

# CUNDALL

Net Zero Carbon

Challenges and opportunities

# Agenda

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- Context
- Net Zero Carbon Buildings
- NZC – Whole life and Embodied Carbon
- NZC – Operational Energy
- Existing Buildings

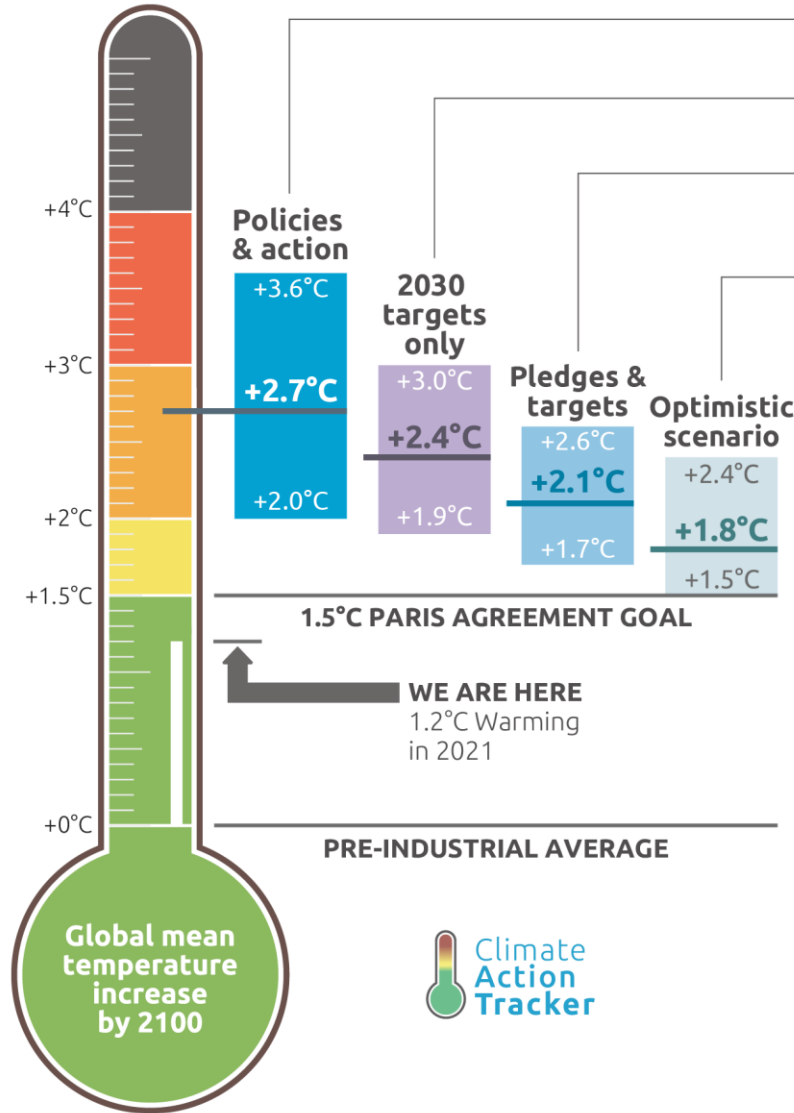
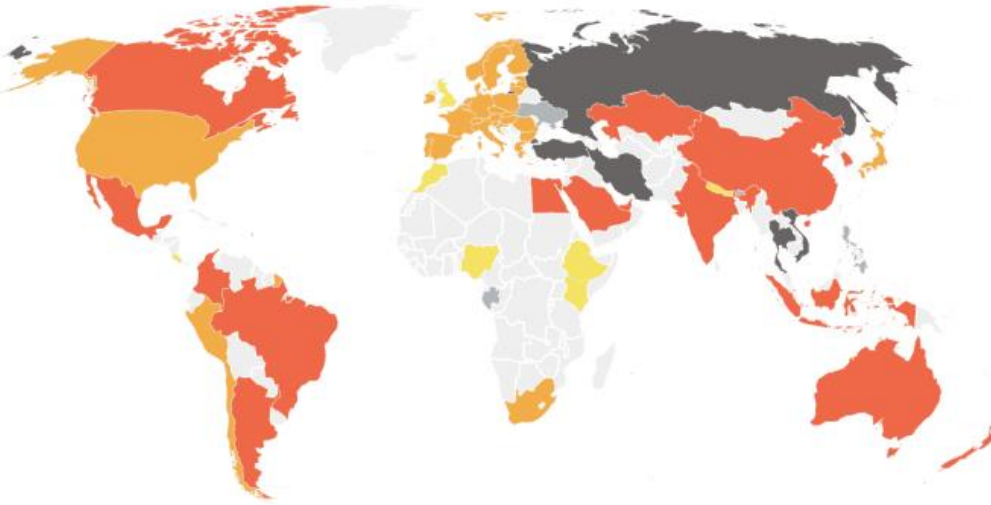




Context

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# Global Trajectory



- Policies & action**  
Real world action based on current policies
  - 2030 targets only**  
Full implementation of 2030 NDC targets\*
  - Pledges & targets**  
Full implementation of submitted and binding long-term targets and 2030 NDC targets\*
  - Optimistic scenario**  
Best case scenario and assumes full implementation of all **announced** targets including net zero targets, LTSs and NDCs\*
- \* If 2030 NDC targets are weaker than projected emissions levels under policies & action, we use levels from policy & action

CAT warming projections  
**Global temperature increase by 2100**  
 November 2021 Update

