NET ZERO

Vs

THE DATA CENTRES

Bob Hicks CEng MIET

- Introduction
- Act 1 Net Zero
- Act 2 Data Centres
- Act 3 Net Zero Vs Data Centres

Bob Hicks Intro

Manoeuvre

Lean

Risk

Disruption

Systems

Act 1

Net Zero

What is Net Zero?

- **And what isn't net Zero**

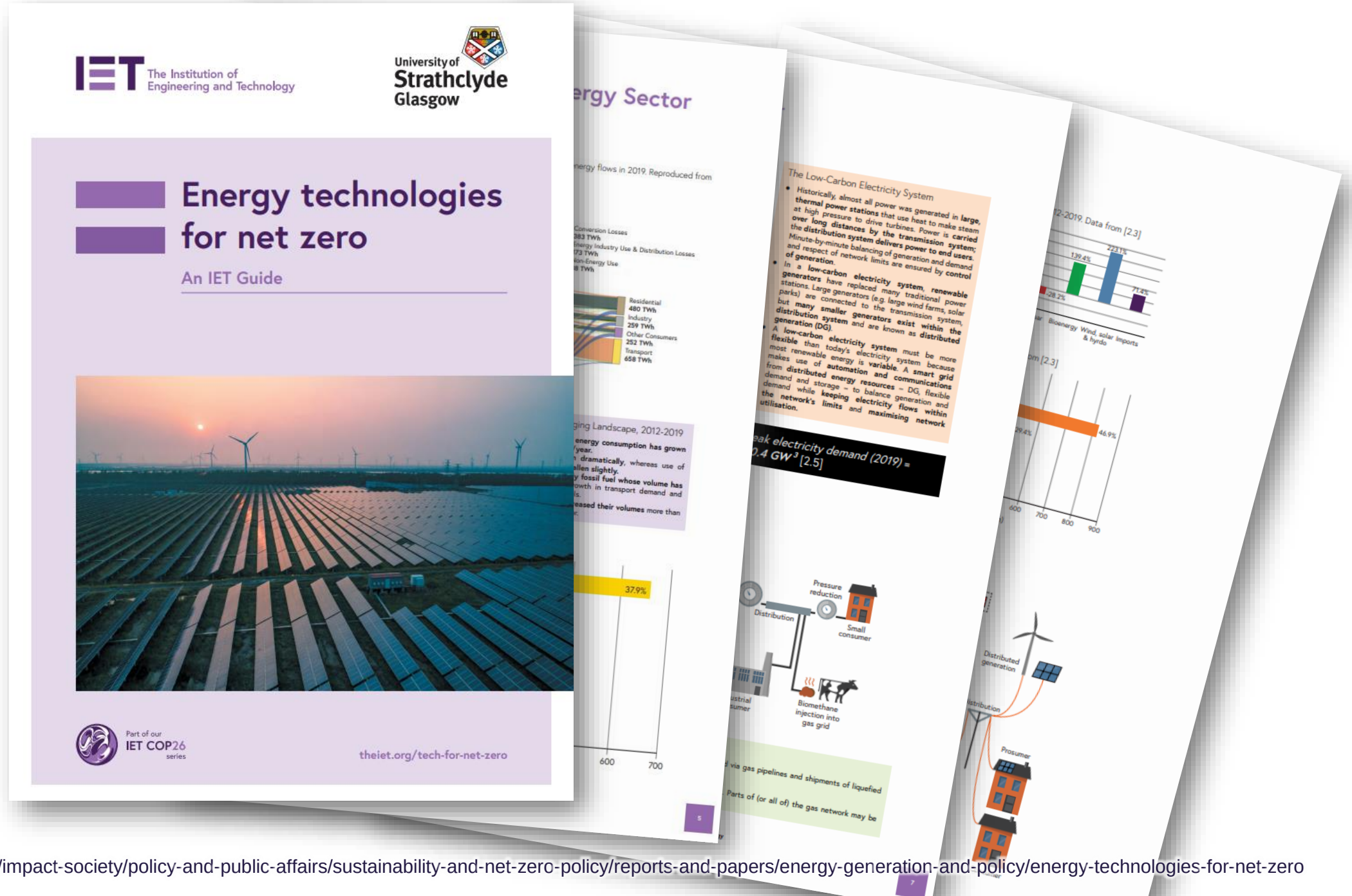
- **Not using fossil fuels**
- **CCS for what you can't avoid**

- **Electrification**

"A state where global emissions of greenhouse gases (GHGs) from human activities are balanced by withdrawal of GHGs from the atmosphere"

"Net Zero is a GHG emissions target binding to the UK to bring all GHG emissions to Net Zero by 2050."

-1.1 What is Net Zero ?, Energy Technologies for Net Zero An IET Guide.



https://www.theiet.org/impact-society/policy-and-public-affairs/sustainability-and-net-zero-policy/reports-and-papers/energy-generation-and-policy/energy-technologies-for-net-zero

Scope limitations

- UK Focused
- Electricity focused
- **Fuel Mix Vs Grid Average**

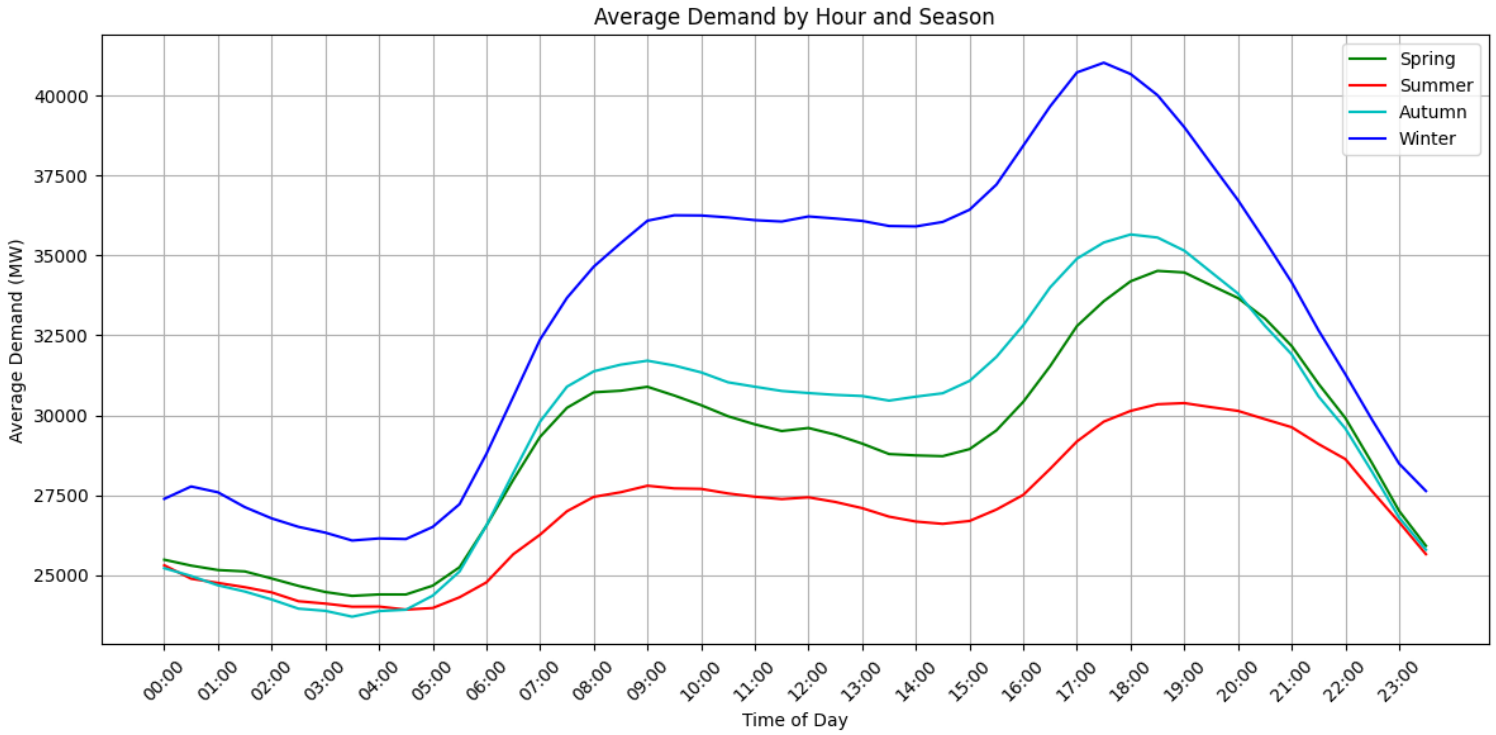
Power & Energy

“Energy is a physical quantity that must be transferred to an object to move or heat it…

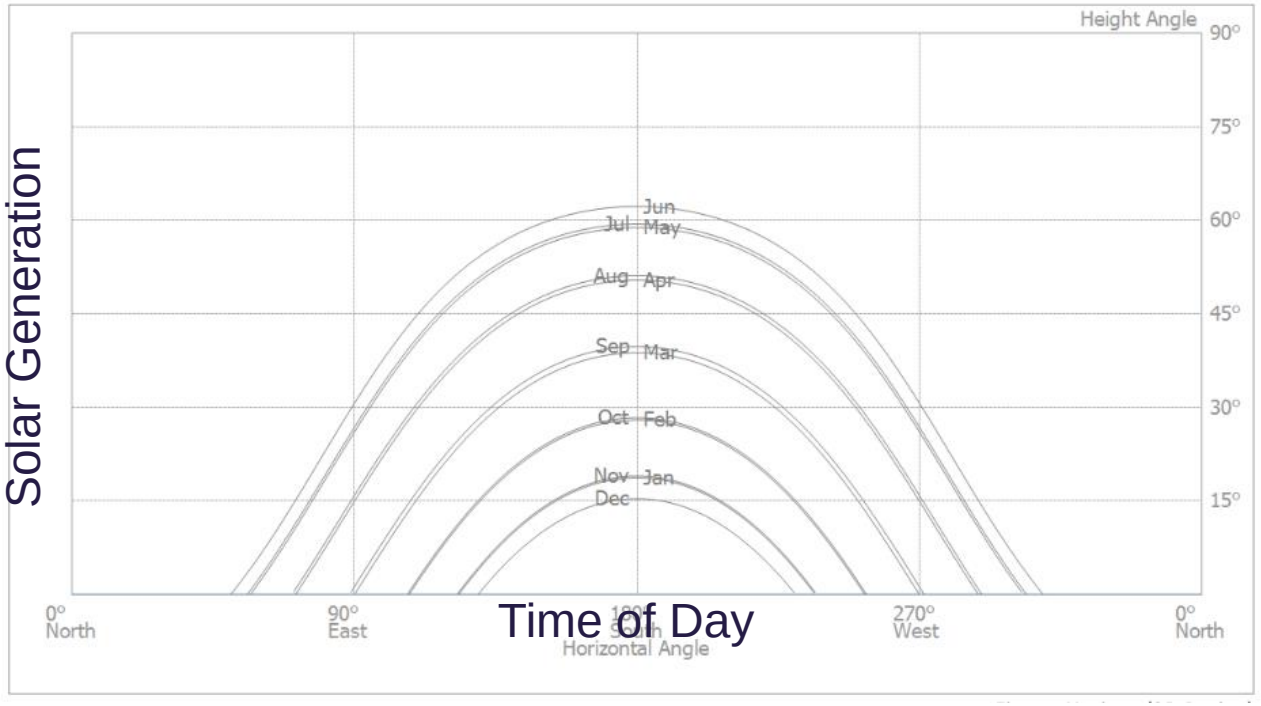
Power is a measure of how quickly energy is produced, converted or used (energy per unit time)”

