From Liquid Air to Supercapacitors, Energy Storage Is Finally Poised for A Breakthrough

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Tesla's Powerwall captured attention at its launch, but the lithium-ion batteries it's based on are just one of a host of energy storage technologies taking root in the UK. Photograph: Patrick T. Fallon/REUTERS

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Banks of batteries and other technologies could lower energy bills and help renewable power, says energy storage industry as it gears up for bumper year

"It doesn't always rain when you need water, so we have reservoirs - but we don't have the same system for electricity," says Jill Cainey, director of the UK's Electricity Storage Network.

But that may change in 2016, with industry figures predicting a breakthrough year for a technology not only seen as vital to the large-scale rollout of renewable energy, but also offering the prospect of lowering customers' energy bills.

Big batteries, whose costs are plunging, are leading the way. But a host of other technologies, from existing schemes like splitting water to create hydrogen, compressing air in underground caverns, flywheels and heated gravel pits, to longer term bets like supercapacitors and superconducting magnets, are also jostling for position.

In the UK, the first plant to store electricity by squashing air into a liquid is due to open in March, while the first steps have been taken towards a virtual power station comprised of a network of home batteries.

“We think this will be a breakthrough year,” says John Prendergast at RES, a UK company that has 80MW of lithium-ion battery storage operational across the world and six times more in development, including its first UK project at a solar park near Glastonbury. “All this only works if it reduces costs for consumers and we think it does,” he says.

Energy storage is important for renewable energy not because green power is unpredictable - the sun, wind and tides are far more predictable than the surge that follows the end of a Wimbledon tennis final or the emergency shutdown of a gas-fired power plant. Storage is important because renewable energy is intermittent: strong winds in the early hours do not coincide with the peak demand of evenings. Storage allows electricity to be time-shifted to when it is needed, maximising the benefits of windfarms and solar arrays.

This alone would not be enough to justify the costs of storage, but it brings multiple other advantages. The UK’s National Grid already spends £1bn a year on balancing the grid, switching power on or off to keep the lights on, and stored energy could play a big role. Storage can also be a much cheaper option than big new power stations that might be paid to lie idle for much of the year and only kick in on cold winter evenings. The widely distributed nature of storage also boosts energy security. “It’s a ‘no regrets’ option,” says Prendergast.

The most established form of energy storage is pumping water up mountains, and the UK has four such plants. But available mountains in useful places are now rare and Highview Power Storage is about to fire up an alternative: liquid air.

Its new £8m demonstration plant, at Pilsworth, near Manchester, and funded by the Department of Energy and Climate Change (Decc), is set to start in March. By compressing air 700 times into a cold liquid, it stores power which is released by evaporating the liquid air into a high pressure gas to turn a turbine. The 5MW system will be able to power many thousands of homes for a few hours. Gareth Brett, CEO of Highview, says it is like pumped storage, but can be sited wherever it is needed.

Another technology backed by Decc is a home battery system from Moixa Group, a UK technology similar to Tesla’s Powerwall. The £2,000 briefcase-sized battery can store surplus energy from rooftop solar panels but it also earns money by being part of a smart network of home batteries - a virtual power station - which the company uses to help balance the National Grid.

“You can turn houses on or off the grid, if the National Grid wants me to do it and pays me to do it,” says Simon Daniel, Moixa founder and CEO. About 350 systems have been installed so far, and Daniel argues that rolling out a much bigger network could be much faster than waiting for planning permission for large energy storage sites.

“Sky installed satellite dishes in a third of UK homes in seven years,” Daniel says. He also jokes his battery “is currently manufactured in [energy secretary] Amber Rudd’s constituency, which is good politically.”

The Moixa system uses lithium-ion batteries and these are the mainstay of the current grid-scale energy storage rollout around the world. In the past they were considered too expensive for larger scale storage but costs continue to fall and their proven track record in consumer electronics gives investors confidence.

