modo

The landscape for battery energy storage in Great Britain

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The aim of this report...

Electricity generation is responsible for 40%* of global CO2 emissions. We need to decarbonise it urgently.

So, how do we do it?

We need to completely rethink the way that we generate, store, distribute and consume energy. This involves the electrification of pretty much everything heat, transport, industry, food, shipping.

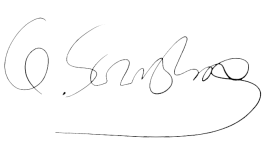
Electricity is key to the future energy system, but our current system is built around coal and gas power stations – this needs to change. Decarbonising electricity means retiring these old plants and building low-carbon infrastructure for the future.

At Modo, we track the performance of battery energy storage system (BESS) assets across all energy markets and ancillary services. So that energy companies, asset operators, the investment community, insurers and banks, can build, operate and optimise these new assets with confidence.

The aim of this report is to provide accessible and impartial information to help explain what's happening in the GB energy storage sector. If you're reading this, please feel free to use, copy and distribute it however you like.

Finally, we'd like to take this opportunity to celebrate the people working hard to build the future energy system and make it a reality.

Yours,



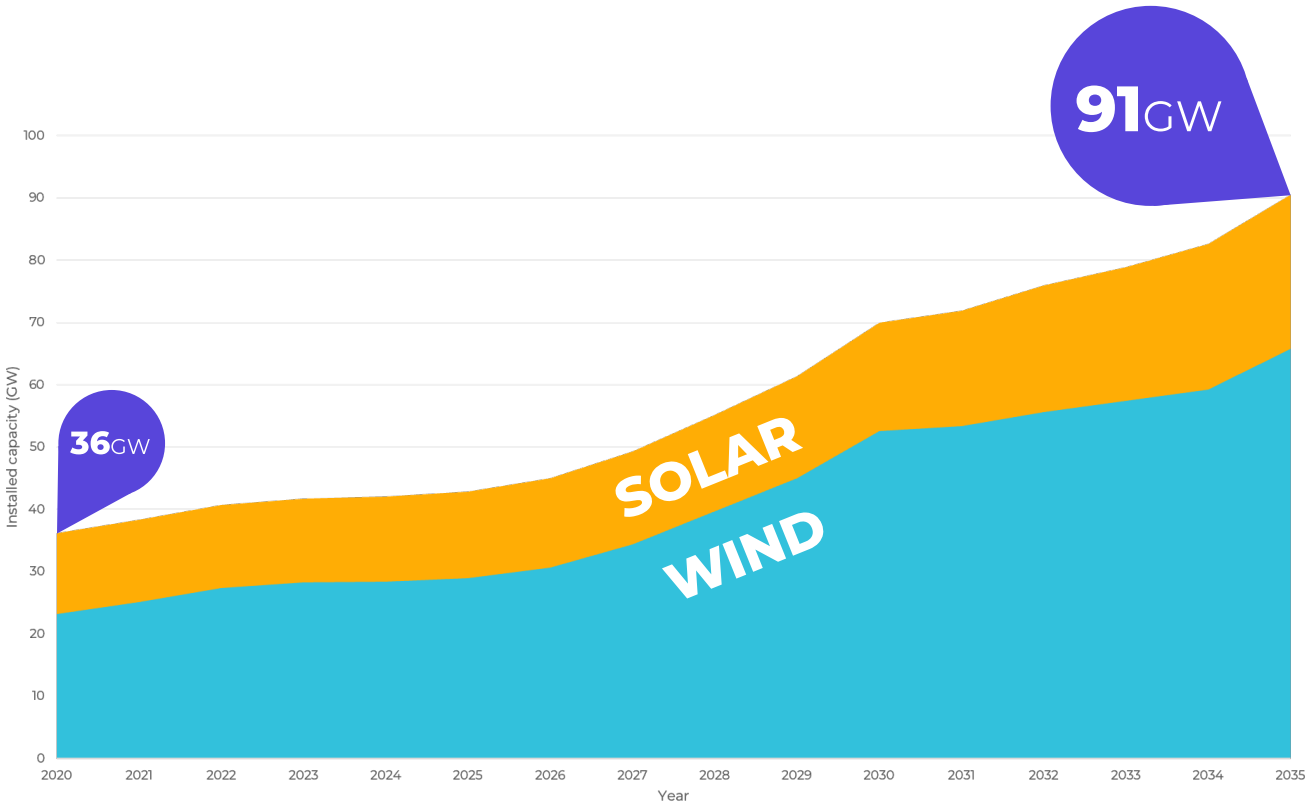
Quentin Scrimshire (Co-founder) and Tim Overton (Co-founder)