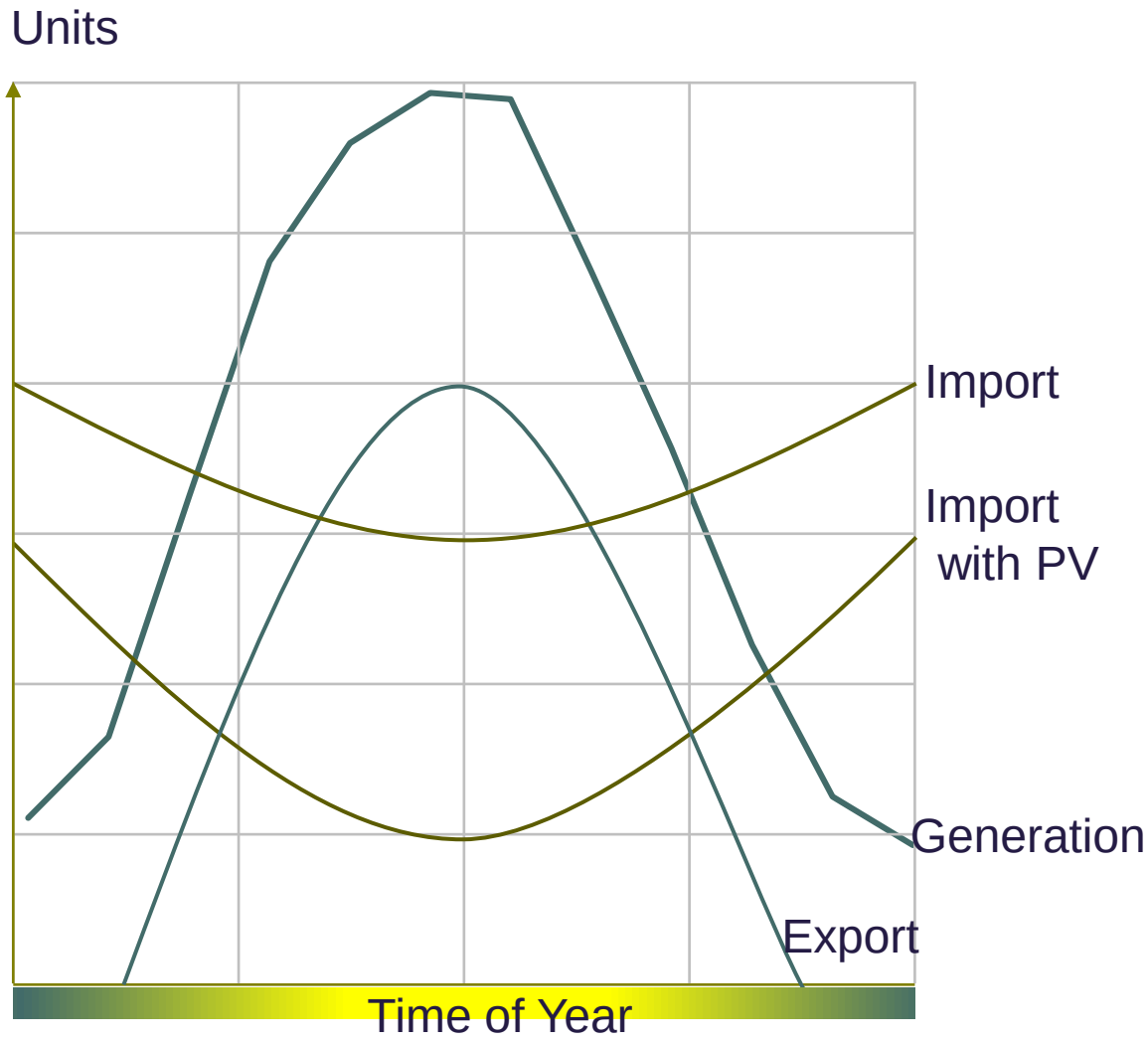
-1.3 Energy & Power, Energy Technologies for Net Zero An IET Guide