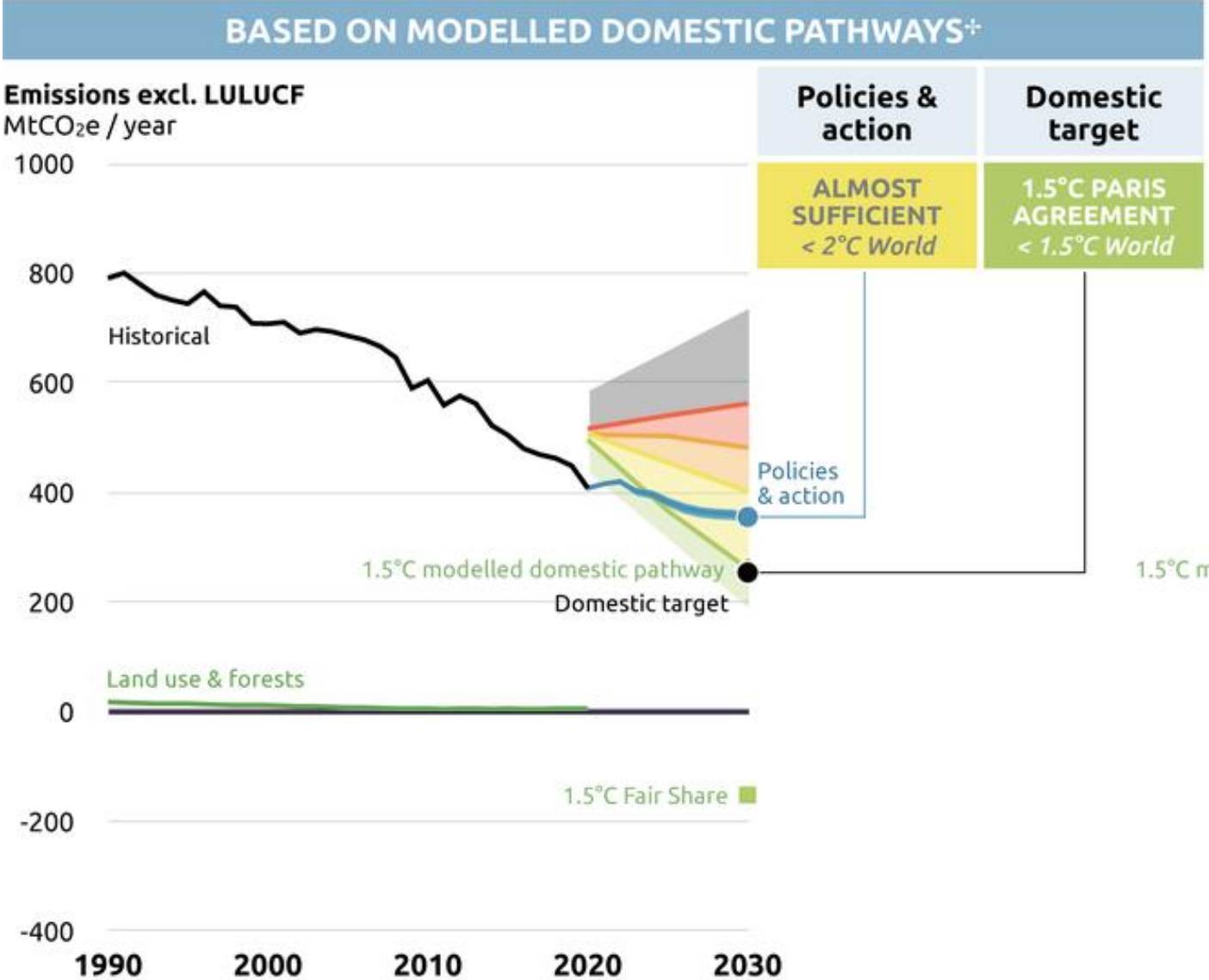


# UK Commitments

- **Net Zero by 2050**  
2019

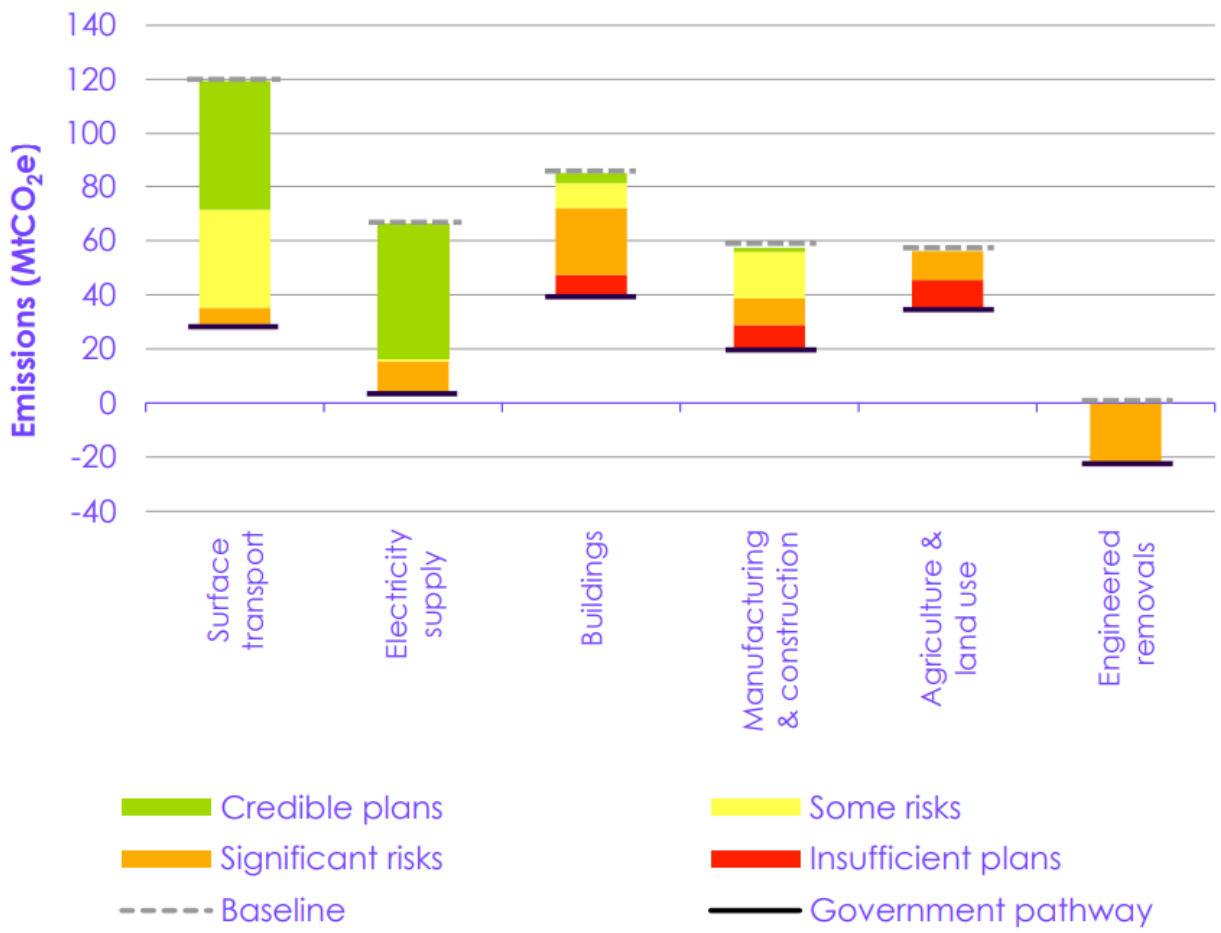
- **78% by 2035**  
2020

- **68% by 2030**  
COP26 2021



# Progress in reducing emissions 2022 Report to Parliament

Figure 5 Assessment of policies and plans in 2035 for key sectors



# Drivers for Change

## **Investors**

*Assets must meet CSR requirements and be “Paris Aligned”*



## **Developers**

*Differentiate developments using Net Zero certifications*



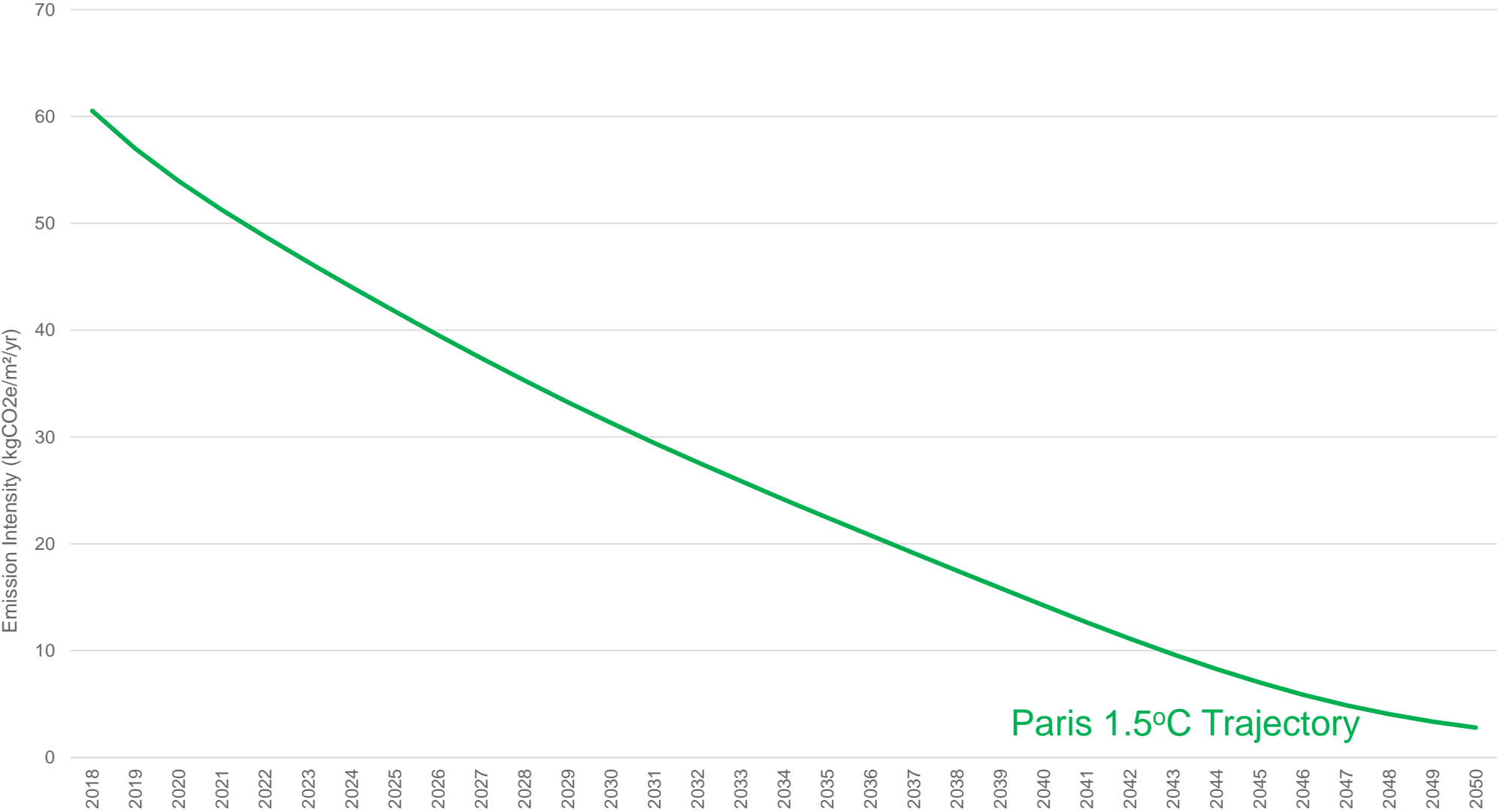
## **Occupiers**

*Buildings must support corporate Science Based Targets*



# Stranded Assets (CRREM & SBT)

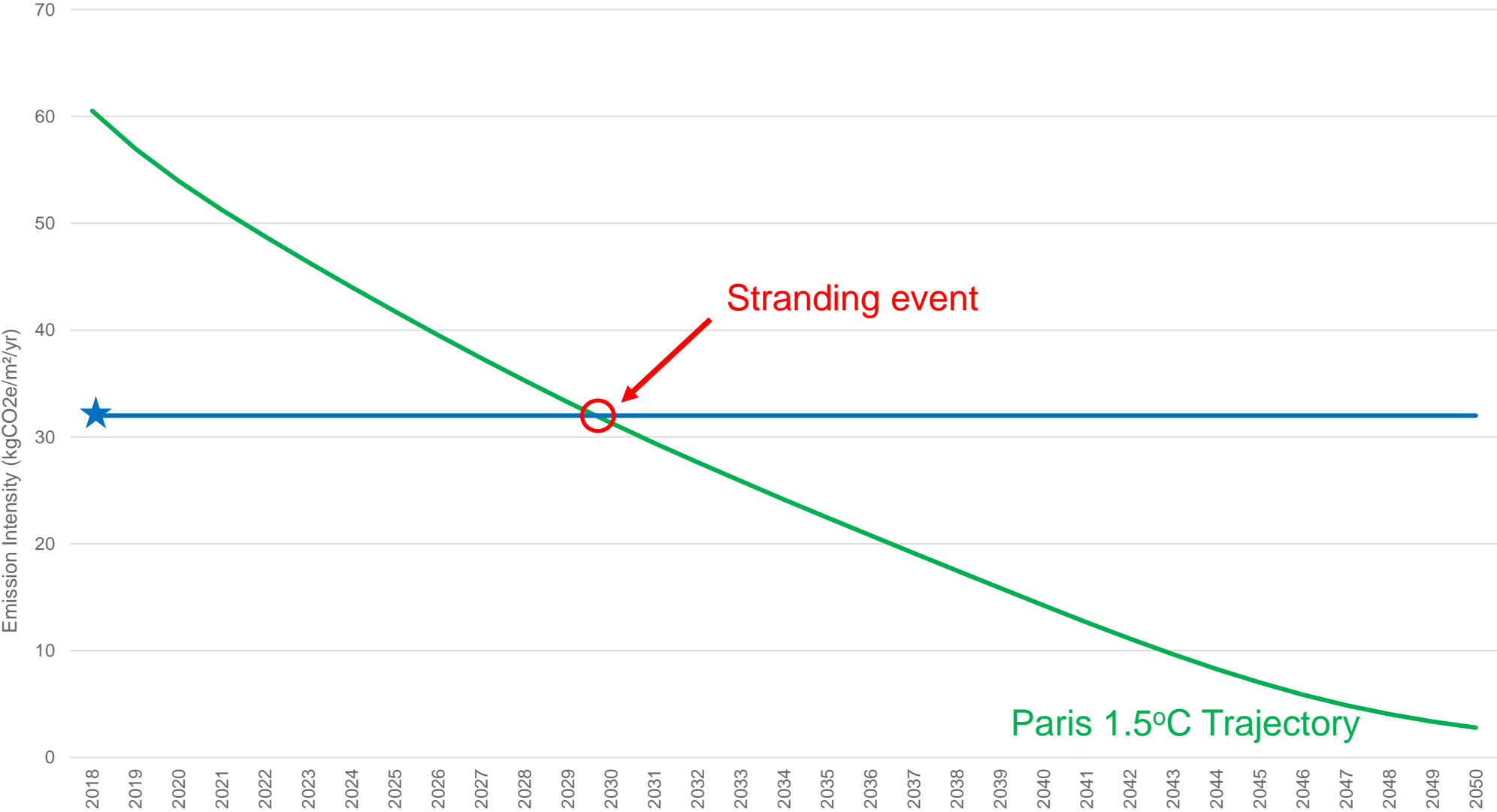
## Decarbonisation Reduction Pathway





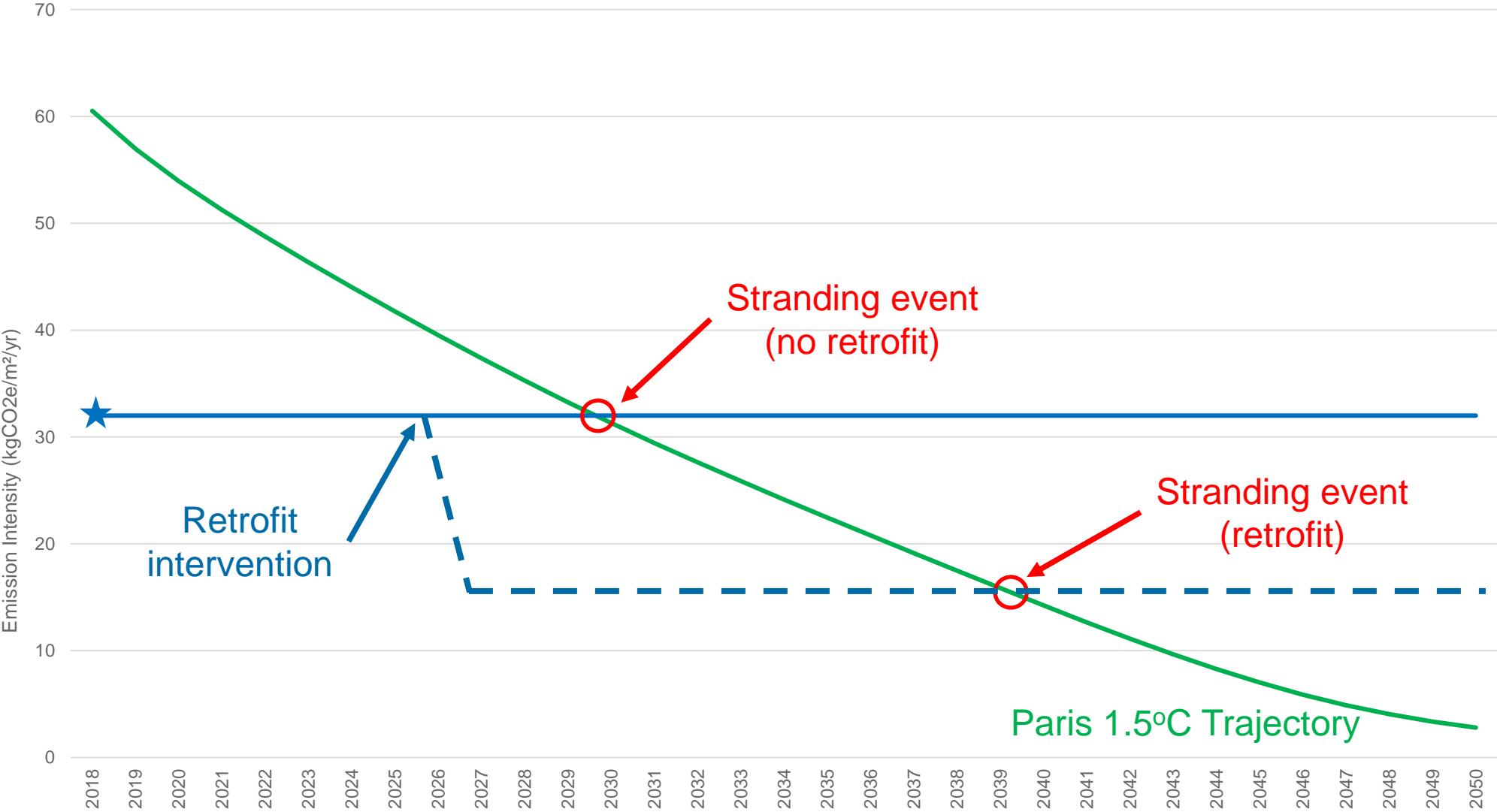
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## Decarbonisation Reduction Pathway



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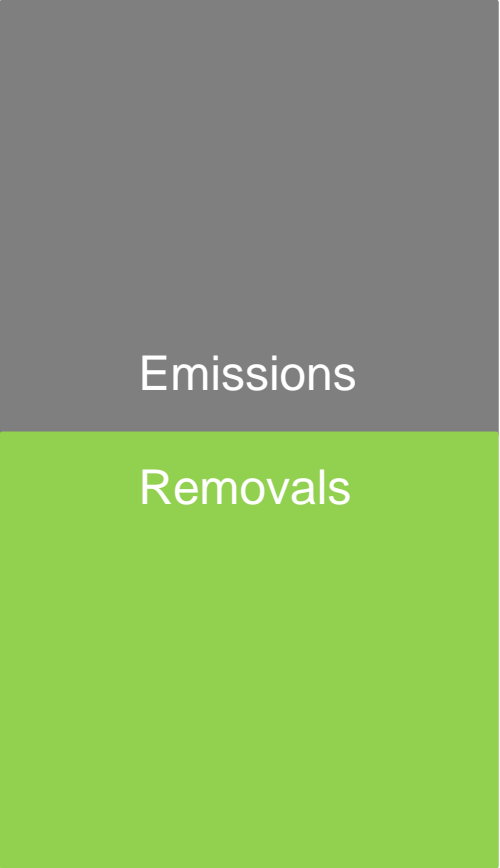


# Net Zero Carbon Buildings

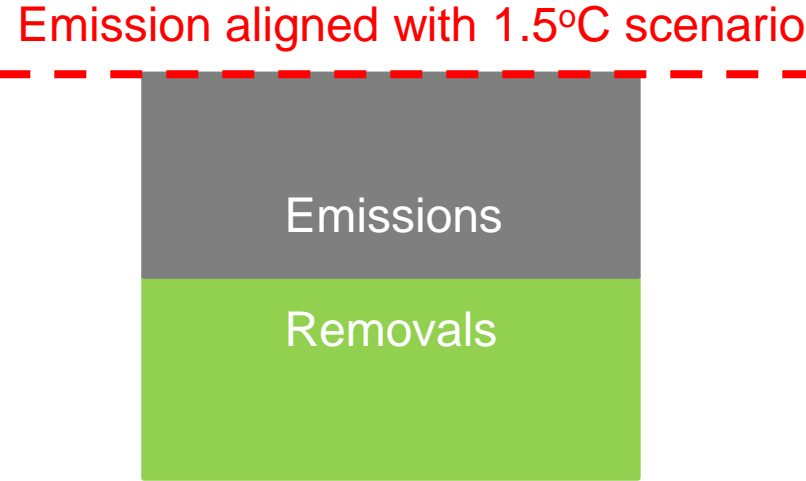
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# Carbon Footprint - Definitions

## Carbon Neutral



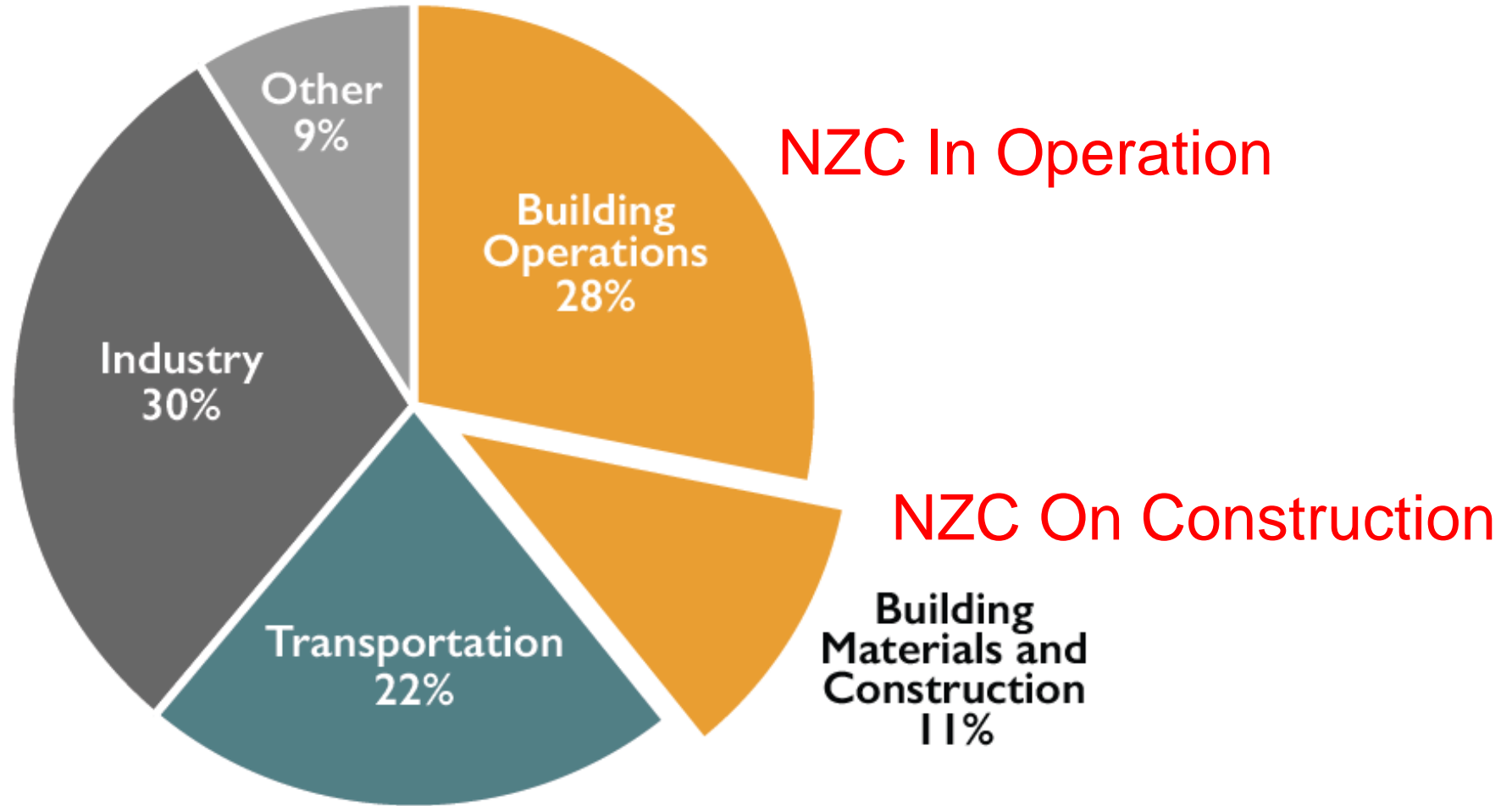
## Net Zero Carbon



## Absolute Zero Carbon



# The Built Environment



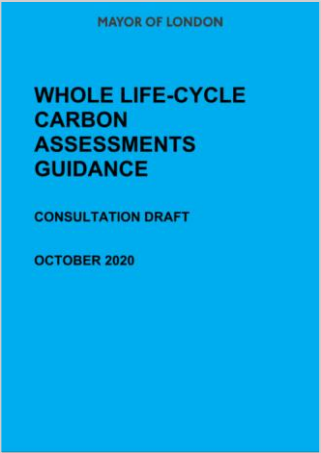
Source: © 2018 2030, Inc. / Architecture 2030. All Rights Reserved. Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

