Socio-economic Assessment of Green Data Centres in Scotland



Final Report

27/05/2026

FRAZER-NASH CONSULTANCY
A KBR COMPANY

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About Frazer-Nash Consultancy

Frazer-Nash is a systems, engineering and technology consultancy that supports clients in making robust decisions on complex strategic, technical and investment challenges. With over 1,500 employees across ten UK and four Australian locations, we combine deep technical expertise with analytical rigour to help organisations improve the performance, resilience and affordability of critical systems and infrastructure.

Frazer-Nash sector expertise

- Aerospace and transport
- Defence
- Placemaking and development
- Innovation and industry
- Security and resilience
- Power and energy



Our techno-economic assessment team combines economics, policy, strategy and technical expertise to support evidence-based decision-making across government programmes and investments. The team has experience in business case development, scenario modelling, cost-benefit analysis, and monitoring and evaluation. By integrating technical understanding with economic and policy analysis, we help clients assess options, understand trade-offs, and develop a clear evidence base for decisions on value for money, deliverability and long-term outcomes.

Executive Summary

Purpose & scope

Why this matters now?

Scotland faces rapid growth in hyperscale data centre interest. This brings both economic opportunities and system pressures, especially on electricity networks, water, and local communities. The strategic question is how to capture the value that data centres can provide, particularly to the digital economy, in a sustainable manner while maximising benefits for the wider good.

Purpose

Frazer-Nash Consultancy were commissioned by Scottish Enterprise to research and assess the potential socio-economic impacts of hyperscale data centres in Scotland. This study examines both the opportunities and challenges these facilities present for Scotland's economic development, energy infrastructure, and local communities. The unique problem for hyperscale data centres is balancing their resource use and local impacts, with the opportunity they present to contribute to Scotland's digital economy and strategic position within the global digital infrastructure landscape. This work contributes to the evidence base for future policy development and strategic decision-making.

This is an independent research report and does not directly reflect the views of Scottish Government or Scottish Enterprise.

Scope

Socio-economic impacts were captured via desk research and interviews within the following themes:

- *Workforce and skills*
- *Supply chain & economic spillovers*
- *Energy & infrastructure*
- *Community impacts*
- *Policy & planning*

We have considered where possible the complex relationship between factors and how direct, indirect and induced effects interlink.

Out of scope elements

GVA impacts: The scope of this study does not include GVA impacts.

Complementary studies

Heat re-use: Scottish Enterprise has commissioned a separate study into the technical feasibility of heat re-use.

Supply chain: Scottish Enterprise has previously commissioned a separate study providing evidence on the Scottish supply chain.

Background

Scotland’s data centre opportunity

Scotland's Strategy 2026-2031 goals: Data centres and supporting infrastructure are a key part of the Scottish Government’s AI strategy. A key goal for 2031 is to ensure that "investment in Scotland's data centre, energy and water infrastructure maximises benefits for the wider good". [1] To achieve this, the government must base its decisions on solid evidence. This will help manage the tension between rapid growth in AI and the practical limits of Scotland’s power and water supplies.

Scotland's context

Scotland has several strengths that make it well suited to developing a data centre ecosystem, including:

- **Temperate climate:** Data centre heat management is a key technical, economic, and social issue due to the large energy and water requirements cooling systems can have.
- **Renewable energy access:** Scotland’s abundant renewable energy sources can support cheaper, greener data centre developments as laid out in Scottish Government’s green data centres action plan.
- **Strong engineering and computing base:** Scotland’s educational institutions and industry provide a strong foundation in engineering skills. Alongside this, Scotland is a key contributor to AI and computing research globally, hosting ARCHER2, the National Robotarium and the University of Edinburgh. [1]

Hyperscale data centres

Large industrial facilities supporting global cloud computing and AI development, typically defined by housing at least 5,000 servers, and 10,000 sq. ft. [2] Hyperscale sites utilise specialised, efficient architectures to manage vast computational loads.

Green / sustainable data centres

Developments designed to minimise the environmental impact of data centres where possible, within the constraints of the hyperscale data centre energy, water, and land demands. Where evidence uses a different definition, this report highlights that interpretation. Note that there is no universally agreed definition, highlighted by use of both green and sustainable as descriptors.

Approach

Research questions

This report answers the following key research questions:

1. How can data centres create socio-economic impacts?
2. To what extent do data centres realise these impacts?
3. How does policy, planning, and interventions influence these impacts?

Approach:



Rapid evidence assessment of international policy, market, and industry material, to address each research question.



14 semi-structured interviews with national utility providers, designers/developers/builders, local government, industry bodies, and community groups, analysed thematically against the research questions.



Synthesis combining literature, interview insights, and technical data centre expertise to develop Scotland-specific implications and insights.

Limitations:

- Data centre sector immaturity and rapidly changing technology constrains data-driven analysis, hence an emphasis on stakeholder insights.
- A fast-moving policy and technology space mean standards and strategy are still being defined.
- Findings reflect evolving positions within industry.

Key findings: energy system risks

Rapid hyperscale expansion could stress Scotland's electricity system without coordinated planning, data transparency, and targeted mitigations.

What the evidence and stakeholders said:

- Utility companies are concerned that they cannot quickly connect multiple large power demands to parts of the electricity grid that are already under rising pressure.
- International examples show governments pausing or reshaping data centre growth when under grid stress, harmful price effects, or backlash from low public acceptability. [3] [4] [5]
- **Tension:** there is pressure to accelerate connections for competitiveness conflicting with full understanding of whole-system consequences.
- **Gap:** there is limited shared visibility of the pipeline and life-cycle load profiles across developers, system operators and local authorities.
- **Implication for Scotland:** Impacts could include a risk of stranded projects or delayed connections; local price/constraint effects; opportunity cost vs other electrification priorities.

What can Scotland do?

- Structured collaboration between developers, networks, and government to map pipeline scenarios and connection options.
- Engage with NESO and NPF4 to support a flexible, data centre specific planning and investment ecosystem that prioritises:
  - diversified siting;
  - load shifting and flexibility (e.g., batteries/on-site generation);
  - and clear energy and water efficiency metrics (e.g., Power Usage Effectiveness (PUE), Water Usage Effectiveness (WUE)) as part of consent and ongoing reporting.
- Track and learn from peer countries (Ireland, Germany, Netherlands) that have introduced efficiency standards, zoning rules, and waste-heat obligations, adapting only what fits Scotland's context and national data centre strategy.

Key findings: hyperscale opportunities

Hyperscale facilities can be enabling infrastructure. Direct impact may be modest, but indirect and induced value can be significant when linked to a wider ecosystem.

What the evidence and stakeholders said:

- There are currently up to 20-25 proposals for hyperscale data centres at various stages of development across Scotland, reflecting strong market interest. [6]
- For the local economy, direct value is limited when capital is imported (pre-fabricated racks & hardware), and when procurement bypasses local supply chains.
- **Tension:** there is pressure to move fast to stay competitive vs taking the time to lock-in local value and system-friendly designs.
- **Gap:** there is greater uncertainty on benefits (e.g., heat reuse, local skills, digital spillovers) contrasting well-understood costs and constraints, creating a risk asymmetry.

How Scotland can make it work

- **Specialise:** focus on intersections where Scotland is strong:
  - renewables integration;
  - research base;
  - and co-location.
- **Retain value:** develop a Scottish supply chain for construction, grid services, operations, and maintenance; promote local skills pathways.
- **Benefits case:** support site-specific, measurable benefit packages (e.g., heat-reuse offtakes, flexibility services, local workforce targets) enabling planning and consent with intent to maximise regional benefit to Scotland.
- **Compete on differentiation:** taking a competitive position on the side of innovation and sustainability rather than price or deregulation.

Priorities & research gaps

Priorities:

- **Define success:** Scottish strategy defines outcomes for the economy, but more detail is needed for both industry and local authorities. Lay out energy targets through PUE and WUE metrics, provide clear expectations for local and community benefits.
- **De-risk developments:** Support collaboration between stakeholders to deepen understanding in energy system impacts, learning lessons from peer countries.
- **Align planning, narrative, and acceptance:** Improve narratives and data on benefits and costs, supporting community acceptance by prioritising data centres with a realistic socio-economic, region-specific impact case.
- **Measure outcomes:** Co-ordinate tracking and measurement of data centre outcomes such as through flexible community benefits frameworks and reporting, enabling evaluation of early socio-economic impacts.
- **Provide unified governance:** Reduce siloed planning and support local authorities lacking the capacity and tools to deliver informed planning decisions.

Opportunities for further research to address data gaps:

- **Grid flexibility valuation:** Quantify the impact data centres can have through grid flexibility, specifically regarding the mitigation of wind curtailment costs across peak and off-peak temporal cycles.
- **Opportunity cost analysis:** Evaluate the trade-offs of hyperscale investment against alternative assets, such as utility-scale green hydrogen, battery energy storage systems (BESS), and co-location clusters.
- **De-carbonising on-site power:** Assess the technical and economic viability of replacing fossil-fuel backup generators with low-carbon alternatives, including small modular reactors (SMRs), hydrogen fuel cells, and advanced biofuels. This is caveated by note of Scotland's existing policy against new nuclear, although important to raise given frequent mention across stakeholder groups.
- **Understanding the end user:** Analyse the profile of hyperscale end-users and identify the ultimate beneficiaries of data-processing value to help address the specific value compared to smaller scale co-locate.
- **International policy analysis:** Monitor and track the success of other national policies over time to identify effective strategies for sustainable growth.