Variability of Demand

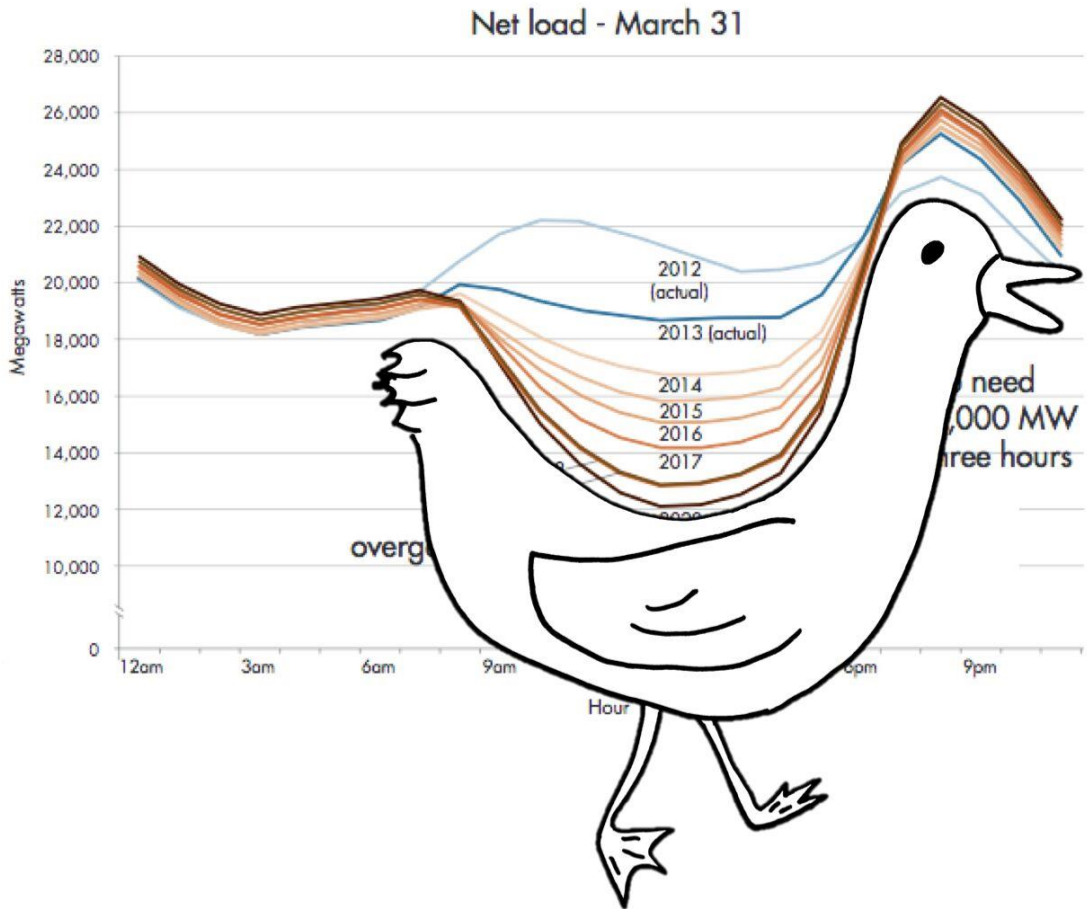


Challenges – Not Zero with Solar





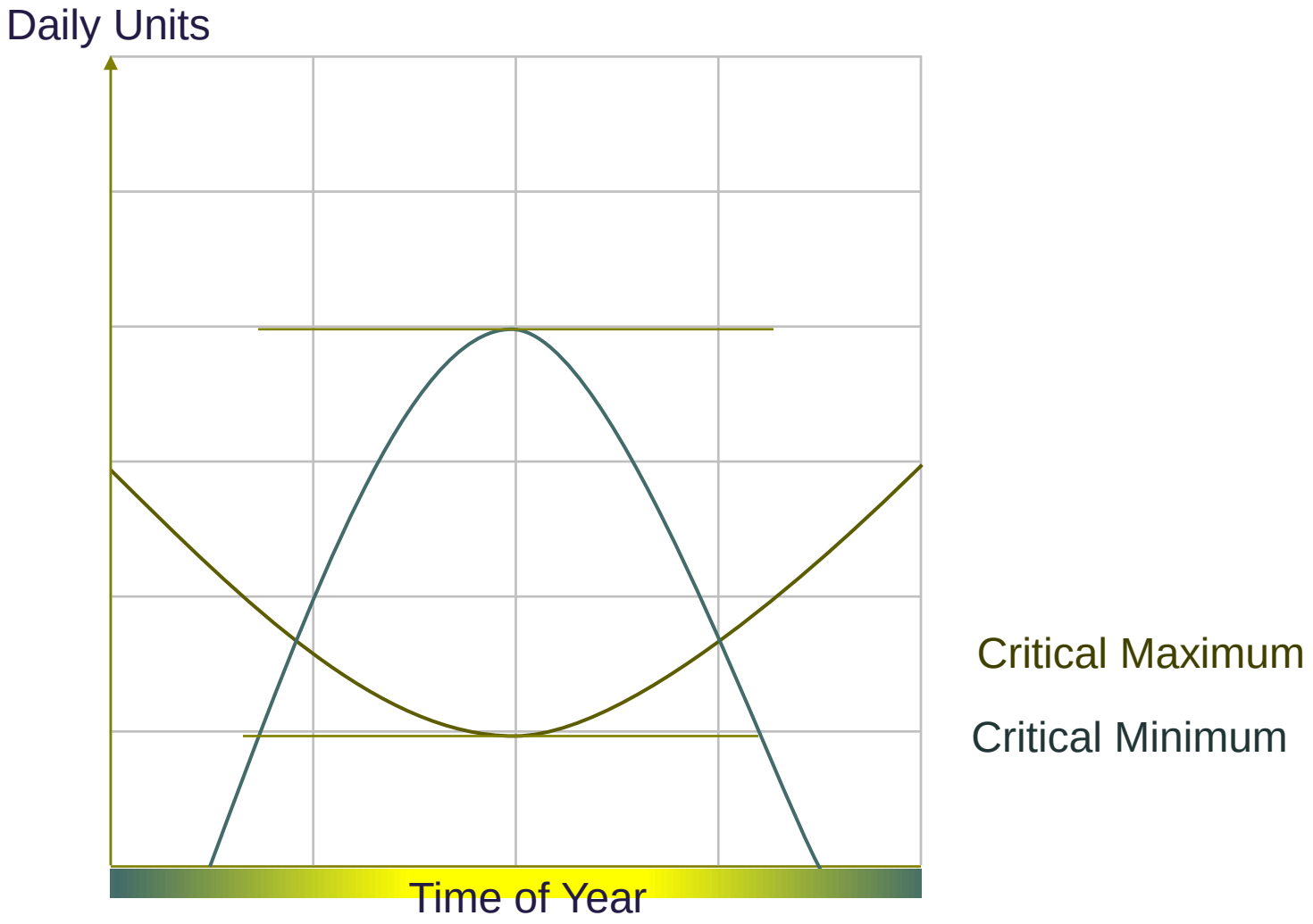
Challenges – Not Zero with Solar



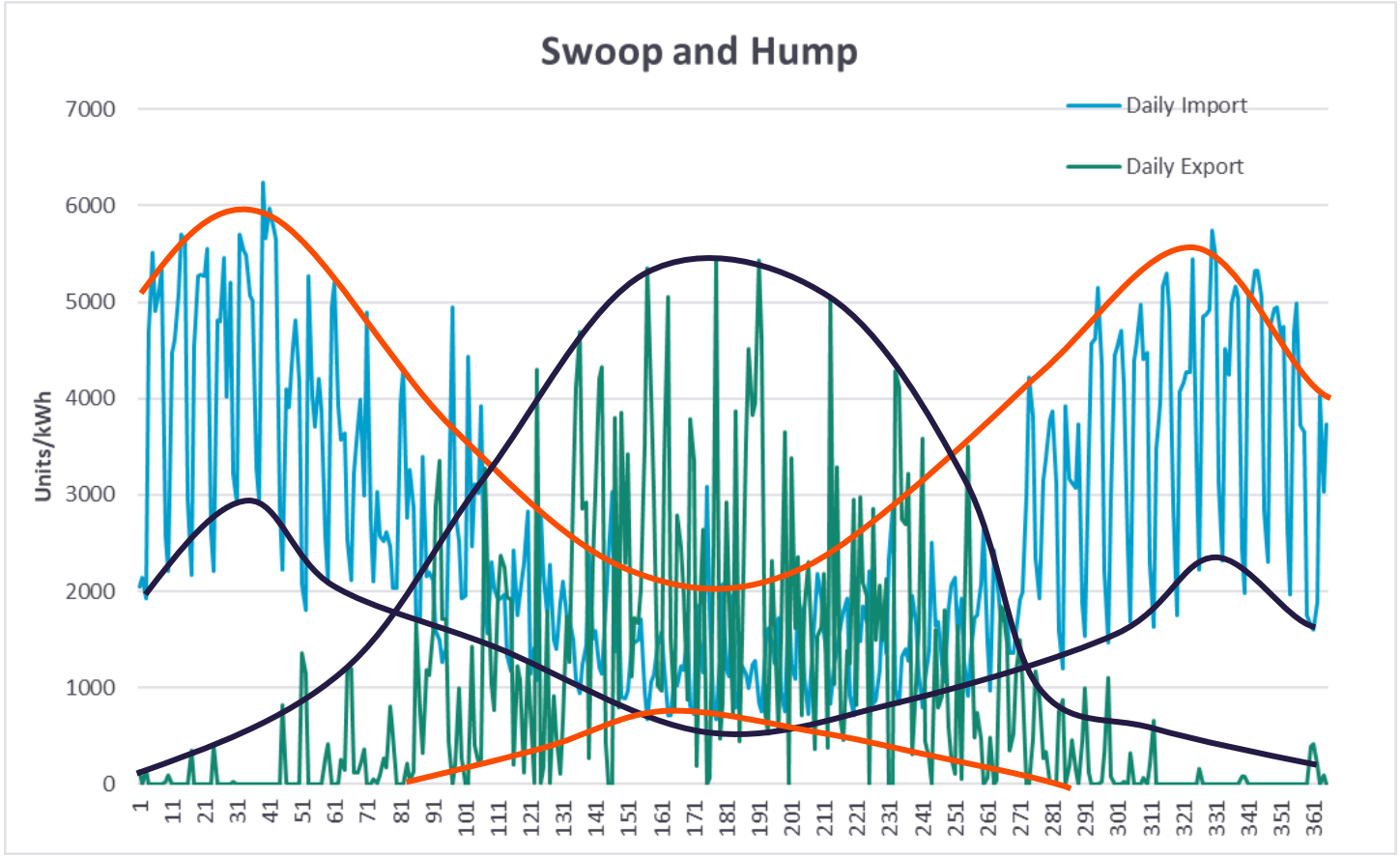
Just add Storage?

Solar Battery sizing

Swoop & Hump Method



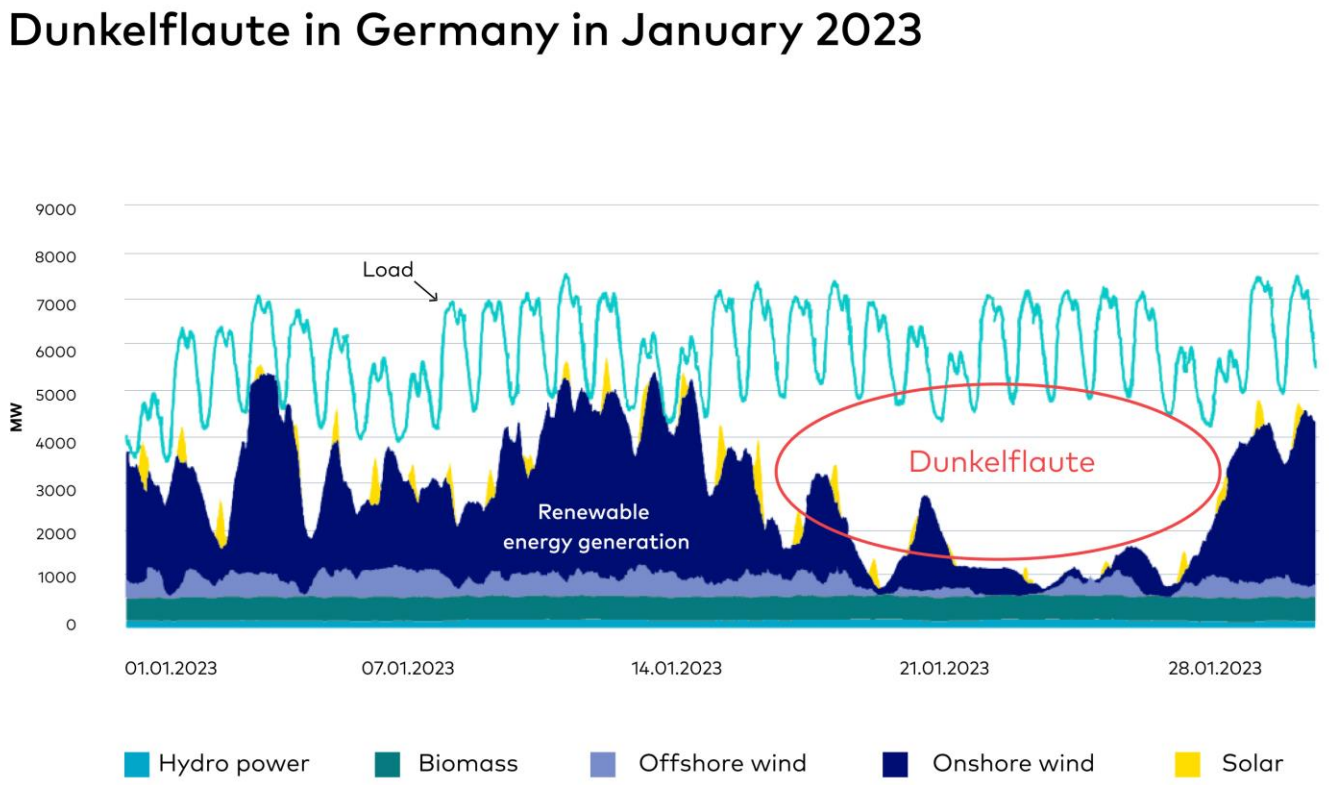
Swoop & Hump Vs Reality



Challenges - Intermittency of Wind

Dunkelflaute

anticyclonic gloom



Challenges - Interconnections

- The sun is always shining somewhere.
- Global problems are difficult to solve nation by nation.

Efficiency Vs Flexibility

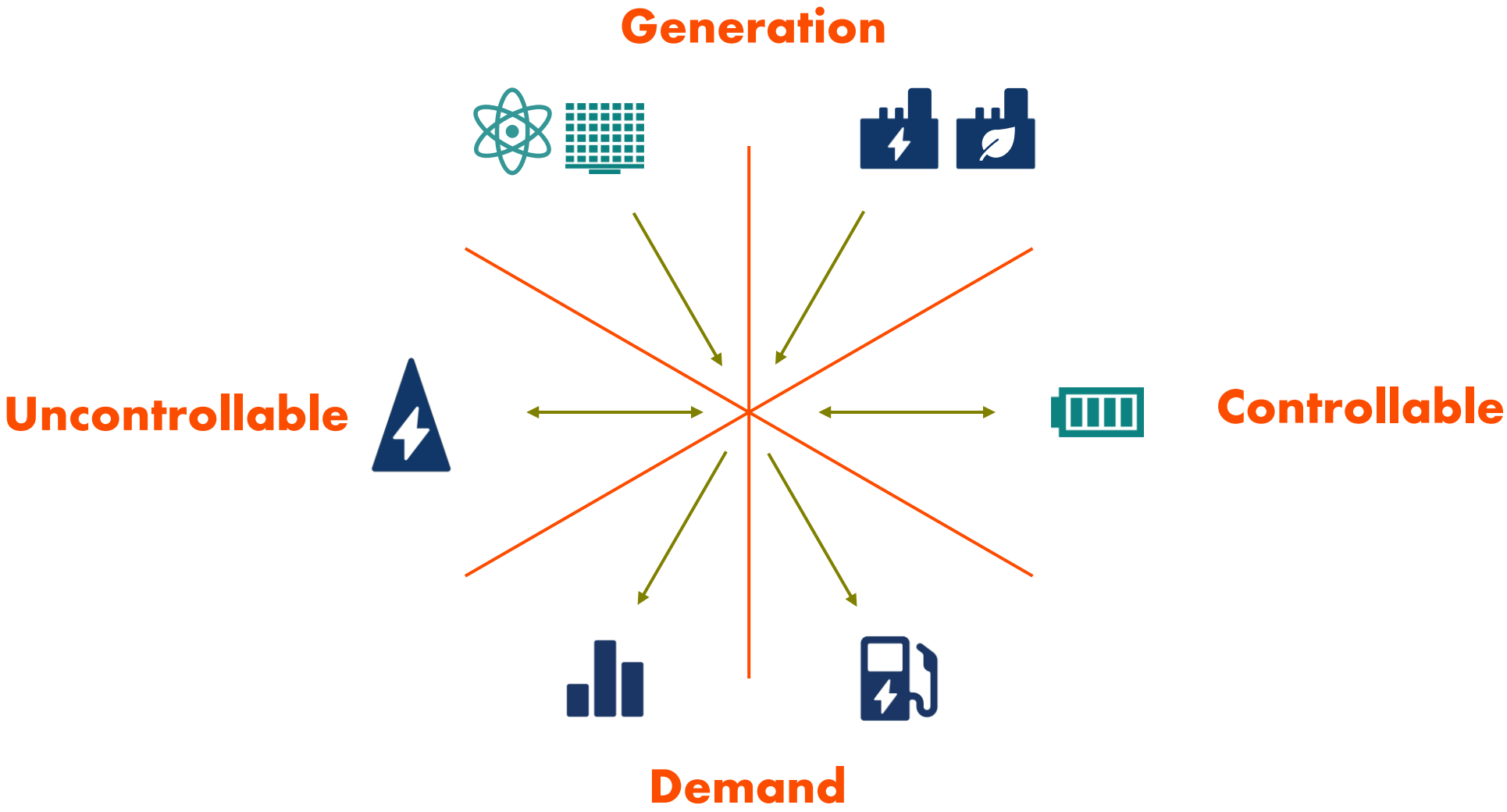
- Gas
- 90% efficiency
- 7p/unit
- 7.8p/kWh(t)

- GSHP
- 330% efficiency
- 25p/unit
- 7.6p/kWh

- Timer & Immersion
- 100% efficiency
- t)

- ASHP & Timer
- 290% efficiency
- 7p/unit
- 2.4p/kWh(t)

Balancing the Hicksagon



Progress to Net Zero

ET for NZ says...