*according the International Energy Agency's Global Energy Review 2021

Why we need flexibility

Every year, National Grid Electricity System Operator (NGESO), the organisation responsible for managing the electricity system in Great Britain, produces a series of models forecasting what the future could look like. These models are collectively called the Future Energy Scenarios (FES).

The latest FES report indicates that by 2035 the installed capacity of wind and solar will more than double:

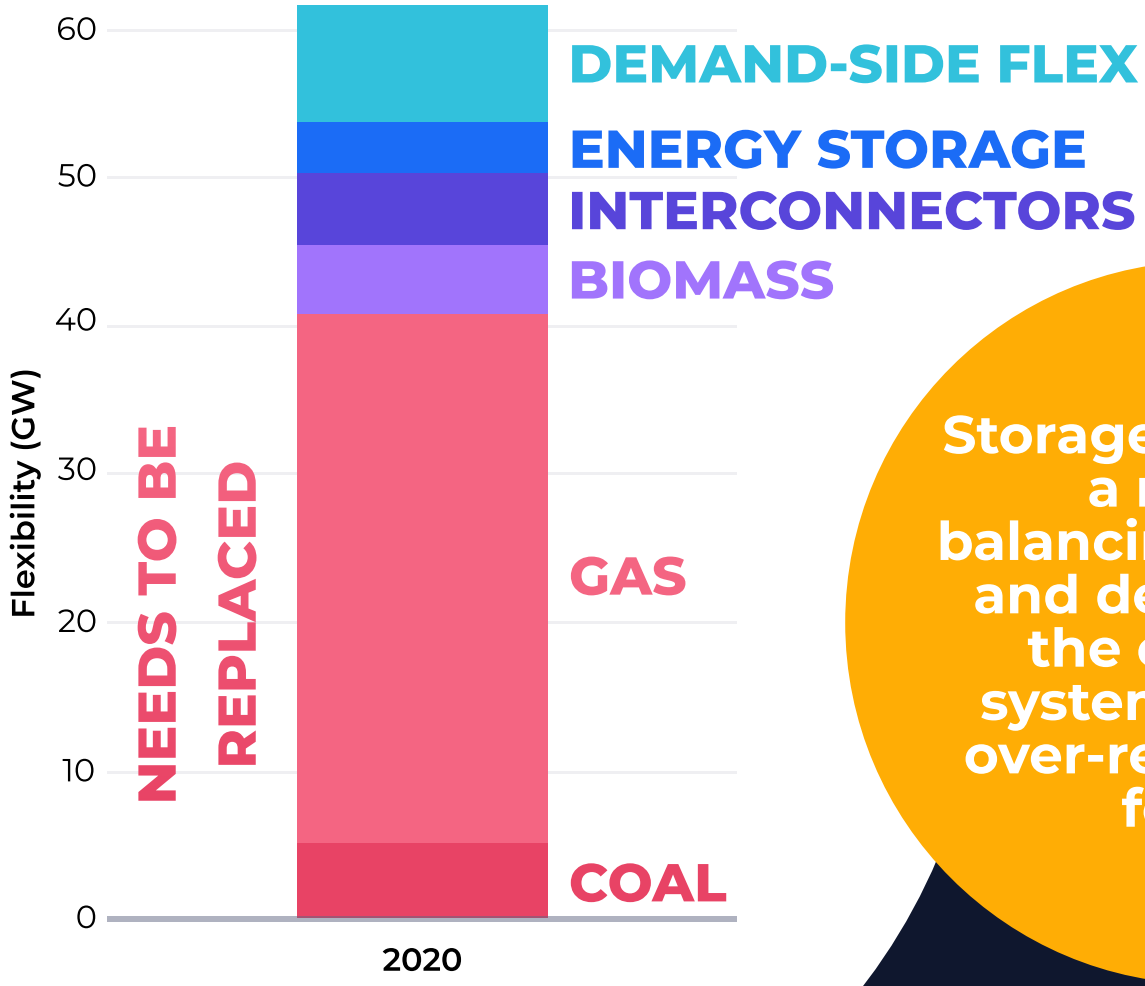


Solar and wind generation are critical to hitting climate targets, but they present a challenge for managing the electricity system.

The challenge is that both solar and wind generation are intermittent – their generation is dictated by external weather factors. This means that if there is a drop in generation (for example due to a large generator coming offline unexpectedly, or due to a wind or solar forecast being significantly different from reality) NGESO cannot decide to turn on wind or solar. To resolve this, there needs to be flexible generation on the system that can be turned on or off.

Why energy storage?

The flexibility in the electricity system required to enable the penetration of renewable generation is currently predominately facilitated by gas-fired power generation (see figure below from FES 2021).



Storage provides a means for balancing supply and demand on the electricity system without over-reliance on fossil fuels

It's an over-simplification, but energy storage can be used to bottle-up excess electricity (e.g. mid-day solar) to use at periods of high demand on the system.
The support that energy storage provides enables the ongoing decarbonisation of the electricity system and provides the system operator with a powerful tool for ensuring security of electricity supply.

Why lithium-ion?

Lithium-ion is a type of battery cell that uses lithium ions as a key component of its electrochemistry. Lithium-ion cells are all around us – in our phones, laptops, and electric vehicles. They're tried and tested technology and crucial to our transition to a low-carbon economy.

Compared with traditional battery technology, lithium-ion batteries charge faster, last longer and have a higher power density. They're also capable of doing thousands of charging cycles with minimal reduction in battery life.

What makes lithium-ion so suitable for grid-scale energy storage?

