AURORA ENERGY RESEARCH

Impact of Datacentres on the GB Power System

5 June 2025

Foreword

I'm delighted to introduce Aurora Energy Research's comprehensive analysis of datacentre growth and its implications for Great Britain's energy system.

The unprecedented expansion of artificial intelligence is transforming our digital infrastructure needs while simultaneously creating significant new demands on our power system. While the range of uncertainty around datacentre growth is vast, the addition of each large datacentre is the equivalent of adding over a quarter of a million electric vehicles to the grid. This surge in computational capacity – and its corresponding appetite for power – is likely to have profound implications for our energy transition.

The datacentre boom has brought new participants into the power market who have historically operated independently. This presents a classic coordination challenge, with datacentres seeking immediate power access, renewable developers pursuing the certainty of longer-term offtake agreements, and networks requiring extended planning cycles. Without strategic coordination, we risk a "tragedy of the commons" where discrete decisions by individual actors lead to suboptimal system outcomes.

The stakes are considerable. Our analysis demonstrates that effective collaboration between datacentres, networks and generators could unlock £35 billion in low-carbon power investment while supporting ~5GW of green datacentre growth over the next decade. Conversely, an uncoordinated approach to power sourcing could increase power sector emissions by 14%, significantly hampering the UK's decarbonisation efforts, while raising wholesale electricity prices.

Aurora has leveraged our analytical capabilities and international experience together with insights from stakeholders across the energy and digital sectors. Their diverse perspectives have been invaluable in shaping our understanding of this complex challenge. I hope you find this report both illuminating and actionable as we collectively navigate the intersection of digital growth and energy transition. We welcome your feedback and look forward to continuing this important conversation.

Brian Potskowski
Head of Advisory, GB & Ireland

Source: Aurora Energy Research

Study participants

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This study was conducted for a group of public sector observers and private sector clients interested in exploring the impact of datacentre demand growth on the GB energy market. As such, this public report is a summary of the wider study conducted for the clients. Our findings and policy conclusions are based on our own independent analysis and do not necessarily reflect the views of the participating clients.

Generators & Developers

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Cubico SUSTAINABLE INVESTMENTS

drax

NTR Securing a Greener Future

sse

Data Centres, Digital Infrastructure Investors & Supply Chain

CBRE

Clarke Energy® A KOHLER COMPANY Engineer - Install - Maintain

GLIL INFRASTRUCTURE

IRON MOUNTAIN® DATA CENTERS

Relode

Key Stakeholders

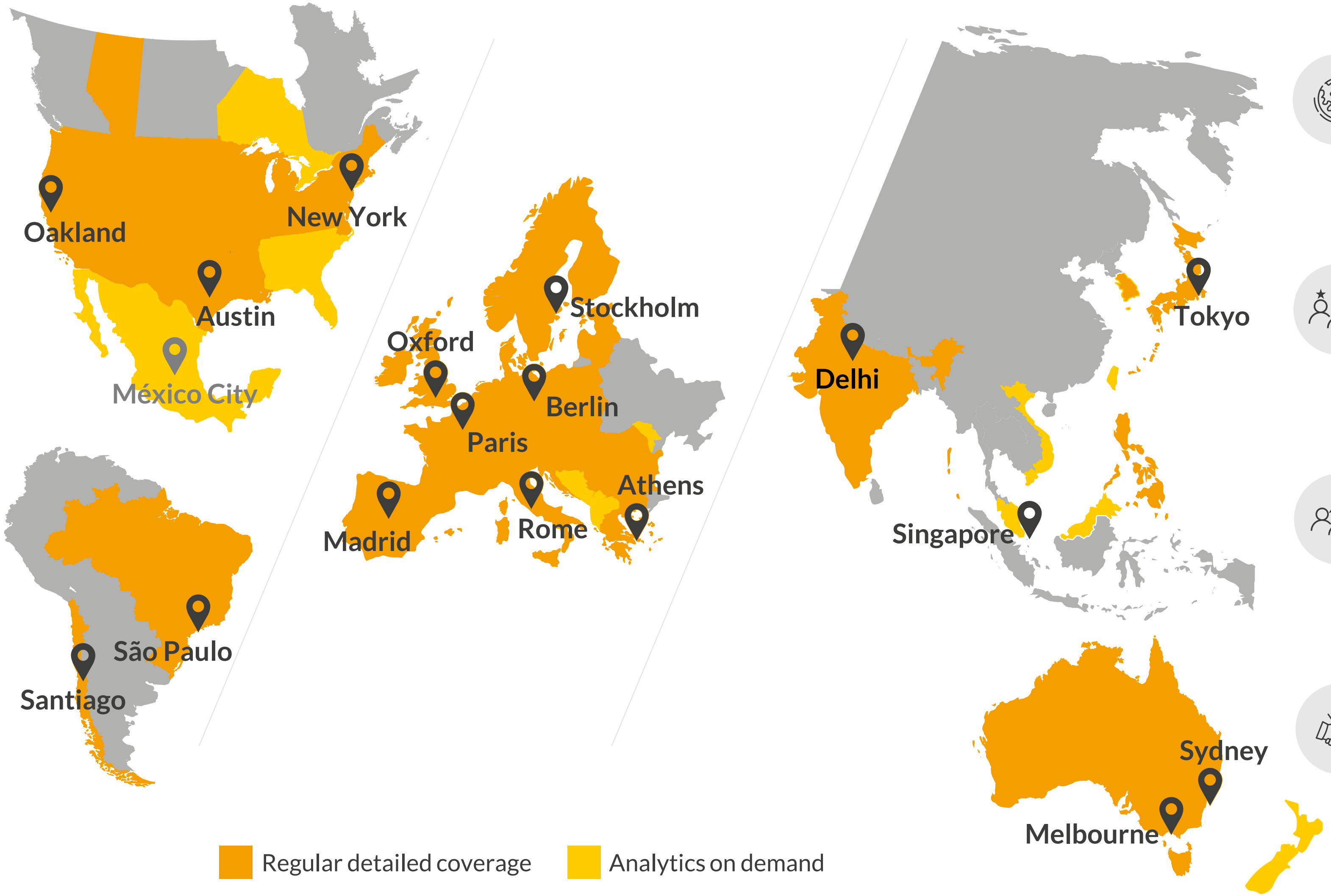
THE CROWN ESTATE

Department for Energy Security & Net Zero

Source: Aurora Energy Research

Aurora provides market leading forecasts & data-driven intelligence for the global energy transition

- Power markets
- Renewables & PPAs
- Storage
- Grid & Congestion
- Electric vehicles
- Hydrogen
- Carbon
- Natural gas



17 offices

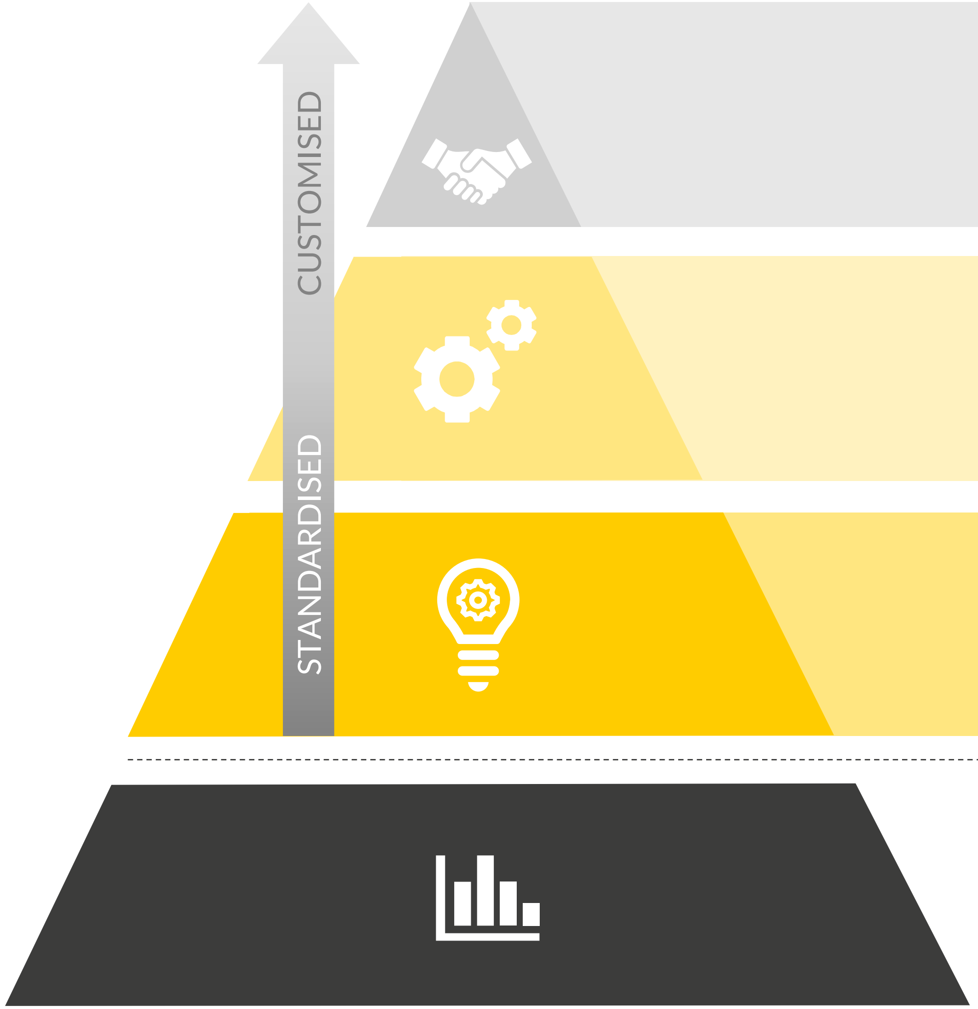
900+ market experts

950+ subscribing companies

150+ transactions supported in 2024

Source: Aurora Energy Research

Our market leading models underpin a comprehensive range of seamlessly integrated services to best suit your needs



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Developed over 12 years, 90+ dedicated modellers

Source: Aurora Energy Research

We work with a very broad range of clients … their constant challenge keeps us up on our toes and ensures our independence

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"With its capabilities, intellect and with its credibility Aurora plays an essential role bringing the dialogue [in the global energy transition] to a different plane"

Ben van Beurden, CEO, Shell

"Aurora analysis and the provision of reliance was crucial for our debt funding. Their ability to explain market logics and revenue streams was vital for this successful financing."

Jeremy Taylor, Director, Green Frog Power

Power & utilities

fortum, e.on, Calpine, Eneco, Viridor, EDF, RWE, Axpo, SSE, Terna, Vattenfall, National Grid

Energy consumers

AlzChem, Glencore, Unilever, Evonik Industries, Google, INEOS, Mitsubishi Power, Orange, DB, Siemens, SIMEC, Heineken

Financial sector & investors

Allianz Global Investors, Barclays, Crédit Agricole, Equitix, Partners Group, Lloyds Bank, NatWest, Octopus Investments, Legal & General, Bluefield Partners LLP, Commerzbank, HSBC

Oil & gas

Vitol, Gasag, bp, Orlen, Equinor, Centrica, SWM Stadtwerke München, Shell, Naturgy, National Grid

Project developers

Green Frog Power, Neoen, Pacifico, Belectric, Boralex, BayWa r.e., powercapital renewable energy, greentech, Invenergy, Technique Solaire, British Solar Renewables, Hive Energy

Policy & regulation

DRC Development Research Center of the State Council of the People's Republic of China, Ministerie van Economische Zaken en Klimaat, SEAI Sustainable Energy Authority of Ireland, Climate Change Committee, European Commission, HM Treasury, Department of Communications, Climate Action & Environment, Ministère de la Transition Écologique et Solidaire, Commission de Régulation de l'Électricité, National Audit Office, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, AEMO Australian Energy Market Operator, Department for Energy Security & Net Zero, Energy Regulatory Office, JETRO Japan External Trade Organization

Source: Aurora Energy Research

We provide a wide range of advisory services in the energy space leveraging our decade long power market presence and extensive software capabilities

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- Sell-side support on transactions
- Buy-side support on transactions
- Ongoing transaction support

Green power procurement and PPA valuation

- Fair value PPA price forecast and contract evaluation
- PPA origination, structuring and negotiation support
- Pricing and structuring of 24/7 green power contracts

Strategy development and decision support

- Auction bid support
- Portfolio assessment and investment strategy
- Pipeline valuation

Policy and regulatory scenario modelling and design

- Detailed analysis on a new policy, or market environment
- Modelling of sustainability measures, energy policies or subsidy schemes
- Evaluation of asset economics

Bespoke scenario modelling for portfolio stress testing

- Tailor-made asset valuations
- Developing bespoke market scenarios
- Asset optimisation

Source: Aurora Energy Research

Seamlessly integrated suite of software products

AMUN
for wind

ORIGIN
for markets

CHRONOS
for batteries

LUMUS
for PPAs

SOLARIS
for solar

Our **market-level model** enables you to create your own market scenarios within hours and quantify market risks and upsides from policy, commodity, demand and supply changes.

Our **contracts valuation engine** lets you price and analyse Power Purchase Agreements, fully consistent with Aurora's view of the market.

Our **asset-level tools** quantify the value of your assets or sites under different configurations and market scenarios.

With Origin: use your own scenarios in your valuations

With each other: value co-located assets and portfolios

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Future datacentres will pose unique challenges to the power grid, given their increasing power density, point-source nature and tendency to cluster

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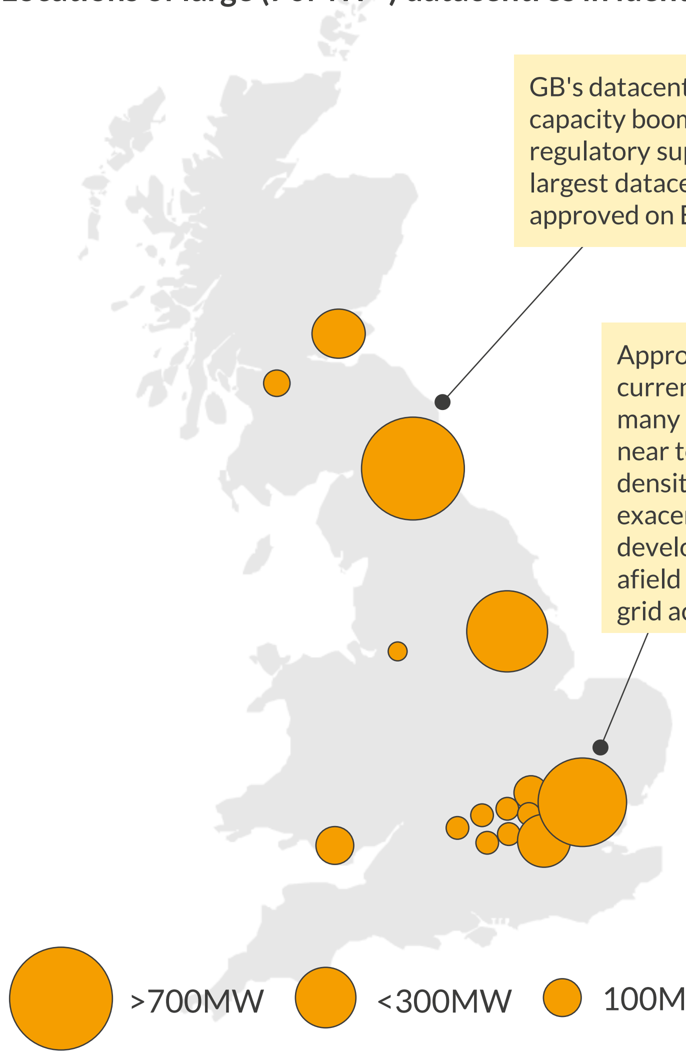
Locations of large (70MW+) datacentres in identified pipeline[1]



GB's datacentre industry has seen a planned capacity boom given recent turning tide of regulatory support[2] and news of some of the largest datacentre capacities in Europe being approved on English soil in 2025.

Approximately 80% of datacentres are currently clustered in Greater London with many new assets still seeking grid connections near to these existing hubs. Increasing power density of newer GPU chips further exacerbates the clustering effect. New developments are increasingly moving further afield however, seeking prospects of faster grid access.

A hyperscale[3] 100MW datacentre connecting to one substation is equivalent to the demand of:

35 shopping malls the size of Westfield London

260,000 households
- This is approximately 1.2% of total households today or equal to the number of houses in Sheffield

Between 250,000 – 300,000 electric cars[4]
- This is approximately 16 - 20% of total EVs on roads today

40% of current electric arc furnace production capacity in the UK
- The UK has 4 operational electric arc furnaces which can produce 3 million tonnes of steel per year

~3 electrolysers, or ~11% of all electrolyser projects supported under HAR1 and HAR2 subsidy rounds

1) Non-exhaustive list of projects compiled through various sources, for illustration only. Includes prospective assets without confirmed planning permission. 2) For example, Critical National Infrastructure designation and AI growth zones. 3) Typically refers to a datacentre greater than 40MW in IT capacity. 4) EV consumption based on bottom-up estimate of annual demand per EV and number of EVs registered as of March 2025.

Sources: Aurora Energy Research, IJGlobal, DCByte, Cushman and Wakefield, news articles, Eurofer, DESNZ, ONS

Datacentre demand is projected to grow by nearly 200% in the next decade, which could make up 11% of GB power demand in 2035

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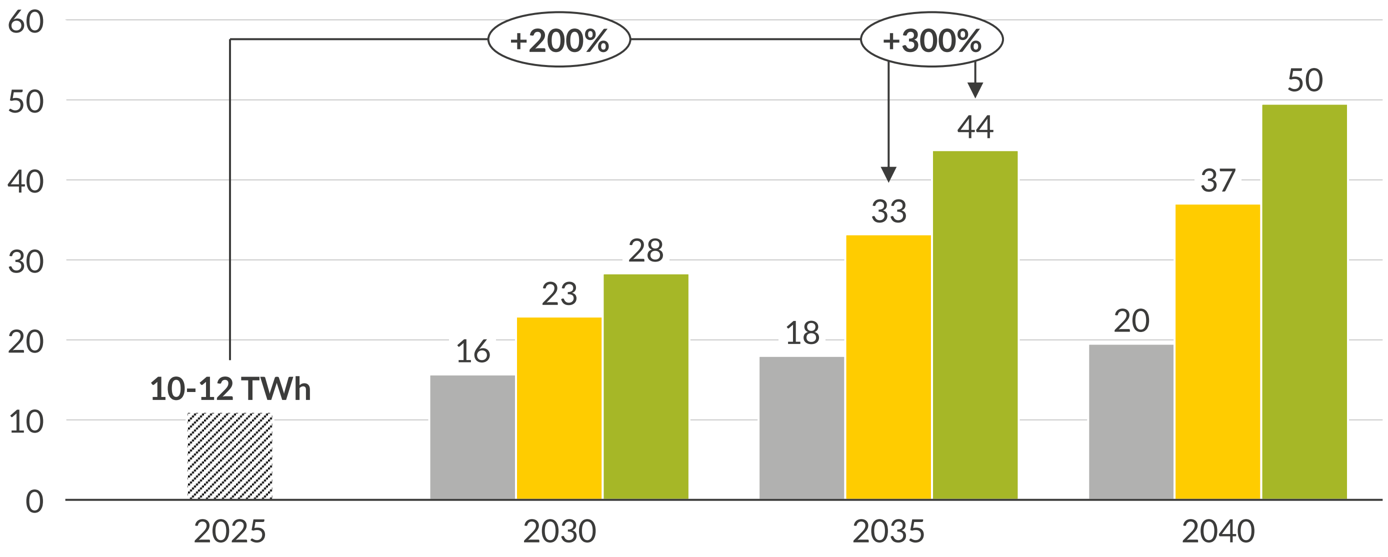
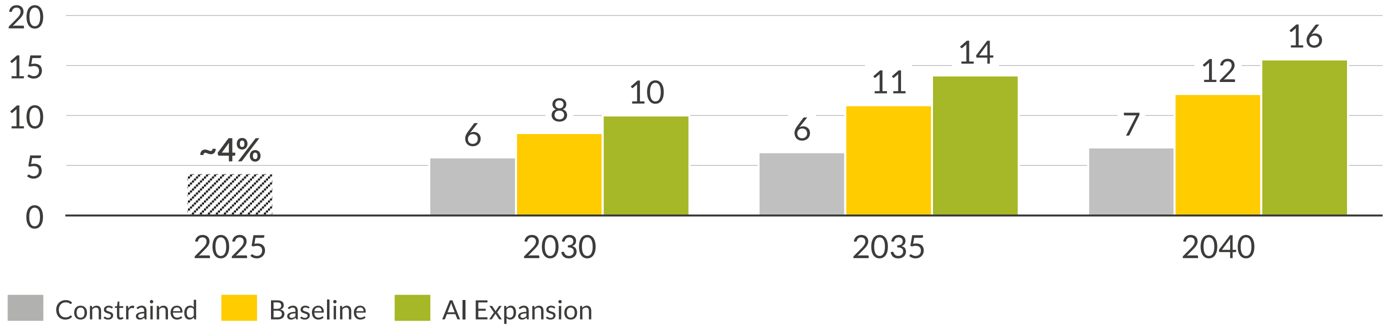
Datacentre power demand in GB[1]

TWh



Percentage of total GB power demand, %



Aurora's Baseline scenario reflects a trajectory of data centre growth in line with 2020-2025 capacity growth rates and reflecting a conservative assumption of delivery in the known project pipeline, reaching **4.7GW** of datacentre IT capacity by 2035.

Aurora's AI Expansion scenario assumes strong growth in AI adoption, driving 50% higher rate of AI-focussed hyperscale datacentre capacity growth than the Baseline scenario. This faster deployment assumes regional flexibility of hyperscale, AI-focussed datacentres away from London hubs, accelerating deployment to reach **6.3GW** by 2035.

Aurora's Constrained scenario assumes significant headwinds on pipeline deployment, resulting from grid connection and planning delays as well as slower rates of AI adoption in the mid- to long-term.

1) Aurora's modelling assumes baseload demand profile of datacentres with demand per MW of IT load considering PUE, vacancy rates, operational power draw and idle power draw by type of datacentre (enterprise, colocation, hyperscale cloud/AI).

Source: Aurora Energy Research

Current timing and spatial misalignment between the expansion of datacentres and energy infrastructure highlights the need for coordination

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Network planners, renewable power generators and datacentres must shift from siloed decisions to coordinated strategies to resolve a mismatch in locational build out and timelines of deployment. Increasing data visibility on the demand-side connection queue and demand-side connection availability could facilitate this.

Aggregators, suppliers and large portfolio owners

Balances supply and demand between…

Datacentres

Deployment timeline: **2 - 3 years**[3]

Priorities: Rapid access to power, reliability

Location of deployment: Market-driven, typically clustering around Greater London

Operational loads: Mostly baseload profiles

Contracts power with…

Requests connections from…

Renewable generators

Deployment timelines: **3 - 8 years**

Priorities: Price and revenue certainty

Location of deployment: Resource-driven with high potential in Scotland, increasingly centrally planned

Operational loads: Intermittent and variable, with potential to be supported by storage

Transmission networks

Deployment timelines: **10+ years**

Priorities: Operational stability

Location of deployment: Needs-driven, highly centrally planned

Operational aims: Balancing supply and demand locationally to maintain system frequency/voltage, preventing overloaded lines

- The challenge in coordinating DC growth with low-carbon generation and power infrastructure upgrades stem from:
  - Faster deployment timelines and prioritisation of speed to power above all other factors for DCs, compared to generators/networks
  - Tendency for DCs to cluster given market drivers[1] while locations of generators are being increasingly centrally planned[2]
- Greater data visibility and focus on demand side-connections in strategic planning policy (such as the Strategic Spatial Energy Plan or Regional Spatial Strategies) could pave the way for this coordination.
- The balancing of intermittent renewable generation to service a datacentre's demand profile is another key operational challenge, which could be facilitated by aggregators, suppliers or large portfolio owners.

1) Such as proximity to population centres to achieve low latency. 2) E.g. through the Connections Action Plan and Clean Power 2030 setting zonal deployment targets for renewables. 3) development timeline assume s a 50-100MW DC. Larger compounds will take longer to develop. After construction is complete, datacentres take about 12 months to fully power up their systems and install server racks.

