NZCiO Schools: Energy in Use

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NZCiO Schools – Energy in Use

DfE SRP Scheme LVB: Existing School Sports Block Replacement

- 1,384m2 Sports hall with Changing rooms, Activity Studio, Gym, and 2no classrooms
- Standalone new build to DfE OS 2021 NZCiO standards
- Mix of Mechanical ventilation with heat recovery, and natural ventilation
- Air source heat pumps for heating and hot water
- PV on roofs
- LED lighting and controls

Design Energy:

- DfE target EUI = 67.0 kW/m^2/annum
- Our design EUI = 56.0 kW/m^2/annum
- No kitchen loads, external lighting, lifts, server room, etc.
- Comparatively bigger loads for heating and hot water
- Plenty of roof area for 100% of PV to offset consumption
- PV target EUI = -56.5 kW/m^2/annum

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NZCiO Schools – DfE OS 2021 Target EUI

Element	DfE Annex 2H 2023 (Secondary)
Heating	8
Domestic Hot Water	5
Internal Lighting	8
Fans and Pumps	5
Cooling	0
Lifts	1
Building Related Services	2
External Lighting	6
Small Power	25
Server	included in small power
Catering	7
Total	67

NZCiO Schools – DfE OS 2021 Target EUI

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)
Heating	8	12.7
Domestic Hot Water	5	8.3
Internal Lighting	8	8.4
Fans and Pumps	5	3.8
Cooling	0	0.4
Lifts	1	0
Building Related Services	2	2
External Lighting	6	0.4
Small Power	25	20
Server	included in small power	Included in small power
Catering	7	0
Total	67	56

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NZCiO Schools – DfE OS 2021 Target EUI

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Difference
Heating	8	12.7	**4.70**
Domestic Hot Water	5	8.3	**3.30**
Internal Lighting	8	8.4	**0.40**
Fans and Pumps	5	3.8	-1.20
Cooling	0	0.4	**0.40**
Lifts	1	0	-1.00
Building Related Services	2	2	**0.00**
External Lighting	6	0.4	-5.60
Small Power	25	20	-5.00
Server	included in small power	Included in small power	
Catering	7	0	-7.00
Total	67	56	**-11.00**

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NZCiO Schools – Actual EUI

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Actual Energy Use (kWh/m²·yr)
Heating	8	12.7	37.05
Domestic Hot Water	5	8.3	6.73
Internal Lighting	8	8.4	9.18
Fans and Pumps	5	3.8	0.91
Cooling	0	0.4	0.40
Lifts	1	0	0
Building Related Services	2	2	0
External Lighting	6	0.4	0
Small Power	25	12	11.13
Server	included in small power	Included in small power	Included in small power
Catering	7	0	0
Total	67	48	65.41

NZCiO Schools – Actual EUI

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Actual Energy Use (kWh/m²·yr)	Difference
Heating	8	12.7	37.05	**29.05**
Domestic Hot Water	5	8.3	6.73	**1.73**
Internal Lighting	8	8.4	9.18	**1.18**
Fans and Pumps	5	3.8	0.91	-4.09
Cooling	0	0.4	0.40	**0.40**
Lifts	1	0	0	-1.00
Building Related Services	2	2	0	-2.00
External Lighting	6	0.4	0	-6.00
Small Power	25	12	11.13	-13.87
Server	included in small power	Included in small power	Included in small power	
Catering	7	0	0	-7.00
Total	67	48	65.41	**-1.59**

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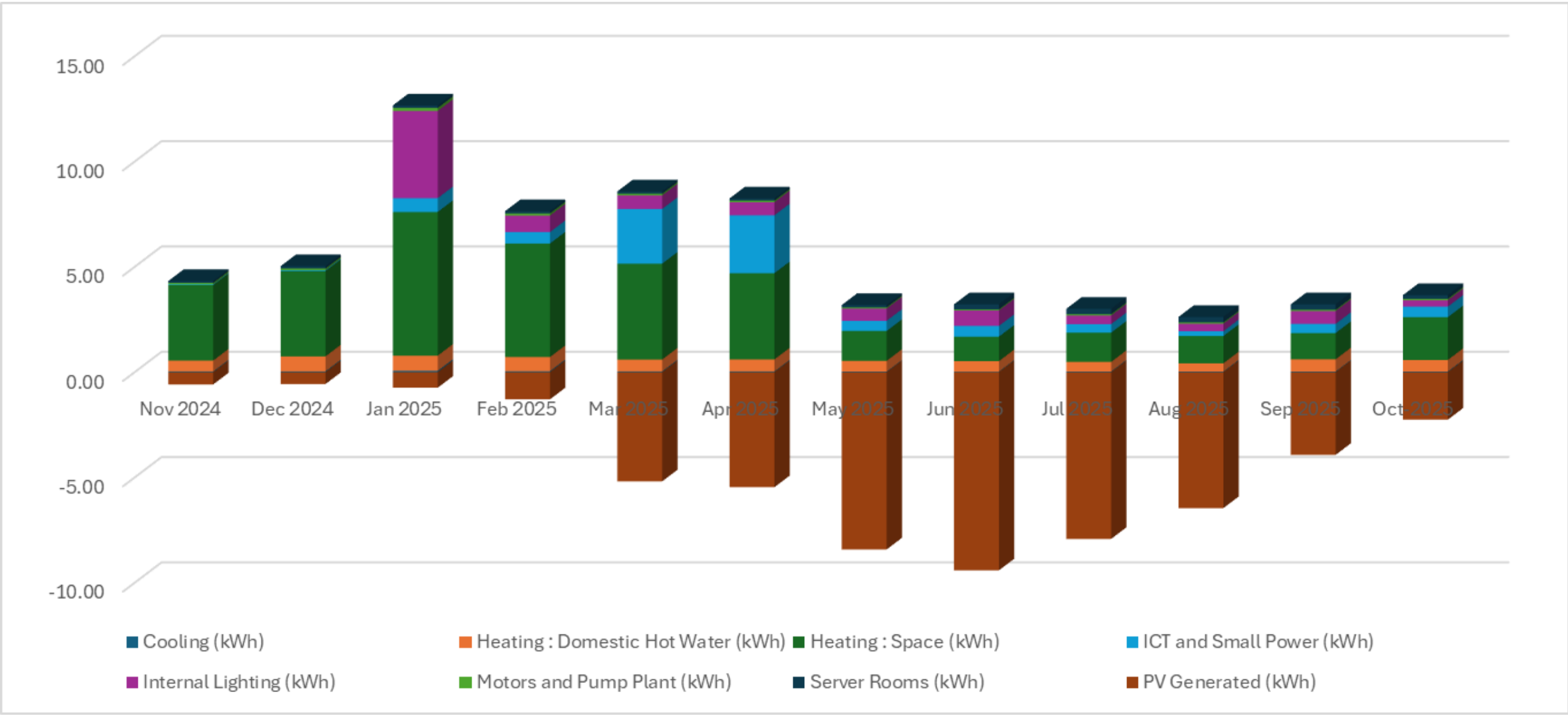
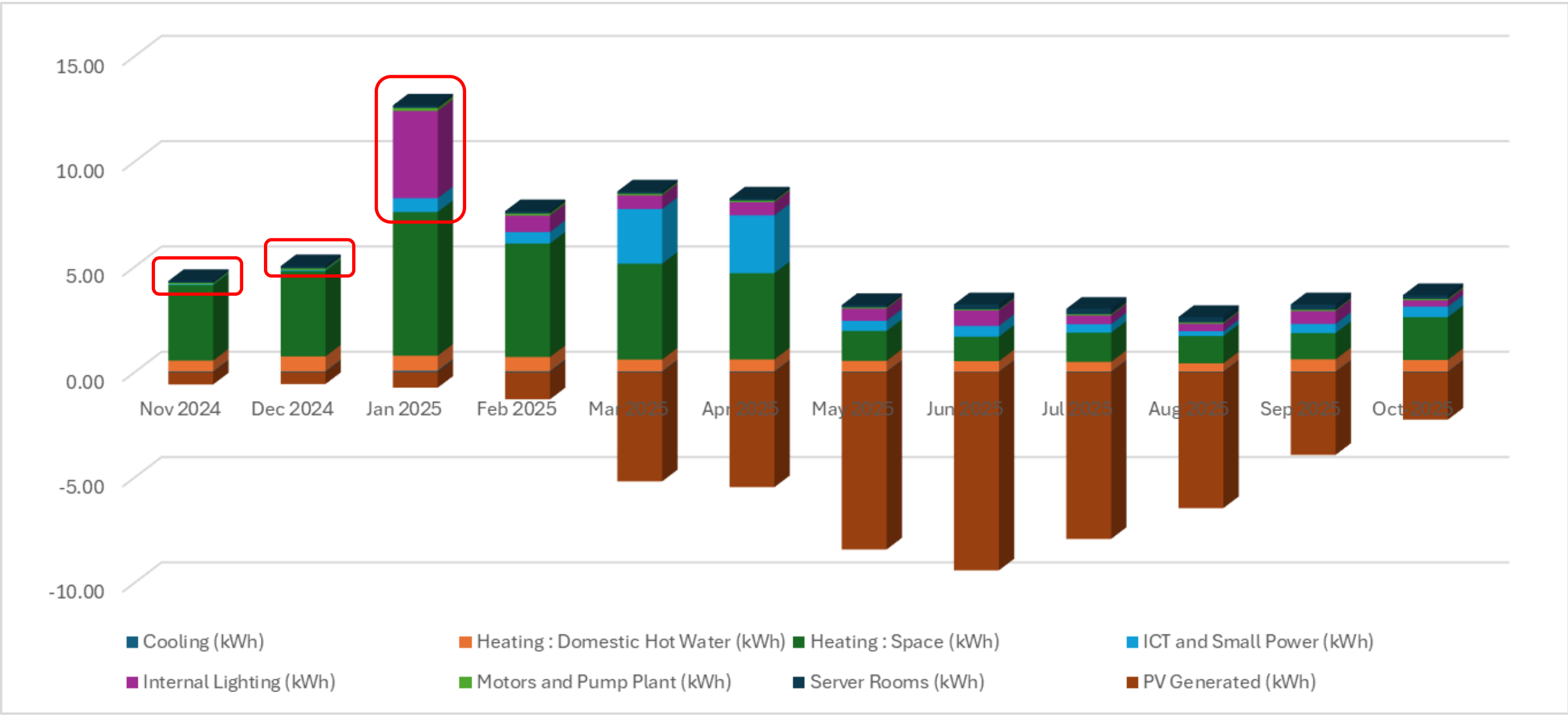
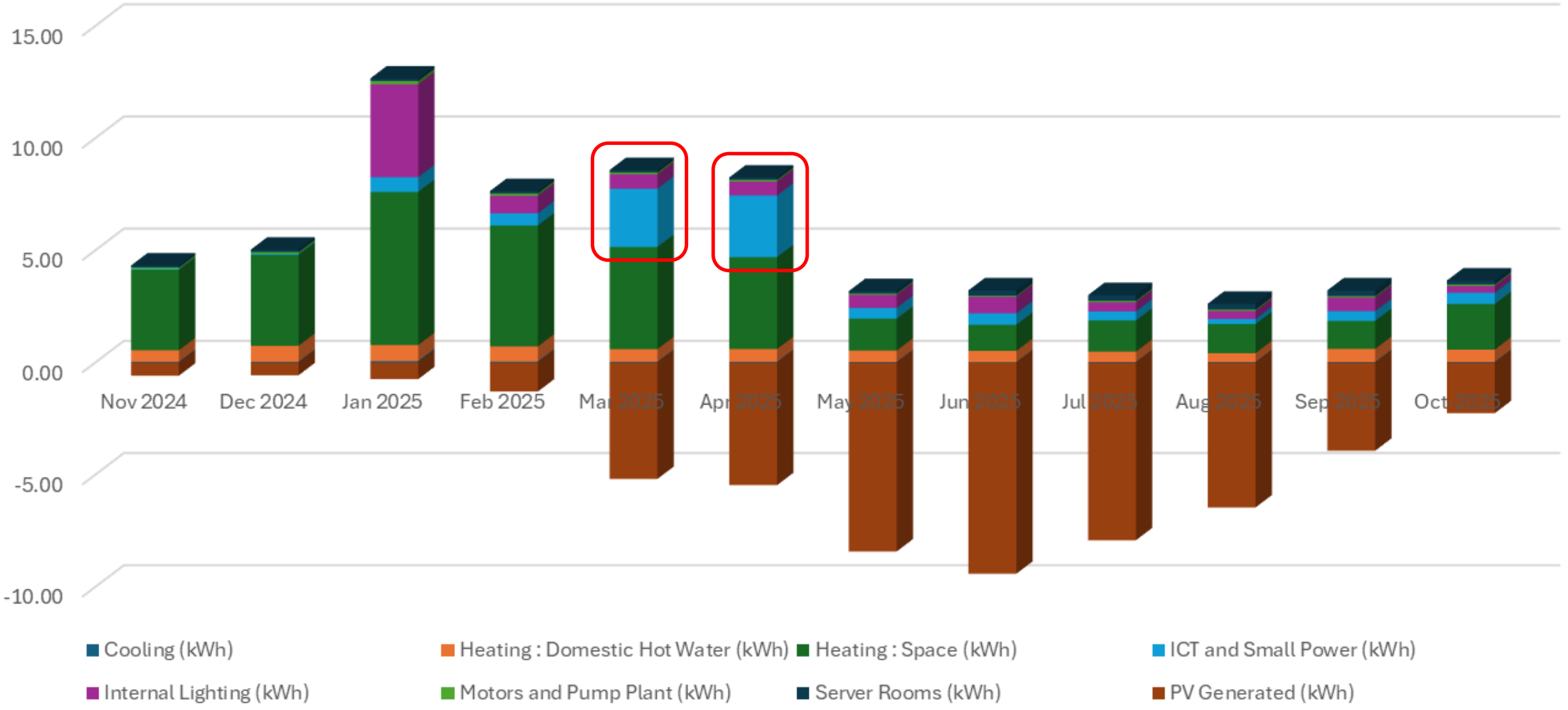
NZCiO Schools – First 12 month's Performance



