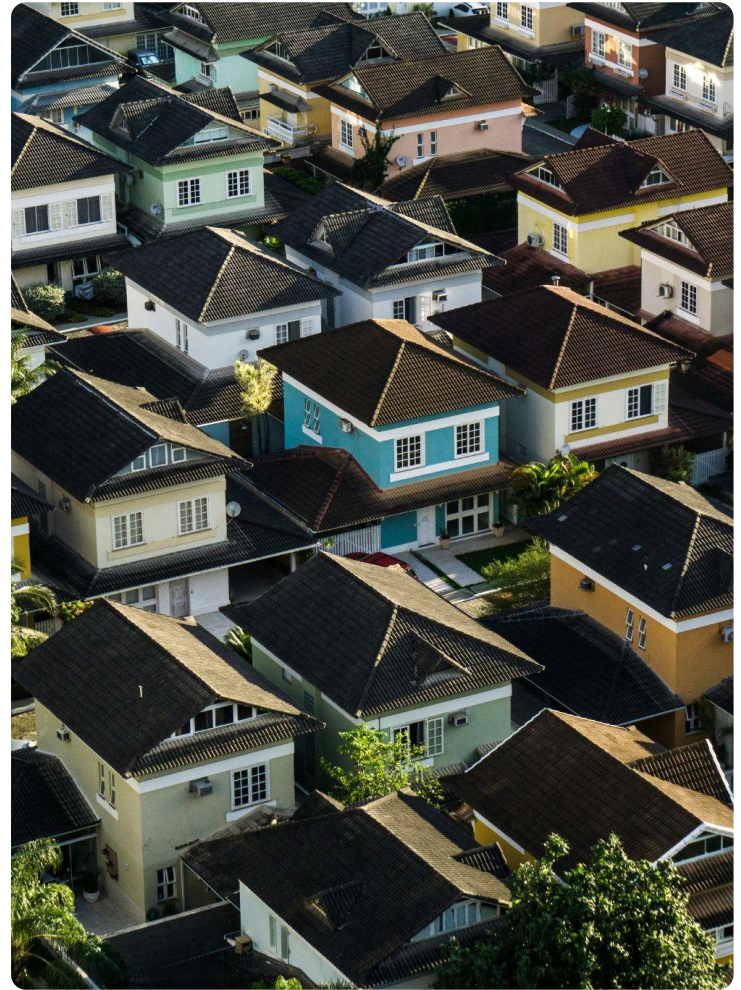


Forecasting the future of energy demand

Powered by Octopus Energy Group



Centre for Net Zero (CNZ)
is a non-profit, open research institute,
founded by the Octopus Energy Group

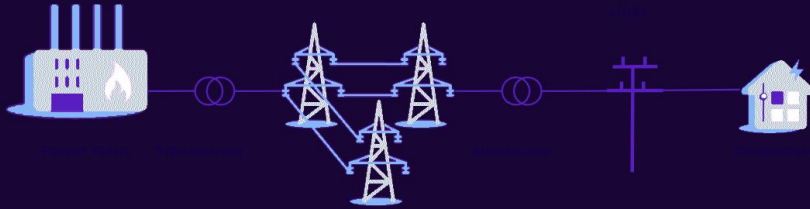
We operate autonomously, leveraging research and AI to forecast the future of energy demand - for the benefit of governments, policy-makers and grid operators.

Our mission is to accelerate the journey to a fully sustainable, global energy system.