Source: Aurora Energy Research

Collaboration between datacentres, networks, generators and policy could unlock £35bn in low-carbon power investment supporting ~5GW of green DCs

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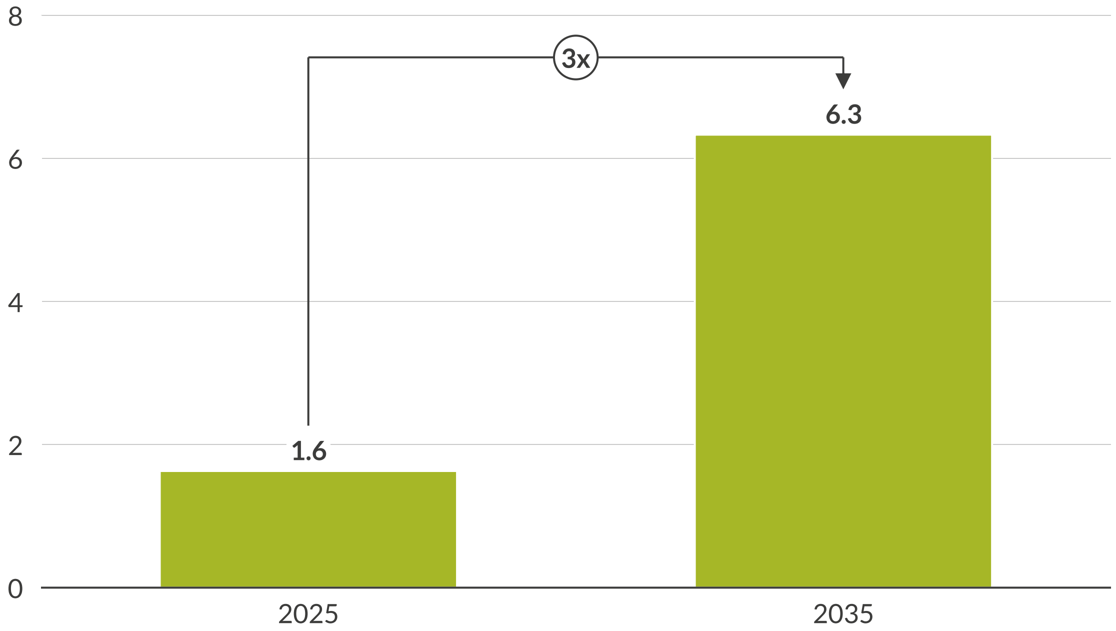
1 **Datacentres are making up an increasing share of total GB power demand which, with high deployment rates, could reach 14% by 2035.**

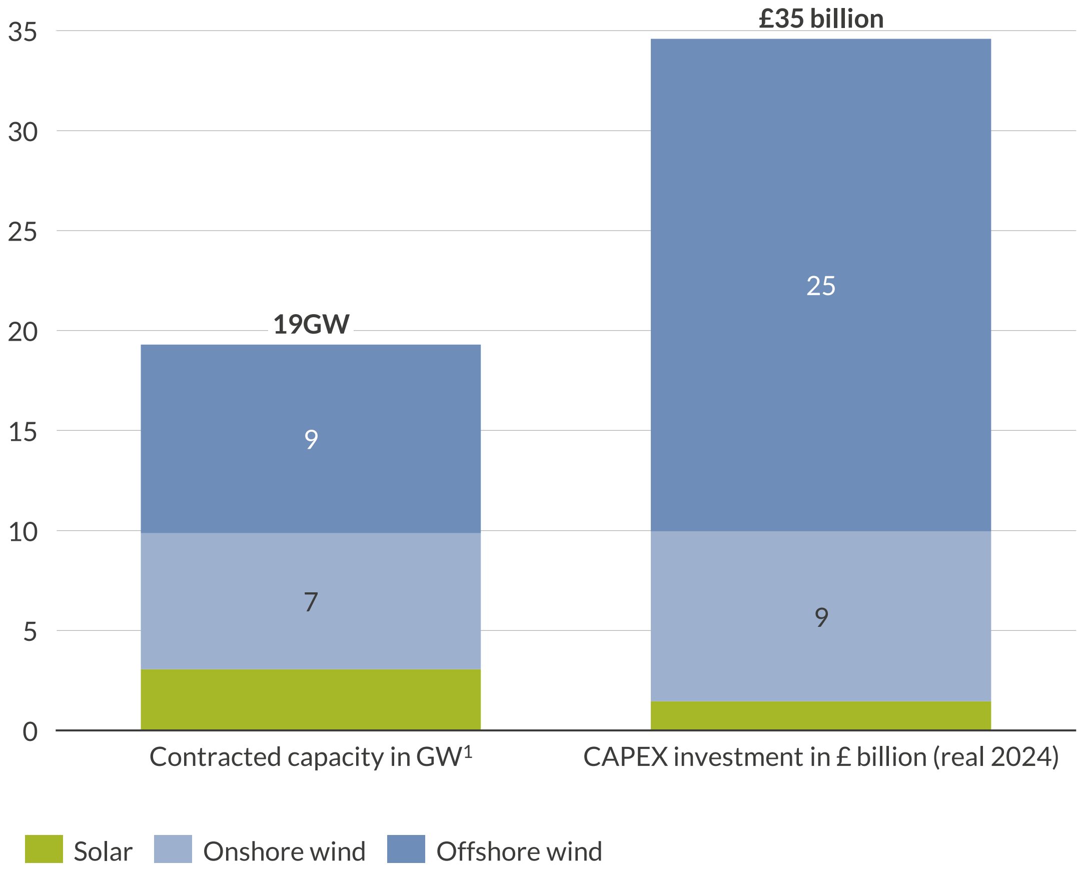
Datacentre IT load capacity in GB, GW



Percentage of total GB power demand, %

2 **DC capacity growth to 2035 could provide a route-to-market for 19GW of variable renewables capacity, totalling up to £35bn in low-carbon investments.**

Capacity and RES CAPEX investment to support green datacentre growth[2]

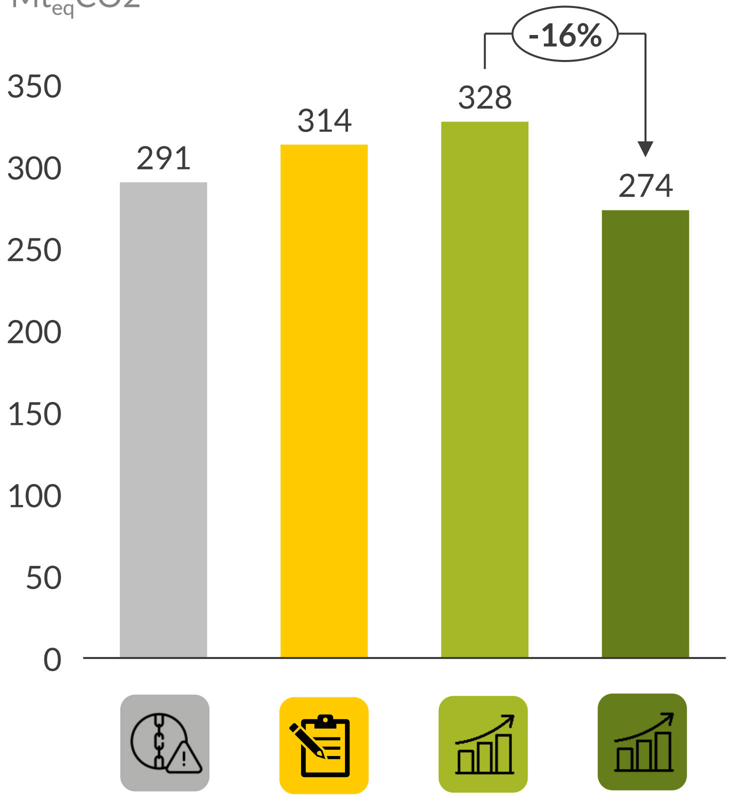


1) Analysis assuming 50% of growth is met by half-hourly time-matched PPAs and 50% by offshore wind REGOs-based virtual PPAs. Based on Aurora's analysis of 95% half-hourly time-matched green power portfolio optimisation, contracting 5.7MW of onshore wind (2.9MW), offshore wind (2.5MW) and solar (1.3MW) per 1MW of baseload demand. Assuming remaining procurement is met through offshore wind, via virtual PPA supported by annual REGOs, based on annual average offshore wind load factor of 40%. 2) This figure excludes CAPEX for datacentre infrastructure and required augmentation of flexible capacity and networks to support high penetration of renewable generation. Source: Aurora Energy Research.

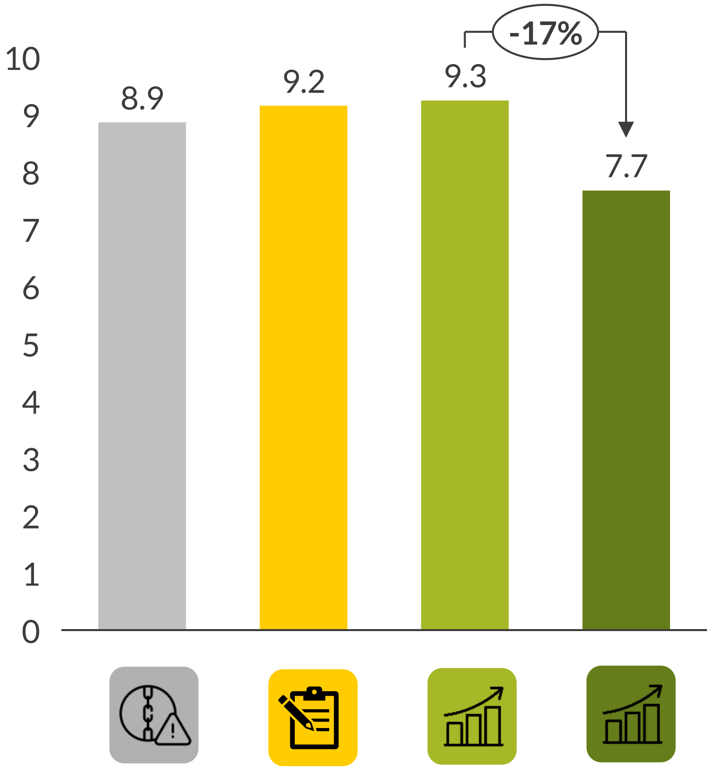
DCs could jeopardise the UK's decarbonisation objectives unless delivery of low carbon technologies and networks is prioritised

The DC industry, generators and policymakers can facilitate a rapid growth of datacentres in GB sustainably while limiting additional constraints to the power system through coordinating DC growth with acceleration of renewables deployment and ensuring delivery of planned network upgrades.

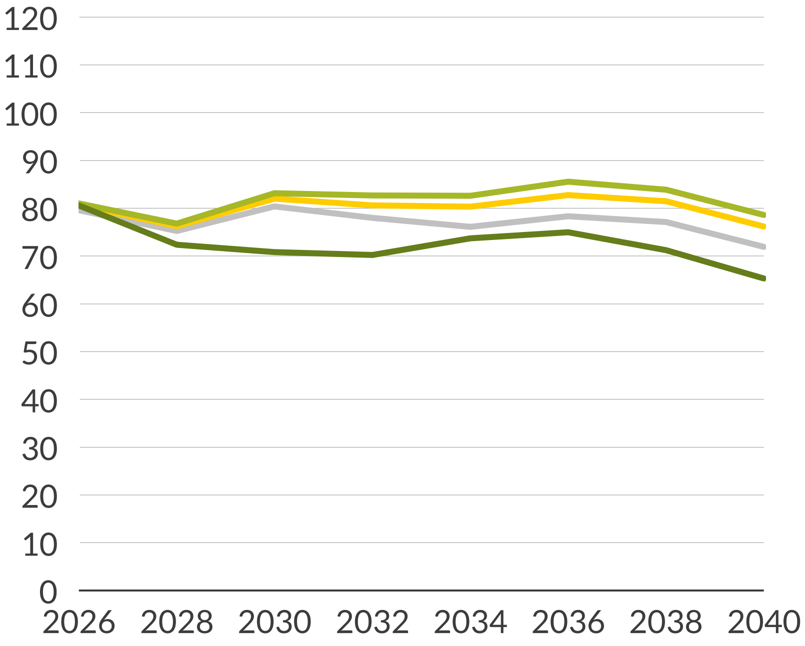
Total 2025-2040 power sector emissions
$Mt_{eq}CO2$



Total 2025-2040 spend on grid constraints[3]
£billion (real 2024)



Wholesale prices
£/MWh (real 2024)



Constrained[1] Baseline[1] AI Expansion[1] AI Expansion - Renewables and Network Acceleration[2]

1) Power system assumptions in line with Aurora's latest Central scenario, including conservative build-out of renewables and partially delayed network delivery relative to Beyond 2030 targets. Detailed assumptions given in full report. 2) Assumes additional variable renewable capacity (onshore wind, offshore wind, solar) than Aurora's Central scenario, meeting 80-87% of Clean Power 2030 deployment targets. Networks build-out assumes full and timely delivery of Beyond 2030 transmission line upgrades.
3) Total system balancing costs net of turn-up and turn down system actions. Source: Aurora Energy Research

Clearer policy support for demand-side connections and facilitating access to low-carbon power are key to supporting sustainable datacentre growth

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NESO Connection Reform

Overview

- GB's **National Energy System Operator (NESO)** is planning a set of policy changes related to grid connections, with the aim of **reducing wait times** for projects to receive a grid connection and **removing 'ghost projects'** from the queue.
- These policies will give connection **priority** to projects that are **further along** in the development process, and have **strategic importance** to the grid/economy.

Measures relevant to datacentres

- **Transmission-connected demand** (such as a large DC) is on the list of technologies deemed to meet the **'strategic alignment' criteria**, allowing it to receive
  - priority in the queue
  - an earlier connection date compared to non designated projects and
  - potential to jump ahead if projects exit the queue.
- **Distribution-connected demand** can also apply for strategic designation if they can show that they **materially reduce constraints**, such as by being **located** behind a boundary constraint (e.g., in Scotland).
- The policy suggests **anticipatory investment in network infrastructure** in strategic demand clusters, meaning users locating here would benefit from faster connection times and **reduced** need for individual demand users to bear the full **cost of network reinforcement works**.

AI Growth Zones

Overview

- Between Dec-24 and Jan-25, the UK government released the **AI Opportunities Action Plan** and opened submissions for expression of interest for **AI Growth Zones.**
- Each designated AI Growth Zone (AI GZ) is required to demonstrate access to **500MW or more** of firm generation capacity by 2030, facilitating the development of AI infrastructure, including datacentres.
- These designated zones benefit from **streamlined planning approvals**, **enhanced grid access**, and **investment incentives** and must provide **sustainability commitments**.

Targeted solutions

- **Problem:** Datacentres face long wait times for grid connections.
  Solution: A core requirement of AI GZs is high-density electricity availability, with guaranteed grid connectivity of at least 100 MW per site, scalable based on demand projections.
- **Problem:** Datacentres face planning objections from local bodies.
  Solution: AI GZs require local councils to provide pre-approved land for datacentre development, reducing bureaucratic delays.
- **Problem:** Datacentres are concerned about their **green credentials** due to their added resource requirements.
  Solution: AI GZs must align with net-zero targets, incorporating energy-efficient cooling, renewable energy procurement, and demand-side flexibility measures.

Sources: Aurora Energy Research, NESO, DESNZ

If datacentres focused growth behind constrained boundaries like Scotland, network balancing costs and wind curtailment could be reduced by 8% and 9%

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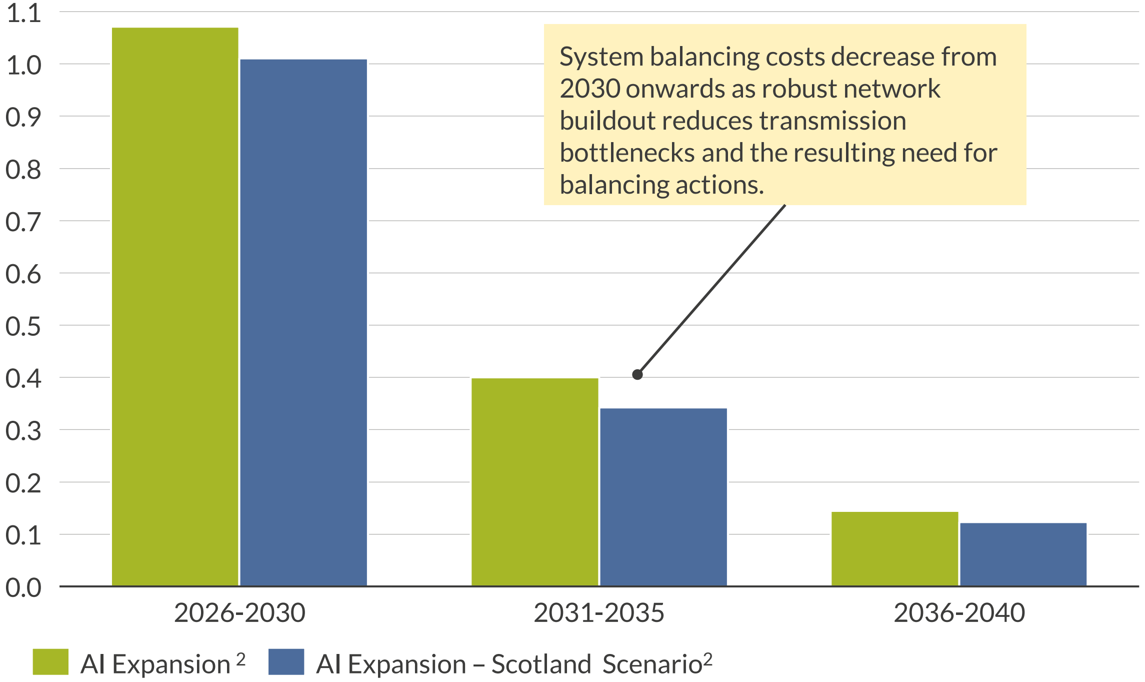
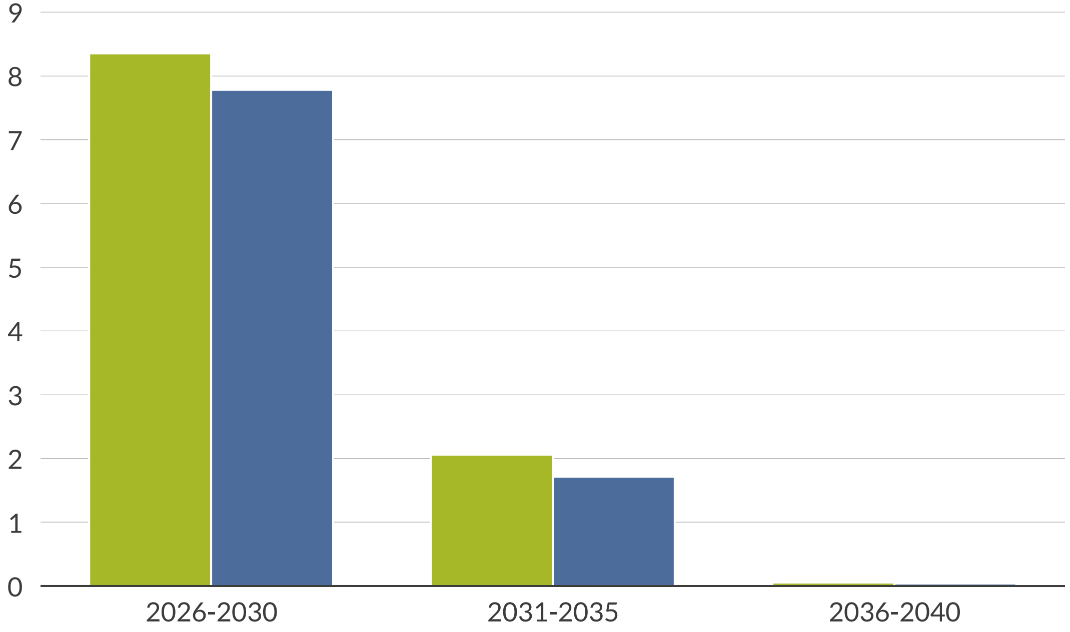
Annual average system balancing costs[1]
bn £/year



Annual average curtailment of offshore and onshore wind in Scotland
TWh/year



- The Scottish AI Expansion sensitivity assumes that a significant portion of datacentre growth is situated in Scotland to take advantage of spare grid capacity and proximity to abundant wind resources. By 2035, 26% of datacentre capacity is assumed to be located in Scotland in this sensitivity. This would require a shift in datacentre siting preferences and infrastructure upgrades for fibre connectivity in Scotland.
- Compared to the AI Expansion scenario which balances growth between the South and the North of England, siting datacentres in Scotland leads to 9% less wind curtailment in Scotland. This is caused by datacentres in Scotland, above constrained transmission boundaries, consuming local wind generation. The same datacentres siting in London would cause additional thermal generation in the South to be turned up during times of transmission constraints.

1) Total system balancing costs net of turn-up and turn down system actions. 2) Power system assumptions in line with Aurora's latest Central scenario, including conservative build-out of renewables and partially delayed network delivery relative to Beyond 2030 targets. Detailed assumptions given in full report.
Source: Aurora Energy Research

Ensuring green datacentre growth would require innovation in power sourcing and flexibility provision, alongside strategic partnerships and siting

Strategies to ensure green datacentre growth and minimise system impacts	Who drives the change?	Details
Facilitating cross-sector partnerships	🟠 ⚪ ⚪ 🟢	▪ Consolidation of **development timelines and siting priorities** through cross-sector partnerships could enable integrated energy parks or PPA-supported generation capacity in tandem with DC deployment.
Developing heuristics for strategic demand siting	🟠 🔴 🔵 ⚪	▪ **DC's willingness and ability to trade off some conditions** like lower latency against faster grid could allow planners to accommodate faster deployment through **strategic planning policy.**
Offering datacentre flexibility through use of onsite assets	🟠 🔴 🔵 🟢	▪ Network operators can provide **financial or grid-connection benefits to DCs** which utilise their back-up generators or dedicated on-site generation/storage for **peak-load reduction to improve grid stability.**
Phasing in connections with 'bridging' generation	🟠 🔴 🔵 🟢	▪ DCs **'bringing their own' firm (gas) generation** for grid-bridging can defer grid investments while facilitating rapid access to power, but a **decarbonisation plan** is necessary.
Supporting innovations in PPA structures	⚪ 🔴 ⚪ 🟢	▪ Time-matched green certificates provides DCs and generators access to 24/7 green PPAs[1] but requires **generators, aggregators and suppliers** to enhance their service offerings.

🟠 Datacentres (DCs) 🔴 Policy makers 🔵 Networks 🟢 Generators

1) PPAs: Power Purchase Agreements.

Source: Aurora Energy Research

Datacentres can employ a variety of power sourcing strategies to minimise power costs, with trade-offs in deployment speed and carbon intensity

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DCs face trade-offs in their power sourcing strategies, with increasing need to balance reliability, speed-to-power and greenness of power. Generators offering low-carbon power solutions face challenges in balancing intermittent generation to a DC's typically baseload and seasonal demand, with increasing variability as AI use cases evolve.

Power sourcing strategy	Renewables-only virtual PPAs[2] with grid connection	Renewables and battery hybrid PPA with grid connection	Behind-the-meter low-carbon baseload (biomass)	Behind-the-meter gas engines Natural / Biogas
Description	▪ The DC enters a financial contract with RES generators to purchase certificates (REGOs) for green generation, while the DC connects to the grid and power is delivered through a utility supplier.	▪ RES generation is supported by a battery onsite to the datacentre or hybridised to the RES. The DC still connects to the grid. ▪ Batteries offer optionality to provide grid services and can discharge stored energy to reduce risks of RES meeting a DC's baseload profile.	▪ The DC sites onsite to a low-carbon generator (eg, biomass, or partial supply from private wire solar). For behind-the-meter solutions, a grid connection is still required for redundancy and reliability needs but is not the primary power source. ▪ Behind-the-meter solutions offer power cost savings through a reduction in non-wholesale costs.[4]	▪ The DC sites onsite with behind-the-meter gas engines as the primary power source. ▪ In addition to non-wholesale cost savings, natural gas being a relatively cheap fuel offers cheap power but high carbon emissions. ▪ Switching to biogas reduces emissions but at a price premium.
Use Case	▪ Allows for time-matched green power at a modest premium to baseload power. This is reliant on achieving a grid connection and finding an aggregator willing to create time-matched RES PPAs.	▪ Comparative costs with the RES-only PPA while offering greater flexibility in using the BESS asset for load-shifting, power trading or providing grid services in the ancillary markets.	▪ Offers low-carbon power at lower prices than the grid through BtM cost savings. However, availability of capacity for BtM biomass in GB is limited.	▪ Onsite gas generation can offer faster speed to power at comparatively low prices.

1) Relative to retail power costs for a datacentre, assuming provision of 95% time-matched green power. Further details in the Appendices of the full report. 2) Power Purchase Agreement. 3) Renewable Energy Systems. 4) Non-wholesale costs can comprise over 50% of retail power costs for consumers and include policy costs, network charges and supplier charges. These are charged per MWh of energy drawn from the grid.

Source: Aurora Energy Research

Key takeaways: Overcoming datacentre deployment barriers

1 **Datacentres form the physical backbone of the UK's digital economy,** delivering essential services like data storage, web hosting, and cloud computing to the public, businesses, and critical sectors. They are vital to supporting the growth of AI, which has the potential to significantly accelerate innovation and productivity across the economy.

2 **While datacentres have historically clustered around London, they are increasingly looking to site outside of existing hubs for faster access to power.** While datacentres can offer community and economy-wide benefits, grid operators must plan ahead to mitigate impacts of this large, clustered demand growth.

3 **Network planners, renewable power generators and datacentres must shift from siloed decisions to coordinated strategies** to resolve a mismatch in locational build-out and timelines of deployment. Additionally, the balancing of renewable intermittent generation to supply datacentres with green baseload power is a key operational challenge, requiring innovation from key stakeholders including aggregators, suppliers and large portfolio owners.

4 **Clearer policy support for demand-side connections in strategic planning and facilitating access to low-carbon power can pave the way for this coordination** and are key to supporting sustainable datacentre growth from a policy perspective. Policymakers should consider how demand can be further accelerated in the connections queue under the UK's Connections Reform and be supported by faster planning and investment incentives through AI growth zones.

Source: Aurora Energy Research

Key takeaways: Impacts of datacentre growth on the GB power system

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1 **Datacentre demand is projected to grow 3-fold by 2035 and under aggressive build rates could comprise up to 14% of total GB power demand.** This growth is increasingly characterised by 100MW+ units clustered in hubs, requiring the power system to accommodate large point-source demand.

2 **Getting coordination right between datacentres, networks and generators could unlock £35bn in low-carbon power investment while supporting ~5GW of green datacentres.** Otherwise, near-term demand growth will likely be met by ramp-up of gas assets, risking higher sector carbon emissions and higher wholesale prices given a lag between renewables deployment and datacentre lead times.

3 **Regional dispersion of datacentres to the Midlands and North England does not meaningfully exacerbate System Balancing actions.** Nevertheless, network build-out at pace remains the most effective way to reduce system constraints.

4 **For the datacentre industry, siting demand behind constrained boundaries can unlock benefits for the power system.** Under a sensitivity analysis where datacentre build-out focuses in Scotland reaching 26% of installed capacity by 2035, this can reduce wind curtailment by 9% and reduce system balancing costs by 8%.

5 **Zonal pricing could offer datacentres in North Scotland £13/MWh cost savings in power by 2035,** with this savings being robust even in scenarios with additional demand from datacentres drawn to Scotland. However, these savings will likely be muted depending on transitory arrangements under REMA[1] and dissipate in the long-term as planned grid investments are completed.

1) Existing generation assets at risk of lower revenues under zonal pricing may receive grand-fathering arrangements that require additional government subsidies. It is possible but not guaranteed that the cost of these market-stabilising subsidy arrangements would be put on end-consumers.