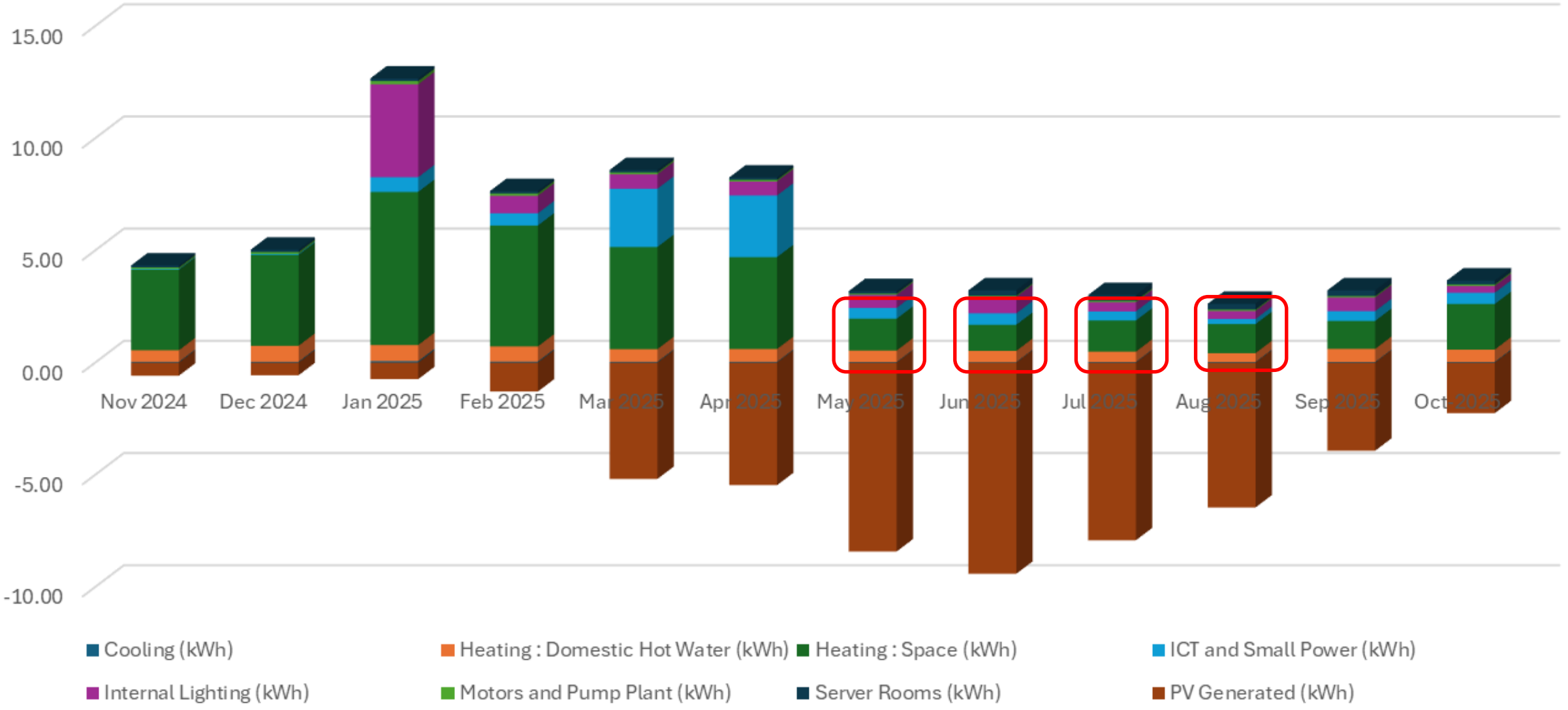
NZCiO Schools – First 12 month's Performance