A brief history of lithium-ion

1977
Michael Whittingham invents the first lithium-ion rechargeable battery

1991
Sony releases the first commercial lithium-ion battery

2014
UK's first grid-scale battery energy storage site comes online (Leighton Buzzard, 6MW)

2018
UK reaches 1 GW milestone of grid-scale battery energy storage

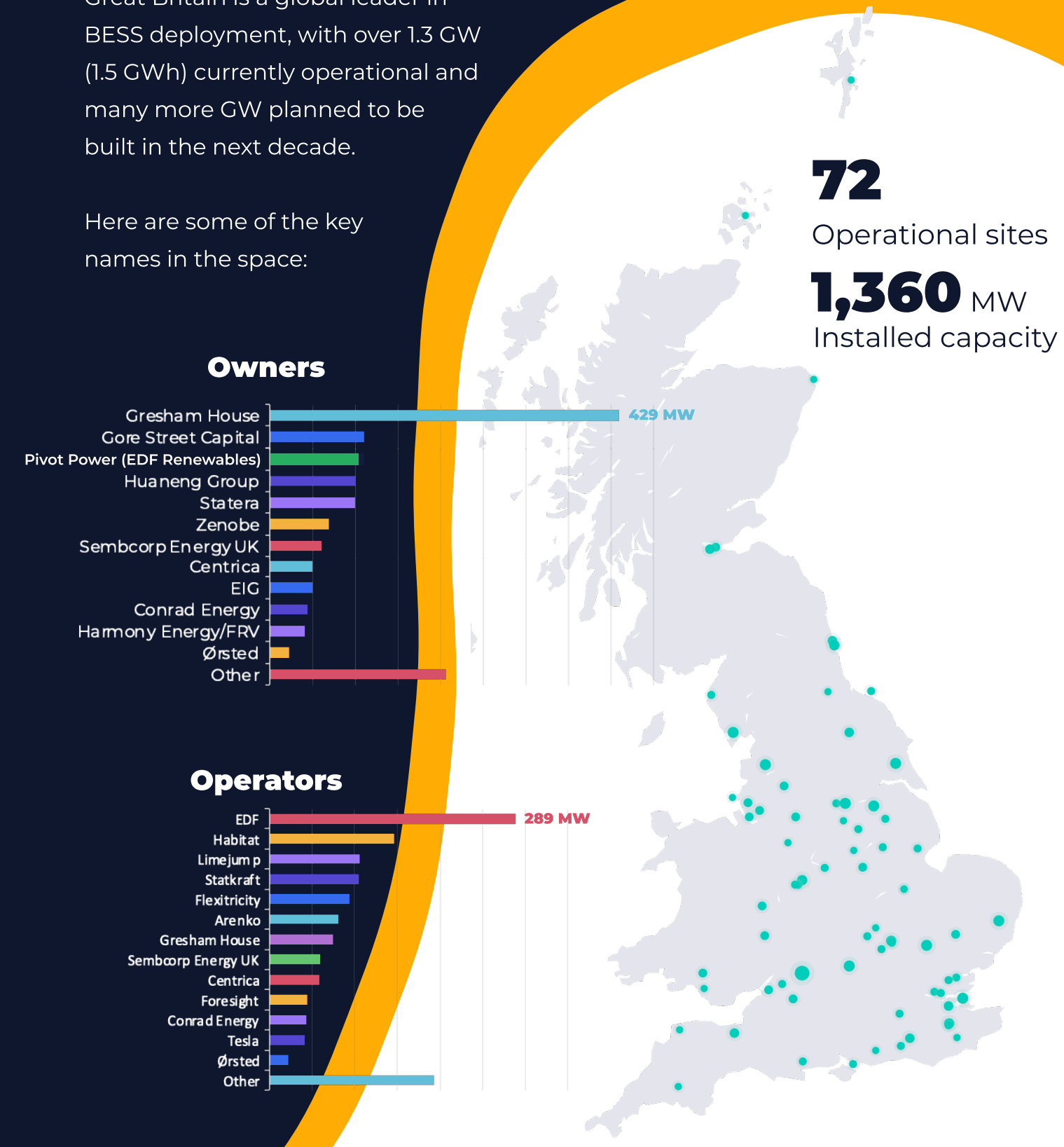
Batteries in GB

Great Britain is a global leader in BESS deployment, with over 1.3 GW (1.5 GWh) currently operational and many more GW planned to be built in the next decade.

Here are some of the key names in the space:

