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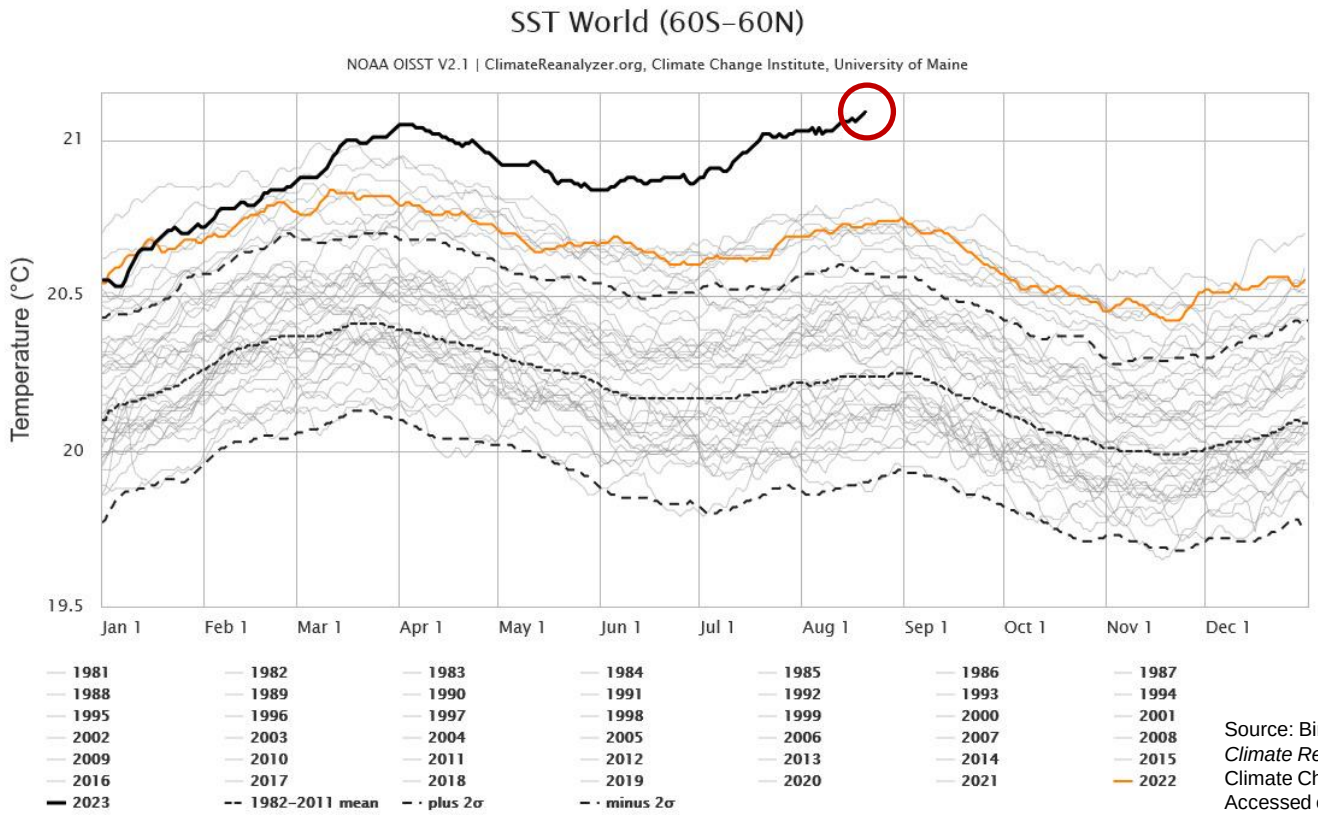
Buildings as Batteries

Presentation to:
CIBSE ANZ Seminar Series Day 1 –
Pathways, Stairways & Highways

Craig Roussac
22nd August 2023, 12:30–12:55 PM

Daily sea surface temperature



Source: Birkel, S.D. *'Daily Sea Surface Temperature', Climate Reanalyzer* (https://ClimateReanalyzer.org), Climate Change Institute, University of Maine, USA. Accessed on 22 August 2023.

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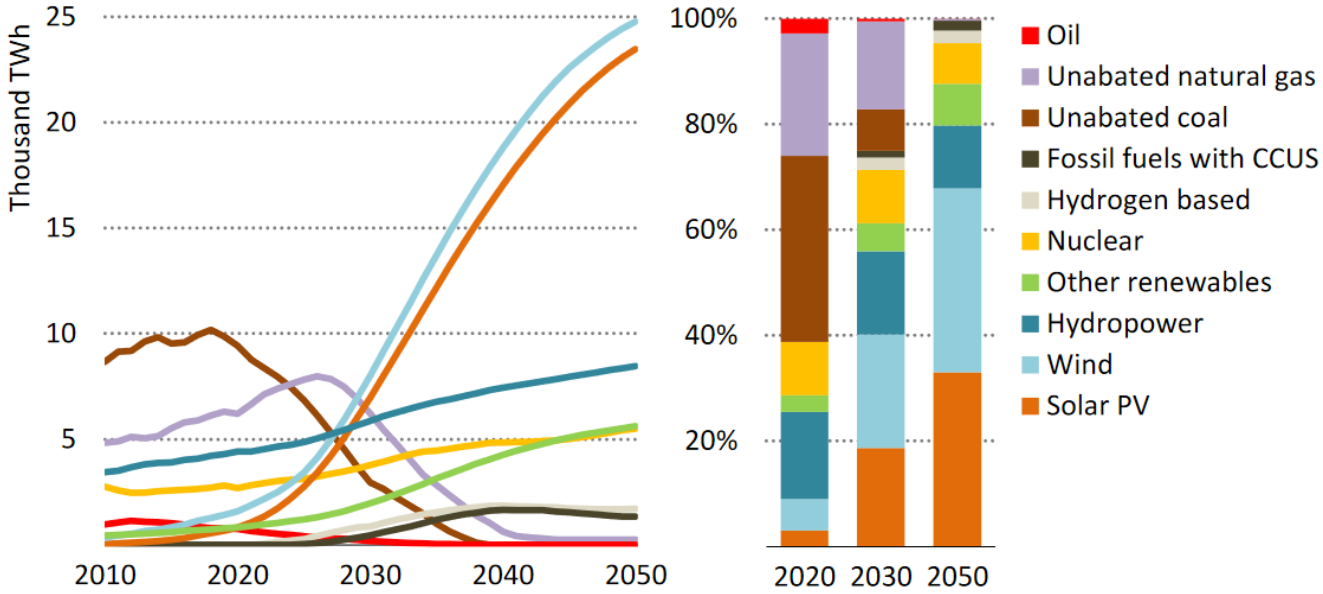
Proportion of solar and wind generation needs to rise dramatically



Source: IEA (2021), Net Zero by 2050, IEA, Paris https://www.iea.org/reports/net-zero-by-2050.

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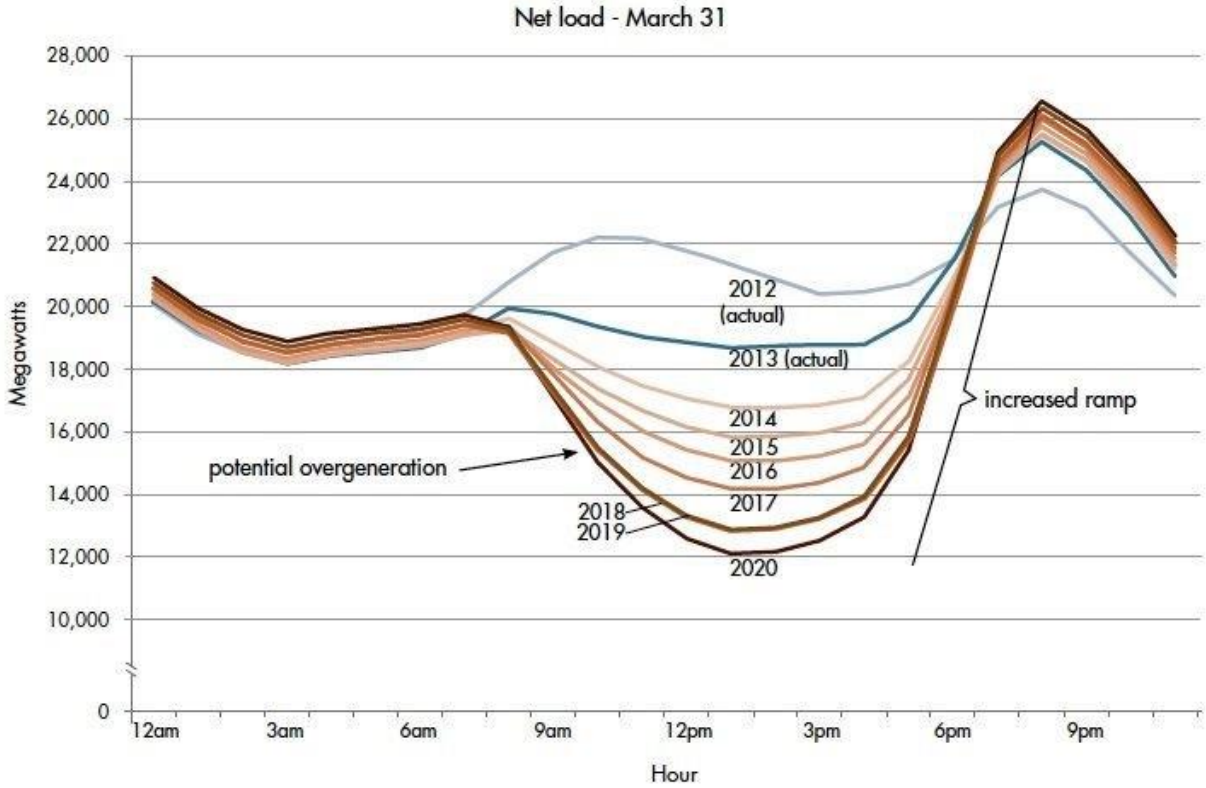
The "Duck Curve"