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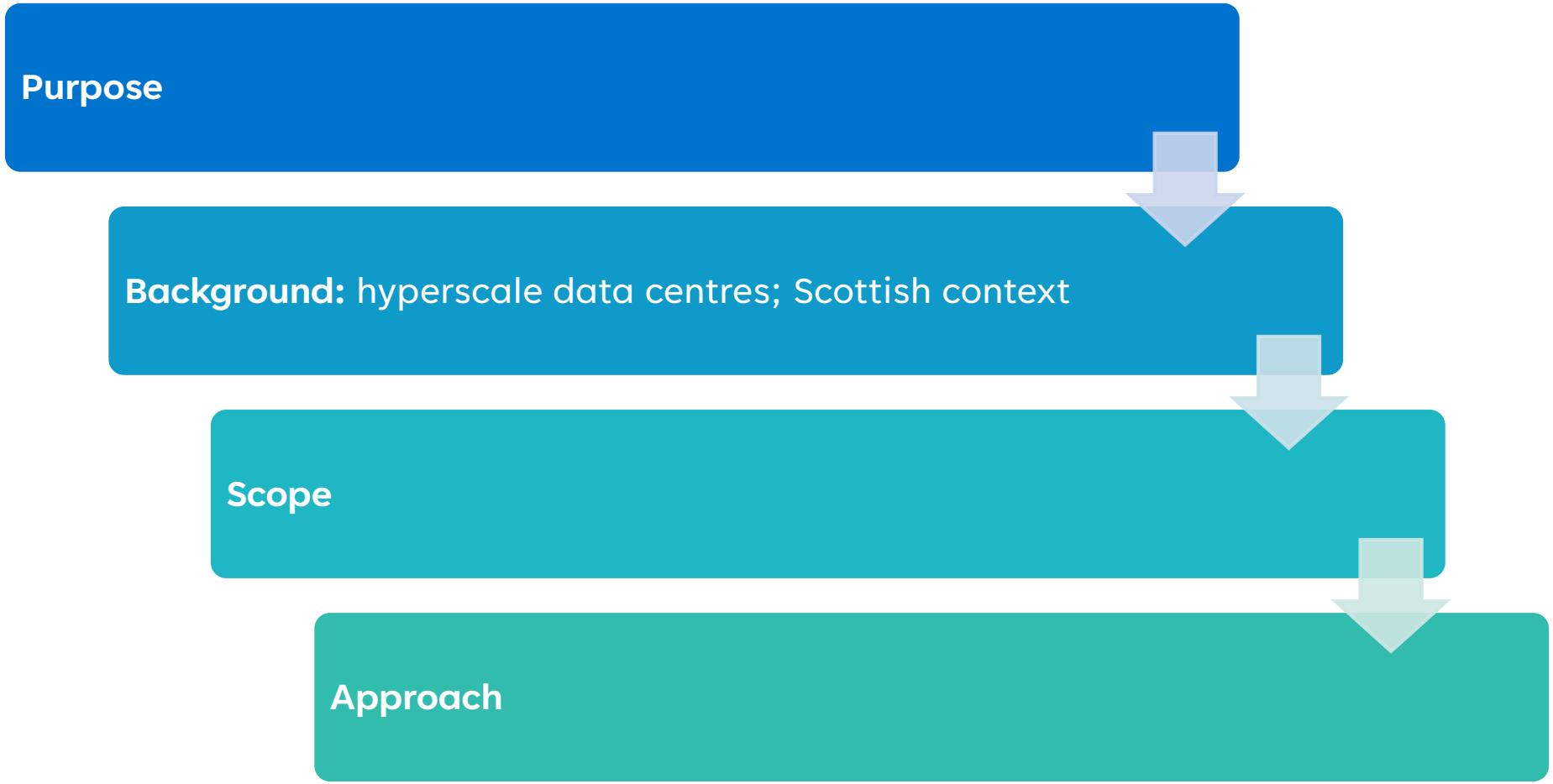
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Introduction

Introduction

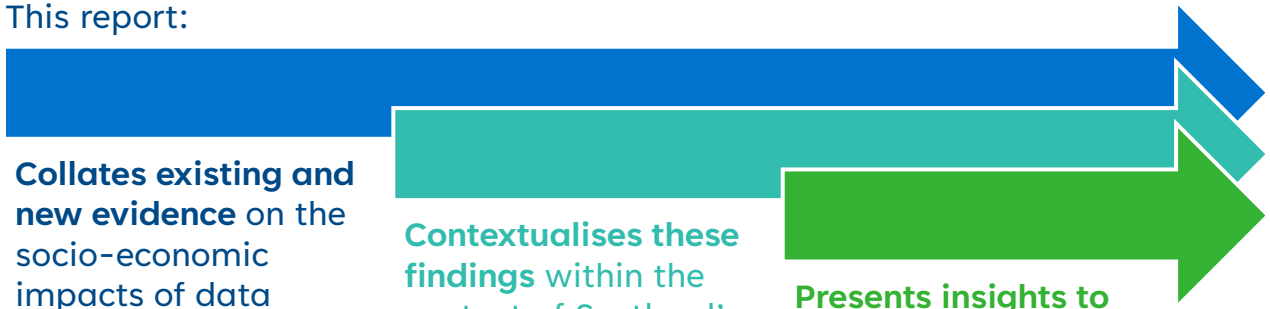
The **introduction** section is structured as follows:



Purpose

Frazer-Nash Consultancy were commissioned by Scottish Enterprise to research and assess the potential socio-economic impacts of hyperscale data centres in Scotland. This study examines both the opportunities and challenges these facilities present for Scotland's economic development, energy infrastructure, and local communities. The unique problem for hyperscale data centres is balancing their resource use and local impacts, with the opportunity they present to contribute to Scotland's digital economy and strategic position within the global digital infrastructure landscape. This work contributes to the evidence base for future policy development and strategic decision-making.

This report:



Collates existing and new evidence on the socio-economic impacts of data centres;

Contextualises these findings within the context of Scotland's existing national economic and strategic policy; and,

Presents insights to Scottish Enterprise and Government to support future investment and policy decisions.



This report adds to the wider evidence base (see slide 13).

Research questions

This report answers the following key research questions:

1. How can data centres create socio-economic impacts?
2. To what extent do data centres realise these impacts?
3. How does policy, planning, and interventions influence these impacts?

Background: hyperscale data centres



Definition*: *Hyperscale data centres are large industrial facilities supporting global cloud computing and AI development, typically defined by housing at least 5,000 servers, and 10,000 sq. ft. [2] Hyperscale facilities employ highly optimised, specialised architectures that manage vast computational workloads while supporting rapid scaling, low-latency networking, and streamlined power and cooling systems. They are recognised as critical national infrastructure by the Department for Science, Innovation and Technology (DSIT), [7] requiring strategic oversight to ensure their development aligns with national sustainability targets, grid capacity constraints, and long-term socio-economic growth goals.

Data centres currently support a wide range of essential digital services, including cloud computing, AI workloads, e-commerce, financial transactions, and public sector platforms, making them foundational to modern economic activity. As hyperscale data centres enable these digital services on a global scale, it is notable that there is no known restriction around Scotland's access to these digital services depending on geographical proximity or no. of data centres hosted. Looking ahead, demand is expected to grow sharply, with forecasts indicating a six-fold increase in global data centre capacity required by 2035, involving around US $3 trillion in new investment. [8] This trajectory underscores the sector's critical present-day role while highlighting its future impact on national, regional, and local socio-economic development.

Definition: Green / sustainable data centres are defined for this project as developments designed to minimise environmental impact as far as reasonably achievable, acknowledging the substantial energy, water, and land demands inherent to hyperscale facilities. These terms reflect how industry and government commonly describe data centres that incorporate measures such as renewable energy use, advanced cooling, improved efficiency, or reduced resource consumption. However, there is no universally agreed definition, and where evidence sources use differing interpretations, this report highlights those distinctions. The lack of a clear definition has been underscored recently by Edinburgh Council's move toward a temporary ban on new AI data-centre developments pending national guidance on what constitutes a 'green' data centre. [9]



There are clear tensions between hyperscale's massive energy demands and Scottish sustainability goals, which this report explores. This intersection is of interest to Scottish Government, as laid out in **Green datacentres and digital connectivity: vision and action plan for Scotland.** [10] The following slide provides further detail on the Scottish context.

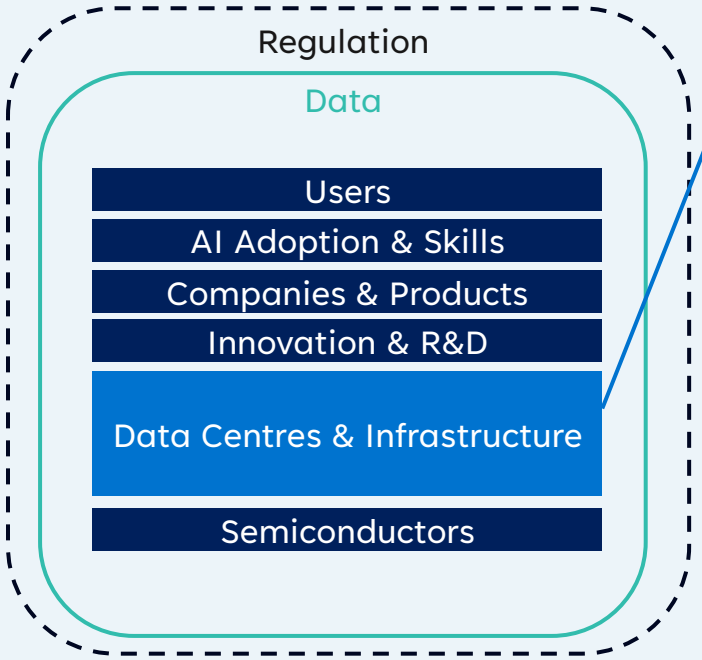
Background: Scottish context

Scotland has several strengths that make it well suited to developing a data centre ecosystem, including:

- **A temperate climate:** Data centre heat management is a key technical, economic, and social issue due to the large energy and water requirements cooling systems can have. Scotland's weather climate and geographic advantage enable open air or even sea water cooling, reducing the energy and water required in the cooling process. [11] [12] [13]
- **Renewable energy access:** Scotland's abundant renewable energy sources can support cheaper, greener data centre developments as laid out in Scottish Government's green data centres action plan. [10]
- **Strong adjacent industry and computing base:** Scotland's educational institutions and industry provide a strong foundation in engineering, high-value construction, large-scale energy infrastructure, IT and advanced manufacturing. Alongside this, Scotland is a key contributor to AI and computing research globally, hosting Edinburgh Parallel Computer Centre the UK's first national supercomputing centre, and the Generative AI Laboratory at University of Edinburgh. [1]

Strategy and policy context

- **Scotland's AI Strategy 2026-2031:** Data centres & infrastructure form a critical component of the Scottish Government's AI Stack. Within the strategy *"investment in Scotland's data centre, energy and water infrastructure maximises benefits for the wider good"* is an outcome for 2031. Achieving this requires a robust evidence base to navigate the strategic conflict between rapid AI-driven growth and the inherent constraints of Scotland's power and water infrastructure. [1]
- **Scottish Government's Green Data Centre Vision and Action Plan:** aims to position Scotland as a leading commercial destination for green data centres, with infrastructural uplift contributing to net-zero targets.



