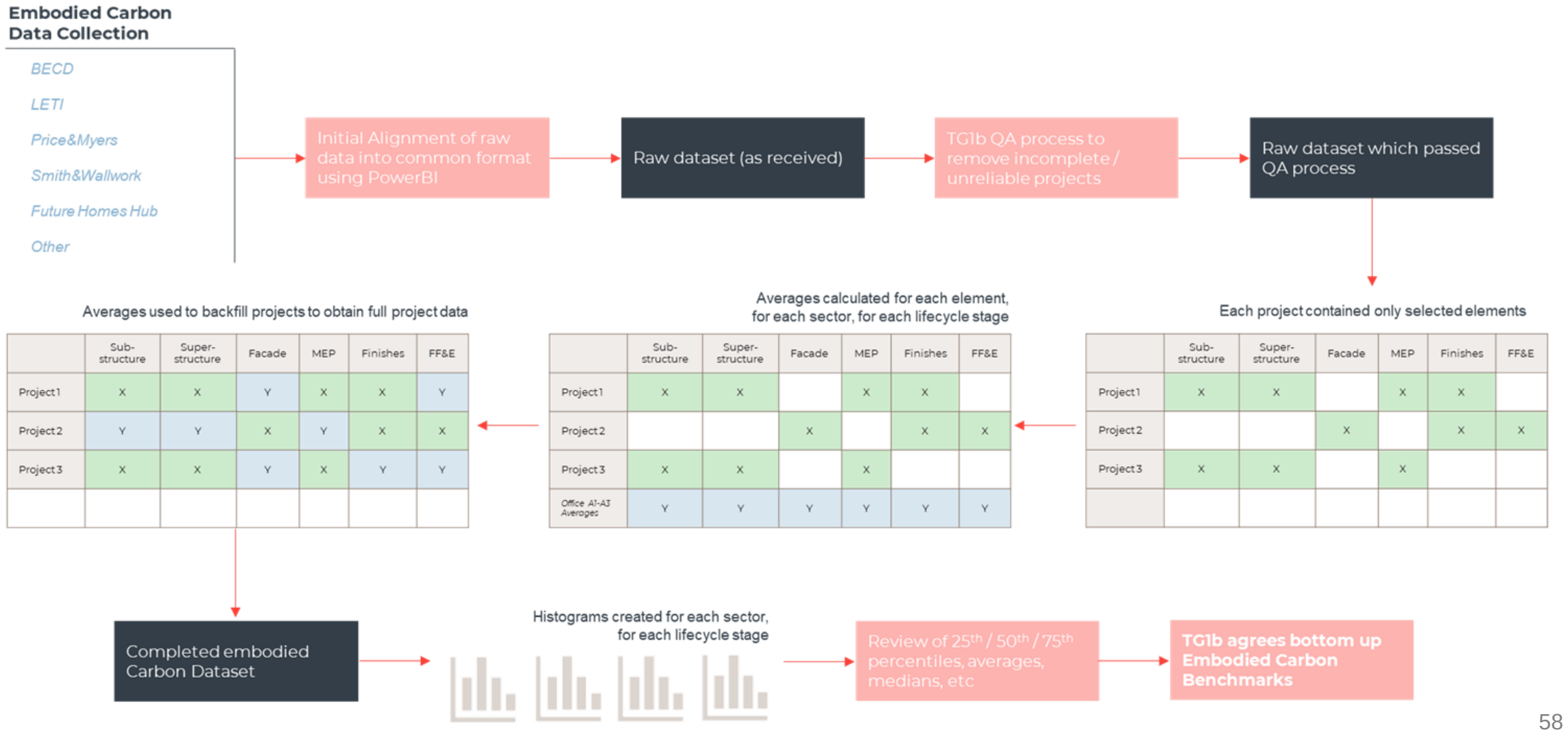
We removed data that was largely incomplete or appeared to be too high or low, and imported the remainder into PowerBI to allow the various sources of data to be compared alongside each other.

As most data submitted was only for some elements (e.g. structural-only, with no data for facades, MEP etc.), we backfilled the gaps using average values from where elements did have data submitted.

This ‘notionally complete’ dataset was then used to create embodied carbon histograms for different sectors, and derive percentiles.

This process is shown overleaf.

New Build Data Collection and Analysis Flowchart



6. Embodied Carbon Performance Levels

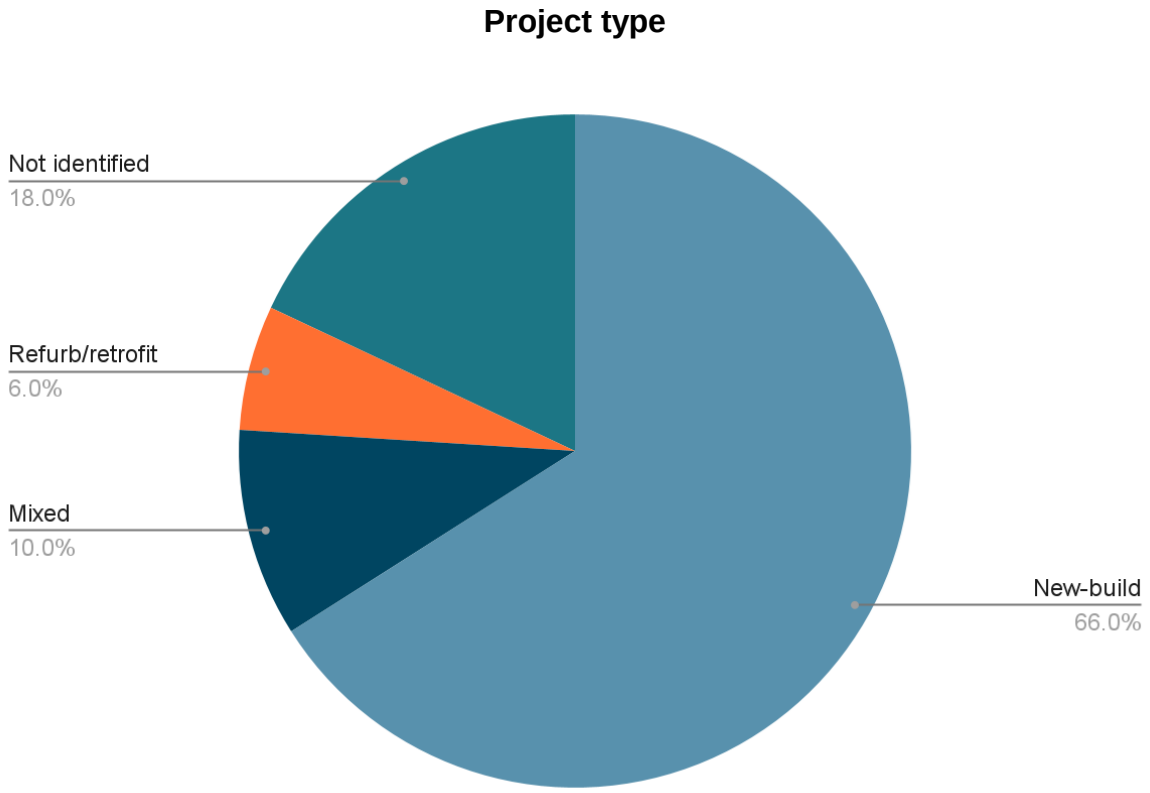
Overview of Submitted Data

Types of Project Submitted

The majority of projects submitted to the call for evidence were new-build, with only 16% containing elements of refurbishment or retrofit.

The work leading up to this consultation document has focussed on interpreting the new-build data only.

The proposed approach to setting retrofit limits (during the next stage of works) is outlined on page 28.



New Build Data Overview and Quality

The table overleaf shows the total extent of data within each sector, and level of scope covered.

Number of datapoints

Four sectors (retail, data centres, hotels, and sports & leisure) had insufficient data across all elements, and so the performance levels of those sectors is not currently understood. It will not be possible to set limits for these sectors without additional data.

The number of data points in the other nine sectors vary from 10 to 238 projects.

Project sizes

The average GIA for each sector is also shown in the table, ranging from less than 1000m^2 (healthcare and culture & entertainment), to more than 100,000m^2 (offices, commercial residential, logistics & warehouses).

It is noted that whilst the homes sector averages 5,900m^2, the majority of the data is from multi-family buildings. The single-family home data submitted by Future Homes Hub will be considered separately when setting limits for this subsector.

Scope of submissions

Many sectors only submitted enough data to understand the performance levels of the sub- and superstructure for that sector.

Most sectors also only submitted sufficient data for upfront embodied carbon (modules A1-A5), meaning that the life cycle embodied carbon performance levels are not understood.

This means that it will only be possible for the standard to set limits on upfront embodied carbon (modules A1-A5) for the nine sectors.

The Standard still intends that life cycle embodied carbon (modules A-C) data will be required to be reported, and the aim is to set limits on this in future versions of the Standard.

Backfilling data

Where projects had no data shared for non-structural elements, this is shown as ND overleaf. Here, the A1-A5 average figures from other sectors were backfilled into the gap, using the *Office* sector figures for the Facade elements, and *Commercial Residential* for all other elements.

New Build Data Overview and Quality

Sector		Offices	Homes*	Commercial residential	Logistics & warehouses	Healthcare	Schools	Higher education	Culture & entertainment	Science & technology	Retail	Data centres	Sports & leisure	Hotels
Number of projects		72	238*	78	20	10	94	10	33	16	1	1	3	0
Mean GIA of projects (m^2)		105,000	5,900*	186,000	159,000	500	2,900	12,300	900	48,000	N/A	N/A	N/A	N/A
Quality of upfront embodied carbon data (A1-A5)	**Substructure (1)**	Good	Good, but not split by element	Good	Good	Good	Good	Good, but not split by element	Good, but not split by element	Good	N/A	N/A	N/A	N/A
	Superstructure (2.1-2.4)	Good		Good	Good	Good	Good			Good	N/A	N/A	N/A	N/A
	Facade (2.5-2.6)	Good		Good	Good	ND	Good	ND	ND	ND	N/A	N/A	N/A	N/A
	Cat A fitout (2.7-3)	Good		Good	Good	ND	ND	ND	ND	ND	N/A	N/A	N/A	N/A
	FF&E (4)	Good		Good	Good	ND	ND	ND	ND	ND	N/A	N/A	N/A	N/A
	MEP (5)	Good		Good	Good	ND	Only 2 projects	ND	ND	ND	N/A	N/A	N/A	N/A
Quality of in-use embodied carbon data (B1-C4)		Poor quality	Poor quality	Good	Good	ND	Poor quality	ND	ND	ND	N/A	N/A	N/A	N/A

ND = no data. For A1-A5 elements, this was then backfilled with average figures (facade taken from *Offices* sector, all other elements from the *Commercial Residential* sector)
*note: 31 projects were Future Homes Hub submissions, analysing single-family homes. This sub-sector will be considered separately when setting limits.

New Build Data Overview and Quality

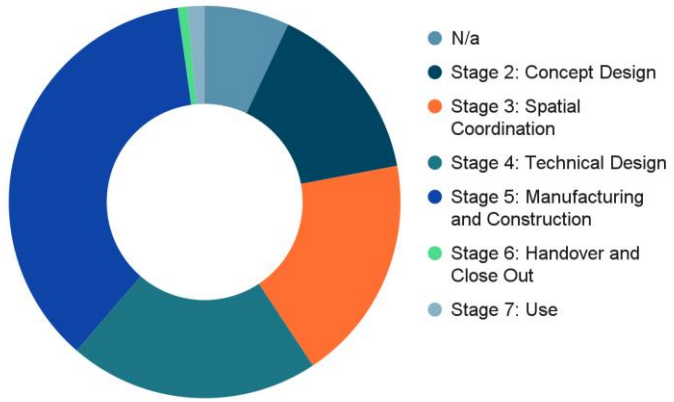
Most data submitted was for projects that were at least into RIBA Stage 4, and nearly 40% of projects were at least into Stage 5.

Over three-quarters of the embodied carbon data submitted was structures-only, in part due to the large amount of data that came from two structural consultancies, Price and Myers, and Smith and Wallwork.

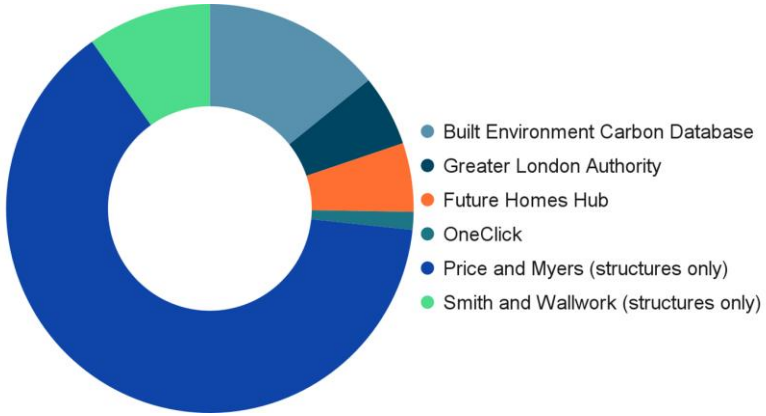
Where data submitted was not split up by element (e.g. where sub and superstructure had been combined) we disaggregated the data based on the percentage split taken from the whole dataset.

Most MEP data was not calculated using CIBSE TM65, and so separate modelling will be run later this year to understand whether a higher carbon intensity should be shown.

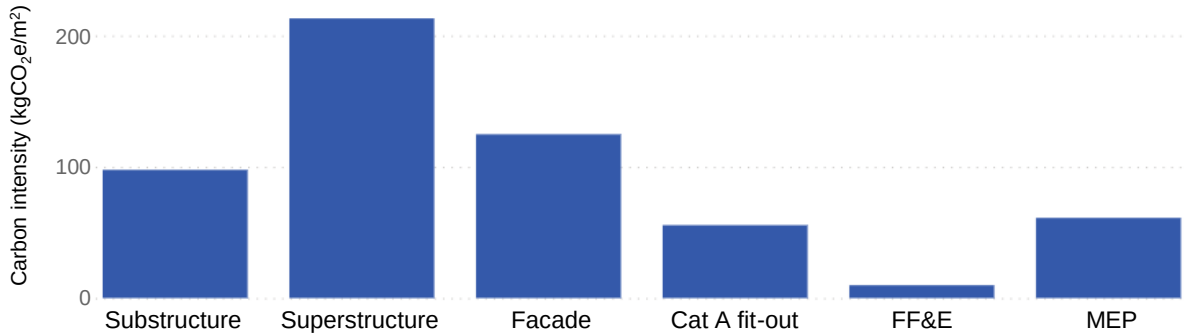
RIBA stages



Data sources



Average embodied carbon intensity per element, all buildings



New Build Data Distribution

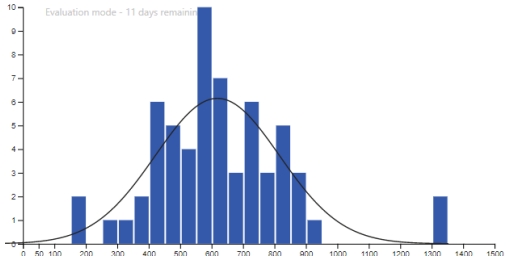
These histograms shown across these two pages demonstrate the range of data submitted for each sector.

Note that very high and very low datapoints were removed as part of the embodied carbon data analysis process.

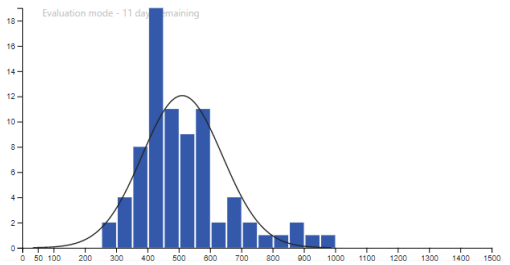
The x-axes on these graphs show upfront embodied carbon intensity ($kgCO_2e/m^2$) and are normalised to allow comparison of the distribution of carbon intensity between sectors.

The y-axes give the number of projects in each band, and are different on each graph as the number of projects submitted for each sector varies.