72
Operational sites

1,360 MW
Installed capacity



Owners

Operators

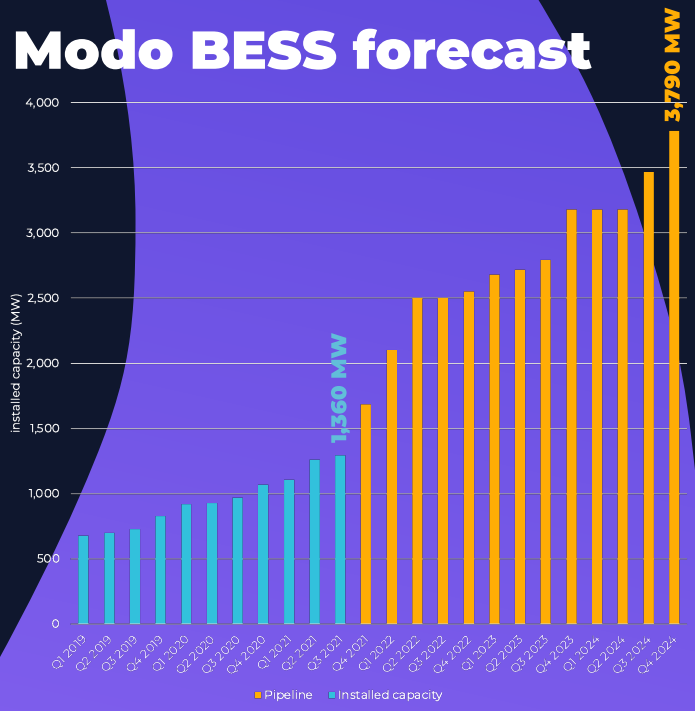
The future

There are multiple ways to forecast the build-out of energy storage in Great Britain.