Global energy systems are rapidly transforming

Old World

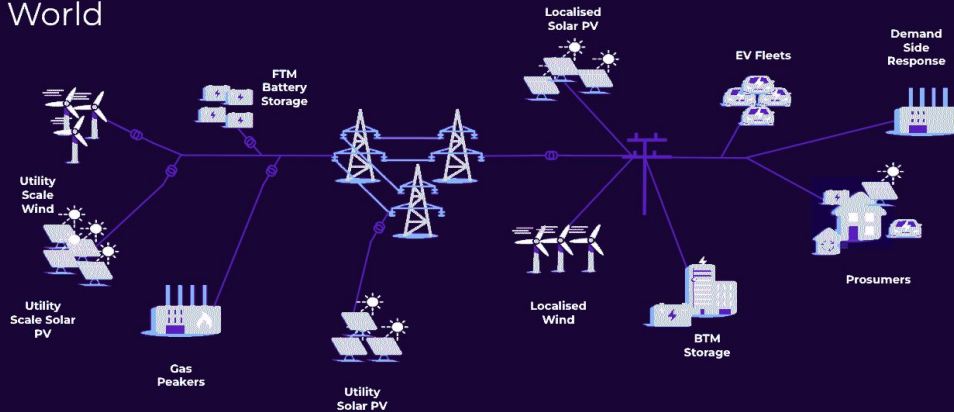


Unidirectional energy flows

Easily adjustable supply to match demand

Centralised generation

New World



Bidirectional energy flows

Demand flexing to meet variable supply


Distributed energy assets




Data-sharing is more important than ever

Grid operators & policy-makers rely on **aggregated** and **out-of-date** demand data, due to privacy and data barriers



 Low granularity data **misses nuances** that are essential to understand in distributed energy systems



 Historical data doesn't tell us about the **changing behaviours** of today, let alone those of tomorrow



CNZ is forecasting future electricity demand

Our focus:

1. **Building advanced AI and ML models**
Trained on vast, real-world consumer data
2. **Running international field trials**
Exploring evolutions in energy behaviours



Our research: A snapshot

1. The size of the prize: flexible heating & transport



Maximising renewables

Domestic demand flexibility can contribute up to ~30 TWh additional renewable generation in 2035.



Optimising grid build

Domestic flexibility reduces distribution capacity needs by ~25% from 2035 compared to scenario without flexibility.



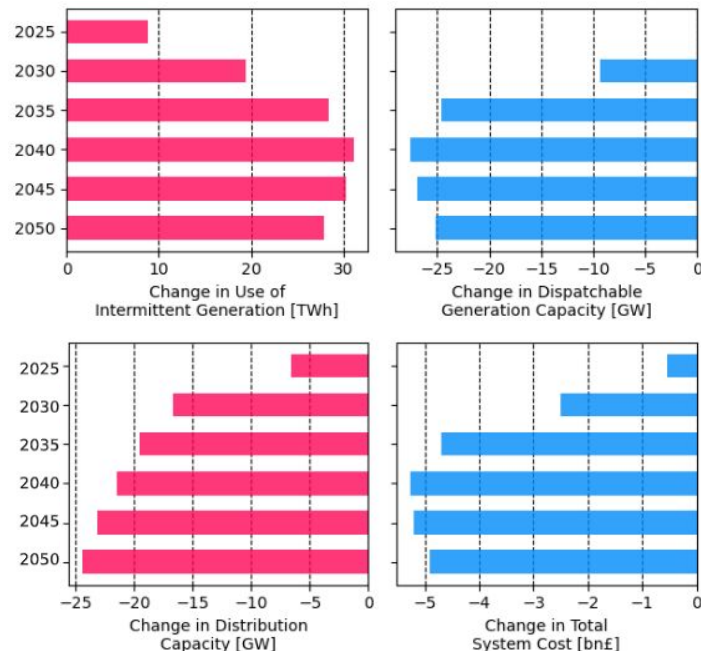
Reducing peak demand

Domestic demand flexibility could shift up to ~17 GW, or ~30%, out of peak demand load by 2030.



System savings

These changes reduce system costs by ~£5 bn in 2035, and a total of £95bn (~€110bn) over the period 2025-2050.



