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How can large energy users like data centres help rather than hinder our progress to net zero?

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Data centres, along with telecommunications networks, provide the core digital infrastructure that supports our modern internet economy. There are over 200 commercial facilities in the UK which collectively consume 2.89TWh of power a year, plus at least the same number of smaller operations in-house, supporting corporate IT functions for organisations from banks to universities. Data centres are part of our energy ecosystem and operators, collectively and individually, have a duty to help the UK meet its net zero targets. A large energy user with consistent and predictable demand, high embedded capacity, and a strong appetite for renewable power, our data centre sector has the potential to support our transition away from an economy dependent on combustion and towards one based on renewables.

This transition depends on action on several fronts. These include operators committing to be anchor customers for renewables, driving new low carbon generation through power purchase agreements, exploiting underused or innovative renewable sources, providing demand side response and becoming energy prosumers in a smart, genuinely distributed grid. Some of these are not straightforward and will take time.

Starting with renewable purchasing, commercial data centres are doing well: 76.5% of electricity consumed by UK operators is certified renewable[i], but while this demonstrates commitment it does not in itself drive additional supply. Fortunately, we are now seeing increasing adoption of Power Purchase Agreements (PPAs) within the industry. PPAs are contracts between customer and generator and stimulate additional renewable capacity by providing long term project funding. However, PPAs are not for the faintheartedso widespread uptake will be slow.

Operators are also locating facilities near to underused renewable power sources. This accounts for rapid growth in data centre developments in Scandinavia by large cloud providers. In the UK opportunities are more limited but there are several projects underway, for example on the Thames at Belvedere using energy from waste. Other, more novel, approaches such as using salt caverns and wind farms in combination, are at development or demonstration stage.

Sectors with embedded generating capacity can potentially support a more distributed pattern of energy supply through DSR (demand side response), allowing greater dependence on intermittent renewable sources in our generating mix without compromising security of supply. Schemes like STOR (Short Term Operating Reserve) incentivise large electricity users to reduce consumption for short periods when supply is insufficient to meet demand, thus releasing capacity back to the grid.

Because computers cannot tolerate interruptions in electricity supply or fluctuations in frequency, data centres collectively have over 2GW of installed emergency generating capacity in the form of batteries for instantaneous supply and generators for longer term outages. Operators could in theory switch supply to their generators to reduce pressure on the grid, but recent air quality legislation now effectively rules out all forms of DSR from diesel plant.

Data centres also generate heat, which is the by-product of computing. While the sector is willing to make waste heat available, initiatives are hampered by lack of infrastructure and operators are working with BEIS to address barriers to heat reuse and are also trialling new forms of cooling that produce higher grade heat. So far, however, progress is slow and the UK lags behind regions like Scandinavia in this respect.

Although the approaches above are welcome in that they increase the supply and adoption of renewables and can relieve pressure on the grid, they are not transformational. The current generating model in the UK is monolithic, with almost complete dependence on a highly reliable, centralised electricity grid. But energy models must change: supply and demand interactions must become more dynamic. With the right technologies, policies and expertise, it should be possible for data centres to be part of this transformation, and to become important prosumers in a smart energy landscape.

Large commercial operators like Digital Realty, Equinix and Microsoft are already trialling fuel cell technology, which, together with developments in battery storage, could allow data centres to play a much more dynamic role in the energy market. For the economics to work, fuel cells need to be run continuously: they would therefore be deployed to provide the baseload energy for facilities, with the grid used to top up. This reduces grid dependency by around 80%. With reduced reliance on the grid, coupled with improvements in battery capacity, the emergency generating requirement can be met by batteries alone and diesel generators will no longer be needed. The ultimate objective is enough battery capacity to enable sites to trade electricity and participate in the energy market.

So, while data centres are undeniably energy intensive, their consumption patterns have some unusual characteristics that can enable greater adoption of intermittent renewables and a more distributed grid. Although demand side response and heat reuse currently look unpromising, these aren't the only options. With the right expertise and policies in place, data centres could make a significant contribution to investment in additional renewable generating capacity. Furthermore, with the deployment of emerging fuel cell and battery storage technologies, they could become useful energy prosumers in a smarter grid. Although the sector is not yet fulfilling this role, there have been some very promising developments and, with more in the pipeline, it is worth watching this space.

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[i] Based on a techUK review of CCA participants in September 2019. 76.5% of power purchased was 100% certified renewable, 7% is between 50% and 100% certified renewable, 6.5% is below 50% renewable and 10% is purchased according to customer requirement.