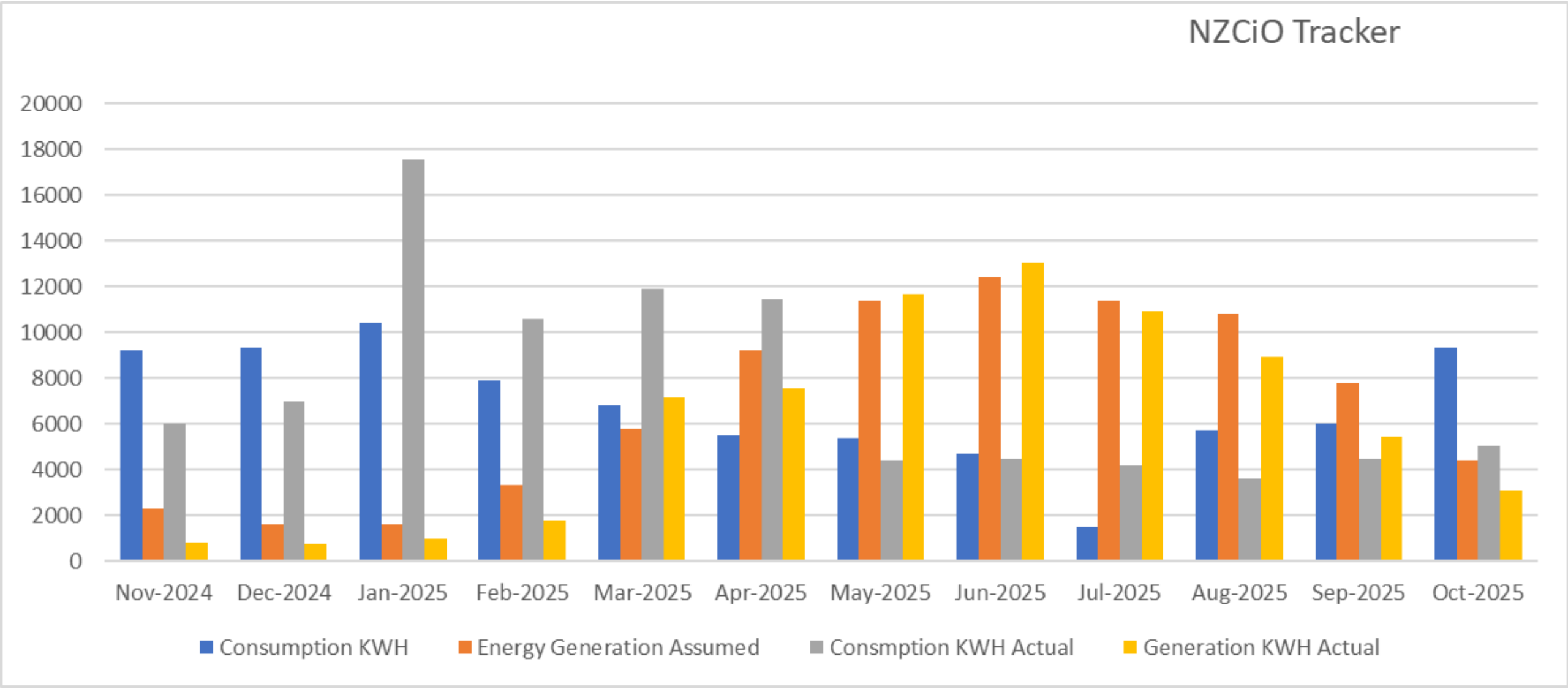
NZCiO Schools – First 12 month's Performance



NZCiO Schools – First 12 month's Performance



NZCiO Schools – First 12 months Target versus Actual



NZCiO Schools – PV performance

Month	Generation Predicted kWh	Generation KWH Actual	Difference kWh
Nov-2024	2,300	795	-1,505
Dec-2024	1,600	769	-831
Jan-2025	1,600	1,011	-589
Feb-2025	3,300	1,778	-1,522
Mar-2025	5,800	7,165	1,365
Apr-2025	9,200	7,550	-1,650
May-2025	11,400	11,640	240
Jun-2025	12,400	13,014	614
Jul-2025	11,400	10,949	-451
Aug-2025	10,800	8,924	-1,876
Sep-2025	7,800	5,426	-2,374
Oct-2025	4,400	3,110	-1,290
Total	82,000	72,131	**-9,869**

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NZCiO Schools – Future interventions

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Actual Energy Use (kWh/m²·yr)	Performance improved Energy Use (kWh/m²·yr)
Heating	8	12.7	37.05	16.01
Domestic Hot Water	5	8.3	6.73	6.73
Internal Lighting	8	8.4	9.18	7.30
Fans and Pumps	5	3.8	0.91	0.91
Cooling	0	0.4	0.40	0.40
Lifts	1	0	0	0
Building Related Services	2	2	0	0
External Lighting	6	0.4	0	0
Small Power	25	20	11.13	7.91
Server	included in small power	Included in small power	Included in small power	Included in small power
Catering	7	0	0	0
Total	67	56	65.41	39.26

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NZCiO Schools – Future interventions

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Actual Energy Use (kWh/m²·yr)	Performance improved Energy Use (kWh/m²·yr)	Difference
Heating	8	12.7	37.05	16.01	**8.01**
Domestic Hot Water	5	8.3	6.73	6.73	**1.73**
Internal Lighting	8	8.4	9.18	7.30	-0.70
Fans and Pumps	5	3.8	0.91	0.91	-4.09
Cooling	0	0.4	0.40	0.40	**0.40**
Lifts	1	0	0	0	-1.00
Building Related Services	2	2	0	0	-2.00
External Lighting	6	0.4	0	0	-6.00
Small Power	25	20	11.13	7.91	-17.09
Server	included in small power	Included in small power	Included in small power	Included in small power	
Catering	7	0	0	0	-7.00
Total	67	56	65.41	39.26	**-27.74**

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NZCiO Schools – Future interventions

Element	DfE Annex 2H 2023 (Secondary)	Targeted Energy Use (kWh/m²·yr)	Actual Energy Use (kWh/m²·yr)	Performance improved Energy Use (kWh/m²·yr)	Difference
Heating	8	12.7	37.05	16.01	**8.01**
Domestic Hot Water	5	8.3	6.73	6.73	**1.73**
Internal Lighting	8	8.4	9.18	7.30	-0.70
Fans and Pumps	5	3.8	0.91	0.91	-4.09
Cooling	0	0.4	0.40	0.40	**0.40**
Lifts	1	0	0	0	-1.00
Building Related Services	2	2	0	0	-2.00
External Lighting	6	0.4	0	0	-6.00
Small Power	25	20	11.13	7.91	-17.09
Server	included in small power	Included in small power	Included in small power	Included in small power	
Catering	7	0	0	0	-7.00
Total	67	56	65.41	39.26	**-27.74**