# 10 year journey of embodied carbon

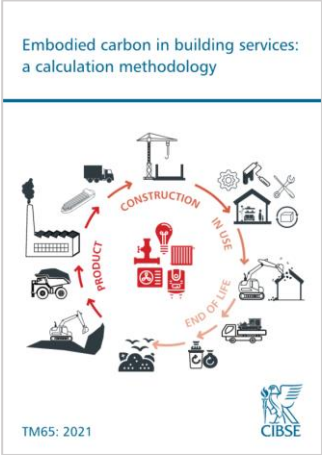
RICS Professional Statement



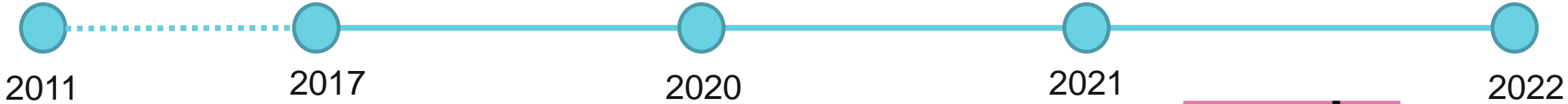
WLC guidance



TM65



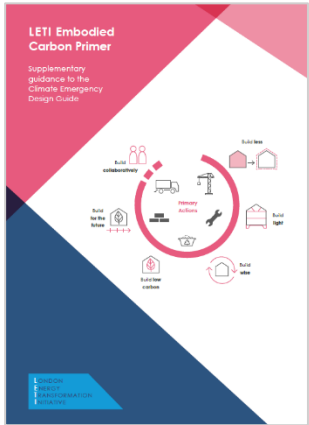
EC in press coverage



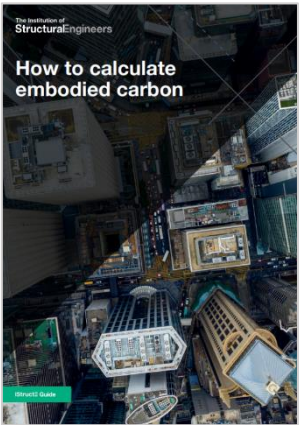
Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method



BS EN 15978



EC Primer



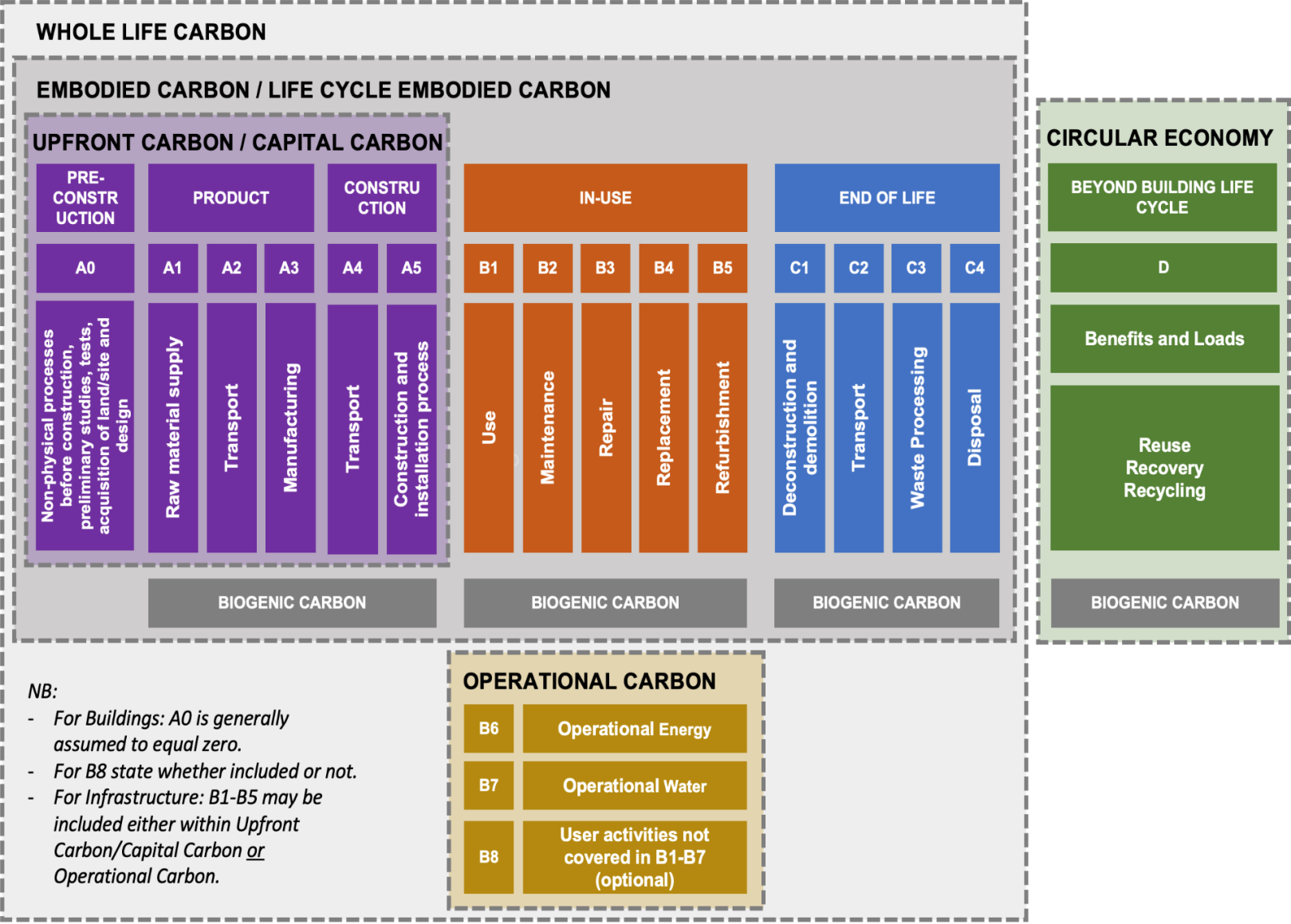
IStructE CEC



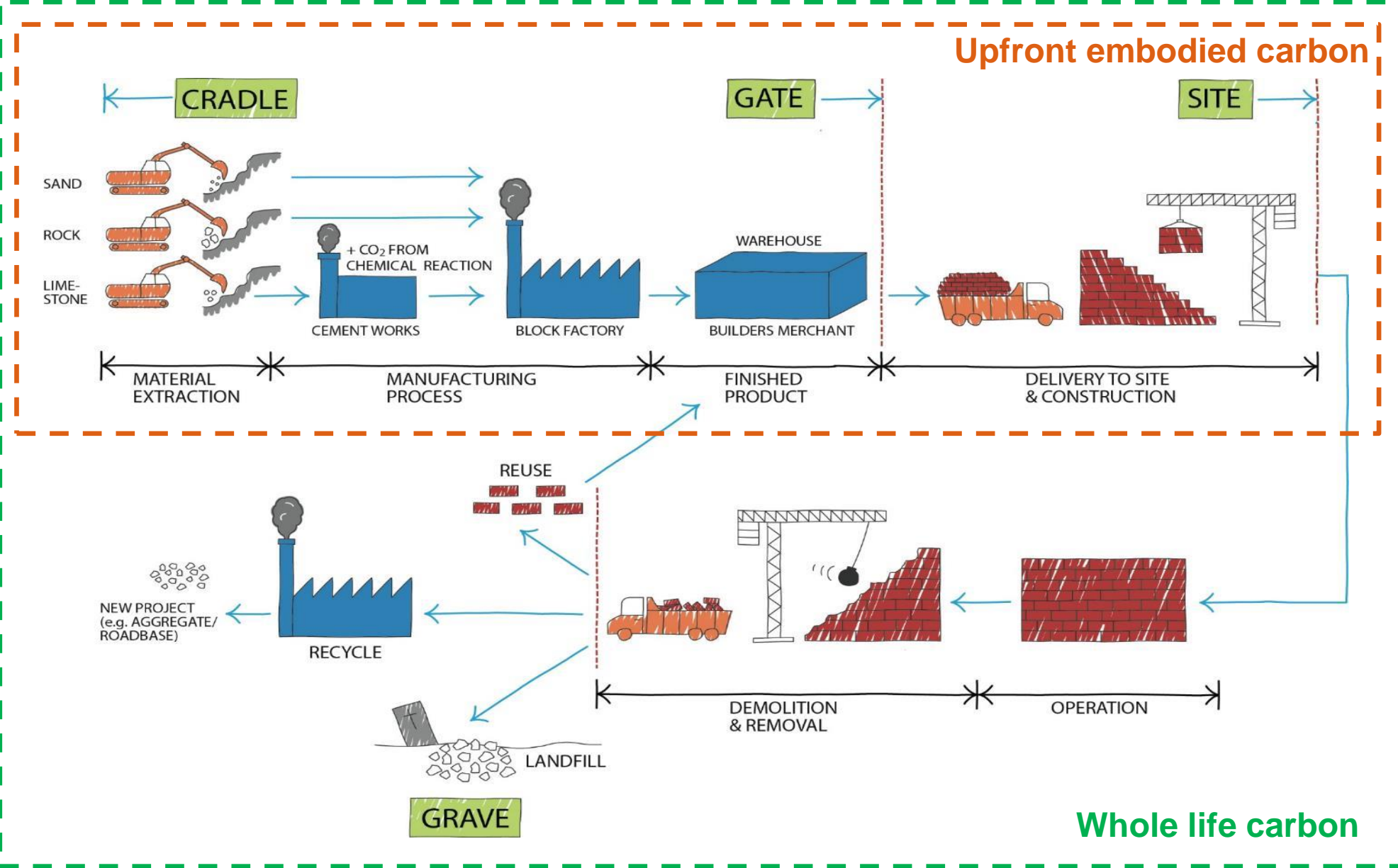
Petitioning of Part Z

2022

# Carbon Footprint - Scoping



# NZC On Construction - Upfront & whole life embodied carbon





# NZC on Construction – New upfront & whole life embodied carbon targets

Upfront Carbon, A1-5 (exc. sequestration)

Band	Office	Residential	Education	Retail
A++	<100	<100	<100	<100
A+	<225	<200	<200	<200
A	<350	<300	<300	<300
B	<475	<400	<400	<425
C	<600	<500	<500	<550
D	<775	<675	<625	<700
E	<950	<850	<750	<850
F	<1100	<1000	<875	<1000
G	<1300	<1200	<1100	<1200

LETI 2030 Design Target

LETI 2020 Design Target

Embodied Carbon, A1-5, B1-5, C1-4 (inc. sequestration)

Band	Office	Residential	Education	Retail
A++	<150	<150	<125	<125
A+	<345	<300	<260	<250
A	<530	<450	<400	<380
B	<750	<625	<540	<535
C	<970	<800	<675	<690
D	<1180	<1000	<835	<870
E	<1400	<1200	<1000	<1050
F	<1625	<1400	<1175	<1250
G	<1900	<1600	<1350	<1450

RIBA 2030 Built Target

All values in kgCO<sub>2</sub>e/m<sup>2</sup> (GIA)

We are developing an industry-led

## UK Net Zero Carbon Buildings Standard

www.NZCBuildings.co.uk



Carbon Definitions for the Built Environment, Buildings and Infrastructure



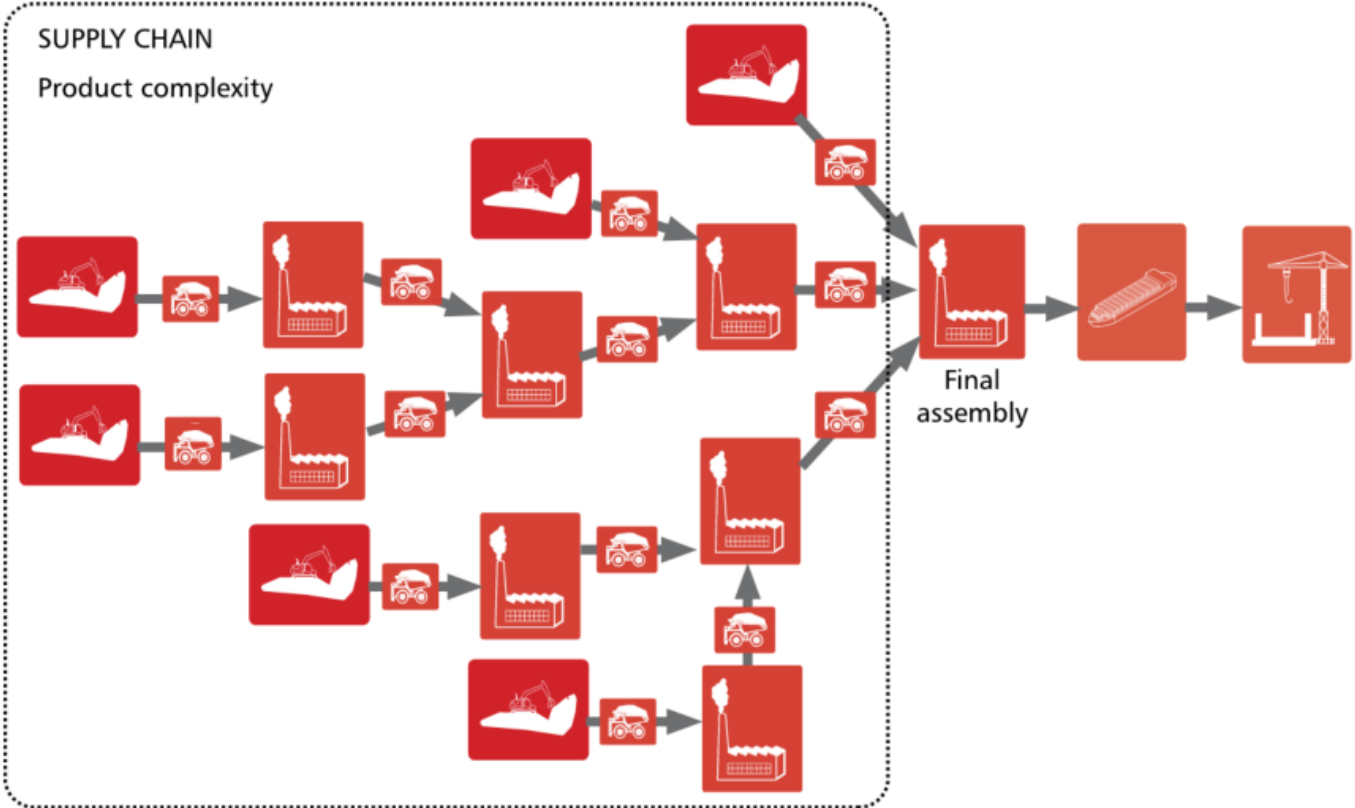
RICS professional statement

RICS professional standards and guidance, UK  
Whole life carbon assessment for the built environment  
1st edition, November, 2017



