Data Centres - FLEX 101

The grid's new best friend: data centre flexibility 101 explainer

By The REA's Data Centre Coalition

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Executive Summary

For years, data centres have been seen as a defining part of the modern energy system: large, dependable consumers whose demand was rising steadily along with the digital economy. That role is evolving: a new generation of facilities, shaped by advances in AI and increasingly sophisticated digital controls, can adjust their energy use with remarkable precision, absorbing surplus wind power during the night and easing demand when the grid is under pressure. The policy challenge has shifted from simple accommodation to strategic integration: how best to deploy data centres as active partners in a more flexible, resilient energy system.

The scale of the challenge

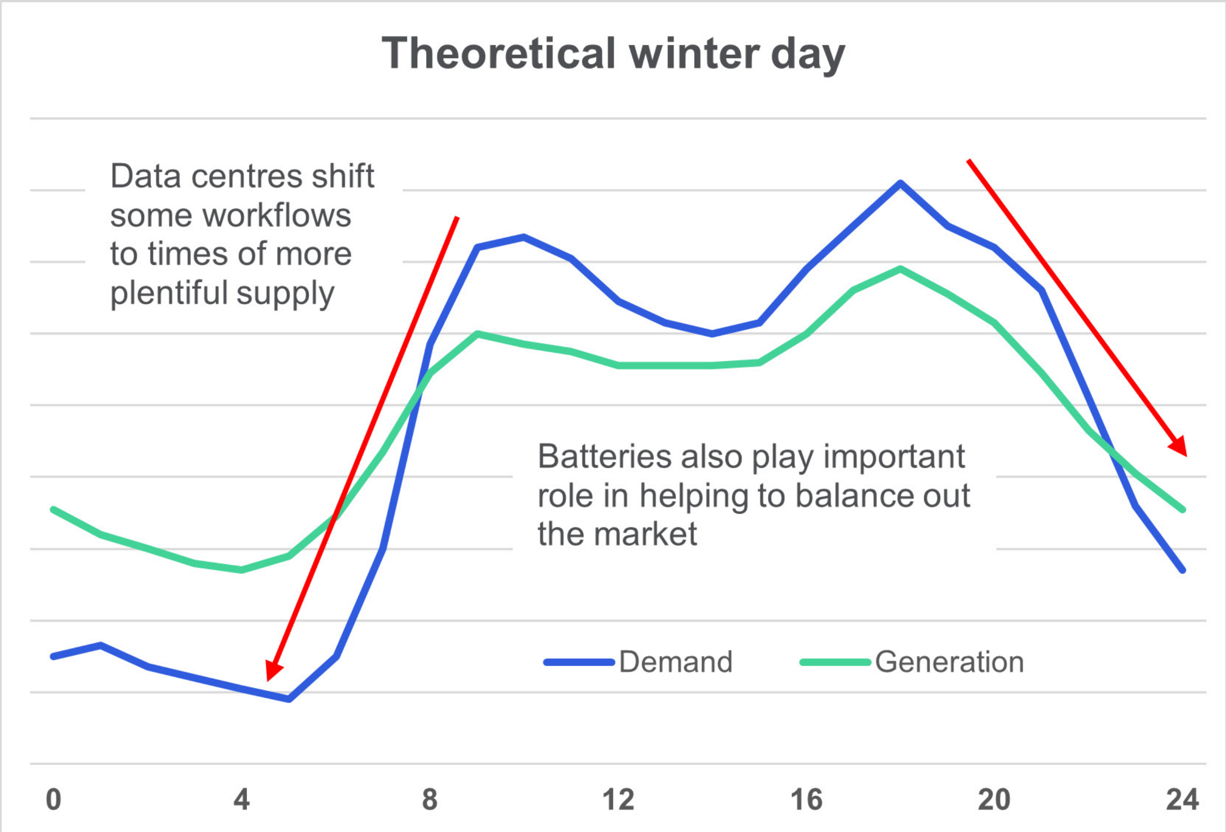
Demand for computing is rising at a pace that would have seemed fanciful a decade ago. The International Energy Agency's report, Energy and AI, calculated that "global data centre electricity consumption has more than doubled since 2022, reaching around 415 TWh in 2024...(and) data centres could consume up to 945 TWh of electricity in 2030," (broadly equivalent to total Japanese electricity demand today). The driver is familiar: AI, and in particular the training and inference workloads that underpin large language models and real-time analytics.