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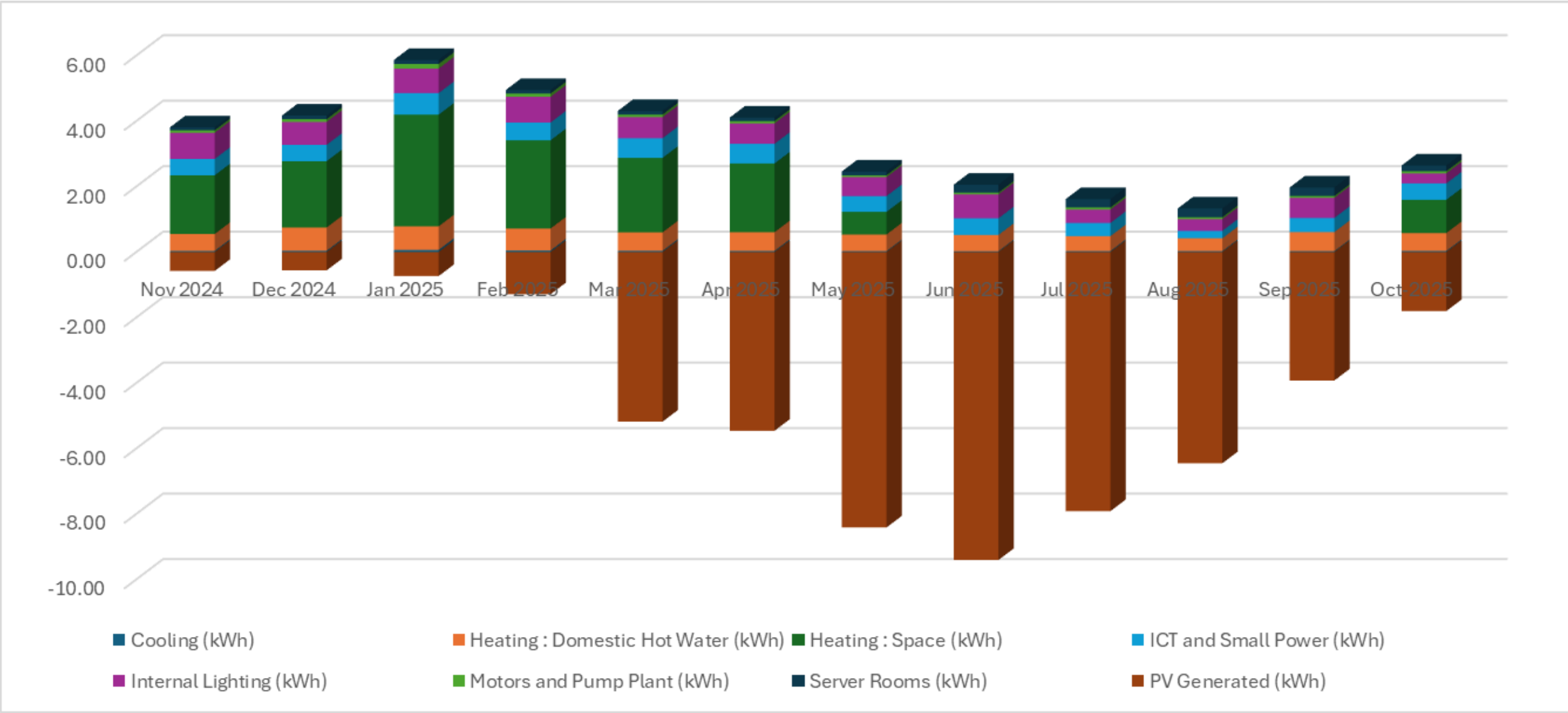
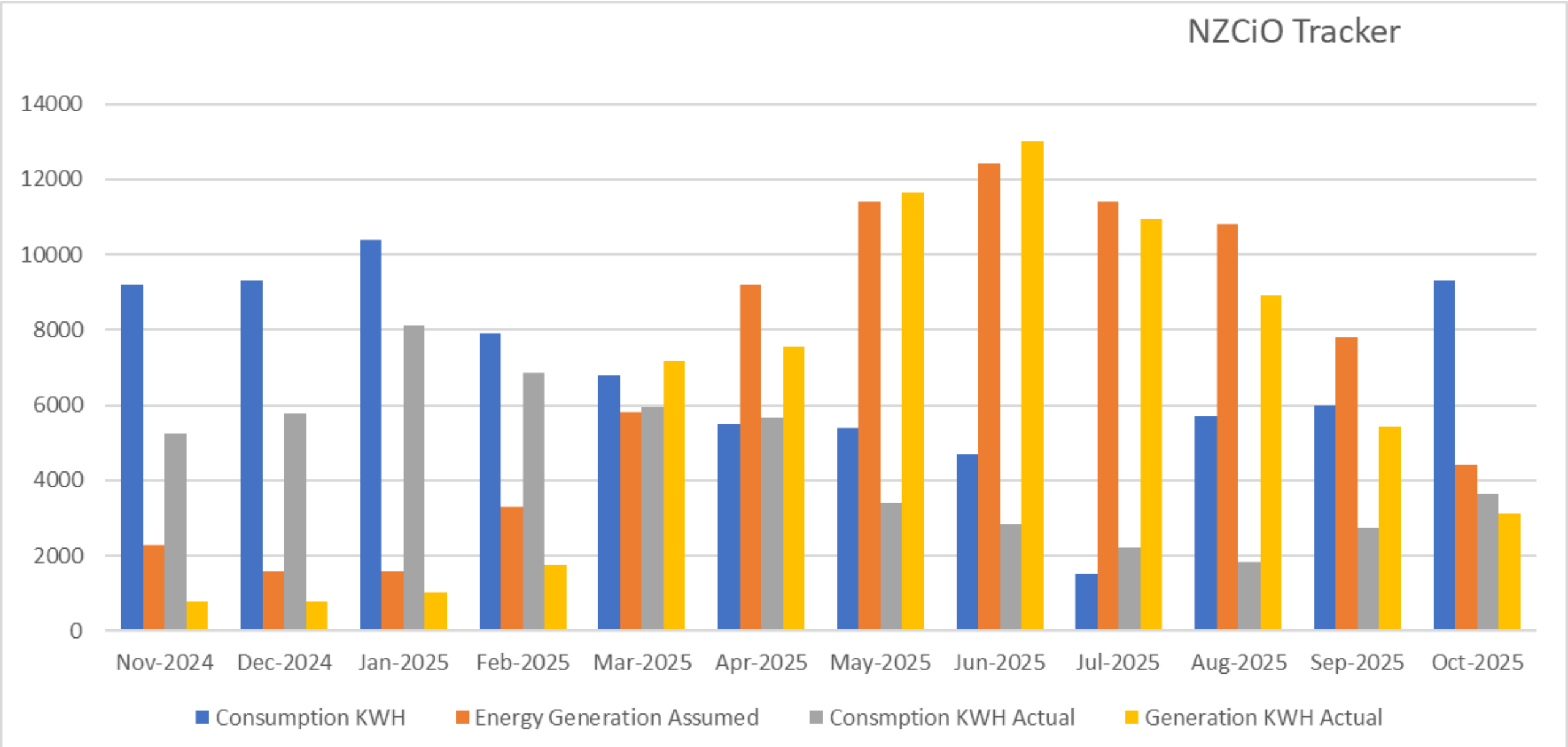
NZCiO Schools – Projected 2nd year in operation



NZCiO Schools – Target versus Projected Actual



UK Net Zero Carbon Buildings Standard

Education Estates 14 November 2025

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BBP BETTER BUILDINGS PARTNERSHIP

RIBA Architecture.com

RICS

UK GBC

The Institution of StructuralEngineers

bre

CIBSE

LETI

CARBON TRUST

The UK Net Zero Carbon Buildings Standard

*What does it mean to be '**net zero**', 'carbon neutral'* or *'zero carbon ready' ??*

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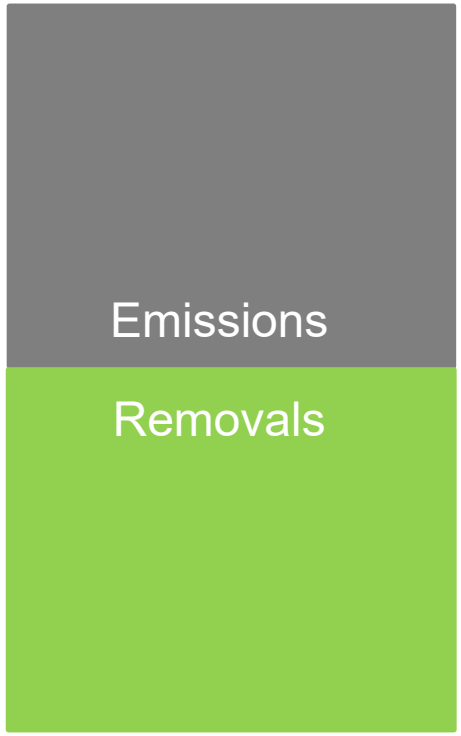
Definitions

Carbon neutral



Net zero carbon

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Sectors

Existing and new buildings.

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Homes	Sports and Leisure	Hotels
Offices	Retail	Commercial Residential
Schools and further education	Culture and entertainment	Logistics/ warehouses
Healthcare	Heritage	Datacentres
	Science and technology	

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Definitions

Embodied carbon

A ‘Net Zero Upfront Carbon’ asset is one where the sum total of GHG emissions, excluding ‘biogenic carbon’, from Modules A1 - A5 is minimised, **which meets local carbon targets or limits** (e.g. $kgCO_2e/m^2$), and with additional ‘offsets’, equals zero.

Operational energy

A ‘Net Zero Operational Carbon – Energy’ asset is one where no fossil fuels are used, all energy use (Module B6) has been minimised, **meets the local energy use target** (e.g. $kWh/m^2/a$) 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’.

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UK Net Zero Carbon Buildings Standard

Mandatory Limits & Targets

- **Operational Energy**
- **Upfront Embodied Carbon**
- **Fossil Fuel Free**
- **Onsite Renewables**
- **Refrigerant Leakage**
- **Delivered Heating and Cooling**

Reporting / Future Limits

- **Lifecycle Embodied Carbon**
- **Demand Management**
- **Operational Water Use**

Optional Requirements

- **Offsetting & Energy Procurement**

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NZCBS options at each project stages

Voluntary - Not NZC Verified

Design Stage

- A project cannot be verified as Net Zero Carbon at this stage
- For any voluntary reporting requirements, it should follow the NZCBS design approach

Practical Completion

- A project cannot be verified as 'Net Zero Carbon' at this stage, as in-use operational energy data is required
- Operational modelling and Whole Life Carbon can be voluntarily **validated** against the Standard requirements
- We are reviewing further options to provide assurance that the building is on track to meet the Standard at Practical Completion

NZC Verifiable

In-use (1 year of data*)

- A building **can be verified as Net Zero Carbon**
- All NZCBS limits and targets must be met, as well as reporting and disclosure requirements
- Third party verification will be required **– you can not self-verify**
- Verification will require renewal over time

* In order to verify operational energy, the building must have at least a year of metered energy use, and demonstrate that it was occupied during this period

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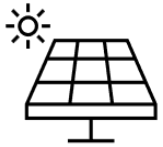
UK Net Zero Carbon Buildings Standard