Source: Aurora Energy Research

Agenda

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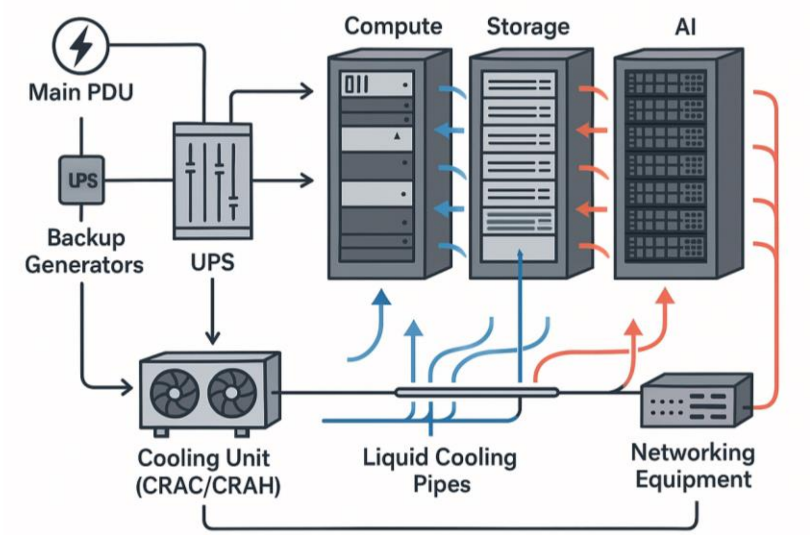
- I. **Key messages summary**
- II. **Current landscape of datacentres in GB**
  1. What are datacentres?
  2. What is driving datacentre growth?
  3. Where are GB's datacentres located?
  4. What are the benefits and risks of further datacentre growth?
- III. **Overcoming datacentre deployment barriers**
  1. The coordination challenge for networks, generators and datacentres
  2. Ongoing policy developments impacting datacentres
  3. Strategies to ensure green datacentre growth
- IV. **Trade-offs in datacentre siting considerations**
- V. **Impacts of datacentre growth on the GB power system**
  1. Datacentre demand trajectories
     - i. Assumptions and sensitivities
  2. Key results
     - i. Impacts on prices and carbon emissions
     - ii. Impacts on system balancing, curtailment and zonal pricing
- VI. **What can GB learn from datacentre growth in other countries?**
  1. Regulatory actions impacting datacentres across the globe
  2. Case studies (Dublin, Virginia, Madrid)
- VII. **Appendices**
  1. Modelling assumptions for the GB power system
  2. Network build-out assumptions
  3. Green power sourcing strategies for datacentres

Datacentres are the backbone of the UK digital economy, providing critical services like data storage, web hosting and cloud computing

Without datacentres, no digital service could exist as they provide the technological infrastructure to support services from video streaming to banking to artificial intelligence and cloud applications. Within the UK, datacentres are designated as **Critical National Infrastructure**[2].

What is a datacentre?

- A datacentre is a **secure building that hosts racks of servers**, providing the **power, cooling, and connectivity** they need to operate.
- These servers deliver three core services: compute (to run applications), storage (to hold data), and AI (to power intelligent tools with GPUs[1]).
- Datacentres provide the **physical infrastructure to support digital services** from video streaming and banking to AI and cloud applications.



Services provided by datacentres

Compute

- Compute servers run the code that powers websites, apps, and cloud services. They handle tasks like processing emails, hosting video calls, or running software.
- Services like Zoom, Gmail, Netflix, and Microsoft 365 all rely on compute infrastructure to deliver fast, seamless digital experiences to users.

Storage

- Storage servers keep data safe and accessible—files, videos, databases, and backups.
- They are used by everything from Google Drive and Dropbox to streaming services and ecommerce sites. This infrastructure is required to for users to access information instantly and reliably.

AI

- AI servers use powerful GPUs[1] (non-standard compute) to train and run machine learning models, powering tools like ChatGPT, social media recommendations, and voice assistants.
- The UK government is actively promoting AI through initiatives like the AI Sector Deal and AI Growth Zones, driving investment in AI infrastructure nationwide.

1) Graphics Processing Units: a type of computer chip. 2) Receiving a CNI designation gives datacentres protections by government against critical incidents such as cyberattacks or outages, given recognition of datacentres' vital importance to the UK economy and national security, boosting datacentres' operational resilience.

Source(s) : Aurora Energy Research

Growth in datacentres is spurred by cloud services, enterprise digitalisation, and generative AI which requires high computational loads

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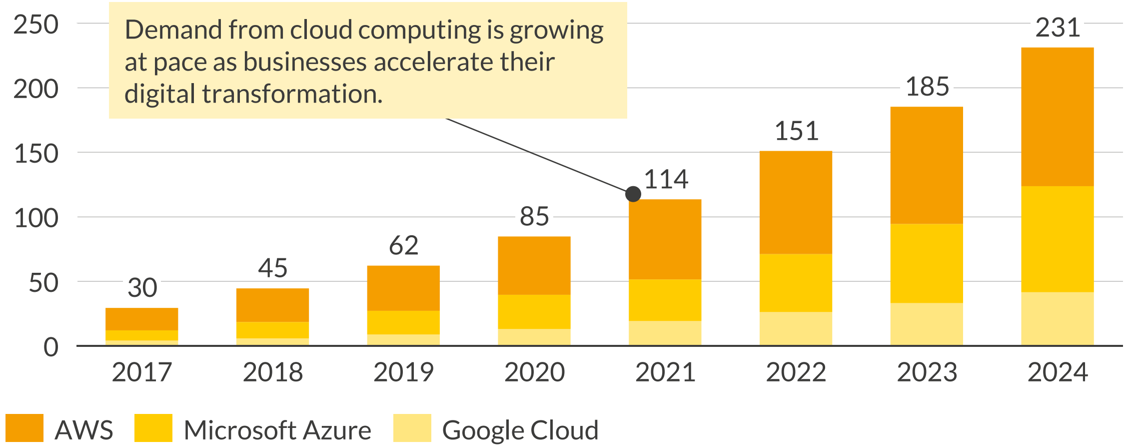
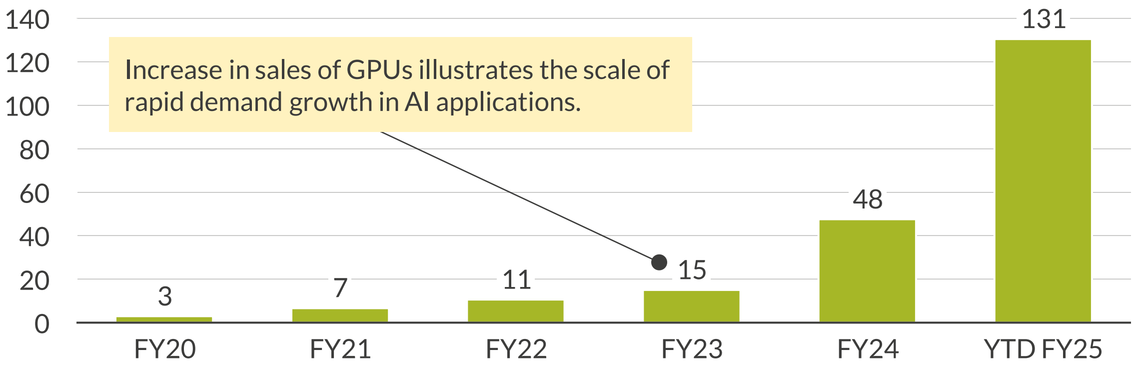
Datacentre use cases	Expected demand growth	Rack density[1] (kW/rack)
AI training and inference Building machine learning models through processing of large datasets	●	50 – 120
Cloud computing and IT services Hosting services such as AWS, Microsoft Azure, Google Cloud	◕	30 – 85
Telecommunications and media Supports 5G infrastructure and telecom networks; stores social media data and supports video streaming	◑	20 – 50
Financial services and banking Supports online banking; hosts stock exchanges and platforms for high-frequency trading	◑	20 – 50
Enterprise data requirements Stores and processes data for companies across healthcare, e-commerce, retail, energy, etc	◑	0.5 – 10

Annual revenue for major Cloud Computing providers
bn $/ year



Annual Revenue - NVIDIA
bn $ / year



1) Compute-related power draw per server rack in a datacentre.

Sources: Aurora Energy Research, NVIDIA, company earnings reports

Future datacentres will pose unique challenges to the power grid, given their increasing power density, point-source nature and tendency to cluster

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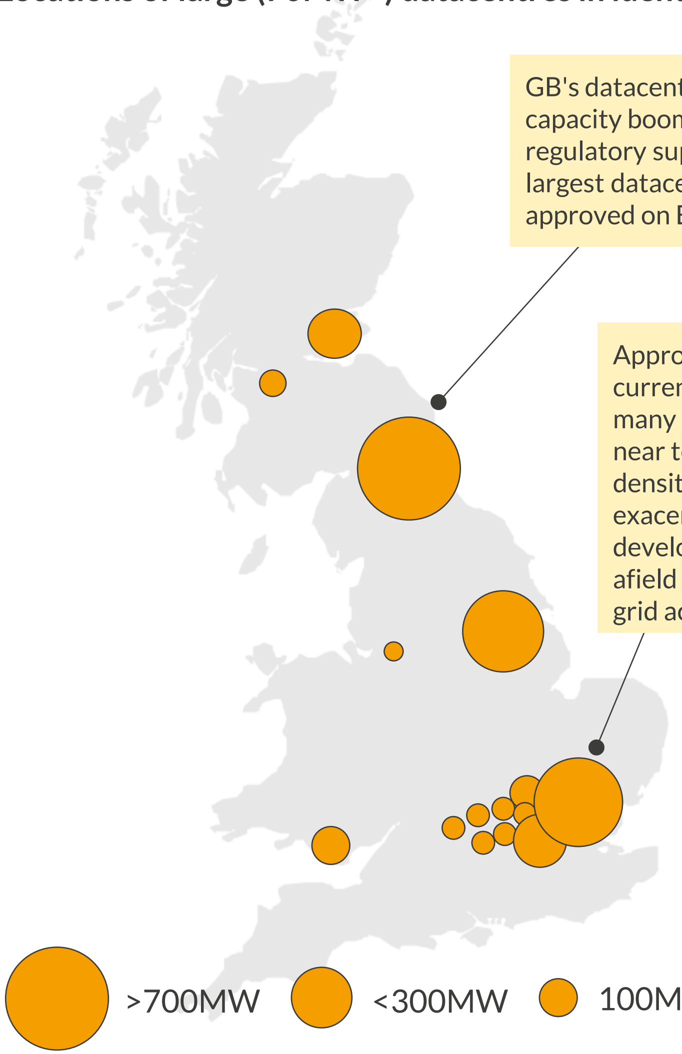
Locations of large (70MW+) datacentres in identified pipeline[1]



GB's datacentre industry has seen a planned capacity boom given recent turning tide of regulatory support[2] and news of some of the largest datacentre capacities in Europe being approved on English soil in 2025.

Approximately 80% of datacentres are currently clustered in Greater London with many new assets still seeking grid connections near to these existing hubs. Increasing power density of newer GPU chips further exacerbates the clustering effect. New developments are increasingly moving further afield however, seeking prospects of faster grid access.

A hyperscale[3] 100MW datacentre connecting to one substation is equivalent to the demand of:

35 shopping malls the size of Westfield London

260,000 households

- This is approximately 1.2% of total households today or equal to the number of houses in Sheffield

250,000 – 300,000 electric cars[4]

- This is approximately 16 - 20% of total EVs on roads today

40% of current electric arc furnace production capacity in the UK

- The UK has 4 operational electric arc furnaces which can produce 3 million tonnes of steel per year

~3 electrolysers, or ~11% of all electrolyser projects supported under HAR1 and HAR2 subsidy rounds

1) Non-exhaustive list of projects compiled through various sources, for illustration only. Includes prospective assets without confirmed planning permission. 2) For example, Critical National Infrastructure designation and AI growth zones. 3) Typically refers to a datacentre greater than 40MW in IT capacity. 4) EV consumption based on bottom-up estimate of annual demand per EV and number of EVs registered as of March 2025.

Source(s): Aurora Energy Research, IJGlobal, DCByte, Cushman and Wakefield, news articles, Eurofer, DESNZ, ONS

London houses the largest datacentre capacity out of Europe's Tier 1 markets, given its skilled workforce and fibre connectivity to Europe and North America

Why London? Key pull factors for datacentres to the GB capital

Global connectivity

London is well-connected as a landing hub for trans-Atlantic fibre connections, ideal for cloud services connecting Europe and America, and houses one of the top 5 global internet exchanges.

A global financial hub

London is home to major financial institutions and the largest stock exchange in Europe, requiring data processing, storage and low-latency connections for trading.

High population density

As the 3rd largest city in Europe with a population of 16 million in Greater London, data needs for telecommunications, internet and streaming services underpin demand.

Better regulatory environment than other European cities

Despite challenges remaining, London still has a less restrictive regulatory environment than other European cities, with the recent turning tide of government support a positive signal.

Why *not* London? Growing challenges to datacentre growth in the South

Lack of grid connections and power availability

40GW+ of demand demand sits in the connections queue as of Dec 24. Delays to substation upgrades like Iver B in West London means connection wait times reach the late 2030's in some cases.

High land price and scarcity

Datacentre construction costs in London have risen by 12% from 2020 to 2023 through a mix of land availability and supply chain challenges, exacerbated by tight competition with housing.

Competition in planning

Datacentres fall under the jurisdiction of local planning authorities with datacentres in London competing directly with all demand (retail, housing, etc).

Public opposition

Public opposition to datacentre development on green belt land and concerns around intensive resource use have historically led to planning rejections.

Source(s): Aurora Energy Research, NESO, DCByte

While datacentres can offer community and economy-wide benefits, the grid needs to mitigate impacts of their large, clustered demand

Benefits to the public and data users	Risks to the power grid
Driving growth in the digital economy Datacentres act as the physical backbone of unlocking digital services and transformation across the economy, underpinning the large potential for AI and cloud computing applications.	**Distribution-level overloads** Local grids face increasing strain in terms of both higher power draw (as DCs get more power dense) and datacentre's largely baseload demand pattern, increasing risk of failures near datacentre clusters.
Supporting data sovereignty and high-value industries By hosting sensitive within the UK, datacentres strengthen national cyber resilience while supporting key strategic sectors like finance, research, defense, and healthcare.	**Grid reinforcement costs** Required network upgrades (transformers, substations, cabling) drive up infrastructure spend, where cost allocation of network upgrades due to datacentres to grid users and the public[1] must be mitigated for.
Transforming deindustrialised sites Datacentres repurposing brownfield sites or siting in deindustrialized communities create new skilled jobs in construction and operation, contributing to regional regeneration.	**Voltage/frequency instability** Large datacentre loads switching to backup power sources in response to grid faults can cause additional operating issues, requiring additional ancillary services to maintain system frequency and voltage.
Providing community heating Waste heat from datacentres can be captured and reused through district heating schemes, providing affordable, low-carbon heating to housing, public facilities, commercial spaces or greenhouses.	**Power competition & delays** Crowding connections in constrained areas may have exacerbated competition with other developments like housing; new datacentre projects risk multi-year wait times (e.g. in West London).

1) Current charging arrangements mean that grid reinforcement expenditure by transmission network operators is recouped through energy bills.

Sources: Aurora Energy Research

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Current timing and spatial misalignment between the expansion of datacentres and energy infrastructure highlights the need for coordination

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Network planners, renewable power generators and datacentres must shift from siloed decisions to coordinated strategies to resolve a mismatch in locational build out and timelines of deployment. Increasing data visibility on the demand-side connection queue and demand-side connection availability could facilitate this.

Aggregators, suppliers and large portfolio owners

Balances supply and demand between…

Datacentres

Deployment timeline: **2 - 3 years**

Priorities: Rapid access to power, reliability

Location of deployment: Market-driven, typically clustering around Greater London

Operational loads: Mostly baseload profiles

Contracts power with…

Requests connections from…

Renewable generators

Deployment timelines: **3 - 8 years**

Priorities: Price and revenue certainty

Location of deployment: Resource-driven with high potential in Scotland, increasingly centrally planned

Operational loads: Intermittent and variable, with potential to be supported by storage

Transmission networks

Deployment timelines: **10+ years**

Priorities: Operational stability

Location of deployment: Needs-driven, highly centrally planned

Operational aims: Balancing supply and demand locationally to maintain system frequency/voltage, preventing overloaded lines

- The challenge in coordinating DC growth with low-carbon generation and power infrastructure upgrades stem from:
  - Faster deployment timelines and prioritisation of speed to power above all other factors for DCs, compared to generators/networks
  - Tendency for DCs to cluster given market drivers[1] while locations of generators are being increasingly centrally planned[2]
- Greater data visibility and focus on demand side-connections in strategic planning policy (such as the Strategic Spatial Energy Plan or Regional Spatial Strategies) could pave the way for this coordination.
- The balancing of intermittent renewable generation to service a datacentre's baseload profile is another key operational challenge, which could be facilitated by aggregators, suppliers or large portfolio owners.

1) Such as proximity to population centres to achieve low latency. 2) E.g. through the Connections Action Plan and Clean Power 2030 setting zonal deployment targets for renewables.

Sources: Aurora Energy Research

Strategic coordination across datacentres, networks, and the system operator will require clear policy direction

The following are examples of how a coordinated regulatory approach from policymakers can support datacenter growth and in turn GB's digital economy:

Whole system coordination

Coordinating policies to define growth zones across industries

- AI Growth Zones and similar policy mechanisms should be used to **coordinate power networks, planning, grid connections** and other enabling infrastructure to unlock datacentre deployment.
- These policies should establish opportunity zones that both support local growth and work clearly with **datacenter siting criteria.**

Power system coordination

Greater integration of datacentres in the Strategic Spatial Energy Plans

- **Clear dialogue** between NESO, datacentres and network providers is needed to manage forthcoming datacentre demand, incorporating it into **connection reform** and helping **accelerate connections for demand.**

Datacentre integration into a low-carbon grid

- Datacentres and NESO should look to explore **how flexibility can be delivered** in a planned and managed way which fits with the **datacentre business model**, as well as **power system needs**.

Connections coordination

Improving data visibility for connection availability

- NESO and networks should work together to enhance **the availability of grid access data for demand-side** projects.

Sources: Aurora Energy Research, NESO, DESNZ

While challenges remain, the AI Opportunities Action Plan and overruling of rejected planning applications signals a changing tide of government support

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The Labour government has acted on its pledge to support datacentre growth given the expected benefits of AI growth for the economy. However, with the backdrop of Clean Power 2030, there is a key question of whether the UK's power system can support growing datacentre power needs.

Q4 2024

Critical National Infrastructure

- The government designated datacentres as Critical National Infrastructure, alongside energy and water systems.
- This designation allows the government to support the sector in the event of critical incidents.

Overruling of datacentre planning rejection

- An application for a 100MW datacentre in Iver, Buckinghamshire, previously rejected on the basis of protecting the green belt, has been overruled by the Secretary of Housing and Planning citing economic benefits and lack of available alternative sites.

National Planning Policy Framework

- The NPPF in its current form requires planning policies to facilitate the development of datacentres.
- As part of its proposed reform of the NPPF, the Government is minded to allow datacentres to request consent under the NSIP regime.[3.]

Clean Power 2030

- The government has announced a target for a 'Clean Power[2]' system by 2030. A datacentre connecting to a Clean Power grid would have direct access to 24/7 'green' power, however Aurora believes this is unlikely to be achieved under current policies.

Q1 2025

Expected policy developments

1 AI Growth Zones (AIGZs)

- The government aims to establish 'AI Growth Zones' (AIGZ), areas with enhanced access to power and support for datacentre planning approvals, with the first AIGZ located in Culham in strategic proximity to the UK Atomic Energy Authority.
- In April 2025, the government has set out a process to identify further AIGZs and explore how these zones can support regional growth opportunities; it will also consider energy requirements, working with NESO.

2 Connections reform (TMO4+)

- NESO is planning to reduce connection wait times by prioritising mature projects and removing "ghost projects" from the 700GW+ connections queue.
- Transmission-connected demand like large DC may receive preferential treatment in the form of queue priority and the potential to jump ahead.

1) Department for Science, Innovation and Technology; 2) Clean Power refers to an electricity sector where at least 95% generation comes from low carbon sources, and up to 5% comes from natural gas

Source(s): Aurora Energy Research, DESNZ

Clearer policy support for demand-side connections and facilitating access to low-carbon power are key to supporting sustainable datacentre growth

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1 AI Growth Zones

Overview

- Between Dec-24 and Jan-25, the UK government released the **AI Opportunities Action Plan** and opened submissions for expression of interest for **AI Growth Zones.**
- Each designated AI Growth Zone (AI GZ) is expected to receive support to rapidly scale energy capacity to **500MW or more**, facilitating the development of AI infrastructure, including datacentres.
- These designated zones benefit from **streamlined planning approvals**, **enhanced grid access**, and **investment incentives** and must provide **sustainability commitments**.

Targeted solutions

- **Problem:** Datacentres face long wait times for grid connections.
  Solution: A core requirement of AI GZs is high-density electricity availability, with guaranteed grid connectivity of at least 100 MW per site, scalable based on demand projections.
- **Problem:** Datacentres face planning objections from local bodies.
  Solution: AI GZs require local councils to provide pre-approved land for datacentre development, reducing bureaucratic delays.
- **Problem:** Datacentres are concerned about their **green credentials** due to their added resource requirements.
  Solution: AI GZs must align with net-zero targets, incorporating energy-efficient cooling, renewable energy procurement, and demand-side flexibility measures.

2 NESO Connection Reform

Overview

- GB's **National Energy System Operator (NESO)** is planning a set of policy changes related to grid connections, with the aim of **reducing wait times** for projects to receive a grid connection and **removing 'ghost projects'** from the queue.
- These policies will give connection **priority** to projects that are **further along** in the development process and have **strategic importance** to the grid/economy.

Measures relevant to datacentres

- **Transmission-connected demand** (such as a large DC) is on the list of technologies deemed to meet the **'strategic alignment' criteria**, allowing it to receive
  - priority in the queue
  - an earlier connection date compared to non designated projects and
  - potential to jump ahead if projects exit the queue.
- **Distribution-connected demand** can also apply for strategic designation if they can show that they **materially reduce constraints**, such as by being **located** behind a boundary constraint (e.g., in Scotland).
- The policy suggests **anticipatory investment in network infrastructure** in strategic demand clusters, meaning users locating here would benefit from faster connection times and **reduced** need for individual demand users to bear the full **cost of network reinforcement works**.

Sources: Aurora Energy Research, NESO, DESNZ

Ensuring green datacentre growth would require innovation in power sourcing and flexibility provision, alongside strategic partnerships and siting

Strategies to ensure green datacentre growth and minimise system impacts	Who drives the change?	Details
Facilitating cross-sector partnerships		▪ DCs, generators and independent connections providers should proactively seek partnerships to co-develop integrated energy parks or bringing online PPA-supported generating capacity. ▪ This could provide access to lower cost financing for both parties through offtake certainty but would mean more complicated governance and consolidation of differing development timelines across datacentres and generators.
Developing heuristics for strategic demand siting		▪ Planners could outline heuristics where DCs can strategically deploy at pace. This could include siting behind transmission constrained boundaries, closer to renewable resources or expedited planning for DCs repurposing brownfield/decommissioned industrial connections. ▪ DCs would need to assess their capability to trade-off sub-optimal conditions like lower network latency against faster grid access.
Offering datacentre flexibility through use of onsite assets		▪ DCs utilising their back-up generators more liberally or deploying dedicated BESS or gas engines can offer peak-load reduction to the grid, unlocking business models which both deliver datacentre flexibility while participating in energy markets or grid services. ▪ Clearer financial incentives or speed-to-grid benefits for DCs on the condition they can provide load flexibility could be explored by network operators to incentivise this shift.
Phasing in connections with 'bridging' generation		▪ DCs phasing capacity in stages, or 'bringing their own' firm generation for grid-bridging can defer grid reinforcements while deploying capacity. A DC's gas-fired baseload generation must have a decarbonisation strategy to avoid the policy risk of stranded gas assets.
Supporting innovations in PPA structures		▪ Time-matched green certificates from suppliers or through REGO[4] reform provides means for DCs and generators to access 24/7 green PPAs[5]. Suppliers or owners of large portfolios would need to upskill in time-matched green generation accounting to offer this to the DC industry.

Datacentres (DCs) Policy makers Networks Generators

1) BESS = Battery Energy Storage Systems. 2) Capacity Market. 3) Behind-the-Meter. 4) Renewable Energy Guarantees of Origin. 5) Power Purchase Agreements.

Sources: Aurora Energy Research

Key takeaways

1 **Datacentres form the physical backbone of the UK's digital economy,** delivering essential services like data storage, web hosting, and cloud computing to the public, businesses, and critical sectors. They are vital to supporting the growth of AI, which has the potential to significantly accelerate innovation and productivity across the economy.

2 **While datacentres have historically clustered around London, they are increasingly looking to site outside of existing hubs for faster access to power.** While datacentres can offer community and economy-wide benefits, grid operators must plan ahead to mitigate impacts of this large, clustered demand growth.

3 **Network planners, renewable power generators and datacentres must shift from siloed decisions to coordinated strategies** to resolve a mismatch in locational build-out and timelines of deployment. Additionally, the balancing of renewable intermittent generation to supply datacentres with green baseload power is a key operational challenge, requiring innovation from key stakeholders including aggregators, suppliers and large portfolio owners.

4 **Clearer policy support for demand-side connections in strategic planning and facilitating access to low-carbon power can pave the way for this coordination** and are key to supporting sustainable datacentre growth from a policy perspective. Policymakers should consider how demand can be further accelerated in the connections queue under the UK's Connections Reform and be supported by faster planning and investment incentives through AI growth zones.