The UK’s biggest operating energy storage system is an £18m battery plant installed by UK Power Networks (UKPN) at Leighton Buzzard, a growing Bedfordshire town. UKPN’s Martin Wilcox says the company, responsible for delivering electricity to homes in south-east England, had a choice: build a third main power line into the town from the National Grid or install 6MW of batteries. With the money it earns by balancing the grid, the latter looked cheaper and went live in 2015.

The UKPN project is set to be overtaken by AES, a global power company, with a 10MW lithium-ion plant at its Kilroot power station in Northern Ireland, while REDT is installing a £3.6m flow battery on the Scottish island of Gigha, to support its wind turbines.

Batteries are also at the heart of the Everest project in East Anglia, but it uses second-hand batteries from Renault electric cars. Ian McDonald, at Future Transport Systems, which is the technical lead for the project, says it buys the batteries - at a fraction of the new cost - after they are about 75% degraded by the “use and abuse” of normal stop-start driving. Because the batteries are then only charged and discharged slowly, as part of an electric car recharging network, they get another five to six years of life.

Electric cars, such as the BMW I3 pictured here, could one day be used as part of a smart energy storage network across the UK. Photograph: PR image

Using electric car batteries as a smart storage network while still in the cars is a promising option in the future, according to Mark Thompson at Innovate UK, a government agency. He says there

could be 4GW capacity - a nuclear power station is about 1GW - by 2025 across the 300,000 electric cars projected to be on UK roads by then. He says cars are stationary for 95% of the time and using them could save billions of pounds, removing the need for new power stations and power lines.

But while interest in energy storage projects in the UK is surging - a recent call from National Grid for 200MW of short-term storage was oversubscribed six times - it is starting from a low base: just 24MW has been installed compared to the 5,000MW the government's official advisers, the Committee on Climate Change, envisages in a low-carbon nation in 2030.

"The UK and Europe really led the way on renewables, with the US following. But the opposite seems to be the case in the energy storage industry," says Audrey Fogarty, at Younicos, a German energy storage company with major operations in US. California alone has mandated 1,200MW of storage by 2020.

Sally Fenton, at Decc, said the government was still deciding how to deploy the £250m it now has for non-nuclear energy innovation, but said: "We certainly expect to have increased funding" for energy storage.

In November, energy secretary Rudd said: "Locally generated energy supported by storage, interconnection and demand response, offers the possibility of a radically different model ... We are looking at removing regulations that are holding back smart solutions, such as demand side response and storage."

That would be welcomed by UKPN's Wilcox: "Storage is absolutely at a tipping point. But [energy] regulation was designed 10-20 years ago for a different system." For example, he says, UKPN has to pay towards government social and green subsides when it buys electricity to charge its batteries, but then customers pay them again when they take the power from the discharging battery.

Brett, at Highview, praises Decc for its support - "they have really stuck with us as a British technology" - but says regulatory issues are having a "chilling effect" on the rollout of storage.

Cainey, director of the trade body Electricity Storage Network, says storage projects can be built very quickly. "A battery project can take 12-18 months from saying we will do it, to completion."

She said California's high ambition came from its commitment to tackling climate change: "California is aggressively pursuing a low-carbon agenda and they don't want diesel [generator back-up] on the system." The UK government has been criticised for recently awarding £175m of subsidy to highly polluting diesel generator farms.

"Amber Rudd is talking a lot about energy storage, but we need a clear regulatory steer," says Cainey. "The planes are circling, but there is no runway to land on."

Prof Ian Arbon, at the Institute of Mechanical Engineers, which in 2014 called energy storage the "missing link" in the UK's energy plans, is even more direct: "As a nation we are nowhere near where we should be on energy storage. There is a clear need for massive and urgent attention. Energy storage is one of the obvious solutions to the [decarbonisation] problems we face."

The government is keen to build new gas-fired power stations and develop fracking, but Arbon said: "The UK is the only country in the world who thinks it is going to hit its renewable targets by doing more fossil fuels."