# NZC On Construction - Embodied Carbon in Building Services

Embodied carbon in building services:  
a calculation methodology



TM65: 2021

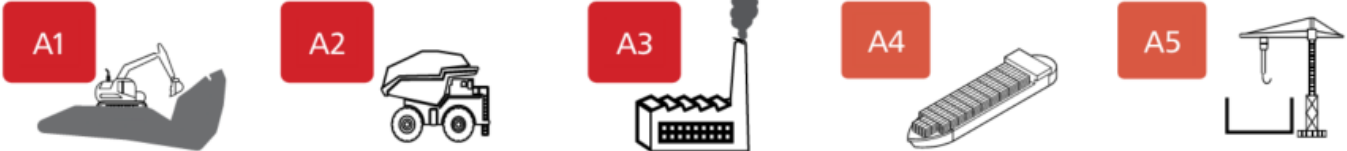
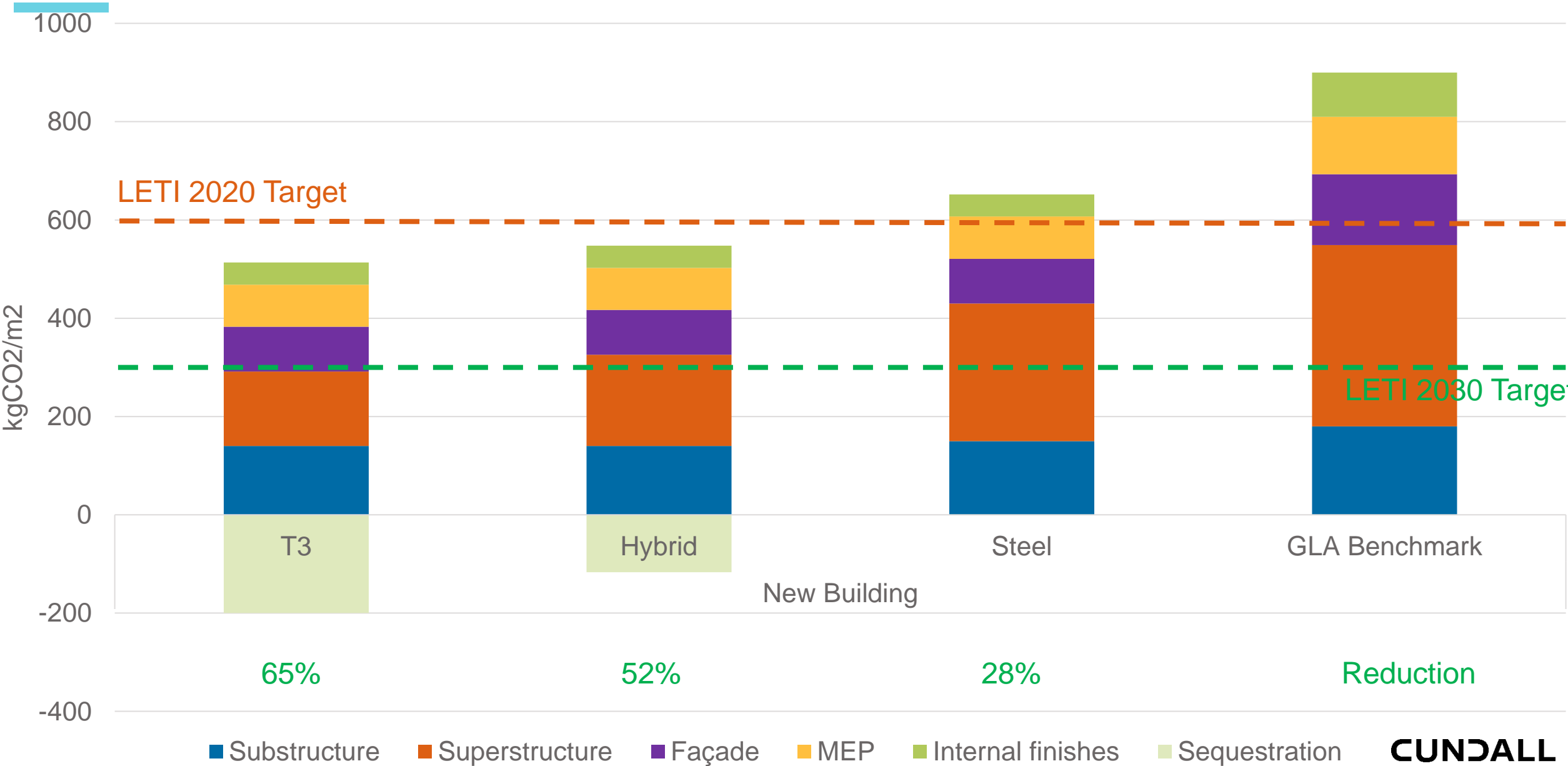
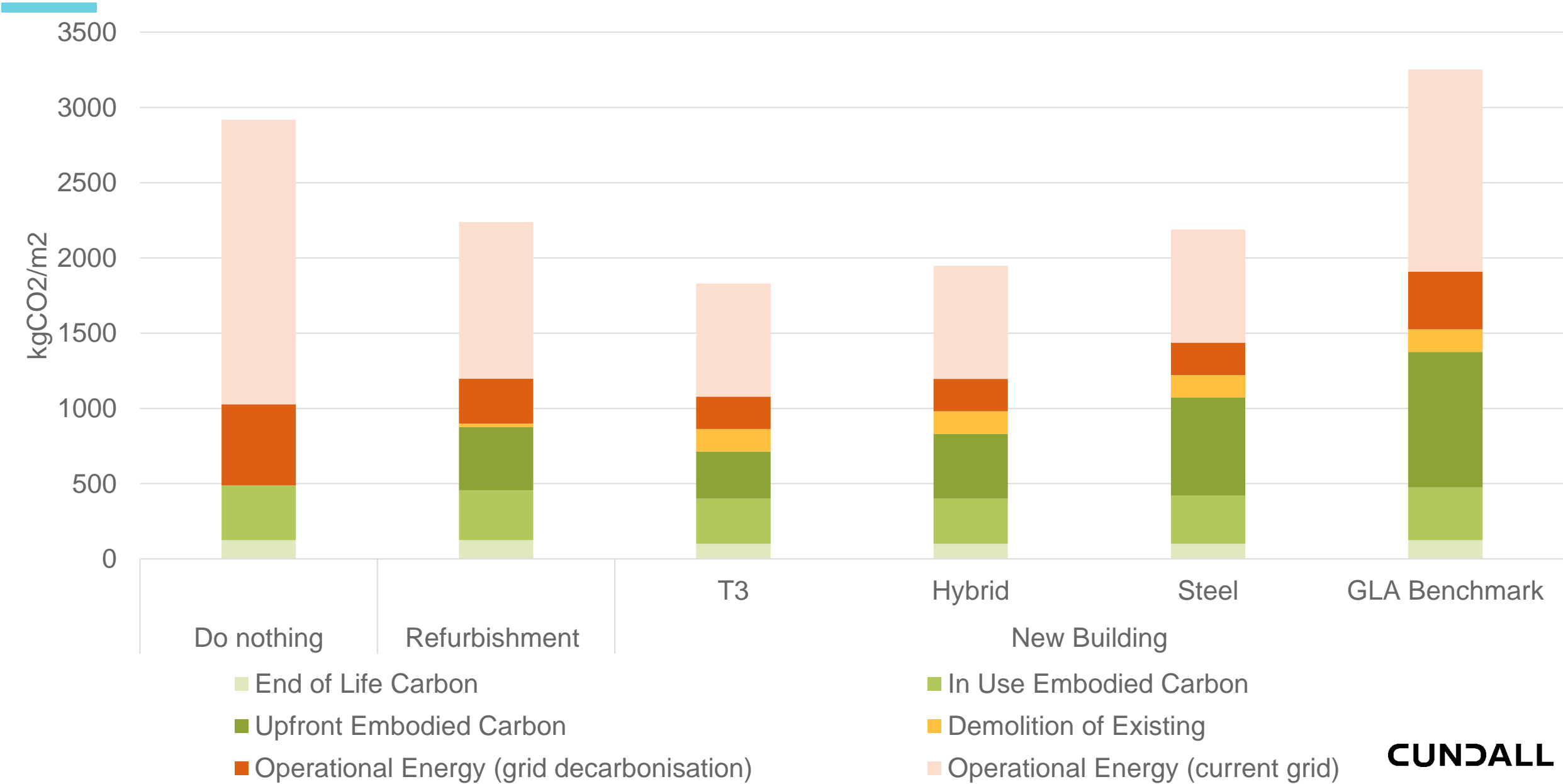


Figure 4.4 Product complexity

# Case Study 1 - Upfront Embodied Carbon (A1-A5)



# Case Study 1 - Whole Life Carbon (A1-C4) – 60 years



# Retrofit First



Time



■ Embodied carbon, (materials)

■ Operating carbon (energy)



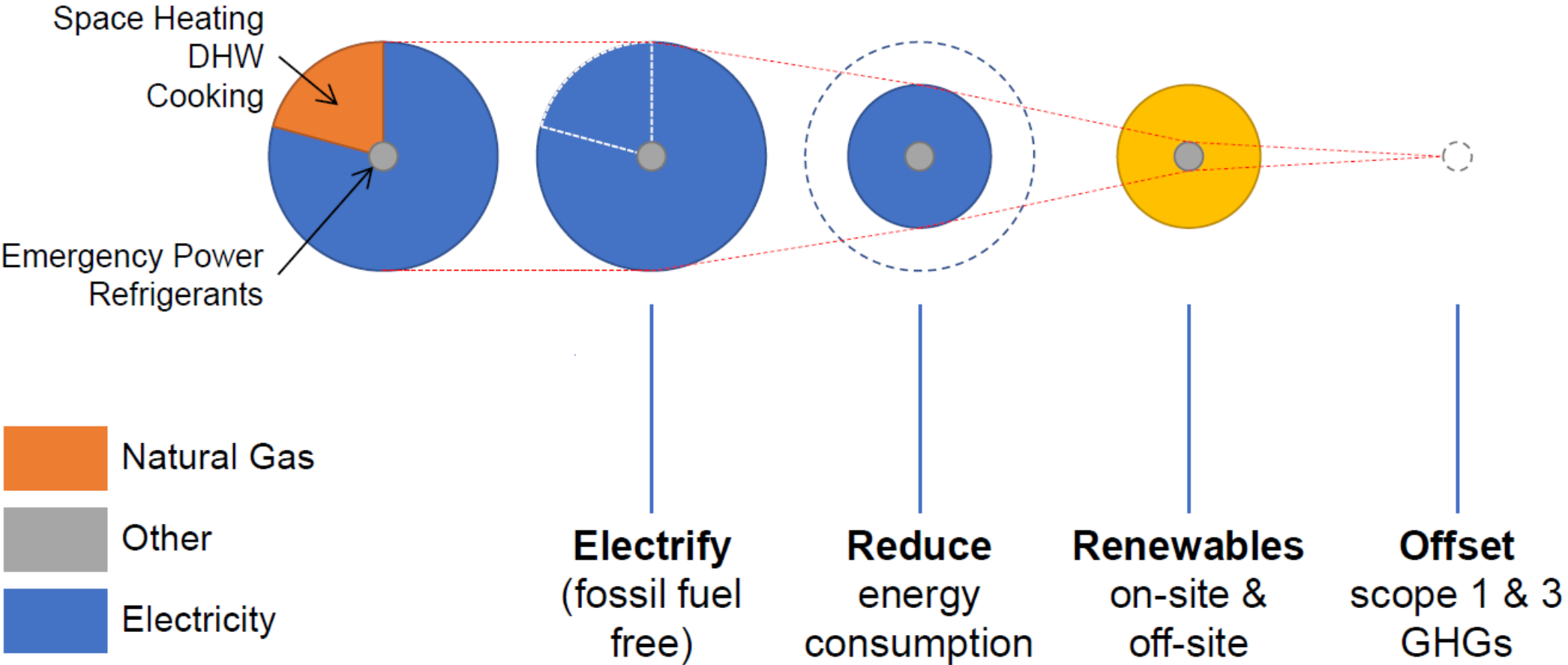
**AJ** Architects' Journal



# Operational Energy

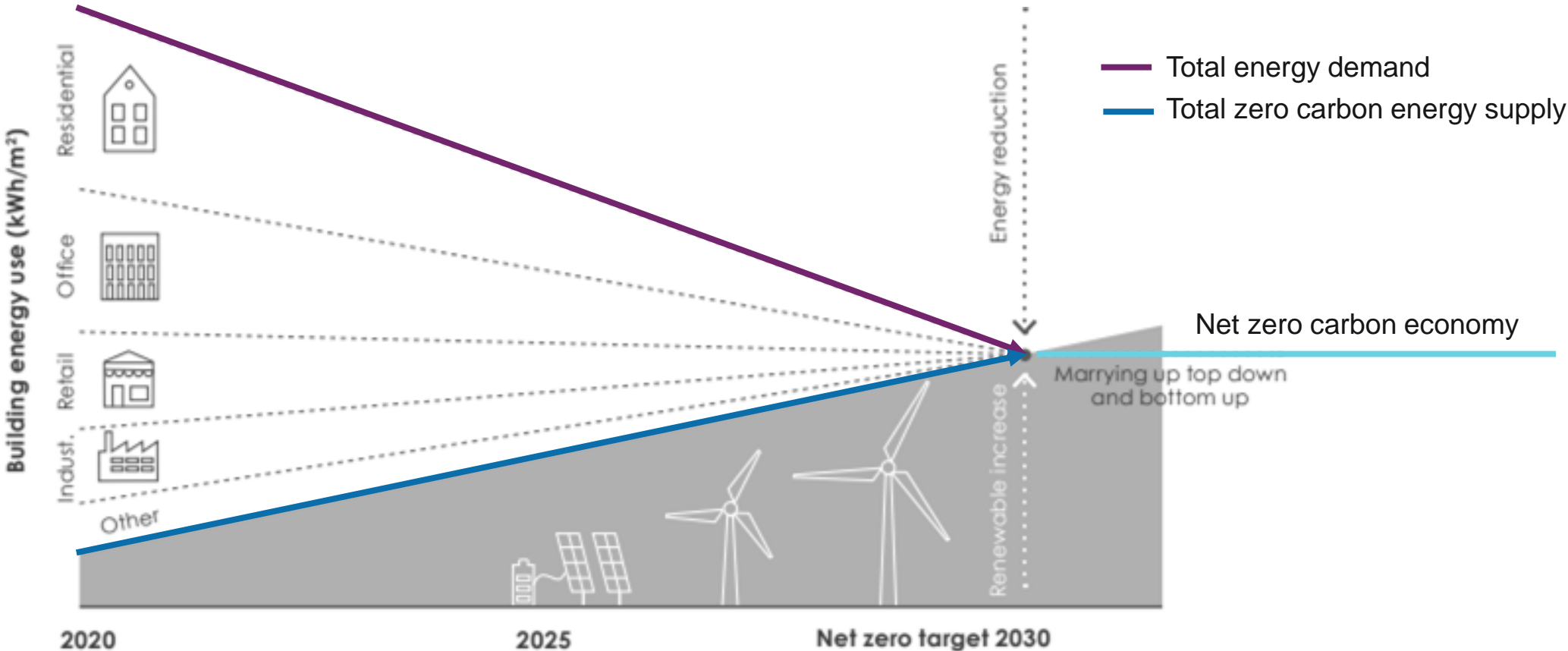
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# Operational Energy – Definition