Source: Aurora Energy Research

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Datacentres are increasingly prioritising deployment speed over latency and proximity to users, though priorities vary by type of datacentre

Type of datacentre	Growth potential	Datacentre priorities						
		Speed to grid connection	*Significant land availability*	*Low latency*[1]	*Proximity to users*	*Access to green power*	*Access to skilled workforce*	*Cooling requirement*
		DC development timelines are 3 to 6 years, while grid connection wait times for demand can be up to 10 years, making connection availability a priority.	DCs need a large tract of land, ranging from 10 to 30 acres for smaller cloud or AI inference DCs to several hundred acres for hyperscalers or AI training DCs.	DCs servicing real-time applications require the lowest latency and prefer being close to fibre landing stations.	Proximity to its user base leads to lower latency and higher uptake of its services.	Access to green power is a priority for hyperscalers enabling them to meet their sustainability goals.	DC development requires a workforce with specific engineering skills relating to construction, cooling, IT etc.	AI datacentres have higher cooling requirements – making locations with lower ambient temperatures more important.
Hyperscale Cloud	Medium	🟢	🟢	🟢	🟢	🟢	🟡	🔴
Hyperscale AI compute or training	High	🟢	🟢	🟡	🟡	🟢	🟡	🟢
Edge AI inference	High	🟢	🔴	🟡	🟢	🔴	🟡	🟢
Retail Colocation or Enterprise	Medium	🟡	🔴	🟢	🟢	🔴	🟡	🔴

🟢 High priority 🟡 Medium priority 🔴 Low priority

1) Latency is the time it takes for data to pass from one point on a network to another, measured in milliseconds

Sources: Aurora Energy Research, SemiAnalysis, DCByte

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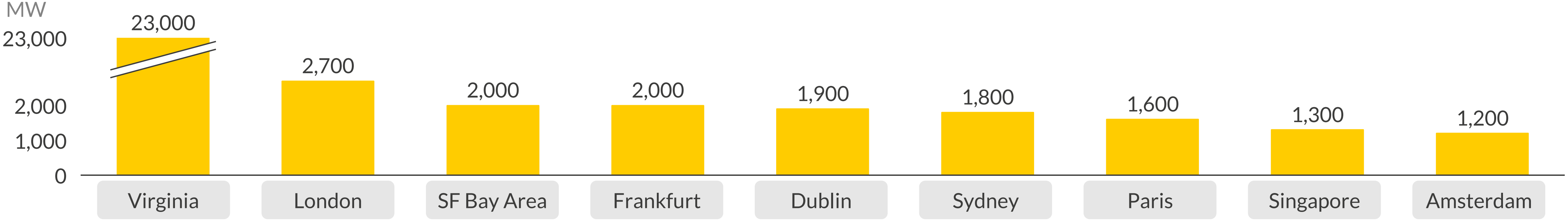
Supportive regulation, robust data demand and good connectivity boosts GB's attractiveness, but is this marred by grid availability and power costs

Market size potential by city (operational, under construction and planned IT capacity)[1]



Driver	Commentary	Virginia[2]	Great Britain[2]	Germany[2]	Ireland[2]	Australia[2]
Regulatory environment	Regulatory certainty, permitting speed and planning policies influence datacenter deployment timelines					
Grid availability & power costs	Constrained networks globally have made grid access the top criterion for datacenter operators					
Land price & availability	Land costs account for around 10% of datacenter CAPEX making it a key driver of location					
Fibre connectivity	Access to high bandwidth, well-connected fibre networks increases site use cases					

Highly attractive   Moderately attractive   Unattractive

Great Britain remains a key growth market for datacenters, supported by strong demand from London's global financial role, **data sovereignty laws**, and a relatively supportive regulatory environment. However, high power costs, grid access issues, and land constraints are pushing some developers toward lower-cost, power-abundant alternatives in Europe (such as the Nordics), where land is cheaper and green energy is more accessible.

1) Capacity as of H2 2024. 2) Reflects metrics for Tier 1 and Tier 2 hubs per country and state (Loudoun in Virginia, London/Manchester/Cardiff in Great Britain, Frankfurt/Berlin/Munich in Germany, Dublin in Ireland, Sydney in Australia).

Source(s): Aurora Energy Research, Cushman and Wakefield

Undersupply and connection challenges in London have spurred development of Tier 2 cities in GB, like Cardiff and Manchester

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Primary priorities

A Speed to Grid

Availability of public data on available demand headroom at TSO/DNO substations is not consistent and therefore hard to quantify across GB. Wherever fast access to a (firm) grid connection can be guaranteed is likely to trump other siting considerations.

B Fibre access

Accessible and robust fibre networks is necessary for ensuring reliability and uptime standards. Fibre networks are privately owned in GB and are most reinforced within and around population centres, being generally more developed in the South of GB than in Scotland.

Secondary priorities

Potential growth hubs

	Location	*Connectivity*[1] *Ping time to London (ms)*	*Population (in millions)*	*Land cost (£/acre, 2024)*	*Solar PV pipeline*[2]	*Onshore Wind pipeline*[2]	*Average summer temperature*[3]
1	Greater London	<1	8.86	£6,000,000	37%	6%	22.8
2	Cardiff	6	0.36	£350,000	20%	10%	21.1
3	Manchester	7	2.83	£1,500,000	23%	26%	19.3
4	Newcastle	6	0.83	£500,000	6%	1%	17.5
5	Edinburgh	10	0.56	£300,000	15%	57%	18.6

1) Datacentre connectivity given by city-to-city ping times according to Wonder Network; AI inference and high frequency trading require <5ms of latency, while cloud gaming, live video and collaboration can operate with 5-15ms latency. Enterprise applications and storage can operate with 15-30ms latency. 2) These percentages are the city's (and surrounding area's) renewable generation pipeline capacity as a proportion of the national renewable generation pipeline capacity per technology. This includes projects applying for connections without approved planning permission; 3) In degrees Celsius. Source(s): Aurora Energy Research; NESO; UK Land Registry; Met Office; WonderNetwork

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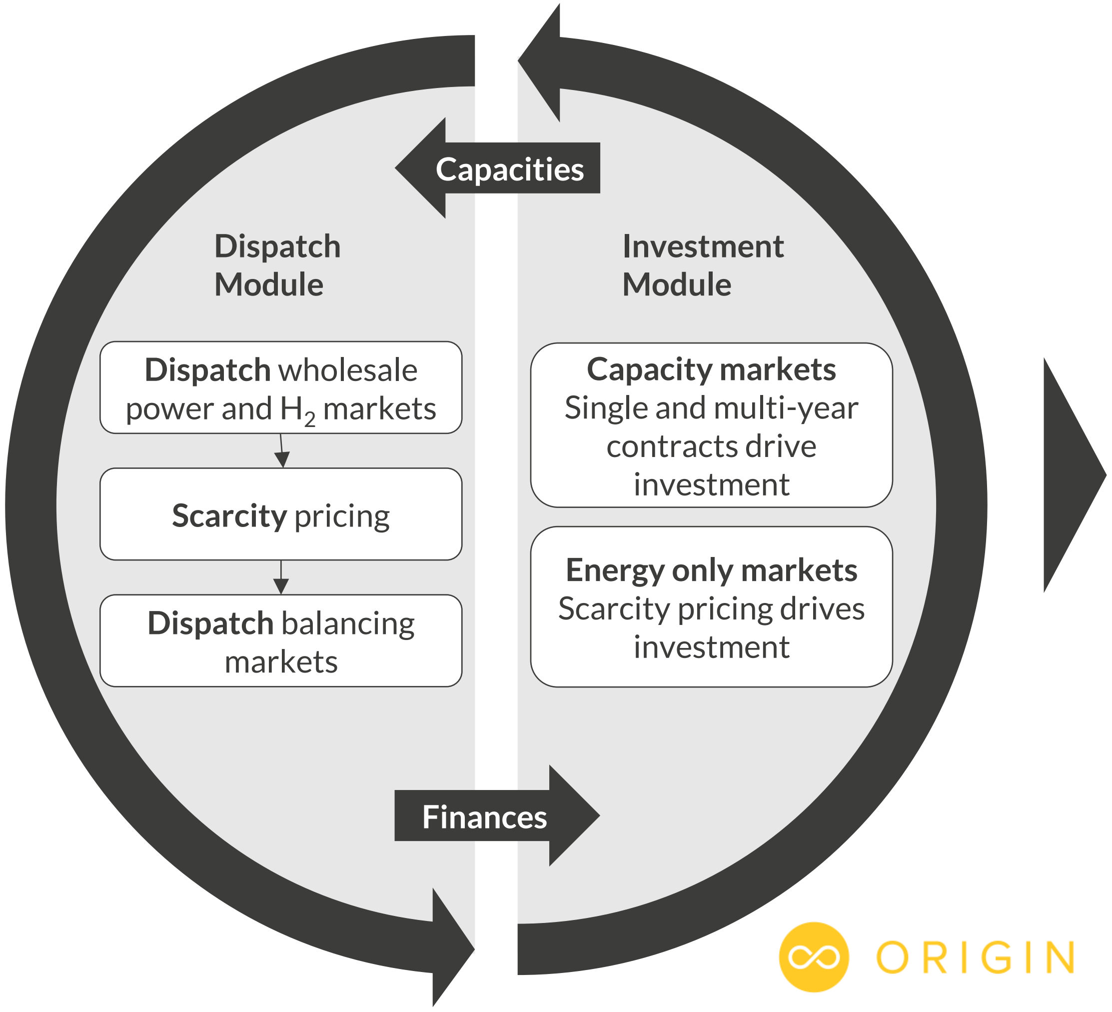
This study uses Aurora’s Origin model to analyse the impact of datacentre demand on the GB power system

INPUTS

- **Supply and I/C** assumptions
- **Demand** outlook
- **Commodities** outlook
- **Weather** patterns
- **Policy** landscape



OUTPUTS

- **System** overview and metrics
- **Capacity** and **generation** mix
- **Wholesale** and **balancing prices**
- **Capacity market** forecasts
- **Capture prices** and **IRRs**

Source: Aurora Energy Research

Datacentre demand is projected to grow by nearly 200% in the next decade, which could make up 11% of GB power demand in 2035

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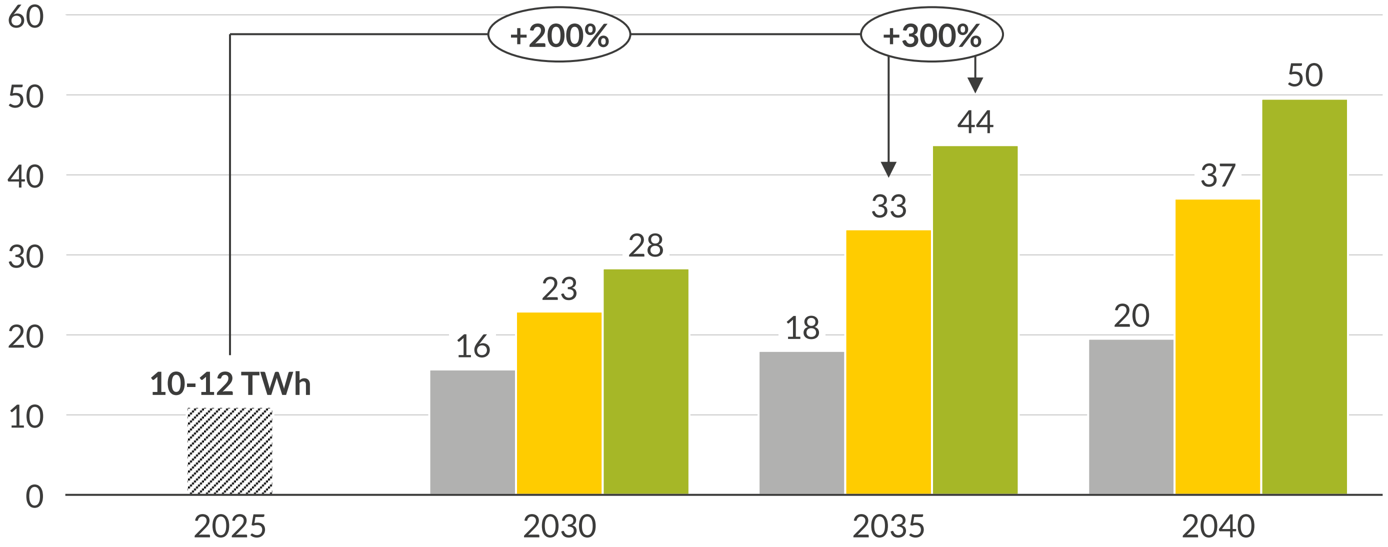
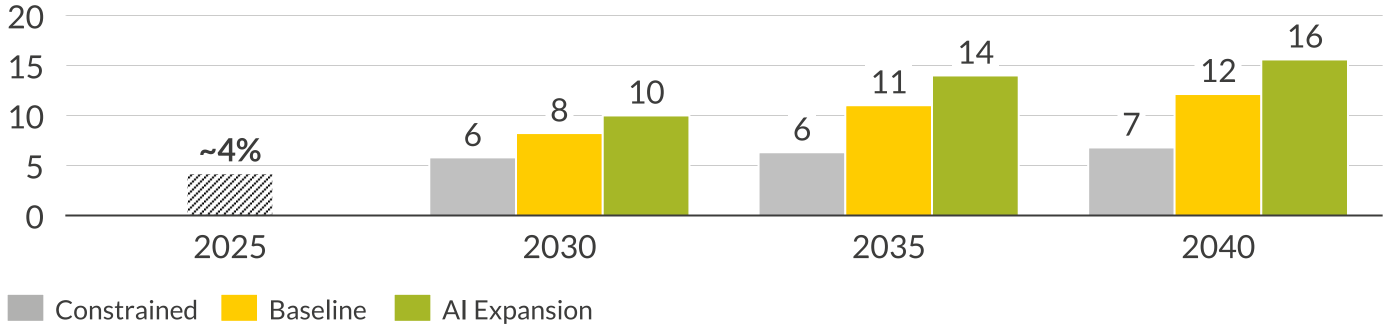
Datacentre power demand in GB[1]

TWh



Percentage of total GB power demand, %



Core scenarios

The Baseline scenario reflects a trajectory of data centre growth in line with 2020-2025 capacity growth rates and reflecting a conservative assumption of delivery in the known project pipeline, reaching **4.7GW** of datacentre IT capacity by 2035.

The AI Expansion scenario assumes strong growth in AI adoption, driving 50% higher rate of AI-focussed hyperscale datacentre capacity growth than the Baseline scenario. This faster deployment assumes regional flexibility of hyperscale, AI-focussed datacentres away from London hubs, accelerating deployment to reach **6.3GW** by 2035.

The Constrained scenario assumes significant headwinds on pipeline deployment, resulting from grid connection and planning delays as well as slower rates of AI adoption in the mid- to long-term.

1) Aurora's modelling assumes baseload demand profile of datacentres with demand per MW of IT load considering PUE, vacancy rates, operational power draw and idle power draw by type of datacentre (enterprise, colocation, hyperscale cloud/AI).

Sources: Aurora Energy Research

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Aurora explores three core DC growth scenarios, with sensitivities on Scottish deployment, additional renewable capacity and networks

Scenarios	Datacentre Capacity by 2035	DC share of demand in 2035	1 Deployed RES capacity by 2035[1]	2 Network build-out scenario[1]	RES share of generation in 2035
Constrained scenario	2.9 GW	6%	Central	Central	79%
Baseline scenario	4.7 GW	11%	Central	Central	77%
AI Expansion scenario	6.3 GW	14%	Central	Central	76%
Renewables and Network Acceleration	6.3 GW	14%	Accelerated	Fully delivered	85%
Renewables Acceleration and Network Delay	6.3 GW	14%	Accelerated	Central	85%
Scotland deployment	6.3 GW	14%	Central	Central	76%

Core scenarios AI Expansion sensitivities

1) See appendix for more information on network buildout assumptions and renewables deployment under Aurora's April 2025 Central scenario.

Sources: Aurora Energy Research, DESNZ, NESO

1 Renewables deployment

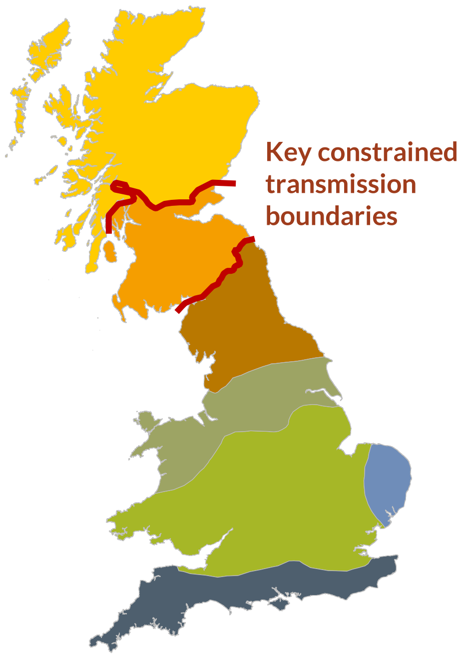
- While Central assumptions are in line with Aurora's April 2025 Central scenario[1], 'Accelerated' assumptions assume rapid but achievable removal of development barriers to RES in addition to large AR7 and AR8 CfD allocation rounds, procuring 80-87% of CP2030's renewable deployment targets by 2030.

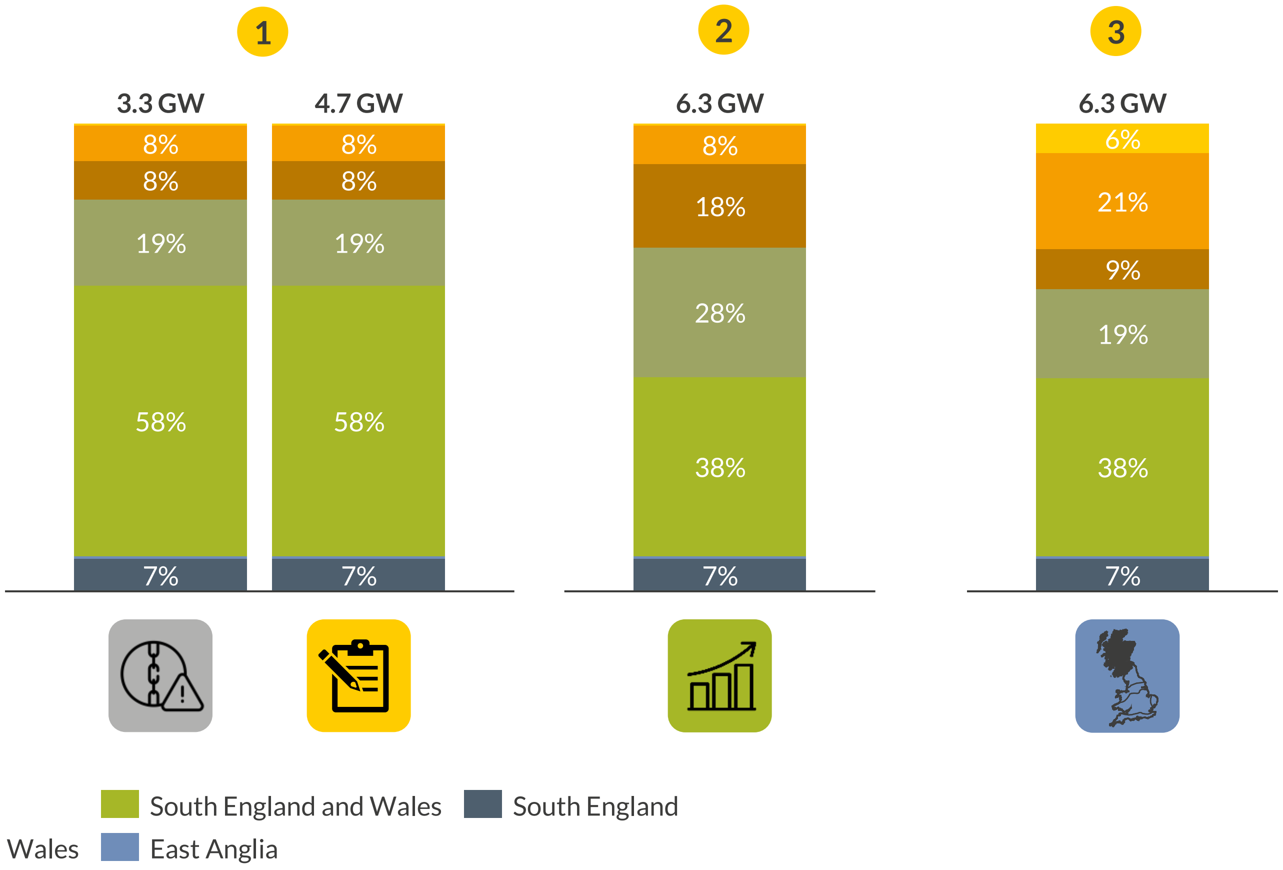
2 Network delivery assumptions

- The Aurora's Central view on network build-out assumes a partial delay to proposed network delivery, reflecting our view on realistic rates of build-out and observed delays. Key transmission lines are delayed by an average of 1.4 years relative to Beyond 2030 plans.
- The 'Fully delivered' network assumption a full and timely delivery of all proposed options from Beyond 2030 plans.

Distribution of datacentre demand across GB varies across scenarios, to illustrate impacts to system constraints

Datacentre demand distribution across GB by 2035 (corresponding datacentre IT load in GW)





1. The constrained and baseline scenarios assume lower overall datacentre deployment. As a result, much of the deployment remains centred around the greater London area in line with existing developer preferences and industry pull factors.
2. The AI Expansion scenario assumes higher overall datacentre growth which cannot all be fully accommodated by the London area. Assuming more flexible location preferences from hyperscalers, this drives demand growth in the North and the Midlands.
3. The Scotland deployment sensitivity assumes that the additional AI growth from AI Expansion accrues largely in South Scotland[1], illustrating potential system benefits.

1) Aurora's assumptions on regional datacentre deployment under the Scotland Expansion sensitivity employs a top-down approach for the purpose of sensitivity analysis rather than a bottom-up assumption based on observed datacentre pipeline in Scotland. We note that significant shift in the datacentre industry's pipeline capacity commitment towards Scotland is required to realise this sensitivity's regional deployment trajectory. Sources: Aurora Energy Research

Agenda

Key results

The following slides summarise the results of our scenario modelling exercise on prices, generation and emissions intensity

In this section, Aurora compares wholesale prices, generation and capacity as well as emissions intensity across the increasing datacentre demand of the three core scenarios and the "Renewables and Networks Acceleration" sensitivity which illustrates the ability of accelerated renewables and networks closer to CP2030 and Beyond 2030 targets to absorb the impacts of additional datacentre demand on the power system.

Key metrics

1. Wholesale prices
2. Generation and capacity
3. Emissions
4. System balancing volumes and costs
5. Curtailment
6. Zonal pricing

Scenarios and sensitivities

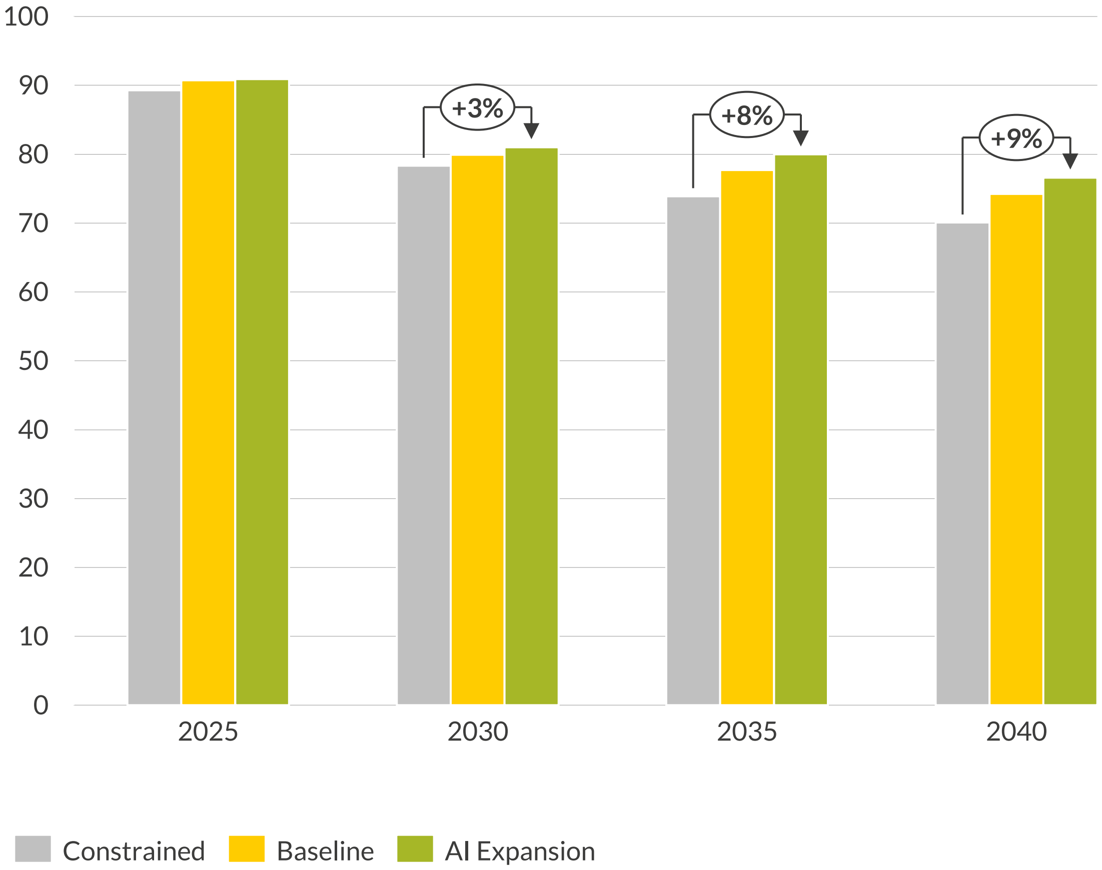
- Constrained scenario
- Baseline scenario
- AI Expansion scenario
- Renewables and Networks acceleration
- Renewables Acceleration and Network Delay
- Scottish deployment

Source: Aurora Energy Research

A lack of dedicated low-carbon power capacity to support datacentre growth means additional demand will likely be met by mostly gas CCGTs or imports

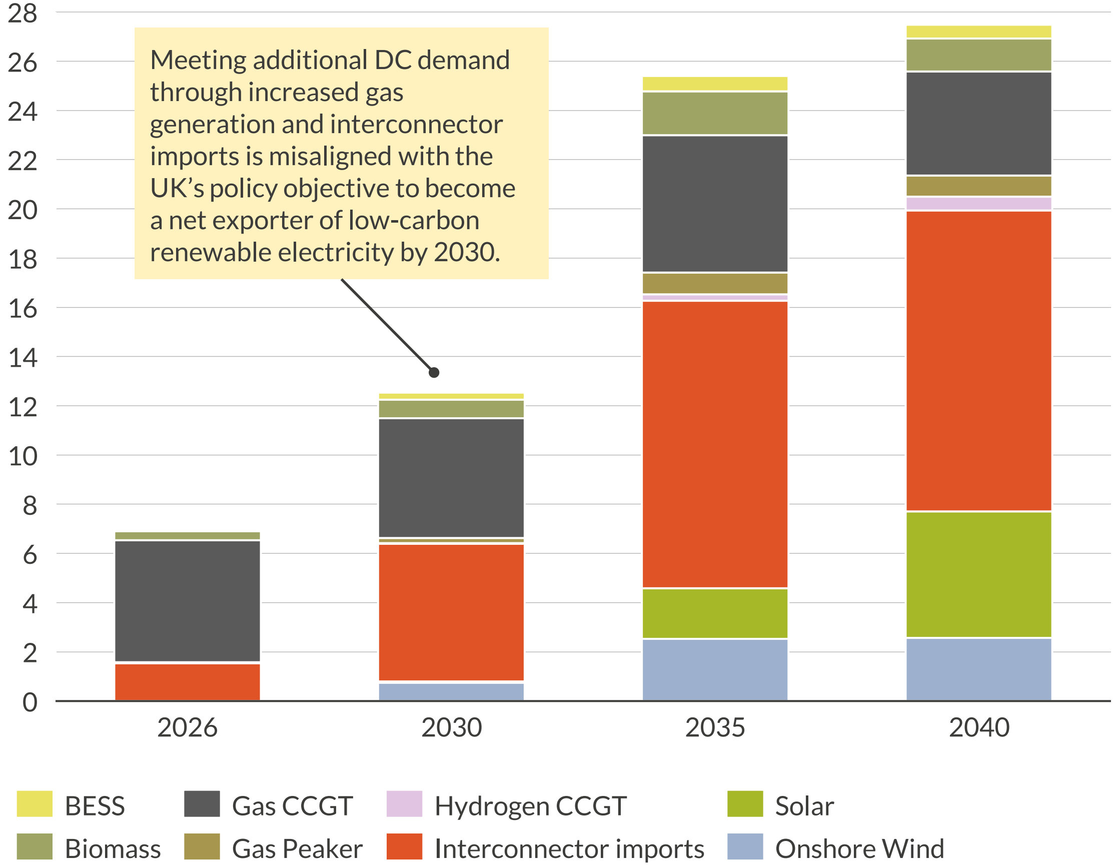
1 Higher datacentre demand driven by AI Expansion could **increase baseload prices by 9%** by 2040 without coupled investments in renewables capacity.