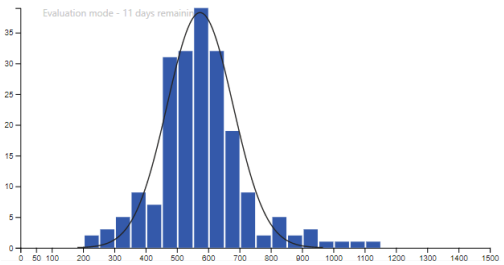
Offices



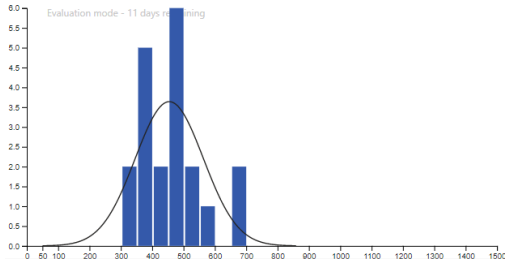
Commercial residential



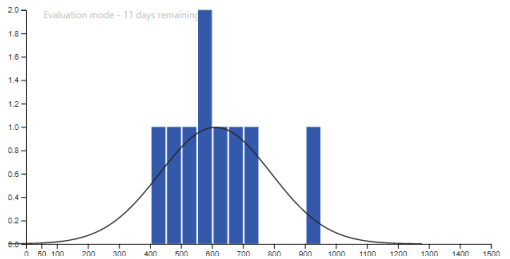
Homes



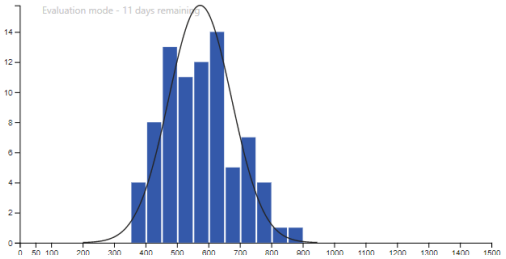
Logistics & warehouses



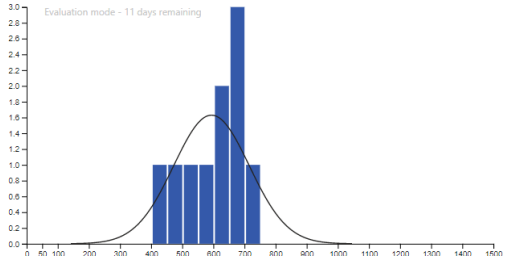
Healthcare



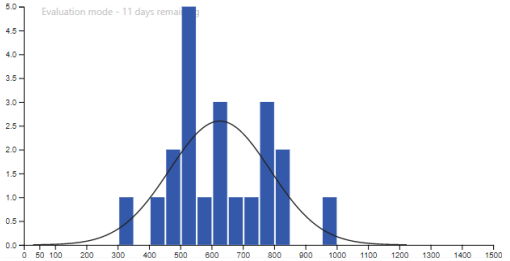
Schools



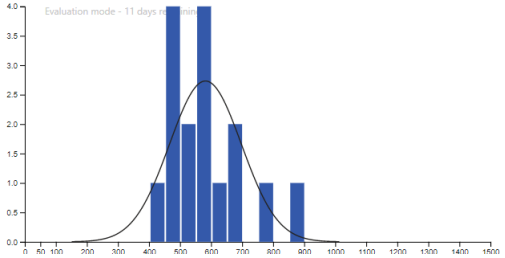
Higher education



Culture & Entertainment



Science & technology



New Build Embodied Carbon Data Gathering and Interpretation

Talking Points

44. What is your general opinion about the quality of data received?

- Highly unsatisfactory.
- Unsatisfactory.
- Neutral.
- Satisfactory.
- Highly satisfactory.

45. 75% of the data collected was structures-only. What is your opinion of this?

- I have no problem with this at all - the structure is the most impactful element for embodied carbon.
- I'm neutral about this situation.
- I would like to see more non-structural data gathered but it won't affect my support for the Standard.
- I won't be able to advocate for the Standard's use without more non-structural data being gathered.

46. Where we had incomplete projects (e.g. structure-only), we backfilled the gaps using average data from other projects in different sectors. What is your opinion of this?

- I have no problem with this approach.
- I'm neutral about this situation.
- I would like to see a different approach followed (explain your approach below under 'any other comments') but it won't affect my support for the Standard.
- I won't be able to advocate for the Standard's use without a different approach (explain your approach below under 'any other comments') being followed for this.

47. Do you have any other comments regarding data gathering and interpretation process?

Analysis Output: Performance Levels

New Build Embodied Carbon Performance Levels

Derived levels of performance

The table overleaf outlines the levels of performance demonstrated by the final 571 new-build projects that passed the QA process undertaken in early 2023.

The performance levels only cover upfront embodied carbon (modules A1-A5), due to the extent of data submitted only covering this.

A range of levels is shown, showing the 25th, 50th and 75th percentiles, along with the mean value of each sector.

This information will be used to inform the embodied carbon limits that will be set during the next stage of the works.

These are not limits

Note that the performance levels shown here do not represent the limits and targets for the Standard - just the findings of the evidence gathering exercise to understand embodied carbon performance of buildings today.

It is important to note that whilst a range of values are shown, the limits may not sit within this range.

We also acknowledge that the projects shown here are probably lower embodied carbon than 'business as usual', and this will be reflected when final limits are set.

New Build Embodied Carbon Performance Levels

Sector	All	Offices	Homes*	Commercial residential	Logistics / warehouses	Healthcare	Schools	Higher education	Culture and entertainment	Science and technology
Number of projects	***499***	*61*	*204*	*78*	*20*	*9*	*80*	*10*	*21*	*16*
Min	**179**	179	226	295	332	409	353	409	335	446
25th %ile	**468**	481	493	419	371	512	480	520	517	491
50th %ile (median)	**561**	592	566	464	460	589	579	616	600	569
Mean	**568**	618	574*	511	455	611	574	594	627	582
75th %ile	**639**	732	632	580	491	687	633	674	760	642
Max	**1344**	1344	1101	972	652	927	865	739	965	866

All figures shown are A1-A5 emissions, $kgCO_2e/m^2$
All numbers rounded to nearest 10kg.
*It is noted that the Future Homes Hub Implementation plan study gave a figure of 425 $kgCO_2e/m^2$ for single-family homes, which will be accounted for when setting limits
Data centres, sports & leisure, hotels, and retail sectors currently have insufficient data and so are not included here

Comparison with Existing Targets

This table outlines some of the carbon targets set by industry already, demonstrating that most of the performance levels shown in the previous table fall within expected ranges.

These numbers are only shown for information and do not necessarily reflect the limits that will be set in the Standard.

Sector	All	Offices	Homes	Commercial residential	Logistics / warehouses	Healthcare	Schools	Higher education	Culture and entertainment	Science and technology
LETI band A[1]	-	375	300	-	-	-	300	-	-	-
LETI band C[1]	-	600	500	-	-	-	500	-	-	-
GLA aspirational target[2]	-	600	500	-	-	-	500	-	-	-
GLA benchmark figures[2]	-	950	850	-	-	-	750	-	-	-
SBTi 2025 targets based on global emissions and GIA[3]	-	600	410	-	-	-	-	-	-	-

A1-A5 emissions, $kgCO_2e/m^2$
All numbers rounded to nearest 10kg.

[1] LETI, https://www.leti.uk/_files/ugd/252d09_25fc266f7fe44a24b55cce95a92a3878.pdf
[2] Greater London Authority, Appendix 2 of https://www.london.gov.uk/sites/default/files/lpg_-_wlca_guidance.pdf
[3] Science Based Targets initiative, Table 6.1 of https://sciencebasedtargets.org/resources/files/DRAFT_SBTi_Embodied-carbon-pathway-development-description.pdf

New Build Embodied Carbon Performance Levels

Talking Points

48. Do you think that the performance levels shown are in the right order of magnitude?

- Far too low
- A bit low
- About right
- A bit high
- Far too high

Do you have any comments on the performance levels shown for specific sectors? Please provide evidence to support any arguments of too high/low you might make.

49. Are you able to share data to support your comments?
If so, please share the data via the BECD (https://beta.becd.co.uk/) and write your Assessment ID, or IDs, (e.g.: *f024ff69-0ff6-4f8b-849a- 08daacf690a1*, found in the top-left corner of the embodied carbon page) in the text-box below:

Future Decarbonisation Predictions

Future Decarbonisation Predictions

To help inform the embodied carbon limits for future years, we must first predict the possible future levels of performance, based on today's levels but modified for our decarbonisation predictions. To do this, we researched the rates at which different sectors could reasonably be forecast to reduce their embodied carbon intensity by considering four main aspects:

Material decarbonisation
This is the forecast decarbonisation of materials used in the built environment. Figure 30 of the UKGBC "Net Zero Whole Life Carbon Roadmap" (2021) gives trajectories for each material. We researched whether any more recent reports or data would supersede this roadmap, including speaking to its original authors, and the only change accounted for is the 2023 Timber Development UK net zero roadmap.

Material consumption patterns
The sector groups were asked to advise as to which materials were used the most in their sectors, to feed into the next two aspects, efficiency gains and material selection. Steel and concrete were highlighted as the main sources of embodied carbon emissions in every sector.

Material efficiency gains
The sector groups were asked to advise as to how much more efficiently they thought that materials could be used in the design of their buildings. Very little quantitative data was found to exist on this, though in general most sectors expected that a 10-20% improvement was possible today. The UKGCB roadmap predicted an improvement of around 20% by 2050 compared to 2018 levels, but predicted a linear change between now and then.

Material selection
Finally, the sector groups advised on material selection, prioritising the use of the lowest carbon material for each building. Many sectors cited timber as an alternative to steel or concrete for small/medium sized projects including housing. Natural and/or reclaimed materials were highlighted as usable for structure, insulation and finishes. Lower-carbon concrete mixes were commonly seen as an option too. This use of lowest-carbon materials, where safe to do so and meeting the functional requirements of the building regulations, will be considered when setting limits during the next stage of work.

The information gathered from these four areas will be used to inform our predictions for the future decarbonisation of each sector, and the expected future performance levels.

From material efficiency gains and swapping, we assume that a 10% improvement over business as usual embodied carbon is possible today, and that this will increase to 20% by 2030. Material decarbonisation benefits will follow on top of this.

Future Decarbonisation Predictions

Talking Points

50. Our understanding of possible future performance levels across the sectors will be informed by the UKGBC Whole Life Roadmap for the Built Environment (2021), specifically the work done to understand predicted material decarbonisation. Do you agree with this approach?

51. Predicted material efficiency increases will also be used to inform limit setting. In your opinion, what percentage reduction in upfront embodied carbon (A1-A5) is possible TODAY purely from more efficient use of materials?

- no room for improvement
- at least 10% better
- at least 20% better
- at least 30% better
- at least 40% better
- at least 50% better

51. Predicted material efficiency increases will also be used to inform limit setting. In your opinion, what percentage reduction in upfront embodied carbon (A1-A5) will be possible BY 2030 purely from more efficient use of materials?

- no room for improvement
- at least 10% better
- at least 20% better
- at least 30% better
- at least 40% better
- at least 50% better

Further Embodied Carbon Considerations

RICS Professional Statement v2

The RICS Professional Statement (PS) on Whole Life Carbon Assessment for the Built Environment is in the process of being updated this year, to bring more consistency to the industry's approach to carbon accounting.

The following key changes will need to be considered as possible modifiers to the shown performance levels, in order to set embodied carbon limits aligned with the updated PS:

- The introduction of new life-cycle stages some of which are mandatory to report (e.g. A5.1, demolition).
- The need for all elements listed in the cost plan to also be included within the carbon assessment.
- Carbon offsets for materials must be excluded (e.g. "net zero carbon" building products must be reported without their offsets accounted for).
- Transport emissions to include return trips, calculated using DEFRA factors.
- Percentages of cement replacement and scrap steel must follow default figures until products are known.
- Upfront carbon should not include biogenic carbon (could be reported separately) but land use and land use change (LULUC) emissions must be reported.
- Biogenic carbon can only be claimed for sustainably sourced materials.

There are further related changes which will not affect the limit-setting process, but may need to be taken into account depending on how the development of the Standard progresses. These include:

- Grid decarbonisation to be reflected in modules B-C emissions. This will become relevant once sufficient data has been obtained for module B-C and limits are being set for the life-cycle embodied carbon emissions (A-C) of projects.
- Infrastructure emissions to be reported. This will become relevant if future revisions of the standard set limits on the infrastructure related to a building's construction.

Beyond new-build & whole buildings

Later in 2023, the embodied carbon performance levels shown in this document will be used to inform embodied carbon limits for new building projects.

Beyond this, we have also been considering the implications of setting embodied carbon limits for other aspects, including:

Retrofit

A new methodology has been devised for the approach to setting embodied carbon limits on retrofit projects. Refer to page 28.

Renewables

Renewable electricity generation needs to be encouraged in order to support grid decarbonisation, however this cannot come at the expense of excessive embodied carbon emissions. Refer to page 37.

Refit

We are considering developing targets for refit (repeated fit-out) works of office, retail and hotel buildings, due to the high cumulative embodied carbon impact of these refits. Refer to page 30.

Refrigerants

Poorly managed refrigerant-based systems can produce greater emissions than gas-based systems, and so limits on the embodied carbon due to refrigerant leakage will be set. Refer to page 40.

Next Steps and Call for Further Data

Next Steps

Embodied Carbon performance levels

Please do complete the technical testing **consultation** giving feedback on the embodied carbon performance levels.

If you feel that the performance levels shown are too high/low due to your experience, we would encourage you to share the data from your own projects (see below).

Embodied carbon further data

The NZCBS is also currently actively seeking further Embodied Carbon data, particularly:

- for the **Retail**, **Data Centre, Hotels, and Sports and Leisure** sectors
- for projects with high-quality data for **Modules A-C.**
- where the assessment has been completed for **all elements**, not only structure.

Higher education, Healthcare, and Science and Technology sectors were also relatively low in data and more would be welcomed.

This data should be uploaded to the **BECD** at https://beta.becd.co.uk.

Refit data

If you have **embodied carbon refit data** from UK-based projects in either the **Office**, **Retail** or **Hotel** sectors, please get in touch by emailing TG1b@NZCbuildings.co.uk.

580

$kgCO_2e/m^2$ GIA A1-A5 mean carbon footprint across all sectors

499

Total number of projects used to determine new-build performance levels

56%

Proportion of A1-A5 emissions due to structure

"A huge thank you to all those companies that have submitted embodied carbon data to develop our understanding of embodied carbon emissions in the UK.

Will Arnold,
Chair of Embodied Carbon Task Group

7. New Build Operational Energy Performance Levels

UK Net Zero Carbon Buildings Standard

New Build Operational Energy Performance Levels

Contents

New Build Operational Energy Performance Levels Principles and Development Process

Operational energy performance levels for **new buildings** have been developed by the Sector Groups using guidelines to ensure consistency in approach. The process was:

1. Understanding the sector

- **Determining which sub-sectors should have dedicated performance levels.** Sub-sectors are associated with genuinely different functions, not different servicing strategies (e.g. whether a building is air conditioned or not does not define a different sub-sector, as this would not necessarily encourage the best performance and design strategies).
- **Determining the core end uses** expected to be present in all buildings in that sub-sector, **and additional "special" energy uses*** e.g. in a hotel; bedrooms and general reception, circulation and back-of-house areas are core uses; but a restaurant or swimming pool are special end uses as they represent an additional function which may or may not be present in buildings in that sector. The special end uses would have an energy performance limit and therefore, if present in a building, would lead to an additional allowance.

2. Defining performance metrics for each sector and sub-sector All sectors include a metric for annual energy use. If the metric proposed is not Energy Use Intensity (EUI, in kWh/m^{2}GIA/yr) then an equivalent EUI is provided to allow comparison and balancing between sectors. In some sectors, additional metrics are also proposed e.g. related to thermal demand.

** Electric Vehicle charging is excluded in all*

3. Analysis of energy performance in the existing stock using benchmarks, large datasets, and references to initiatives such as NABERS, Passivhaus, LETI. This provides an understanding in each sector of current median and best practice energy use.

4. Identification of individual best practice projects with metered energy use, to refine the understanding of best practice energy use in the existing stock. This relied on the projects submitted through the Call for Evidence, and others identified separately.

5. Energy performance modelling (NOT compliance modelling) e.g. using CIBSE TM54, PHPP or Design for Performance. Where possible, modelling was done under a range of scenarios e.g. occupancy patterns, climate, geographical locations, to provide a level of confidence in the performance levels. Available modelling e.g. from LETI or Design for Performance, could be used instead of or to complement the work.

6. **Combining all the work into performance levels, taking account of the performance gap**. Two levels are considered: **Best practice today, and Future exemplar,** for projects really stretching performance both in terms of the project's ambition and through possible advancements in technology and practice. These 2 levels intend to provide a range to assist the development of NZC limits and targets, by balancing these with the top-down carbon budgets when available.

New Build Operational Energy Performance Levels: Development Process Steps

1 – Preparation

- Produce List of sub-sectors
- Produce List of “core” and “special” end uses

2 – Develop Sector-specific performance metrics

3 – Determine the sector profile of the existing stock

- Use Call for Evidence data, Sector Group expertise & additional resources
- Define the sector median & best practice zone

4 – Analyse projects from the Call for Evidence

- Integrate with sector profile, refine best practice
- Review and confirm metrics and special end uses
- Identify useful performance characteristics from these projects, if relevant

5 – Prepare the modelling

- Use Task Group 1A (Operational Energy) guidelines
- Identify resources
- Identify key assumptions
- Identify key performance inputs
- Liaise with other Sector Groups where relevant

6 – Determine the current best practice and future exemplar new build performance levels

- Determine Current best practice and Future exemplar modelling inputs
- Carry out modelling, including scenario testing
- Check consistency across the whole sector and whole building
- Carry out Quality Assurance at all steps
- Report the outcomes

New Build Operational Energy Performance Levels

Status of this Technical Update & Consultation issue

The following pages provide:

- An overview on proposals for all sectors
- For each of the 13 sectors, a summary of proposals. The 14th sector is Heritage – this group are not in charge of producing performance levels, instead they are developing guidance for all groups on how to address heritage buildings.

- The performance levels proposed here apply to new buildings only
- The performance levels are open for comments through this consultation.
- As noted earlier, they are NOT the limits which will be set by the Standard, as these will also be informed by the UK carbon budgets ("Top Down modelling") and balancing of efforts across all sectors.