Mandatory Limits & Targets

Upfront Embodied Carbon

Operational Energy

Fossil Fuel Free



Onsite Renewables

Refrigerant Leakage

Delivered Heating and Cooling

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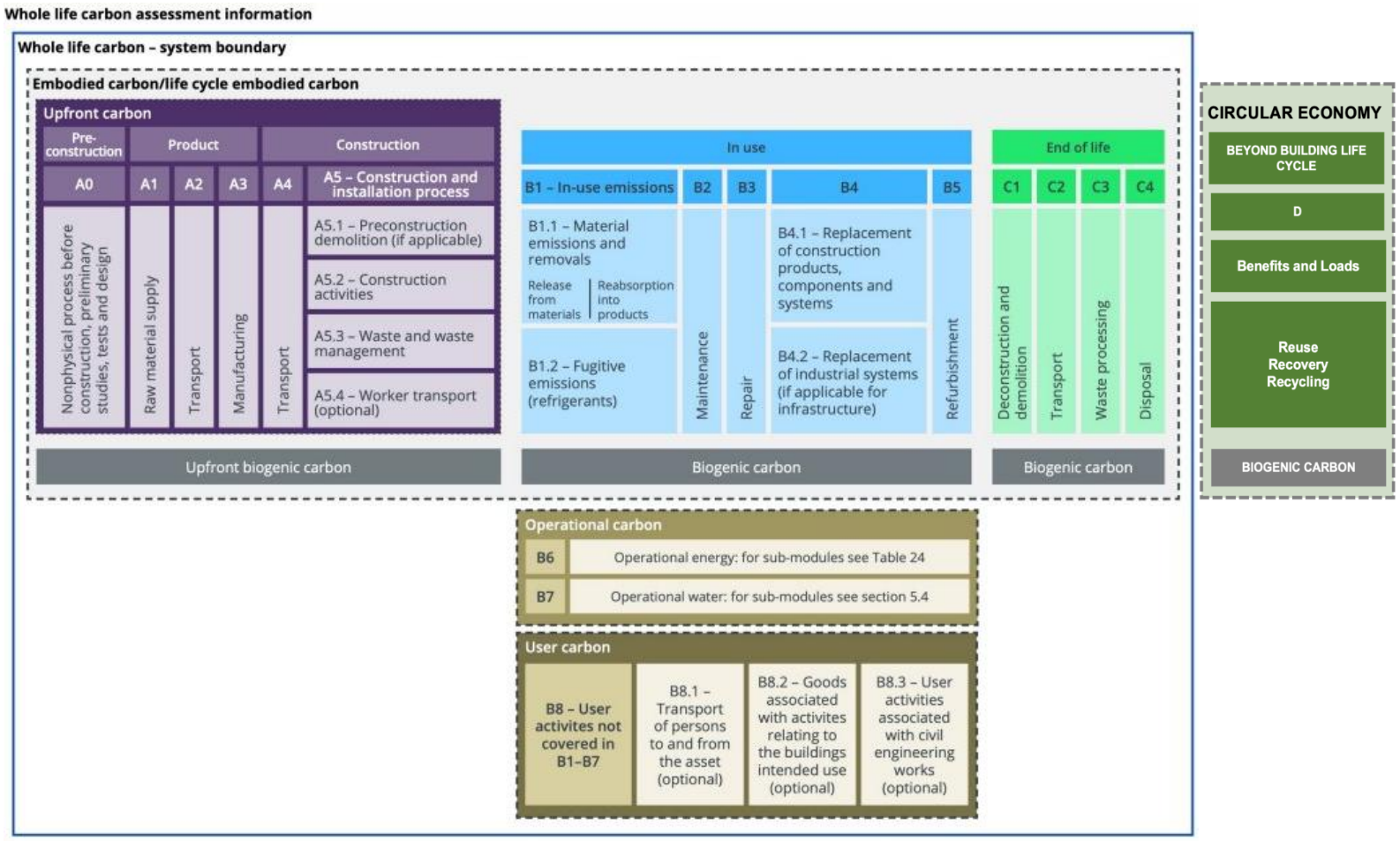
Upfront embodied carbon



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Upfront embodied carbon: limits and targets

New buildings

Table EC-1: Upfront carbon limits, New Works

← Date of Commencement on site	Commercial Residential	Culture, Worship & Entertainment		Data Centres	Healthcare	Higher Education	Homes		Hotels	Offices		Retail	School
	-	General	Performance Spaces	-	-	-	Single family homes	Flats	-	Whole building	Shell and core	-	-
	kgCO₂e/m²GIA												
2025	580	570	855	745	790	640	430	565	670	735	475	715	530
2026	550	540	810	705	750	610	400	525	635	700	450	680	505
2027	525	515	770	670	710	575	375	490	605	660	425	645	480
2028	495	485	725	635	670	545	345	450	570	625	400	610	450
2029	465	460	685	600	635	515	320	420	540	590	380	575	425
2030	435	425	640	555	590	480	290	380	500	550	355	535	395

2050

DfE CF 25 A1-A5 550kgCO_{2e}/m^2

Retrofit

Table EC-2: Upfront carbon limits, Retrofit works

← Date of Commencement on site	Commercial Residential	Culture, Worship & Entertainment		Data Centres	Healthcare	Higher Education	Homes		Hotels	Offices		Retail	School	Science & Technology	Sport & Leisure	Storage & Distribution
	-	General	Performance Spaces	-	-	-	Single family homes	Flats	-	Whole building	Shell and core	-	-	-	-	-
	kgCO₂e/m²GIA															
2025	460	450	605	525	615	475	270	425	520	600		500	380	605	655	310
2026	435	425	570	495	585	455	255	395	490	575		475	365	575	620	295
2027	415	405	545	475	555	425	235	370	470	540		450	345	545	590	275
2028	390	385	510	450	525	405	220	340	440	510		425	325	515	555	265
2029	370	365	485	425	495	385	205	315	420	485		400	305	485	525	250
2030	345	335	450	390	460	355	185	285	390	450		375	285	455	485	230

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Operational energy

Measured data – meter readings

Occupancy rate:

- ≥80% GIA;
- ≥75% NIA.

Renewable energy included

Exclusions:

- Electric vehicle charging;
- Heavy process loads;
- Energy used by external works;
- Energy used within car parks, even where internal.

Additional Use Areas

Sector	Areas may be classified as AUAs when sub-metered and used for the following:
Commercial Residential	Laundry.
Culture & Entertainment	Theatre production workshops.
Hotels	Conference centres; Laundry.
Retail; Landlord Areas subsector within Commercial Centres / Shopping centres	Waste storage & management areas (even if internal).
Schools	Community uses and other out-of-hours use; Large specialist uses (e.g., CDT equipment, multiple kilns, etc.).
Science and Technology	Equipment with safety critical function (e.g., ETP etc.); Higher performance laboratory spaces above Hazard Group Level 2 or similar specialist applications, manufacturing facilities, or those with more onerous vibration criteria of R<1.
Sport and Leisure	High intensity uses; Community uses (e.g., “warm spaces”).

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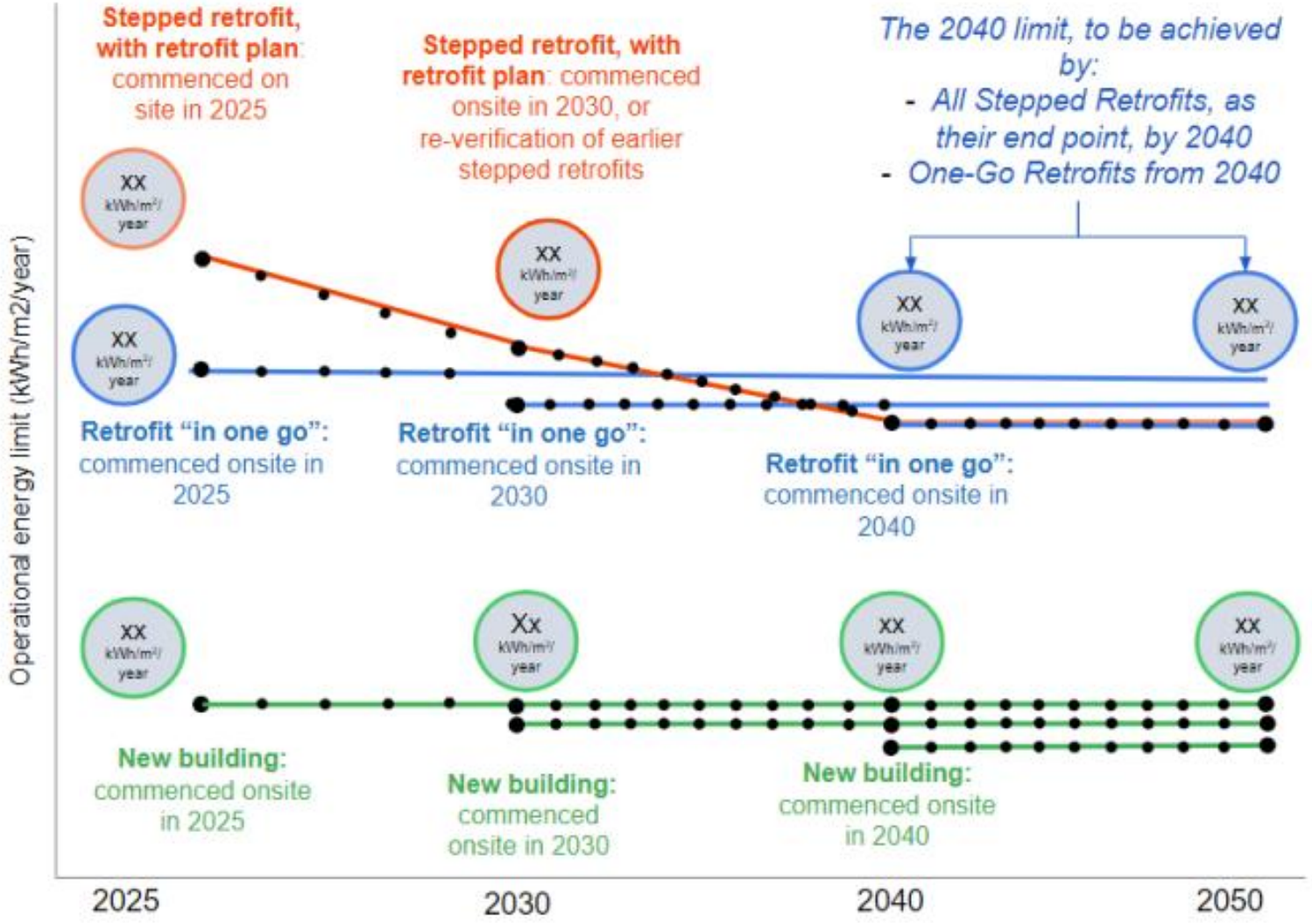
Operational energy: limits and targets

Retrofit "step by step":
Not achieving the end point limit on 1st verification, but with a Retrofit Plan and improvements over time to meet the intermediate limits and the end point limit by 2040.