Wholesale baseload prices
£/MWh/year



2 The majority of additional demand is met by ramp up in gas CCGTs and interconnector imports, deviating from net zero targets.

Generation differences between AI Expansion and constrained scenario
TWh/year



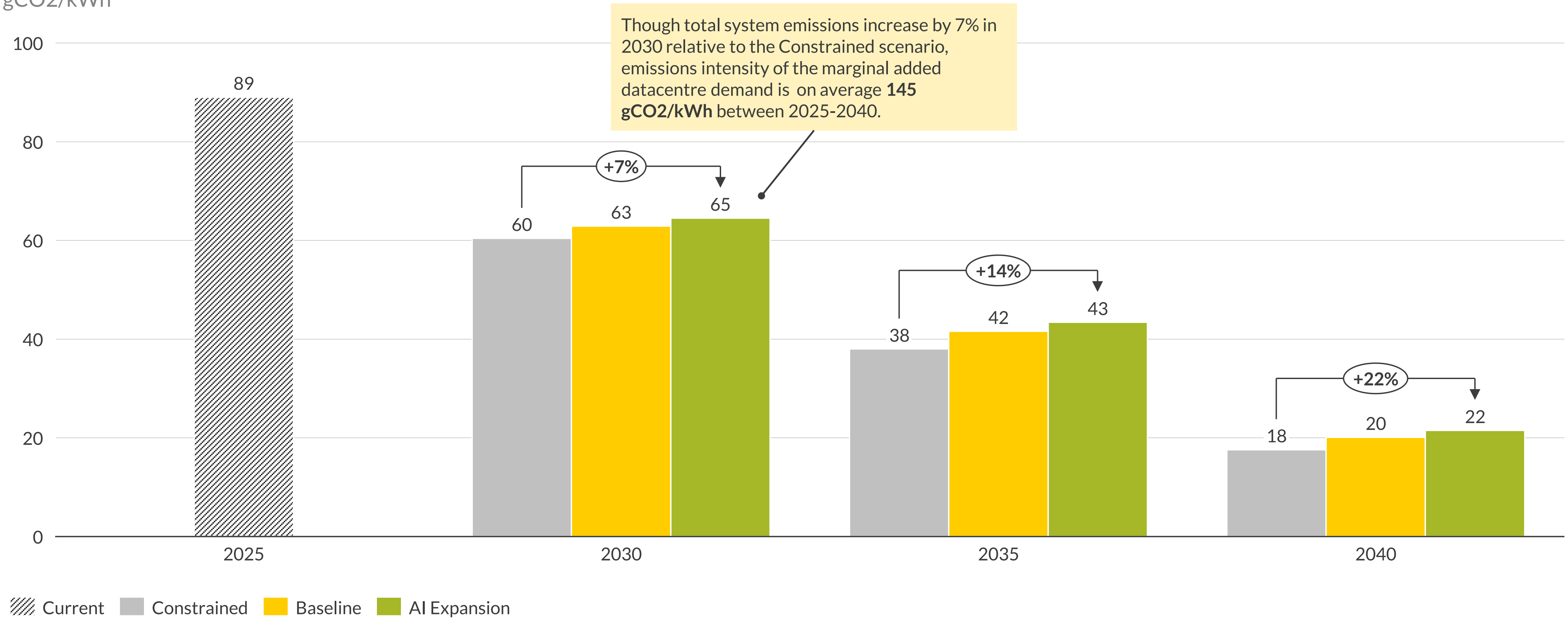
Sources: Aurora Energy Research

Emissions impacts of accelerated datacentre build-out materialises most in the medium and long-term, deviating from Net Zero targets

Emissions

As scenarios have increasing demand, the marginal resources required to meet demand **are increasingly gas-fired power plants**, resulting in higher carbon dioxide emissions

Yearly power sector emissions intensity
gCO2/kWh



Source: Aurora Energy Research

Deploying 16GW of additional RES by 2035 would avoid an increase in fossil generation and interconnector usage due to datacentres

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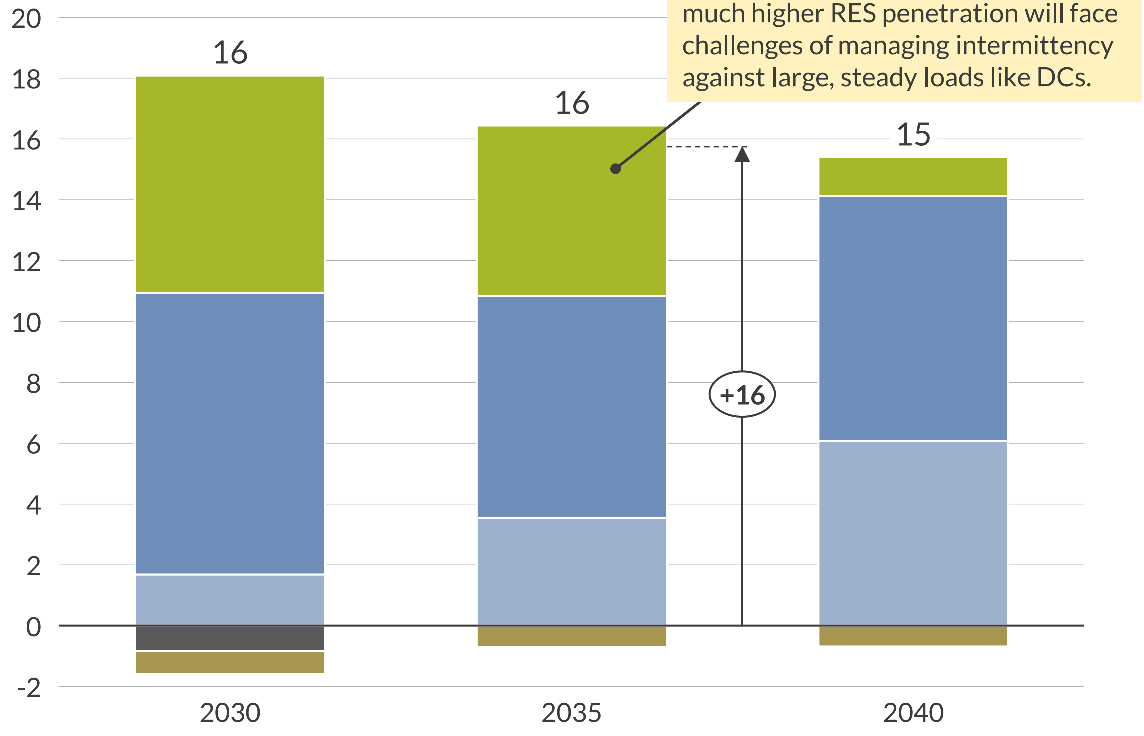
Capacity & generation

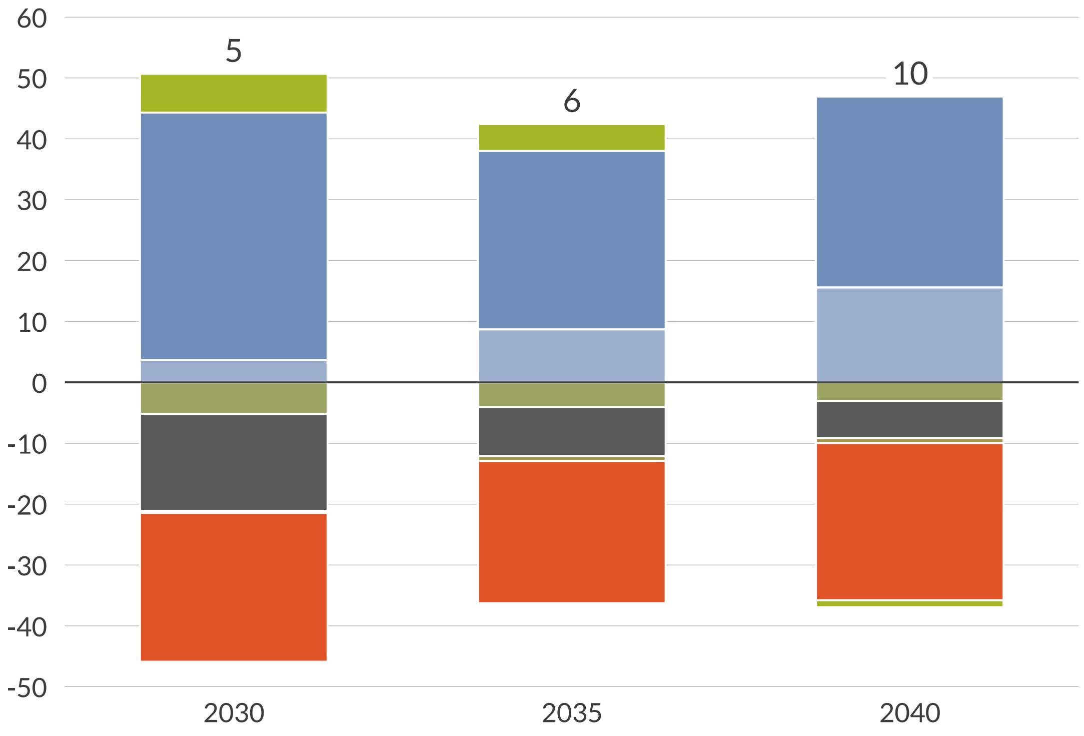
vs

The **AI Expansion – Renewables + Network Acceleration sensitivity**[1] sees **16 GW of additional renewables** by 2035 to support green datacentre growth and system decarbonisation. This scenario also has reduced interconnector imports, decreasing reliance on other countries for energy security.

Capacity delta between Renewables and Network Acceleration sensitivity vs AI Expansion scenario
GW/year



Generation delta between Renewables and Network Acceleration sensitivity vs AI Expansion scenario
TWh/year



Biomass | Gas CCGT | Gas Peaker | Interconnector imports | Solar Photovoltaics | Wind Offshore | Wind Onshore

1) This sensitivity assumes additional variable renewable capacity (onshore wind, offshore wind, solar) than Aurora's Central scenario, meeting 80-87% of Clean Power 2030 deployment targets. Networks build-out assumes full and timely delivery of Beyond 2030 transmission line upgrades.

Source: Aurora Energy Research

Key results

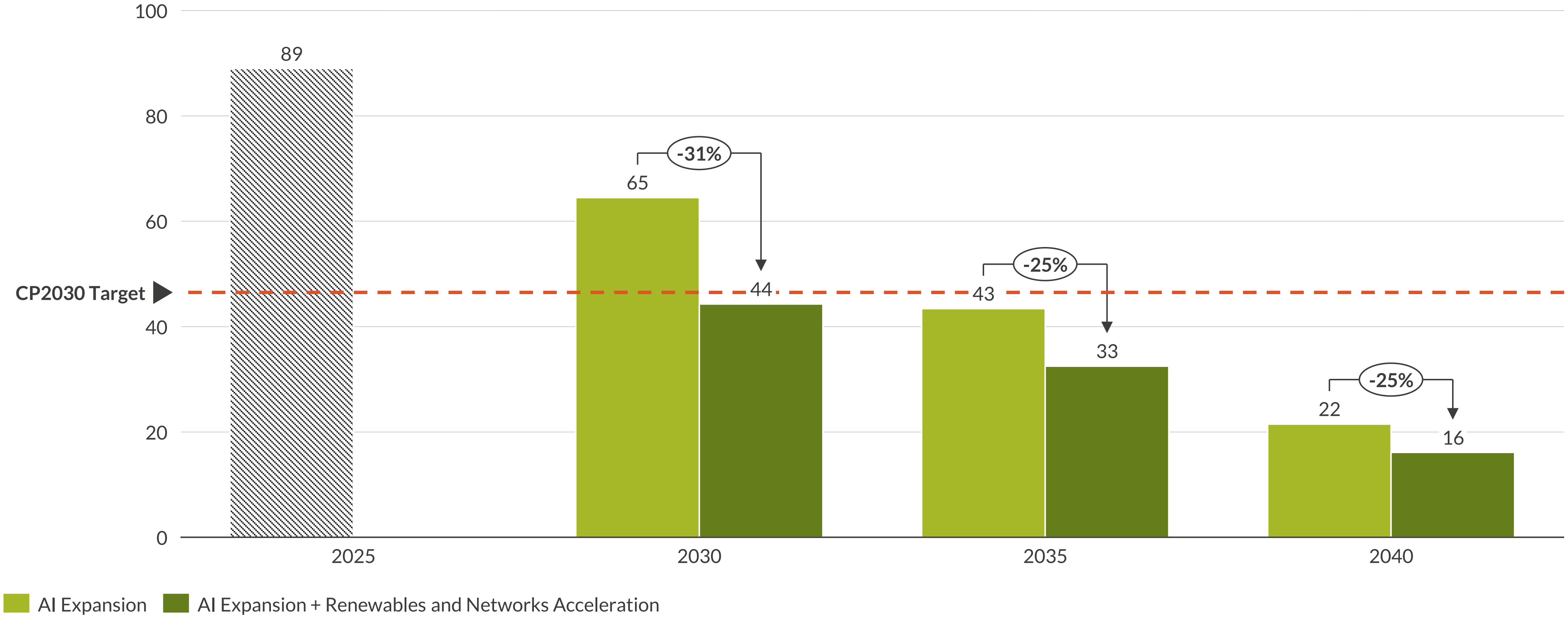
Successful RES acceleration can accommodate additional datacentre growth without risking sector decarbonisation targets

Emissions

vs

The **Accelerated RES and Network sensitivity** is able to meet Clean Power 2030 target of 50gCO2/kWh set out by the government. This sensitivity requires large amounts of capacity to be procured during AR7 and AR8 while realising a network build-out in line with "Beyond 2030" targets.

Yearly power sector emissions intensity
gCO2/kWh



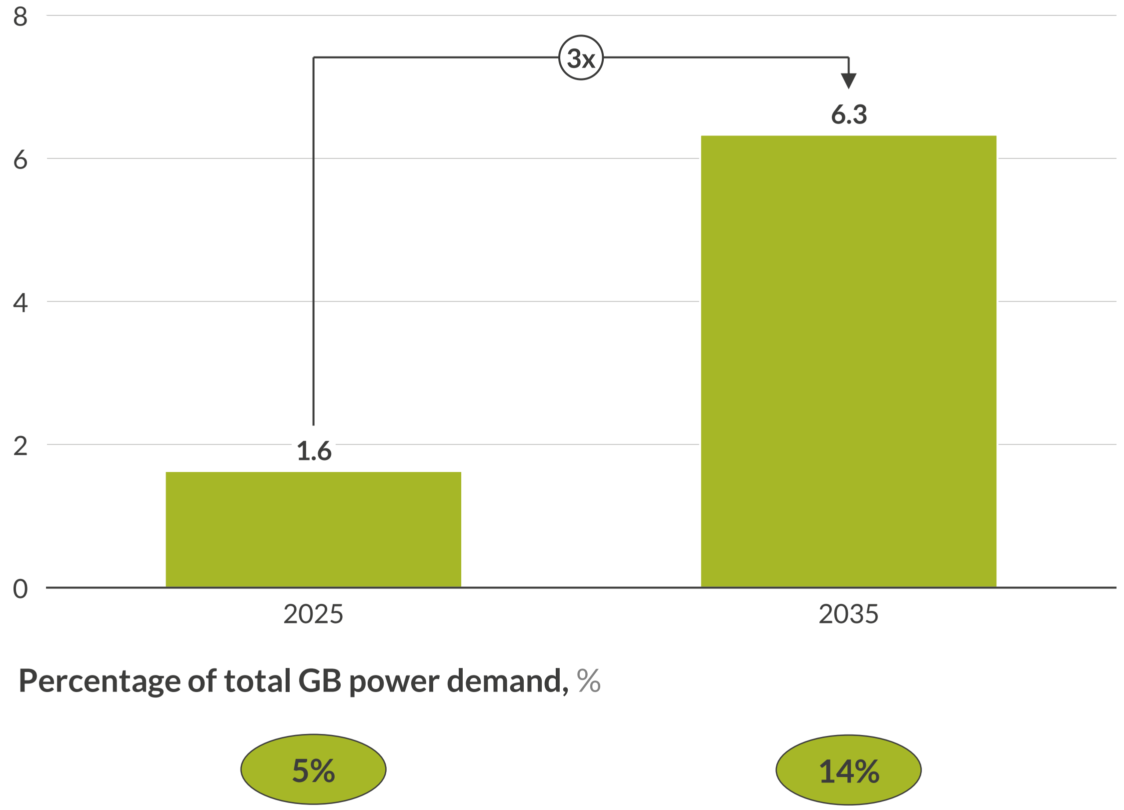
1) This sensitivity assumes additional variable renewable capacity (onshore wind, offshore wind, solar) than Aurora's Central scenario, meeting 80-87% of Clean Power 2030 deployment targets. Networks build-out assumes full and timely delivery of Beyond 2030 transmission line upgrades.
Source(s): Aurora Energy Research, DESNZ

Key results

Collaboration between datacentres, networks, generators and policy could unlock £35bn in low-carbon power investment supporting ~5GW of green DCs

1 Datacentres are making up an increasing share of total GB power demand which, with high deployment rates, could reach 14% by 2035.

Datacentre IT load capacity in GB, GW



2 DC capacity growth to 2035 could provide a route-to-market for 19GW of variable renewables capacity, totalling up to £35bn in low-carbon investments.

Capacity and RES CAPEX investment to support green datacentre growth[2]

1) Analysis assuming 50% of growth is met by half-hourly time-matched PPAs and 50% by offshore wind REGOs-based virtual PPAs. Based on Aurora's analysis of 95% half-hourly time-matched green power portfolio optimisation, contracting 5.7MW of onshore wind (2.9MW), offshore wind (2.5MW) and solar (1.3MW) per 1MW of baseload demand. Assuming remaining procurement is met through offshore wind, via virtual PPA supported by annual REGOs, based on annual average offshore wind load factor of 40%. 2) This figure excludes CAPEX for datacentre infrastructure and required augmentation of flexible capacity and networks to support high penetration of renewable generation. Source: Aurora Energy Research.

Agenda

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The following slides summarise the results of our scenario modelling exercise on system balancing volumes, costs and curtailment

- *In this section, Aurora compares system Balancing costs and curtailment to highlight the effects of differential network buildouts and datacentre siting on locational balancing.*
- *Additionally, we test the impacts of a sensitivity in which RES deploys at pace while network buildout lags behind (Renewables Acceleration and Network Delay).*
- *Lastly we consider a sensitivity of the AI Expansion scenario in which additional datacentre demand growth heavily deploys in Scotland to illustrate effects on the balancing system.*

Key metrics

1 Wholesale prices

2 Generation and capacity

3 Emissions

4 System balancing volumes and costs

5 Curtailment

6 Zonal pricing

Scenarios

Constrained scenario

Baseline scenario

AI Expansion scenario

Renewables and Networks acceleration

Renewables Acceleration and Network Delay

Scottish deployment

Key results

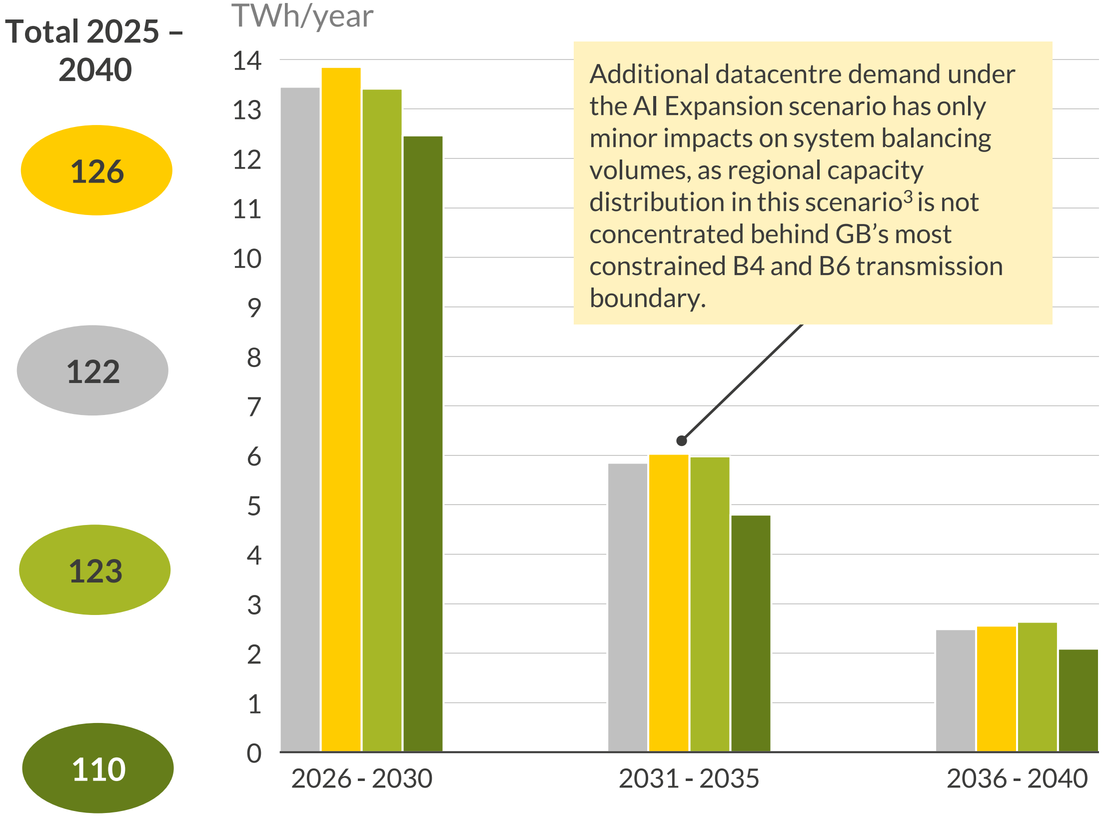
Locational balancing volumes are robust against DC growth scenarios, showing negligible cost increases given regional dispersion of capacity

System balancing

Under the AI Expansion scenario, regional distribution of capacity means that additional datacentre demand does not strongly affect locational energy balancing under different datacentre growth scenarios. The average annual cost difference between the **Constrained and AI Expansion scenario** is only ~£**10m.**

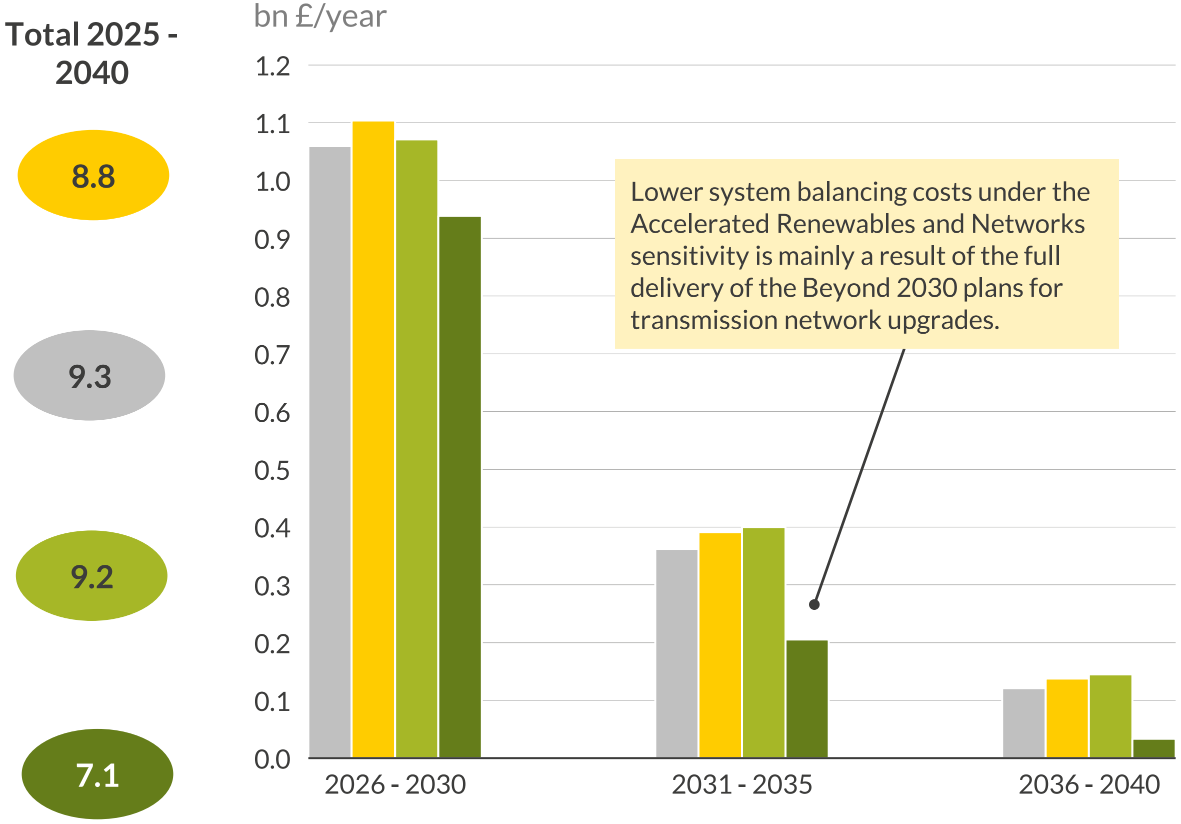
Annual average system balancing volumes[1,2]

TWh/year



Annual average system balancing costs[1,4]

bn £/year



Constrained Growth | Baseline Growth | AI Expansion[3] | AI Expansion + Accelerated Renewables and Networks[3]

1) Values in this section given as annual averages in 5 year intervals due to year-on-year volatility. 2) System balancing volumes in this section refer to the turn-up of generators after the wholesale day-ahead market has cleared to resolve transmission constraints which prevents contracted power from flowing to its intended offtakers. 3) The AI Expansion scenario's DC locational build-out assumes accelerated DC build rates are accessible through regional diversification of sites, in regions of identified pipeline capacity growth outside of London. 4) Total system balancing costs net of turn-up and turn down system actions. Sources: Aurora Energy Research

Accelerated renewables deployment to provide datacentres green power would require network transmission buildout at pace to avoid constraints

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System balancing

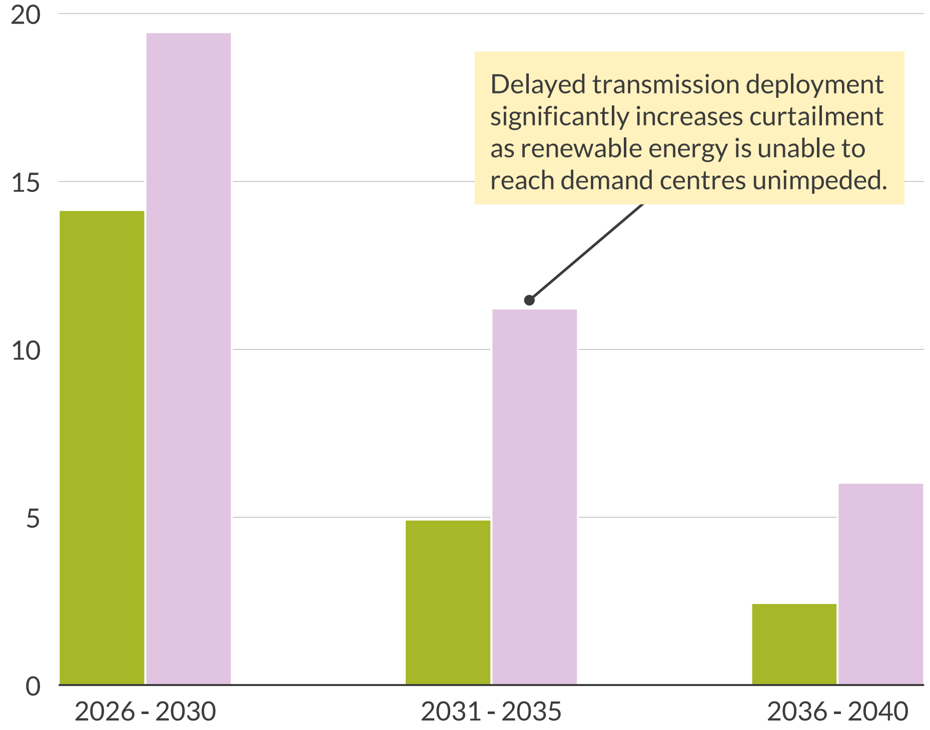
Increased renewables deployment requires sufficient transmission buildout to deliver the additional generation to demand centres. A delayed transmission buildout coupled with renewables acceleration would almost double average system balancing costs as curtailment sharply increases.