The 13 sectors groups have been divided into three categories:

- Sectors with a reasonably high level of completeness and confidence on performance level
- Sectors with a medium level of completeness and confidence on performance levels
- Sectors at early stage of development for the performance levels.

Acronyms used in this section:

BP – Best practice

FE – Future exemplar

SG – Sector Group

Where annual energy use performance levels are proposed in a different metric than kWh/m^{2}GIA/yr, then an indicative equivalent EUI in kWh/m^{2}GIA/yr is also provided, for information. This does not apply at asset-level, but is provided at the sub-sector or sector level, to help comparisons.

Additional information is available for all sectors to explain how the information presented here was arrived at. This is provided as separate reports and is also open for comments as part of the consultation.

In the following tables, performance levels marked "tbc" indicate that either there is no value yet available, or the value shown is indicative only and still being developed.

New Build Operational Energy Performance Levels: Overview of Proposals

The following slides provide an overview of the development of performance levels in each sector, including benchmarking of the existing stock and comparison with existing in-use projects. Where performance levels are proposed, they are shown here as Energy Use Intensity (EUI) in kWh/m2GIA/yr for comparison purposes. Note that in some sectors, different metrics are proposed to be used at the asset level, and the EUI here is just indicative as sector-wide equivalent - see details on individual sector slides. Where a range is provided rather than a single value, this indicates the range between Future Exemplar and Best Practice Today (as explained in the background on development of performance levels: see page 81).

Sector	**Existing stock benchmarking**	**Proposed performance levels**			**In-use projects achieving Performance Levels?**
		Available ?		**Equivalent kWh/m^{2}GIA/yr ***	
Schools	Yes - for 2 out of 4 sub-sectors	Sectors with reasonably high level of completeness and confidence on performance levels, at least for some sub-sectors	Yes - for 2 out of 4 sub-sectors (Best Practice Today & Future Exemplar)	Primary schools: 30 - 38 Secondary: 43 - 58	Yes - for 2 out of 4 sub-sectors
Homes	Yes - for 4 sub-sectors		Yes - for 2 out of 4 sub-sectors (Best Practice Today)	Flats: 35 Detached houses: 40 tbc	Yes - for 2 out of 4 sub-sectors
Offices	Yes		Yes (Best Practice Today & Future Exemplar)	30-60 (EUI route; varying if following NABERS Rating route)	See details in Offices slides, depending on EUI and NABERS Rating route
Healthcare	Yes		Yes	Varying depending on space types provided	Not yet identified

New Build Operational Energy Performance Levels Overview

Sector	Existing stock benchmarking	Proposed performance levels			In-use projects achieving Performance Levels?
		Available ?		Equivalent kWh/m^{2}GIA/yr	
Datacentres	Yes, partial (median)	Sectors with medium level of completeness and confidence on performance levels: drafts available at least for some sub-sectors, but still being developed	Yes, in draft	tbc	Not yet identified
Higher Education	Yes		Being developed - draft provided on illustrative building	tbc	Tbc once performance levels are available
Science and Tech	Yes		Draft for one sub-sector	tbc	Tbc once performance levels are finalised
Logistics and Warehouses	Yes for some sub-sectors		Draft for two sub-sectors	tbc	Tbc once performance levels are available
Retail	Yes		Draft for three sub-sectors	tbc	Tbc once performance levels are available

New Build Operational Energy Performance Levels Overview

Sector	Existing stock benchmarking	Proposed performance levels			In-use projects achieving Performance Levels?
		Available ?		Equivalent kWh/m^{2}GIA/yr	
Hotels	Yes	Sectors with low level of completeness and confidence on performance levels: drafts not available, but proposals include sub-sectors, performance levels, and benchmarking of the existing stock	no	Not available yet	Tbc once performance levels are available
Sports & Leisure	Yes for 2 sub-sectors				
Commercial residential	Yes for 1 sub-sector				
Culture & Entertainment	Yes				

Sectors with a reasonably high level of completeness and confidence on performance levels

New Build Operational Energy Performance Levels

Typically, these are sectors where:

- performance levels are proposed for most or all of the sub-sectors, informed by modelling, in-use projects, analysis of industry benchmarks, and consideration of the performance gap.
- There are available industry references to compare the proposed performance levels with.

Schools – Performance Levels

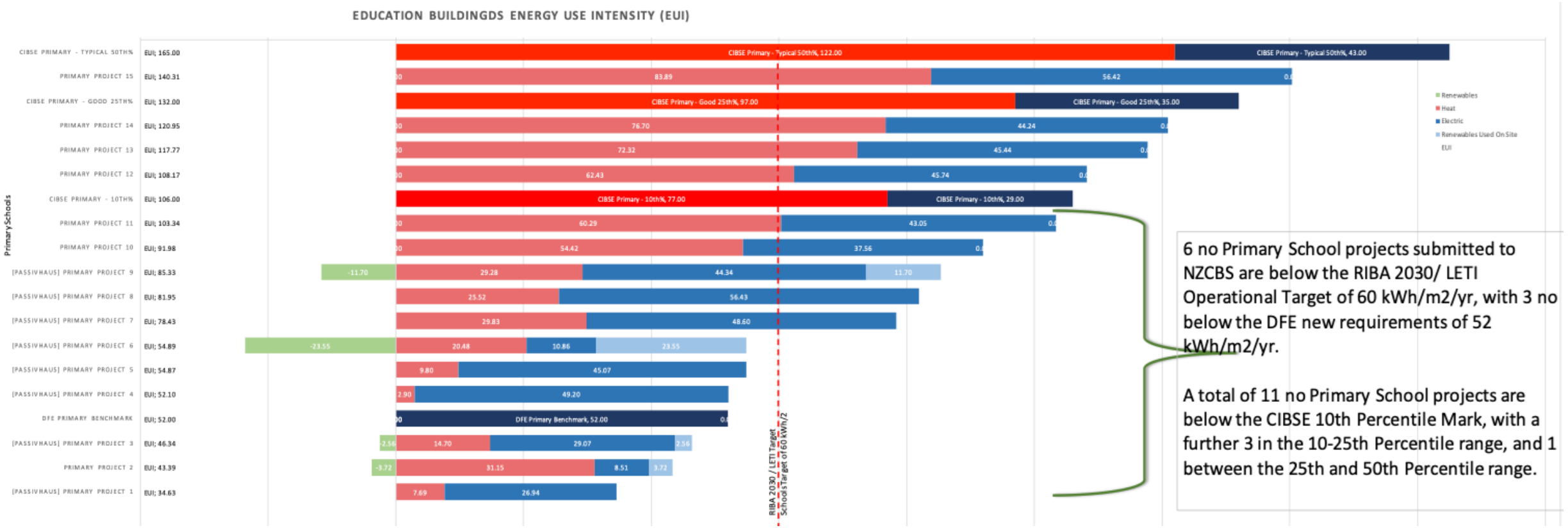
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)			
					Best Practice today		Future exemplar	
	Core	**Additional**	**Median**	**Best practice**	**Annual energy use**	**Space heating & cooling**	**Annual energy use**	**Space heating & cooling**
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	EUI, kWh/m^{2}GIA/yr	Peak demand (W/m^2)	EUI, kWh/m^{2}GIA/yr	Peak demand (W/m^2)
Early-years or pre-school	General functions plus curriculum delivery & support, incl. specialist curriculum spaces in secondary schools	Swimming pool Flood lights Large specialist uses e.g. CDT equipment, multiple kilns	tbc	tbc	tbc	-	tbc	tbc
Primary (incl. SEN)			122 (CIBSE 50th)	77 (CIBSE 10th)	38	15 (SH) 15 (SC)	30	12 (SH) 12 (SC)
Secondary (incl. SEN)			113 (CIBSE 50th)	66 (CIBSE 10th)	58	15 (SH) 15 (SC)	43	12 (SH) 12 (SC)
6th form			tbc	tbc	tbc	tbc	tbc	tbc

Schools – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: CIBSE, as used above	Targets and limits: • Primary: DfE (52) and LETI (65) and RIBA Challenge (60) • Secondary: DfE (67), LETI (65) and RIBA Challenge (60) • Primary and secondary: Scottish Futures Trust: expectation to be below 100kWh/m2/yr	
Existing buildings meeting PL?			Yes – see approach described below	Yes, but fewer than meeting the Best Practice today – see approach described below
Modelling			No dedicated modelling: the proposed performance levels are based on the analysis of in-use projects (modified to convert the fossil fuel gas elements into electric ASHP). The Best Practice Today levels are based on the average of the top 5 schools (i.e. approximately half of the data points submitted below the CIBSE 10th Percentile 11no Primary & 9no Secondary) .	No dedicated modelling. The same process was used as for Best Practice Today, based on in-use operational data of existing buildings, but assuming technological performance would improve over time: • Primary: performance was clustered closely. The second highest performing school data point was used i.e. 30 kWh/m2.a. • Secondary: less data was available, and it was less clustered. The average of the top three performing schools was used. A review was also carried out of the reductions on an elemental breakdown, to ensure the targets improvements seemed reasonable.
Performance gap			The performance levels are based on existing buildings, so inherently incorporate a performance gap: see details above	The performance levels are based on existing buildings, so inherently incorporate a performance gap, but reduced due to the more onerous levels: see details above
Further development	Profile for remaining 2 sub-sectors		• Review whether equivalent performance levels could be developed in kWh/pupil/yr (e.g. to relate to funding requirements) • Develop approach to special uses e.g. CDT equipment, multiple kilns. For example, this could be approached with an additional allowance of 10kWh/m2/yr (from Schools with standard areas based on BB98 and BB99) • Develop Performance Levels for remaining 2 sub-sectors i.e. Early years / Pre-schools, and 6th Form • Review how to address out of hours community use : they are currently included in Performance Levels but may be provided a separate allowance, subject to metering & monitoring	

Schools

This shows analysis for Primary Schools. Similar analysis for Secondary Schools is included in the Performance Level report.



Homes – Performance Levels

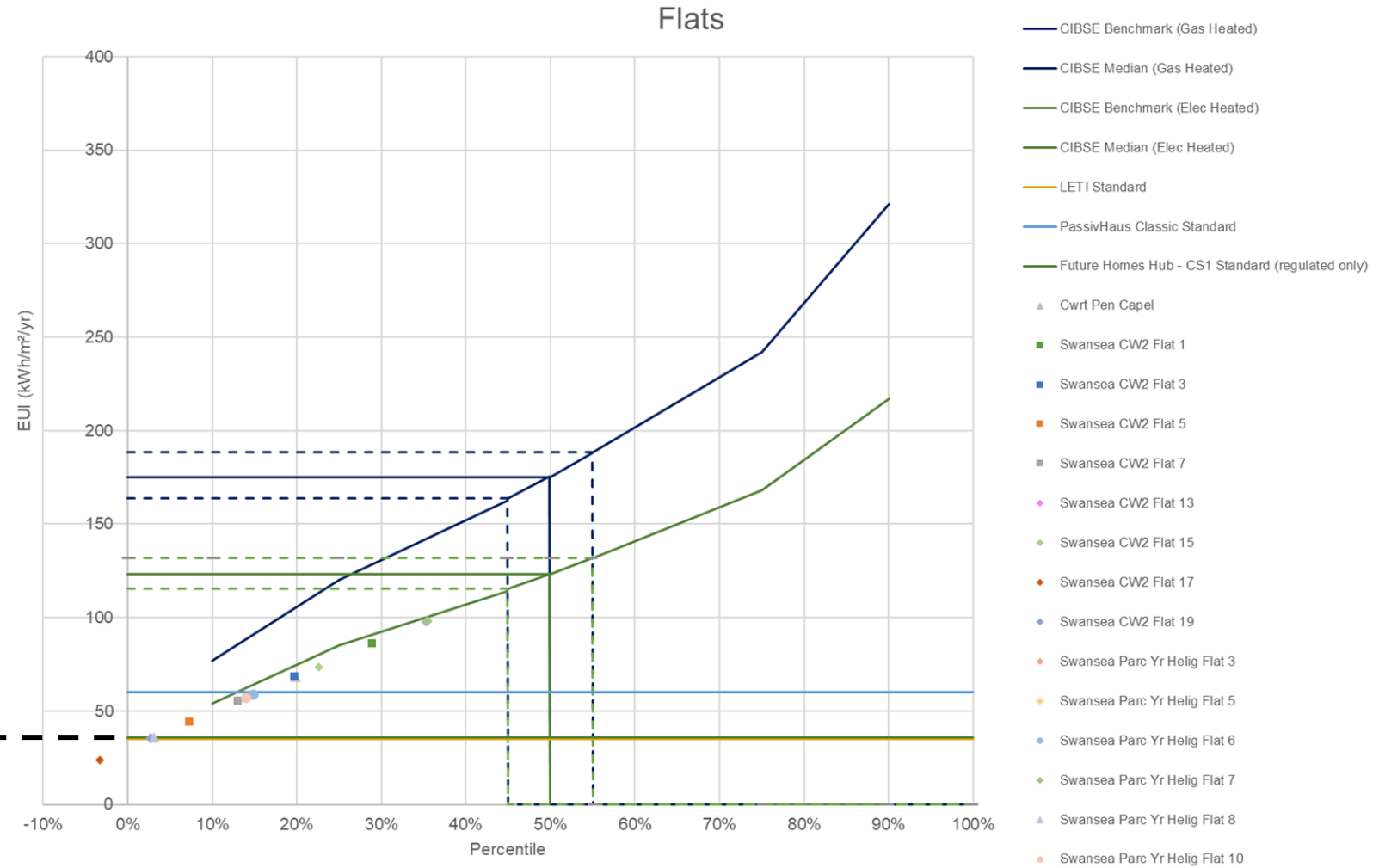
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)					
					Best Practice today			Future exemplar		
	Core	Additional	Median	Best practice	Annual energy use	Space heating & cooling		Annual energy use	Space heating & cooling	
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)
Flats	All internal to demises (i.e. excl. internal communal areas	None	123 (all-elec) 175 (gas + elec)	85 (all-elec) 120 (gas + elec)	35 (tbc)	15 (SH) (tbc)	10 (SH) (tbc)	tbc	tbc	tbc
Detached			118 (all-elec) 199 (gas + elec)	58 (all-elec) 148 (gas + elec)	40	20 (SH)	10 (SH)	tbc	tbc	tbc
Semi-detached and End terrace			127 -141(all-elec) 196-203 (gas + elec)	79-95 (all-elec) 145-152 (gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc
Bungalow			158 (all-elec) 225 (gas + elec)	106 (all-elec) 165 (gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc

Homes – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: CIBSE (large database, QAed): used above	Targets and limits: • LETI: EUI of 35, SH demand of 15: PL are aligned for flats, a bit less ambitious for detached houses • RIBA Challenge - as per LETI • Passivhaus: broadly as per LETI, with a heat pump • Future Homes Hub: several levels: see informative paper in SG report, and levels plotted on sector profile analysis in SG report	
Existing buildings meeting PL?			Flats: 15 flats across 3 projects in Swansea: median 57.4kWh/m^2/yr (23.7-98.3); 3 of them meeting or close to proposed PL Detached houses: 14 houses across 6 projects: median 69kWh/m^2/yr (32.5-123.7); 3 of them meeting the proposed Semi-detached and End terrace: 2 houses across 2 projects: 50-80kWh/m^2/yr Bungalow: 2 bungalows across 2 projects : 25-50kWh/m^2/yr	
Modelling			Energy performance modelling (PHPP), including testing of space heating demand in different climates (London, Swindon, Birmingham and Glasgow) • Complete: detached houses (1 model); flats (2 models, preliminary results) • Modelling not yet complete for semi-detached / end terraces, and for bungalow Use of industry performance modelling, through comparison against LETI levels	
Performance gap			The Performance Levels are not directly the modelling results: they also take account of analysis of in-use projects, which inherently incorporate a performance gap	
Further development	-		• Complete PL for missing sub-sectors and for Future Exemplar PL • In this sector, a renewable energy generation target may be applied (using the Passivhaus methodology) rather than just a reporting requirement – see question in main section of the Technical Issue on this • Develop verification rules for each sub-sector, in different market segments: see proposals in SG report	

Homes

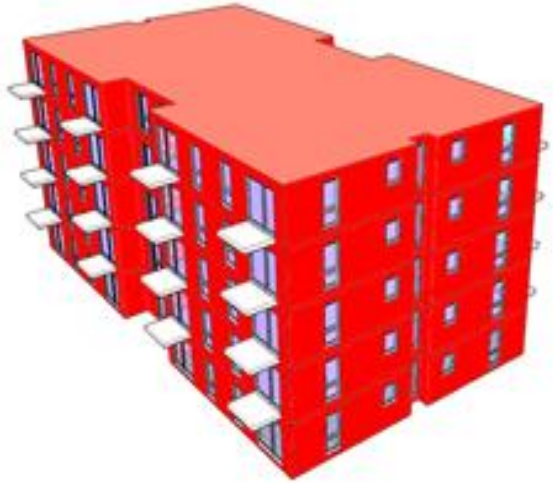
This combines data from the CIBSE database, from projects made available to the UKNZCBS through the call for evidence, and industry targets such as LETI and the Future Homes Hub. This is for Flats. Similar analysis is available in the SG profile report for the other sub-sectors i.e. Detached Houses, Semi-detached and End terrace houses, and Bungalows.