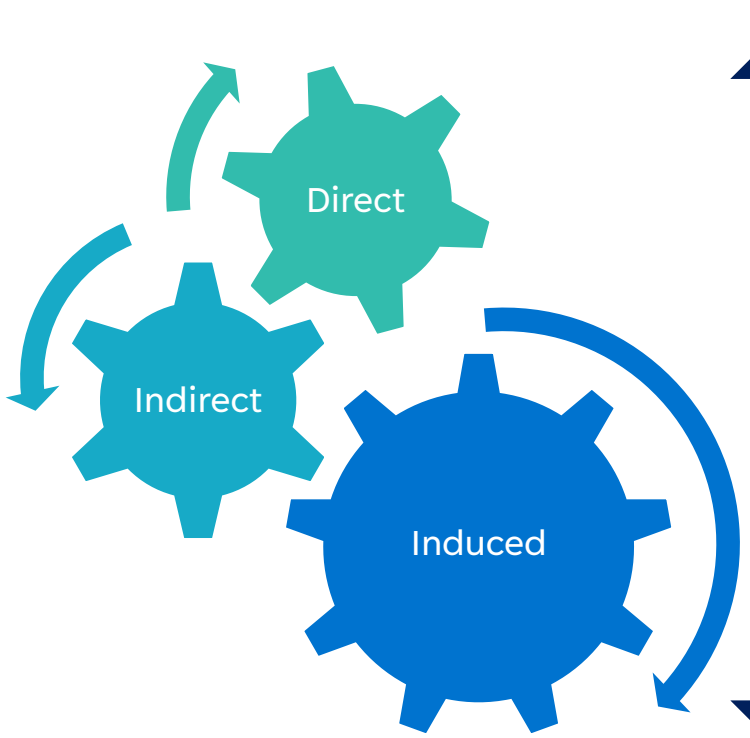
Outcomes outlined by Scottish Strategy:

- Globally competitive investment landscape in sustainable data centre development
- Green data centre connectivity
- Tangible benefits realisation across community, AI compute, talent and innovation
- Resilient infrastructure, sovereign AI capability critical service support.

Scope

This report covers the following research questions:

1. How can data centres create socio-economic impacts?
2. To what extent do data centres realise these impacts?
3. How does policy, planning, and interventions influence these impacts?



Socio-economic impacts were captured within the following themes:

- *Workforce and skills*
- *Supply chain & economic spillovers*
- *Energy & infrastructure*
- *Community impacts*
- *Policy & planning*

We have researched where possible around the complex relationship between factors in the system, and how direct, indirect and induced effects interlink to create a holistic analysis. This particularly links to our primary theme Workforce & Skills and the sub-themes such as those concerning additionality and displacement.

What isn't covered?

Out of scope elements:

GVA impacts: The scope of this study does not include GVA impacts.

Environmental impacts: This study does not conduct any environmental assessments of data centres.

Complementary studies:
Heat re-use: Scottish Enterprise has commissioned a separate study into the technical feasibility of heat re-use.
Supply chain: Scottish Enterprise has previously commissioned a separate study providing evidence on the Scottish supply chain.

Approach

Rapid evidence assessment: Conducted a rapid assessment of existing literature, covering impact studies, international policy, and industry reports, to answer each research question.

Interviews and thematic analysis: Hosted 14 semi-structured interviews with stakeholders across industry, government and community groups (see table below). Thematic analysis was used to group insights by research question and theme.

Synthesis: Developed findings, cross-referencing our REA, interview, and technical data centre expertise to provide insights to Scottish Enterprise. This report contains the totality of our findings.

Organisation Type	Public bodies	Industry, supply chain & private companies	Community & education
Organisations	Scottish Water, North Lanarkshire Council, Scottish Government planning, Scottish Government Start-ups, Scottish Environment Protection Agency	RedEng, Carbon3IT, Apatura, DataVita, DataARK, ScotlandIS, Scottish Power	Action to Protect Rural Scotland, Data Lab
Example stakeholder roles	Chief Executive Officer, Head of Sustainability, Managing Director, Chief Growth Officer, Senior Planner, Chief Strategy Officer.		

Findings

Findings

The **findings** section is structured as follows:

Research question 1: How can data centres create socio-economic impacts?

Research question 2: To what extent do data centres realise these impacts?

Research question 3: How does policy, planning, and interventions influence these impacts?

International comparisons: lessons for Scotland, hyperscale data centres, green data centres

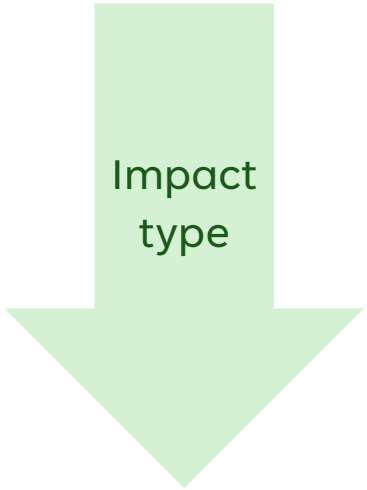
Hyperscale vs co-locate

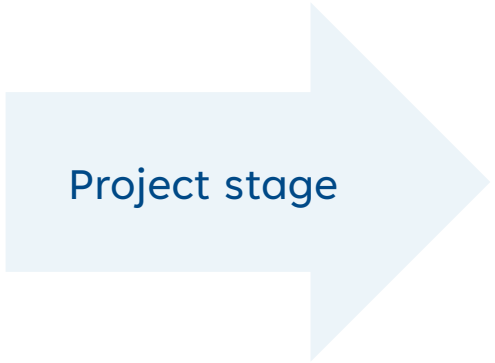
Findings:
Research question 1: How can data centres create socio-economic impacts?

RQ1: How can data centres create socio-economic impacts?

The following slide presents a data-centre development timeline (design, construction, operation & maintenance), featuring key socio-economic impacts investigated within this research (not an exhaustive list), categorised by impact type and project stage.

Impacts are categorised by...





... to identify the impacts data centres *could* have.

RQ1: How can data centres create socio-economic impacts?

Impact Type / Project Stage	Investment & planning stage	Build / construction stage	Operations & maintenance stage	Downstream digitalisation (spillovers) stage
Workforce and skills	• Direct, indirect, and induced employment • Skills & training impacts	• Direct, indirect, and induced employment • Skills & training impacts	• Direct, indirect, and induced employment • Skills & training impacts	• Direct, indirect, and induced employment • Skills & training impacts
Supply chain & economic spillovers	• Developing sovereign capability • Talent attraction and retention • Supply chain development • Attracting further investment • Connectivity infrastructure	• Developing sovereign capability • Talent attraction and retention • Supply chain development • Attracting further investment • Connectivity infrastructure	• Enabling the digital economy • Developing sovereign capability • Talent attraction and retention • AI & digital tech clusters • Attracting further investment • Supply chain development	• Enabling the digital economy • Developing sovereign capability • Talent attraction and retention • AI & digital tech clusters • Attracting further investment • Connectivity infrastructure
Energy & infrastructure	• Investment in connection infrastructure • Investment in renewable energy	• Investment in connection infrastructure • Investment in renewable energy	• Energy use impacts on grid capacity, inc. curtailment impacts • Energy cost impacts • Grid balancing impacts • Water use impacts • Heat re-use impacts	
Community impacts	• Community support and engagement impacts	• Site-specific disruption • Local infrastructure development • Community support and engagement impacts	• Heat network integration • Educational partnerships • Hyper-local community benefits and funds • Community support and engagement impacts	• Hyper-local upskilling and talent attraction • Community support and engagement impacts

Findings:
Research question 2: To what extent do data centres realise socio-economic impacts?