Annual average system balancing volumes
TWh/year

Total 2025 – 2040

121

197

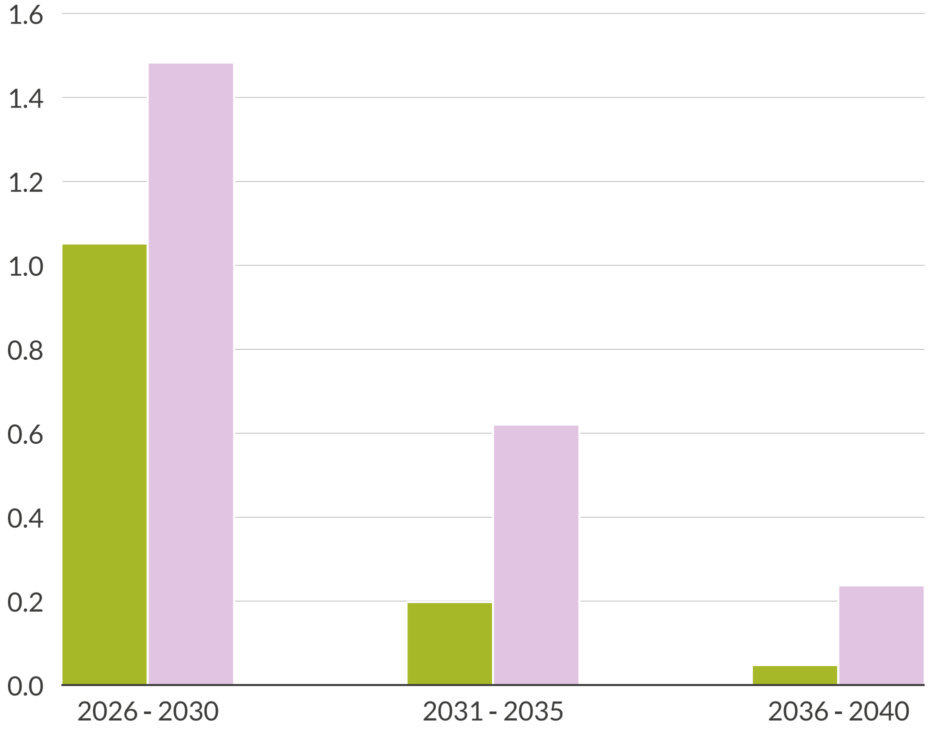


Annual average system balancing costs[1]
bn £/year

Total 2025 – 2040

7.7

12.9



AI Expansion - Renewables and Network Acceleration
AI Expansion - Renewables and Network Delay[2]

1) Total system balancing costs net of turn-up and turn down system actions. 2) This sensitivity assumes additional variable renewable capacity (onshore wind, offshore wind, solar) than Aurora's Central scenario, meeting 80-87% of Clean Power 2030 deployment targets. Networks build-out assumes partial delay of line delivery relative to beyond 2030 plans – further details in the Appendix.

Sources: Aurora Energy Research

Datacentre siting can offer system benefits: for example, higher DC build-out in Scotland can reduce constraint costs by 8% to 2040

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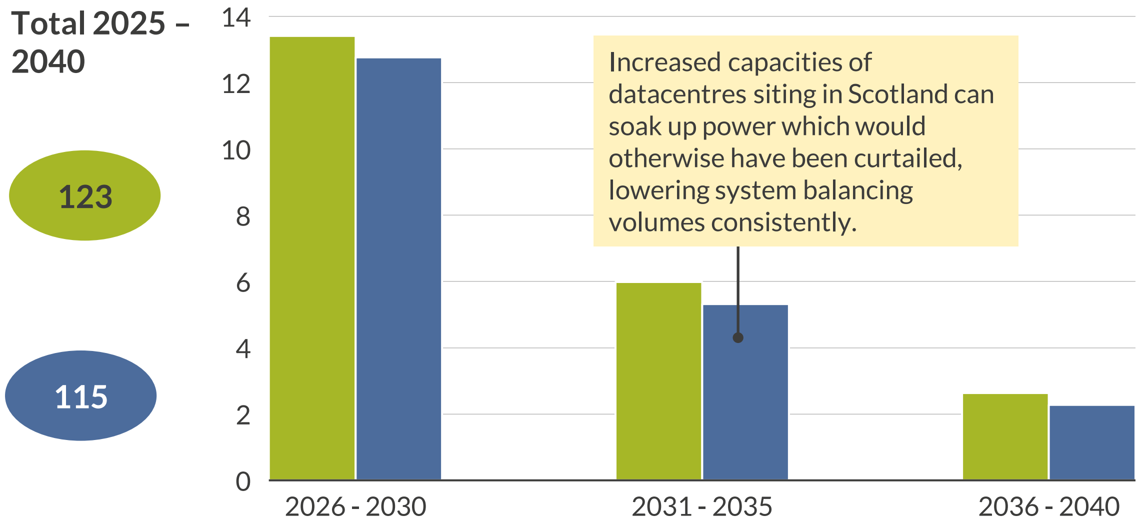
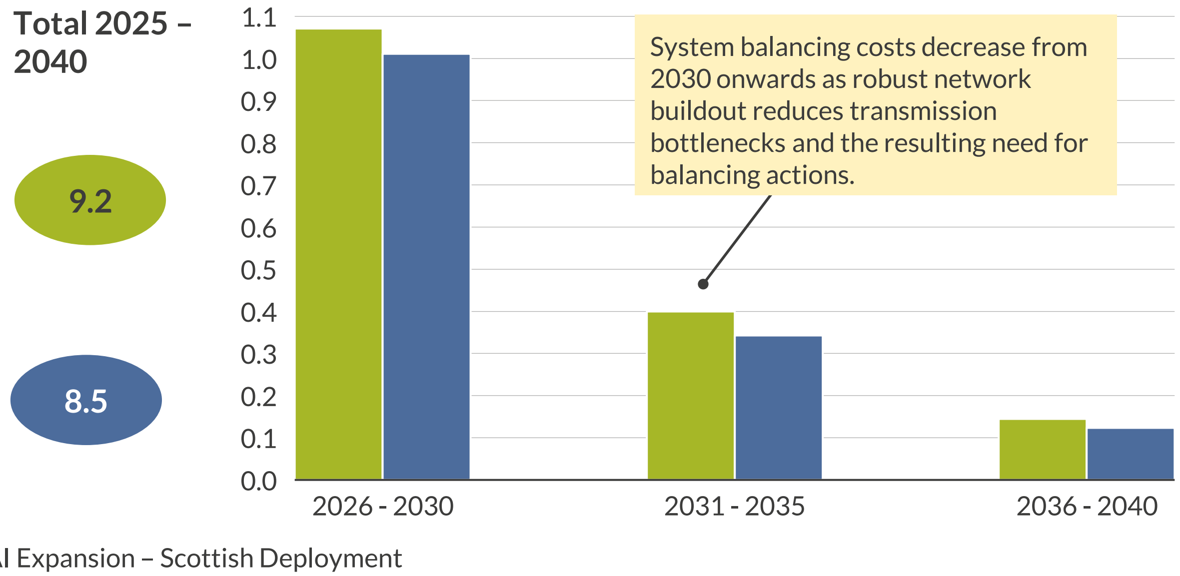
Scotland – System balancing

Datacentres **siting in Scotland** could provide bi-directional benefits from datacentres receiving abundant wind power while consuming power that would have otherwise been curtailed or turned down, thereby reducing system balancing costs.

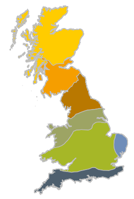
Annual average system balancing volumes
TWh/year

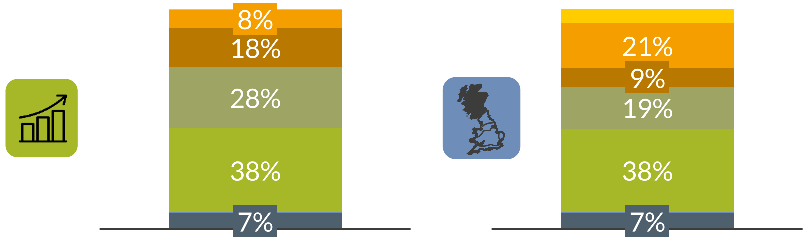


Annual average system balancing costs[2]
bn £/year



Datacentre demand distribution across GB by 2035





- By 2035, the Scottish AI Expansion sensitivity assumes that 1.7GW of datacentre capacity locates in Scotland, up from 544 MW in the AI Expansion scenario.
- While this is a bullish sensitivity, both the Scottish government and largest Scottish datacentre operator have signalled a strong willingness for significant growth in datacentre capacity in the near-term.

1) Scenarios explored on this slide assume a partially delayed network build-out to Beyond 2030 in line with Aurora's view of realistic deployment and observed delays 2) Total system balancing costs net of turn-up and turn down system actions. .

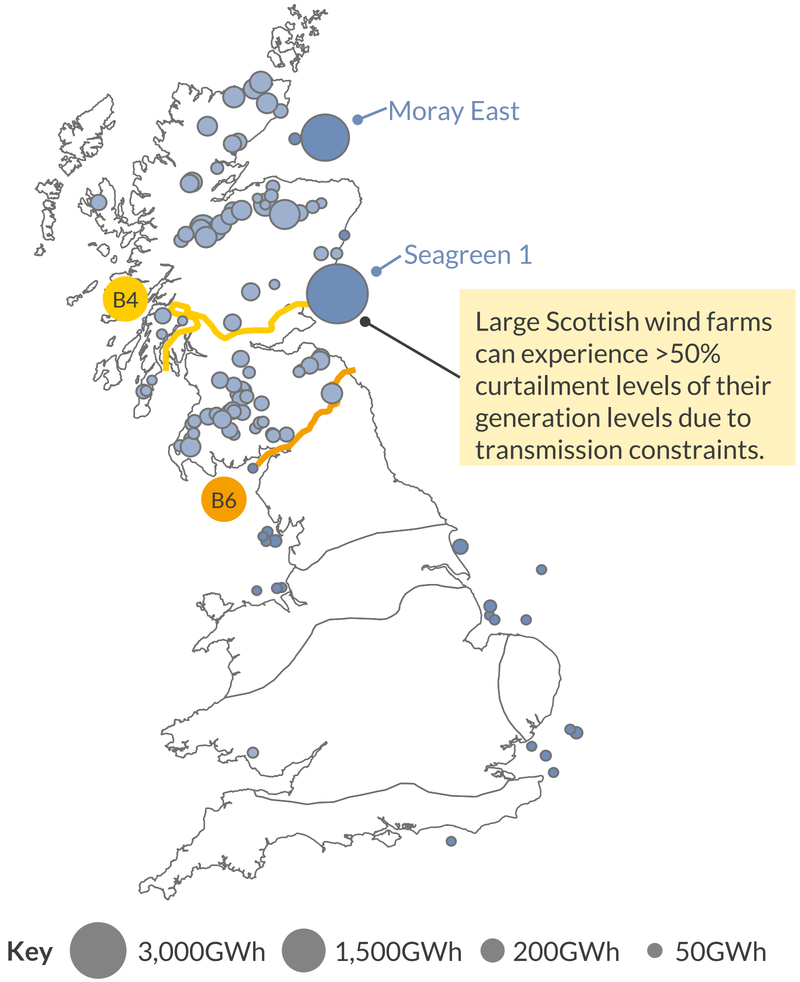
Sources: Aurora Energy Research

Key results

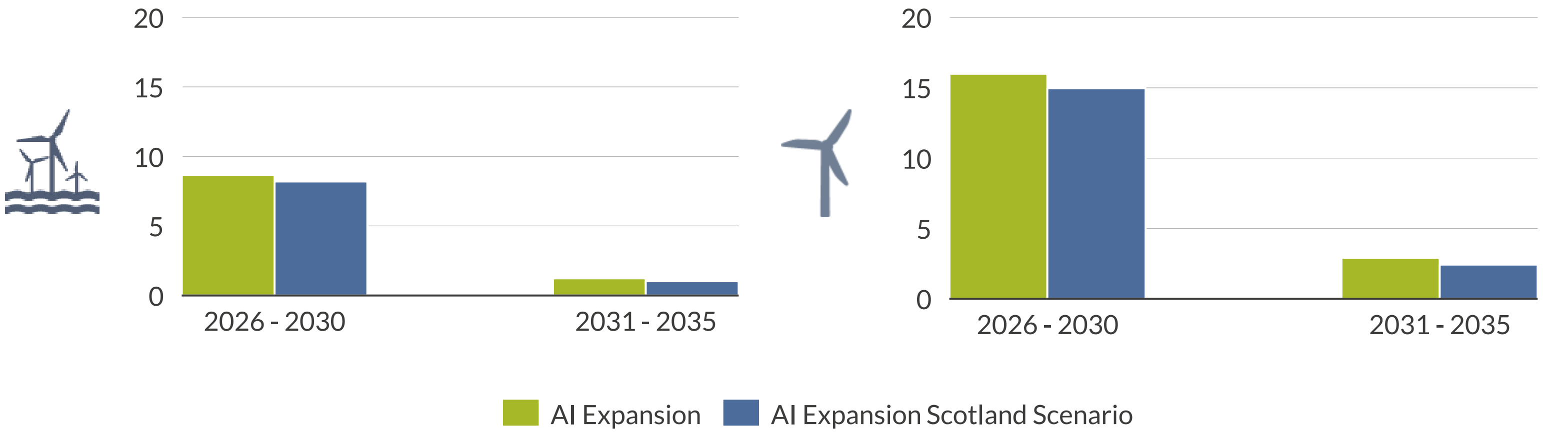
Additionally, with increased datacentre demand in Scotland, wind curtailment can be reduced by 9% until 2035

Scotland – Curtailment

System balancing volumes by site
February 2024 – February 2025



Average Percentage of Scottish wind generation turned down annually[1]
%/year

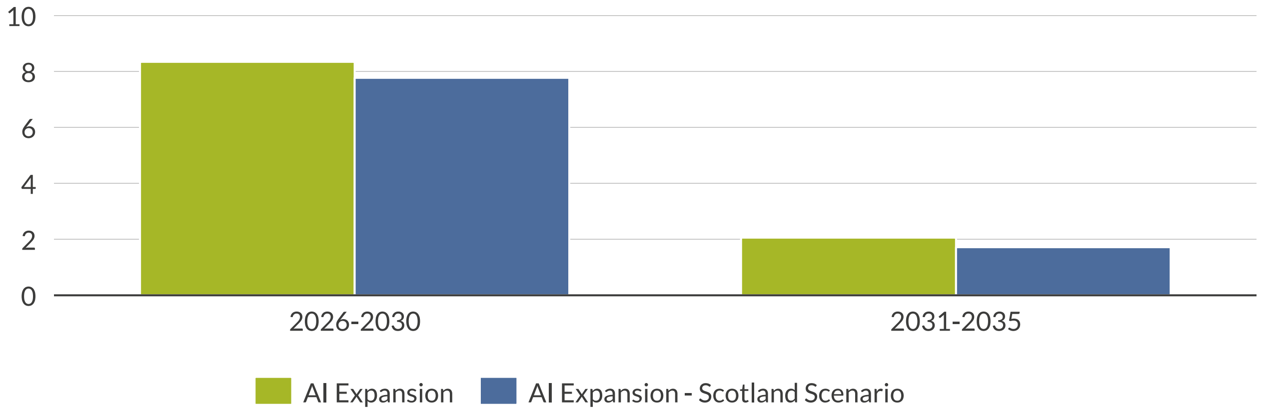


Total 2025-2030

45

42

Annual average wind turn-down volumes in Scotland[1]
TWh/year



1) Scenarios explored on this slide assume a partially delayed network build-out to Beyond 2030 in line with Aurora's view of realistic deployment and observed delays.

Sources: Aurora Energy Research

The following slides summarise the results of our scenario modelling exercise for zonal pricing

In this section, Aurora compares the potential outcomes of a zonal pricing reform between the Baseline scenario, the AI Expansion scenario and the Scottish deployment sensitivity. This illustrates how regional dispersion of datacentre demand affects the comparatively smaller markets in a zonal system and explores differential price impacts across zones and scenarios.

Key metrics

1. Wholesale prices
2. Generation and capacity
3. Emissions
4. System balancing volumes and costs
5. Curtailment
6. Zonal pricing

Scenarios

- Constrained scenario
- Baseline scenario
- AI Expansion scenario
- Renewables and Networks acceleration
- Renewables Acceleration and Network Delay
- Scottish deployment

Source: Aurora Energy Research

The introduction of zonal pricing in the upcoming electricity market review announcement may impact power costs for certain datacentres

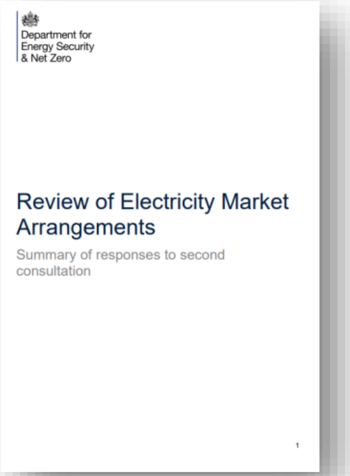
The UK is conducting a **wide-ranging overhaul of electricity markets** to make them fit for a system based mainly on renewable generation. Part of this is a move from the current system with a uniform electricity price to one where prices differ by location, expected to improve the efficiency of networks.

The problem — Excessive levels of grid congestion

- Current market arrangements provide limited incentives to market participants to consider network conditions in their investment and dispatch decisions.
- As generation is becoming more variable and located further from demand, NESO must 'redispatch' more generation in the Balancing Mechanism, beyond levels that wholesale market arrangements were designed for.

Proposed solution — Zonal pricing

- As part of its **Review of Electricity Market Arrangements (REMA)** the UK Government is considering the option of zonal pricing for a reform of electricity wholesale markets.
  - GB power market divided into **up to 12 zones** with different electricity prices, network transfer capacities are reflected in cross zonal trades.
  - A key benefit of this option is that network constraints will be already considered at the day ahead stage.
- **Implications for datacentres**:
  - Datacentres siting in zones with low demand relative to supply (such as Scotland) may benefit from significantly lower power costs.
  - Datacentres in the London area may see marginally higher power costs.


Department for Energy Security & Net Zero

Review of Electricity Market Arrangements

Summary of responses to second consultation


Department for Energy Security & Net Zero

Review of Electricity Market Arrangements

Autumn Update

December 2024

The timeline — Decision Summer 2025

- The Government will take a final decision between the two options in the summer 2025.
- The implementation of zonal pricing will take at least 5 years.
- Existing plants will be eligible for grandfathering arrangements. However, considerations of these are still at an early stage.

Source: Aurora Energy Research, DESNZ, NESO

Zonal pricing offers datacenters in North Scotland potential savings of up to £13/MWh by 2035, however this benefit dissipates in the long-term

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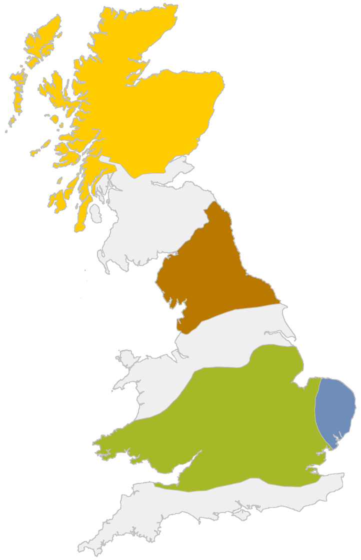
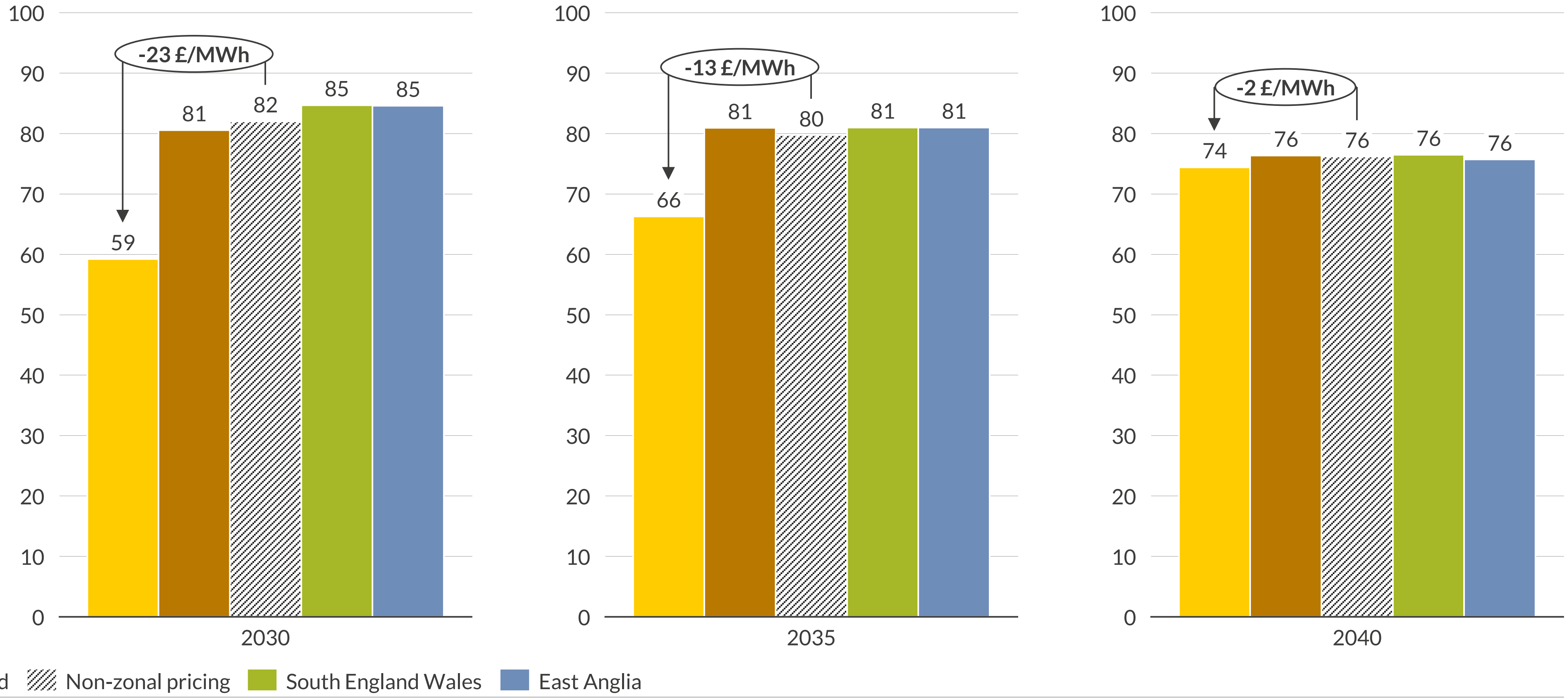
Zonal pricing

Zonal pricing could offer datacentres the potential to site in zones with surplus generation such as Scotland to access lower prices. However, the magnitude of cost savings will heavily depend on speed to implementation, transitory arrangements of zonal pricing from the current national pricing system and investment impacts.