Source: California ISO

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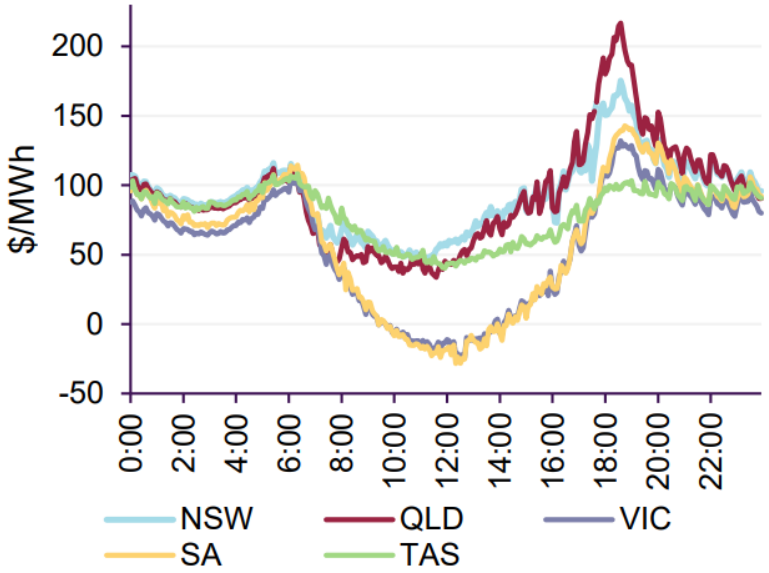
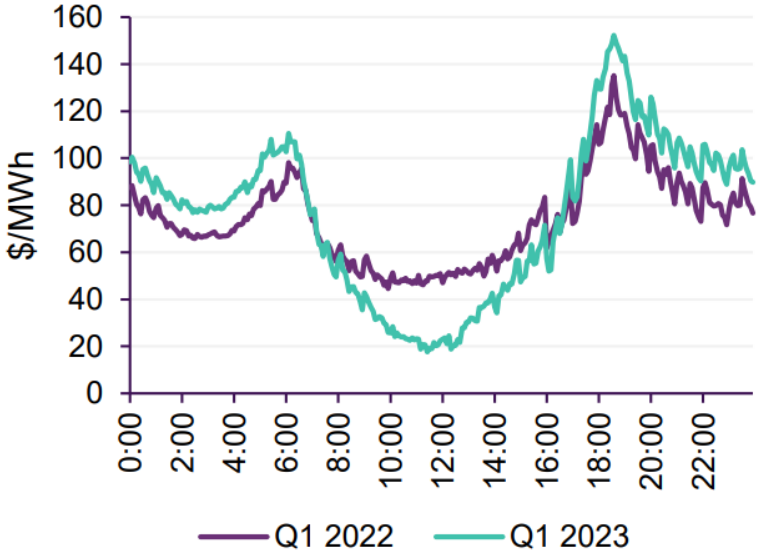
The "Duck Curve"

Average energy prices by region – Q1 2023



Average NEM energy prices by time of day – Q1 2023 vs Q1 2022



Source: AEMO, 2023. *Quarterly Energy Dynamics Q1 2023*

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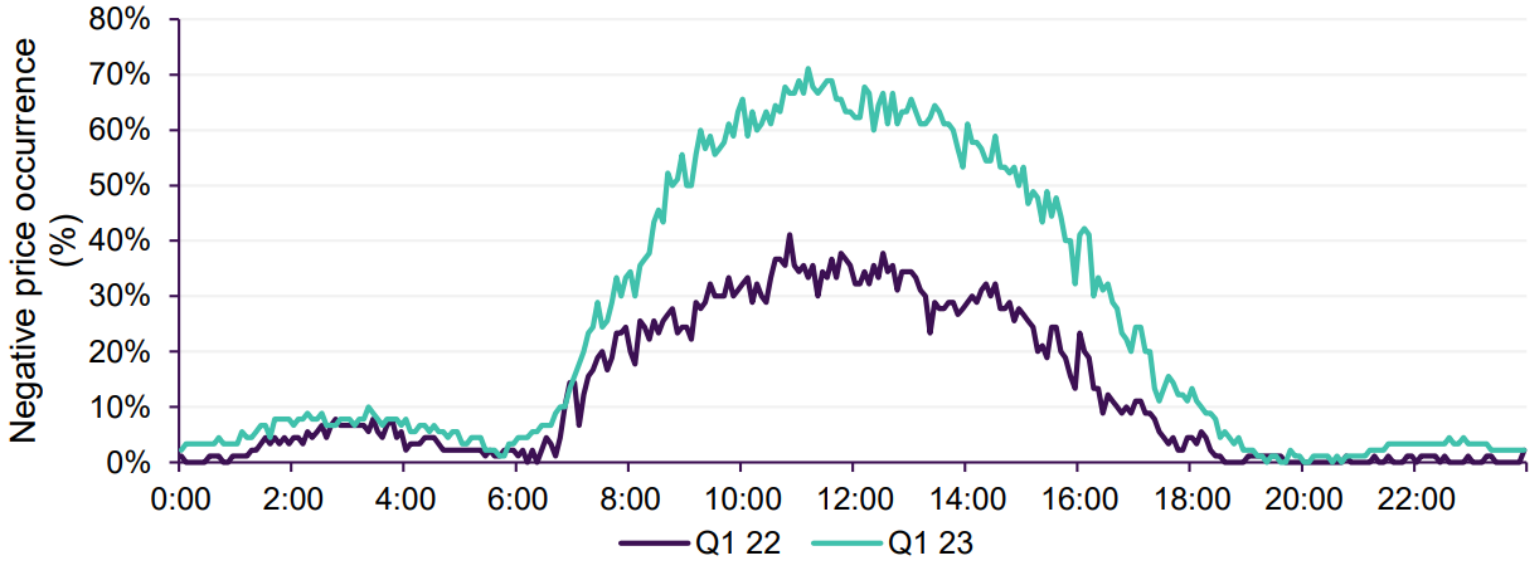
Growth in solar PV generation is driving wholesale prices negative

Occurrence of Victorian negative or zero prices by time of day – Q1 2023 and Q1 2022



Source: AEMO, 2023. *Quarterly Energy Dynamics Q1 2023*

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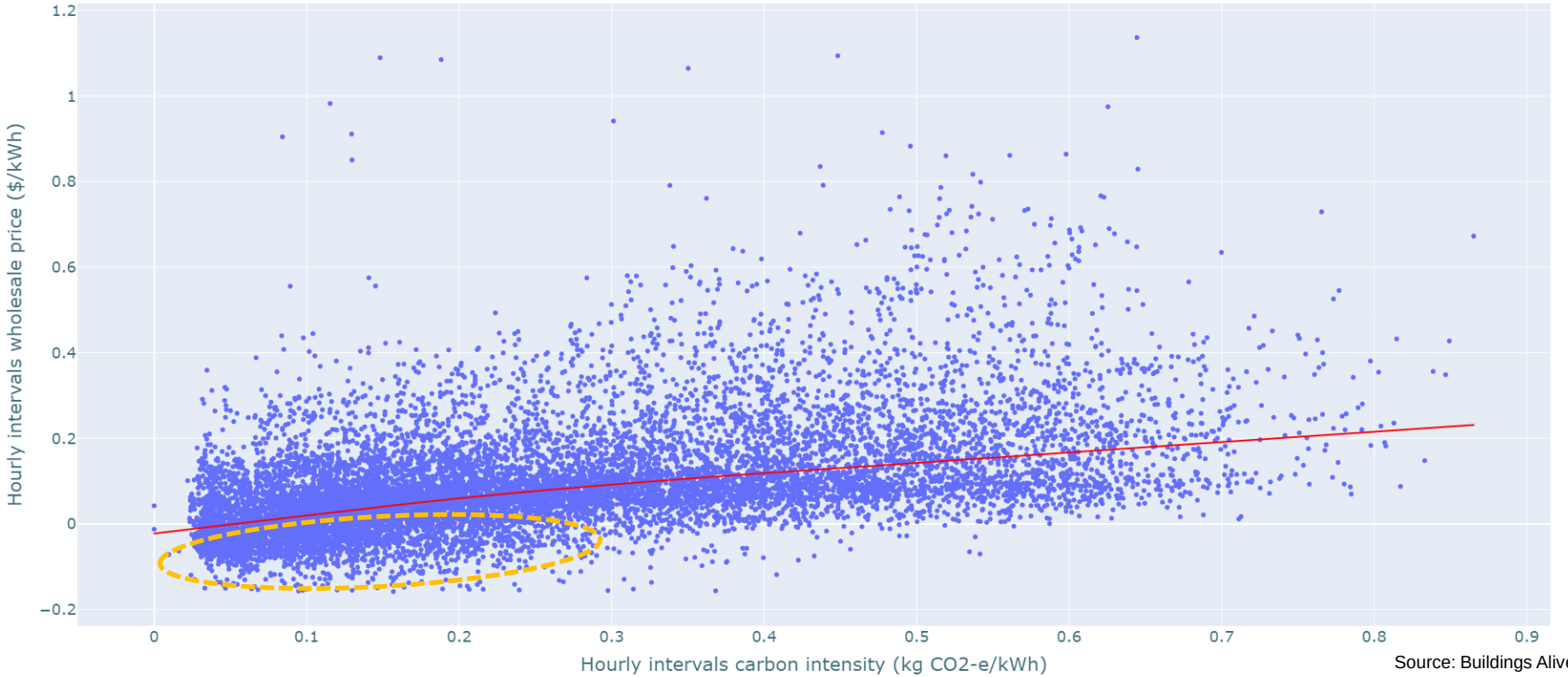
Emerging correlation between carbon intensity and price (South Australia)