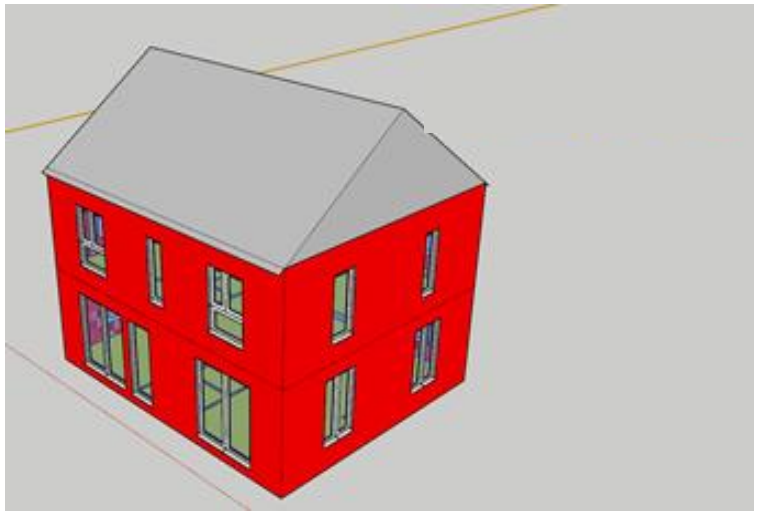


Proposed Best Practice
Today performance level:
35 kWh/m^{2}GIA/yr

Homes

Below are illustrations of models used to inform the performance levels: flats (left, middle) and detached house (right).





Offices – Performance Levels

	End uses		Existing stock benchmarks		New build performance levels							
					Best Practice today				Future exemplar			
	Core	Additional	Median	Best practice	Whole building Annual energy use	Base building Annual energy use	Space heating & cooling	Demand flexibility	Whole building Annual energy use	Base building Annual energy use	Space heating & cooling	Demand flexibility
Metrics			kWhe/m2NIA/yr (gas@0.4)		NABERS stars or kWhe/m2NIA/yr (gas@0.4)		N/A		NABERS stars or kWhe/m2NIA/yr (gas@0.4)		N/A	
Route A: NABERS rating	Same in principle as Route B but NABERS Rules must be followed and these provide more detailed requirements so there may be some differences for very specific circumstances.		REEB 2021 Best Practice 90.0 REEB 2021 Good Practice 114.0 Local Government Offices Good Practice 120.8 Central Government Offices Good Practice 126.5 REEB 2021 Typical (Median) 164.0 Local Government Offices Typical 165.3 Central Government Offices Typical 174.3 Above data is shown graphically in slide 'Offices – performance levels vs empirical data'. Data from REEB provided to NZCBS by BBP Data for Central and Local Government Offices from CIBSE Benchmarking Tool https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/energy-benchmarking-tool		**NABERS 5 stars** Evidence for this already being achieved today is less compelling than it is for the Base Building rating The likely range of EUIs applicable to NABERS 5 stars is 75 to 140 for low (75% occupied) to high (100% occupied) intensity buildings. This is shown graphically in 2 accompanying slides	**NABERS 5 stars** The likely range of EUIs applicable to NABERS 5 stars is 62 to 76 for low to high intensity fully occupied buildings [Low Intensity of use Occupant density 1:20 Occupancy (hrs/week) 40 High Intensity of use Occupant density 1:10 Occupancy (hrs/week) 60]			**NABERS 6 stars** The likely range of EUIs applicable to NABERS 6 stars is 38 to 70 for low (75% occupied) to high (100% occupied) intensity buildings. This is shown graphically in 2 accompanying slides	**NABERS 6 stars** The likely range of EUIs applicable to NABERS 6 stars is 31 to 38 for low to high intensity fully occupied buildings [Low Intensity of use Occupant density 1:20 Occupancy (hrs/week) 40 High Intensity of use Occupant density 1:10 Occupancy (hrs/week) 60]	
Route B: EUI	Scope is all energy uses including for associated outdoor spaces (pro rata if used by other buildings). Exclusions: EV charging and non-office premises in building if sub-metered				**75 kWh/m2 NIA and 60 kWh/m2 GIA** The EUI limit equates to NABERS UK 5-stars for a low intensity building that is 75% leased or occupied zonally (minimum allowed to get a NABERS rating)	N/A			**40 kWh/m2 NIA and 30 kWh/m2 GIA** The EUI limit equates to NABERS UK 6-stars for a low intensity building that is 75% leased (minimum to be allowed a NABERS rating)	N/A		

Offices – Background and Next steps

	End uses		Existing stock		Performance levels (for core end uses)	
					Best Practice today	**Future exemplar**
Other schemes			Data from REEB and CIBSE Benchmarking Tool (DECs) See previous slide titled Offices – Performance Levels		5 star NABERS UK target is aligned with 2023 Update of BCO Guide to Specification Key Design Criteria Proposed EUI Route performance levels for new buildings are 7% higher than UKGBC NZC Paris Proof energy performance targets for offices (Jan 2020), LETI CEDG and RIBA Challenge (70 kWh/m2 NIA and 55 kWh/m2 GIA)	
Existing buildings meeting PL?					Empirical data from known low energy buildings completed since 2000 was collected for Buildings Energy Mission 2030 Very few exemplars available with verified energy data and public disclosure All buildings in this data set have a single occupier. And all are believed to be owner-occupied hence not subject to landlord – tenant conflicts related to energy efficient building operation 3 of 5 have GIA < 500 m2 All are over 5 - 15 yrs old and likely designed 10 - 20 yrs ago Four out of five buildings have EUIs > 100 kWhe/m2 NIA (gas @0.4, DH @0.5) **The Enterprise Centre UEA was 69 kWhe/m2 NIA (DH @0.5) in 2017-18** [Source: Extract of 20180211-BEIS Energy Mission-Initial report-Rev M]	Evidence for future achievability of NABERS 6 stars is provided in *Cohen RR, Desai K, Elias J and Twinn R, "Net zero carbon: energy performance targets for offices", first published by BSER&T online 09 February, 2021
Modelling					Based on independently verified industry modelling of at least 19 new projects with published Design Reviewed Target **Base Building** Ratings within Design for Performance Agreements and compliant with DfP Guide. Two thirds have 5 star target ratings, one is 5.5, the others 4 or 4.5. No dedicated modelling.	
Performance gap					25% margin on predicted performance accounted for explicitly within Design for Performance modelling. Mandatory off-axis scenarios also account for potential design failure modes and different intensities of use	
Further development			Office SG embodied carbon specialists are confident EC limits can and should be integrated with each NABERS scope to enable whole-life carbon certification		Work on streamlined verification rules for the EUI route. See Appendix to the Offices sector group report for current proposals	

See current proposals for verification on page 99

Offices - New Build Proposed Performance Levels

Please note the related consultation question on delineation of Whole building, Base building and Tenancies, on pages 19-20.

- **Option A: use NABERS UK (full suite of ratings possible: whole building, base building, tenancy)**
  - **From launch = Current Best Practice = NABERS 5***
  - **From 2030 = inferred interim step = NABERS 5.5***
  - **From 2035 = Future Exemplar = NABERS 6***

NABERS UK is designed for commercial offices. By delineating whole building energy use between the base building and tenancies, it gives agency to both the landlord and each tenant to achieve energy performance limits for the energy uses each party controls and is responsible for. See below note on scopes.

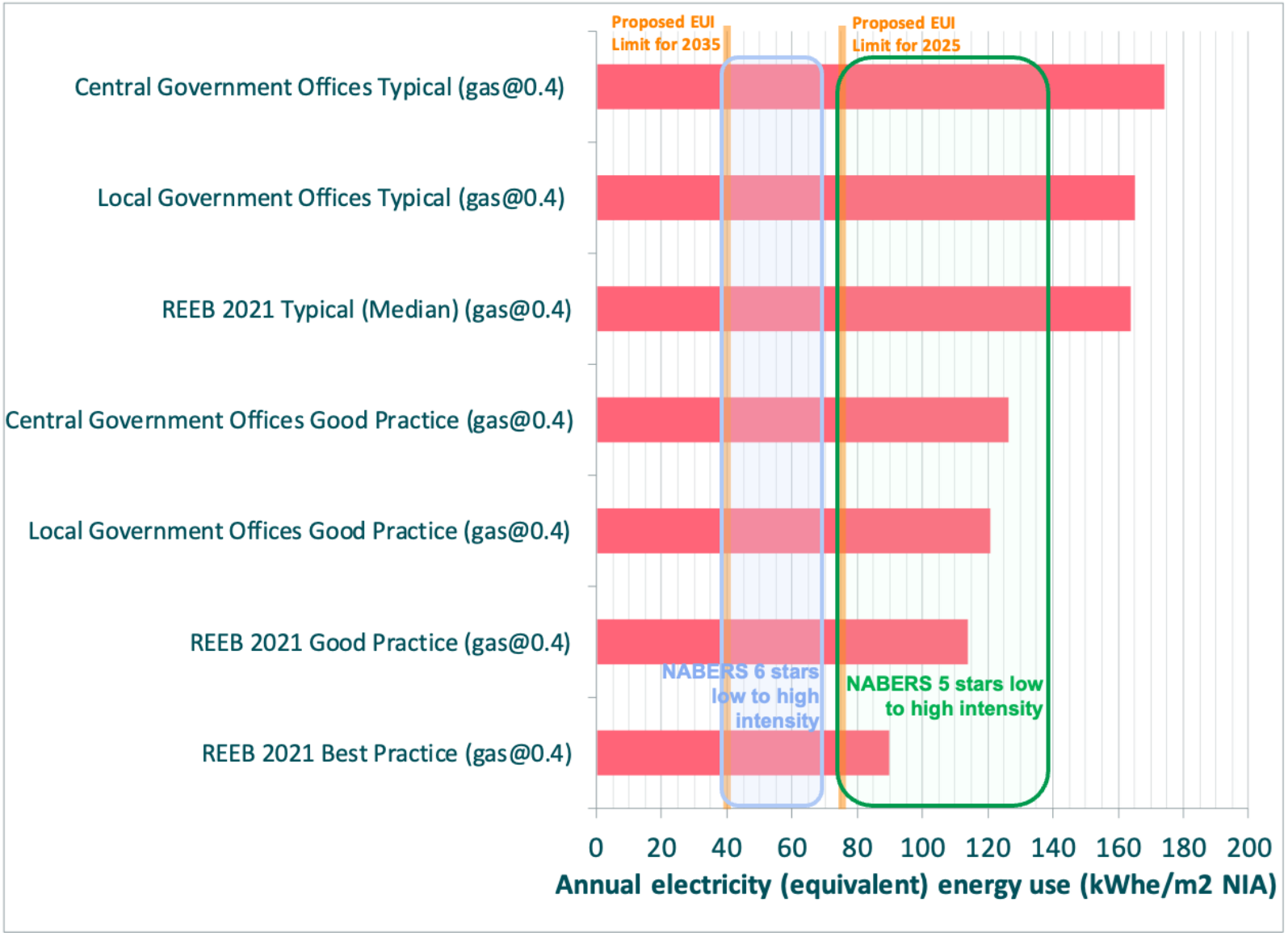
- **Option B: use EUI approach (whole building scope only)**
  - **From launch = Current Best Practice = 75 kWh/m2 NIA and 60 kWh/m2 GIA**
  - **From 2030 = inferred interim step = 60 kWh/m2 NIA and 50 kWh/m2 GIA**
  - **From 2035 = Future Exemplar = 40 kWh/m2 NIA and 30 kWh/m2 GIA**

The EUI method is a simpler, non-proprietary approach expected to be most applicable to owner-occupied offices for which whole building performance is the only paramount energy efficiency KPI. It may also be suitable for smaller buildings with less complex building services, not needing or wishing to expend the extra effort required to pursue the NABERS UK rating option. Proposed Rules for the EUI method are shown in an Appendix slide.

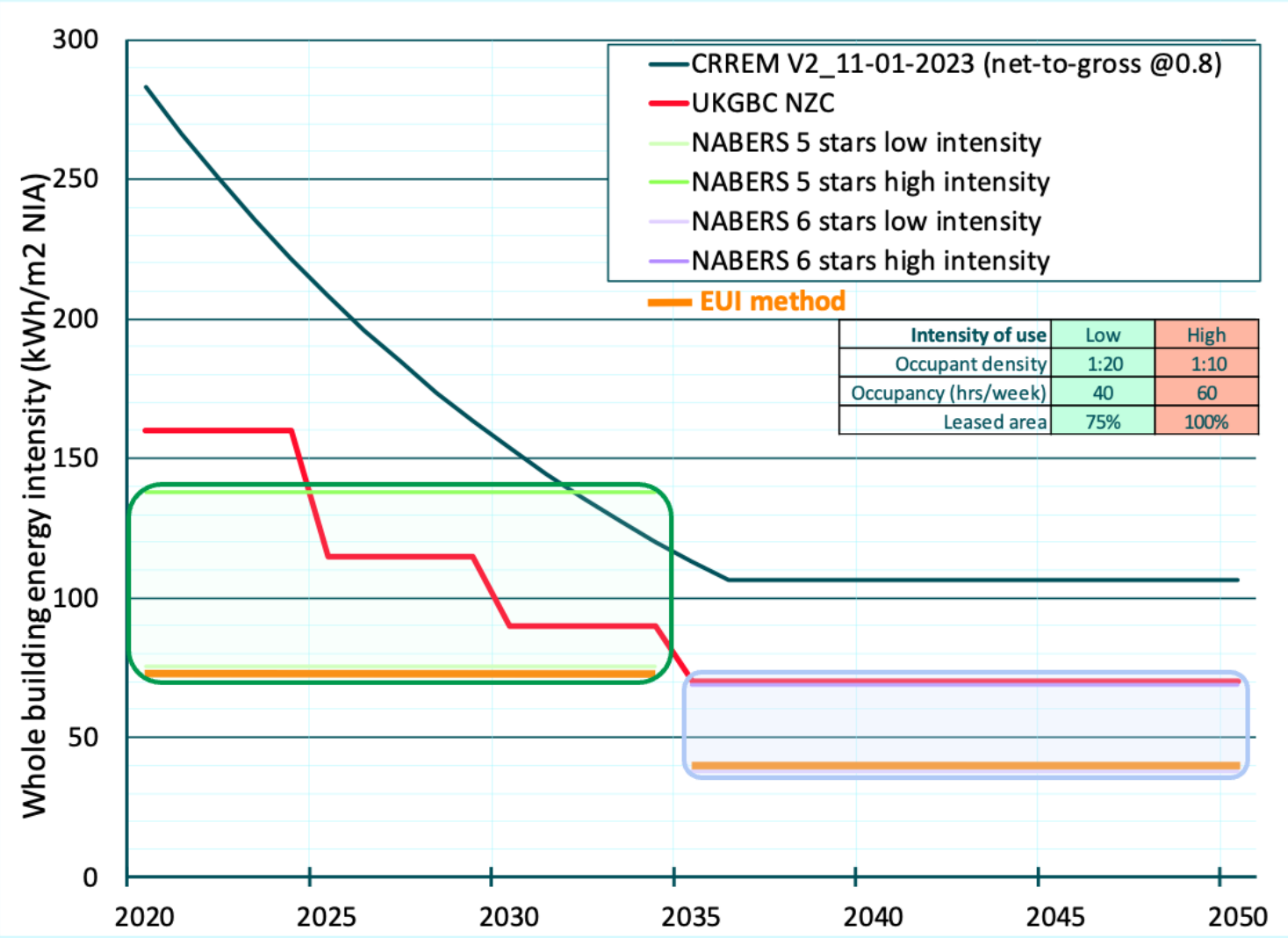
Note on timeline definition for what is a 'new building':
The first rating period experienced by the building (when it has at least 75% occupancy) starts after the given time period.
The stringency of limits applicable to a building when new may be tightened as the building ages out to 2050. This will be considered when setting limits for existing buildings.

Note on different scopes of NABERS UK ratings:
- General agreement that NZCBS should capitalise on an initiative being adopted by the industry and which is so closely aligned with NZCBS aims
- Offices Sector is seeking special dispensation to be allowed to offer NZC base building and tenancy certifications.
- Acknowledge that whole building is ultimate goal but each party must play their part and so fair to recognise when each achieves their goal
- Office SG embodied carbon specialists are confident EC limits can and should be integrated with each NABERS scope to enable whole-life carbon certification

Offices – Whole Building Performance Levels vs Empirical Data



Offices – Whole Building Performance Levels vs UKGBC and CRREM Pathways



Note: The CRREM pathway is applicable to the whole offices sector, so including existing buildings. It can be anticipated that the limits for new buildings should be more stringent.

