How to power AI

Boosting compute capacity for UK AI

Sam Robinson
John Asthana Gibson

SMF Social Market Foundation

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ABOUT THE AUTHORS

Sam Robinson

Sam is a Senior Researcher at the SMF. Before joining, he was a Senior Research Fellow at Bright Blue, where he wrote reports on a variety of topics including tax reform, self-employment and pensions policy. He has been published in a number of national media outlets including The Times, The Express and City AM. Prior to that, he worked in Parliament at the Policy Research Unit, writing research briefings for MPs. Sam studied Philosophy, Politics and Economics at the University of Leeds.

John Asthana Gibson

John joined the Social Market Foundation in March 2023 as a researcher. Prior to joining the SMF, John worked at the Centre for Cities, where he conducted research on topics including transport policy, devolution and the geography of the innovation economy. He holds a BA Hons in Economics from the University of Manchester.

EXECUTIVE SUMMARY

Data centres are critical to maintaining UK strengths in AI

- AI and other digital innovations rely on huge amounts of computational power to operate. This computation is typically carried out in large purpose-built data centres, which provide compute capacity.
- Ensuring sufficient compute capacity is important for the UK's AI and economic ambitions for several reasons:
    - Data centres facilitate digital services, and are vital to the functioning of the digital economy.
    - Widespread adoption of AI will be a key driver of future economic growth, and AI inference (the process by which AI models carry out tasks) often requires computation in proximity to users.
    - Firms with the best access to compute will lead the development of frontier AI models.
    - With AI likely to become sensitive to national security, the UK needs an independent capability to develop and deploy frontier AI technologies, and to avoid reliance on other countries for critical services that data centres provide.

The UK has strong fundamentals in the burgeoning era of artificial intelligence.

- The UK's AI sector and data centre market is the largest in Europe, with the largest number of generative AI start-ups in Europe.
- The country has been ranked fourth in the world in the level of implementation, innovation and investment in AI, with particular strengths in key sectors such as healthcare and biotechnology.

However the UK faces challenges, mostly driven by energy, in maintaining data centre growth and therefore its position as an AI and digital leader.

- **Power availability.** Electricity grid constraints are slowing down data centre growth, particularly in certain parts of the country.
- **Energy costs**. UK electricity prices are 4 times what they are in the United States and 46% above the 31 IEA country median. This weakens the UK's competitiveness and incentivises data centres to operate elsewhere.
- **Sustainability.** The operators of data centres increasingly demand low carbon electricity to power their operations. European competitors can supply greener electricity at substantially lower prices. If the UK cannot supply data centres with no or low carbon energy at affordable prices, they will be incentivised to operate in countries that can.
- **Planning delays.** It can take a long time to secure planning permission to build new data centres and the necessary electricity grid infrastructure. This is underpinned partly by local opposition to data centres, and partly by an

inadequate planning regime that does not provide sufficient clarity or speed on planning decisions for data centres.

The UK needs to build on the AI Action Plan to address these challenges

Addressing these obstacles is critical to the UK's hopes of building a thriving AI industry and for the continued growth of the UK's modern economy. A crucial first step was taken in January 2025 with the publication of the AI Opportunities Action Plan. There are several policies which now need to be implemented to address the barriers holding back data centre development in the UK. These include:

Energy solutions and sustainability

- **Adopt a fleet-based approach to nuclear reactor development and signal support for SMRs as part of a more ambitious role for nuclear in the UK's long-term generation mix.** This will help to maximise the conditions for clean energy abundance – the only durable solution to the energy constraints facing data centres and the UK – by making nuclear power cheaper and easier to build in the UK.
- **Introduce locational energy pricing**. Medium-term reforms are required to alleviate the energy challenges data centres face. Reforming Great Britain's wholesale electricity market to better reflect local conditions of supply and demand will provide stronger price signals to data centre operators, encouraging them to locate outside of the capacity constrained South East area, and incentivise electricity generation in this part of the country. For locational pricing to have the intended effects, it must be twinned with liberalisation of planning rules to ensure that users and generators can change location on the basis of the price signals they face.
- In the immediate term, **develop an official measure of renewable additionality for physical Purchase Power Agreements (PPAs)**. Where renewable additionality – renewable electricity added to the grid that otherwise would not have been – can be established, the Government should offer tax credits based on the amount of renewable output being procured through PPAs or produced via on-site generation.