Source: Buildings Alive

Period: 1 May 2021 to 12 Dec 2022; r = 0.523

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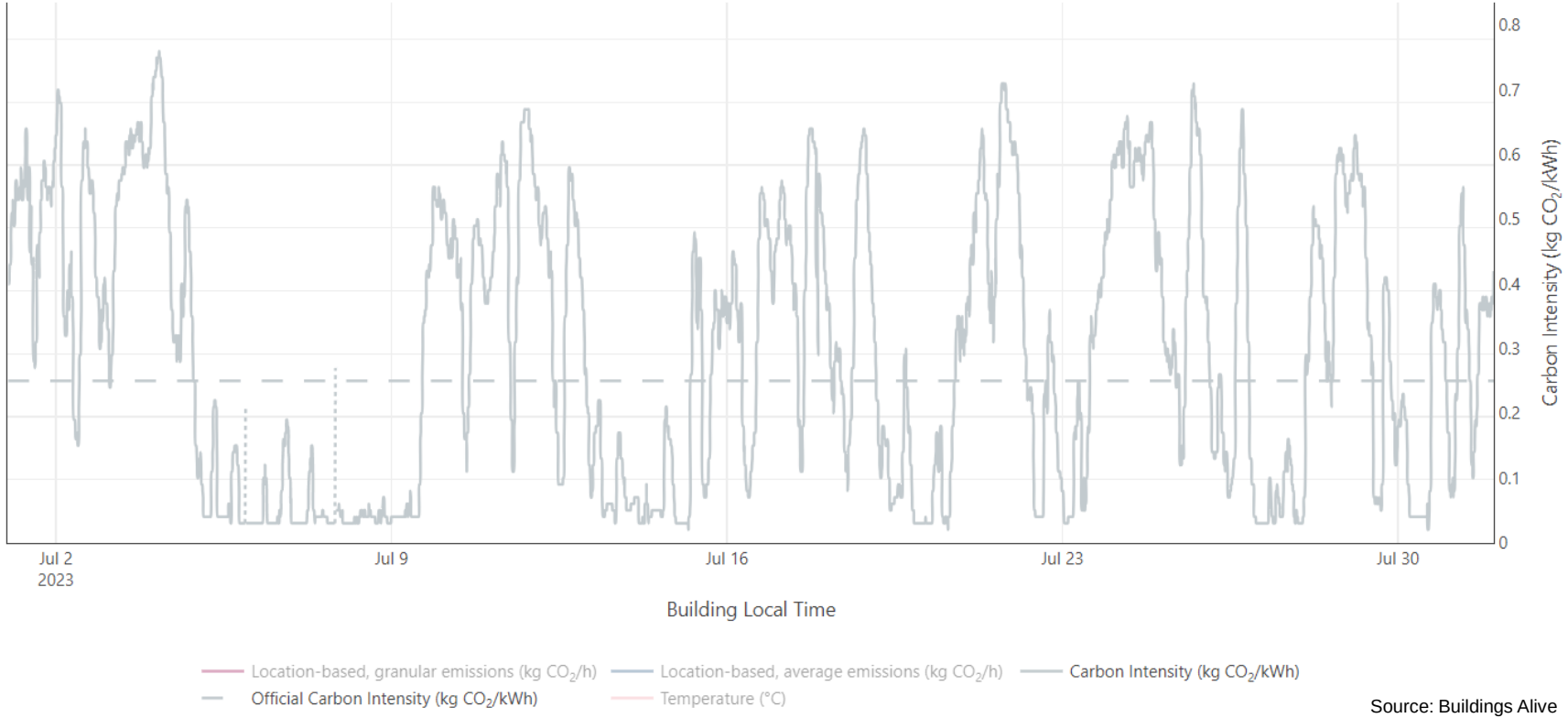
Most reporting of emissions from electricity use is misleading – South Australia



Source: Buildings Alive

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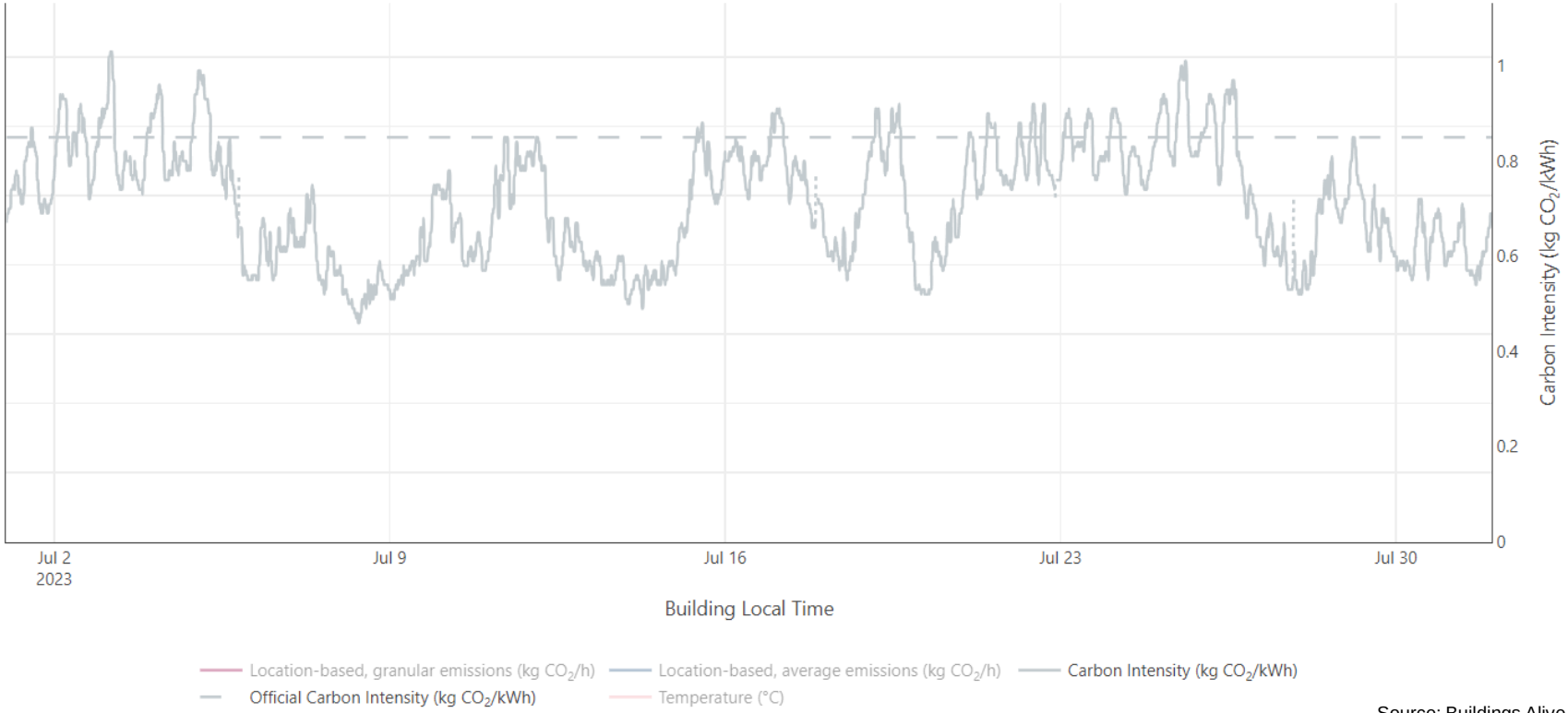
Most reporting of emissions from electricity use is misleading - Victoria