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Workforce & skills	
Direct employment: Most direct employment is concentrated in the temporary construction phase of data centre developments. • **Construction:** Creates the largest volume of jobs, mostly standard construction activities. Hardware (e.g., chips) for these sites would likely come from overseas, meaning the majority of the investment may be imported. • **Operation:** Direct onsite staffing is relatively light-touch and modest. Estimates suggest at most 100 permanent for a large-scale facility, focused on 24/7 security, site engineering, and facilities management. Due to the speciality equipment, some maintenance would require specialist engineering, likely imported from overseas where hardware is manufactured. **Additionality and displacement effects:** There were mixed views on the additionality of employment in Scotland. • **Construction:** Stakeholder evidence suggests that Scotland has the right skills to construct hyperscale data centres. However, there are concerns around capacity, especially given the current focus of proposals around the Central Belt, where there would be competition for labour. This may be exacerbated by concurrent energy infrastructure projects to support data centre operation, and result in a need for strategic prioritisation of resource. • **Operation:** Some stakeholders emphasised that skills were highly transferable, suggesting high levels of displacement, while others argued that data centres offered the opportunity to create genuinely new roles. Given the level of competitions for roles, both between industries nationally, and within the sector internationally, it is likely that some level of data centre employment results in employment reductions in other sectors, though this is mitigated by the low number of staff data centres employ.	**Reporting mismatch:** Pre-construction planning studies tend to focus on the impacts of individual sites, whereas post-construction impact studies tend to focus on regions. This makes tracking impacts from planning through to realisation more difficult. **Data aggregation:** The impact of data centres in creating jobs is often aggregated across impact types, sector, and or national and sub-national economies, obscuring local impacts. **Data assumptions:** Key assumptions, particularly around the value of imported goods and services, can have a large impact on final results. Across the available literature there is a lack of publicly available sensitivity analysis. **Capacity data gaps:** There is a lack of system capacity modelling to understand future scenarios.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Workforce & skills	
Indirect and induced employment effects: The economic multiplier from data centres has a wide range of estimates across contexts, from 2.1 to 6.5. [14] [15] There are arguments in both directions on likely outcomes in Scotland: • Scotland's specialised supply chain can immediately provide indirect support to data centre development, supported by demand for renewable energy boosting other sectors in the supply chain, with stakeholders noting uncertainty in Scotland's supply chain capacity to handle concurrent projects across data centre roll-out and infrastructure upgrades (see slide 26). • As discussed elsewhere, a crucial assumption is around the proportion of spend that actually occurs in the Scottish economy. Large amounts of the data centre supply chain are overseas, particularly for the specialised equipment, potentially mitigating indirect spend and jobs. Additionally capacity and skills constraint discussed in the corresponding sections may result in Scotland being unable to match the requirements for supporting engineering roles, resulting in further imports.	**Data assumptions:** Multiplier effects are constructed with significant economic assumptions. • The data centre industry does not have a specific sector in the national accounts, so it is implicitly assumed to broadly follow the characteristics of the wider tech industry. • There can be regional differences in multiplier effects that are not captured within existing studies. Developments in rural versus urban areas may see differences in indirect and induced spending patterns.
Wages: Data centre jobs offer average annual salaries approximately £10,000 higher than comparable roles in other industries, reflecting their value and supply shortages. [16] Stakeholders broadly agreed with this sentiment for engineering roles, but several questioned the actual mix of roles in data centres, with several believing many of the local jobs, would be for less technical roles like security guards, cleaners, and ground staff.	**Data gap:** This study did not collect systematic job-level primary data from developments on their skills and wage requirements. There remains some uncertainty, which was reflected by stakeholder sentiments.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Workforce & skills	
Skills • **Scottish strengths:** Scotland has a historically strong engineering base with transferable skills from the offshore wind, oil and gas, and shipbuilding sectors, and many well-regarded universities. • **Scottish weaknesses:** Despite existing general expertise in engineering, there are specific gaps in skills that require further training to address. Industry currently import talent to fill specific shortages, particularly in high voltage engineering, further reducing the immediate impact of data centres. Skills gaps aren't exclusive to industry, with public bodies also addressing a lack of capacity within local authorities in planning roles. **Training** • **Opportunities:** Developers are already working with educational institutions to establish digital and STEM upskilling programmes at a national and regional level to meet anticipated demand for data centre skills.	**Additionality of skills:** Talent and skills programmes improve cross-sector mobility, according to the organisations that host them. Yet there is a risk of low additionality, as these programmes might only be training people who were already planning to enter the tech sector and would have received similar training regardless. **Regional disparities:** Current proposals are focused on the skills and capacity in the Central Belt area: • This risks creating and or widening the productivity gap between regions, with secondary effects of brain drain between regions. • This can increase pressure on local infrastructure. • The optimal location to site data centres depends on energy resource, workforce and land availability. It may not be possible to optimise all in the same location.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Supply chain & economic spillovers	
Enabling the digital economy • Evidence and stakeholders agree that a key potential benefit of data centres is the value they provide in supporting the wider economy, both directly providing services to tech, AI, and innovation, but also as an enabler across all sectors, in cloud services, banking, and communication. **Sovereignty:** There are two key questions around the question of sovereign capability and hyperscale data centres: 1. Is whether having these data centres physically in Scotland necessary to unlock these benefits, as cloud services can often be accessed remotely with negligible latency for many applications? 2. Following on, is Scottish domestic hyperscale a strategic capability that should be supported, or, can these be accessed through partners hubs in London, Dublin, or the Netherlands? This report attempts to provide an answer to question one, while Scottish national strategy does not yet explicitly answer question two.	**Attribution:** Data centres underpin a large proportion of economic activity, with a *"theoretically unlimited range of purposes"*. [17] Quantifying and attributing that impact to specific regions and or sites is an economic question often left unanswered. Our focus is therefore on the direct and traceable spillover impacts of data centres rather than AI and data as a whole. Direct support for local tech sector productivity may include low-latency services and improved digital connectivity/infrastructure, although notably some of these gains may have been realised otherwise. **Hyperscale and co-locate:** There is uncertainty in the role hyperscale plays, with many of these services being supported by smaller, specifically designed data centres. This is explored further on slide 46.
Talent attraction and retention: • Having hyperscale digital infrastructure helps a region keep and attract skilled people. However, because markets in Europe and the USA are more established, this infrastructure is not a unique advantage. It is also important to note that data centres create relatively few jobs, which limits their ability to attract talent directly. Therefore, the greater value lies in creating confidence in other local technology sectors, such as offshore wind.	**Hyperscale and co-locate:** There is also uncertainty about whether large industrial hyperscale units or smaller co-locate facilities are more attractive. Hyperscale sites tend to offer permanent operational roles, whereas smaller facilities attract specialists looking for high-value research and development opportunities. More details on slide 46.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Supply chain & economic spillovers	
Supply chain: • **Scotland's current capability:** Scotland has existing capabilities in civil engineering that can support data centre development. A Soben study, commissioned by Scottish Enterprise, has identified Scottish suppliers with capabilities with data centre construction, though notes significant development would place extreme demand on the Scottish supply chain. [31] • **Import dependency:** There is a significant proportion of data centre investment that will be imported to Scotland primarily in the high-value components. This limits the investment's value to Scotland's economy. • **Scottish capability growth:** Stakeholders believed Scottish firms could grow to meet specialised data centre demands in mechanical and electrical engineering through proposed projects. • **Knowledge spillovers:** Local engineering firms and staff can gain valuable experience from international projects, which they can then apply to other sectors.	**"Zombie projects"** are speculative data-centre proposals that have no confirmed buyers, tenants, or committed operators. These proposals may look credible on paper, but they are unlikely to proceed. They consume significant time and resources, utilities must assess grid-connection requests, public bodies must review planning submissions, and local supply-chain firms may prepare bids. In short, leading to inefficiency, delays, and wasted effort. **Procurement constraints:** Public bodies cannot legally force developers to use local suppliers. Local benefits depend on whether Scottish firms are competitive, whether data centres are already tied into global contracts, and the developer's own voluntary social goals.
Connectivity infrastructure: • Data centres drive investment in subsea and terrestrial fibre infrastructure, improving overall Scottish connectivity.	**Connectivity bypass:** There is a risk that new fibre cables will connect data centres but bypass local communities, acting like a motorway with no junctions for residents.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Supply chain & economic spillovers	
AI & digital tech clusters: • Large data centres can anchor innovation districts by attracting AI start-ups and research spinoffs. However, stakeholders believe existing co-location facilities are also effective at fostering local clusters and may be more accessible to smaller businesses. Evidence suggests a common example of hyperscale data centres creating clustering effects is where data centres themselves cluster, to take advantage of local fibre and power infrastructure. [37] • Recent synthetic-control analysis of around 770 US data centres (2008–2024) finds that counties receiving a hyperscale facility see information-sector employment (IT services, telecoms, software) rise by approximately 22%, while colocation-only counties show no equivalent effect. The mechanism is that hyperscale campuses generate localised demand for fibre installers, network operations, managed service providers and IT contractors, whereas colocation tenants are typically remote. [38] • The same study finds that counties hosting one data centre see modest total employment gains but no significant information-sector growth, whereas counties with four or more facilities see a 23% increase in information-sector employment. The technology ecosystem effects that distinguish data centres from other large industrial assets appear to require concentration and time to develop.	**Cluster maturity:** Clusters won't necessarily form on their own without wider support. To be effective, government, academia, and operators must work together from the start to put a collaboration framework in place. **Evidence transferability:** Findings are drawn from the US labour market and may not transfer cleanly to Scotland's smaller economy. Naive estimates used in many industry-funded studies overstate cluster effects by a factor of three, and wage gains for local workers are modest (3–4%). The result also complicates the stakeholder view that colocation is the stronger driver of local clusters. **Scale and concentration risk:** A single anchor facility is unlikely to generate meaningful clustering on its own. Realising cluster benefits may require accepting a degree of geographic concentration, which risks reinforcing existing tech hubs at the expense of other regions. Multi-year horizons for cluster maturity also sit uneasily with shorter political and planning cycles.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Supply chain & economic spillovers	
AI & digital tech clusters: • Recent analysis argues that standard warehouse-style data-centre deals deliver short-term construction jobs and tax revenue but limited durable economic upside. Where wider clustering benefits do materialise, they are typically the result of explicitly negotiated co-investment: Microsoft's Wisconsin deals include an AI Co-Innovation Lab with the University of Wisconsin–Milwaukee, a Datacenter Academy training pipeline, and broader workforce programmes; CoreWeave co-founded the NJ AI Hub with Princeton alongside a $20 million startup fund; the Massachusetts Green High-Performance Computing Center is a shared testbed jointly developed by six universities and industry partners. The UK's National Quantum Computing Centre, which funded seven testbeds with around £30 million, is cited as an analogous European model. [39]	**Pre-conditions and capacity:** The evidence base is largely composed of early-stage cases whose durability is unproven. Success appears contingent on regions already having strong universities and an innovation base to leverage, with equity implications for siting in areas without these assets. Effective negotiation also requires significant public-sector capacity, which smaller authorities may lack.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Energy & infrastructure	
Grid impacts • **Connection and capacity:** Grid connection is one of the biggest constraints to deployment. Queues are currently pressured by speculative applications, although Scottish Government is engaging collaboratively with NESO and the UK Government on its Connections Accelerator Service and Grid Connection Reform, to hasten project connectivity. • **Infrastructure investment:** Data centres can drive upgrades to local power networks. However, a beyond baseline power requirement by hyperscale facilities may drive high utility costs for consumers or slow connectivity of other assets in queue. • **Investment timing:** Infrastructure often requires 5–10 years to build, whereas data centres want speed to market within 24 months. This creates a timing gap where data centre facilities can be built much faster than the power systems needed to run them. • **Energy costs:** Costs are another primary driver of competitiveness and site selection. Part of the appeal of Scotland is access to theoretically cheaper surplus renewable power. • **Efficiency gain:** Hyperscale facilities are significantly more efficient than legacy on-premise servers due to optimized cooling and reduced distribution losses.	**Price mechanisms:** Scottish green electricity is currently priced against natural gas due to UK market structures. This makes Scottish electricity more expensive than in competing nations like Norway and Sweden, challenging the assumption of cheap green power. **New technology:** Rapid changes in data centre design and technological components mean current energy and water data on requirements could quickly become obsolete, creating new challenges for local infrastructure planning. **Location trade-offs:** Data centre locations often face a conflict between economic needs (workforce and connectivity) and resource availability. These trade-offs are hyper-local and change depending on the site's climate. **Jevons paradox:** Increased efficiency often drives higher demand. As computing becomes more affordable and efficient, alignment with Scotland's AI strategy is likely to trigger an increase in total energy use across the economy, rather than a reduction.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Energy & infrastructure	
Grid flexibility & balancing • **Grid balancing:** Data centres can act as an asset for the grid, With onsite generation that can give back to the grid at peak times. This on-site, or private wire, system has to be a core feature in the design. Stakeholders suggested data centres could offer free or discounted power to communities in these scenarios. • **Renewable opportunity:** While Scotland's renewable supply attracts operators, their stated interest in hydro-power and small modular reactors suggests they need a more diverse and reliable energy supply than Scotland currently offer. ○ Some stakeholders were concerned data centres would use existing renewable capacity rather than contributing to genuinely new capacity, especially in the short-term.	**Curtailment management:** While data centres can absorb excess wind power and reduce curtailment costs, their constant 24/7 demand means they also contribute to peak load. There is a lack of a clear understanding of how this constant demand affects the wider energy system and what the cost-benefit ratio would be. **Assumption of flexibility:** Data centres are inherently inflexible due to their constant power needs. It is a risk to assume they will use any available flexibility to lower system costs; instead, they may use it as a way to generate additional profit.
Water use and cooling: • Scotland's cool climate can reduce some energy demand for data centre cooling, which was considered by some interviewees as an advantage. It was also assumed water as a resource in Scotland was abundant too. • Stakeholders warn that public perception is heavily influenced by US open-loop cooling scandals, even if Scottish proposals indicate use of closed-loop systems.	**Drought risk:** Recent dry spells in Scotland have challenged the assumption of water abundance. High-density facilities rely heavily on water-based systems, meaning Scotland would not avoid significant water use even with closed-loop systems. **Technical complexity:** Without access to specific technical plans, it is difficult to judge how much water and cooling data centres across Scotland will really need, and therefore the impacts.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Energy & infrastructure	
Heat re-use and waste energy • **Theoretical potential:** Hyperscale facilities can produce massive amounts of low-grade waste heat suitable for district heating, greenhouses, or industrial drying, which has been successfully demonstrated in other contexts. Further details are contained on slide 44. • **Infrastructure requirements:** The supporting infrastructure requirements are specific and costly, both for the data centres and for the application receiving heat. Heat pumps, exchangers, heat storage tanks, and district heating compatible systems are primary examples of large-scale infrastructure required. Due to the scale and cost, the implementation of this infrastructure would be best suited for new builds/developments. • **Synergies:** Potential exists for co-location with hydrogen production or vertical farming to create circular energy hubs.	**Seasonal mismatch:** Data centres produce peak heat in summer when cooling is hardest, but demand for district heating peaks in winter. **Location trade-offs:** Data centre location faces numerous trade-offs, which are complicated further by heat re-use. Any development would have to consider whether it is economically feasible in line with other aspects of the design, such as proximity to power and workforce.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Community impact	