1. Electrification
2. Storage
3. Some amount of fuels
4. Small amount of fossil fuels
5. Negative emissions

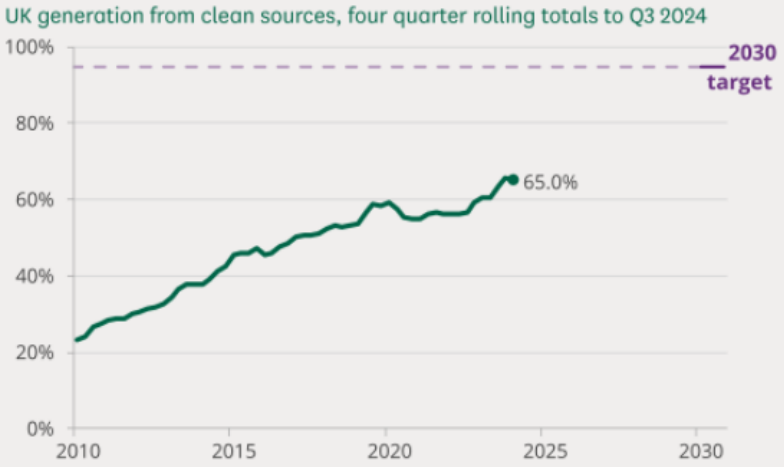
NESO suspended new applications for connected generation while they sort out the queue – which already has enough generation for not just 2030 but 2050 too.

Table 1 Key indicators from the CCC monitoring framework

Key Indicator	Progress	Targets
Households receiving energy efficient measures	Not on track	All fuel-poor homes should be at least band C by 2030.[9,10]
Residential energy demand	On track	Reduce energy demand by 15% by 2030.[11]
Public EV charging points	On track	300,000 EV charging points throughout the UK by 2030.[12]
Offshore wind capacity	Slightly off track	50 GW of offshore wind by 2030.[13]
Onshore wind capacity	Slightly off track	30 GW of onshore wind.[14]
Unabated gas share of electricity generation	Slightly off track	No more than 5% by 2030.[1]
Heat pump installations (PN 699)	Not on track	600,000 installations a year by 2028.[15]
Trained heat pump installers	Not on track	50,200 installers by 2030.[16]

Source: Progress in reducing emissions: 2024 Report to Parliament - CCC[1]

1a: Clean sources produce at least 95% of GB's generation

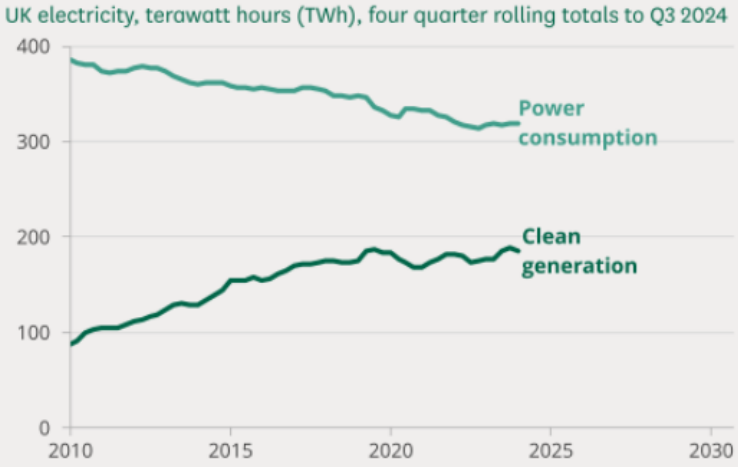


In the latest 12 months 65.0% of UK generation came from clean sources.

Most of the growth in the past three years has been from offshore wind.

Nuclear generation has fallen consistently since 2016. Bioenergy output peaked in 2021.

1b: Clean sources produce at least as much power as GB consumes in total

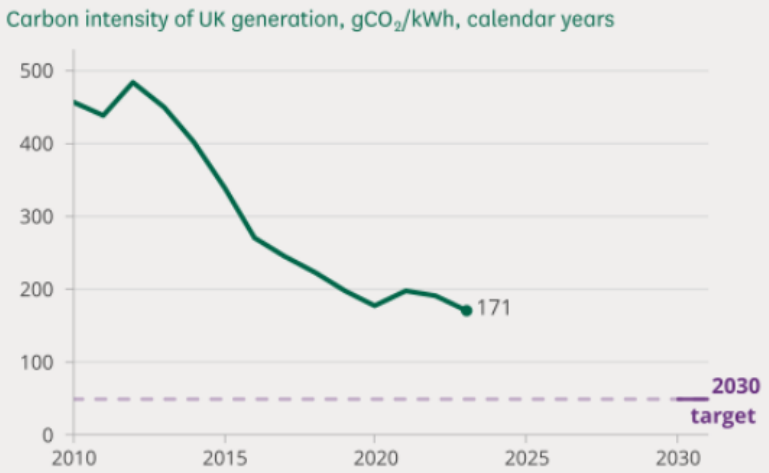


In the latest 12 months UK clean generation was 185 TWh, or 42%, lower than UK power consumption.

There has been little change in total clean generation since 2020.

UK power consumption has fallen steadily over the past 20 years.

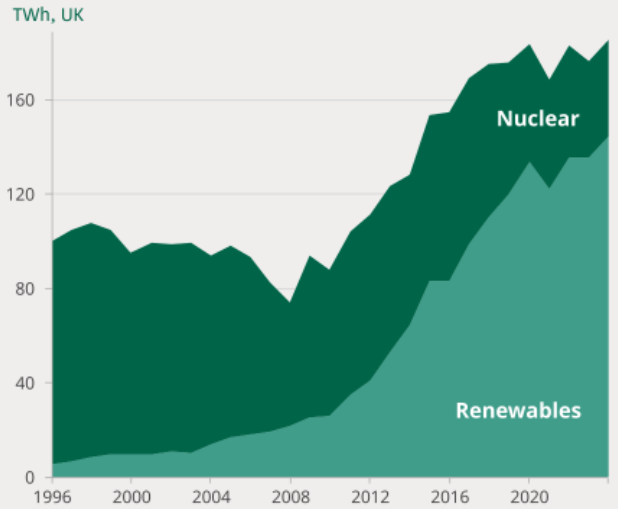
2: Reduce the carbon intensity of electricity generation to below 50gCO_2e/kWh



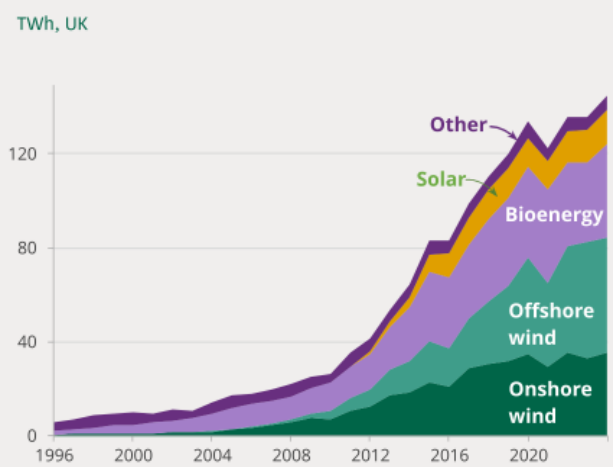
In 2023 the average carbon intensity of UK generation was 171g of CO_2 per kWh.

There was a 65% drop in carbon intensity between 2006 and 2020. This was initially due to the shift from coal to gas, and latterly to increased renewable generation.

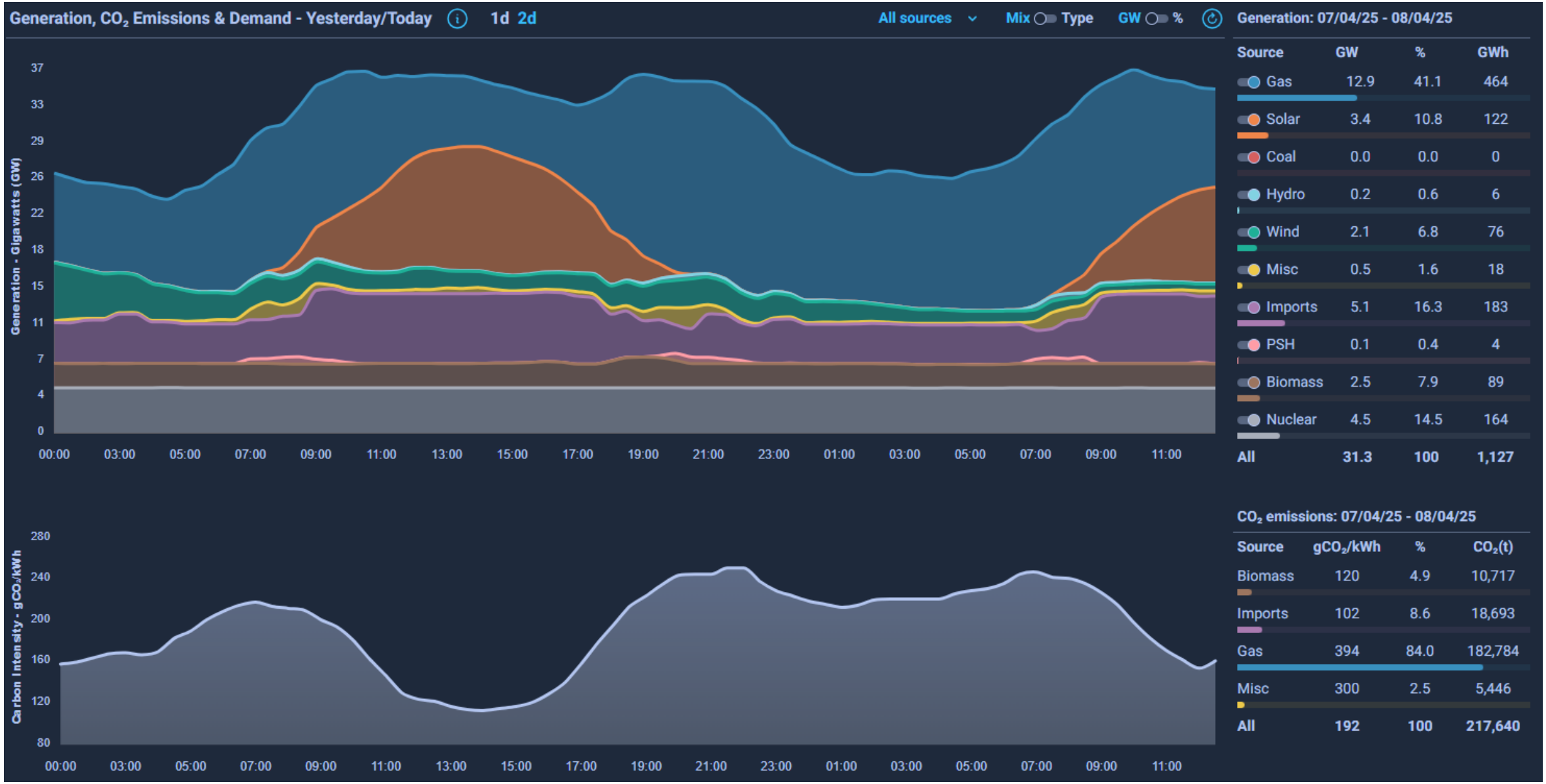
Clean power output more than doubled 2008 to 2020



Wind power increasingly dominates UK renewable generation

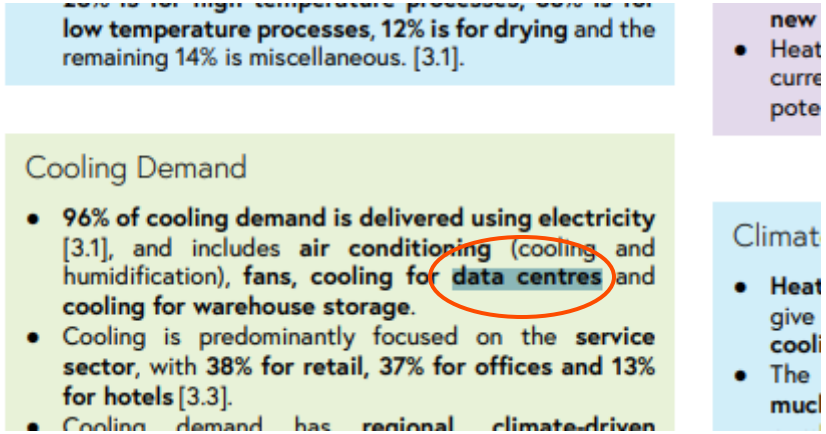


https://commonslibrary.parliament.uk/research-briefings/cbp-10182/



www.energydashboard.co.uk/live

- **Are Data Centres in the Pathways?**



low temperature processes, 12% is for drying and the remaining 14% is miscellaneous. [3.1].