Source: Buildings Alive

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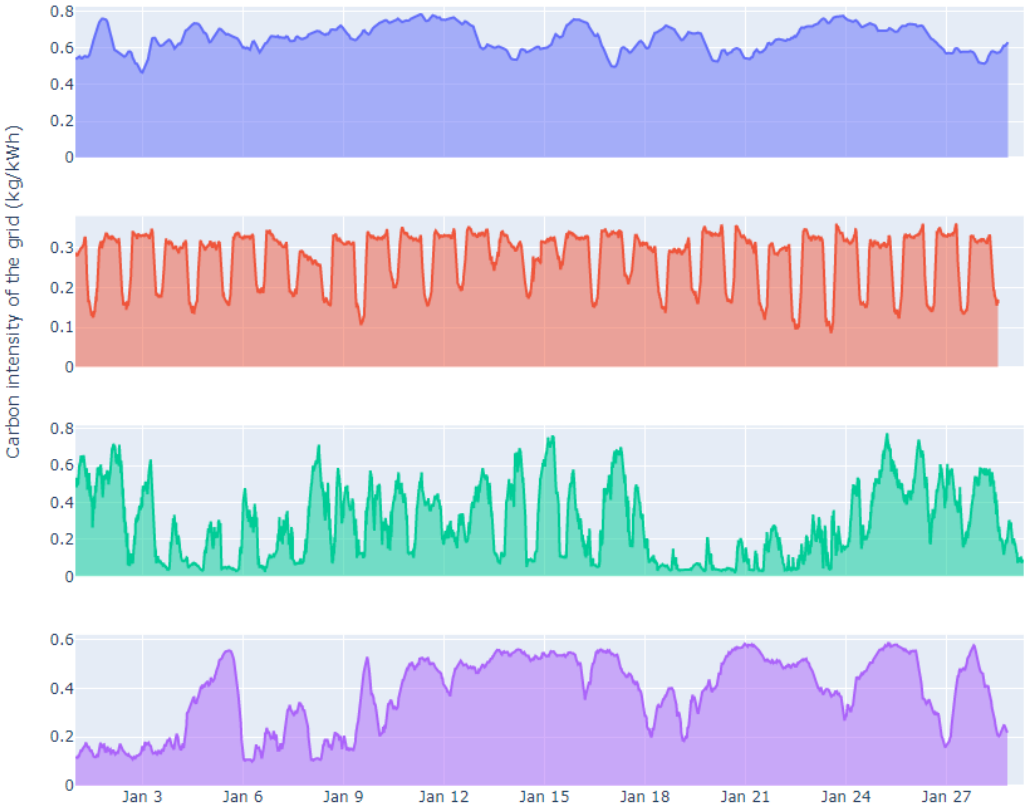
Carbon intensity varies depending on renewable generation sources



Poland (some wind)

California (solar)

South Australia (wind & solar)

Ireland (wind)

Source: Buildings Alive

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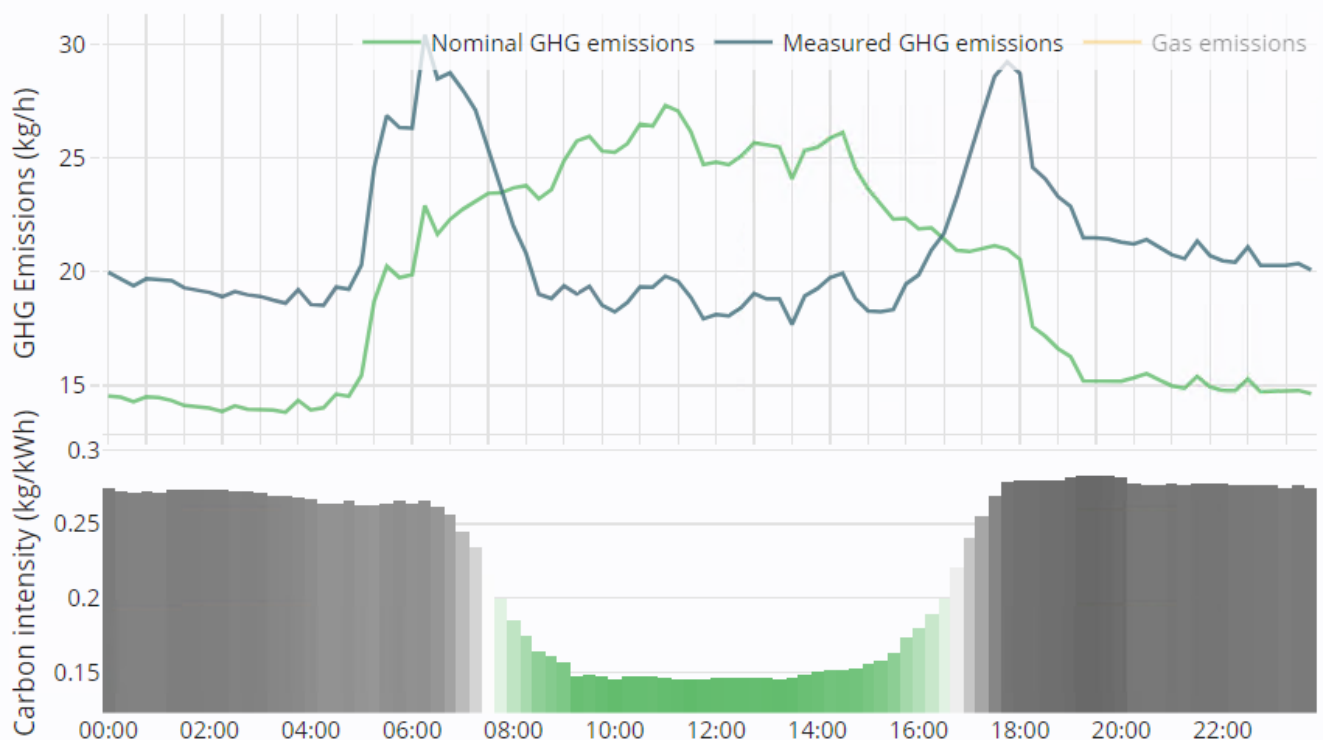
Commercial building consumption profile vs emissions profile



Source: Buildings Alive

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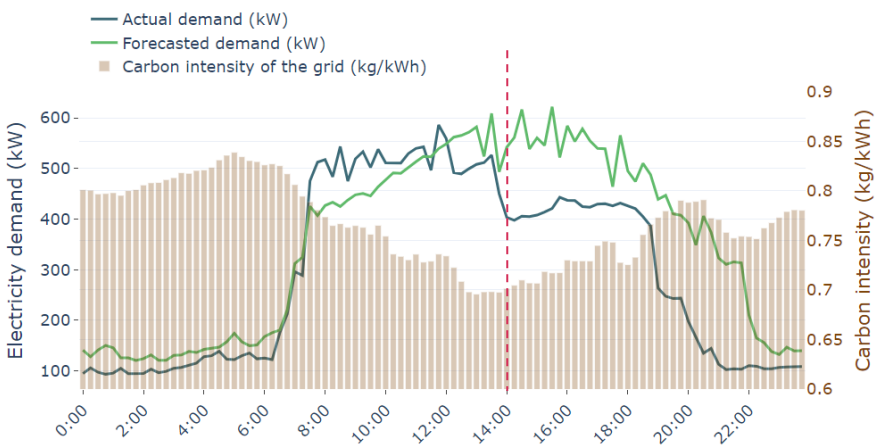
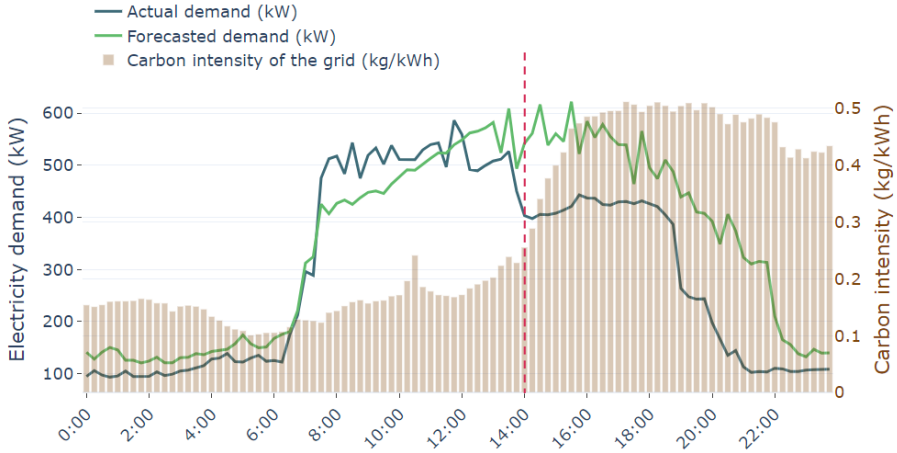
EE + DR = "Active efficiency" and GHG reductions



Forecast GHG emissions: **6,370 kg CO_2-eq (grid)**
Demand reduction: **175 kVA**
Measured GHG emissions: **5,350 kg CO_2-eq (grid)**
GHG saving: **16%**



Measured GHG emissions: **2,022 kg CO_2-eq (grid)**
GHG saving: **68%**

Demand response, 17th Jan 2022: At 8:00am, the global setpoint was changed to 22.0°C. This was increased to 24.5°C at 1:45pm. The setpoint was reset to the normal summer setpoint (23.0°C) at the end of the day.

The plot on the left shows the carbon intensity of electricity supplied to Sydney on 17th January, the plot on the right juxtaposes the building onto the South Australian electricity grid, highlighting the emerging emission reduction opportunity.