Retrofit "in one go": *achieving the end point limit from its 1st verification. Limits are fixed based on the time the retrofit commenced onsite i.e. once verified as a Retrofit using the "in one go" limit, a building will retain the same operational energy limit in future verifications.*

New build:
Limits are fixed based on the time the development commenced onsite i.e. once verified as a New Build, a building will retain the same operational limit in future verifications.



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Operational energy: limits and targets

Table OE-1: Energy use intensity limits, New Building

← Date of Commencement on site	Commercial Residential		Culture & Entertainment			Data Centres		Healthcare	Higher Ed.	Homes		Hotels	Offices (either /GIA or /NIA metrics may be used)				Retail						Schools		
	Student resi.	Care homes	Performance	Collection	Archives	Low utilisation	High utilisation	-	-	Single family homes	Flats	-	General		Call Centres		Trading Floors		Supermarket	High street retail, dept. store	F&B without catering[a]	F&B with catering[b]	Landlord areas[c]	Retail warehouse	Early years	Primary	Secondary incl. SEN
	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	PUE	PUE	As per NHS-NZ Standard	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²NIA/yr	kWh/m²GIA/yr	kWh/m²NIA/yr	kWh/m²GIA/yr	kWh/m²NIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²CPA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr	kWh/m²GIA/yr
2025	75	150	80	60	5	1.4	1.2		100	45	40	125	85	107	127	159	147	184	200	70	215	380	55	80	50	45	60
2026	74	147	79	59	5	1.4	1.2		98	45	40	122	83	104	123	154	143	179	194	68	209	370	54	78	50	45	59
2027	72	144	77	58	5	1.39	1.19		95	44	40	119	80	100	119	149	138	173	188	66	202	359	53	75	49	44	58
2028	70	140	75	56	5	1.38	1.18		92	43	39	116	77	97	115	144	133	167	182	63	195	348	52	72	48	43	57
2029	69	137	74	55	5	1.38	1.18		90	43	39	113	75	94	111	139	128	160	176	61	189	338	51	70	48	43	56
2030	67	134	72	54	5	1.37	1.17		87	42	39	110	72	90	106	133	123	154	170	59	182	327	50	67	47	42	55

Typology	Energy Use Intensity (EUI)[6]
Primary School	52 kWh/m² maximum
Secondary School	60 kWh/m² maximum
College	70 kWh/m² maximum
Special School / Special College and Alternative Provision (AP)	52 kWh/m² maximum

Table 1: Energy Use Intensity

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Fossil fuel free

Practically all buildings with some exceptions

- Emergency and life safety systems.
- Essential back-up systems serving buildings with functions of critical importance,
- Essential back-up systems serving data centres
- Fossil fuels used in construction process.

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Onsite renewables

Scotland

- For single family homes, and single-story storage and distribution: minimum **60 kWh/m²** building footprint/year
- For all other building types: minimum **30 kWh/m²** building footprint/year

Middle and North England, Northern Ireland, Wales

- For single family homes, and single-story storage and distribution: minimum **65 kWh/m²** building footprint/year
- For all other building types: minimum **40 kWh/m²** building footprint/year

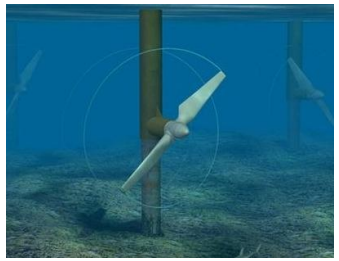
South England

- For single family homes, and single-story storage and distribution: minimum **75 kWh/m²** building footprint/year
- For all other building types: minimum **45 kWh/m²** building footprint/year

Photovoltaics

On-site wind turbines

On-site hydroelectric turbine



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Onsite renewables

DfE

Renewable energy generation

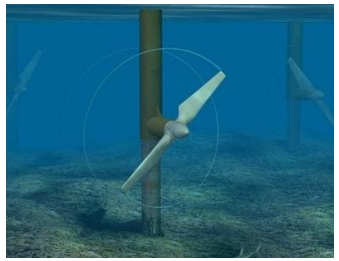
5.7.8 Renewable energy generation

- **Requirements:**
  - Provide an onsite renewable energy source that generates at least 60% of the overall energy use and provides a minimum annual yield of 45 kWh/m² of the building footprint (this is not GIFA or available roof area)

Photovoltaics

On-site wind turbines

On-site hydroelectric turbine



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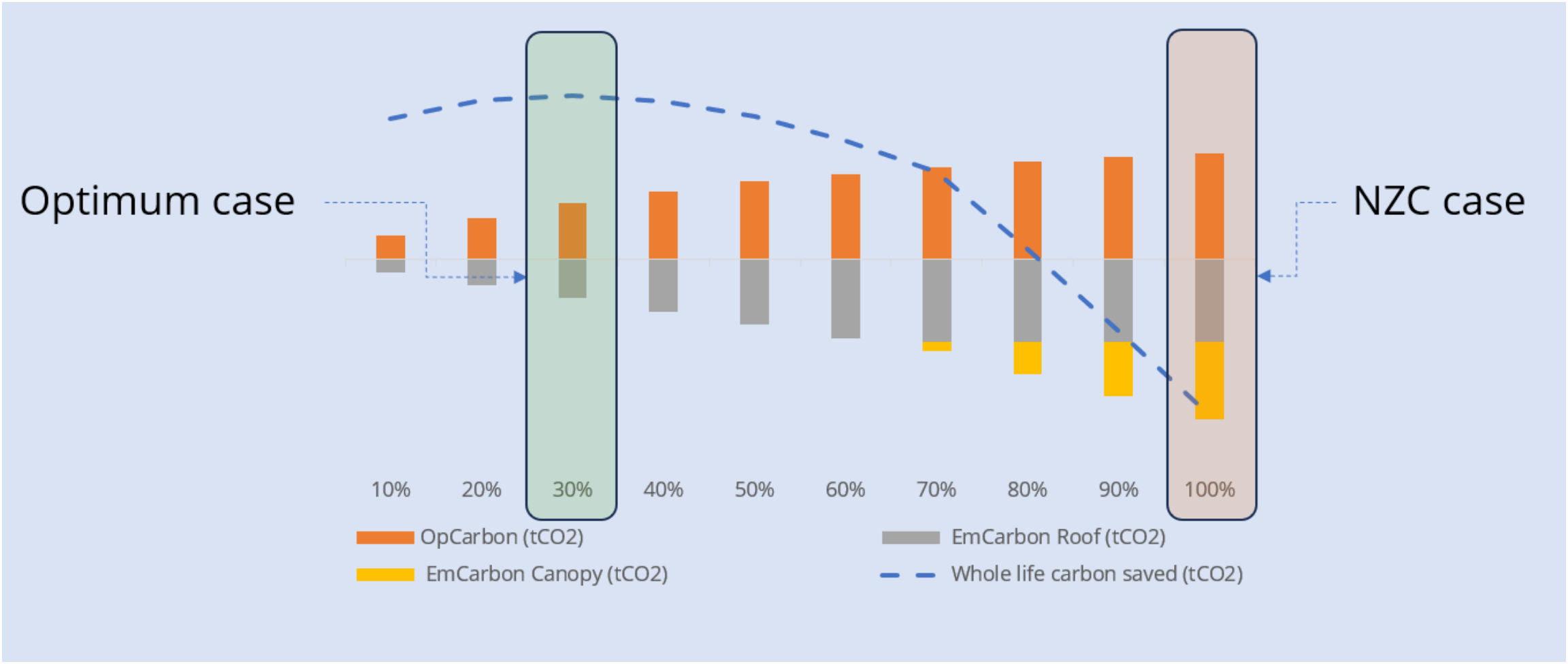
Designing on-site solar PV systems using whole life carbon approach