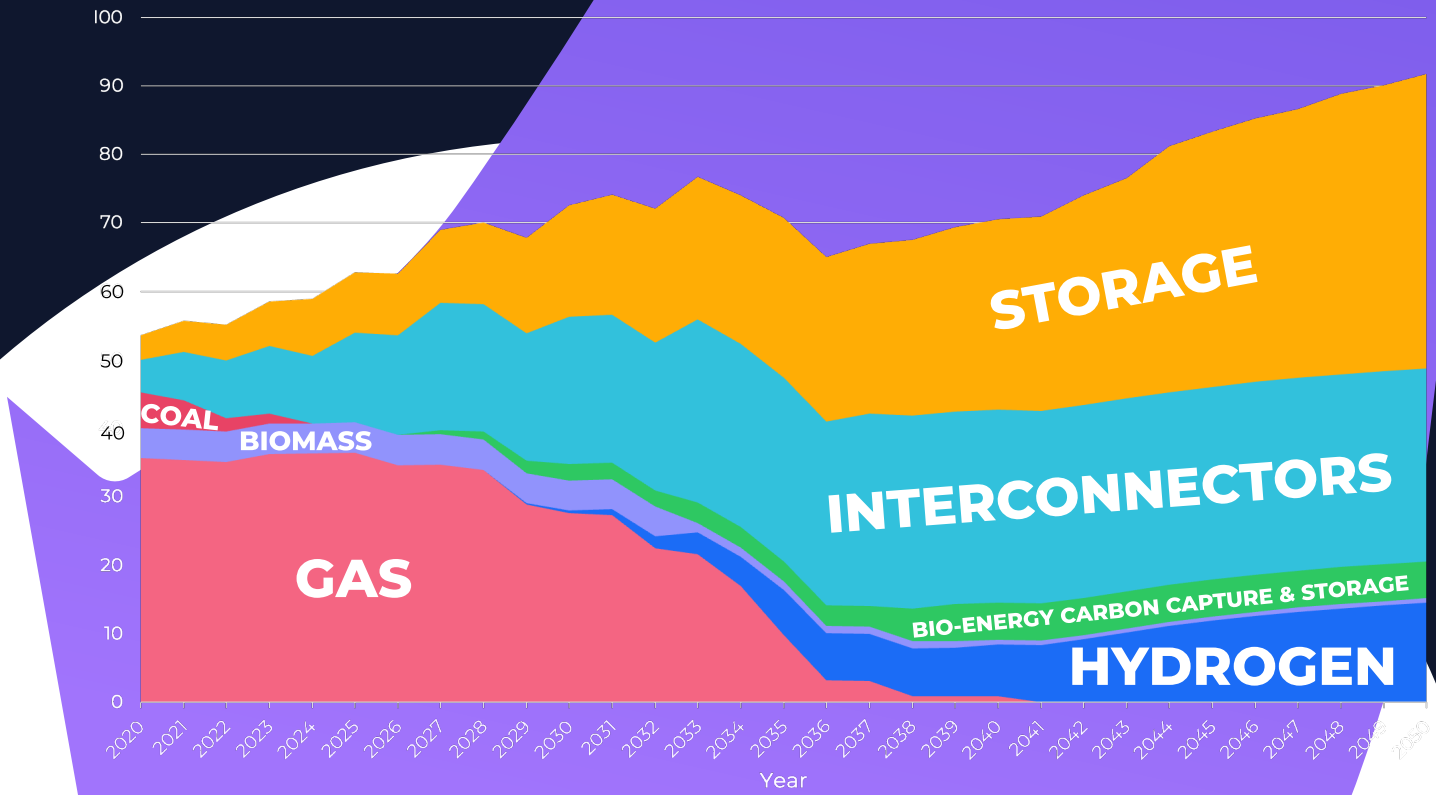
At Modo we produce a short-term forecast based on secured capacity market contracts, financial committments, and press releases.