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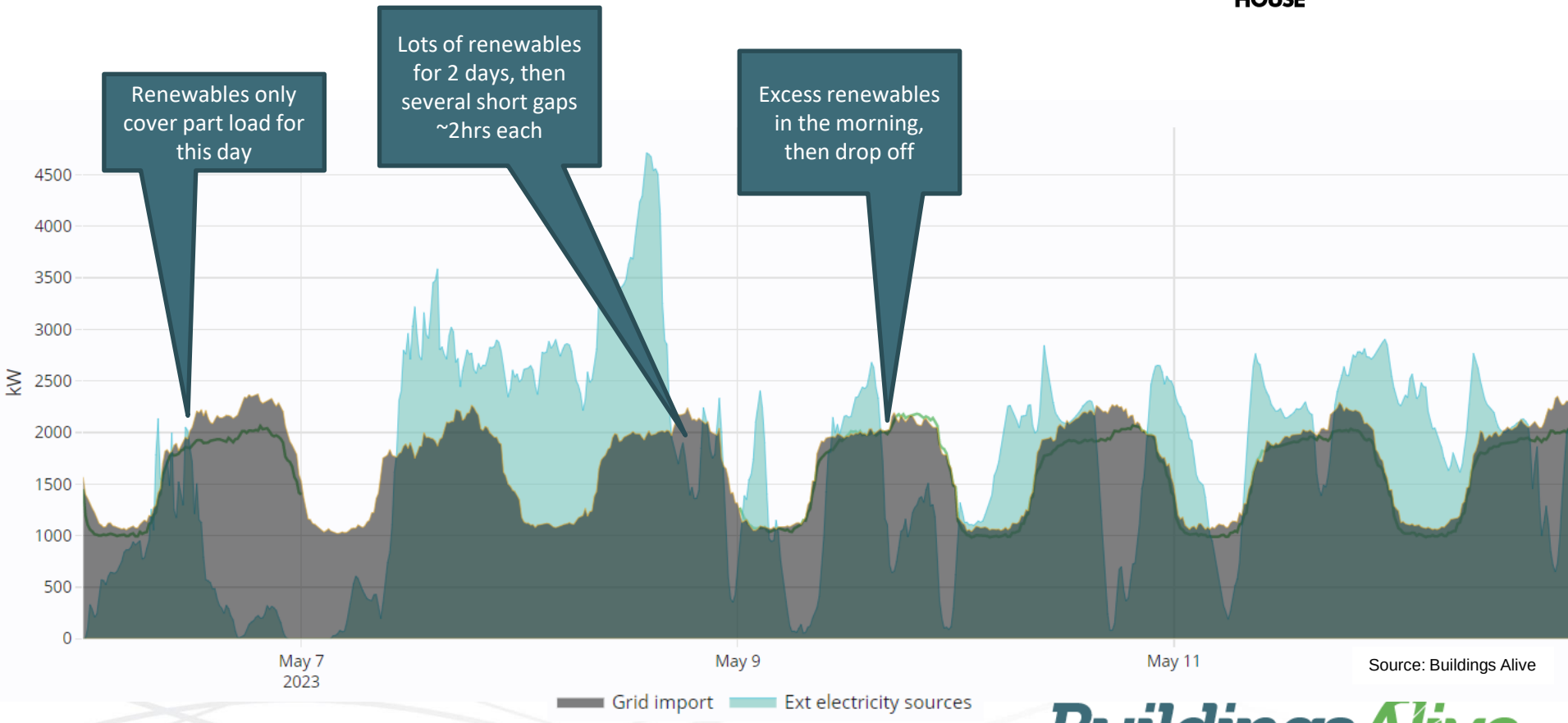
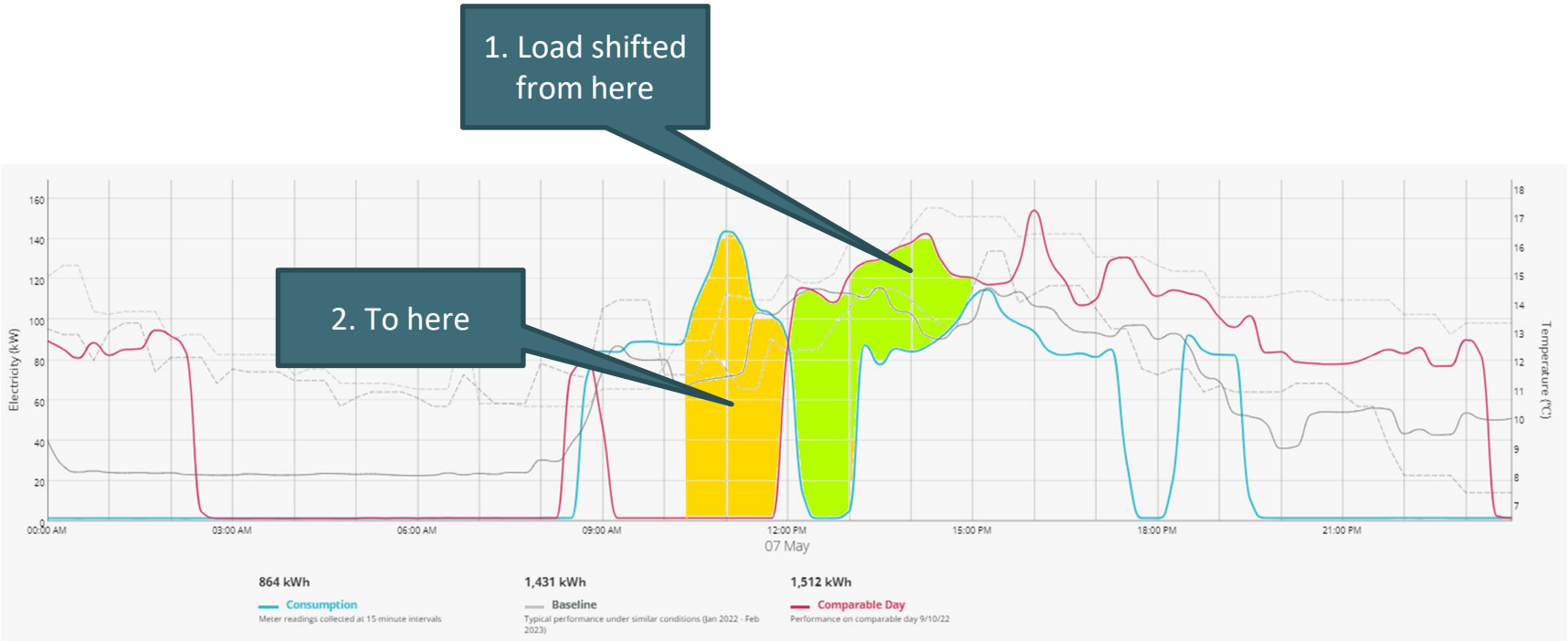
Sydney Opera House: Time-sleeved Power Purchase Agreement