Cooling Demand

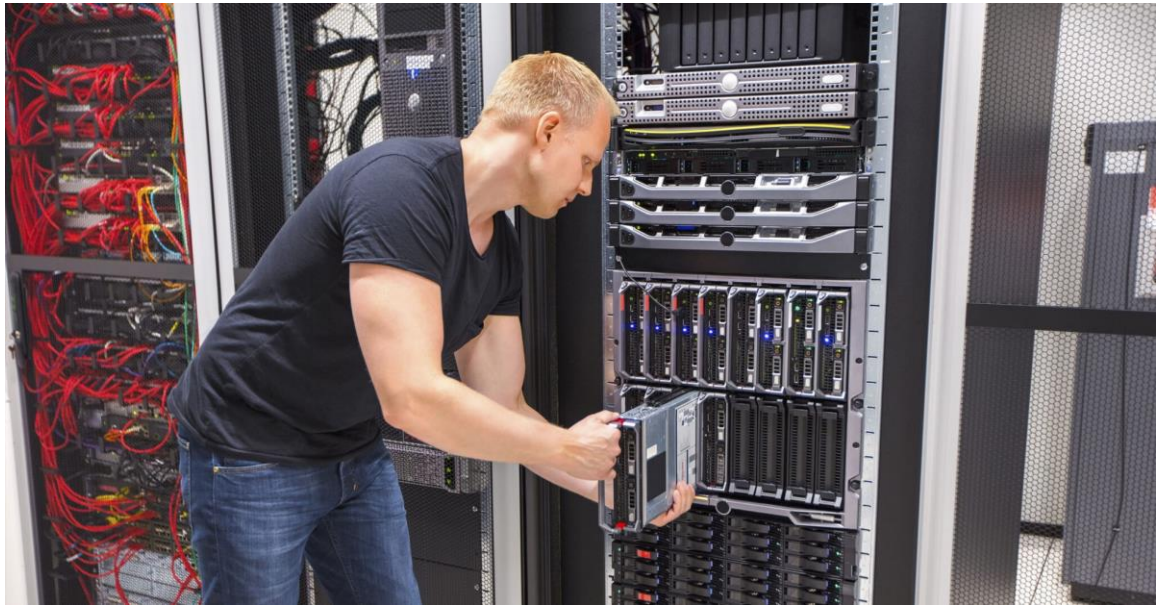
- **96% of cooling demand is delivered using electricity** [3.1], and includes **air conditioning** (cooling and humidification), **fans, cooling for data centres** and **cooling for warehouse storage**.
- Cooling is predominantly focused on the **service sector**, with **38% for retail, 37% for offices and 13% for hotels** [3.3].

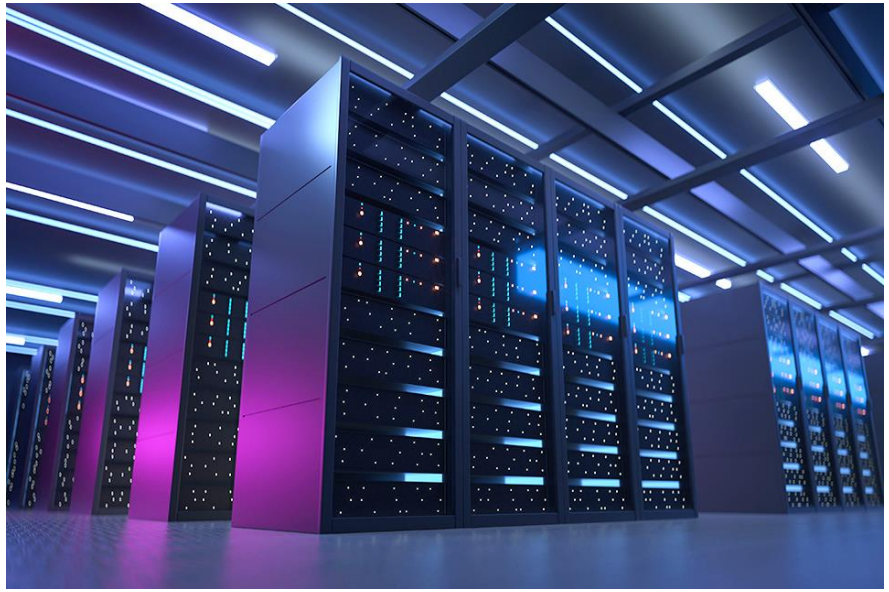
Pg10 ET for NZ

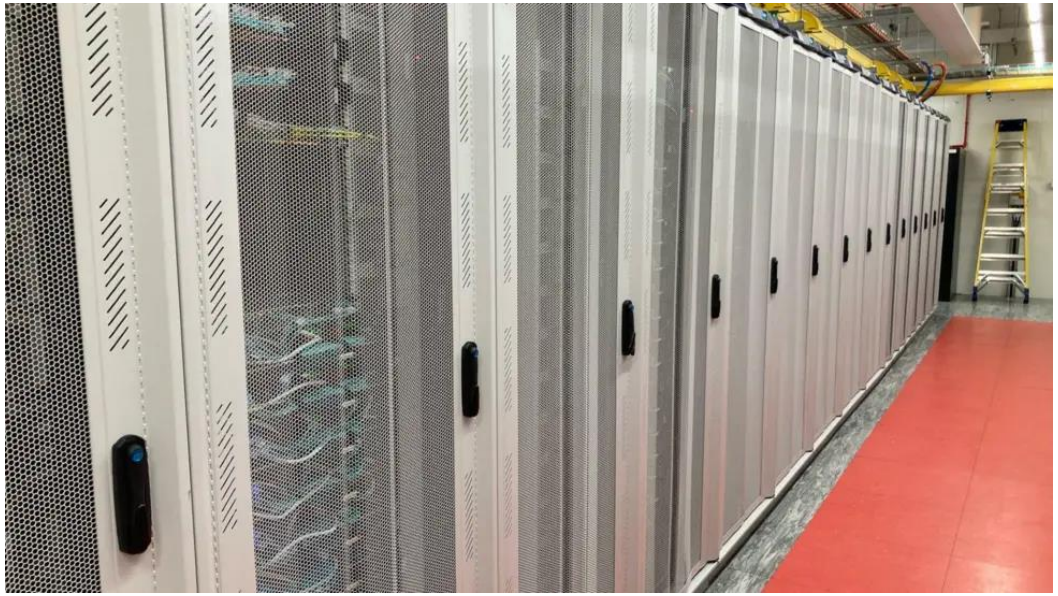
Act 2

Data Centres

Data Centres: What are they?