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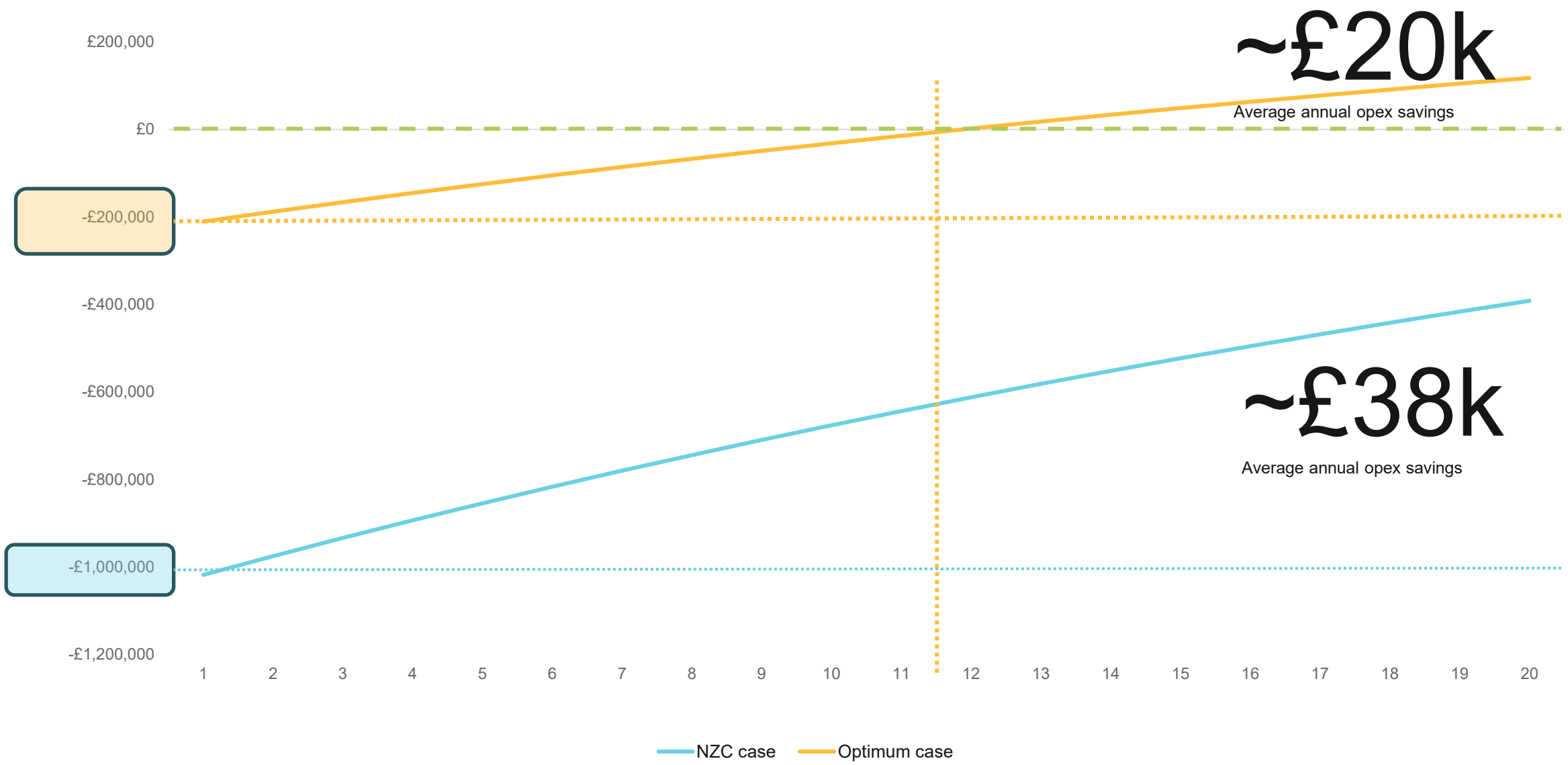
Cashflow analysis



Carbon balance – NZC Case

-397 tCO_2

Upfront embodied carbon

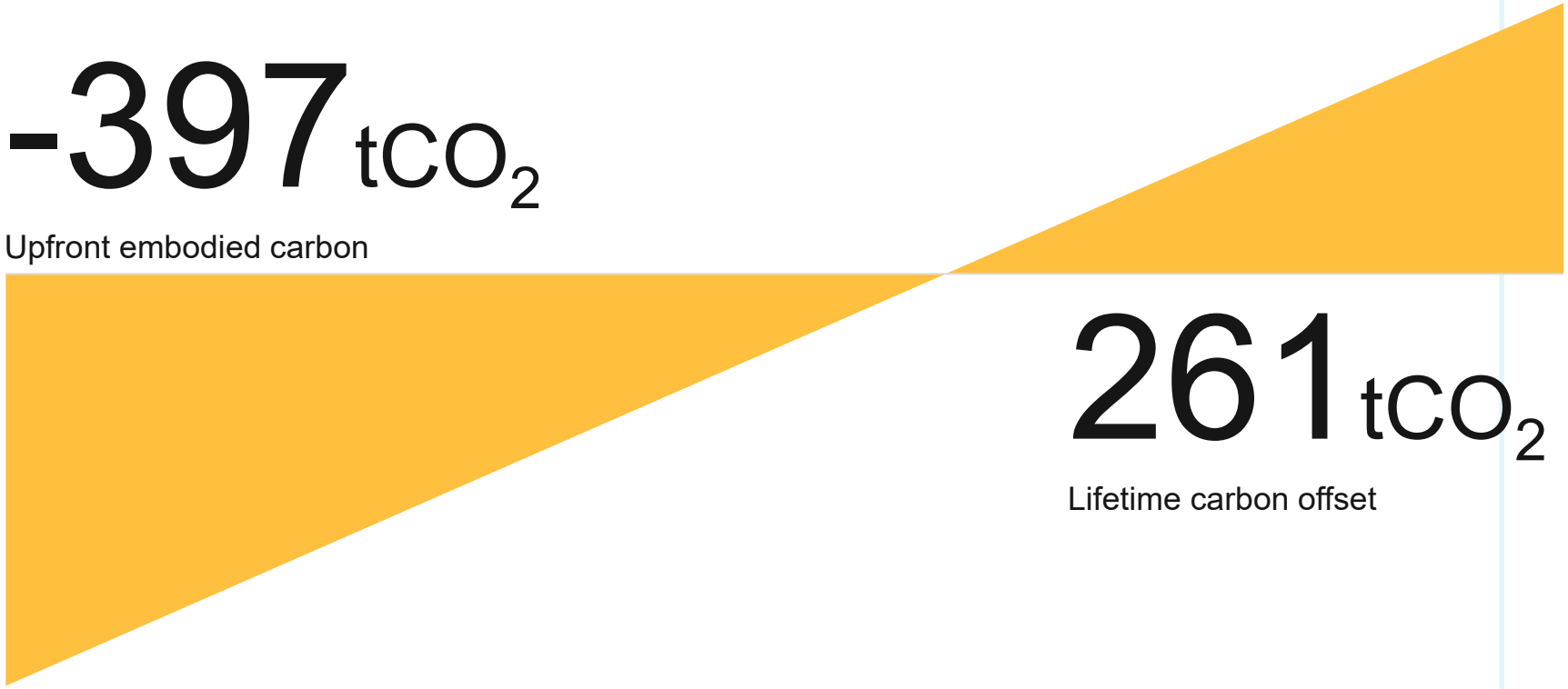
-136 tCO_2

Net carbon savings

Upfront embodied carbon outweighs lifetime carbon offset

261 tCO_2

Lifetime carbon offset



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Carbon balance- Optimised Case