Offices – Proposed Rule Book for EUI Method

1. Only available for whole building scope of net zero (not base building or tenancy)
2. Building must be all-electric (avoids setting rules for DH/DC etc.)
3. Energy supplied by on-site Renewable Energy Systems (RES) used by the building counts towards EUI (the EUI is for gross building energy use)
4. All energy uses (apart from EV charging) served from utility supply meter(s) must be included (no other exclusions)
5. Energy used for outdoor facilities (car parks, signage, security lighting, etc) used by any office occupiers must be included even if on a separate utility meter. if the building's associated outdoor spaces are also used by other buildings, pro rata the total energy use by NIA or GIA of each building, or by using the evidence of how the cost of this energy is recovered.
6. NIA relates to office or office like spaces only
7. Both EUI limits must be satisfied (NIA and GIA basis)
8. Energy use must be based on a continuous 365 day rating period
9. Office NIA must be verified as at least 75% leased or occupied throughout the 365 day rating period

Note on treatment of on-site RES - Rule 3 above **:**

- Rule for EUI method proposed for offices is consistent with EUI method used by other sectors for NZCBS
- NABERS UK method allows on-site RES used on-site to count towards target achievement, but this is unlikely to be worth > 0.1 stars

Note on consistency between EUI limits and NABERS UK ratings - Rule 9 above **:**

- The EUI limits equate to NABERS UK 5 or 6-stars for a low intensity building that is 75% leased (minimum to be allowed a NABERS rating)
- Buildings with higher occupancy and/or intensity which as a result do not achieve the EUI limit, have the option to use NABERS

Healthcare – Performance Levels

	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)	
					Best Practice today	Future exemplar
	Core	Additional	Median	Best practice	Annual energy use	Annual energy use
Metrics **Space types**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr
No sub-sector, but space types defined as per NHS standard, each with performance level			75 elec + 194 thermal (see details on next page)	94 elec + 152 thermal (see details on next page)	Overall performance level determined by space mix. Indicative levels for generic buildings in each sub-sector will be produced, for comparison with benchmarks	Best Practice today is set to be aligned with NHS Standard performance levels. It is considered ambitious, so no additional level of ambition is proposed at this stage
Low tech space	As per space types	As per space types			Type 1- 30 Type 2- 70	
Medium tech space					Type 1- 95 Type 2- 45 Type 3- 40 Type 4- 50	
High tech space					Type 1- 165 Type 2- 80	
Ultra high tech & specialist spaces					n/a	
Support spaces					n/a	

Healthcare – Performance Levels

The following sub-sectors (Acute Trust, Care Trust etc) would not be directly associated with performance levels, since these performance levels would instead be provided by space type as described in the previous page, aligned with the approach in the NHS Standard. However, indicative performance levels for typical buildings in these sub-sectors could be produced for illustration and benchmarking against the existing stock.

7. Operational Energy Performance Levels

	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)	
					Best Practice today	Future exemplar
	Core	Additional	Median	Best practice	Annual energy use	Annual energy use
Metrics **Space types**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr
Acute Trust	Not defined: these sub-sectors are just shown here for benchmarking purposes, not definition of core & additional uses for the purpose of the performance lEvels		112 elec + 279 thermal	146 elec + 172 thermal	Tbc (to be provided as illustration)	
Care Trust			50 elec + 162 thermal	73 elec + 143 thermal	Tbc (as illustration)	
Community Trust			62 elec + 184 thermal	83 elec + 196 thermal	Tbc (as illustration)	
Mental Health & Learning Trust			71 elec + 181 thermal	88 elec + 184 thermal	Tbc (as illustration)	
Ambulance Trust			tbc	tbc	Tbc (as illustration)	

Healthcare – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: ERIC database, large, used for mandatory reporting: used above	• NHS Net Zero Standard: the performance levels proposed here are aligned with it. • Scottish Futures Trust: no specific limit, but an indication that it is likely as a whole building limit to be above 100kWh/m2/yr	n/a
Existing buildings meeting PL?			-	n/a
Modelling			No dedicated modelling, but modelling was carried out to inform the NHS standard.	n/a
Performance gap			tbc	
Further development	Map the sub-sectors against NHS space types, check all are covered		Produce indicative PL for full buildings with generic mixes of uses (in each sub-sector), for illustration and comparison with ERIC benchmarks and with existing projects. Develop PL for missing space types, if needed once have mapped NHS space types vs sub-sectors	

Healthcare

Overview of how UKNZCBS works with NHS Net Zero Standard, for operational energy performance levels

See details in right hand side: UKNZCBS only set performance outcomes, not elemental limits

Step 1: Building Performance Targets

Whole Building
At whole building level, the performance targets are to be applied to the envelope and other whole building systems

Step 2: Space-type Energy Limit and Performance Targets

Space-type
Identify the relevant Energy Limit or Building Services Performance Targets in the Standard for all space-types in the design

Measurement and Verification – Section 6
- Engaging Facilities Management through Government Soft Landings and Post Occupancy Evaluation Rigorous enhanced commissioning
- Extensive monitoring, metering and controls of energy usage, including publicly reported and disclosed.
- Data collection to enable the ability to report per patient outcome and treatment in the future to support decarbonising the whole NHS

Required by UK NZCBS: compliance is only achieved with in-use verification, to the UK NZCBS verification rules

Low Tech Spaces	Low Tech Type 1: E.g. Public Circulation, waiting areas	Low Tech Type 2: E.g. Offices, teaching areas
Medium Tech Spaces	Medium Tech Type 1: E.g. A&E, single ICU room	Medium Tech Type 3: E.g. Consultation
	Medium Tech Type 2: E.g. Exam/Treatment, procedure room	Medium Tech Type 4: E.g. Single bedroom, maternity ward
High Tech Spaces	High Tech Type 1: E.g. Operating Theatre	High Tech Type 2: E.g. High tech laboratories
Ultra High Tech and Specialist Spaces	Ultra High Tech and Specialist Spaces: E.g. Imaging, containment labs and burns units	
Support Spaces	Support Type 1: E.g. Catering	Support Type 1: E.g. Server Rooms
	Support Type 3: E.g. Plant spaces	

UK NZCBS follows the NHS NZ Standard classification of space types and associated energy limits, so that energy performance limits are aligned between both schemes

~~**Select Building Performance Targets**~~

~~Select and specify the performance targets values that are best suited to the building, construction type and location.~~
~~**Performance Targets include:**~~
~~Envelope - U values, air tightness, glazing parameters.~~
~~Other - metering and monitoring of energy systems, refrigerant GWP, and domestic hot water (DHW) efficiencies~~

Not required by UK NZCBS: no elemental requirements, only in-use performance outcome requirements

Energy Limits

Derive Energy Limits based on space-type, location, equipment and domestic hot water demand (DHW) based on provided ranges of values.

Advisory limits for DHW and unregulated loads.

Required by UK NZCBS: DHW and unregulated loads to be included in overall performance limits

~~**Follow Performance Targets**~~

~~Follow building services performance parameters for specialist and support spaces including AHU SFPs, SCOPs, SEERs, heat recovery efficiency and lighting loads.~~

Not required by UK NZCBS: no elemental requirements, only in-use performance outcome requirements

Sectors with a medium level of completeness and confidence on performance levels

New Build Operational Energy Performance Levels

Typically, these are sectors where:

- Some performance levels proposed, some modelling has been carried out but with a more limited scope and testing (e.g. fewer models, limited scenario testing, no dedicated accounting of the performance gap). The levels are shown here for indication, to seek industry feedback, but are still subject to much more development work.

  AND/OR

- There are few industry references that could be used to compare the proposed performance levels with.

Datacentres – Performance Levels

	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)					
					Best Practice today			Future exemplar		
	Core	**Additional**	**Median**	**Best practice**	**Annual energy use**	**Sub-sector EUI**	**Space heating & cooling**	**Annual energy use**	**Sector EUI ****	**Space heating & cooling**
Metrics **Single sector, accounting for intensity of use:**			PUE*	PUE*	PUE*	kWh/m^{2}GIA/yr	Energy Reuse Factor (ERF), as % of total heat rejection	PUE*	kWh/m^2 GIA/yr	heat reuse, as % of total heat rejection (ERF)
0-15% utilisation	DC + power generation / back up generation / fuel storage + MEP/ICT systems	Offices Car park, external areas	1.67	tbc	1.4	Tbc	Minimum heat re-use on site to satisfy all heating demands	1.3	Tbc	Minimum re-use on site to satisfy all heating demands
16-25% utilisation				tbc	1.35			1.22		
26-50% utilisation				tbc	1.3			1.125		
51-100% utilisation				tbc	1.2			1.1		

Sector-specific Acronyms:
***PUE -** Power Usage Effectiveness, annualised

Datacentres – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (<u>for core end uses</u>)	
			Best Practice today	**Future exemplar**
Other schemes		Uptime Institute 2020, UK average used above	None identified	
Existing buildings meeting PL?			None identified	
Modelling			Yes – tool developed by one member of the Sector Group, reviewed by other members	
Performance gap			Tbc, but expected to be less significant than in other sectors due to lesser influence from occupants than in other sectors	
Further development			Work with TSG on additional performance requirements (especially WUE - Water Utilisation Effectiveness) Peer-review of modelling tool	

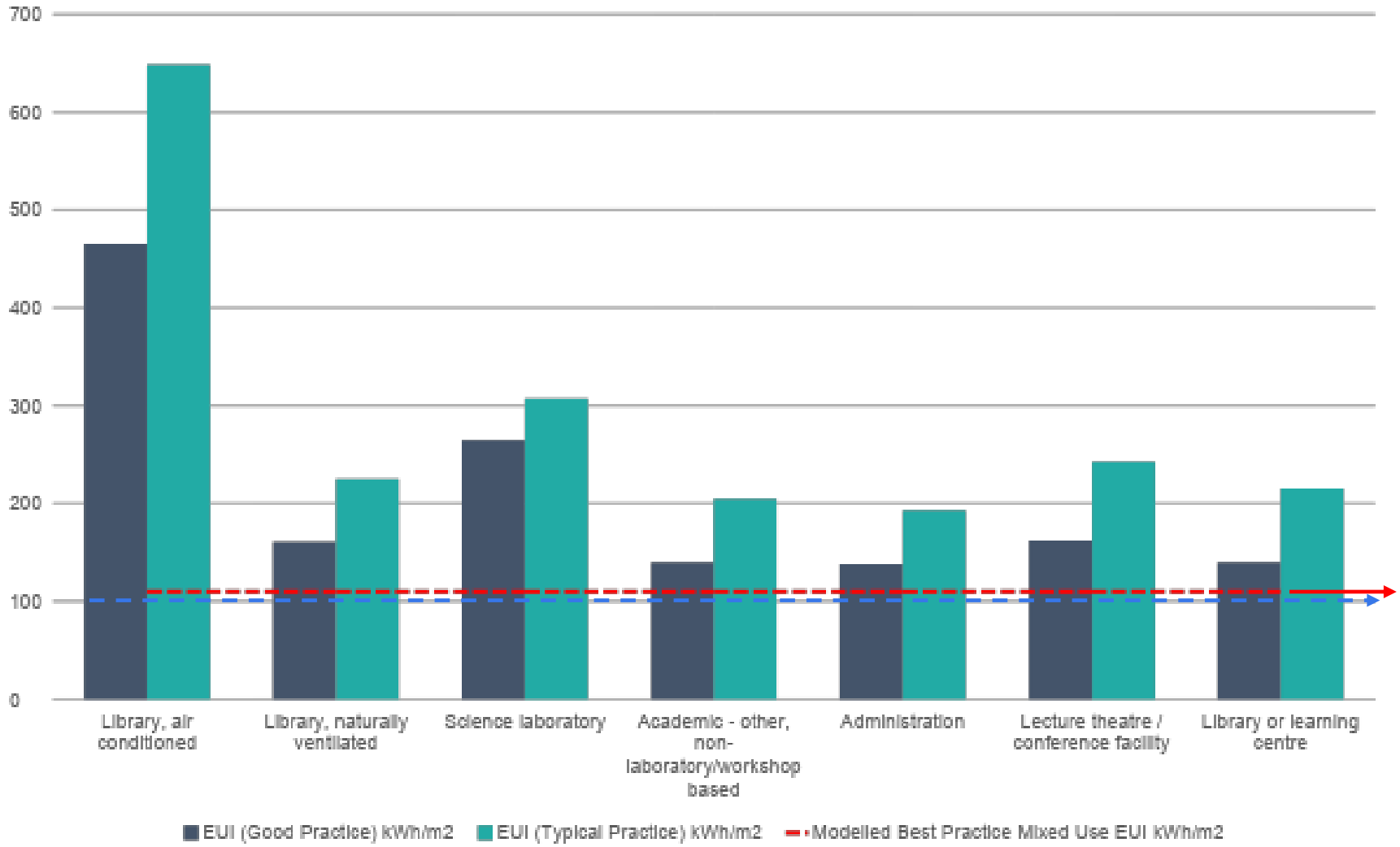
Higher Education – Performance Levels

	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)					
					Best Practice today			Future exemplar		
	Core	Additional	Median	Best practice	Annual energy use	Space heating & cooling		Annual energy use	Space heating & cooling	
Metrics **Space types**			kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	Annual demand (kWh/m²/yr)	Peak demand (W/m²)	kWh/m²GIA/yr	Annual demand (kWh/m²/yr)	Peak demand (W/m²)
No sub-sector, but space types, each with performance levels, as detailed below. Overall performance level determined by area mix. E.g. indicative "general mix" building:					110 (for indication)	12 (SH) 5.9 (SC) (for indication)	22.5 15.1 (for indication)	tbc	tbc	tbc
Seminar / teaching spaces	As per space types	Offices, sports centre, labs, warehouse, catering, residential	196 - 261 (CIBSE "typical", gas + elec)	162 - 223 (CIBSE "good", gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc
Library / learning centre			215 (CIBSE "typical", gas + elec)	140 (CIBSE "good", gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc
Lecture theatre			243 (CIBSE "typical", gas + elec)	162 (CIBSE "good", gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc
Workshop			205 (CIBSE "typical", gas + elec)	140 (CIBSE "good", gas + elec)	tbc	tbc	tbc	tbc	tbc	tbc

Higher Education – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: CIBSE (used above) . Note they are full building benchmarks. They are not directly comparable with the Performance Levels which will apply to spaces within a building. For "seminar / teaching spaces", the range represents several CIBSE benchmarks available: Higher Ed - Lecture theatre, Further & Higher Ed – Lecture room – Arts and – Science	Targets and limits: • Scottish Futures Trust Net Zero Public Sector Building Standard: general operational energy limit of 100kWh/m^2/yr for mixed-use higher education buildings / campus, possibly higher in some cases (e.g. buildings with labs) or lower in others (e.g. higher education teaching)	
Existing buildings meeting PL?			Limited selection of existing building information to provide analysis against differing space types: - One 'mixed use' new build project currently at ~126kWh/m^2. - Best practice mixed use Passivhaus facility performing at ~97kWh/m^2	
Modelling			TM54 model on one 'mixed use' building to provide indication of performance for a 'general' facility	Tbc e.g. higher efficiencies for some systems (though already high efficiencies assumed), reduced performance gap
Performance gap			Integrated within TM54 model, through consideration of operational factors (occupancy, system run hours, small power usage etc.)	
Further development			Produce Performance Levels per space type, for Best practice today and for Future Exemplar Produce indicative PL for full buildings with generic mixes of uses, for illustration and comparison with benchmarks and with existing projects.	

Higher Education



Indicative “Best practice today” performance level (tbc – as per previous page): 110 kWh/m^2/yr

Scottish Futures Trust limit (broadly, with possible variations – as per previous slide): 100 kWh/m^2/yr

Note: Typical and Good Practice benchmark EUIs presented here are a simple addition of electricity and gas benchmarks

Science and Tech – Performance Levels

	End uses		Existing stock benchmarking		New build Performance levels (<u>for core end uses</u>)					
					Best Practice today			Future exemplar		
	Core	Additional	Median	Best practice	Annual energy use	Space heating & cooling		Annual energy use	Space heating & cooling	
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)
Research Lab – General (< or = CL 2)	tbc	Specialist equipment which has safety critical function (i.e. ETP etc.)	860 (median)	400 (10th percentile from i2SL)	<u>**tbc**</u> 310-300	<u>**tbc**</u> 7.9-22.4 (SH) 28-37.4 (SC)	<u>**tbc**</u> 26.8-36.1 (SH) 49.5-113.5 (SC)	tbc	tbc	tbc
Research Lab – High Demand (CL3 or above, Animal Unit etc)	tbc				tbc	tbc	tbc	tbc	tbc	tbc
Pharmaceutical R&D	tbc				tbc	tbc	tbc	tbc	tbc	tbc
Pharmaceutical Manufacturing	tbc				tbc	tbc	tbc	tbc	tbc	tbc
Computational Science	tbc				tbc	tbc	tbc	tbc	tbc	tbc
Other science & technology building	tbc				tbc	tbc	tbc	tbc	tbc	tbc

Science and Tech – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks Median: BEES: Low confidence Best practice: 306 buildings, taken mainly from i2SL (International Institute for Sustainable Laboratories) benchmarking tool. All are in use US Lab buildings, screened by matching climate zone as UK) plus 12 labs sourced from the call for evidence, from DEFRA and Astra Zeneca	No current ratings / standards / certification schemes to compare to the proposed performance levels.	
Existing buildings meeting PL?			There are 28 US buildings achieving the proposed draft performance level, from the available data set. No detailed broken down data for any in- use buildings.	
Modelling			TM54 modelling, under a range of inputs and profiles to give an indicative level of performance.	
Performance gap			Tbc: this will be defined as part of setting PL, once modelling is complete	
Further development	Sub-sectors to be confirmed, depending on assessment for the need (or not) of different performance levels		Confirm PL through: - Confirmation of core vs additional end uses and other specialist equipment (e.g. within total PL, or as additional energy use allowance, or as decided performance requirement for that system) - Confirmation of whether and how to address intensity of use (e.g. adjustable EUI based on sliding scale descriptions of lab type plus % lab area within the building) within PLs - more modelling (scope and number of models), and calibration with as built data to stress test the impact of inputs.	