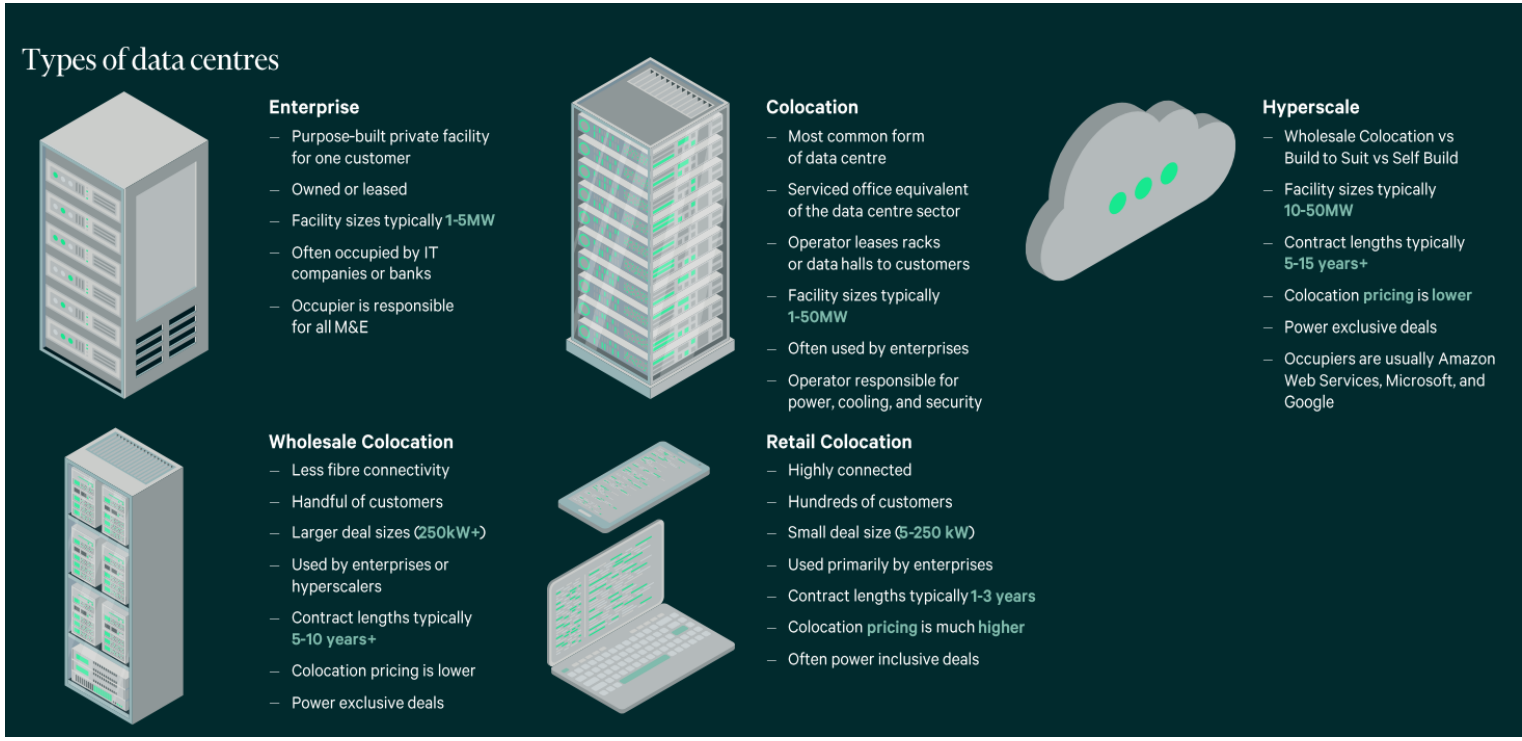




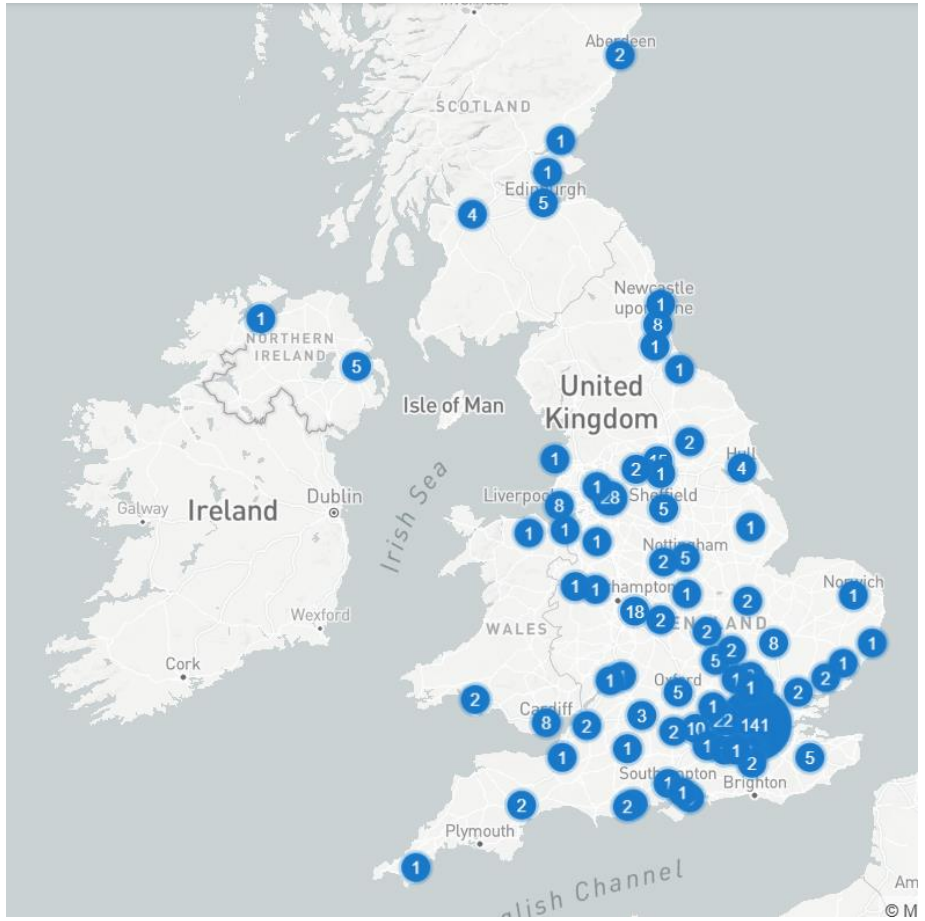


Data Centres: Where are they?

- **Enterprise** – with the IT department on site or cloud access
- **Co-locate** – third party datacentre
- **Hyperscale** – MS, Google, FB, Amazon
- **Edge / Urban** – low latency



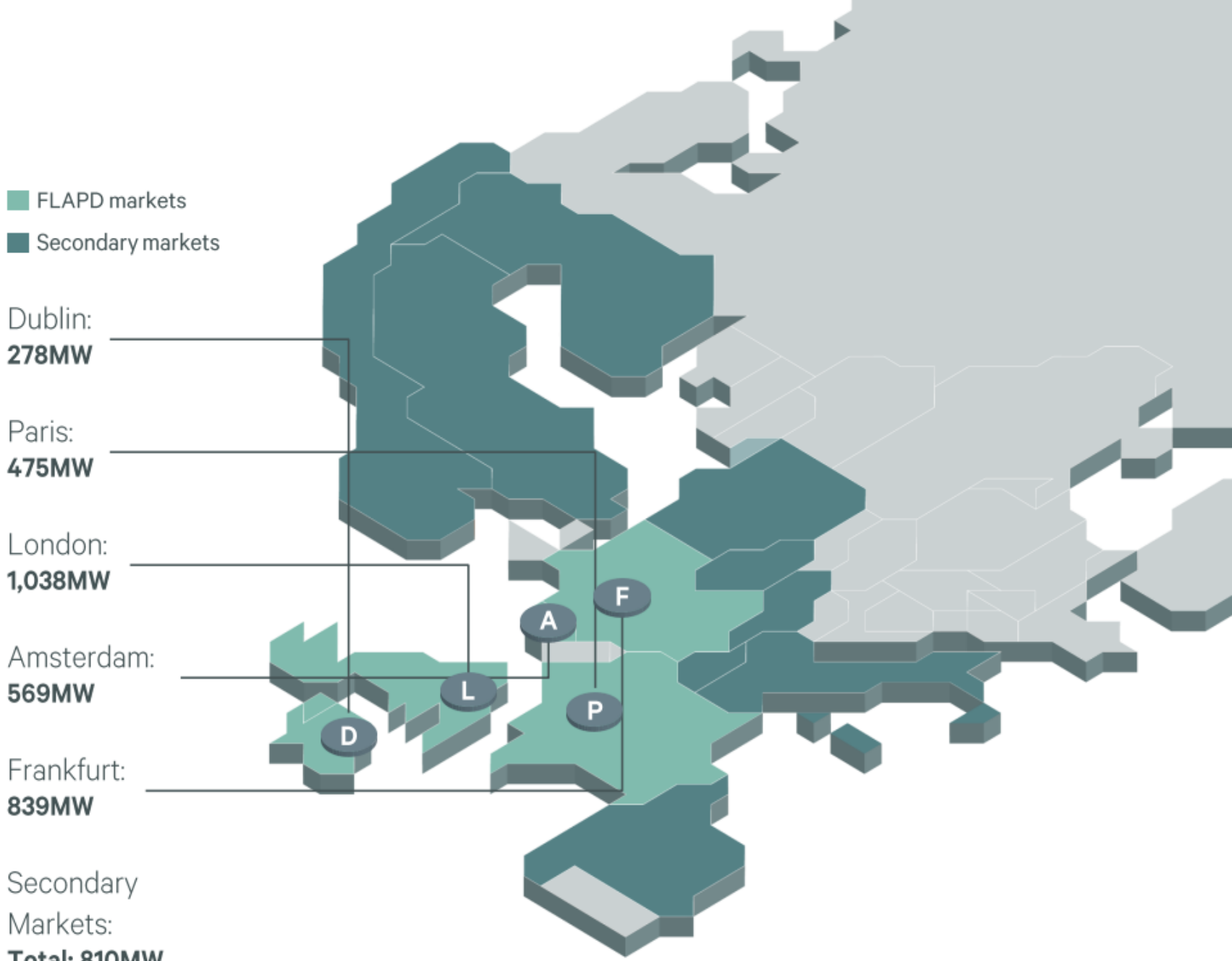
Virtual Tour



https://www.datacentermap.com/

FLAPD and secondary market supply

The biggest data centre markets of Europe are Frankfurt, London, Amsterdam, Paris and Dublin – collectively referred to as FLAPD. Secondary markets in Europe are also expanding, albeit from a low initial base. Some secondary markets, such as Milan, have fast-growing wholesale segments.



Note (1): Data are reflective of market size c. Q4 2023.

Note (2): The secondary market category is comprised of the following markets: Berlin, Brussels, Madrid, Milan, Munich, Stockholm, Warsaw, Vienna, and Zurich.

Source: CBRE

Characteristics of Demand : Power

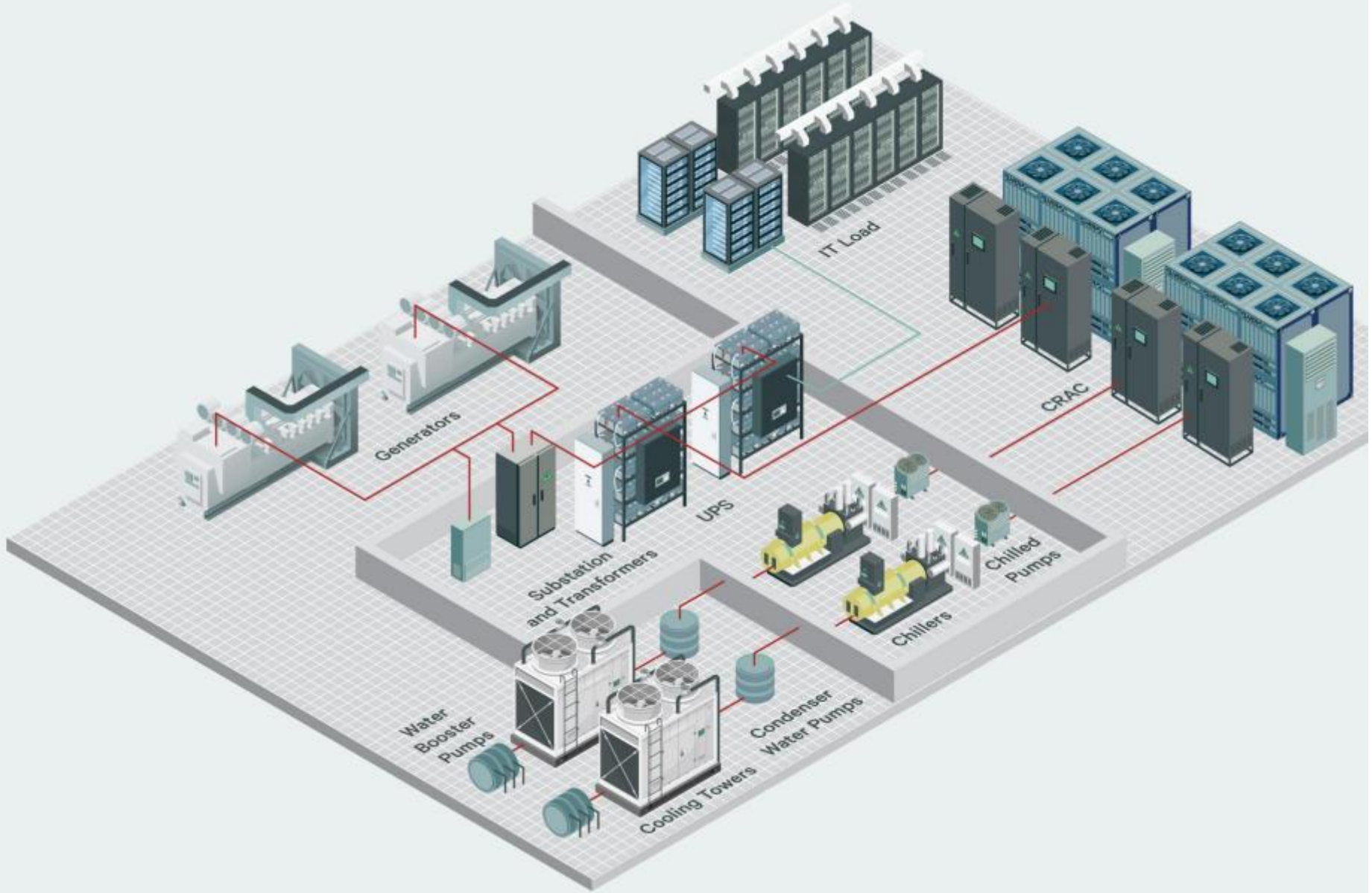
- Pwr IT
- PUE
- 2N supply
- USP
- Island only generation

Typical infrastructure

A data centre is a facility at the crossroad between a real estate asset and the local infrastructure. The schematic depicts part of the structural equipment required to operate such a facility.