-98tCO_2

Upfront embodied carbon

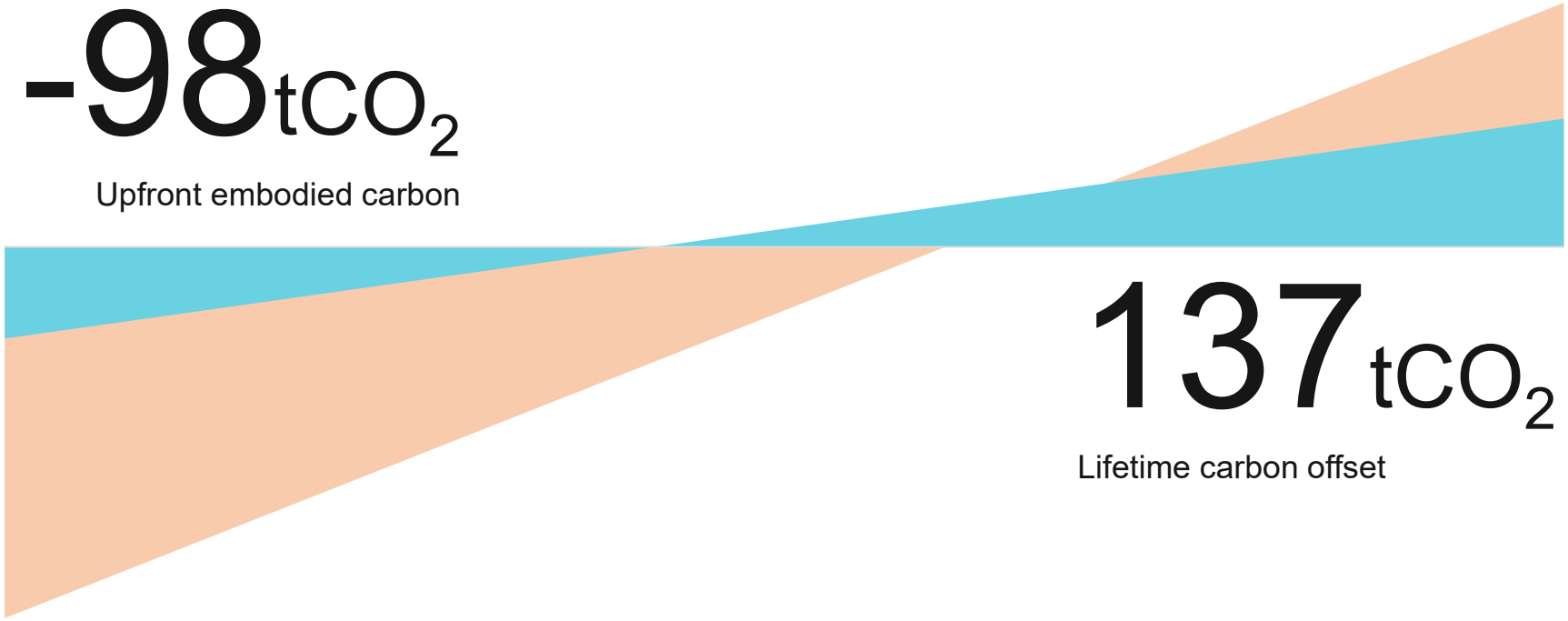
137 tCO_2

Lifetime carbon offset

39 tCO_2

Net carbon savings

Lifetime carbon offset outweighs upfront embodied carbon



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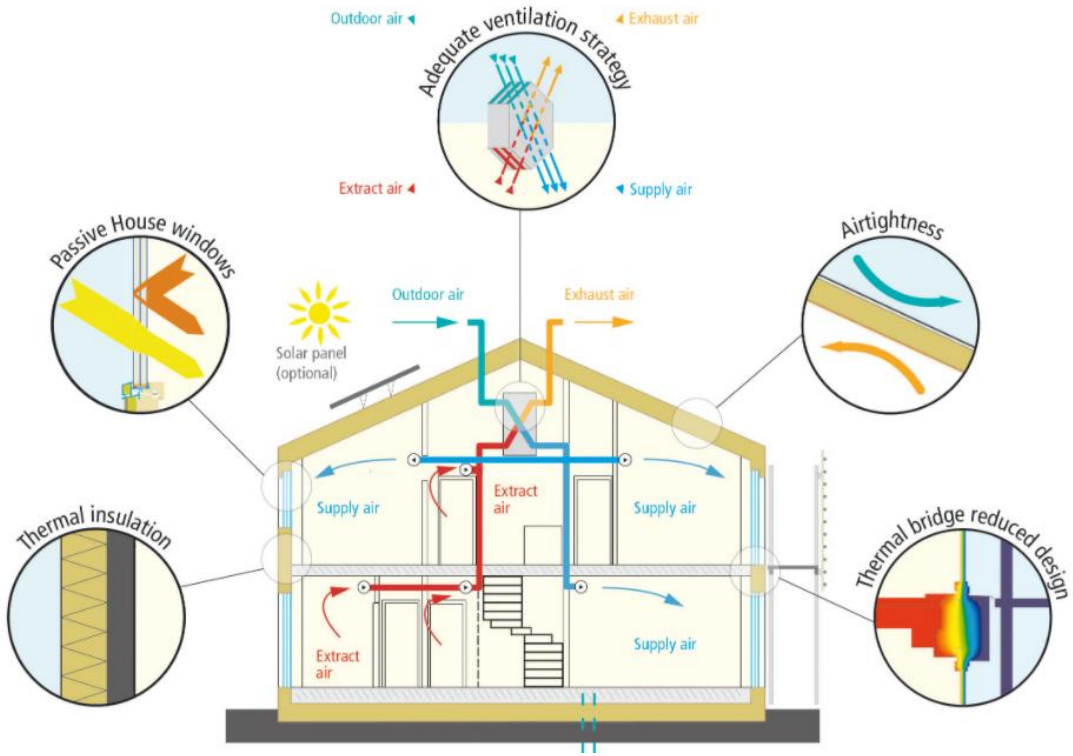
Delivered heating and cooling

- Metered annual space heating delivered to the building limit [kWh/m^{2}GIA/year] - Limit **15kWh/m^2**
- Metered annual space cooling delivered to the building limit [kWh/m^{2}GIA/year] - Report
- Metered peak energy delivered for space heating limit [W/m^{2}GIA] - Report



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UK Net Zero Carbon Buildings Standard

Reporting / Future Limits

Lifecycle Embodied Carbon

Demand Management

Operational Water Use

Optional

Offsetting & Energy Procurement

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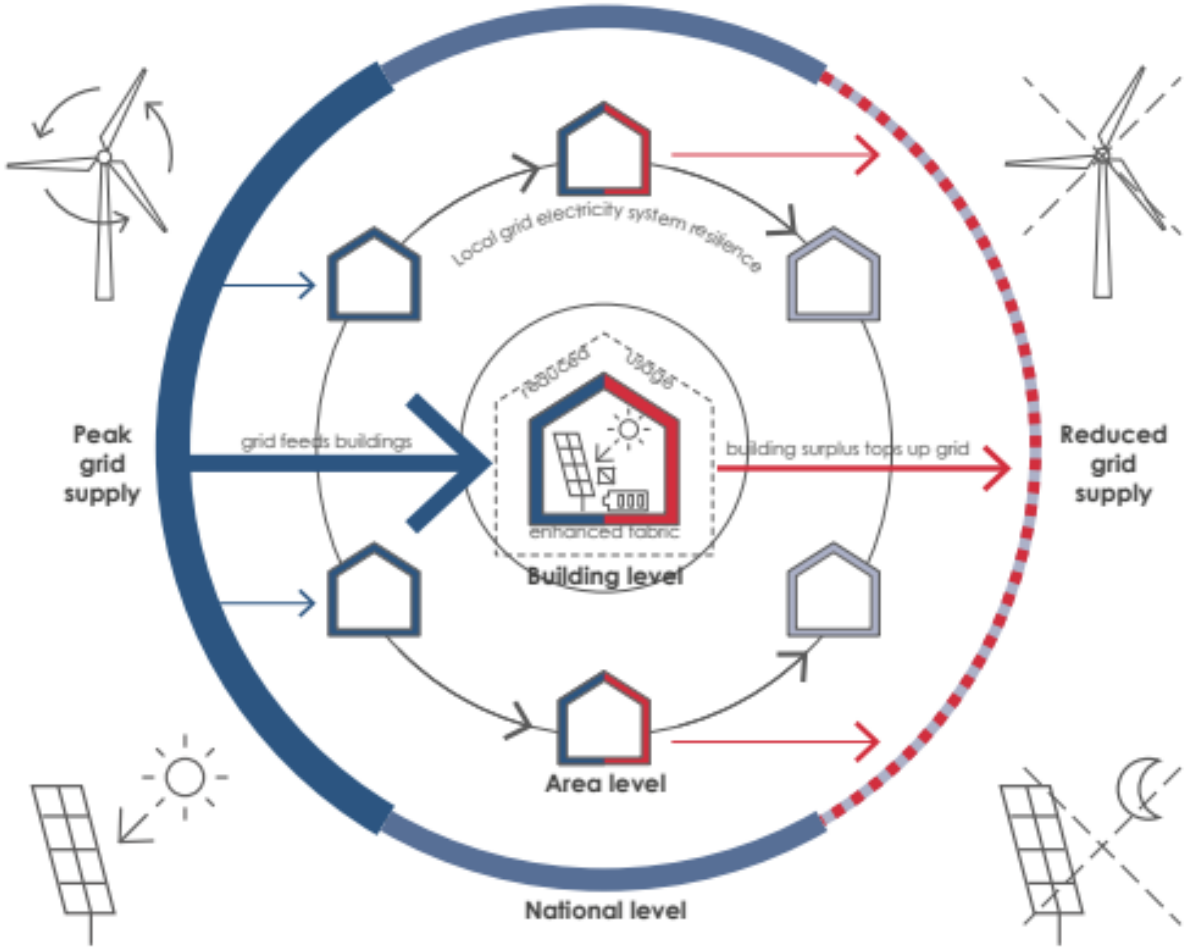
Demand management

1. Develop a **demand response strategy**.
2. Design to **reduce peak electrical demand**.
3. **Incorporate active demand response** measures e.g. thermal storage and set point control.
4. **Influence occupant behaviour** with display and reporting of demand and usage.



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Operational water use

Reporting metric(s) name and unit

- Annual operational water use [m^3/year]
- Annual operation water use per m2 GIA [m^3/m^2 GIA/year]
- Annual operational water use carbon emissions per m2 GIA [$khCO_2e/m^2$ GIA/year]

Also,

- For Homes and Offices – Liters per person per day [l/person/day]
- For Schools – Annual operational water use per pupil per year [m^3/pupil/year]
- For Data Centres – Water Use Effectiveness (WUE) [WUE]

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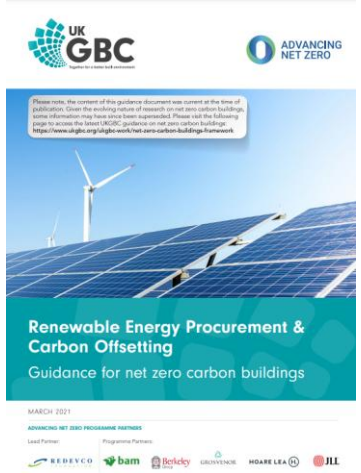
Optional Requirement: Offsetting and energy procurement

Route 1: Recognised offset frameworks

ICROA
International Carbon Reduction & Offset Alliance

iC | THE INTEGRITY COUNCIL FOR THE VOLUNTARY CARBON MARKET

Route 2: Renewable energy procurement



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Key Takeaways

Clarity: Sets clear targets for zero carbon in building design.

Flexible Approach: Defines performance criteria without mandating specific methods.

Ambitious Carbon Targets: Annual increases in upfront embodied carbon targets to encourage innovation.

Focus on Real Performance: Prioritises “in-use” targets, based on actual metered data.

Questions?

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