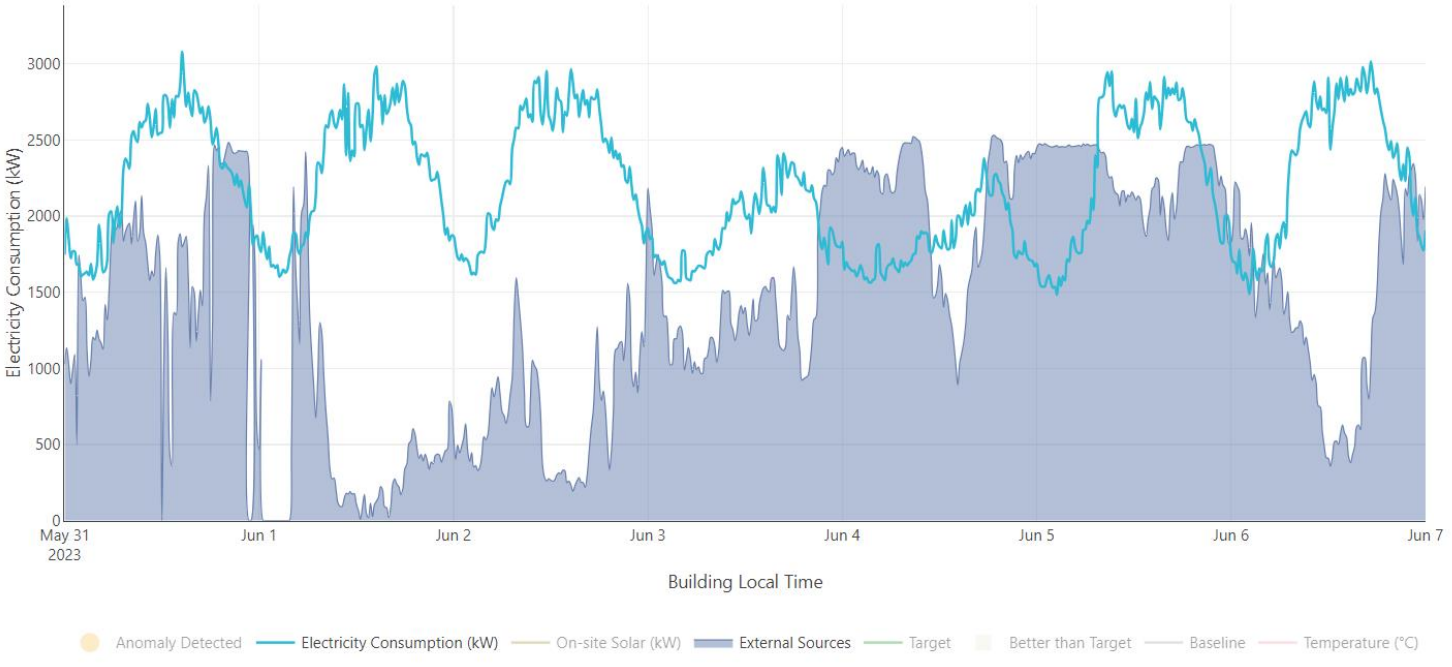
Source: Buildings Alive

Sydney Opera House: Load Shifting



Source: Buildings Alive

Monash University – Clayton Microgrid – Wind Supply



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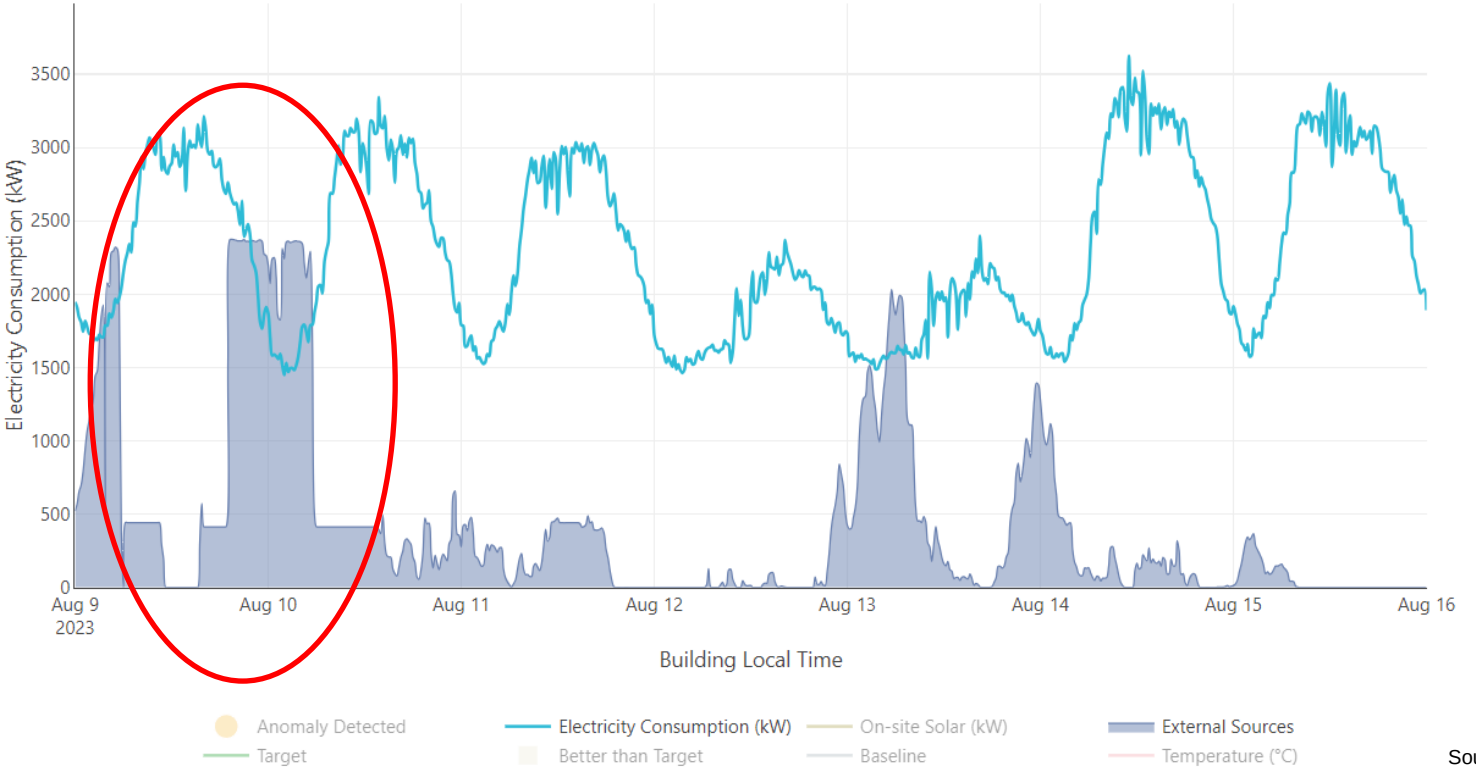
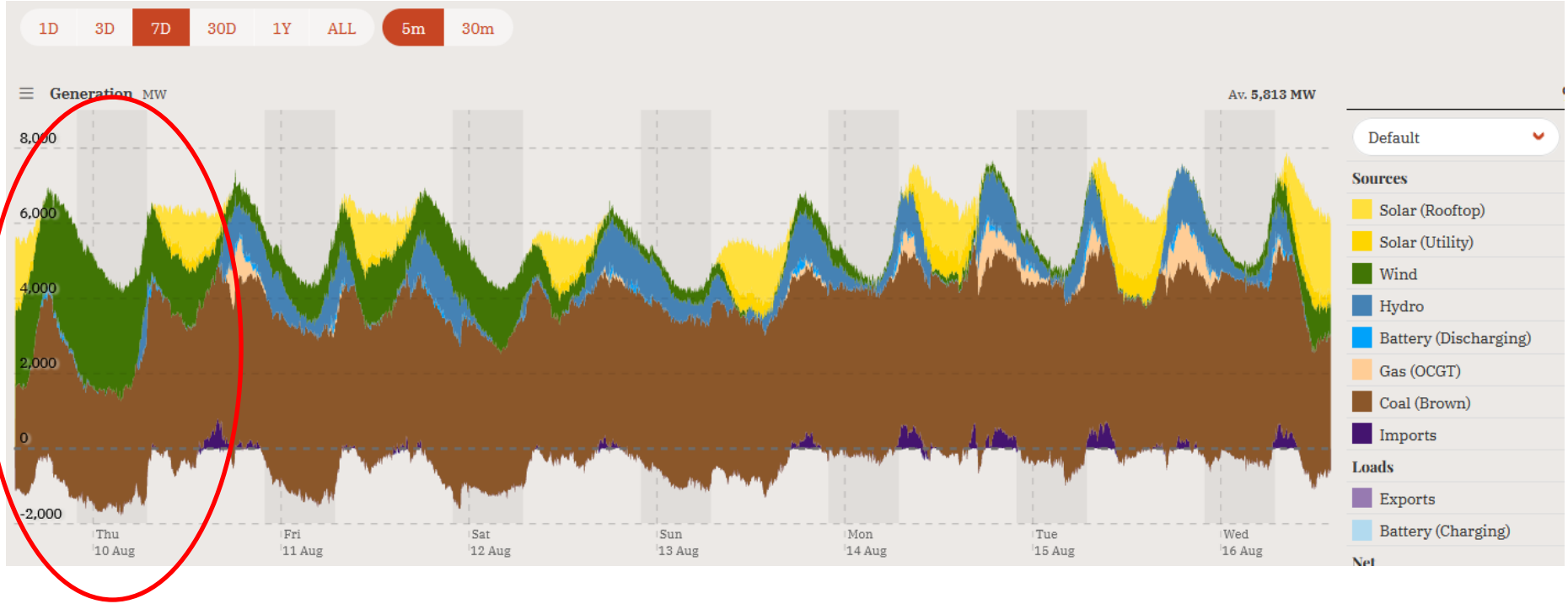


Source: Buildings Alive

Monash University – Clayton Microgrid – Victoria Energy Mix



Source: OpenNEM https://opennem.org.au/energy/vic1/?range=7d&interval=5m captured 16 August 2023