However, the FES includes a forecast based on the needs of the wider electricity system in Great Britain to produce a view over the next 30 years.

Modo BESS forecast



FES - Leading the way scenario



Key trends - building bigger

There is a significant trend towards larger power assets being developed, with economies of scale, but also legislative changes.

In July 2020, legislation was introduced to make it easier to build larger assets, increasing the size of asset that could be consented by local planning authorities.

In November 2020, the department for Business, Energy and Industrial Strategy (BEIS) granted Intergen consent for a 320MW/640MWh battery in Essex.

The table below shows the largest existing assets, compared against the size of some of the largest assets under development.

	Site	Owner	Rated Power	Energy Capacity	Online?
EXISTING	Minety	Huaneng Group	100 MW	136 MWh	Yes
	Thurcroft	Gresham House	50 MW	75 MWh	Yes
	Wickham Market	Gresham House	50 MW	75 MWh	Yes
	Oxford Superhub	Oxford City Council	52 MW	55 MWh	Yes
	Kemsely	Pivot Power	50 MW	50 MWh	Yes
PLANNED	Trafford	Carlton Power	250 MW	500 MWh	No
	Blackhillock	Zenobe	200 MW	400 MWh	No
	Spalding	Intergen	175 MW	350 MWh	No
	S25BS4	Sembcorp	150 MW	300 MWh	No
	Project E2	Gresham House	150 MW	150 MWh	No