CNZ published results of whole-system energy modelling



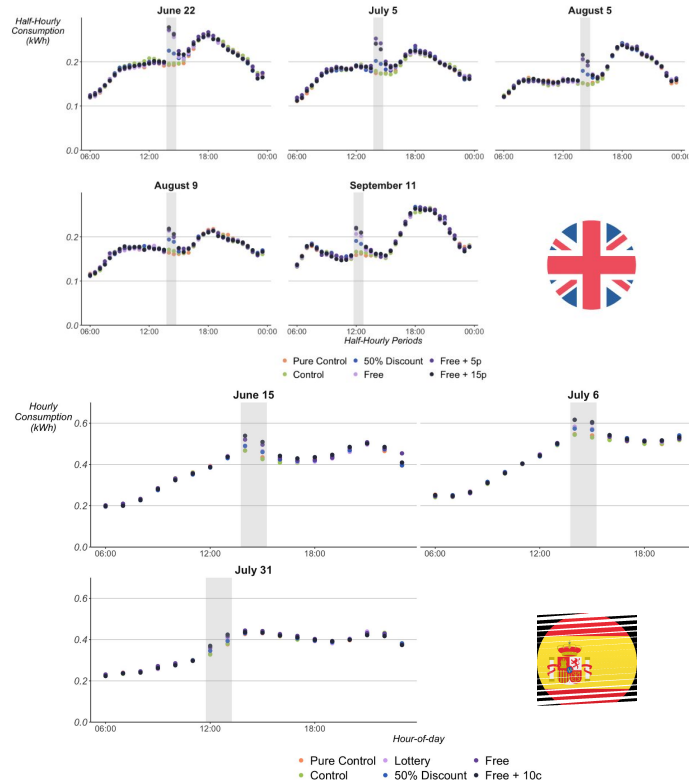
2. Reducing curtailment through 'turn ups'

Paying people can help address grid constraints

Instead of paying renewable generators to stop production, this project investigates the impact of incentivising consumers to 'turn up' their consumption, with cheaper, free, or negative electricity prices.

Early results from events this summer shows:

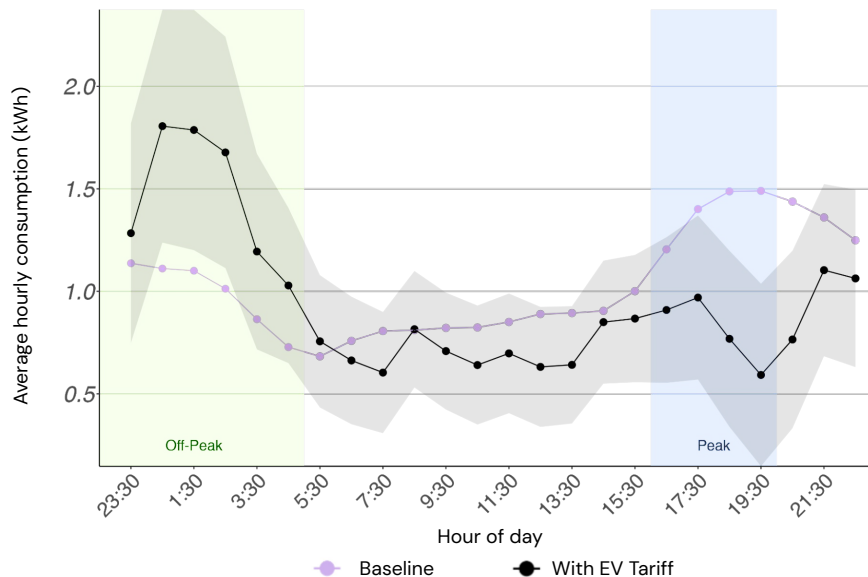
- UK: A **30% increase in electricity for free pricing groups**. Adding payments on top did not generate additional consumption increases.
- Spain: A **13% increase in electricity for free and negative pricing groups**, when there is an oversupply of renewables.



Not yet published - confidential



3. Shifting EV charging demand: at home



Participants reduced peak electricity use by 42%, with 100% of this demand shifted to low-cost, low-emission off-peak periods

AI-managed charging provides significant demand flexibility

Peak consumption reduces by 42%, with the entirety of EV demand shifted to off-peak hours.

High adherence to automation, with manual overrides only accounting for 2.3% of total electricity consumption.

For the consumer, the tariff reduces annual energy bills by about £650, compared to standard tariff.