Logistics and Warehouses – Performance Levels

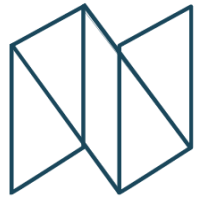
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)					
					Best Practice today			Future exemplar		
	Core	Additional	Median	Best practice	Annual energy use	Space heating & cooling		Annual energy use	Space heating & cooling	
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)	kWh/m^{2}GIA/yr	Annual demand (kWh/m^2/yr)	Peak demand (W/m^2)
Un-conditioned storage	Logistics, warehousing/storage, picking	Office and associated staff support areas e.g. canteen	Electric 67 + Fossil fuel 169 (CIBSE typical Distribution warehouses)	Electric 53 + Fossil fuel 103 (CIBSE good – not best Distribution warehouses)	33.7 tbc	2.34 (SH) 0.19 (SC) tbc		12.6 tbc	1.3 (SH) 0.016 (SC) tbc	11.14 (SH) 0.16 (SC) tbc
Conditioned storage					tbc	tbc	tbc	tbc	tbc	tbc
Distribution sorting – main hub					294 tbc	0.19 (SC) tbc		125 tbc	109 (SH) 0.014 (SC) tbc	208.2 (SH) 0.22 (SC) tbc
Distribution – final mile					tbc	tbc	tbc	tbc	tbc	tbc
Automated picking					tbc	tbc	tbc	tbc	tbc	tbc
Manual picking					tbc	tbc	tbc	tbc	tbc	tbc
Cold store			tbc	tbc	tbc	tbc	tbc	tbc	tbc	tbc

Logistics and Warehouses – Background and Next Steps

7. Operational Energy Performance Levels

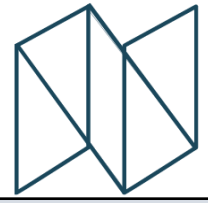
	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		CIBSE, used above	CRREM – Distribution Warehouses: • Cold - 2030: 84 kWh/m^2, 2040: 65 kWh/m^2 • Warm - 2030: 36 kWh/m^2, 2040: 25 kWh/m^2	
Existing buildings meeting PL?			In-use projects have been identified within the sector group and network which have shown a similar range of improvement (more than 40% improvement), and thus guided the evaluation process	
Modelling			TM54 modelling: 1 model per sub-sector; scenario testing not complete.	TM54 modelling: 1 model per sub-sector; scenario testing not complete.
Performance gap			Not yet accounted for in the numbers above, which are simply modelling results – approach to the performance gap is tbc e.g. additional margin to be added, or performance gap to be included in some scenario testing in the model	
Further development	-		Complete the modelling and produce Performance Levels for all sub-sectors.	

Retail – Performance Levels



	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)							
					Best Practice today				Future exemplar			
	Core	Additional	Median	Best practice	Annual energy use	Sub-sector EUI equivalent	Space heating & cooling	Demand flexibility	Annual energy use	Sub-sector EUI equivalent	Space heating & cooling	Demand flexibility
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^2/yr – m2 GIA unless stated	kWh/m^{2}GIA/yr		-	kWh/m^2/yr – m2 GIA unless stated	kWh/m^{2}GIA/yr		-
High Street Retail Units	tbc	tbc	125	69	tbc				tbc			
High Street Retail – Food & Beverage	tbc	tbc	723	180	tbc				tbc			
Retail Centre – Landlord Areas	tbc	tbc	137	63	57 (Not modelled) per m^2 CPA	tbc			tbc	tbc		
Retail Warehouse	tbc	tbc	183	84	**Tbc** 80.8	tbc			tbc	tbc		
Supermarket	tbc	tbc	459	342	**Tbc** 191.6	tbc			tbc	tbc		

Retail – Background and Next Steps



	End uses	Existing stock benchmarking	New build Performance levels (for core end uses)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: several sources have been identified e.g. REEB, CIBSE – listed in SG report. The benchmarks above are based on submitted datasets, converted to approximate all-electric total using a conversion factor from gas to electricity of 0.76	Targets and limits: 2035 CRREM targets	
Existing buildings meeting PL?			None identified at this stage	
Modelling			TM54 dynamic modelling carried out on supermarket and warehouse. Scenario testing: London and Glasgow; 2020 and 2080; normal and extended operating hours Supermarket: detailed HVAC modelling Warehouse retail: simple HVAC, which was considered acceptable given the limited level of complexity in the servicing strategy, the end-uses and the overall operation of a retail warehouse	
Performance gap			The indicative performance levels currently shown are “raw” modelling results, but with some scenario testing to incorporate an element of performance gap: ‘typical hours’ use as well as extended operational scenarios have been modelled to understand the range of EUI performances between a perfect operation within standard operating hours and a 24-hour operation.	
Further development			• Finalise performance levels for warehouses and retail, including more scenario testing and confirmation of how to treat variations such as operating hours • Produce performance levels for the remaining sub-sectors • Produce Future Exemplar Performance levels	

7. Operational Energy Performance Levels

Sectors at early stage of development for the performance levels

New Build Operational Energy Performance Levels

Typically, these are sectors where:

- No performance levels have yet been developed, but
- The proposals here include the sector analysis i.e. proposed sub-sectors, proposed performance metrics, and analysis of energy use in the existing stock.

The sector analysis is the foundation for performance levels, to understand where the performance levels sit against the existing stock, and how to assess performance in these sectors (which sub-sectors should have different limits, what metrics to use etc). As these sectors are typically less well understood by the wide industry, the sector analysis is very important to inform the next stages of development, so the Standard team would welcome feedback on the proposals.

Hotels – Performance Levels

Examination of metrics for annual energy use: Three metrics are commonly used in this sector and are currently considered for setting annual energy use limits: per m^2 GIA, per m^2 conditioned area (m^2CA), and per bedroom. Evaluation of their pros and cons to decide the most relevant one/s for the Standard will be carried out once modelling results are available. Figures in the table below are based on conditioned area to be approximately 80% of GIA.

Comments on the choice of metric are welcome as part of the consultation response. ***(57)***

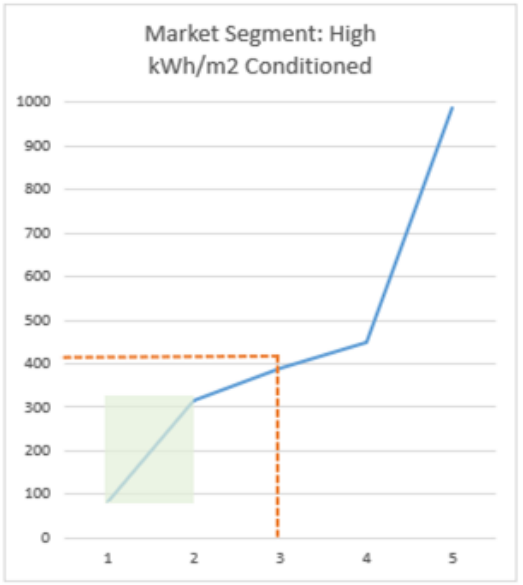
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)							
					Best Practice today				Future exemplar			
	Core	Additional	Median	Best practice	Annual energy use		Sub-sector EUI equivalent	Space heating & cooling	Annual energy use		Sub-sector EUI equivalent	Space heating & cooling
Metrics **Sub-sectors**			kWh/m^2/yr	kWh/m^2 /yr	kWh/m^2GIA /yr **OR** kWh/m^2CA/ yr **- tbc**	kWh/m^2/bedroom **- tbc**	kWh/m^2GIA /yr	tbc	kWh/m^2GIA/yr **OR** kWh/m^2CA/yr **- tbc**	kWh/m^2/bedroom **- tbc**	kWh/m^2GIA/yr	tbc
High (5 Star)	Bedrooms, Common areas, Back of House	Swimming pool, Conference, Laundry, Restaurant, Kitchen	389 (m^2CA) or 311 (m^2 GIA)	82-314 (m^2CA) or 65-251 (m^2 GIA)	tbc	tbc	tbc	tbc	tbc	tbc	tbc	tbc
Medium (3-4 Star)			210-320 (m^2CA) or 168-256 (m^2 GIA)	68-153 (m^2CA) or 54-123 (m^2 GIA)	tbc	tbc	tbc		tbc	tbc	tbc	tbc
			195 (m^2CA) or 156 (m^2 GIA)	82-151 (m^2CA) or 65-121 (m^2 GIA)	tbc	tbc	tbc		tbc	tbc	tbc	tbc
Low (2-1 Star)												

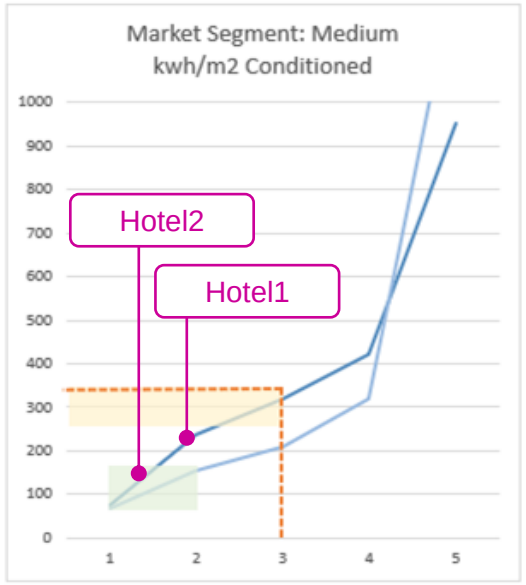
Hotels – Background and Next Steps

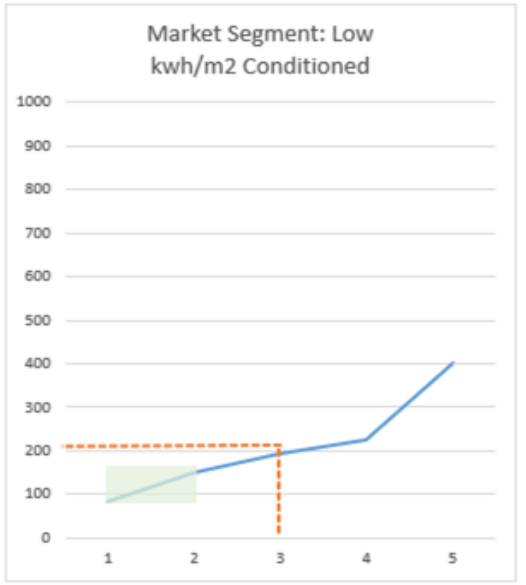
	End uses	Existing stock benchmarking	New build Performance levels (<u>for core end uses</u>)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: CIBSE and BEES datasets are from 2012 and 2014 respectively, and are not considered representative of latest technologies and practices. Additionally BEES doesn't provide market segment granularity. The Cornell dataset has been used here as it contains data from 2019 and includes multiple granularity levels	Targets and limits: None have been identified	
Existing buildings meeting PL?			Projects have been identified through call for evidence, which will be available for comparison as performance levels are developed. *Submission of best practice projects in response to this consultation is welcome.*	
Modelling			TM54 modelling not yet complete, under way for 5 Star sub-sector, for 3 typologies (small / town house, country, metro). Including scenario testing – see details in SG report	
Performance gap			Within TM54 modelling, including scenario testing – see details in SG report	
Further development	-		Complete modelling and PL for all sub-sectors	

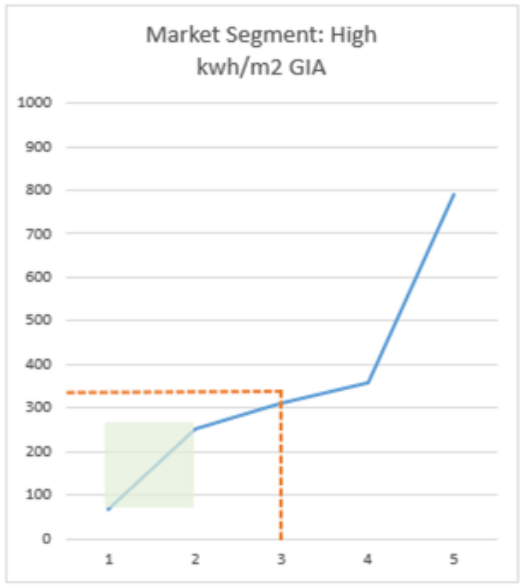
Hotels – Existing stock profile

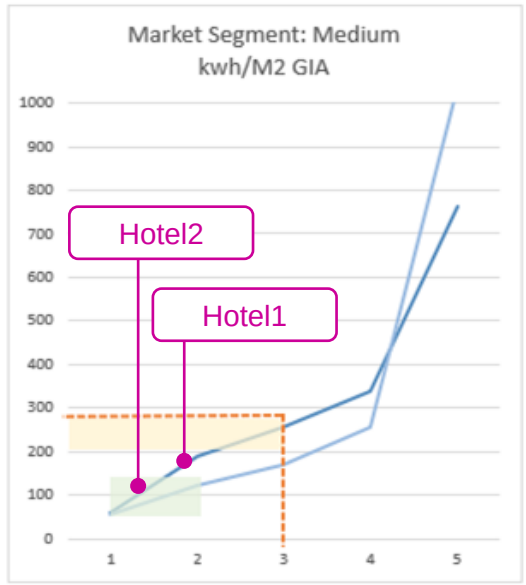
4 Star
3 Star

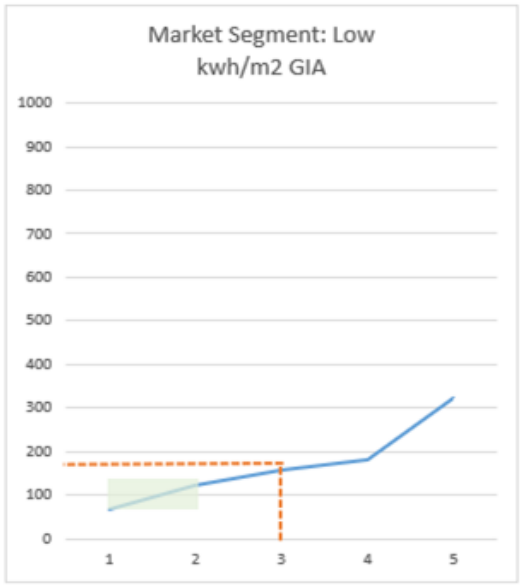












As noted in the previous slide, CIBSE and BEES benchmarks are not used here due to lower levels of confidence. Details and a comparison with the Cornell benchmarks are included in the sector profile report.