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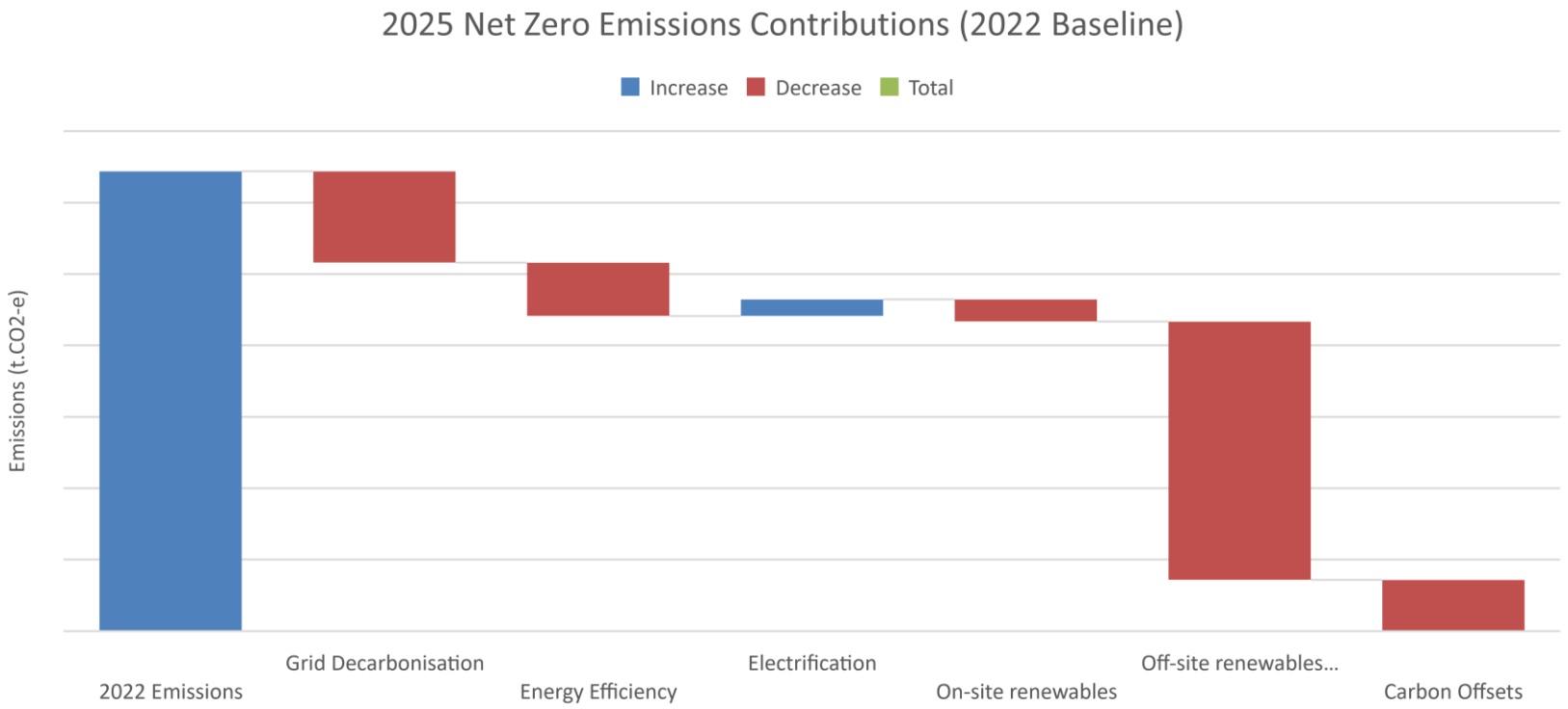
What is the conventional net zero carbon strategy / roadmap?



Source: Buildings Alive

Google's energy journey

Carbon Neutrality
(Offsetting emissions)

100% Renewable Energy
(Reducing emissions)

24/7 Carbon-free Energy
(Eliminating emissions)

Since 2007

Google has purchased enough high-quality carbon offsets and renewable energy to bring our net operational emissions to zero.

Since 2017

Google has matched its global, annual electricity use with wind and solar purchases. However, our facilities still rely on carbon-based power in some places and times.

By 2030

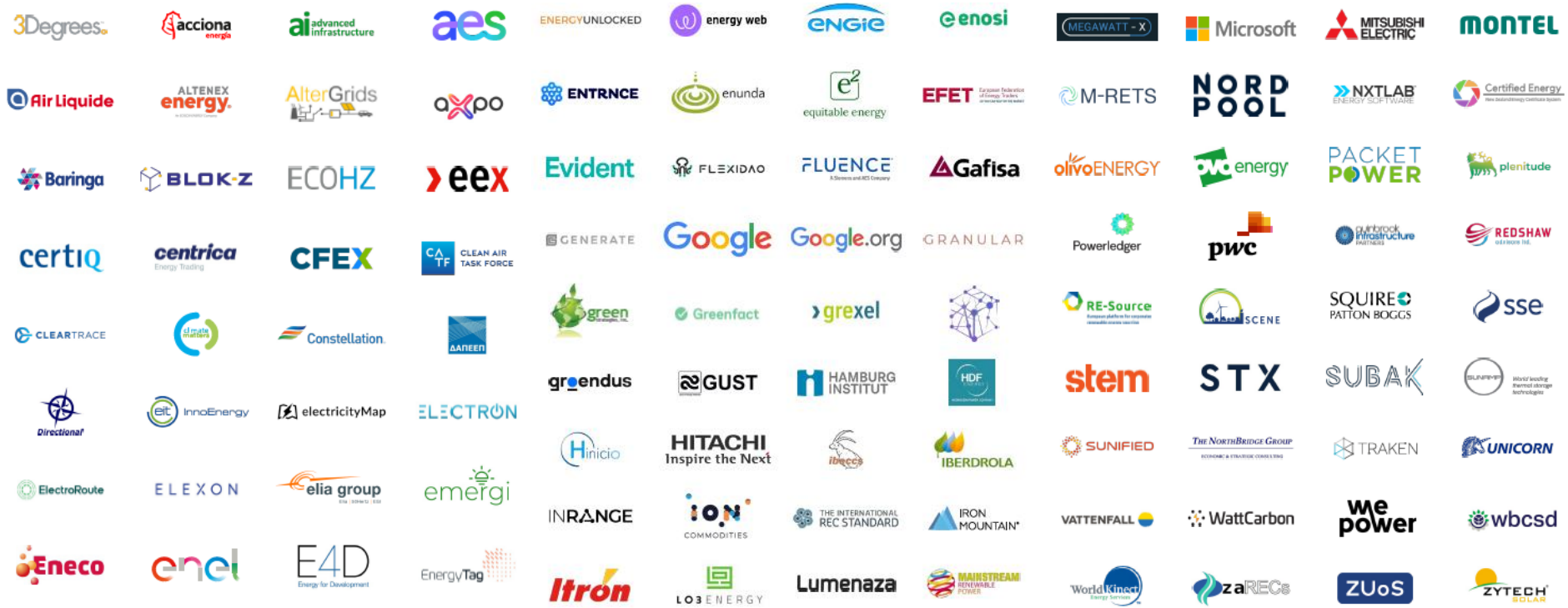
Google intends to match its operational electricity use with nearby (on the same regional grid) carbon-free energy sources in every hour of every year.

Although we matched 100% of our global, annual electricity consumption with renewable energy in 2019, on an hourly basis 61% of all the electricity we used was matched with regional, carbon-free sources.

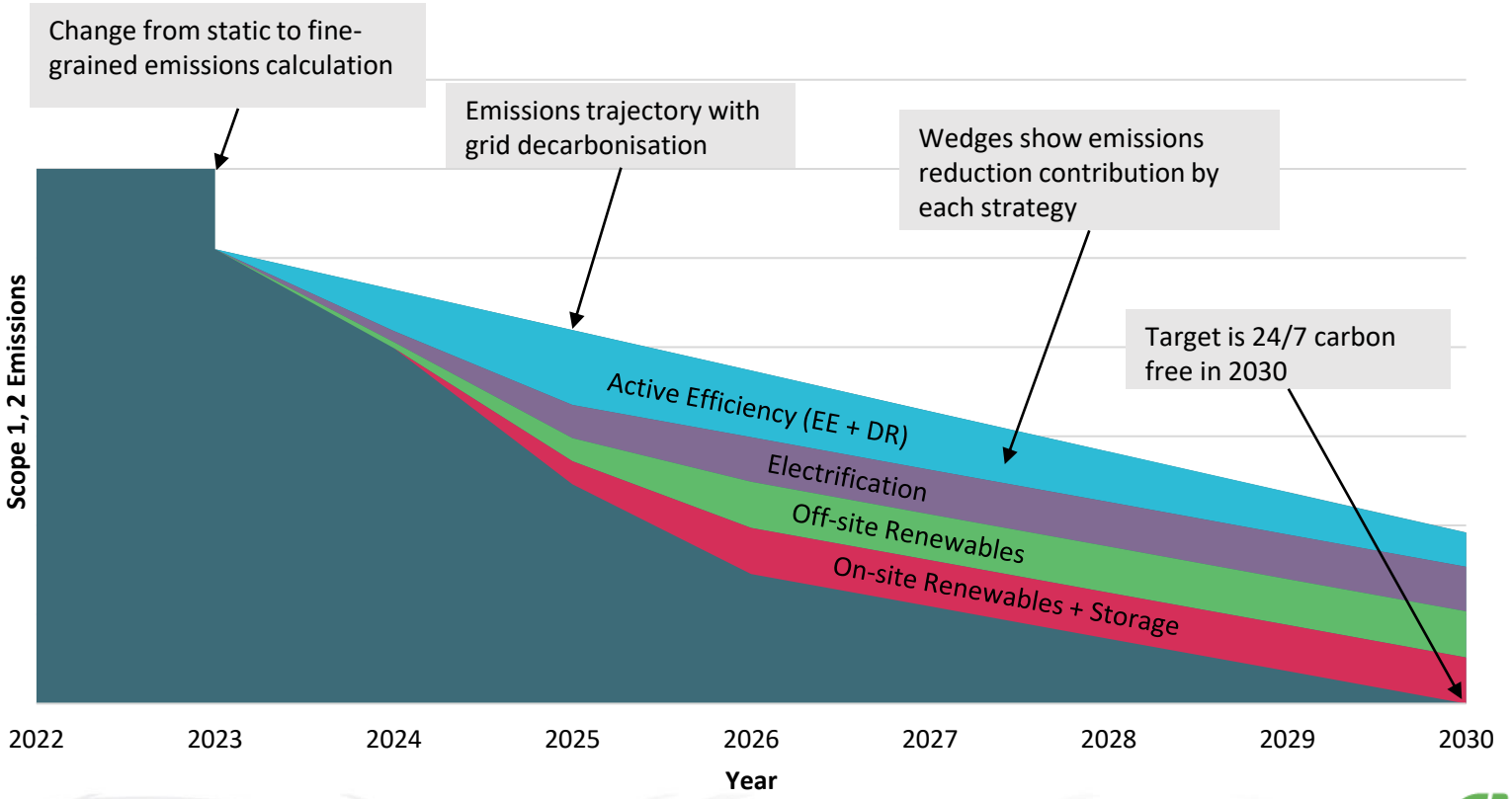
Source: Google, 2020. *24/7 by 2030: Realizing a carbon-free future*

The industry is shifting – more and more corporates want carbon innovation

- Leading tenants are looking for innovation in sustainability – Net Zero emissions
- Carbon management - changing from static, annual calculations to dynamic, hourly accounting



What does a “zero” carbon strategy look like?