Zonal wholesale prices[1] under Baseline scenario for select regions
£/MWh (real 2024)



1) The scenario explored on this slide assumes a partially delayed network build-out to Beyond 2030 in line with Aurora's view of realistic deployment and observed delays.

Sources: Aurora Energy Research

Key results

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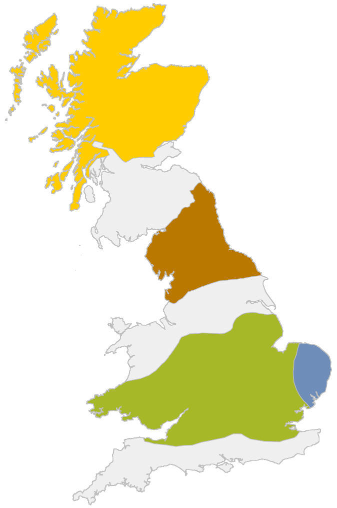
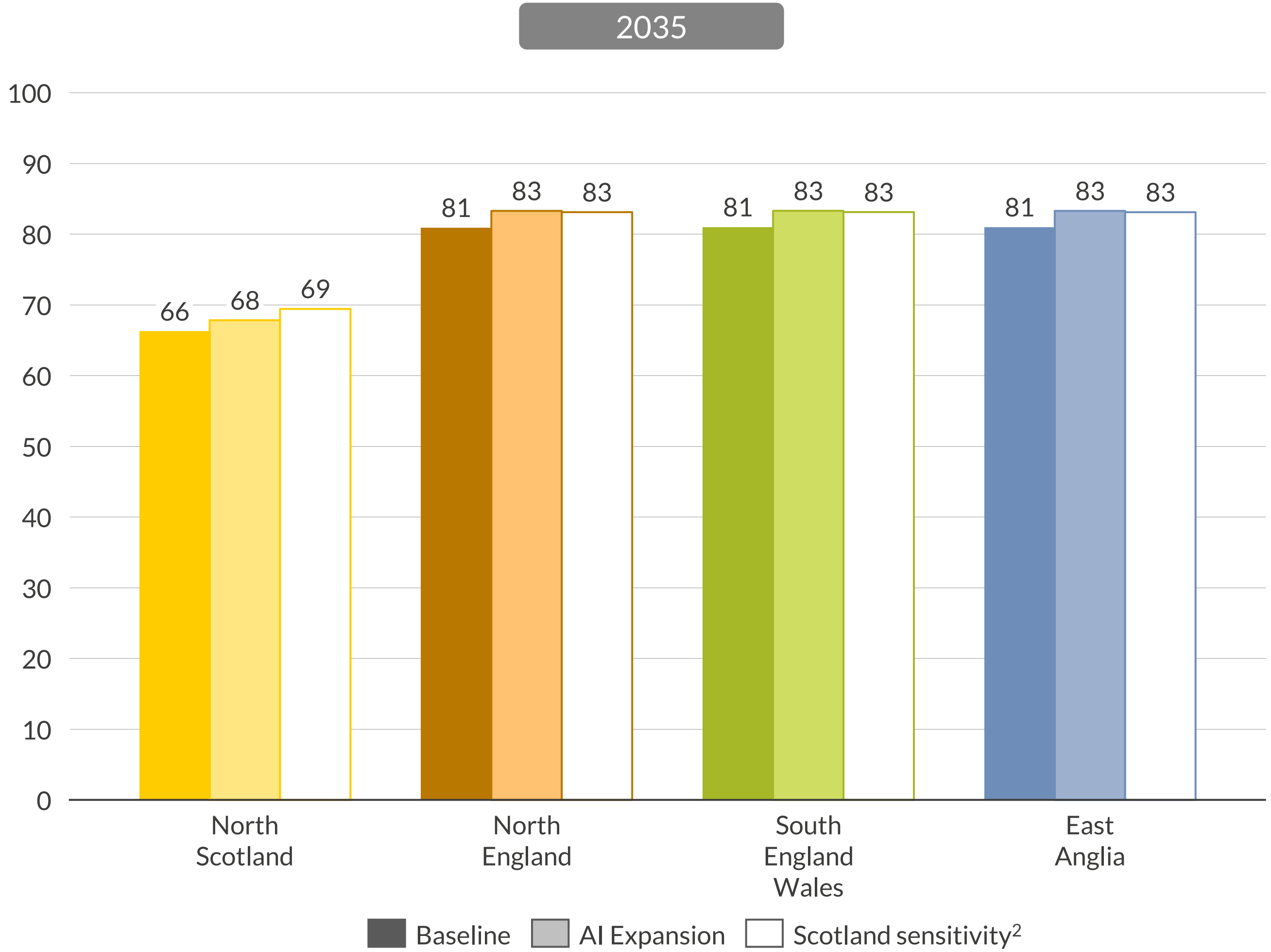
Zonal pricing

Faster demand growth and diversification of DCs siting in Scotland raises wholesale prices in North Scotland by only £3/MWh

Zonal wholesale prices[1] – Baseline vs AI Expansion vs Scotland[2] sensitivity
£/MWh (real 2024)





- Accelerated deployment of datacentre demand in line with the AI Expansion scenario results in a £2/MWh increase in zonal prices across zones relative to the Baseline scenario.
- With a higher proportion of DC demand siting in Scotland under the Scotland deployment sensitivity[1], wholesale cost savings for DCs in North Scotland remain robust with only £1/MWh price increase.
- It is worth noting that potential savings are conditional on network-build as well as wider market and investment impacts of zonal pricing. Accelerated network build-out would likely reduce zonal price deltas.
- Furthermore, cost savings are a benefit but not necessarily critical to datacentre siting decisions, with the DC industry prioritising speed to power and access to fibre connectivity above other factors.

1) Scenarios explored on this slide assume a partially delayed network build-out to Beyond 2030 in line with Aurora's view of realistic deployment and observed delays. 2) Under this sensitivity, 26% of datacentre demand is sited in South and North of Scotland by 2035.
Sources: Aurora Energy Research

Key takeaways

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1 **Datacentre demand is projected to grow 3-fold by 2035 and under aggressive build rates could comprise up to 14% of total GB power demand.** This growth is increasingly characterised by 100MW+ units clustered in hub, requiring the power system to accommodate large point-source demand.

2 **Getting coordination right between datacentres, networks and generators could unlock £35bn in low-carbon power investment while supporting ~5GW of green datacentres.** Otherwise, near-term demand growth will likely be met by ramp-up of gas assets, risking higher sector carbon emissions and higher wholesale prices given a lag between renewables deployment and datacentre lead times.

3 **Regional dispersion of datacentres to the Midlands and North of England does not meaningfully exacerbate System Balancing actions.** Nevertheless, network build-out at pace remains the most effective way to reduce system constraints..

4 **For the datacentre industry, siting demand behind constrained boundaries can unlock benefits for the power system.** Under a sensitivity analysis where datacentre build-out focuses in Scotland reaching 26% of installed capacity by 2035, this can reduce wind curtailment by 9% and reduce system balancing costs by 8%.

5 **Zonal pricing could offer datacentres in North Scotland £13/MWh cost savings in power by 2035,** with this savings being robust even in scenarios with additional demand from datacentres drawn to Scotland. However, these savings will likely be muted depending on transitory arrangements under REMA[1] and dissipate in the long-term as planned grid investments are completed.

1) 1) Existing generation assets at risk of lower revenues under zonal pricing may receive grand-fathering arrangements that require additional government subsidies. It is possible but not guaranteed that the cost of these market-stabilising subsidy arrangements would be put on end-consumers.

Source: Aurora Energy Research

Agenda

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Global pressure points: Rapid growth is forcing government action in regions with high demand penetration from datacentres

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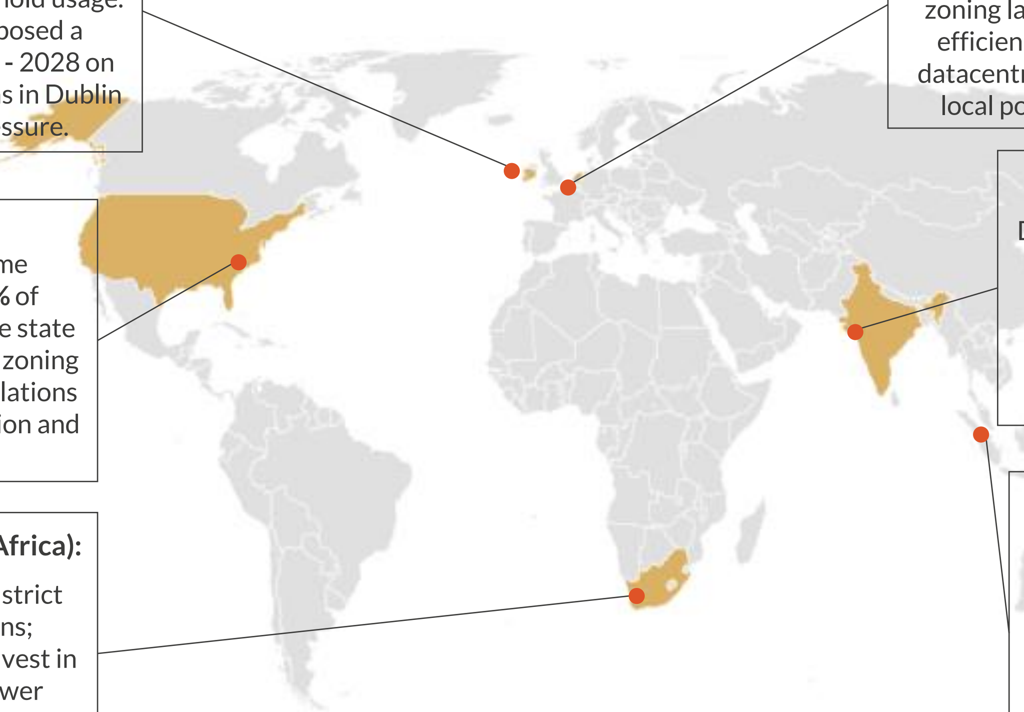
With datacentres consuming up to 25% of electricity in some regions, governments are imposing moratoriums, mandating self-sufficiency, and tightening planning laws. Others could follow.



Dublin (Ireland):
Datacentres consumed **21%** of Ireland's electricity in 2023, surpassing urban household usage. The Government imposed a moratorium from 2022 - 2028 on new DC grid connections in Dublin to alleviate grid pressure.

Virginia (USA):
Datacentres consume approximately **25.6%** of Virginia's electricity. The state is implementing stricter zoning and environmental regulations to manage rapid expansion and grid strain.

Johannesburg (South Africa):
Government imposing strict grid-access conditions; operators required to invest in significant on-site power generation due to national electricity shortages.

Amsterdam (Netherlands):
Government enacted temporary moratorium, strict zoning laws, and mandatory efficiency standards after datacentre boom threatened local power grid stability.

Mumbai (India):
Datacentres consume **~18%** of Mumbai's peak electricity, prompting state policies promoting green energy and streamlined, regulated expansion.

Singapore:
Datacentres account for over **7%** of Singapore's electricity consumption. Post a 2019–2022 moratorium, the Government now permits limited expansions under stringent energy efficiency conditions.

Emerging Common Policies

Moratoriums on New Connections:

- Grid operators in Ireland, Singapore, and Amsterdam have paused or capped new datacentre connections in high-demand areas.

Power Self-Sufficiency Mandates:

- New facilities need to provide additional generation or storage in proximity to the DC, or prove demand flexibility during peak periods (e.g. Ireland, Johannesburg).

Zoning and Land-Use Restrictions:

- Authorities are limiting datacentre construction on farmland or in urban zones, with designated tech corridors emerging (e.g. Amsterdam, Virginia).

Efficiency and Climate-Based Permitting:

- Governments are requiring low PUE targets, integration with district heating, and alignment with national decarbonisation strategies (e.g. Germany, Singapore).

Sources: Aurora Energy Research, EirGrid, Cushman & Wakefield, CRU, Virginia State Corporation Commission (SCC), Dominion Energy

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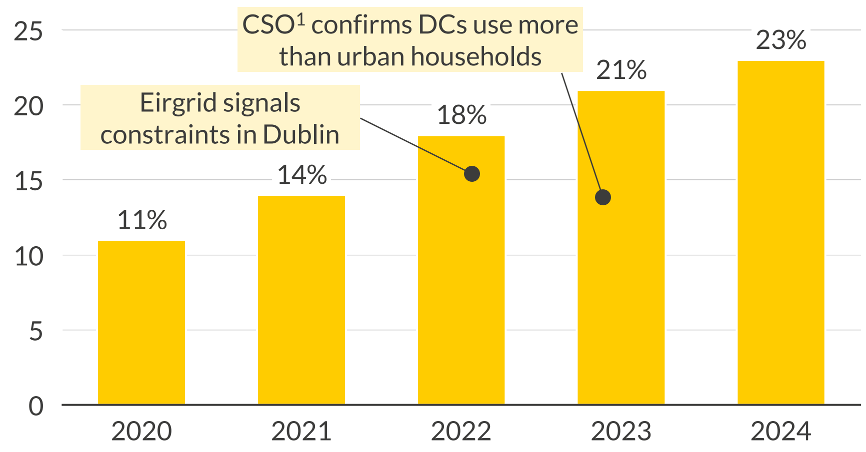
Ireland's Government introduced a moratorium on new datacentre capacity to aid grid constraints caused by rapid datacentre buildout

Ireland's datacentres now use over a quarter of the national electricity consumption. As a result, the Irish Government has imposed grid limits, mandated self-sufficiency, and tightened planning to control runaway growth.

Energy consumption by DCs in Republic of Ireland, %



Recent news headlines on datacentre growth


TECH MONITOR

Ireland's data centre nightmare – and what others can learn from it

Irish economy

Ireland struggles to consolidate role as data centre hub

Ireland wanted to build data centres for the AI boom. Now they fear blackouts

THE IRISH TIMES

Video

Data centres in Ireland: 'The size of the grid is too small for our economy'

How has deployment developed in Ireland?

- **Early 2000s Onset**: Dublin became a datacentre hub in the early 2000s due to its cool climate, EU access, low corporate tax, and strong connectivity with transatlantic subsea connections, attracting major players like Microsoft and Amazon.
- **Rapid Growth (2010s–2020)**: The city saw significant expansion driven by cloud demand, with over 70 datacentres established in Dublin by 2022.
- **Grid Strain & Policy Response**: By 2023, datacentres consumed 21% of Ireland's electricity, prompting EirGrid to pause all new Dublin datacentre connections and the CRU to impose stricter connection criteria focused on energy self-sufficiency.

Key government responses

- **Self-Sufficiency Requirements (Feb-2025)**: New datacentres must prove additionality of generation in proximity to sites[2] and may be required to provide demand reduction as a condition for planning approval, with a target of 16% demand flexibility by 2026.
- **Planning and Policy Tightening (Mar-2022):** Local councils have begun rejecting proposals (e.g. South Dublin), while national policy now integrates datacentres into Ireland's Climate Action Plan.
- **Grid Connection Restrictions (Jan-2022):** Eirgrid imposed a moratorium on new datacentre connections in Dublin until 2028 due to severe grid capacity constraints.

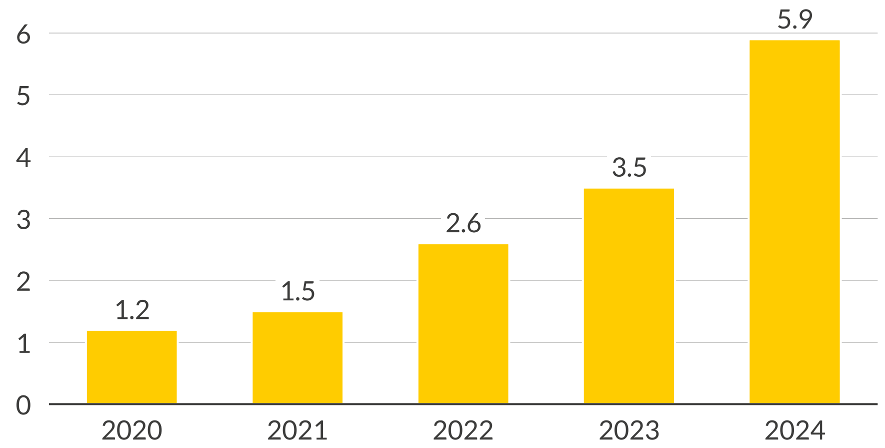
1) CSO = Central Statistics Office. 2) DCs must develop onsite or nearby generation and/or storage, with derated generation capacity matching the DC's maximum import capacity.

Sources: Aurora Energy Research, Cushman & Wakefield; EirGrid; CRU; CSO

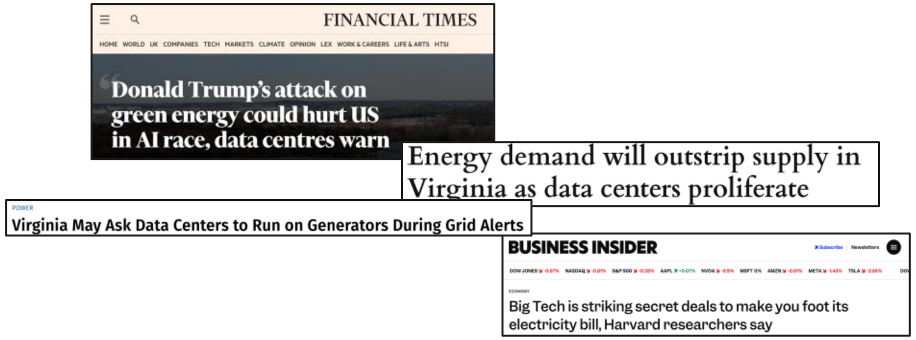
Similar to Ireland, Virginia faces large grid constraints in the face of explosive datacentre build-out and capacity pipeline

Virginia's datacentre (DC) capacity has tripled over the past four years, with no indication of slowing down. In a similar response to Ireland, local and state governments are enacting legislation to reduce this rapid growth while mitigating pressure on the electrical grid.

Virginia's datacentre installed capacity, GW



Recent news headlines on datacentre growth



How has deployment developed in Virginia?

- **Early Start (1990s)**: A combination of location at a critical US internet exchange point (MAE-East), low taxes, and cheap power allowed Virginia's datacentre industry to begin in the early 1990s.
- **Explosive Growth (2010s–Present)**: Over time, the region became one of the world's largest datacentre markets, with massive investments from AWS, Microsoft, and Google. Proximity to key Gov't and defence facilities creates strong demand.
- **Grid Strain & Policy Response**: Soaring power demand prompted local grid operators to plan major powerline buildout to keep up with the growing constraints caused by the datacentres.

Key government responses

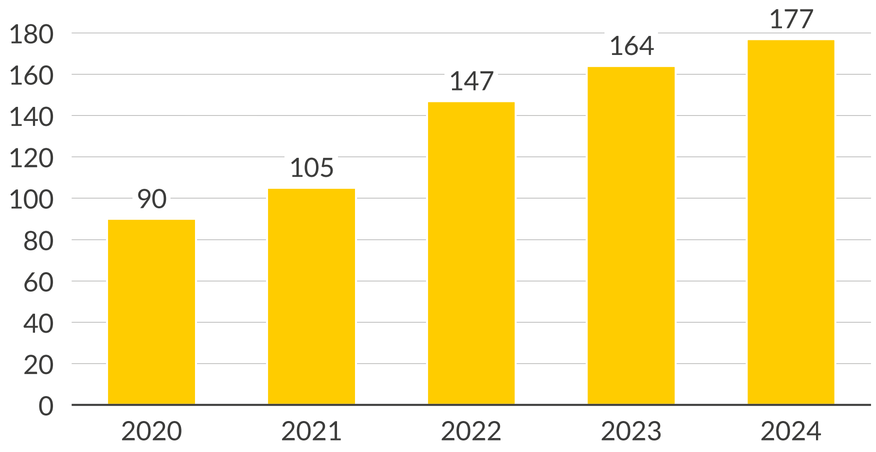
- **Large-scale Grid Buildout (Mar-2025):** Dominion Energy is expanding the grid with a new 500kV transmission line in Loudoun County, scheduled for completion in 2026. This is in response to the utility adding 4GW of DC capacity in Virginia since 2019.
- **Upcoming Legislative Pressure on DCs (Dec-2024):** Although Virginia has not imposed any moratoriums on DC buildout, the Government is planning legislation to mandate demand response programs for DCs to support effective grid management.
- **Experimentation with Onsite Generation (Jan-2023):** The Virginia Department of Environmental Quality (DEQ) considered allowing DCs to use diesel generators during grid stress events but withdrew the proposal due to environmental concerns.

Sources: Aurora Energy Research, Cushman & Wakefield; Dominion Energy; Virginia State Corporation Commission (SCC)

Spain plans ahead for grid constraints as datacentre buildout accelerates in key hubs; a move to ease DC’s planning regulations mirrors that of GB

Unlike Ireland and Virginia, Spain is in the early stages of a rapid datacentre buildout with DC capacity doubling in the past 5 years. As a result, the government is acting in advance to reduce the strain on the Spanish grid. Spain and GB both propose facilitated planning for datacentres building in identified strategic regions.

Madrid’s datacentre installed capacity, MW



Recent news headlines on datacentre growth

How has deployment developed in Spain?

- **Early 2000s Onset**: Spain’s datacentre development began in Madrid in the early 2000s with local colocation facilities serving telecoms and enterprises.
- **Rapid Expansion (2017–Present)**: Hyperscalers including Google, Microsoft, and IBM launched major projects in Madrid, from 105 MW in 2021 to 205 MW today.
- **Initial Grid Strain & Policy Response**: Power and land constraints in central Madrid are pushing development to outlying areas like Aragón, where the DC pipeline reaches ~1800MW thanks to abundance of renewables and supportive local regulations.

Key government responses

- **Future Grid Capacity Planning (Jan-2025)**: Authorities are addressing Madrid’s future grid strain by enhancing transparency, promoting demand response programs, and pushing to update national energy transport plans to reflect the datacentre growth.
- **Grid Access Paywall (Dec-2023)**: Spain introduced mandatory financial guarantees for high-voltage grid access and is updating regulatory frameworks to prevent speculative grid reservations.
- **Actively attracting DC capacity (Present)**: The local government in Aragón encourages DCs to build by providing tax incentives and easing planning regulation, leading to a positive regulatory environment for hyperscalers.

Sources: Aurora Energy Research, Cushman & Wakefield; Reuters; CMNC; Colliers

GB can draw lessons from DC deployment in other regions to avoid local grid constraints and to scale datacentre capacity effectively and greenly

Explanation	Key case study examples and takeaways for GB
How well do existing policies provide strategic planning for datacentre siting?	(Ireland – Poor) A lack of strategic national planning for datacentres allowed for rapid clustering of datacentre demand close to Dublin. The moratorium for DCs in Dublin sends a siting signal, but policy offers no siting benefits in other hubs to spur growth outside of Dublin. (US – Fair) Datacentres' ambiguous planning classification historically led to clashes with residential developments; more stringent regulations passed in Apr'25 in Virginia increases the minimum distance to residential land and requires public consultation for planning consent. (Spain – Good) The Madrid gov't has identified a minimum of 20 public plots, totaling over 80,000 square metres, for new datacentres. ➢ *A strategic national planning approach could have facilitated regional build-out to other potential hubs in Ireland, while Virginia's regulations are tightening in response to clashes with residential developments. GB is more in line with Spain's approach, with AI Growth Zones beginning to identify strategic siting options, but national planning still lacks heuristics to provide strong locational signals to DCs.*
How well do existing policies facilitate access to power and grid connections for datacentres?	(Ireland – Poor) Ireland provides no speed-to-grid incentives, with the need for additionality of nearby generation[1] posing challenges to deployment. (Good) The system operator will be required to regularly publish capacity mapping on the electrical network to increase data visibility. (US – Fair) There are no power sourcing mandates and datacentres have a clear route to grid connections in Virginia, however co-location to existing power plants require refinement of policies, as exemplified by the rejection of the Susquehanna[2] datacentre. (Spain – Good) Security deposits in the grid connection process disincentivises speculative applications, streamlining the connections queue; independent are emerging with speed-to-grid offerings and joint venture opportunities[3] for datacentres. ➢ *Greater visibility on headroom capacity in GB would facilitate speed to power for datacentres. While GB currently has no self-build generation mandates in place, policy which encourages linking of investments in low-carbon generation to datacentre growth can spur both industries.*
How well do existing policies manage grid reinforcements?	(Ireland – Poor) While the Transmission Development Plan outlines proposed network upgrades, there is onus on DCs to self-build generation to avoid constraints, with a high risk of planning rejections if applying to build in areas of high existing or future constraints. (US – Fair) Dominion Energy has delivered transmission upgrades at pace to support ~5GW of DCs coming online in the past 5 years, committing ~$5bn in transmission upgrades to 2027/28, but demand growth is still expected to outpace electrical infrastructure build-out. (Spain – Poor) Underinvestment in the grid in Spain has led to high local constraints and lower grid reliability relative to European neighbours.

Good Fair Poor

1) Onsite or proximate local generation, with derated generation capacity matching the DC's maximum import capacity. 2) Planning proposal for the Susquehanna nuclear facility to power a 960MW datacentre by rejected in Apr'25. 3) E.g, Solaria's behind-the-meter solution for powered land and Iberdola's commitment to joint ventures with the datacentre industry.