Cornell Data for Graphs

kWh/m2 Conditioned						Sub-sector
Sub-T	Low	Lower Q	Median	Upper Q	High	
5 Stars	82	314	389	449	988	High
4 Stars	74	237	320	423	953	Medium
3 Stars	68	153	210	320	1298	
2 Stars	82	151	195	226	402	Low
kWh/m2 GIA						
Sub-T	Low	Lower Q	Median	Upper Q	High	
5 Stars	65	251	311	360	791	High
4 Stars	60	189	256	339	763	Medium
3 Stars	54	123	168	256	1038	
2 Stars	65	121	156	181	321	Low

Hotels from call for evidence

	Hotel 1 (high end)		
3.5 Star			
kWh/yr	712,000		
GIA	4,000	178	kWh/m2 GIA
Conditioned	3,200	223	kWh/m2 Conditioned
	Hotel 2 (high end)		
4 Star			
kWh/yr	393,207		
GIA	3,200	123	kWh/m2 GIA
Conditioned	2,560	154	kWh/m2 Conditioned

Sports and Leisure – Performance Levels

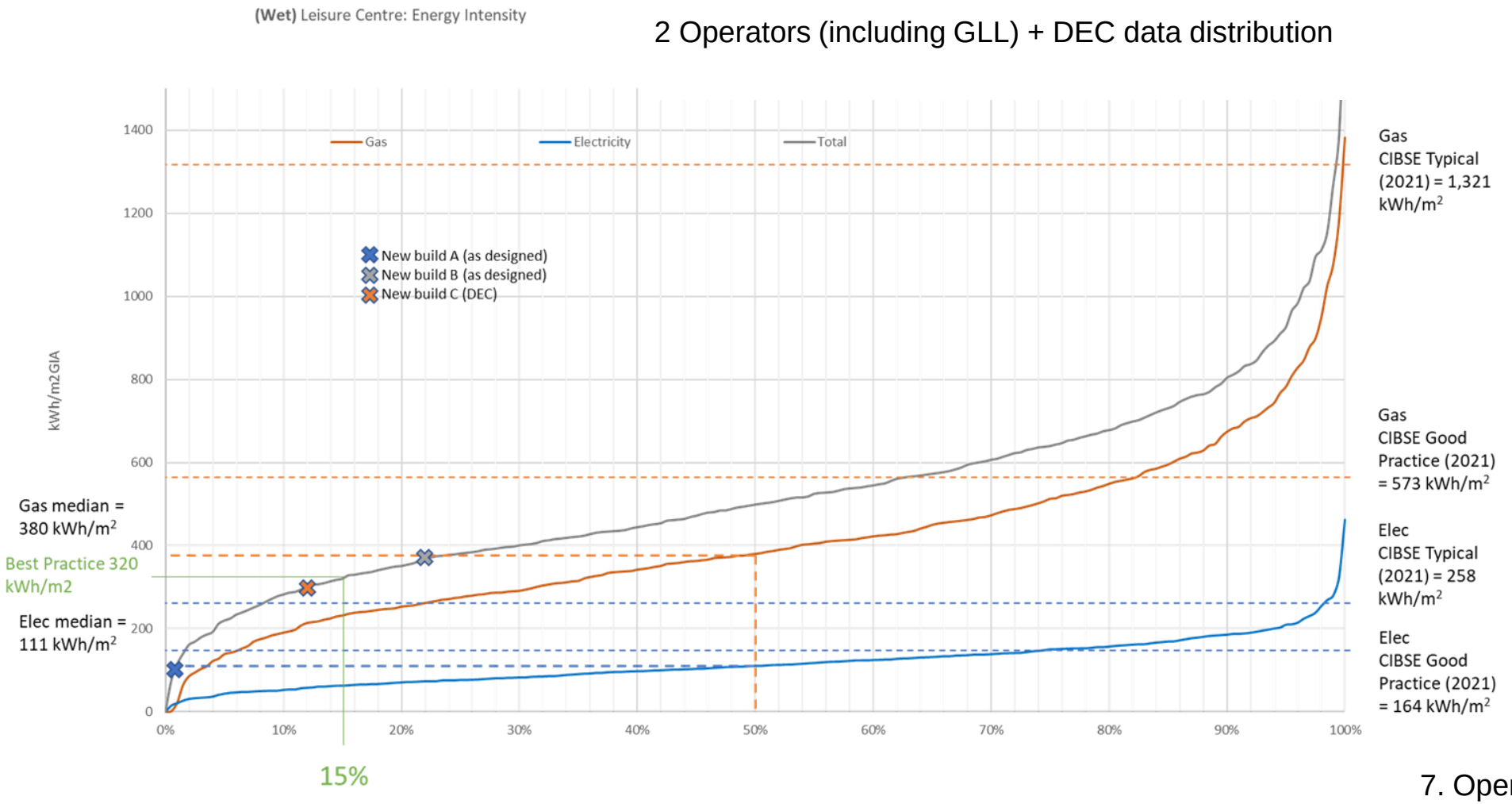
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)			
					Best Practice today		Future exemplar	
	Core	Additional	Median	Best practice	Annual energy use	Sub-sector EUI equivalent	Annual energy use	Sub-sector EUI equivalent
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr
Dry leisure centre	Sports areas and associated staff & customer support e.g. shower and changing etc	Tbc e.g. high intensity uses such as ice rinks; athletics tracks and associated lighting; community uses (“warm spaces”)	Electric 60 + Fossil fuel 116 (ref: see below)	Electric/total 90 No fossil fuel	tbc	tbc	tbc	tbc
Wet leisure centre			Electric 111 + Fossil fuel 380 (ref: see below)	Electric/total 320 No fossil fuel	tbc	tbc	tbc	tbc
Tbc incl. velodromes, ice rinks, stadiums, training grounds			tbc	tbc	tbc	tbc	tbc	tbc
Performance gap					Accounted for within the model			

Sports and Leisure – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (<u>for core end uses</u>)	
			Best Practice today	**Future exemplar**
Other schemes		Benchmarks: Figures above are from DEC + 2 datasets from large sports & leisure operators (GLL and 1 other operator) CIBSE: considered too high	• Sports England reference designs are being used for building typologies for modelling; recommendations for "sustainable" design are out of date (10+ years) • Scottish Futures Trust: no set limit, but an indication that the operational energy use limit for dry leisure centres should be below 100kWh/m^2/yr, and that for wet leisure centres should be above.	
Existing buildings meeting PL?			Dry: None identified at this stage Wet/mixed (completed in last 18 months): • New build A - designed 100kWh/m^2/yr - 1st% • New build B - design limit published 375kWh/m^2/yr - 22nd% • New build C - DEC 291kWh/m^2/yr - 12th% Note large range of performance. New build B is recently completed and designed to Passivhaus standard, but falls around 22nd% of existing building stock - well outside proposed performance level. New build C falls within proposed PL but uses fossil fuel. The variation is likely due in part to the mix of facilities within each building. "Wet" areas use much more energy than "dry" areas. The 320 limit would be for a facility that has a large proportion of wet areas compared to dry.	
Modelling			TM54 modelling being carried out based on the Sports England reference building types – not yet complete.	
Performance gap			Accounted for within the model	
Further development	Consider expansion to other sub-sectors such as stadia, but no data is available for those.		• Finalise modelling for "bare minimum" pool, so it can be used as "additional energy use" PL in other sectors e.g. hotels, secondary schools • Modelling and PL for dry and wet leisure centres. • Ideally provide benchmarks/limits for wet, dry (sports hall, low energy intensity) and fitness (dry but with higher energy intensity to run machines, vent/cooling etc) that can be weighted according to the % area within a building	

Sports & Leisure – Existing stock profile

This combines data from the DEC database, and that from 2 large sports & leisure operators, made available to the UK-NZCBS through the call for evidence. The SG report also includes graphs using data from just these 2 data providers, with resulting median values. The results are a bit lower than those shown here including the DEC dataset, but not markedly different.
This is for Wet leisure centres. Similar analysis is available in the SG profile report for Dry leisure centres.



Commercial Residential – Performance Levels

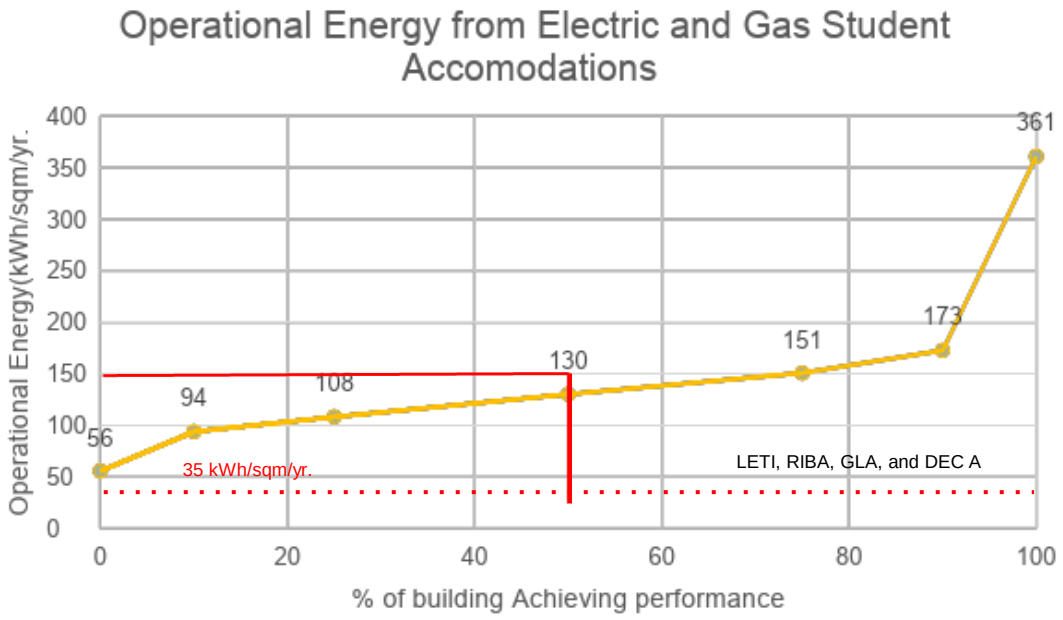
	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)					
					Best Practice today			Future exemplar		
	Core	**Additional**	**Median**	**Best practice**	**Annual energy use**	**Sub-sector EUI equivalent**	**Space heating & cooling**	**Annual energy use**	**Sub-sector EUI equivalent**	**Space heating & cooling**
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^2/yr	kWh/m^{2}GIA/yr	Annual space heating demand, kWh/m^2/yr	kWh/m^2/yr	kWh/m^{2}GIA/yr	Annual space heating demand, kWh/m^2/yr
Student accommodation	Heating Cooling Fans Heat Rejection Pumps DHW Lighting Small Power (e.g., computers / TVs / other) Cooking Elevators Refrigeration	Laundry Server rooms Admin spaces	124 (all elec) 130 (gas + elec) (50th)	94 (10th)	tbc	tbc	15 (space heating) - tbc			15 (space heating) - tbc
Care homes			Not available – see comments on next slide. Indicative range: 130-145 kWh/m^{2}GIA/yr	Not available – see comments on next slide. Indicative range: 70-90 kWh/m^{2}GIA/yr	tbc	tbc	15 (space heating) - tbc			15 (space heating) - tbc

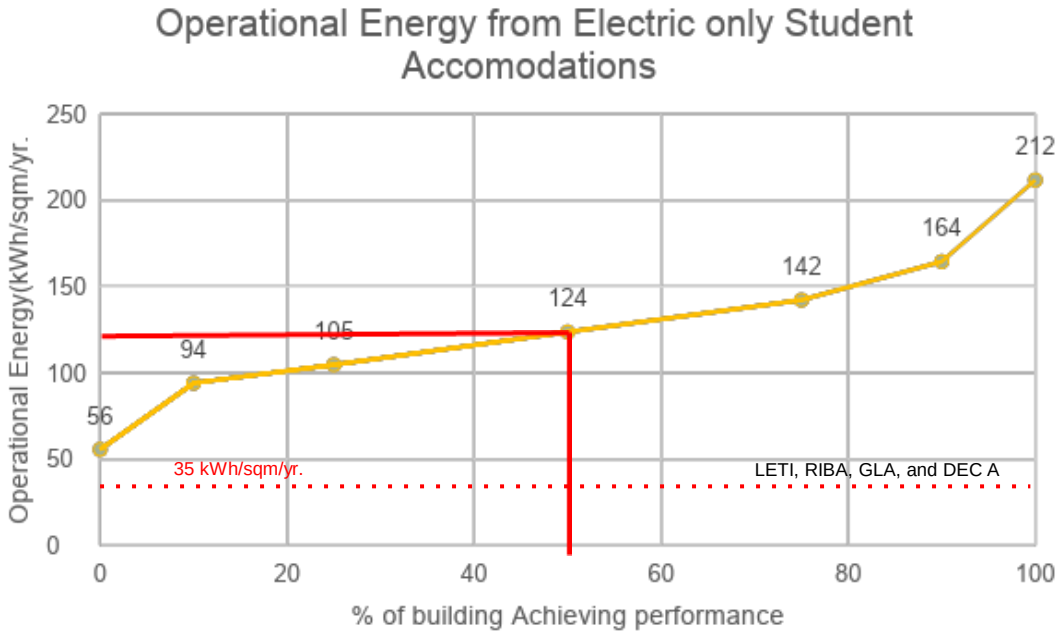
Commercial Residential – Background and Next Steps

	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)	
					Best Practice today	**Future exemplar**
Other schemes			Benchmarks: Student accommodation: the above is based a collection of 80 student accommodation operational energy consumption (2019). Care homes: No available benchmarks were identified. The range above is based on healthcare (per the NHS recommendations to follow LETI offices) and residential (RIBA Challenge), with care homes expected to sit somewhere between the two.		Targets and limits: Student accommodation: proposing general Net Zero initiatives • Unite Students Net Zero Target: https://www.unitegroup.com/wp-content/uploads/2021/12/38271_UniteStudents_NetZero.pdf Vero Homes Net Zero Inputs: https://vertohomes.com/zero-carbon/ GSA Group: https://www.gsagroup.com/global-footprint/uk/ Care homes: none identified at this stage	
Existing buildings meeting PL?					The performance levels are not confirmed yet. Further modelling and data availability is needed.	
Modelling					One model for a Care Home building has been produced. Further modelling, including scenario testing (e.g. climate variations) and additional models, are needed in order to produce performance levels.	
Performance gap					Tbc as part of development of Performance Levels	
Further development	Develop the current existing stock median and best practice values with a bigger dataset for increased accuracy.				Develop Performance Levels for the 2 sub-sectors based on 3 IES models per sub-sector, against agreed performance metrics, and with involvement of a qualified third party to QA the models and assumptions.	

Commercial Residential

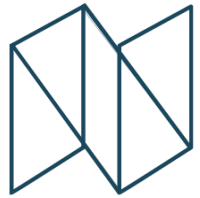
The dataset represents a collection of 80 student accommodations from the year 2019 operational energy consumption. Graph 1 dataset represents heat from gas boilers, local electric heating, and district heating. Graph 2 dataset is limited to local electric heating and district heating.





7. Operational Energy Performance Levels

Culture and Entertainment – Performance Levels

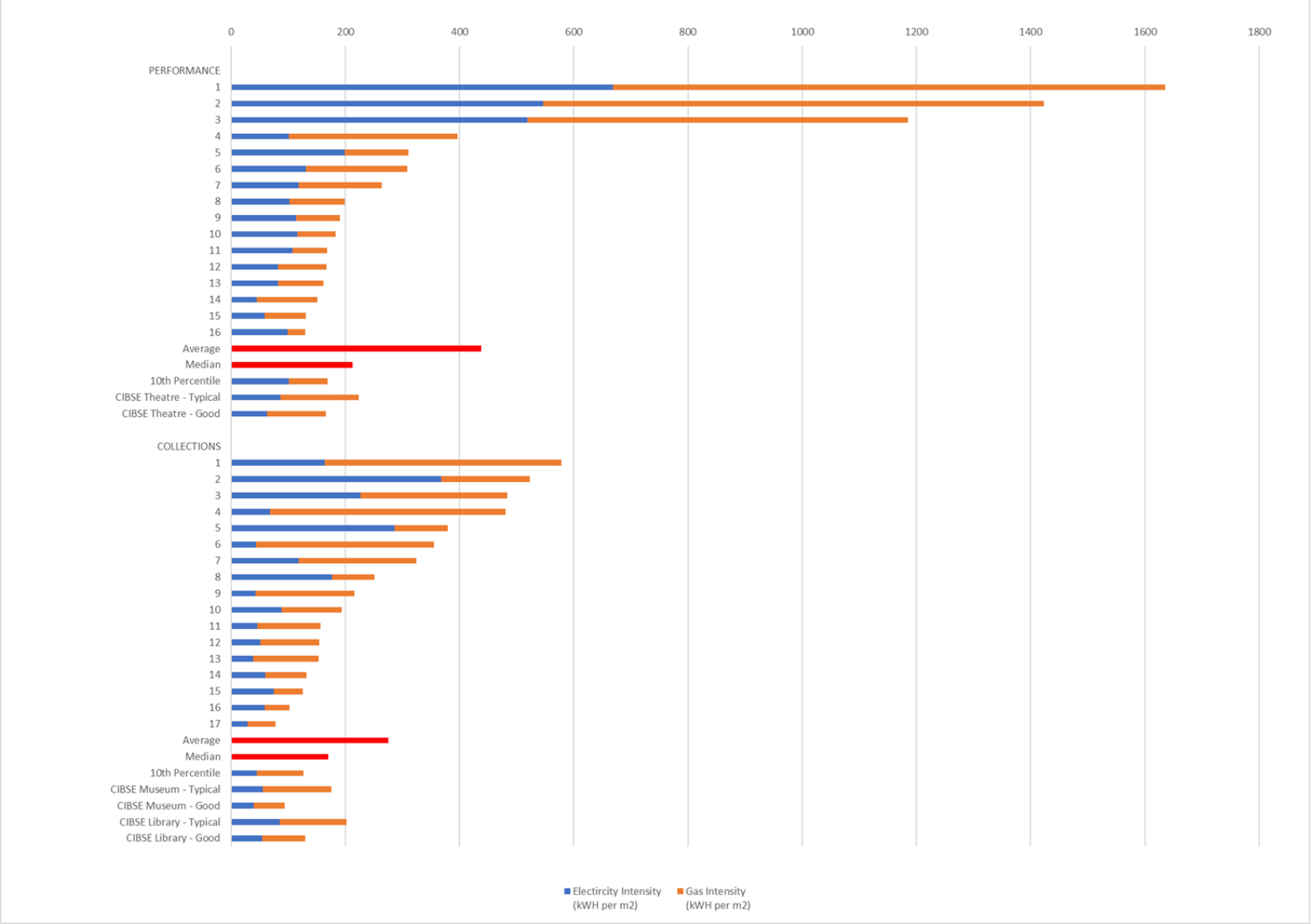


	End uses		Existing stock benchmarking		New build Performance levels (for core end uses)							
					Best Practice today				Future exemplar			
	Core	Additional	Median	Best practice	Annual energy use	Space heating & cooling		Demand flexibility	Annual energy use	Space heating & cooling		Demand flexibility
Metrics **Sub-sectors**			kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr	kWh/m^{2}GIA/yr				kWh/m^{2}GIA/yr			
Performance (interval based)	theatres, cinemas, opera houses	catering, workshops for producing theatres	Total: 203 Gas: 102 Elec: 111	Total: 134 Gas: 63 Elec: 70 (10th Percentile)	tbc	tbc	tbc	tbc	tbc	tbc	tbc	tbc
Collection based (non-interval)	museums, art galleries (possibly visitor centres and libraries)	archives	Total: 170 Gas: 111 Elec: 59	Total: 91 Gas: 50 Elec: 41 (10th Percentile)	tbc	tbc	tbc	tbc	tbc	tbc	tbc	tbc