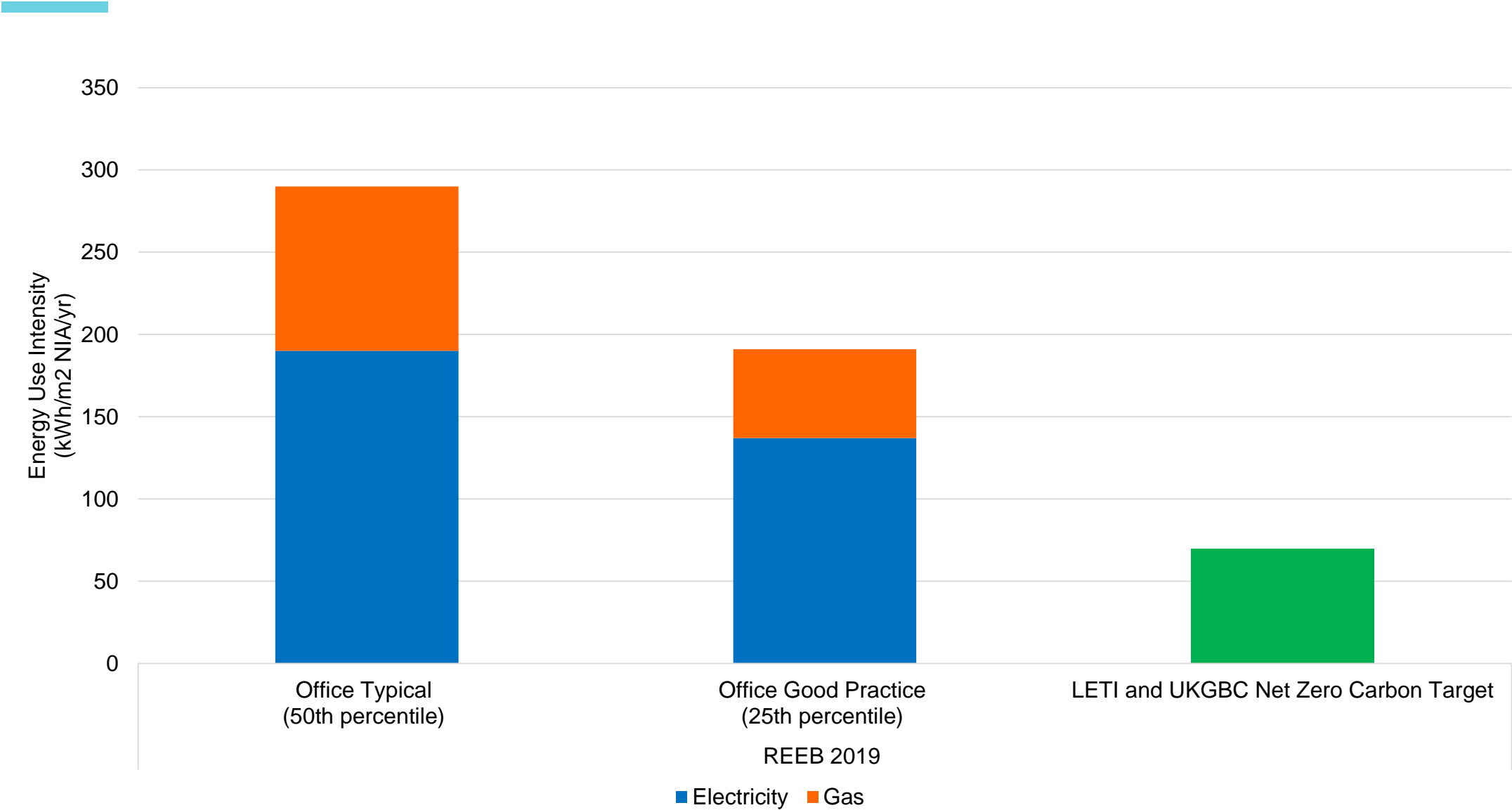
*A 'Net Zero Operational Carbon – Energy' asset is one where no fossil fuels are used, all energy use (Module B6) has been minimized, meets the local energy use target (e.g. kWh/m2/a) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Direct emissions from renewables and any upstream emissions are 'offset'.*

# Operational Energy – ‘Paris Proof’ Targets

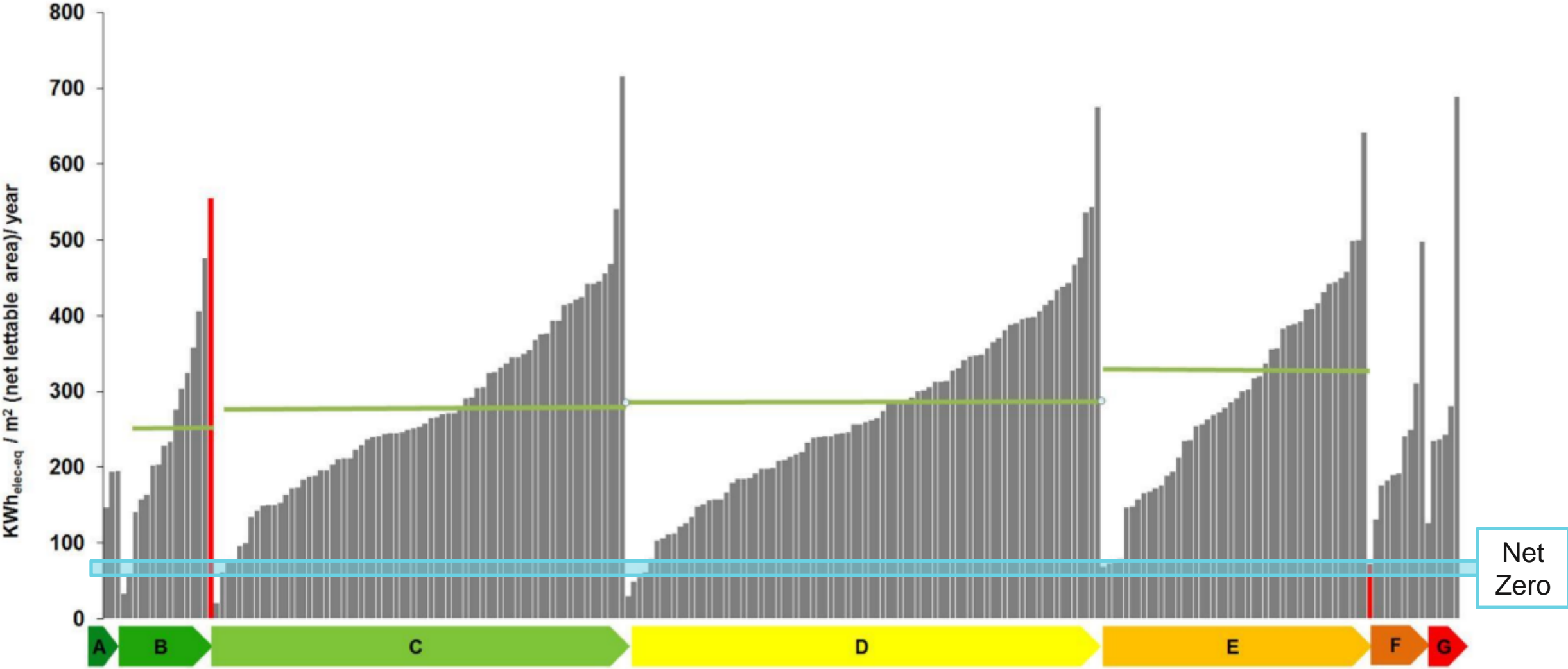




# NZC in Operation– 2050 Energy Intensity Target vs Benchmarks



# Current tools - EPCs



Source: Better Buildings Partnership

# NZC in Operation – Energy Intensity Targets?

**Table 1: Energy performance targets for buildings targeting net zero carbon for operational energy**

Scope	Metric	Interim Targets			Paris Proof Target
		2020-2025	2025-2030	2030-2035	2035-2050
Whole building energy	kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year	160	115	90	70
	kWh <sub>e</sub> /m <sup>2</sup> (GIA) / year	130	90	70	55
	DEC rating	D90	C65	B50	B40
Base building energy	kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year	90	70	55	35
	kWh <sub>e</sub> /m <sup>2</sup> (GIA) / year	70	55	45	30
	NABERS UK star rating	4.5	5	5.5	6
Tenant energy	kWh <sub>e</sub> /m <sup>2</sup> (NLA) / year	70	45	35	35

NLA = net lettable area

GIA = gross internal area

Current best practice

Paris Proof Target

# NZC in Operation – NZC “Enabled”

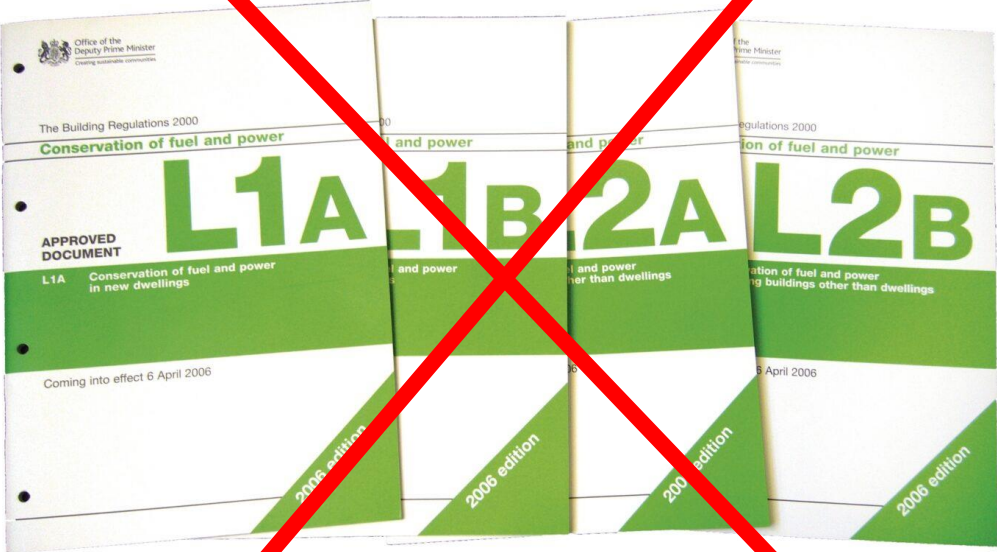


Evaluating operational energy performance of buildings at the design stage



# NZC in Operation – Design Assessments (B6)

IT IS NOT!

An Energy Performance Certificate (EPC) for Chalgrove Primary School, crossed out with a large red X. The certificate is for a non-domestic building and shows an energy efficiency rating of A+ (83) and a net zero CO2 emission rate. It includes technical information and benchmarking data.

**Energy Performance Certificate** HM Government  
Non-Domestic Building

CHALGROVE PRIMARY SCHOOL SCHOOL HAUS Certificate Reference Number:  
Chalgrove Primary School 008 1-0235-4820-07 21-4002  
Chalgrove Gardens  
LONDON  
N3 3PL

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website [www.communities.gov.uk/eppd](http://www.communities.gov.uk/eppd).

**Energy Performance Asset Rating**

More energy efficient

A+ 83 This is how energy efficient the building is. Net zero CO<sub>2</sub> emissions

A 0-25  
B 26-50  
C 51-75  
D 76-100  
E 101-125  
F 126-150  
G Over 150

Less energy efficient

**Technical Information**

Main heating fuel: Grid Supplied Electricity  
Building environment: Heating and Mechanical Ventilation  
Total useful floor area (m<sup>2</sup>): 100  
Building complexity (NDS level): 4  
Building emission rate (kgCO<sub>2</sub>/m<sup>2</sup>): -52.67

**Benchmarking**

Buildings similar to this one could have ratings as follows:

31 If newly built  
92 If typical of the existing stock

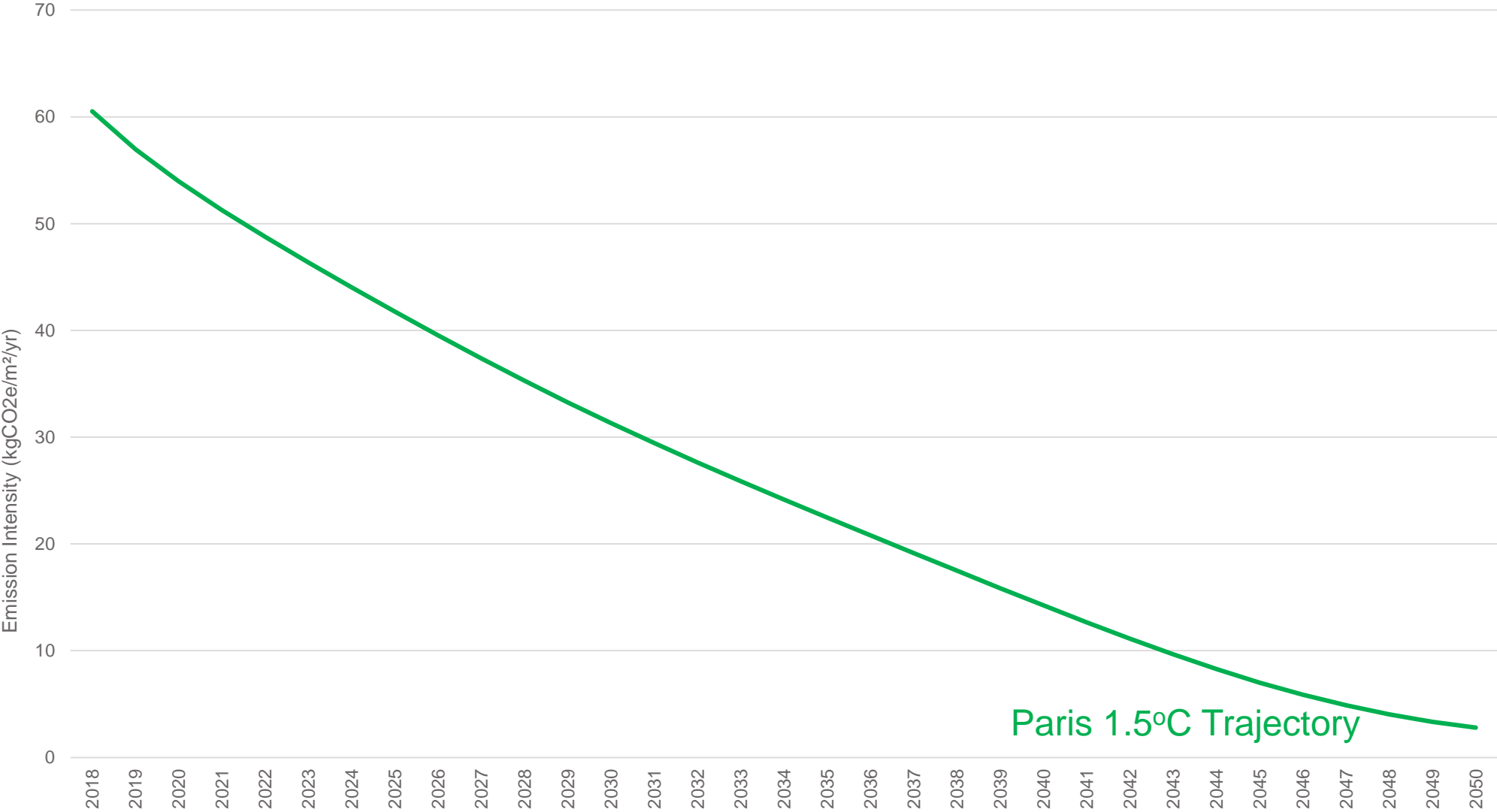
**Green Deal Information**

The Green Deal will be available from later this year. To find out more about how the Green Deal can make your property cheaper to run, please call 0800 123 1234.