In Great Britain, NESO's Future Energy Scenarios estimated data centre demand at 7.6 TWh in 2025 (from 2.4 GW connected facilities) rising to 33 TWh by 2035 in NESO's 10-year forecast. That tension, between AI ambition, grid constraint and net-zero commitment, will preoccupy Ministers for years, but the framing of data centres as a burden is already outdated. The assumption that a data centre simply draws power at maximum capacity, around the clock, has never been accurate and is becoming less so. A recent ECA Insight report found that "data centres may operate over 80% of the time when training AI models, but this drops to ~40% when utilised for AI inference. For hyperscale data centres providing mass scale internet services, this figure may be 50%, while multi-tenant, strategically co-located data centres may have operation rates of only 20-35%." There is far more heterogeneity, and far more latent flexibility, than the headline connection numbers suggest.

What flexibility means

Flexibility, in the language of energy systems refers to the ability of a load (or generator) to vary its consumption (or output) in response to signals from the system operator, network companies or market prices. Historically, demand-side flexibility has been dominated by large industrial users (e.g. aluminium smelters, cement kilns) that can reduce consumption when the grid is tight. Data centres are now joining that club, and they bring some unusual advantages.

Not all computing is equally time sensitive. Training a large AI model is a multi-day affair; whether a particular batch runs on Wednesday afternoon or Thursday morning matters little to the end-user. The same logic applies to large-scale data processing, archiving and backup routines. Operators can schedule these tasks to coincide with periods of high renewable generation (overnight when the wind is blowing or midday when solar output peaks), reducing demand at precisely the moments when the grid is under stress. AI data centres “can be connected and managed without major new network capacity, flexing their power up or down in real time to support the whole system” according to Steve Smith (President, National Grid Partners).