Culture and Entertainment – Background and Next Steps

	End uses	Existing stock benchmarking	New build Performance levels (<u>for core end uses</u>)	
			Best Practice today	**Future exemplar**
Other schemes		Other industry benchmarks available: • Julie's Bicycle: at organisation level • CIBSE benchmarks are available for Theatres, Museums and Libraries, based on DECs. They are shown for comparison in the following slide. The ones for Cinemas are considered too old. The benchmarks proposed in the table in the previous page are derived from a combination of projects from Julie's Bicycle database as well as projects submitted through the call for evidence – see details on next slide.	Targets and limits: there are (as of yet) no clear recommended targets that are science-based targets.	
Existing buildings meeting PL?			TBC once Performance Levels are developed	
Modelling			<u>Performance buildings:</u> Modelling has been carried out for buildings in the Performance sub-sector, but not yet completed. The results are significantly better than the current 10th percentile, so need more analysis and refinement. <u>Collections buildings: A m</u>odel is available - on-going.	
Performance gap			Tbc as part of development of Performance Levels	
Further development	Confirm benchmarks (median and best practice) for both sub-sectors		Develop performance levels for the 2 sub-sectors, against agreed performance metrics	

Culture and Entertainment



7. Operational Energy Performance Levels

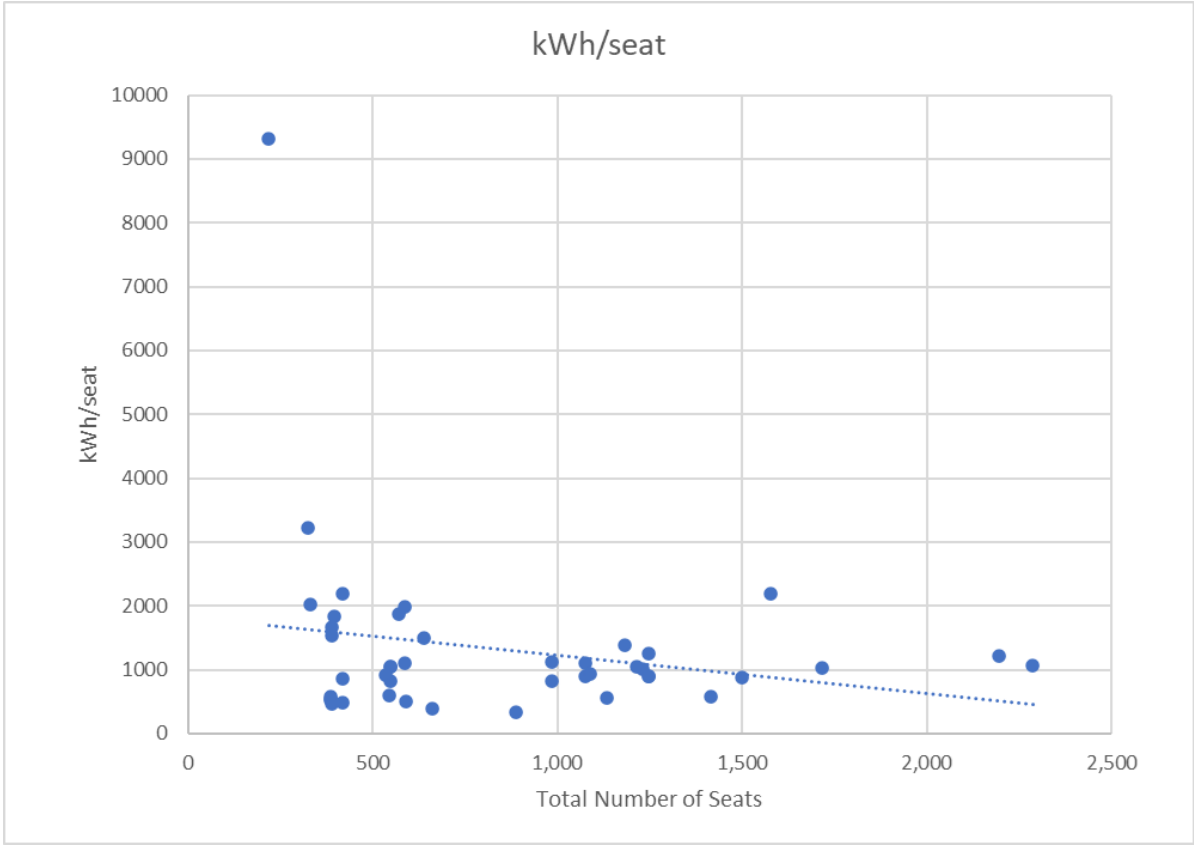
Energy Use Intensity for current benchmark projects, and CIBSE benchmarks where available

Culture and Entertainment

Examination of metrics for annual energy use:

- Based on rudimentary DEC analysis, area per seat varies.
- There is a trend to theatres with larger seat counts have slightly lower EUI per seat – but it is a shallow trend line.
- The ‘cleanest’ metric is EUI per m^2 of total floor area, possibly with EUI per seat as a sub-metric.
- EUI per ticket sale was also considered, but is difficult to collect as a wide dataset.
- All told, the Sector Group’s view is that EUI per m^2 of total floor area is the best metric to use.

Comments on this choice of metric are welcome as part of the consultation response. (58)



New Build Operational Energy Performance Levels

Talking Points

53. Do you have comments on the benchmarks (median and best practice) for the existing stock detailed in this section, and additional information which could refine these? Please provide evidence to support your comments

- Sector and sub-sector to which your comments apply
- Can you recommend other benchmark sources we have not identified here?
- Any other comments on the median benchmark?
- Any other comments on the best practice benchmark?

54. Do you have comments on the sector analysis detailed in this section, and additional information which could refine it? Please provide evidence to support your comments

- Sector and sub-sector to which your comments apply
- Comments on the proposed categorisation into sub-sectors?
- Comments on the proposed “core” and “additional” energy end uses?
- Comments on proposed performance metrics?
- Any other comments?

55. Do you have comments on the performance levels detailed in this section, and additional information which could refine them? Please provide evidence to support your comments

- Sector and sub-sector to which your comments apply
- Comment on the “best practice today” performance level: do you think it is too ambitious, or not ambitious enough? Please provide evidence for your comments e.g. data from an existing building in this sub-sector, energy performance modelling in this sub-sector
- Comment on the “best practice today” performance level: do you think it is too ambitious, or not ambitious enough? Please provide evidence for your comments e.g. data from an existing building in this sub-sector, energy performance modelling in this sub-sector
- Any other comments?

56. Would you be able to contribute to further development of performance levels in a sector or sub-sector? If so, please provide your email, the sub-sector(s), and the type of support you could provide:

- Sector and sub-sector to which your comments apply
- Expertise of energy use in that sub-sector
- Energy performance modelling
- Project examples with in-use energy data
- Other - please specify

Next Steps

Operational energy performance levels

Please do complete the technical testing **consultation** giving feedback on the operational energy performance levels and associated background i.e. sub-sectors, performance metrics, existing stock benchmarks and best practice projects.

If you think from your experience that the performance levels shown are too high/low, we would encourage you to share the data from your own projects - see consultation questions in previous slide.

Please also get in touch if you can support the development of performance elves in any sector, but particular in:

- The sectors where draft performance levels are currently available but at an early stage of development: Datacentres, Higher Education, Science & Tech, Logistics & Warehouses, Retail.
- The sectors where draft performance levels are not yet available i.e. Hotels, Sports & Leisure, Commercial Residential, Culture & Entertainment.

"A huge thank you to all the individuals and companies who have submitted operational energy data in aggregate or for individual projects, and who have provided modelling and analysis resources to develop our understanding of operational energy use in the UK."

Julie Godefroy,
Chair of Operational Energy Task Group

8. Top-down Pathways

Current workstream and developments driven by climate science

Overview

Top Down – What this means:

Task Group 1c is tasked with developing the science based methods and principles of how the UK National Carbon Budget is allocated to the built environment, so that each sector and asset is doing their fair share to ensure the UK achieves net zero by 2050.

Key Roles and Responsibilities

- Establishing the nationally derived carbon ‘budget allocations’ for each of the built environment sectors so that they are aligned with science-based trajectories needed to achieve net zero by 2050 and 78% by 2035 in the UK.

- Developing a suite of asset level budget-aligned, science based net zero carbon characteristics, limits and targets.

Introduction

The Top-down Task Group has been developing the methods and principles behind the national budget allocation process. This includes establishing the relevant national carbon 'budgets' for each sector and aligning these with science-based trajectories needed to achieve net zero by 2050 and 78% by 2035 in the UK (see p. x).As well as establishing the carbon budget, a stock model and a downscaling methodology have been developed, which is described overleaf.

Approach

All industries on 1.5C pathway

The work has sought to understand what the carbon budget for the built environment would be if all industries were on track to meet a 1.5°C pathway, recognising that this is not the case. This approach should result in targets that are highly ambitious, without requiring the built environment to compensate for underperformance in other industries.

Background:
According to the UN Environment Programme, there is "no credible pathway to 1.5°C in place", and recent reports indicate that the world is going to exceed that temperature limit within the next few years.

On that basis, the remaining carbon budget that complies with a 1.5°C pathway – not just for the built environment, but for all economic industries– is essentially zero.

However, there is an unavoidable practical need for some types of construction, maintenance and refurbishment to proceed. Therefore approach assumes equity across industries making similar ambitious progress.

Stock Model

A stock model is being developed which will help to inform the net zero carbon asset level energy and carbon limits.

Through extensive literature review and engagement with a broad range of prospective data partners, a series of preferred data sources have been identified which are documented in this report.

Stock Model Characteristics

- Total floor area (m²),
- Number of properties
- Energy performance (EUI and heating fuel/fuel mix) of the residential and non-residential building stock across the UK, disaggregated into building sub-sectors (6 residential, 38+ non-residential).

- Projections of the change in floor area of the stock between now & 2050 for each sector, capturing overall growth, demolition rates, new build and retrofit projection, with a range of growth scenarios to be explored (low, medium and high growth)

Stock Model

Two stock modelling are being developed the residential and non-residential stock models, respectively.

Residential

Country	Floorspace Dataset(s)
England and Wales	EHCS (2020) & WHCS (2017-18)
Scotland	SHCS (2019)
Northern Ireland	NIHCS (2016)

Notes

The primary stock dataset will be validated against relevant comparator datasets as the model is developed (e.g. national housing statistics, EST home analytics datasets, domestic energy consumption statistics at national level).

Non - Residential

Country	Floorspace Dataset(s)
England and Wales	BEIS BEES Dataset
Scotland	Derived from Scotland's ND-NEED Baseline, mapped to BEES sub-sectors
Northern Ireland	Extrapolated from BEIS BEES Dataset, with average floor area to be derived based on population.

Notes

There has been engagement with DESNZ and UCL to clarify the timelines for a forthcoming update of the BEES study. Whilst the publication timeline does not align with the first issue of the standard, opportunities to future proof the structure of the stock model to facilitate an efficient future update are being pursued.

Carbon Budgets

Following review of the available literature and existing precedents for deriving industry/built environment-specific carbon budgets and scenarios, we have developed a set of **fourteen criteria** by which to review and assess existing budgets.

Preferred Criteria

- Future scenarios
- End user allocation
- Consumption based
- Sector definition alignment
- UK budget compatible
- Paris-aligned (1.5°C)
- Realistic
- Relevant trends
- Disaggregated (trends)
- Disaggregated (sectors)
- All GHGs
- Single dataset
- Single scenario
- Energy and carbon

Budgets Assessed

- UK GHG Inventory
- DEFRA Carbon Footprint
- CCC Carbon Budget
- BEIS EEP
- National Grid FES
- UKGBC Roadmap
- Tyndall Centre Budget

Carbon Budgets

- To date, no single data source reviewed has met all assessment criteria and no precedent for a formal carbon budget being adopted at a industry level has been identified in the UK or internationally.
- Although the Climate change committee has set out indicative decarbonisation pathways for different industries to inform decision-making, it does not prescribe sector-specific targets.
- Establishing a carbon and energy budget will therefore require further analytical work to adapt one or more of these data sources. The adjusted budgets will then be downscaled to different sub-sectors and building types to enable targets and limits to be derived.

Current Recommendation: Carbon and energy budgets derived from the CCC's Sixth Carbon Budget will be used. The carbon budgets will be 'upscaled' to reflect consumption-based emissions, rather than territorial (i.e., including embodied emissions that originate outside of the UK)*.

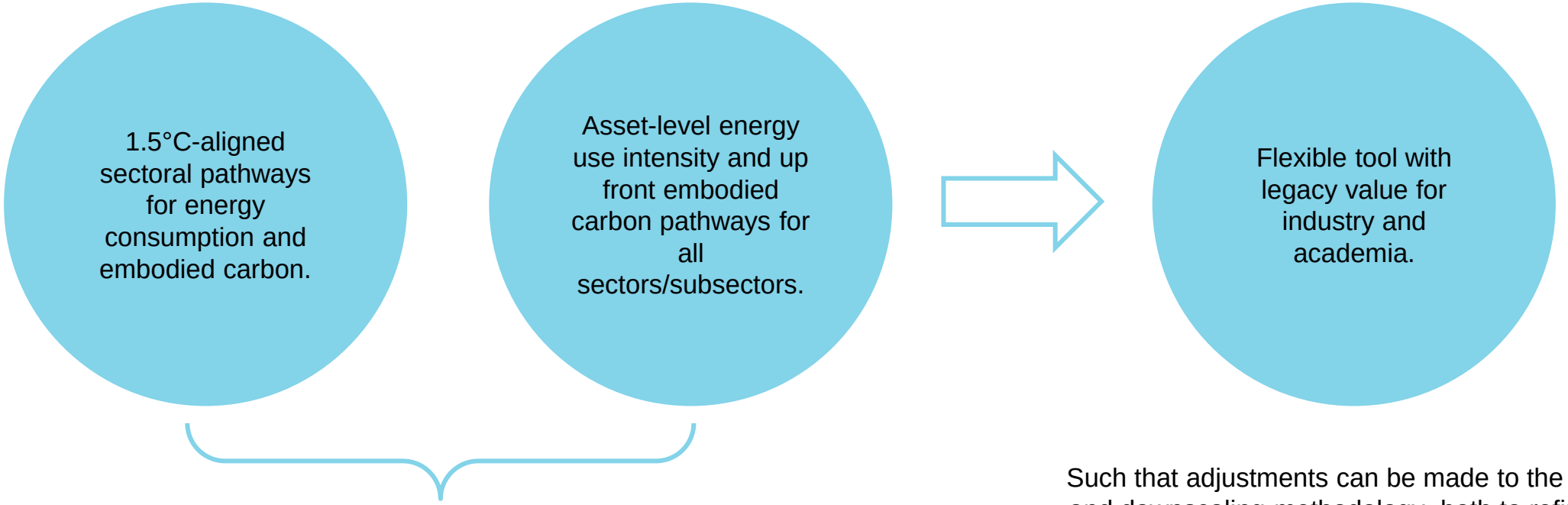
** Territorial emissions are those that occur within the geographic boundary of the UK. This approach excludes consumption-based emissions, i.e. emissions from imported goods, if these occur outside of the UK. Many construction materials are produced in other countries, which means that a territorial carbon budget would not fully account for the embodied carbon of the built environment. The process for upscaling the budget in this way is still being discussed and confirmed.*

Downscaling

- The aim of the Downscaling work was to set out a broad methodology for aligning top-down budgets with bottom-up performance data, by undertaking background research and preparation to inform the development of the Science Based Sectoral Limit Setting (SBSLS) Tool.
- The aim of the Science Based Sectoral Limit Setting Tool is to provide a functional data model which is able to ‘downscale’ the relevant UK national carbon and energy budgets for the built environment to asset level operational and embodied carbon limit pathways, by drawing together outputs including:
    - Energy and carbon budgets, baseline floorspace, energy use, fuel mix, and growth projections accounting for new build, refurbishment and demolition rates.
    - Embodied carbon and operational energy asset-level performance data from the Call for Evidence

Downscaling

Key outputs of the Science Based Sectoral Limits Setting Tool (SBSLS) tool are summarised below.



Taking into account not only reductions in emissions but also any consequent increases due to the actions required to deliver the net zero transition (e.g. embodied impact of retrofit).

Such that adjustments can be made to the inputs and downscaling methodology, both to refine the first iteration of the limits and to enable future use.

Top Down Elements

Talking Points

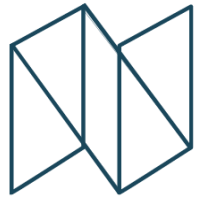
59. Do you have any comments on the proposed approach to developing the stock model?

60. Do you have any comments on the proposed approach to developing the budgets?

61. Do you have any comments on the proposed approach to developing the downscaling?

With thanks

From the UK Net Zero Carbon Buildings Standard



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Fiona Cousins – **CIBSE**

Hywel Davies – **CIBSE**

Patrick Hayes – **IStructE**

Julie Hirigoyen – **UKGBC**

Bill Hughes – **PIA**

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David Porter – **ICE**

Sarah Ratcliffe – **BBP**

Jonathan Rickard – **BRE**

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Chris Twinn – **LETI**

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