THERE IS NO SUCH THING AS 'REGULATED ENERGY NZC'

# NZC in Operation – New Building Energy Intensity Targets

## Decarbonisation Reduction Pathway

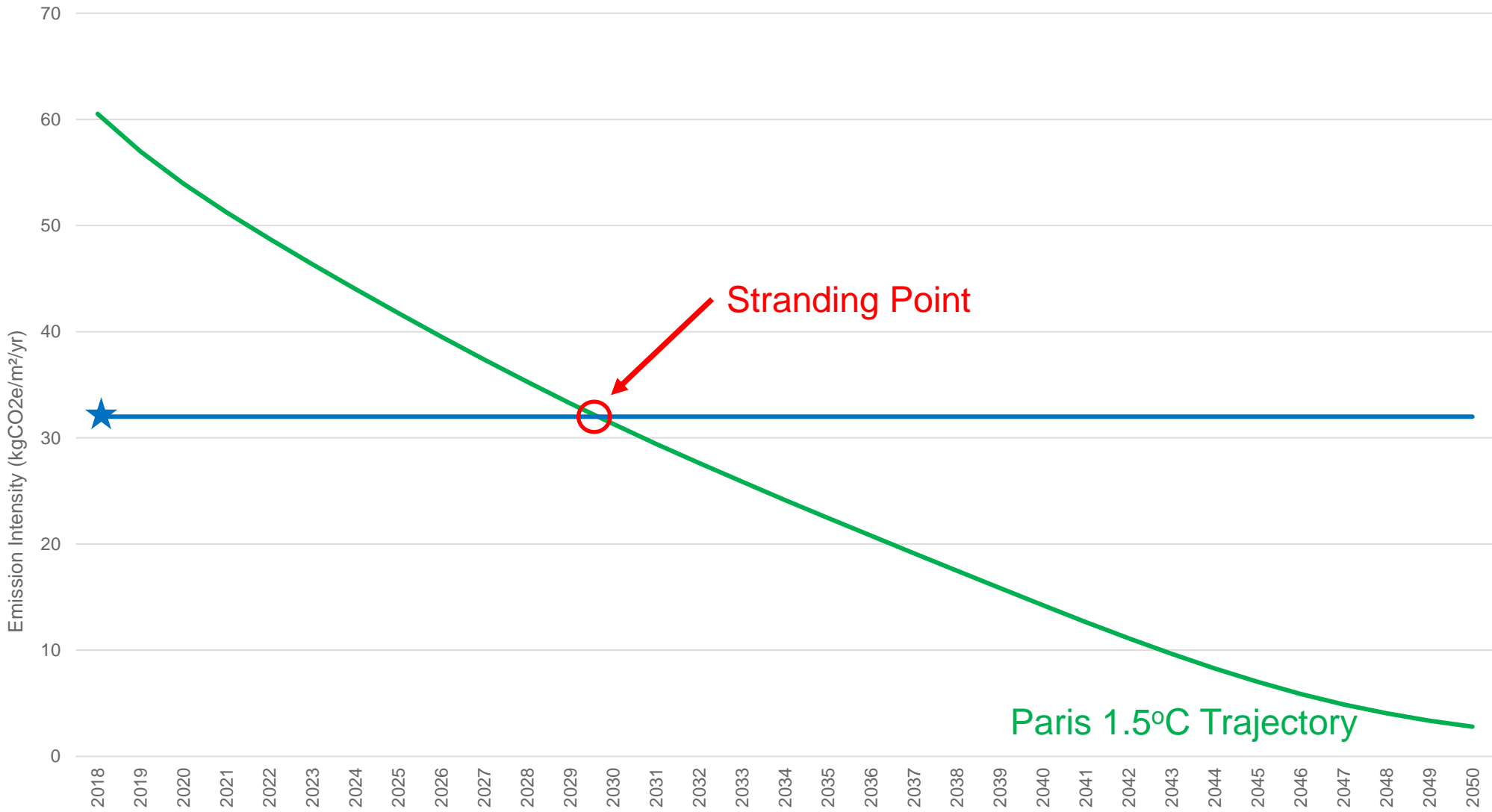


Paris 1.5°C Trajectory



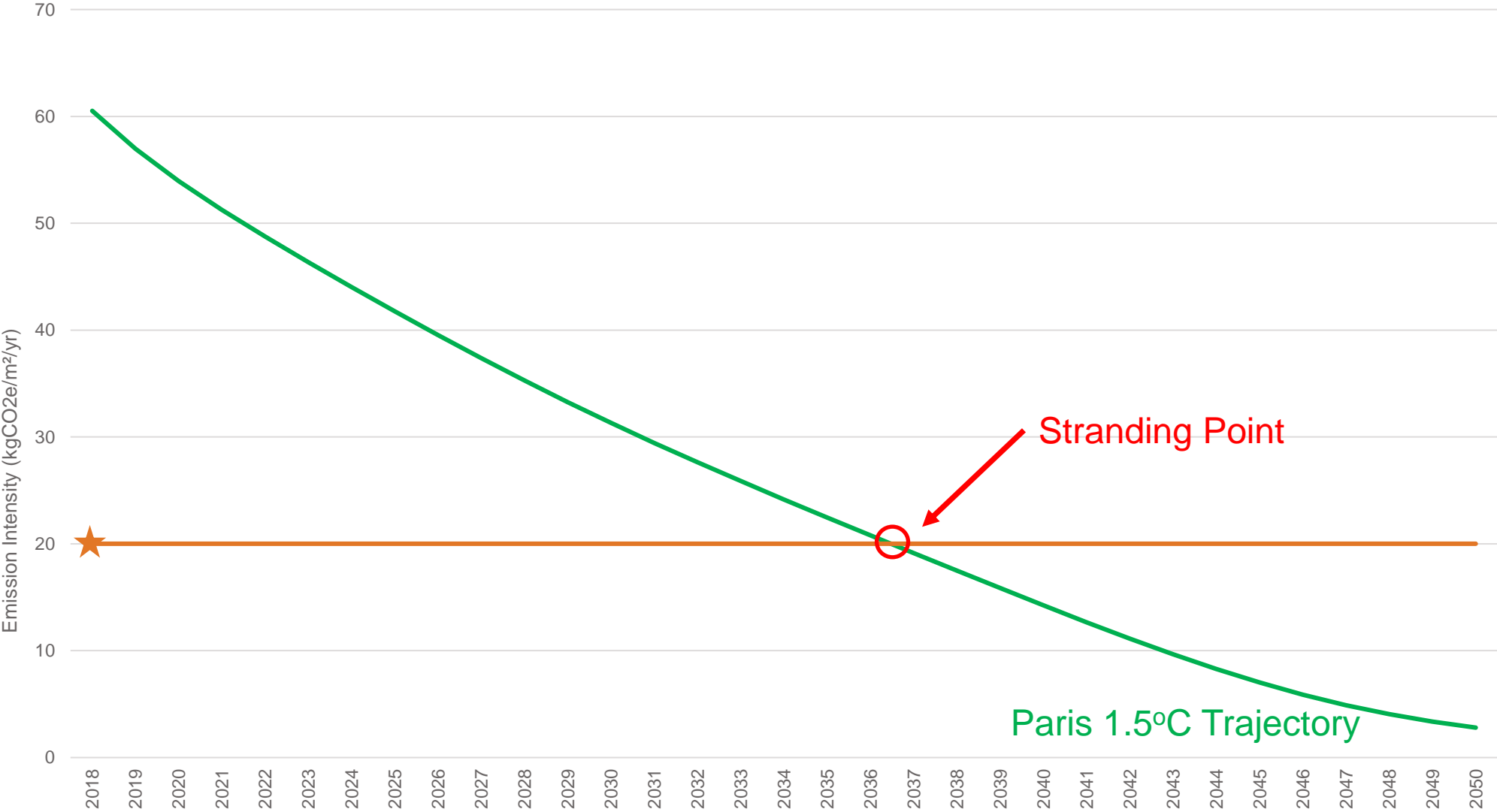
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## Decarbonisation Reduction Pathway



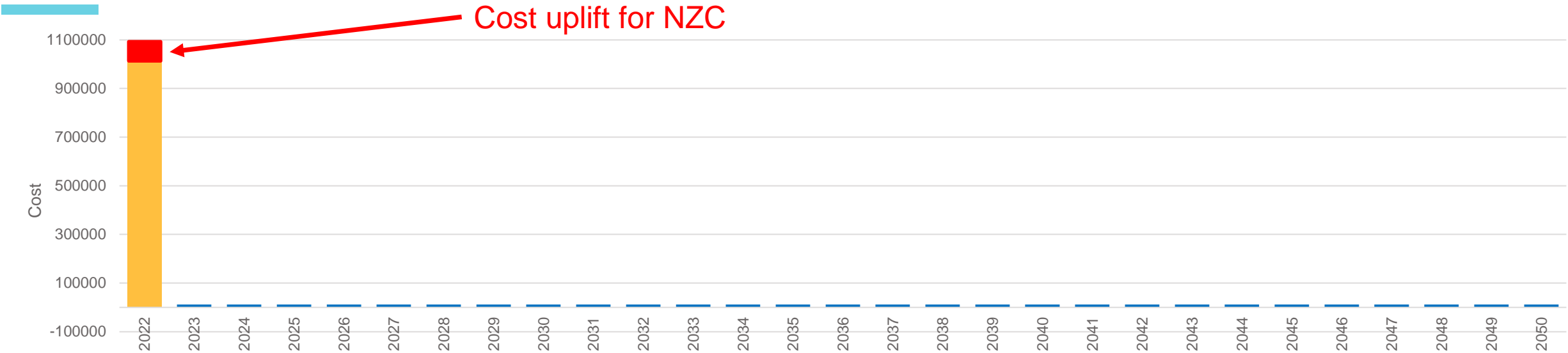
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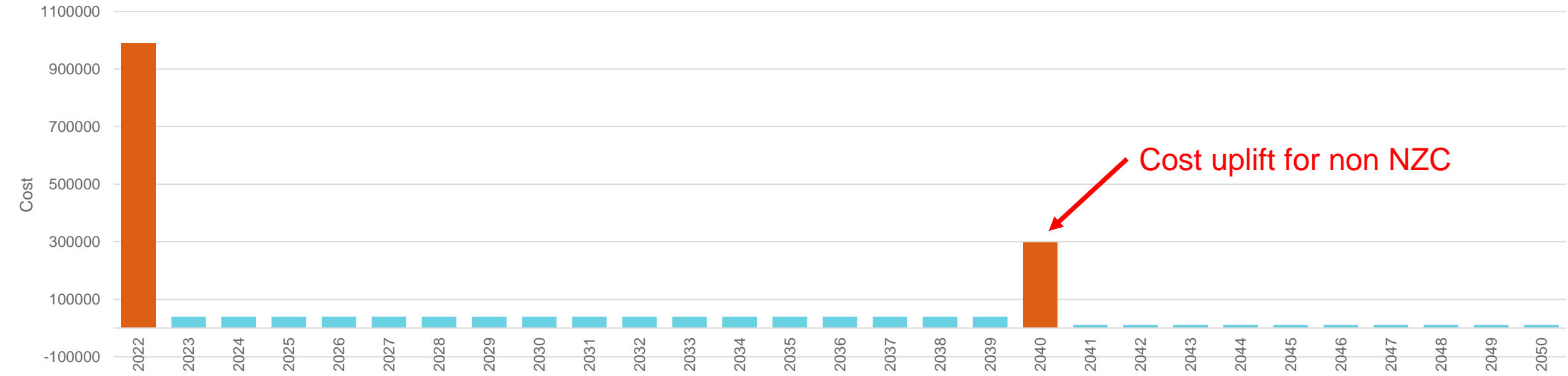
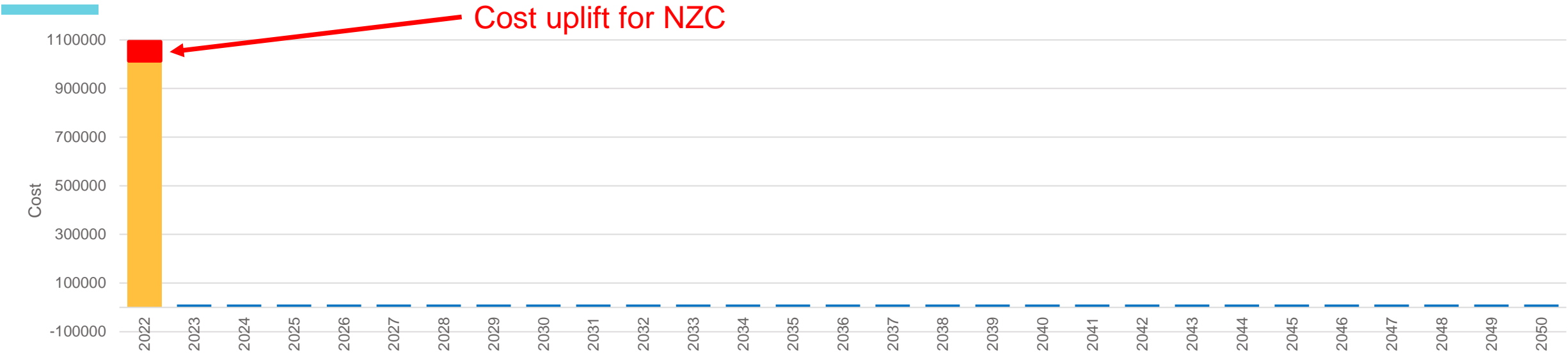




# Stranded Assets (CRREM & SBT)



# Stranded Assets (CRREM & SBT)



# Case Study - Project Eden, Salford



# In use verification: NABERS UK – Energy

12 months Utility Bills

Hours of Operation

Leased Area



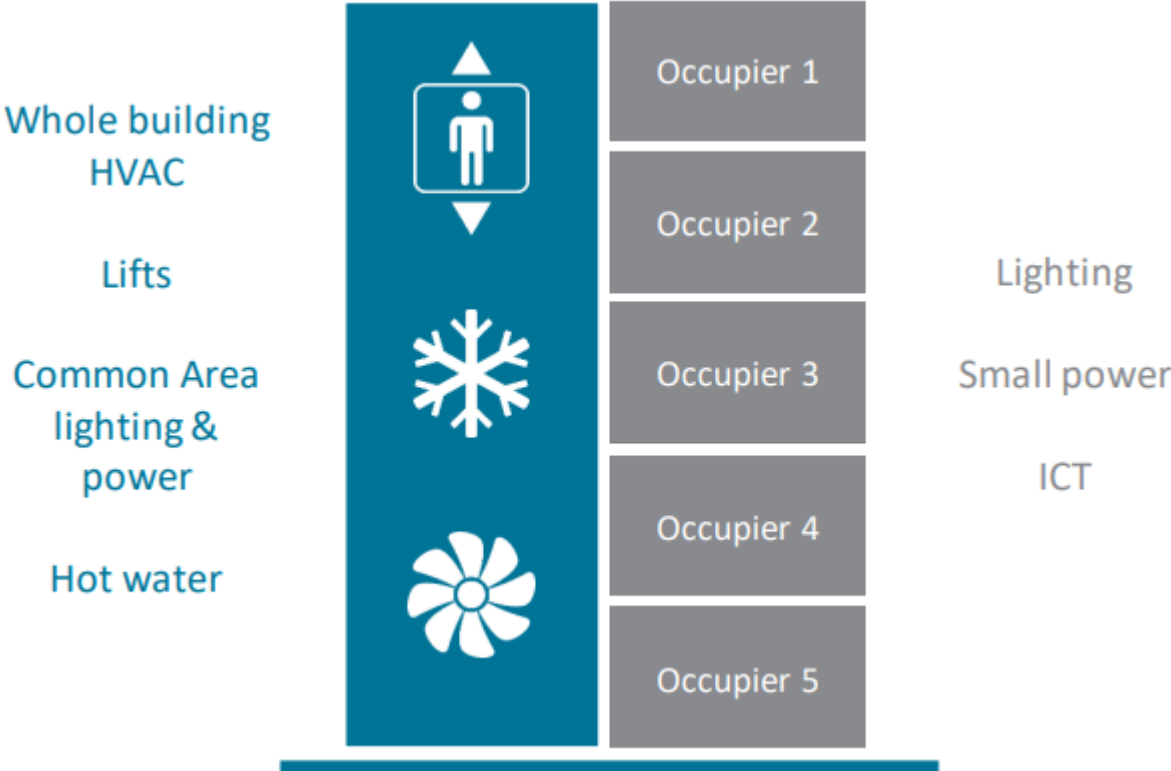
# NABERS UK - Energy Scope

- ✓ Common-area lighting and power
- ✓ Lifts and escalators
- ✓ Exterior lighting
- ✓ Car park ventilation and lighting  
If carparking is provided to tenants
- ✓ Exterior signage
- ✓ Air conditioning and ventilation

**Fan Coil Energy must be included**

- ✗ Retail energy
- ✗ Tenant lighting and small power
- ✗ Tenant ICT
- ✗ Air conditioning energy provided to retail

➤ Exclusions may only be done on the basis of metering data



# NABERS Design for Performance



## 1. SIGN UP YOUR PROJECT

Gain internal buy-in and sign a Design for Performance Agreement.