Sources: Aurora Energy Research, Eirgrid, CRU, Virginia State Commission (SCC), Dominion Energy, CoStar

Agenda

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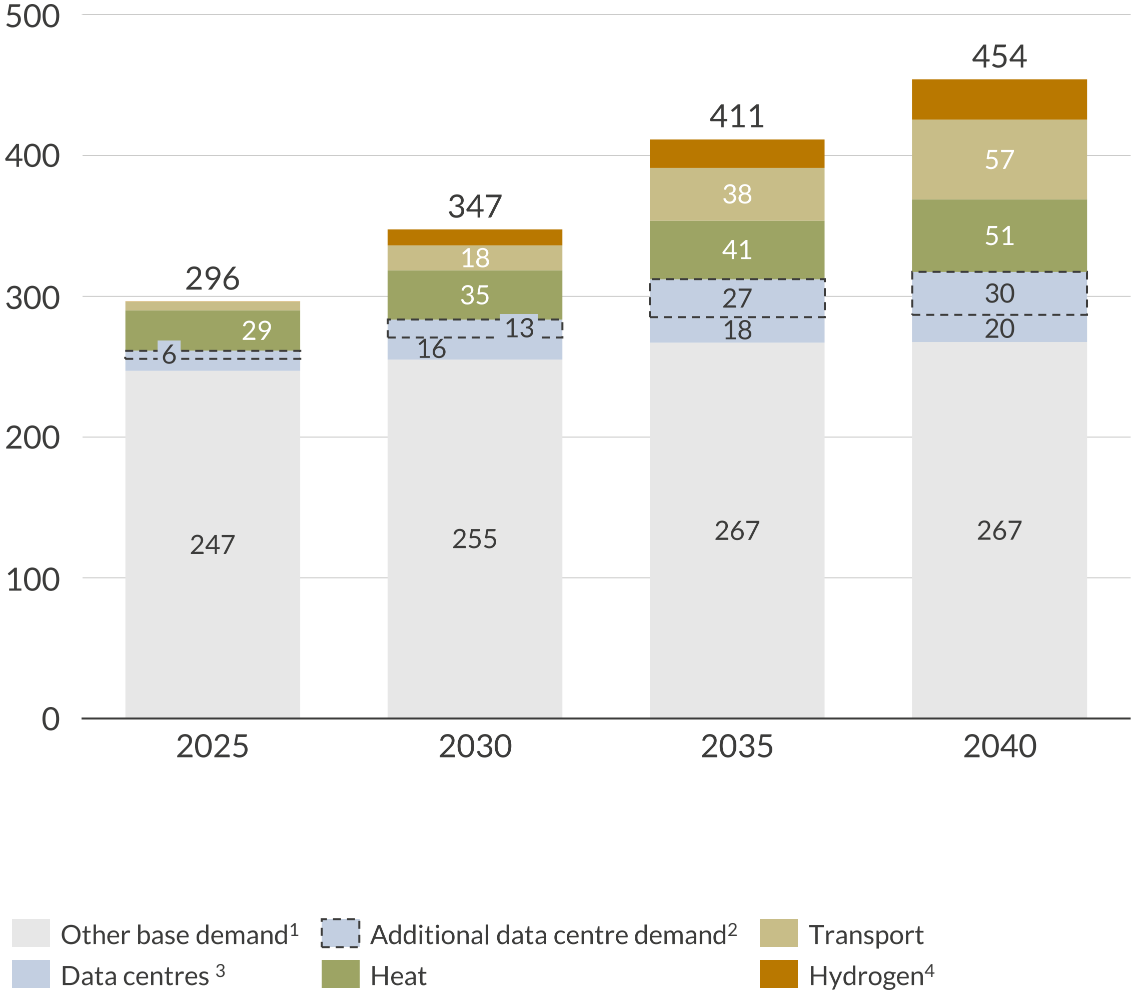
Core scenarios are modelled against Aurora's Central assumptions of power system evolution

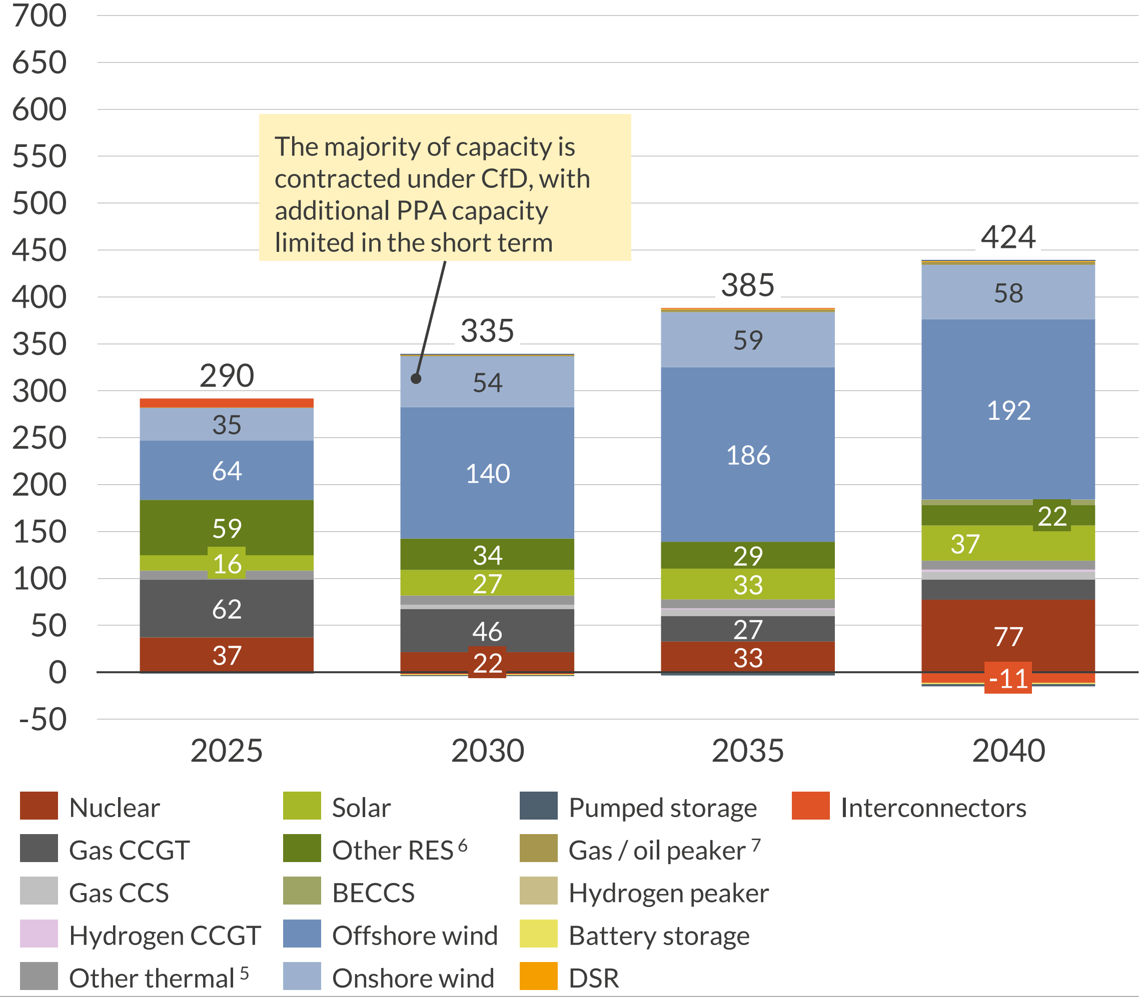
Annual Power Demand – AI expansion

TWh



Electricity Production and Net Imports – Aurora Central

TWh



1) Includes industrial, commercial and residential demand, excluding heating; 2) In line with AI Expansion scenario; 3) In line with Constrained scenario; 4) Demand for Green hydrogen production from electrolysis; 5) Other thermal includes embedded CHP; 6) Other RES includes biomass, EfW, hydro and marine; 7) Gas / oil peaker includes OCGT and reciprocating engines.

Sources: Aurora Energy Research

Boundary capacity assumptions are reflective of upgrade options in ‘Beyond 2030’ and vary across scenarios based on assessed deliverability

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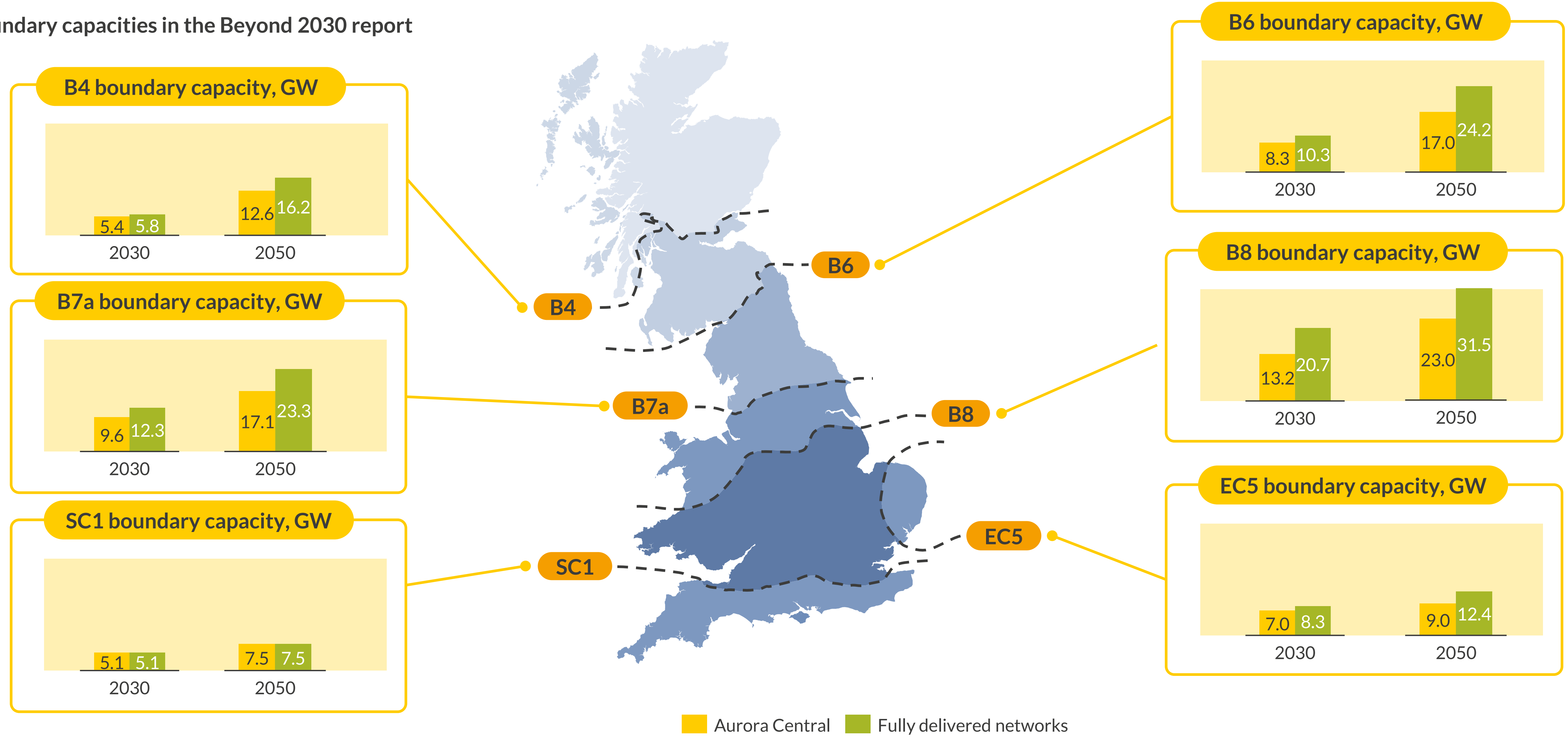
Boundary capacities in the Beyond 2030 report



Sources: Aurora Energy Research, NESO

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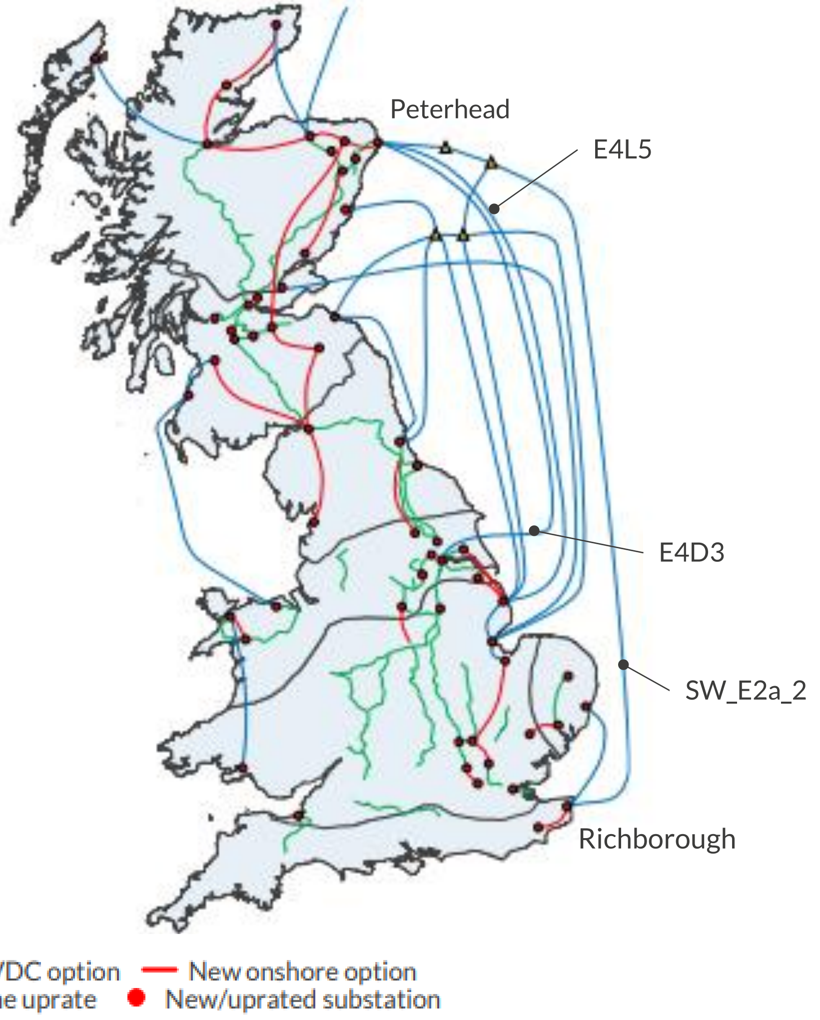
The AI Expansion - Accelerated RES and Networks scenario assumes full delivery of network options presented in 'Beyond 2030'

Illustration of network build-out[1]



Key HVDC lines proposed in 'Beyond 2030'

Line	Year built	Length	Description
E4L5	2030	680km	▪ HVDC link between Peterhead and the East Coast of England
SW_E2a_2	2032	657km	▪ Offshore network cable from a coordinated series of wind farms connecting to Richborough
E4D3	2029	436km offshore and 69km onshore	▪ HVDC link between Peterhead and Drax

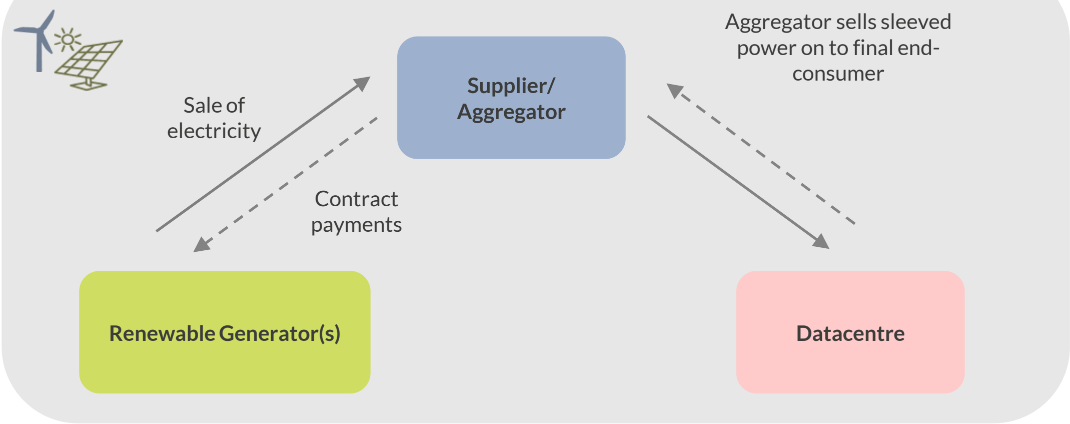
- A full delivery of options proposed in 'Beyond 2030' is assumed in the AI Expansion – Accelerated Renewables and Networks sensitivity, implying rapid deployment of lines relative to the past 10-years of deployment. Total network build-out in this scenario exceeds 5,500 km in total.
- Other core scenarios and sensitivities assume a more conservative network buildout. In these scenarios, 83% of lines proposed in 'Beyond 2030' deliver (based on length). Those that are built, are assumed to be built with an average delay of 1.4 years, relative to the Renewables and Network Acceleration sensitivity.

1) In line with Beyond 2030 plans.

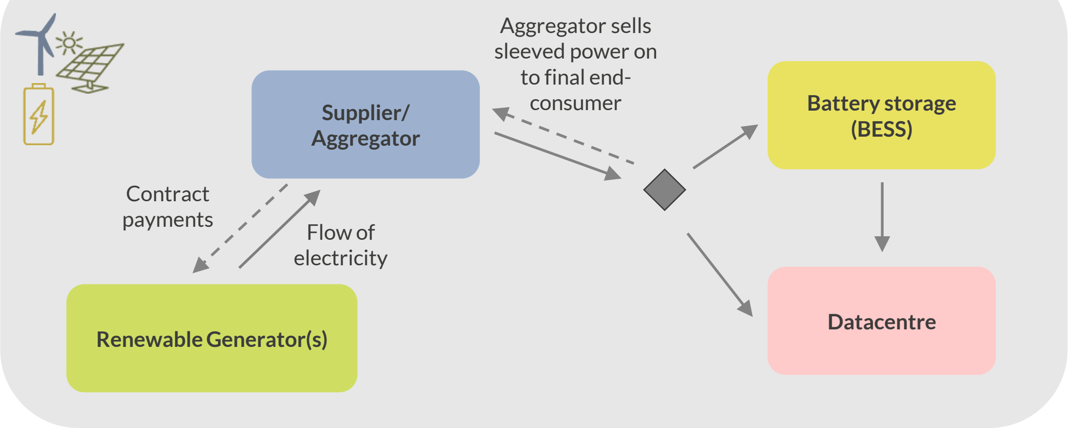
Sources: Aurora Energy Research, NESO

Aurora explored four archetypes that an offtaker such as a datacentre can use to procure time-matched green power

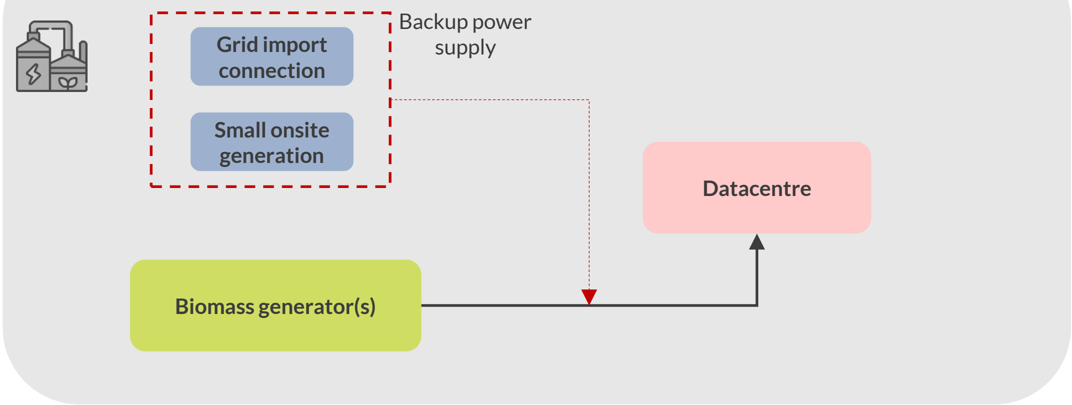
Archetype 1: RES-only



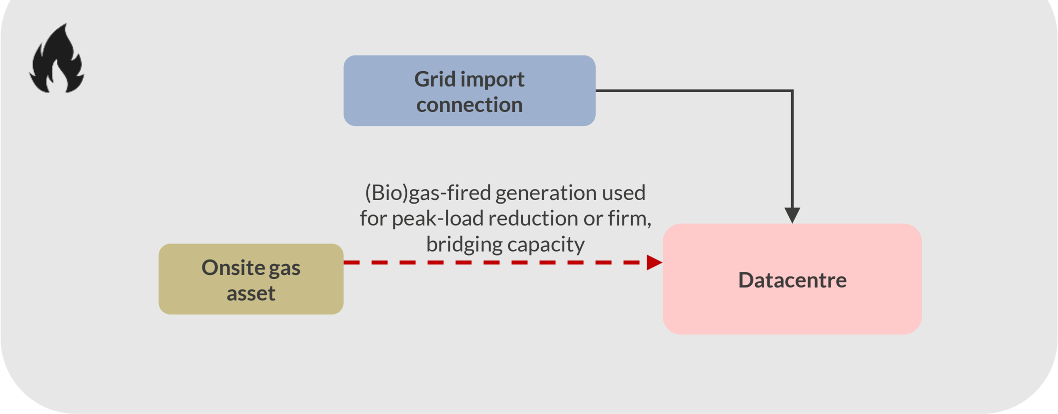
Archetype 2: RES + BESS



Archetype 3: Low carbon baseload (biomass)



Archetype 4 – Onsite gas generation



Source(s) : Aurora Energy Research

To procure time-matched green power, RES portfolio strategies can reach near grid-parity, with behind-the-meter solutions offering cost savings

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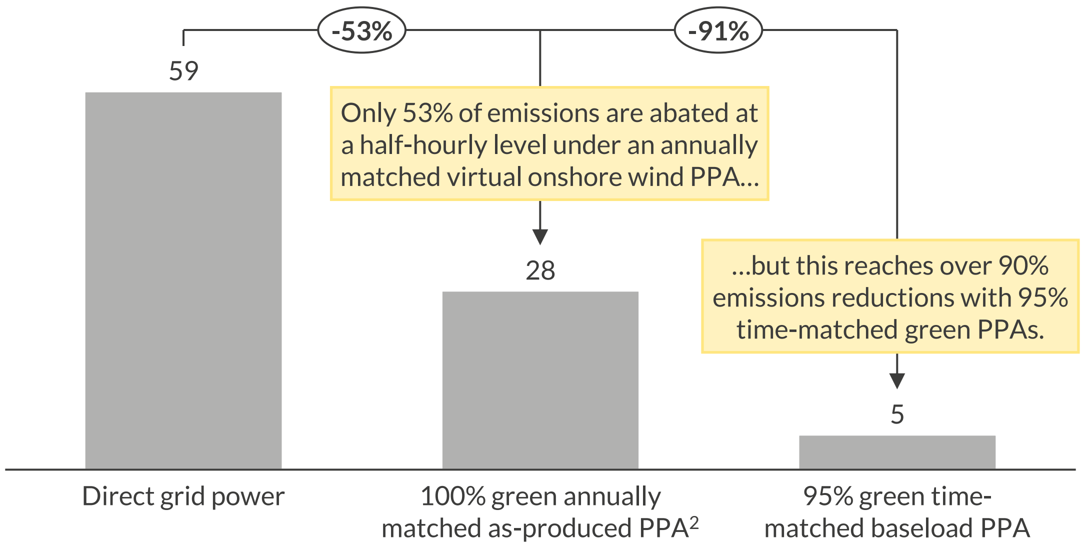
1 The status quo of annually-matched RES PPAs[1] are not fully 'green' given demand during low RES generation would incur carbon intensity of the grid

- Datacentres procuring '100% green power' through annually matched RES PPAs[1] supported by REGOs[2] are not fully emissions-free, since hours of low RES generation require grid imports to meet a DC's baseload demand.
- **Time-matched RES PPAs** provide a guarantee that each half hour of consumed power is supplied by RES generating within the same half-hour.

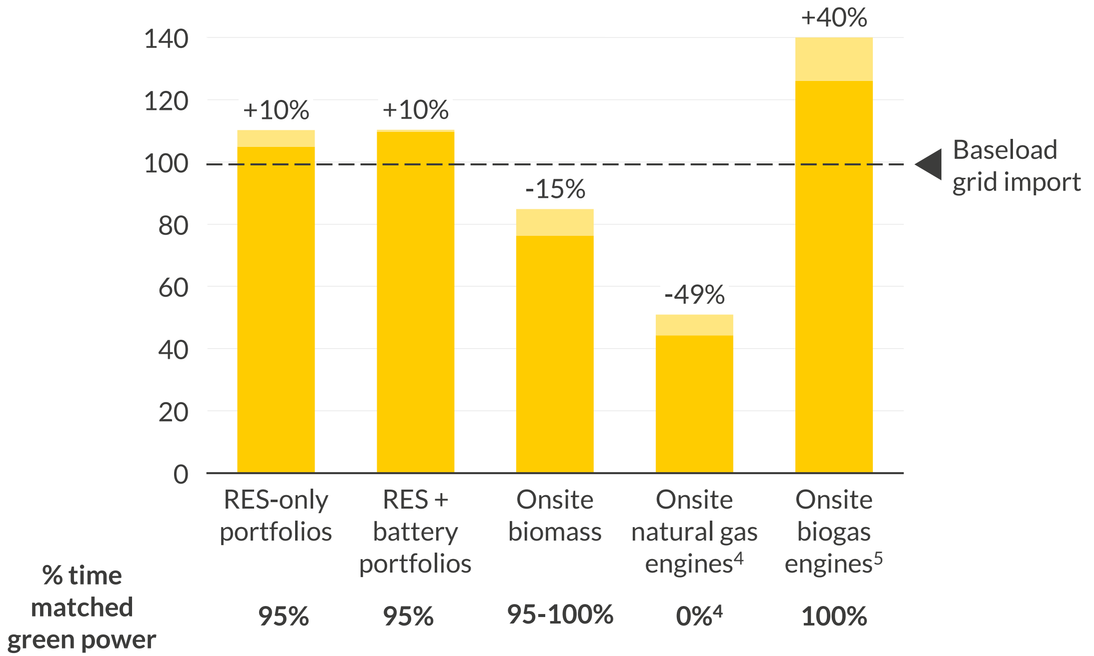
Average emissions intensity for a datacentre (2027-2036 average)
gCO_2e/kWh



2 Aurora explores costs of 95% time-matched green power, ranging between a 15% discount to 40% premium relative to grid imports

- Through modelling costs of four power procurement archetypes for DCs we found that 95-100% time matched green power can be procured at a discount of 15% below or a premium of 40% above grid imports depending on technology strategy and fuel selection.

Datacentre power costs[4] for time-matched green power (2027-2036 avg) normalised to grid import costs, %



1) RES = Renewable Energy Source. PPA = Power Purchase Agreements = bilateral contracts between a consumer and an energy generator for the purchase of electricity, outlining among other clauses a power price and volume of delivery. 2) Renewable Energy Guarantees of Origin. 2) Onshore wind example. 4) Includes wholesale and non-wholesale costs, including network charges (transmission-connected), policy costs and supplier premium. 5) Onsite baseload generation fired by natural gas has $422gCO_2/MWh$ emissions intensity – 7x higher than average emissions intensity of baseload grid imports between 2027-2036. 5) Onsite baseload generation fuelled by biomethane. Source: Aurora Energy Research

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Details and disclaimer

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