If the utility power fails, batteries provide instant power, usually for 10 minutes, followed by generators that are usually powered by diesel. The uninterruptible units (UPS) can then maintain stability in the facility and continue to provide the power distribution units (PDUs) with power.

The chiller components provide cooling to the data centre. The chillers create cool air, delivered to the servers. The water within the chiller network removes the hot air exerted by the servers out of the data centre.



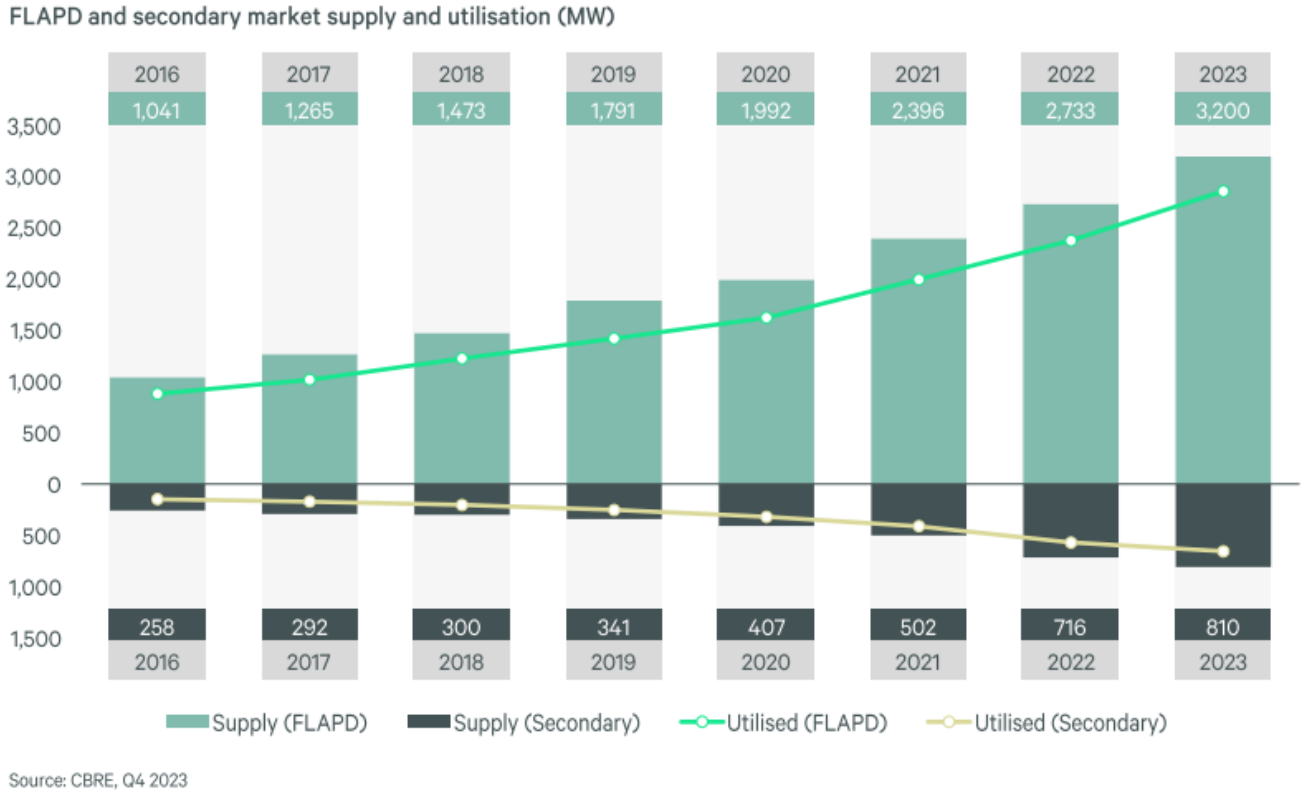
Sources: Digital Realty and CBRE

Characteristics of Demand : Energy

- Demand from Capacity
  - Space sold to clients – uptake 85%
  - How much clients use their allocated capacity - utilisation – 15-85%
  - PUE 1.1 - 1.5
  - Actual power demand ~ 14-108% of rated size. Call it 50%
- Demand profile
  - Flat and constant – 24/7/365
  - Hard no to flexibility
  - AI is all over the place.

Increasing Demand

- **Moore's Law** – transistor density doubles every 2 years
- **Wirth's Law** – Software efficiency halves every 18 months.
- **Jevons Paradox** – Spend increases as cost decreases



Source: CBRE, Q4 2023

How much energy is that?

1GW capacity IT

~500 MW Pwr demand

24/7/365

= 4.38 TWh in 2024

Enough energy to make 62,571,428,571.4 cups of tea!

Rising by 5% to 10.95 TWh by 2030

"Homes, cars, **data centres**, industry: our collective appetite for electricity will continue to grow at an exponential rate."

EU projects estimate that data centre demand power demand will triple by 2030, rising from 62 TWh to over 150TWh.
This would increase their share of total consumption from 2% today to about 5% by 2030.

-Matthias Buck, Why data centres should feature prominently in the clean industrial deal.

Act 3

Net Zero Vs The Data Centres

What can be done to save us all?

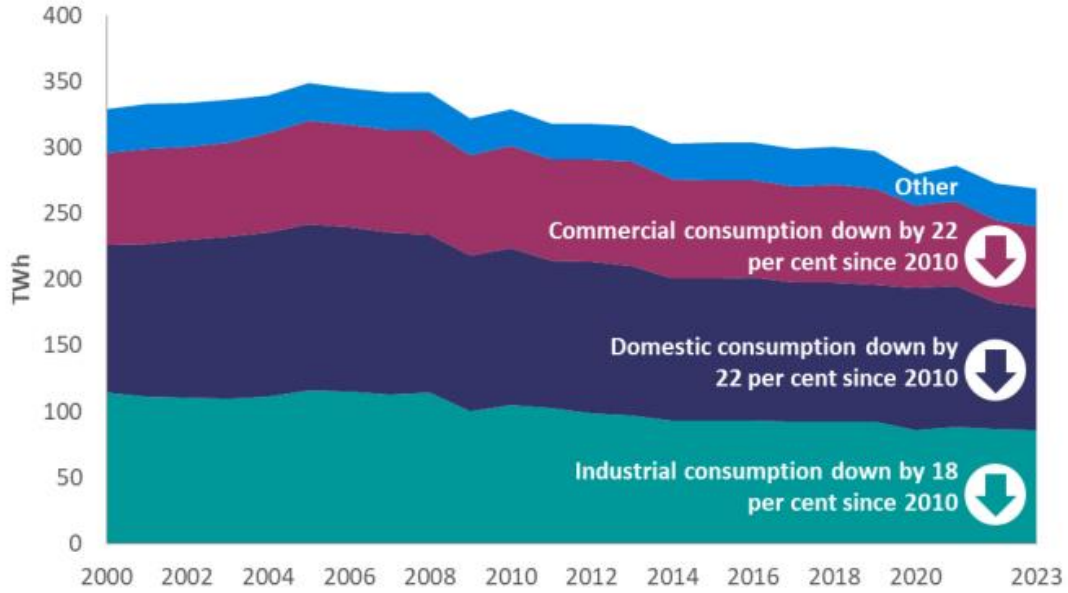
- New Nuclear – SMRs ✖
- Flexibility ✖
- DCs as a heat source ✖
- Site with natural generation/cooling ✖
- Reduce demand for data ✖

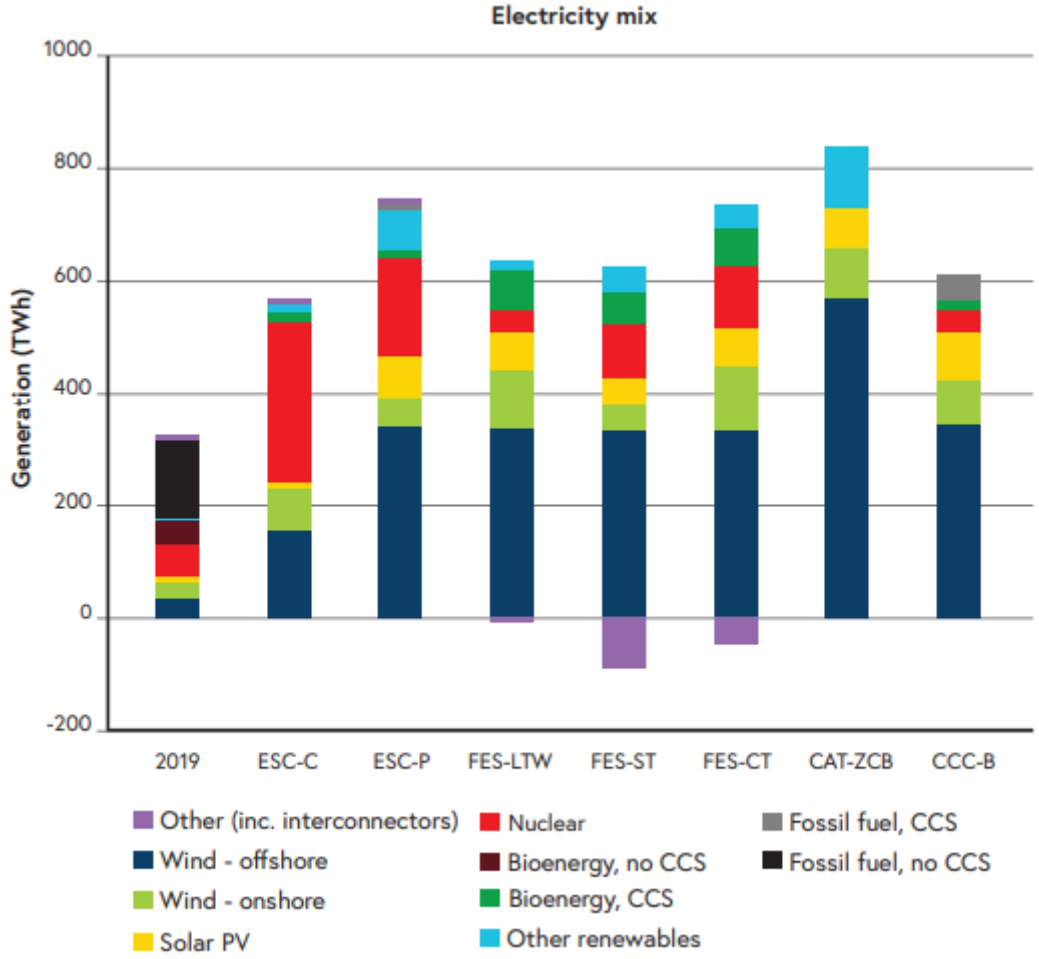
But, is it a big number?