Commit to a minimum NABERS Energy rating of 4 Stars for office base buildings.

## 2. PROMOTE TARGET RATING

Promote your project's target rating across marketing and media publications.

Communicate to investors and occupiers the aspirations of the project.

## 3. MODEL THE BUILDING AS IT WILL OPERATE

Communicate your target to the project team.

Design the building to operate at the target rating.

Advanced simulation is used to test the design against a range of expected operational conditions.

## 4. INDEPENDENT DESIGN REVIEW

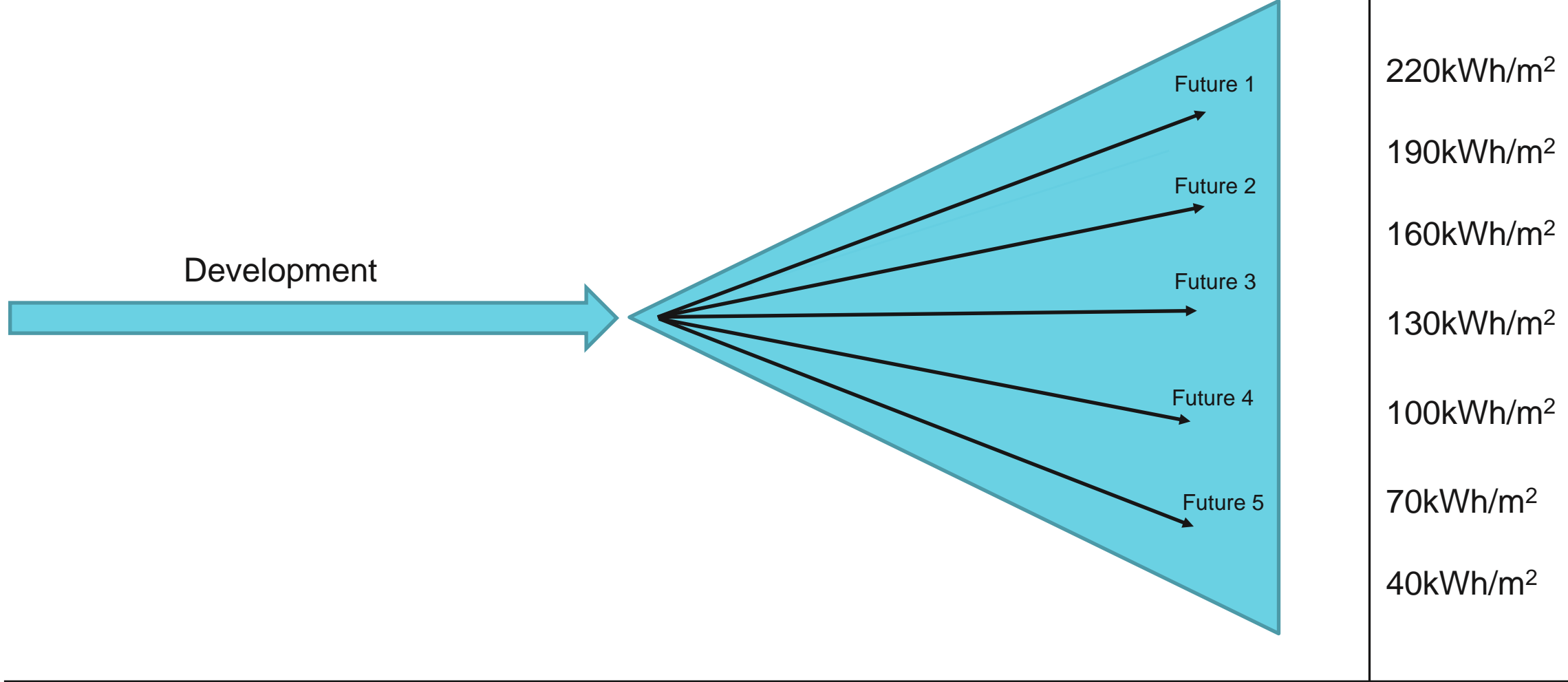
Approach independent design reviewers to obtain 2-3 quotes.

The panelist you select will review the model to check whether the design will meet the target rating.

## 5. VERIFY YOUR RATING

Once the building has been occupied for 12 months, approach an accredited assessor to verify you've achieved your target rating.

# Independent Design Review – Risk Management

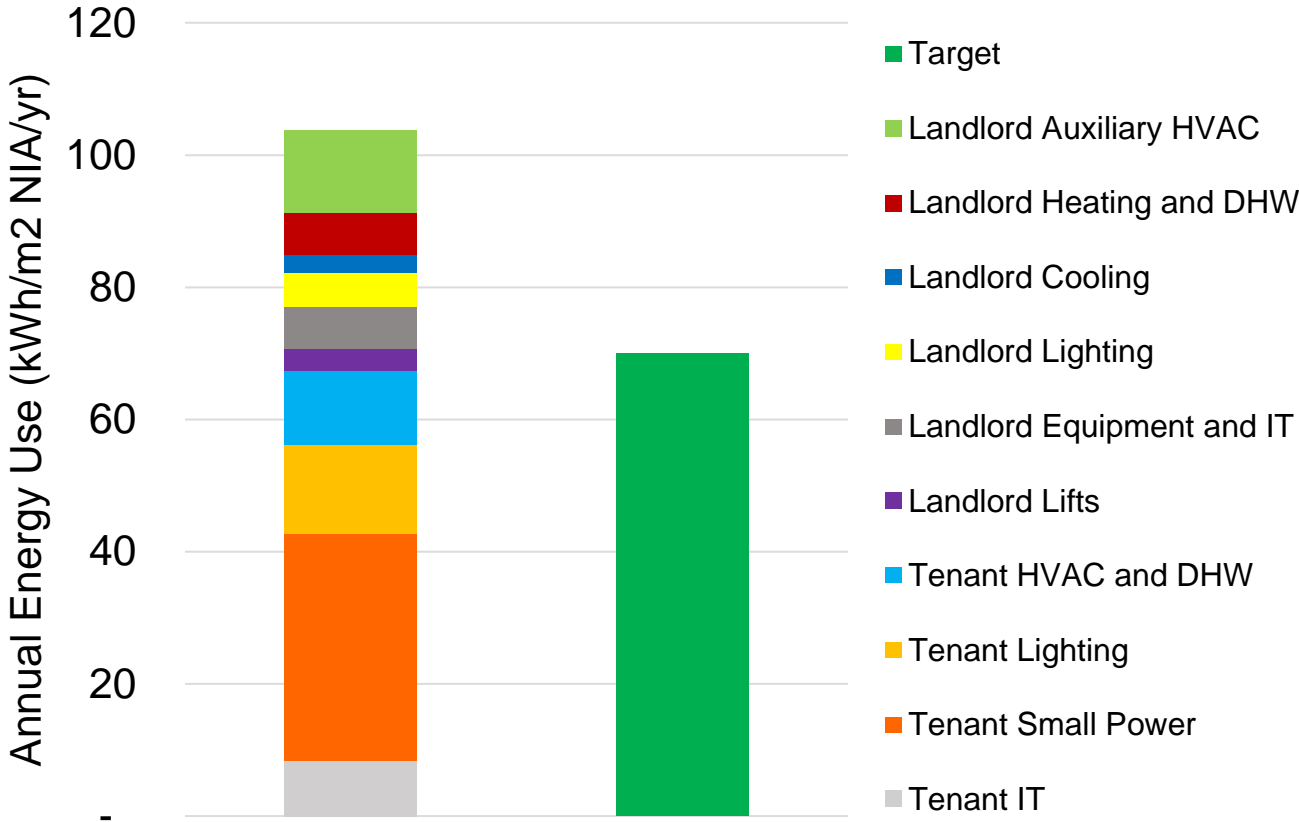


➤ Based on the results of this review, is the project capable of achieving the Target Rating?

# Case Study - Project Eden, Salford

- ✓ Optimised facades and openings to minimize heat loss and maximise use of natural light (60:40 solid to glass ratio)
- ✓ Enhanced insulation values in line with passivhaus standard
- ✓ Air tightness rating of 2m<sup>3</sup>/hr/m<sup>2</sup> at 50Pa compared with Building regulations target of 10m<sup>3</sup>/hr/m<sup>2</sup> at 50Pa
- ✓ Operationally combustion free – all electrical building
- ✓ Air source heat pumps providing low carbon heating and cooling
- ✓ CO<sup>2</sup> heat pumps providing high efficiency low carbon hot water
- ✓ Wider heating and cooling setpoints to reduce energy whilst maintain comfort conditions
- ✓ Reduced internal heat gains and loads to improve equipment efficiencies

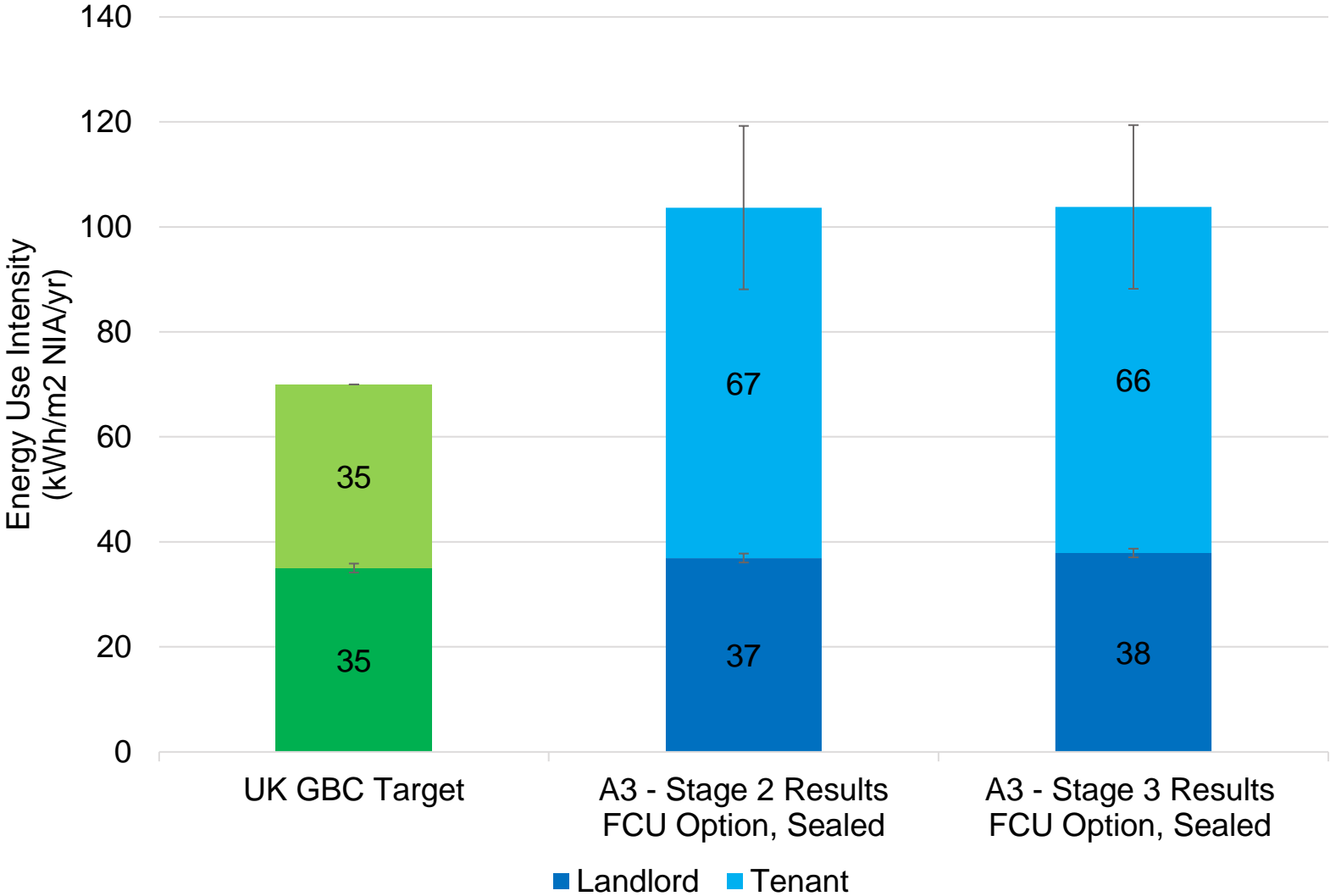
### Whole Building Energy Estimate by End Use





# Case Study - Project Eden, Salford

### Energy Use Intensity by Demise



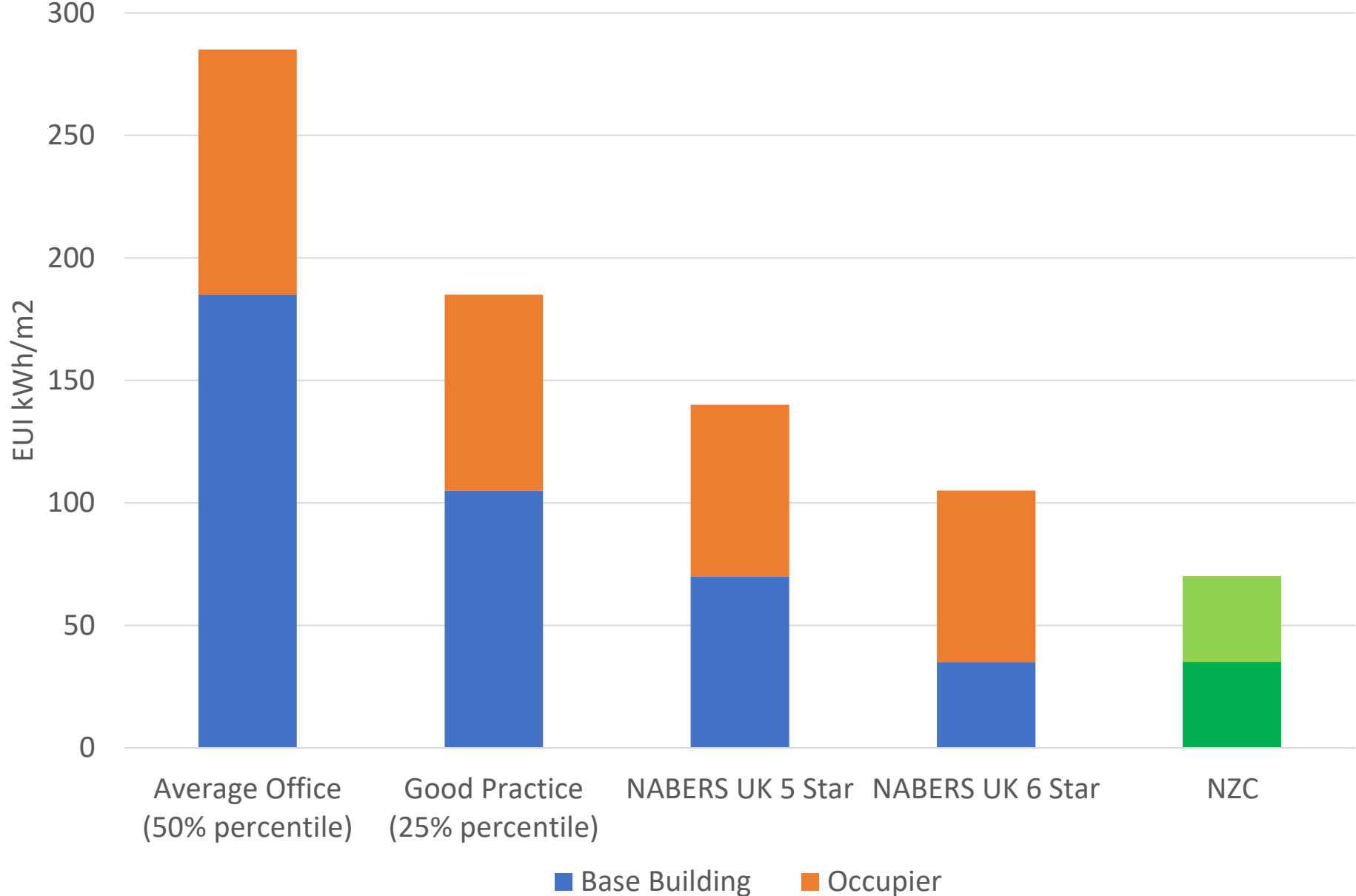
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NLA = net lettable area    GIA = gross internal area