Public perception
• Negative public attitudes were cited as a key barrier to data centre development, and an area where more work was required to build public understanding of the sector, with one industry member saying, “data centres have done a terrible PR job”. Achieving positive socio-economic outcomes requires greater clarity around costs and benefits, particularly local impact, communicated by data centre operators and government with local councils and communities.
  ○ **Imported narratives:** Stakeholders were conscious of negative public sentiment being imported from the US.
  ○ **Design aesthetics:** Stakeholders expressed an increasing expectation for architectural excellence or better landscaping to hide the industrial nature of the sites, to help improve the image of data centres.
  ○ **Engagement risk:** Poor engagement leads to planning delays. Public opposition is cited as a major speed to market barrier.
  ○ **Nimbyism:** There is a risk that excessive focus on community veto power or over-consultation could stifle the rapid deployment required to compete internationally.
  ○ **Information gaps:** Stakeholders suggested planning authorities often lack the technical expertise to counter community misinformation.
	Perception gap: Unlike a new bridge or school, the benefits of a data centre are often abstract. This may cause consistent challenges in explaining their value to the community in a way that feels tangible and direct.
	
	Consultation fatigue: Communities near grid hotspots –wind farms, batteries, and data centres clusters – risk experiencing fatigue, leading to increased hostility toward any new infrastructure.

Skills and education in communities • **Hyper-local focus:** Skills and education programmes are a tangible, hyper-local way to secure benefits, and supports the long-term talent pipeline.	**Education to employment:** Permanent roles at data centres are limited. To add real value, programmes need to be general so that skills can spillover into other sectors of the local economy.

RQ2: To what extent do data centres realise socio-economic impacts?

Key findings	Analytical considerations
Theme: Community impact	
Community benefit frameworks • Public bodies emphasised a need for benefit frameworks, to support benefit management. There was concern a one size fits all approach would develop in industry as a tick-box exercise. • **Community funds and financial contributions:** Some stakeholders suggested community funds as a way to provide benefits, in the form of charitable donations or other fund mechanisms, tied to the MW requirements of the site.	**Enforceability:** Community benefits often face planning drift, where early promises aren't upheld. To prevent this, clear mechanisms are needed to hold developers accountable at every stage of the project. **End of life use:** Decommissioning was not discussed by stakeholders or in literature. Given the rapid turnover in capital in the industry, there is a risk that sites are short-term projects. Identifying future uses for sites is an aspect that could be further explored to ensure a long-term asset is provided to the community.

Findings:
Research question 3: How does policy, planning, and interventions influence these impacts?

RQ3: How does policy, planning, and interventions influence these impacts?

The following slides answer research question three by grouping interventions into three levels:

- **National & strategic interventions:** National agencies and Government effecting the high-level rules and policy regulating and supporting the industry. *Examples: Defining sustainable developments, national moratoriums and strategic priorities.*

- **Regional interventions:** Interventions working with utilities, industry and regional development organisations to directly affect infrastructure, ecosystem planning and capacity mapping. *Examples: streamlining connection times, clustering & growth zones, infrastructure investment.*

- **Local & community interventions:** Hyper-local interventions managing site-specific impacts. *Examples: Heat re-use, community benefit funds, local noise and water pollution management.*

These levels are linked, especially where national policy shapes regional and local decisions. This broad categorisation provides a basic framework for grouping similar policies, without being too strict.



RQ3: National and strategic interventions

Policy and problem it addresses	Evidence on effectiveness	Transferability to the Scottish context
National leadership on planning regulations: Providing clear top-down guidance to support local and regional planning decisions.	Designating specific sectors or zones sends a clear signal to international markets. This reduces perceived investment risks and shows that the state supports these projects. While industry opinions on the need for more planning regulations are mixed, public bodies agree that further support could help speed up the approvals process.	**Highly relevant:** This is highly relevant, as green data centres are already featured in National Planning Framework 4 (NPF4). [18] Further steps to support this, especially by providing clearer definitions of what a successful project looks like, would work well in Scotland, where strict definitions are currently lacking.
National grid prioritisation: National prioritisation of connectivity, with alignment in decision-making across planning, acceptance and grid connectivity.	Evidence shows gating linked to specific metrics, such as renewable use, benefits frameworks, and feasibility, can help manage the grid connection queue, freeing up capacity for deliverable assets.	**Highly relevant:** Given the number of proposals facing Scotland, national prioritisation is needed to support decision-making across the national, regional, and local authority levels. However, this remit covers both Scottish and British strategy and policy. This includes the Strategic Spatial Energy Plan and NESO's Centralised Strategic Network Plan. [34] [35]
Tax policy: Tax breaks or incentives to attract developers could increase competitiveness by reducing costs and allow for stricter requirements elsewhere.	Tax breaks for data centres are common in the US, where there is significant competition between states to attract business, and have been the subject of scrutiny. This debate would be complicated in the UK by the tax status of many of the large hyperscalers as US companies.	**Low relevance:** It is unclear the mechanisms are in place to attempt this. It also risks competition with other UK regions that is zero-sum, and results in lower impacts per site.

RQ3: Regional interventions

Policy and problem it addresses	Evidence on effectiveness	Transferability to the Scottish context
AI Growth Zones: Supports and facilitates co-ordinated development to align incentives across stakeholders.	Stakeholders indicated that clusters can be an effective way to create ecosystem benefits from data centres.	**Further work needed:** Further monitoring and evaluation to measure impact needed to measure success.
Mandatory infrastructure contributions: Co-investment in infrastructure can help de-risk sites, reduce costs for tax-payers and support the provision of modernised resource infrastructure.	Given the scale of investment, this can generate significant sums, best evidenced in the Australian context, where up to AUS$9.2 billion (£4.8 billion*) will be invested by data centres into national infrastructure by 2030. [19] However, this would come to the detriment of reduced national competitiveness and attractiveness, due to increased costs for operators.	**Further work needed:** Given the UK's high energy costs already, and Scotland's attractiveness based on access to low-cost renewable energy, further work to understand a suitable level of co-investment is needed. Framing this around the sharing of on-site generation might be more palatable for developers, though these sources are generally not renewable at the moment, and this flexibility has several caveats discussed under research question 2.
Regional infrastructure planning: Collaboration between utilities and industry to address the siloed approach where developers select sites without knowing utility constraints.	Strategic regional mapping of water, power, and data latency can help to reduce failed planning applications and technical friction, building consensus for projects with wider support.	**Highly relevant:** Scottish utilities emphasised this as a key step to addressing concerns with current proposals. Exploring the role of NESO's transitional Regional Energy Strategic Plan (tRESP), and the data centre sector's position within it, could provide a framework for collaboration. [36]

* Based on exchange rates at time of writing.

RQ3: Regional interventions

Policy and problem it addresses	Evidence on effectiveness	Transferability to the Scottish context
Regional skills pipelines: Creating regional training programmes to address skills shortages can help retain value within the Scottish economy, future proof workforces, and create knowledge spillovers.	Stakeholders were complementary of Scotland's existing education system and saw further training as an opportunity to supplement existing skills.	**In-progress:** Operators and large tech companies are already running and developing schemes in this area.
Renewables additionality: Requiring developers to prove that their sites support the creation of new renewable energy capacity, rather than just using existing sources, would help meet net-zero goals and create further demand in other sectors.	This lever can support new renewable energy, driving demand in other areas of the economy, and provide developments with cheaper, sustainable energy. However, this may delay time to connection as data centres become tied to energy projects, reducing competitiveness. This can also create challenges in network management due to volatility of supply.	**Highly relevant:** There are existing examples of companies like Amazon signing PPAs with Scottish Power, [20] and stakeholders from industry discussed their own exploration of the mechanism in interviews. Proposals would have to align with the outputs of Clean Power 2030 and other relevant strategy to avoid contradictions with national spatial plans. [34]
Grid balancing and storage: Supporting data centre developments with balancing and storage capabilities can turn them into assets for the grid.	Data centres can support grid stability using onsite generation and batteries. However, this is highly dependent on technological developments and economic factors, with significant uncertainty surrounding this impact.	**Needs further work:** Emerging technical and economic requirements means the impact of this is not well understood from a feasibility perspective.