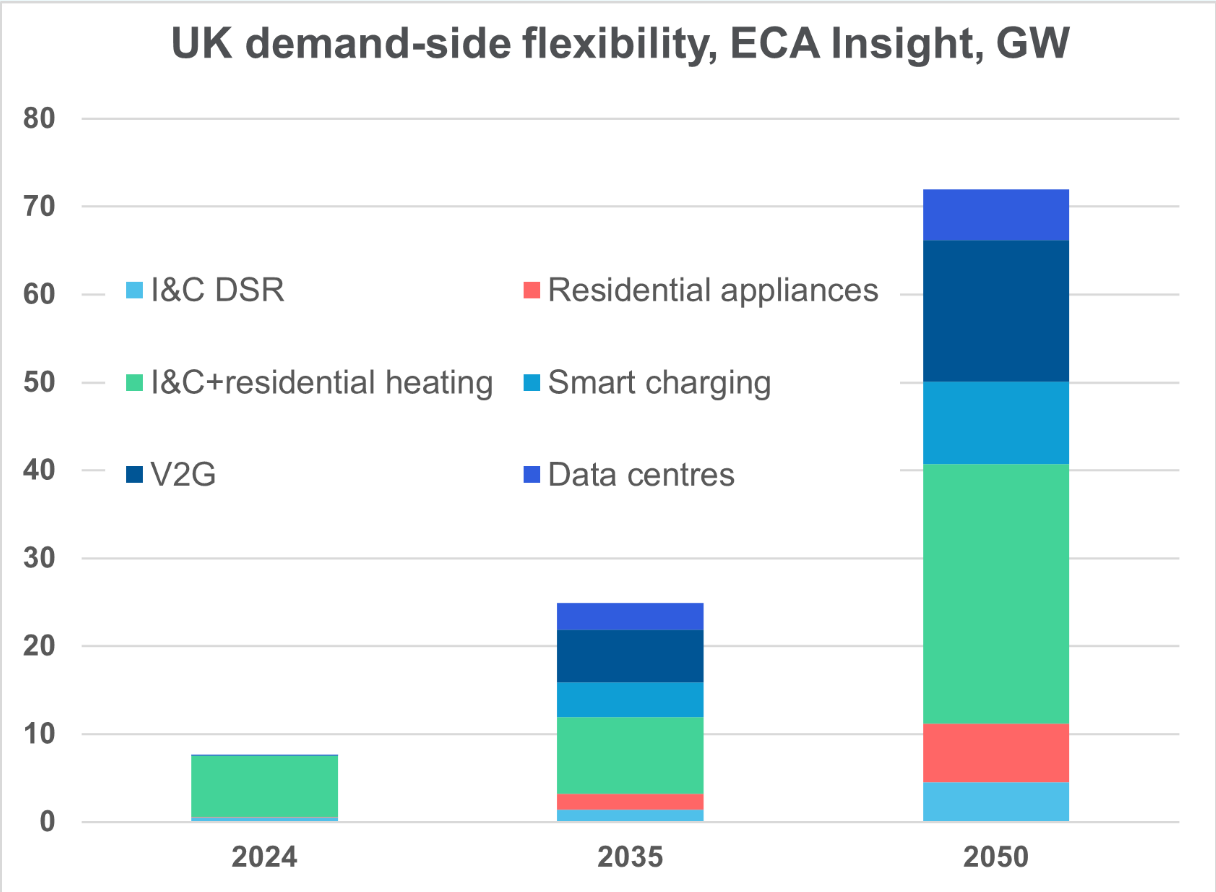


Beyond scheduling, modern data centres can respond within seconds to direct signals from networks. When a local constraint emerges (e.g. transformer tripping), a modern data centre can reduce load, buying time for the system to stabilise. This kind of fast-response capability has historically been the preserve of gas peakers. Data centres, at scale, could perform a similar function at lower cost and without combustion.

New data centre facilities are being designed with storage on site. These assets can charge when electricity is cheap, then reduce apparent demand (even export to the grid) when it's expensive. The combination of flexible load and on-site storage makes a well-designed data centre an unusually versatile grid asset. Such flexibility is more valuable to the genuine green credentials of a country than the old-fashioned approach of simply buying renewable energy certificates (in Britain, Renewable Energy Guarantees of Origin, REGOs) which permit electricity to be labelled as renewable even though it is drawn from the same mixed grid as everyone else.

Opportunity for the UK

With modern data centres readily able to flex around 50% of loads this would increase available flexibility capacity by 1.6 GW to 3.3 GW by 2035 (ECA Insight), equivalent to 9% to 16% of additional headroom on the system. By 2050, ECA Insight foresees UK data centres being able to flex up to 5.8 GW. Data centre "load can vary by 10s or 100s of MW in a matter of seconds...(and) with data centres facing long connection queues and grid bottlenecks, this has renewed investigations of options...(including) on-site generators (or batteries), shifting compute workloads to other locations, or temporarily reducing workloads, such as delaying non-urgent tasks." This additional data centre flexibility can be mobilised as soon as new facilities come online; it does not require a separate investment cycle. The implications for costly future grid upgrades are substantial.



Large, predictable, and increasingly flexible consumers can help unlock network reinforcement that benefit all users in a region. When a data centre would have previously required dedicated grid upgrades at public expense, a flexibility-capable facility may be able to connect more quickly, with fewer costly works, and actively contribute to system stability. Josh Parker (Head of Sustainability, at NVIDIA) noted that AI-powered infrastructure "can act as a grid-aware asset, modulating demand in real-time to support stability. By making AI workloads responsive, we accelerate deployment while reducing the need for costly grid upgrades." National Grid Partners' recent trial of AI data centre demand-side capabilities concluded that such sites could enable the UK to connect significant new demand quicker and help lower network charges.

There is also a broader economic argument for domestic flexible data centres. The alternative to large, optimised UK data centres is often less efficient server rooms scattered across the country, or overseas facilities that export both jobs and carbon. Consolidating computing capacity into hyperscale or co-location facilities improves the effectiveness of the UK's power usage, potentially reduces waste heat and supports the digital infrastructure on which the wider economy (e.g. financial services, healthcare and logistics, etc.) depends.