# Doesn't Stop at NABERS





Existing Building

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# Existing Building

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28 million homes



1.7 million non-domestic buildings

# Decarbonisation of Heat

Estimated UK Emissions Attributable to Heating, 2016

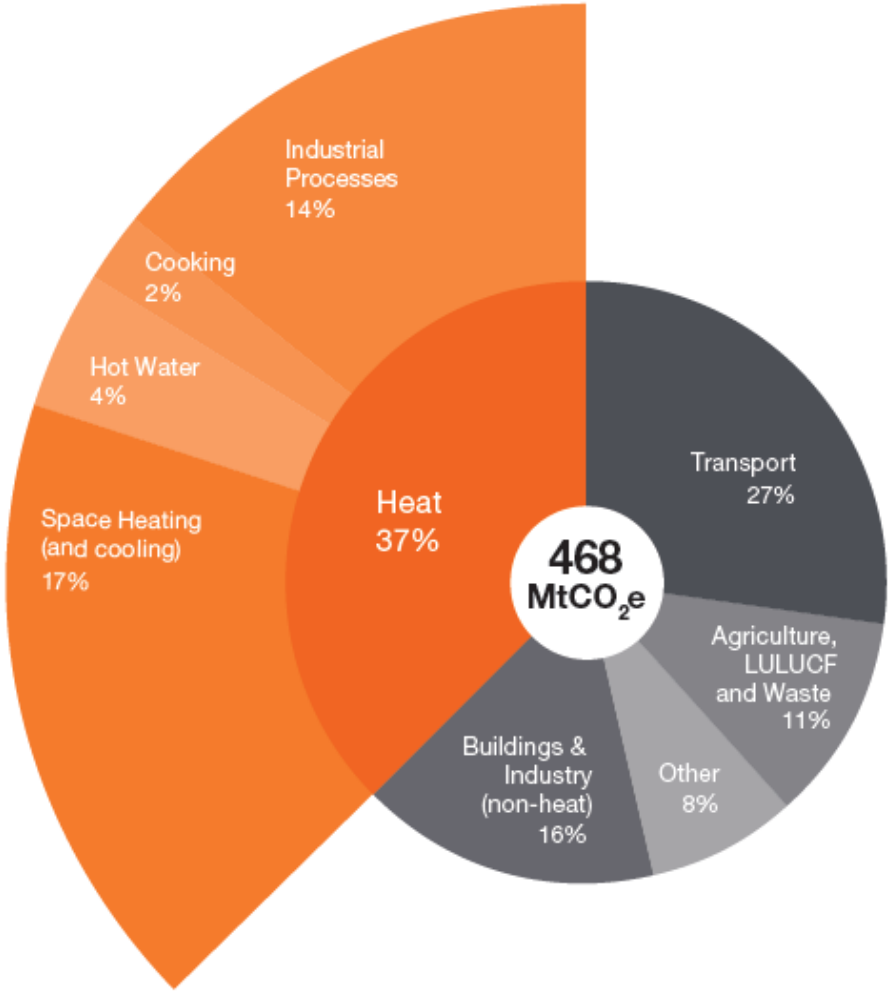
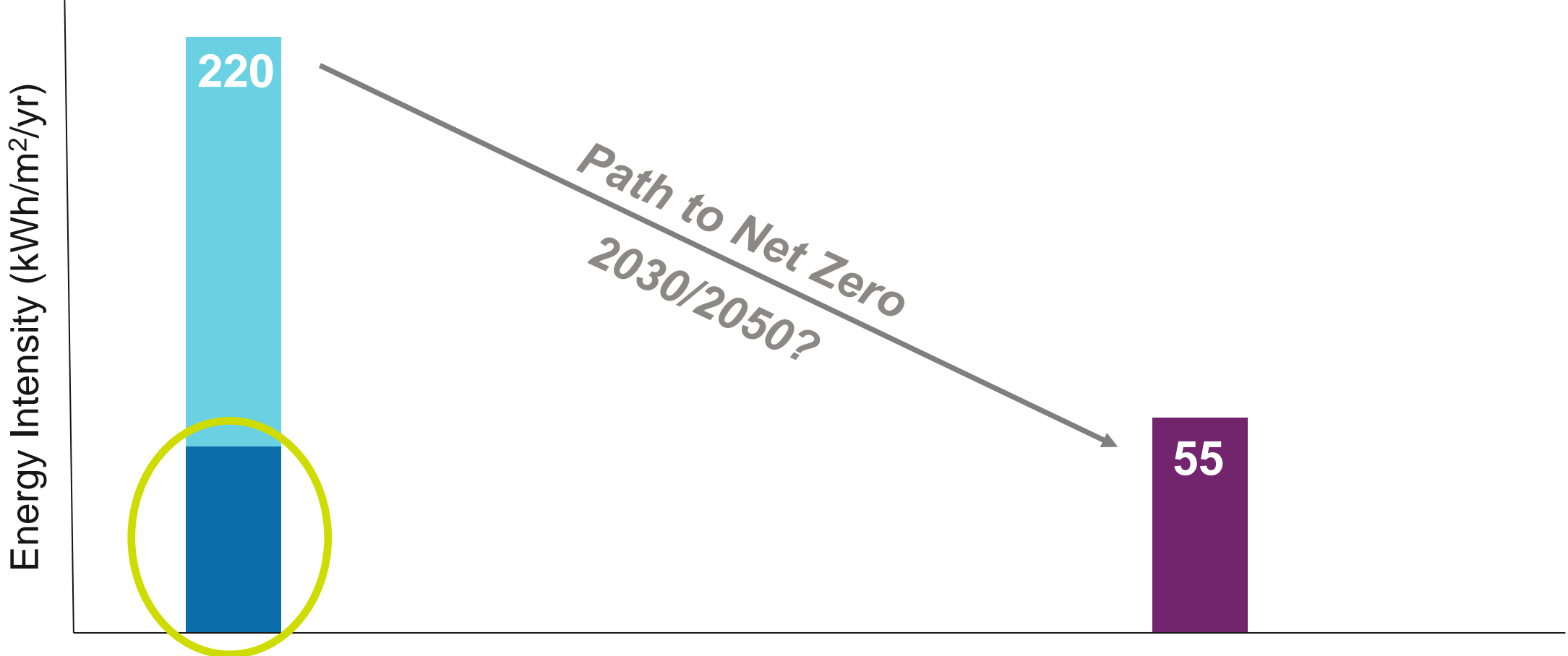


Figure 2.1 UK emissions in 2016 across different sectors<sup>4</sup>

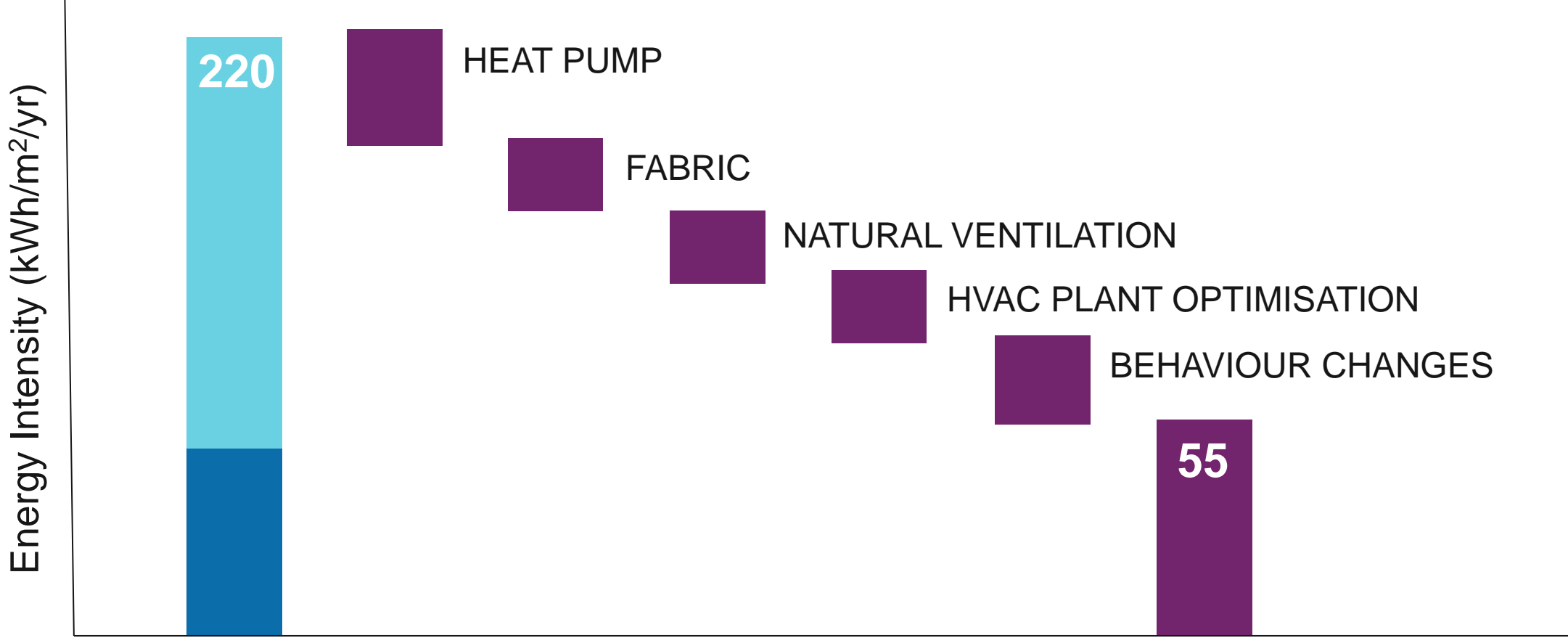
# Existing Building Case Study - Net Zero Carbon Audits

	Net Zero Carbon					Standard Practice				
1) Passive design	█	█	█	█	█	X	█	█	█	█
2) Operational energy	█	█	█	█	█	█	X	█	█	█
3) Eliminate fossil fuels	█	X	█	█	█	█	█	█	█	█
4) Renewable energy and storage	█	█	█	█	█	X	█	█	█	█
5) Upfront embodied carbon	█	█	█	█	X	█	█	█	█	█
6) Whole life carbon	█	█	█	█	█	█	█	█	X	█
7) Publicly disclose performance	█	█	█	█	█	█	█	█	█	X
Overall	█	█	█	█	█	█	X	█	█	█

# Existing Building Case Study - Net Zero Carbon Audits

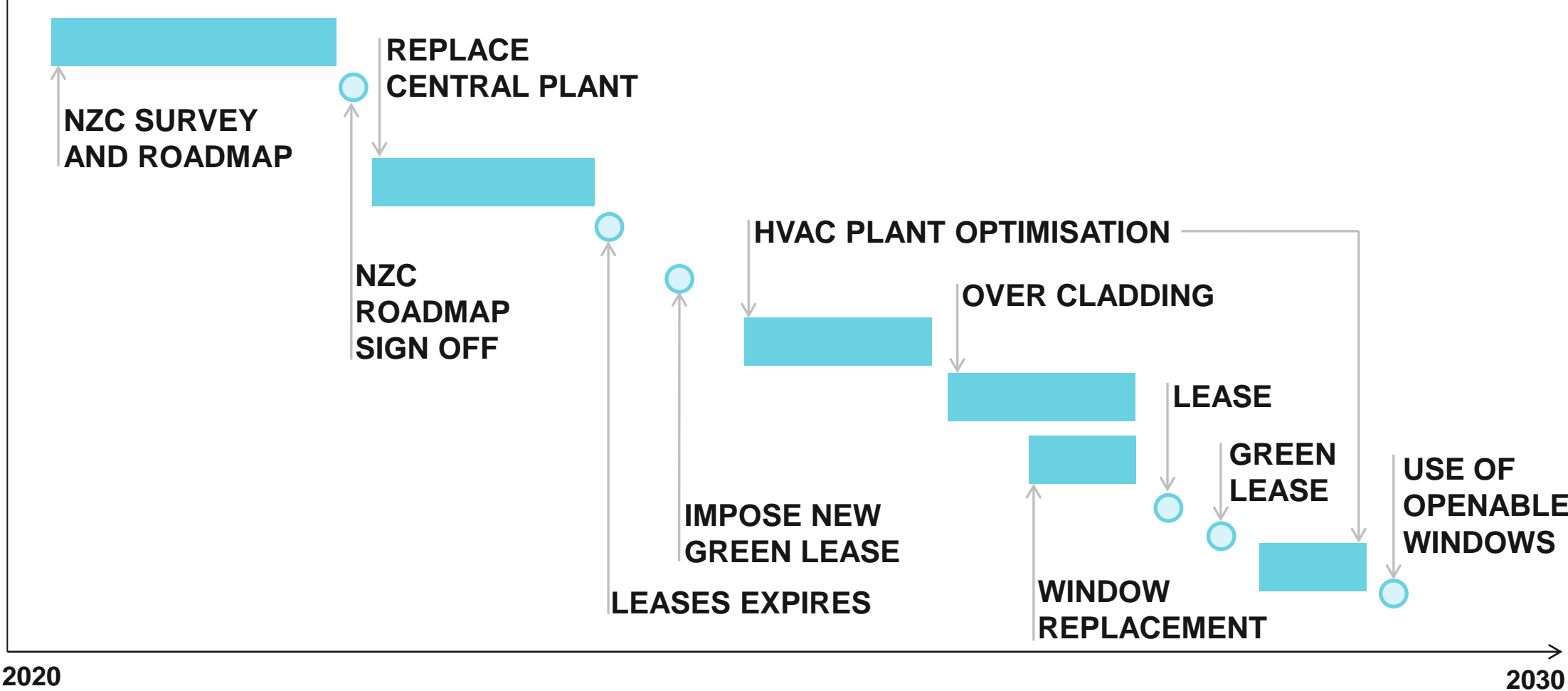


# Existing Building Case Study - Net Zero Carbon Audits





# Existing Building Case Study - Net Zero Carbon Audits



# What next?

RICS professional statement



RICS professional standards and guidance, UK  
Whole life carbon  
assessment for the  
built environment  
1st edition, November, 2017



We are developing an industry-led

## UK Net Zero Carbon Buildings Standard

[www.NZCBuildings.co.uk](http://www.NZCBuildings.co.uk)

BBP BETTER BUILDINGS PARTNERSHIP



CARBON TRUST



The Institution of Structural Engineers



RIBA Architecture.com