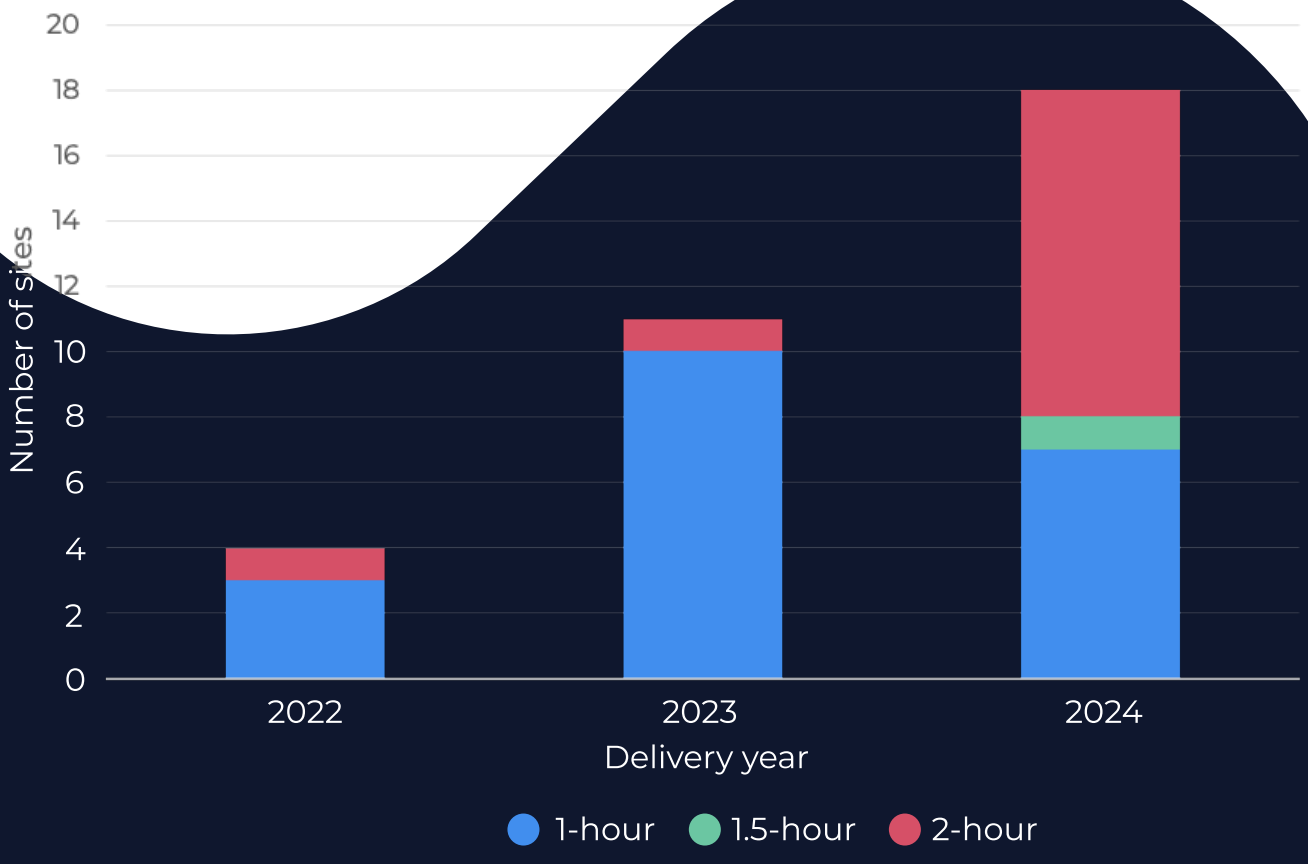
Key trends - building longer

Alongside there being a trend to develop assets with larger rated power (megawatts), there is more and more attention being devoted to longer duration systems.

More 2-hour systems?

A longer duration battery is able to provide its maximum power for longer periods of time.

Most assets built until 2021 were 1 hour capacity. According to the Capacity Market Register this is likely to remain the case until 2024.