RQ3: Local interventions

Policy and problem it addresses	Evidence on effectiveness	Transferability to the Scottish context
Environmental impact assessments (EIA): Mandatory EIAs would support wider understanding of impacts across stakeholders and provide confidence proposals are effectively planned.	Compulsory EIAs significantly reduce the risk of hidden negative effects. They provide a solid evidence base, allowing planning authorities to make justifiable decisions based on data rather than a developer's marketing. However, an assessment does not automatically mean a project has a lower impact; it simply means the impact has been measured.	**Highly relevant:** Community groups strongly advocate for this, as some applications are currently seen as too high-level to evaluate. This would align well with Scottish AI strategy outcomes and the green data centre vision.
Local community funds: Low local job impact can be mitigated by financial contribution to community projects.	This can be an effective way at building social license. There are caveats around implementation, particularly measurement if these contributions are voluntary. Linking these impacts to planning may mitigate this, but complicate approvals processes without a clear framework. Stakeholders suggested Section 75 agreements as a potential mechanism.	**Highly relevant / proposed:** A similar scheme has been proposed for offshore wind developments, and industry gave examples of existing proposals where such schemes would be implemented.
Hyper-local educational outreach: Providing specific community education can help community acceptance.	This is a low-cost, high-impact way to engage with communities. While it does not change the physical impact of a project, it helps people better understand and engage with new developments.	**In-progress:** Some stakeholders are already delivering sessions to improve public perception.

RQ3: Local interventions

Policy and problem it addresses	Evidence on effectiveness	Transferability to the Scottish context
Heat network integration: Supporting the transfer of heat waste to other applications can provide local benefit by reducing energy costs.	Can be technically effective if mandated at the new-build stage. However, effectiveness drops significantly if there is no pre-existing local heat demand that meets infrastructure requirements (e.g., a nearby leisure centre or housing). There was concern heat network proposals were often impractical, and a purely hypothetical benefit.	**Further work required:** The infrastructure requirements mean this impact is speculative and likely not realistic across all proposals.

Findings:
International comparison

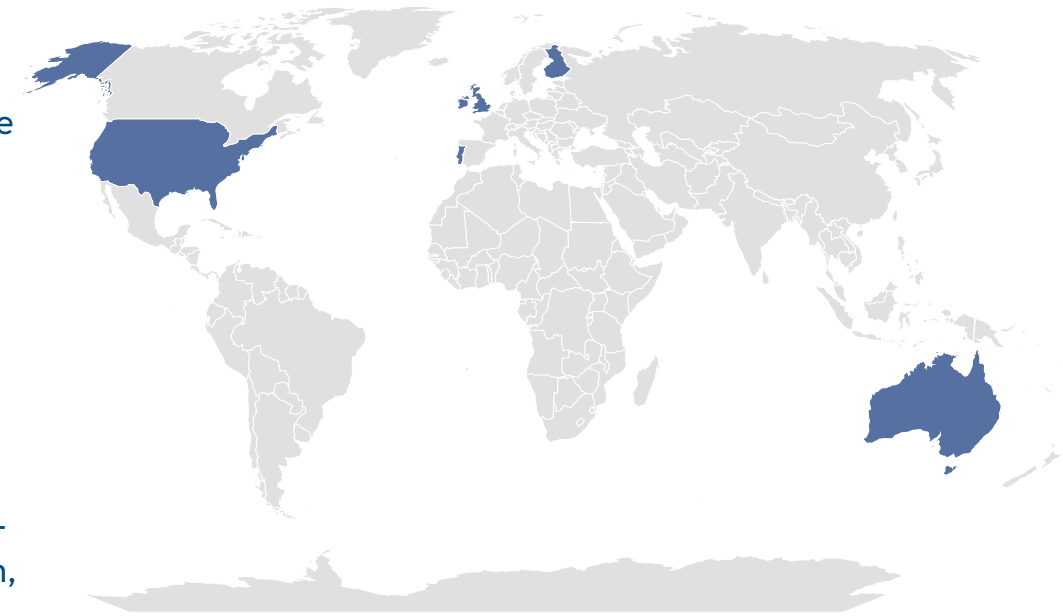
International comparisons

The following three slides provide concrete examples of data centre implementation from other international contexts. These findings are split out from the research questions as they combine realised impact and policy interventions to help illustrate the data centre experience other countries have experienced. This includes both lessons Scotland can learn, and areas where the findings are likely not applicable to the Scottish context.

This is across three slides covering:

- **Lessons for the Scottish context:** Broad socio-economic impacts including supply chain development, investment clustering, and infrastructure co-benefits, alongside common pitfalls such as inadequate upfront planning and unsustainable resource use.
- **Lessons specific to hyperscale data centres:** Regulatory and planning challenges unique to large-scale deployment, including energy grid capacity constraints and the importance of national strategic frameworks.
- **Lessons specific to green data centres:** Sustainability-focused impacts such as renewable energy integration, waste heat recovery, skills retention, and local economic development benefits specific to environmentally-driven developments.

The map opposite illustrates the countries we have included in these findings.



Data Centre Market Size
[32]

No. of Data Centres
USA: 4200
UK: 515
Ireland: 127
Finland: 117
Portugal: 45
Australia: 271

West Europe: 2749

Lessons for the Scottish context

Key learnings

Co-ordinated, strictly monitored and strategically-aligned policy and planning frameworks are likely required in Scotland for green hyperscale development. Realising green socio-economic impacts requires **early planning around infrastructural investment and mixed renewable use.** For example, sustainable onsite generation must be considered from the outset for successful implementation.

International comparability, lessons learnt to transfer

- A **reliable forecast of the renewable energy/grid development pipeline** raises investor confidence and allows a structured approach to understanding how many data centres are demanded and beneficial to Scotland.
- Data centres sometimes invest in surrounding grid infrastructure, education, and public transportation. However, outcomes must be **prompted and tracked** to ensure impacts are realised.

International incompatibility – lessons learnt to avoid

- Open loop water systems, oil & gas led on-site generation, and energy blackouts due to infrastructural capacity must be avoided in development and operation.
- The expediency of early-adopters in deployment of hyperscale data centres has, in some cases, come at the cost of moratorium, extended tax breaks that may detract from national economic value and having to implement a challenging and expensive green/sustainable and community benefits model in post.

Socio-economic impacts across international developments

Heat reuse: In Finland, Microsoft is building the world's largest data centre heat recycling region, proposing it could heat Finland's 2nd largest city, Espoo, while other estimates suggest 40% of heating needs could be covered. [21] [40]

Utility upgrade: Whilst AI data centre water consumption is still a resource constraint on scaling, Australian data centres have provided mandatory contributions to utility pipelines, upgrading reservoirs and pumping stations (up to $40m) in proportion to their growing water demand. [19]

Attracting cross-sector investment: Centres attracted further investment and clustering, across subsea infrastructure and the wider tech ecosystem. [37]

Wage growth: Data centre employees experienced a 70% faster growth rate on average gross private-sector wages compared to the all-industry average in one US case. [37]

Supply chain development: Ireland was an early adopter of data-centres and has built a supporting supply-chain capability. The digital infrastructure ecosystem, including data centres, contributes approximately €228 billion to the Irish economy, with ICT services accounting for nearly 60% of Ireland's service exports. [16].

Hyperscale data centres

US Hyperscale AI Data Centres



The US is the dominant market for hyperscale data centres, hosting approx. 45-55% in global facility count, with cumulative spending by the top 5 largest infrastructure providers (Amazon, Alphabet, Microsoft, Meta, and Oracle) exceeding $650bn. [22]

- Over 36 hyperscale projects in the US, worth $162bn in investment, were blocked or delayed due to grid connectivity or local challenge. [23]
- Analysis by the Environmental and Energy Study Institute (EESI) reports that about 56% of the electricity used to power the 3900-5400 no. of U.S. data centers comes from fossil fuels. [24]
- Total share of US power demand consumed by data centres expected to reach 11.7% by 2030. [25]
- Some states had introduced regulation, however executive orders removing barriers to investment have been introduced. [26]

What Scotland can learn from US hyperscale context

- The US data centre model for energy doesn't align with Scottish strategy. Scotland may struggle to compete at hyperscale due to large-scale US tax incentives.
- It is more challenging to implement a 'green' model or encourage community benefits after construction, so planning upfront is the best option, even if it sacrifices deployment speed.
- A unified national policy and planning are required for coherent decision making and national strategic alignment.

Ireland's Hyperscale AI Data Centres



Ireland is one of the leading hyperscale markets in Europe, but faces significant energy grid constraints due to the expansion of the industry, with data centres using 22% of national supply in 2024. [27]

- A moratorium on new developments was in place from 2021, ending with the introduction of a new framework for future developments. [28]
- This framework emphasises:
  - **Self-sustainability**, generating their own renewable energy, that can also act as assets for the grid, feeding back into the national system.
  - **National oversight** on renewables use (over 80%), carbon emissions, and regional distribution.

What Scotland can learn from the Irish hyperscale context

- Ireland has now implemented strict planning requirements for new data centres. However, their market position is well established, acting as a gateway between Europe and America, and their infrastructure is further developed meaning data centres may be more amenable to stricter regulation compared to an immature market such as Scotland.
- While it remains to be seen how effective these changes to regulation are for Ireland, they provide a comparison framework for a country focused on delivering sustainable hyperscale data centres.

Green data centres

Finland's Green AI Data Centres



Data centre developers and operators reported their enthusiasm for green AI investment in Finland stemmed from **grid reliability**: suitable grid capacity now and in future, with low levels of interruption and high confidence.

There is potential for **demand responsive flexibility** in green data centres, becoming a stabiliser in a renewable-heavy grid. Data centres can respond to periods of surplus renewable generation.