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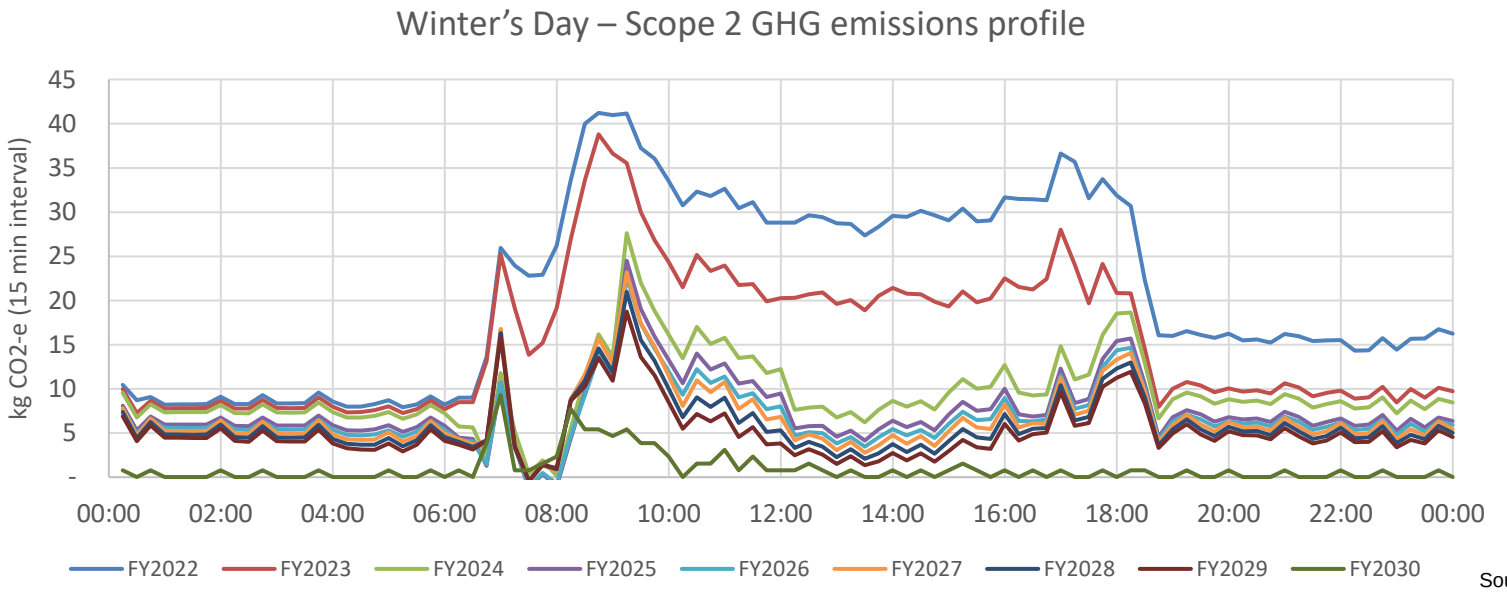

Source: Buildings Alive

This portfolio’s decarbonization pathway considers: grid real-time GHG intensity; energy efficiency initiatives; DR / flex initiatives; electrification; on-site renewables; off-site renewables; and, on-site storage.

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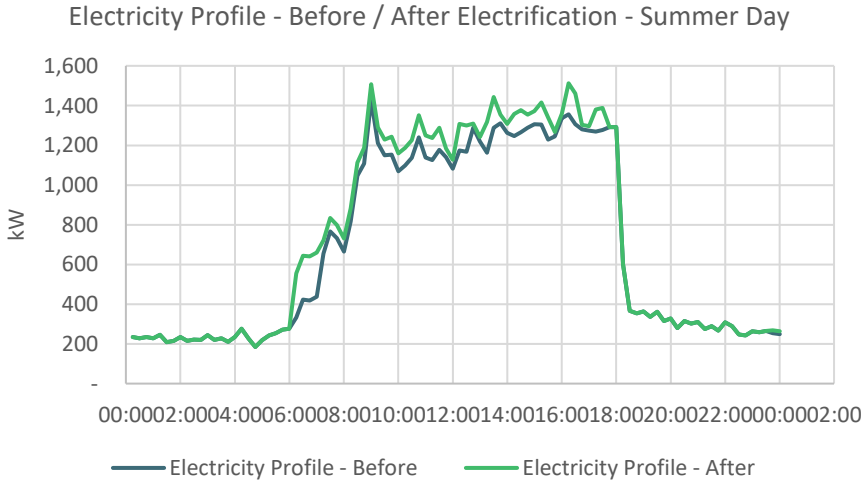
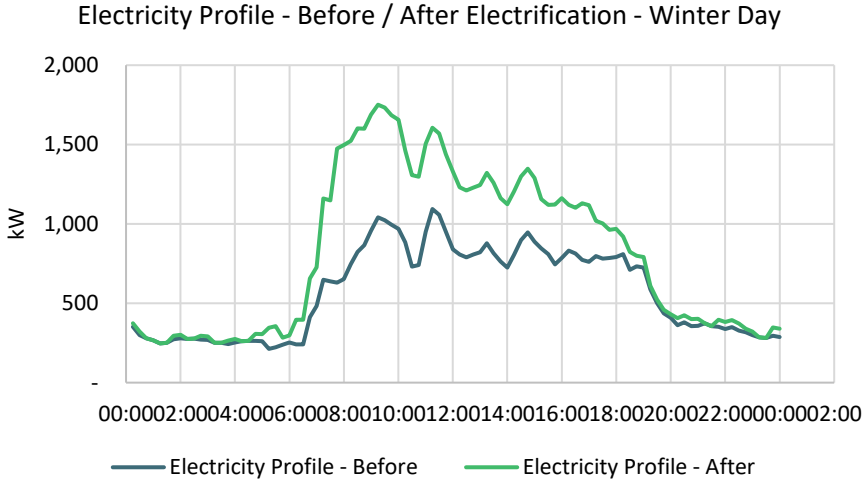
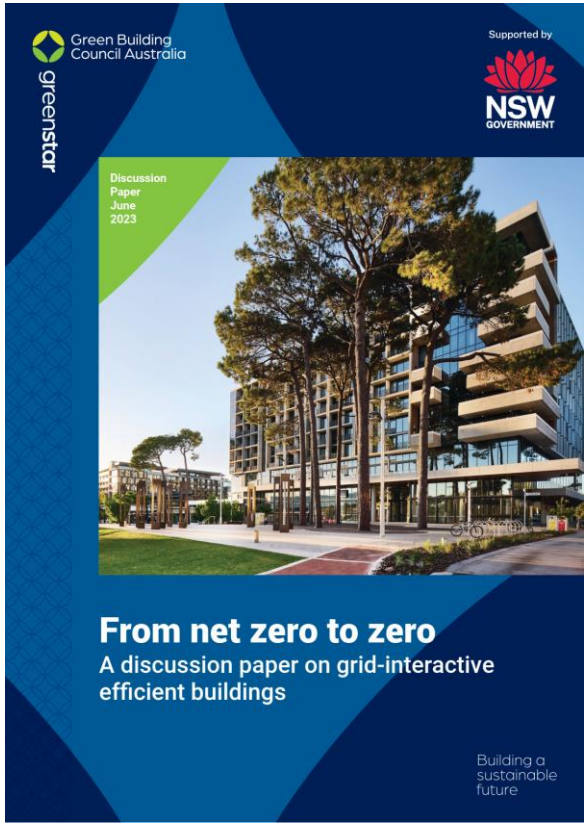
Impact of electrification





Source: Buildings Alive

GBCA Discussion Paper



Source: GBCA

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Takeaways

1) Understanding – Buildings have a huge role to play – 50% electricity, 75% demand
2) Peak Demand Management – Save $$ now, prepare for grid-interactive future
3) Electrification – combined with flexibility creates $$ and carbon savings
4) Building Controls – Prepare for grid-interactivity
5) Energy-procurement – understand the market dynamics, emerging opportunities
6) Thermal Storage – emerging opportunities
7) Energy Efficiency is evolving into Carbon Efficiency – ~~Net~~ Zero

Thank you!

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