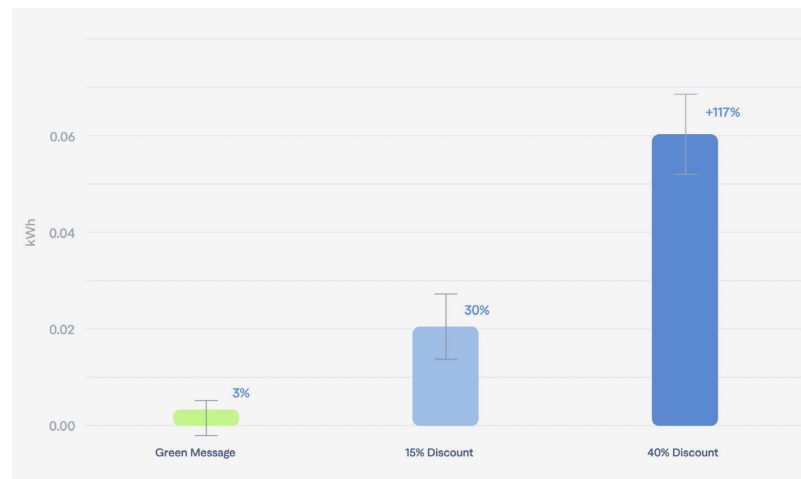
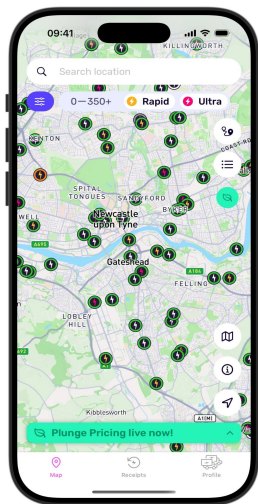
3. Shifting EV charging demand: in public

EV drivers are highly responsive to price signals in public charging

117% increase in demand across the network from a 40% reduction in price from a subset of chargers.

Greater response from drivers in lower income areas and closer to charge points; these factors also appear to influence the impact of the green message.

Savings for consumers puts EV running costs on par or better than petrol, and narrows the gap to home charging.



Impact of varying incentives on charging demand during events. Higher financial discounts saw the greatest effects.



4. Powering AI with renewable microgrids

Grids have **limited spare capacity and backlogs** to upgrade infrastructure.

Microgrid solutions co-locating generation and storage with sources of demand can run independently from the wider grid.

Microgrids could be **cheaper** (by roughly 43%) and **faster** (by roughly half the amount of time) than nuclear SMRs in the UK.

Governments, hyperscalers, investors and the energy sector should recognise that **renewables are a proven and deployable option** that can meet AI energy demands.

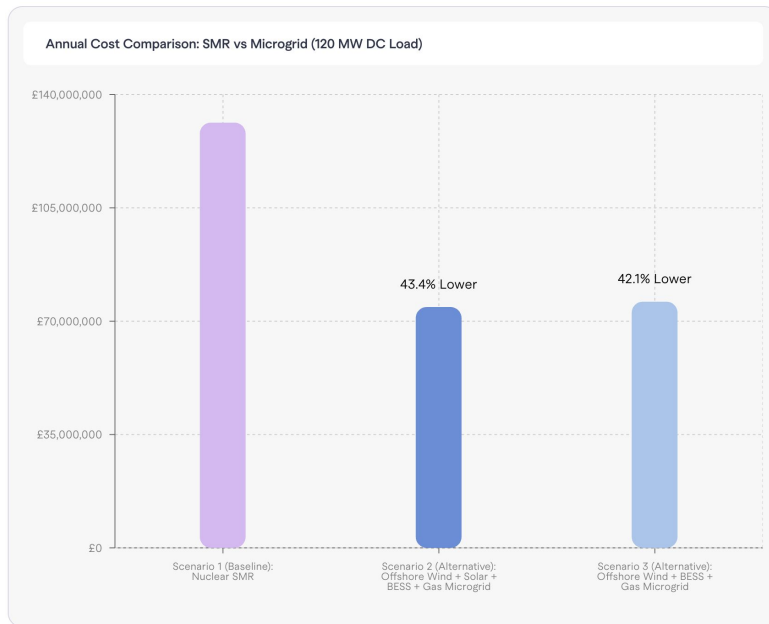
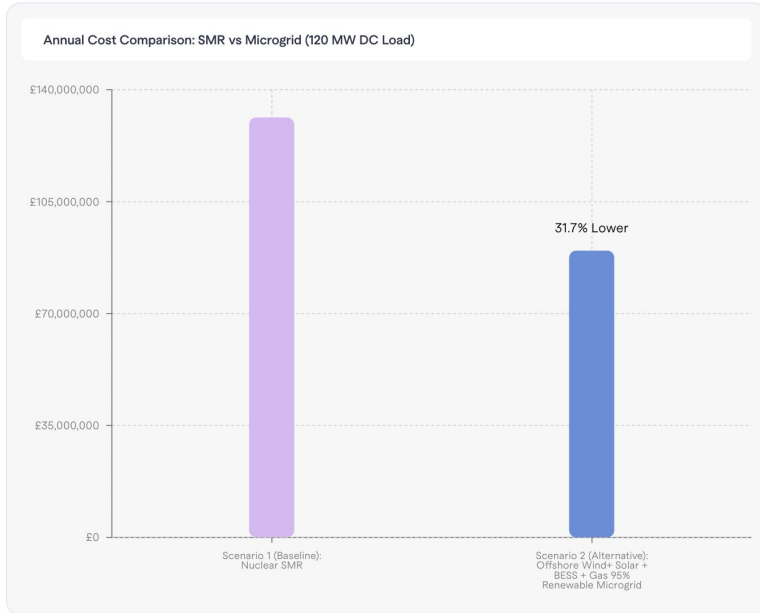