(vs increasing demand for electrification)

- 2023 – 316.8TWh
- 2050 - >600TWh

Chart 5.1 Electricity consumption by sector, 2000 to 2023 (DUKES Table 5.1)



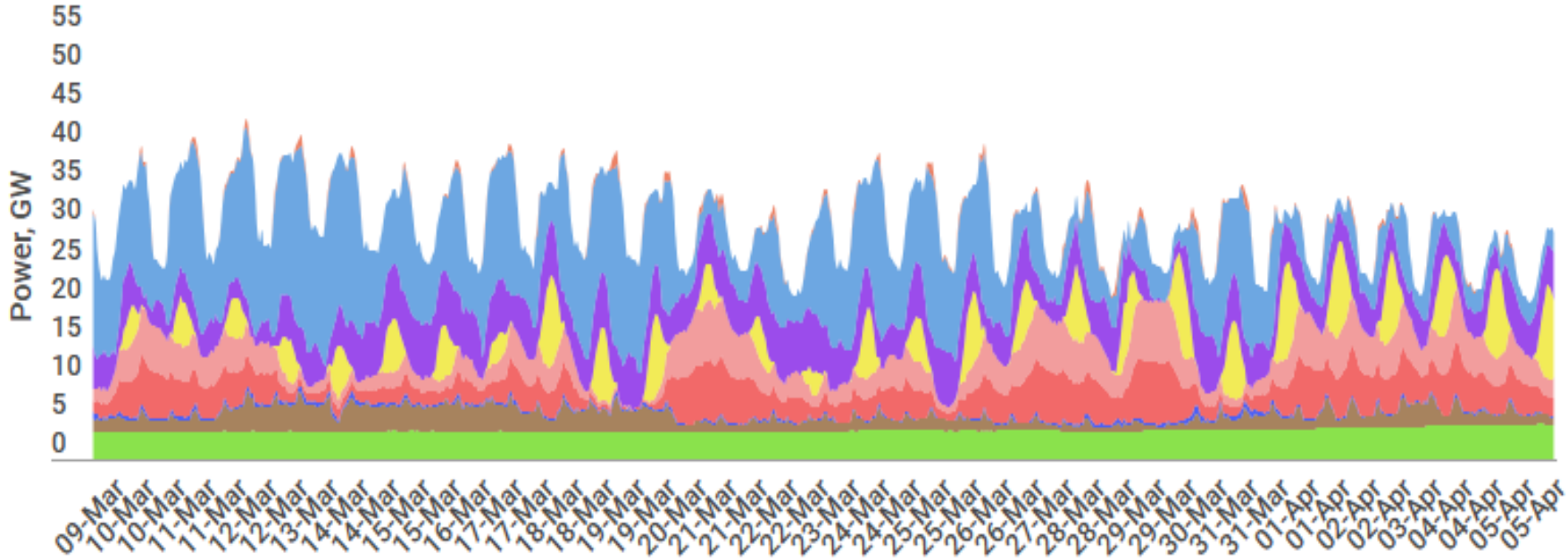


Chapter 5 - ETforNZ

But, is it a big number? (Power)

~1GW IT

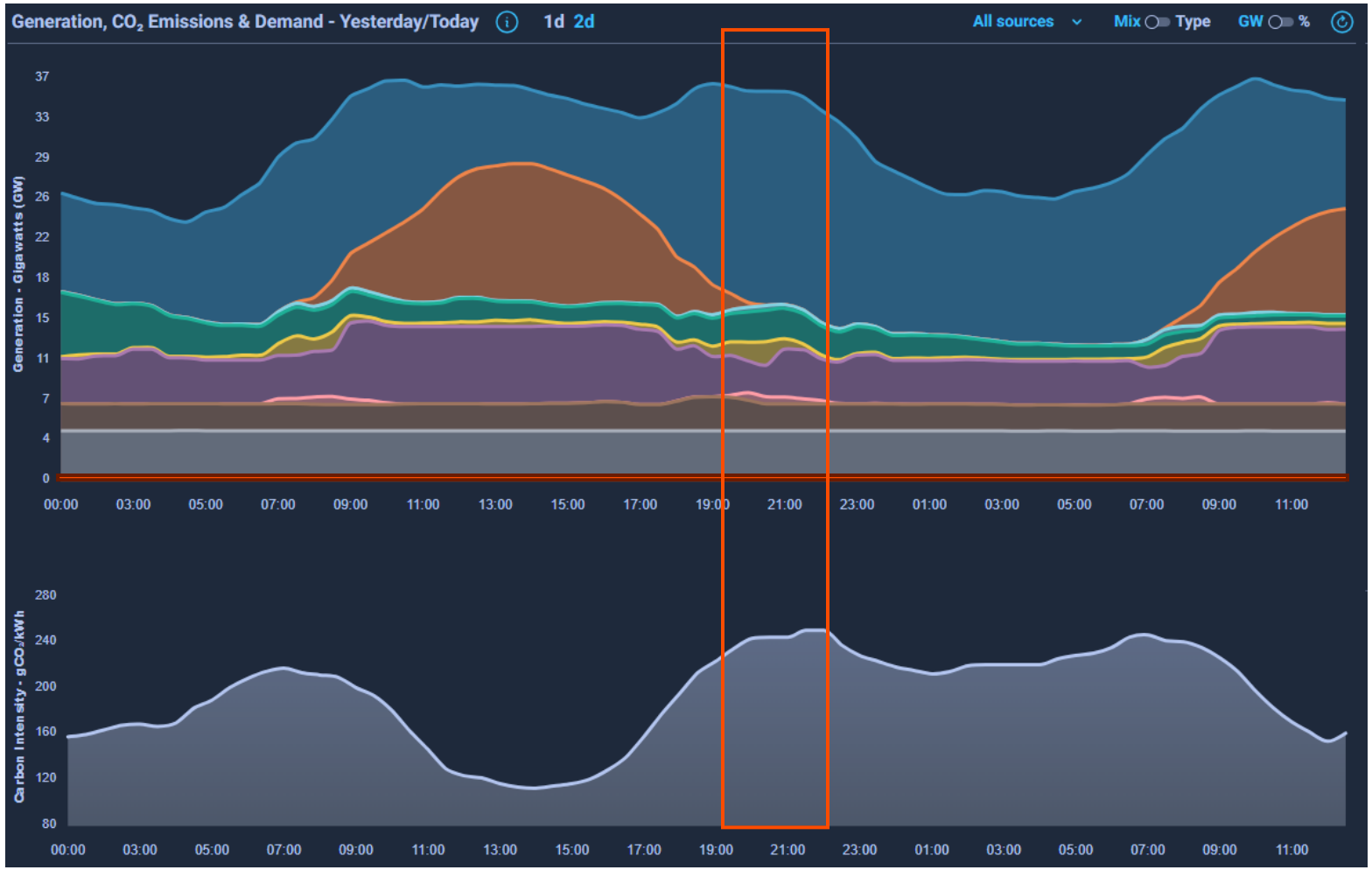
~0.5 MW Pwr



https://www.mygridgb.co.uk/last-28-days/

But its inflexible load..?

12GWh



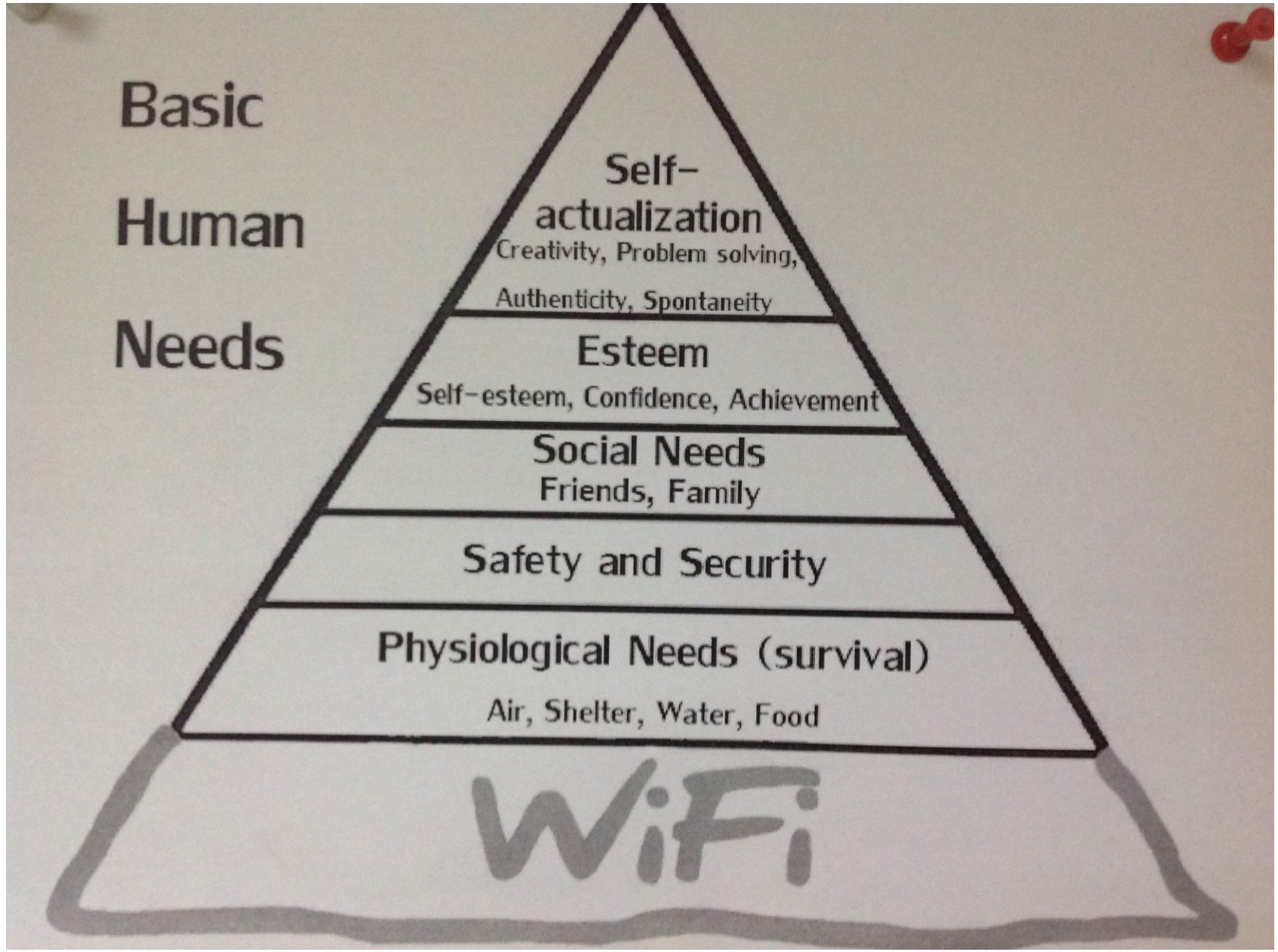
...its reliable base load.

Conclusions

- **Climate Emergency!!!**

Or

- **Storm in a tea cup?**


Basic
Human
Needs
Self-actualization
Creativity, Problem solving,
Authenticity, Spontaneity
Esteem
Self-esteem, Confidence, Achievement
Social Needs
Friends, Family
Safety and Security
Physiological Needs (survival)
Air, Shelter, Water, Food
WiFi


Google
how many cups of tea are consumed in the uk per year
All
Images
Short videos
News
Videos
Web
Forums
More
AI Overview
The UK consumes approximately 62 billion cups of tea per year, equivalent to around 165 million cups daily.
Here's a more detailed breakdown:
Daily Consumption: Britons drink roughly 165 million cups of tea every day.
Annual Consumption: This translates to about 62 billion cups annually.
Tea Market: The UK tea market is worth approximately £700 million annually.
Consumption Location: Around 86% of tea is consumed at home, while 14% is consumed outside the home.
Per Capita: The UK is a major tea-drinking nation, with Turkey and Ireland being the only countries with higher per capita consumption.
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Tea Fact
Company

Corrections

Net Zero Vs The Data Centres

Before we go to the floor...

In 1987, the United Nations Brundtland Commission defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

-un.org

Global population is tending to stabilise at Ten Billion in this century.

We need to reconfigure the planet to sustainably support ten billion people in comfort.

Our current global agricultural system is designed to operate in our current climate.
The less the climate changes, the easier this will be.

Q & A

Net Zero Vs The Data Centres