Finland's renewable electricity mix, including hydro, wind, and nuclear, alongside **waste heat recovery into district heating networks**, strengthens its green positioning. [41]

Portugal's Green AI Data Centres



Through stakeholder interviews, a data centre study in Portugal identified the following socio-economic impacts:

- **Retaining skills and capability domestically**, creating future-proof jobs whilst attracting international talent.
- **Industry-to-academia partnerships, upskilling and adapting curriculum** to tailor future sector needs.
- **Encouraging economic development of underserved local communities**, building up surrounding infrastructure in health, education, and public transportation.
- **Lead to additional investments in related sectors** such as electricity grid development, renewable energy generation or subsea cables. [14]

Why Scotland can be compared with the Nordic countries:

- Sovereign control over utilities, for waste and re-use of a data centre critical resources.
- High renewable capacity across offshore and onshore wind, hydroelectric, and tidal electricity.
- Cold climate, reducing cooling requirements.
- Government leadership such as national strategy and dedicated AI growth zones.
- Strong industrial base in advanced manufacturing, construction and operation.

Why Scotland can be compared with Portugal:

- Comparable economy and population size.
- Access to renewable energy and water-cooling technologies and infrastructure.
- High fibre network coverage, particularly in academic, urban hubs close to high-tech clusters.
- Resilient subsea cable investment pipeline, such as the £950m framework announced by SSEN. [30]

Findings:
Hyperscale vs co-location

Hyperscale vs co-location

Building on the findings from research question 3, stakeholders consistently raised data centre scale, whether hyperscale or co-location, as a critical factor influencing both Scotland's unrealised opportunities and foreseeable risks in data centre deployment.

To set out a definition, co-location data centres offer a service for organisations to rent out rack space to store servers and other IT hardware necessary for business operations. They are often scalable in size, and customisable for specialised connections. [33]

Scotland hyperscale characteristics

- They are more energy-efficient than on-site servers. [19] However, it is not clear how end users benefit from this efficiency, as different data centres serve different purposes.
- Could aid in curtailment of excessive renewable energy, however requires steady on-site generation, which more typically lends itself to oil & gas.
- More energy intensive, complicating sustainability.
- These projects can support improvements to infrastructure, including upgrading the national grid, providing fibre broadband to rural areas, and investing in transport.
- Can contribute greatly to high-skill construction sector pipeline, however, may intensify labour shortages for other projects.

Scotland co-location characteristics

- Small-scale heat reuse proven, with some sites air-cooled alone.
- Can be connected to the grid directly due to lower MW, lower queue time to connectivity.
- The costs and benefits are better understood but are not necessarily comparable to hyperscale units. There is often a clear case for how these benefit Scotland.
- Quickly scalable around new technology or growth in capacity.

Triangulated findings discussion

- **End-user considerations:** Hyperscale facilities with international end uses, such as LLM training, may generate less local value than co-location facilities supporting specific use cases.
- **Investment potential:** Develop-build-operate stakeholders cite hyperscale infrastructure as enabling potential inward investment in the billions of pounds.
- **Strategic importance:** Both hyperscale and co-location facilities can catalyse innovation parks, clustering, and business incubation, with value primarily realised through indirect and induced employment and providing sovereign compute and Scottish AI capabilities.
- **Evidence gaps in demand:** Stakeholders raised a demand-side concern, with keen interest in hyperscale sized facilities from a design-build perspective but a lack of evidence that major hyperscale operators will come to Scotland – most notably due to sheer energy prices.

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Discussion

Discussion

The **discussion** section is structured as follows:

- Triangulated findings summary
- Key findings: energy system risks
- Key findings: hyperscale opportunities
- Key findings: priorities and research gaps

Triangulated findings summary

Triangulated findings summary

This section combines evidence from across our research to provide a clear view of how green data centres impact Scotland's economy and society.

The findings follow the five key themes:

- **Workforce & skills:** Employment impact, required skills, labour capacity, and education.
- **Supply chain & economic spillovers:** Scotland's competitive edge, value capture, bottlenecks, and innovation.
- **Energy & infrastructure:** Grid constraints, renewable energy, heat reuse, and resource trade-offs.
- **Community impacts:** Social licence, community engagement, and benefit sharing.
- **Policy & planning:** Policy coordination, level of impact, and stakeholder interests.

Our assessment criteria

For each theme, we highlight:

- **Areas of agreement:** Where literature and stakeholder views align.
- **Tensions:** Where evidence or opinions differ.
- **Evidence gaps:** What remains unknown or uncertain.
- **Confidence levels:** Our assessment of how reliable the findings are, accounting for the gaps and tensions highlighted.

This approach supports evidence-based decisions by distinguishing between what is known, what is contested, and what is uncertain.

Triangulated findings summary

Theme	What does the evidence agree on?	What are the tensions in the evidence?	What are the gaps in the evidence?	What is the confidence level in these findings?
Workforce and skills	**Jobs:** The direct employment impact of data centres is agreed to be limited both temporally during construction, and in number of long-term operational jobs, and that jobs were generally over-reported in headline figures. **Pipeline:** Requirement for greater visibility on the workforce requirement / pipeline particularly in the construction industry. **Knowledge:** Calls to bridge information gaps at the planning/decision making level (local council). **Skills & education:** Play to Scottish strengths, future-proof education, offer new apprenticeships/courses.	**Imported labour:** Contention in literature and interviews around whether Scotland had enough capacity in the construction and manufacturing industries to deliver on time. **Additionality:** discussion of whether developers and operators might carry specialist labour from abroad, particularly those of high-skill, or create new jobs within expertise base in Scotland (particularly concerning engineering and maintenance).	**Displacement:** The extent of job displacement is uncertain, with evident overlap with oil & gas, advanced manufacturing, IT, and offshore energy sectors. **Wage uplift:** Uncertainty around salaries or potential wage uplift in Scotland, reflected in stakeholder sentiment. Lack of maturity, tracking/measurement and benchmarks. Highest skills and wages will be on the tails of lifecycle (design, operation and maintenance (O&M)), although are known to have the fewest number of direct jobs.	**High** for direct job impacts. **Medium** for indirect/induced multiplier effects due to lack of data around international suppliers.

Triangulated findings summary

Theme	What does the evidence agree on?	What are the tensions in the evidence?	What are the gaps in the evidence?	What is the confidence level in these findings?
Supply chain and economic spillovers	**Scotland's role:** Evidence aligns that infrastructure, engineering, construction, and energy are where Scotland adds value whilst high-value components and electrical assets are almost all imported. **Spillovers**: Benefits of spillover are anticipated to be caused by clustering, productivity, and research around the infrastructure that hyperscale exists within - however the extent of this is vague. **Bottlenecks:** Constraints are agreed to exist around high-value engineer shortages, overburdened construction pipelines, and grid capacity. Uncertain level of readiness within the supply chain.	**Technological advancement**: Most evidence indicates that the technology housed in data-centres will become outdated in the time taken between build-operation – however there is contention around whether this poses continuous opportunity / value in O&M or only contributes to supply chain uncertainty and risk of technological obsoletion. **Crowding out:** While many stakeholders see strong potential for innovation, investment attraction, and productivity gain, a minority argue that hyperscale models may externalize spillover benefit value (away from Scotland) and may crowd-out investment in other growing industries.	**Value recipient:** Where is the IP, profit, and economic spillover being received for green hyperscale? If this differs between proposals, critical stakeholders interviewed suggested prioritisation of acceptance based on Scottish relevance and direct value add. **Cross-sector synergies:** Across robotics, advanced manufacturing, offshore energy, life sciences, academia, etc. the scale of synergy and clear narrative around spillover benefits and spinouts was not fully apparent. With intent to maximise strategic benefit by harmonising Scotland's sector specialities, clusters, and technology innovation hubs, this evidence gap should be further investigated in relation to green hyperscale.	**Medium** with speculation on the long-term innovation spillover success rate in Scotland but supported by existing co-location cases studies.

Triangulated findings summary

Theme	What does the evidence agree on?	What are the tensions in the evidence?	What are the gaps in the evidence?	What is the confidence level in these findings?
Energy and infrastructure	**Grid constraints:** Deployment is held back primarily by bottlenecks in timely grid connectivity. **Strong Scottish advantage:** In renewable energy abundance, although many cite a misalignment between generation hubs, grid infrastructure, and prime data centre locations. **Heat reuse:** Is a huge opportunity mentioned in most proposals, although lacks proof of success at scale. Cited high CAPEX, geospatial challenges, oversupply of excess heat from hyperscale, retrofitting difficulty, and up-front planning requirement.	**Opportunity cost:** Limited resources such as land, water and electricity are utilised for hyperscale data centres, alongside labour force requirements for large-scale infrastructure. These resources could otherwise could have been dedicated to co-location facilities, Scottish businesses, academia, hydrogen, battery storage etc. therefore posing a considerable trade-off. **Unaligned timescales:** A critical tension exists between the 5–10 year timeline for major grid upgrades and the shorter connection time requirement for hyperscale developers, and as such the emphasis stakeholder have on what matters.	**Heat reuse feasibility:** A major gap in evidence regarding the actual commercial and technical viability of heat networks. **Definition of green:** There is currently no formal national definition or technical metric for a green data centre in Scotland, leading to inconsistent environmental expectations across different local authorities. **Cumulative impact modelling:** A gap exists in understanding the whole system impact of hyperscale data centres under different scenarios.	**High** confidence that there are grid/power constraints, but **low** confidence in scale of benefit data centres can bring in alleviating constraint payments. **Low** for heat-reuse realisation and long-term water scarcity impacts.

Triangulated findings summary

Theme	What does the evidence agree on?	What are the tensions in the evidence?	What are the gaps in the evidence?	What is the confidence level in these findings?
Community benefits	**Engagement:** Meaningful early engagement is critical for social license. At present, stakeholders anticipate low local sentiment for data centres.	**Tangible vs. abstract benefits:** There is tension between what developers offer (e.g., cycle paths, energy grid upgrades) and what communities may truly need (e.g., lower energy bills, direct high-volume employment).	**Long-term monitoring:** Lack of evidence or framework for how community benefits are tracked or enforced over the lifecycle. **Energy bill impacts:** There is a significant gap in data regarding whether large-scale data centre grid upgrades will lead to "socialised costs" that increase local residential energy bills, as has been observed in some US jurisdictions.	**Medium** as public perception risks are well-documented globally, but specific "Scottish" community sentiment is still emerging. Mixed confidence in specific impacts contribute to overall uncertainty.
Policy & planning	**Policy direction:** Levers that drive success for data-centre firms, such as speed to acceptance, often work in opposing directions, i.e. quicker solutions lead to less confidence in impacts. See slide 58 for further details of intervention recommendations.	**Stakeholder alignment:** Stakeholders have different priorities. Clear guidance is needed to bring them together and agree on what Scotland should prioritise.	**Implementation:** This report does not address specific implementation plans for policy, rather analyse likely effects. **Decommissioning:** End-of-life management was not discussed in any evidence but could become a key planning and policy issue as developments have shorter lifespans than traditional infrastructure projects.	**High confidence** that policy space is complex and emerging.