Figure 1: Annual cost comparison (£2025) of powering a 120MW data centre in three scenarios: using nuclear SMR (scenario 1), offshore wind + solar + BESS + gas microgrid (scenario 2), offshore wind + BESS + gas (scenario 3)



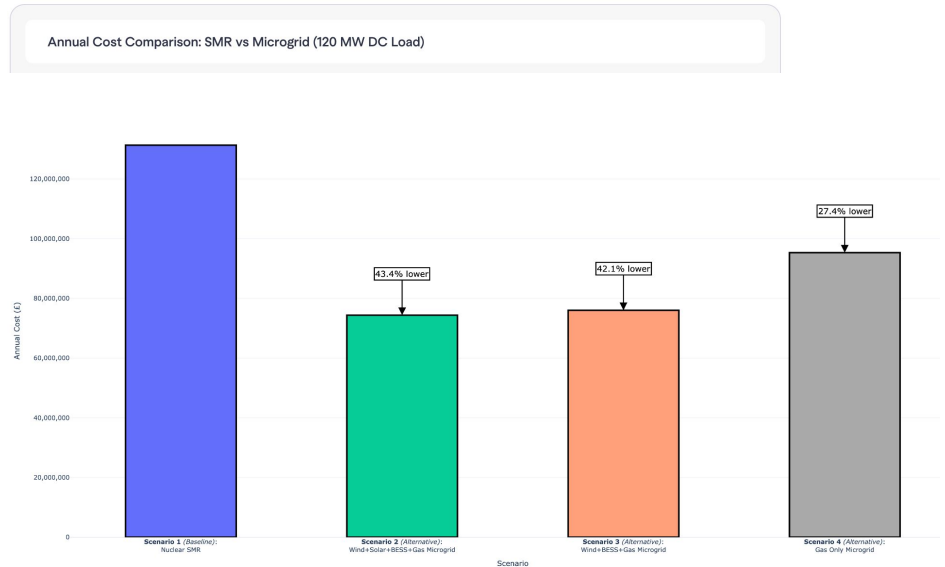
4. Powering AI with renewable microgrids

Additional scenario: 95% renewables



Annual cost comparison (£[2025]) of powering a 120MW data centre comparing a SMR Nuclear Scenario against a 95% Renewable Microgrid Scenario (aligned with the UK's 2030 clean power target)

Additional scenario: gas-only



Annual cost comparison (£[2025]) of powering a 120MW data centre in three scenarios: using nuclear SMR (scenario 1), offshore wind + solar + BESS + gas microgrid (scenario 2), offshore wind + BESS + gas (scenario 3), gas (scenario 4)



Key recommendations

Consumers and technology

1. **Reform electricity markets and rebalance levies** to accelerate electrification and unlock flexibility.
2. **Roll out low carbon tech and put fuel-poor first in line**; expand and broaden funding; targeted subsidies for solar and batteries.
3. **Incentivise consumers**: adequately reward flexibility in services as they scale; timely nudges when switching tech or supplier.

Data and digital

1. **Open up smart meter data**: Open Banking style consumer consent & synthetic data to accelerate efforts and address gaps
2. **Double down on digitalisation & AI**: smart meter rollout, asset registration & visibility, address grid operators' AI skills gap
3. **Develop strong governance frameworks to accelerate trust and adoption of AI** in high-impact, domain specific AI use cases.
4. **Meet new demand surges** in the short-term with renewables and storage.



Thank you

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