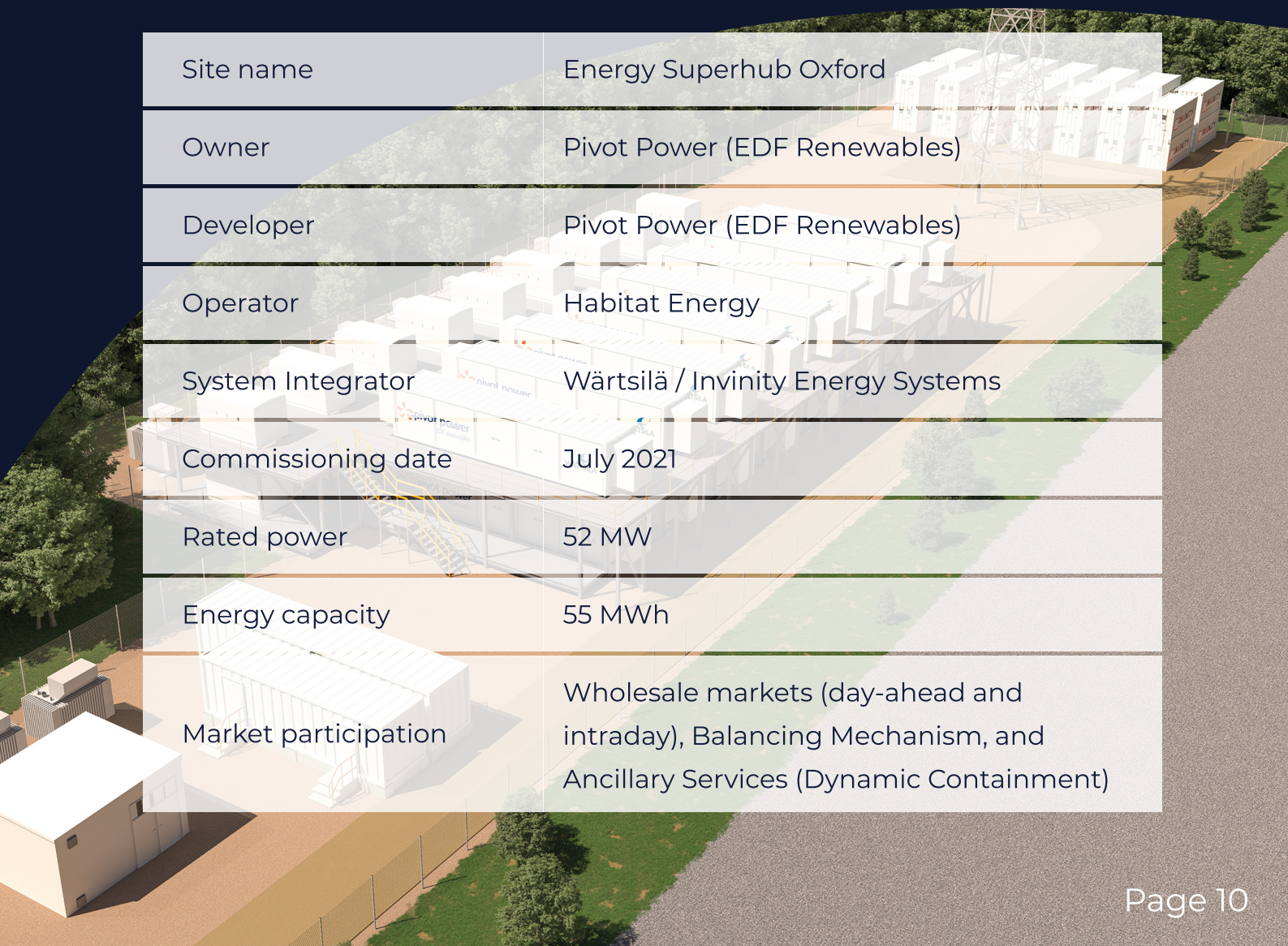
A case study

Cowley, Oxford

Energy Superhub Oxford is a government-backed demonstrator project comprising of six partners, led by Pivot Power (part of EDF Renewables). The partners include public, business and academic organisations, all working together to lower Oxford's carbon emissions and clean up its air.

The project is showcasing a combination of battery energy storage (BESS) assets, ground source heating and electric vehicle charging infrastructure to support Oxford's ambitious plans to be net-zero by 2040.

The Cowley BESS will combine a lithium-ion (50MW/50MWh) and vanadium-flow (2MW/5MWh) battery to operate as one hybrid system. The lithium-ion system went live in June 2021 and is helping National Grid ESO to balance grid frequency and ensure security of electricity supply. The BESS will provide an estimated energy throughput of 4GWh / year, which is equivalent to running one of the UK's nuclear power stations at full power for 4 hours.



Site name	Energy Superhub Oxford
Owner	Pivot Power (EDF Renewables)
Developer	Pivot Power (EDF Renewables)
Operator	Habitat Energy
System Integrator	Wärtsilä / Invinity Energy Systems
Commissioning date	July 2021
Rated power	52 MW
Energy capacity	55 MWh
Market participation	Wholesale markets (day-ahead and intraday), Balancing Mechanism, and Ancillary Services (Dynamic Containment)


PHASE