Key findings

Key findings: energy system risks

Rapid hyperscale expansion could stress Scotland's electricity system without coordinated planning, data transparency, and targeted mitigations.

What the evidence and stakeholders said:

- Utility companies are concerned that they cannot quickly connect multiple large power demands to parts of the electricity grid that are already under pressure.
- International examples show governments pausing or reshaping data centre growth when grid stress, price effects, or public acceptability bite.
- **Tension:** there is pressure to accelerate connections for competitiveness vs understanding whole-system consequences.
- **Gap:** there is limited, shared visibility of the pipeline and life-cycle load profiles across developers, system operators and local authorities.
- **Implication for Scotland:** Impacts could include a risk of stranded or delayed connections; local price/constraint effects; opportunity cost vs other electrification priorities.

What can Scotland do?

- Structured collaboration between developers, networks, and government to map pipeline scenarios and connection options.
- Engage with NESO and NPF4 to support a flexible, data centre specific planning and investment ecosystem that prioritises:
  - diversified siting;
  - load shifting and flexibility (e.g., batteries/on-site generation);
  - and clear energy and water efficiency metrics (e.g., Power Usage Effectiveness (PUE), Water Usage Effectiveness (WUE)) as part of consent and ongoing reporting.
- Track and learn from peer countries (Ireland, Germany, Netherlands) that have introduced efficiency standards, zoning rules, and waste-heat obligations, adapting only what fits Scotland's context.

Key findings: hyperscale opportunities

Hyperscale facilities can be enabling infrastructure. Direct impact may be modest, but indirect and induced value can be significant when linked to a wider ecosystem.

What the evidence and stakeholders said:

- There are currently up to 20-25 proposals for hyperscale data centres at various stages of development across Scotland, reflecting strong market interest.
- For the local economy, direct value is limited when capital is imported (prefabricated racks & hardware), and when procurement bypasses local supply chains.
- **Tension:** there is pressure to move fast to stay competitive vs taking the time to lock-in local value and system-friendly designs.
- **Gap:** there is greater uncertainty on benefits (e.g., heat reuse, local skills, digital spillovers) vs well-understood costs and constraints, creating a risk asymmetry.

How Scotland can make it work

- **Specialise:** focus on intersections where Scotland is strong
  - renewables integration;
  - research base;
  - and co-location.
- **Retain value:** develop a Scottish supply chain for construction, grid services, operations, and maintenance; promote local skills pathways.
- **Benefits case:** support site-specific, measurable benefit packages (e.g., heat-reuse offtakes, flexibility services, local workforce targets) enabling planning and consent with intent to maximise regional benefit to Scotland.
- **Compete on differentiation:** position on innovation and sustainability rather than price or deregulation.

Priorities & research gaps

Priorities:

- **Define success:** Scottish strategy defines outcomes for the economy, but more detail is needed for both industry and local authorities. Lay out energy targets through PUE and WUE metrics, provide clear expectations for local and community benefits.
- **De-risk developments:** Support collaboration between stakeholders to deepen understanding in energy system impacts, learning lessons from peer countries.
- **Align planning, narrative, and acceptance:** Improve narratives and data on benefits and costs, supporting community acceptance by prioritising data centres with a realistic socio-economic, region-specific impact case.
- **Measure outcomes:** Co-ordinate tracking and measurement of data centre outcomes such as through flexible community benefits frameworks and reporting, enabling evaluation of early socio-economic impacts.
- **Provide unified governance:** Reduce siloed planning and support local authorities lacking the capacity and tools to deliver informed planning decisions, building on existing elements including tRESP identification of strategic investment areas. [36]

Opportunities for further research to address data gaps:

- **Grid flexibility valuation:** Quantify the impact data centres can have through grid flexibility, specifically regarding the mitigation of wind curtailment costs across peak and off-peak temporal cycles.
- **Opportunity cost analysis:** Evaluate the trade-offs of hyperscale investment against alternative assets, such as utility-scale green hydrogen, battery energy storage systems (BESS), and co-location clusters – with potential for regional opportunity cost comparisons.
- **De-carbonising on-site power:** Assess the technical and economic viability of replacing fossil-fuel backup generators with low-carbon alternatives, including small modular reactors (SMRs), hydrogen fuel cells, and advanced biofuels. This is caveated by note of Scotland's existing policy against new nuclear, although important to raise given frequent mention across stakeholder groups.
- **Understanding the end user:** Analyse the profile of hyperscale end-users and identify the ultimate beneficiaries of data-processing value to help address the specific value compared to smaller scale co-locate.
- **International policy analysis:** Monitor and track the success of other national policies over time to identify effective strategies for sustainable growth.

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Annexes

Annexes

The **annexes** section is structured as follows:

- **Methodology annex**
- **Topic guides:** Questions to all stakeholders, organisation specific questions
- **Scottish Enterprise studies consulted**
- **Frazer-Nash copyright and disclaimer**
- **Contact details**

Methodology annex

Rapid Evidence Assessment (REA)

What Frazer-Nash did: Conducted a focused literature review on green and hyperscale data centres.

- This used a proportionate and robust Rapid Evidence Assessment (REA), presenting the findings in a workshop.
- This established the necessary context to support stakeholder interviews.

REA: A structured search against three research questions, investigating academic texts, industry reports, databases (e.g., ONS) and grey literature. Followed by synthesis and summary of findings, highlighting any remaining data gaps.

Interviews and thematic analysis

What Frazer-Nash did: Interviewed 14 stakeholders and delivered thematic analysis insights.

- This gathered expert knowledge on the data centre sector, structured around three core research questions and over 50 sub-themes.
- Further details on the topic guides can be found on the following s, and details of our sample size are on 15.

Thematic analysis: Codified interview insights against a series of emerging themes and sub-themes, categorised and summarised across stakeholder groups. Identifies frequency of comments that represent, or caveat, emerging themes across socio-economic impacts.

Triangulation and reporting

What Frazer-Nash did: Delivered collated and triangulated insights from research to Scottish Enterprise.

- Our final reporting provides a strong research base, understanding of potential socio-economic impact, and insightful analysis that supports decision making moving forward.
- Delivered alongside lessons learnt, method, topic guides, other annexes.

Triangulation: Assessed the strength of consensus by triangulating across all evidence identified in interviews and the REA. Highlighted subjects of agreement, conflict, gaps, and confidence levels. Organised evidence underneath socio-economic themes and sub-themes.

This research was commissioned in January 2026, and complete by April 2026.

Topic guides – Questions to all stakeholders

General shared questions

- Could you introduce yourself, your role, and your organisation's connection to data centres? (development, operation, planning, policy, supply chain, etc.)?
- How would you characterise Scotland's current position for green hyperscale data centres vs alternative locations?
- What factors are currently limiting deployment of hyperscale data centres in Scotland? *[or other familiar region / country]*

Workforce & skills

- Across the lifecycle (site selection, design, build, operations, upgrades), where is employment supported most?
- Where are the hardest-to-fill roles? How do you address gaps (upskilling, recruitment from adjacent sectors/locations)?
- What's roles are likely to be new vs displaced from other activities/locations?

Supply chain & spillovers

- In which parts of the hyperscale data centre supply chain is Scotland strongest, and which are more likely to be import-dependent?
- Which parts of the supply chain would likely be most impacted by hyperscale data centre deployment in Scotland? Why?
- What knock-on benefits have you seen, or would you expect, from hyperscale data centre deployment?

Energy & infrastructure

- What are the main challenges and opportunities for Scotland's energy system from hyperscale AI data centre deployment?
- What is your view on the practical potential of heat reuse? Do you have insight from prior projects that have worked (or otherwise)?

Community Impact

- What forms of community benefit or engagement have taken place in the past when developing hyperscale data centres?
- Are there expectations or standards (formal or informal) emerging for community engagement in this sector?

Policy & planning

- Data centres can raise concerns around issues such as energy demand, water use, land use, and environmental impacts. From your perspective, what are the key risks or challenges associated with large-scale data centre development? What policy or planning measures do you think could help mitigate these?
- To what extent is policy intervention required to unlock benefits from hyperscale data centre deployment?
- Are you aware of examples where policy or planning interventions have worked (or not)?
- In your view, which approaches would translate well to Scotland, which would need adaptation, and which are poor fits and why?

Topic guides – Organisation specific questions

Public Bodies

Is there a proportionate way to require heat-reuse considerations for new data centres?

If Scotland adopted a clear community-benefit framework for data centres, what elements should be in scope and how should they be measured?

What policies or strategies are currently in place to support hyperscale data centre deployment in Scotland?

In your view, what policy changes could be deployed in the near term to support low-carbon, hyperscale data centre deployment?

Which interventions would help maximise public benefit from hyperscale deployment?

Do you have any thoughts on what would make these interventions work in practice, or any caveats?

Which international (or UK) interventions have strong evidence of effectiveness, and how would you adapt them to Scotland's governance and market structure?

What risks or trade-offs should Scotland anticipate when importing these policies, and how could those be mitigated?

Design/Build/Operate/Consult

What are the most significant factors you consider to decide where to build a hyperscale data centre?

Under what conditions is it feasible to utilise heat for the community? What are the technical and financial constraints?

When the grid is short of power or has too much, could your data centres temporarily use less or more electricity, or use on-site kit (like batteries or backup generation) to help? In what situations would that be realistic, or not?

Do you offer any local training, apprenticeship, or internship programmes linked to data centre operations?

Have you partnered with local colleges, universities, or skills providers to support workforce development?

If Scotland implemented one or two targeted policy moves in the near term, which would most accelerate your next investment decision, and why?

Supply Chain

Where are the most significant bottlenecks in Scotland's hyperscale data centre supply chain?

What opportunities would your organisation expect from future hyperscale deployment in Scotland?

In your opinion, which targeted interventions would most benefit the data centre supply chain in the near term?

Scottish Enterprise studies consulted

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