Beyond the data centre: AI as a decarbonisation tool

It is tempting to evaluate data centres solely as energy consumers, but the compute they provide is itself an instrument of decarbonisation. The Alan Turing Institute's [State of AI for Decarbonisation 2025] shows that AI-driven tools are already helping to maximise flexibility in energy networks, optimise EV charging and reduce emissions in heating and building systems, as well as improve efficiency in manufacturing and freight. For example, "in 2025 AI has a measurable impact on the UK's ability to operate a low carbon electricity grid. AI-powered solar... reduced emissions by an estimated 300,000 tonnes, smart EV charging lowered peak electricity usage from EVs by 42% and virtual power plants helped balance the grid." Data centres are the infrastructure that makes these applications possible.

This creates a virtuous logic: well-sited, low-carbon data centres power AI tools that optimise energy networks, reduce waste in manufacturing and freight, and help consumers manage their own demand. The IEA projects that global renewable generation will need to grow by over 450 TWh to meet global data centre demand through to 2035. If those centres are active participants in managing that renewable output (absorbing surplus, deferring load, storing energy), the system becomes cheaper and more resilient for everyone.

How policymakers can best support this essential resource

The policy framework has not kept pace with technological reality. Planning guidance, grid connection loads and flexibility market design were largely conceived when data centres played largely passive roles. Three priorities for policymakers of the future stand out:

1. Flexibility-first planning.

National and local planning frameworks should require applicants to demonstrate their flexibility capabilities (shift capacity, response times, on-site storage) as a condition of consent. Flexibility should be genuinely rewarded and not simply a nice-to-have.

2. Streamlined connections for flexible loads.

Ofgem and NESO should develop connection pathways that offer faster, cheaper access for loads that commit to demand-response obligations. A data centre that can shed load on instruction is a different grid asset from one than cannot.

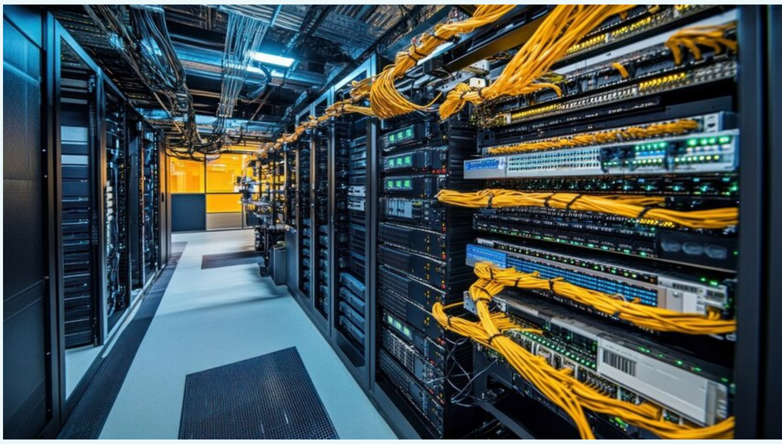
3. Market access for demand-side response.

Balancing and ancillary service markets should be reformed to allow data centre operators to participate directly and at appropriate timescales.

Conclusion

The narrative of data centres as an unbounded drain on the electricity system is outdated. Most of the facilities being built today (and those planned for the next decade) are increasingly sophisticated energy players, capable of matching their appetite to the rhythms of a renewable grid rather than fighting against them. The IEA's projections assume that roughly half of global data centre demand growth will be met by renewables; active flexibility on the demand side is what makes that arithmetic work.

For the UK, the prize is significant. A fleet of flexible, low-carbon data centres provides not only the compute backbone for an AI-enabled economy, but a substantial new instrument of grid management. The risk is that outdated planning frameworks, inflexible connection rules and poorly designed markets leave that prize unclaimed or send it offshore. Getting the conditions right is, at its core, an energy policy question as much as a technology one.



Thanks to the founding members of the REA Data Centre Coalition for their contributions that have helped inform and produce this report.

Find out more and support the sector

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