Planning solutions

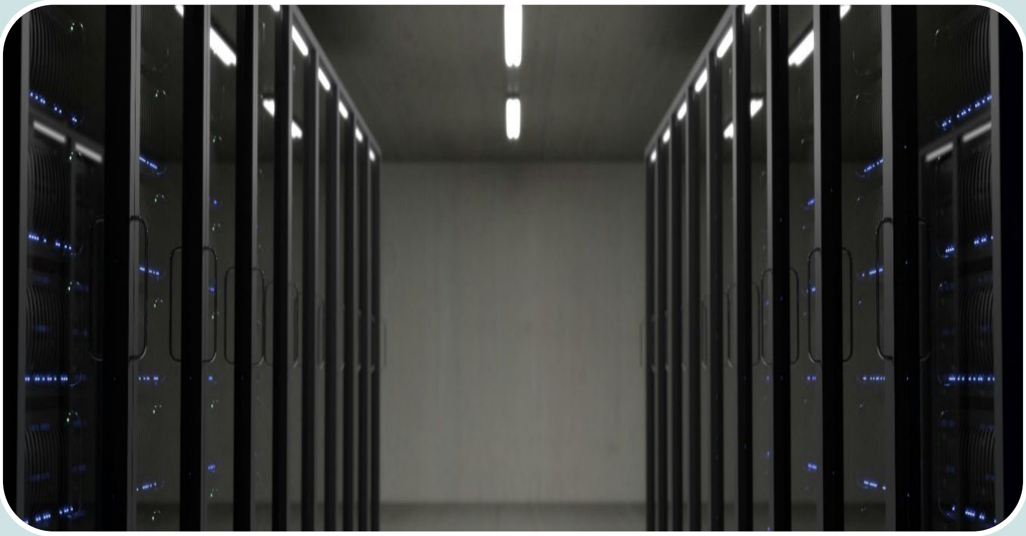
- **Facilitate AI Growth Zones** in line with the government's AI Opportunities Action Plan by clarifying the objectives they are to support; designating zones with Special Development Orders combined with clear, simplified environmental standards; and using the expertise of Great British Energy to identify technically feasible sites.
- For major proposals outside of AI Growth Zones, **a new planning passport for data centres should be developed.** This would offer expedited planning processes for data centre proposals meeting pre-approved standards on sustainability and efficiency.
- For data centres going through a standard local planning application, **a single use class for data centres should be introduced**. Currently, local authorities commonly categorise data centres as either B8, 'warehousing and storage' or

sui generis. This undermines clarity among planning authorities as to the role and requirements of data centres.

- Government should set out a **planning capacity action plan** to support local authorities to deliver on their strategic planning priorities, including data centres.
- Local authorities should gain **full business rates retention** for data centres in their jurisdiction to incentivise them to support such development. Currently, they only retain 50%.
- **Full expensing should be extended to brownfield sites.** This would simplify the relief system for brownfield land and send a much clearer signal to developers, including data centres, that such relief is available.

INTRODUCTION

An overview of data centres



What is a data centre?

- A data centre is a physical facility that houses computing infrastructure, chiefly servers, data storage and network equipment.
- They are used for a variety of functions, from storing media to data analysis to training AI models. These uses can be categorised into "low latency" - which require little to no lag, such as financial transactions - and "high latency" uses where the time requirement is less important, such as training AI models.
- Data centres vary considerably in scale, which is measured in terms of its power requirements in megawatts (MW), rather than physical size.
- Data centres require massive amounts of power to operate. Even a small 5MW data centre might consume 43,800MWh of power annually (equivalent to the power usage of around 16,000 average UK homes over a year). Collectively, data centres and the networks that connect them account for around 3% of the world's electricity use.

The nature of data centres has evolved with the changing demands of the digital economy

The growth of the modern digital economy has led to a huge increase in the amount of computational power needed to carry out an ever-increasing number of digital tasks. As both the volume and complexity of online activity has grown substantially in recent decades, so too has the electricity that this computation requires, shaping the infrastructure that underpins the digital world.

During the beginning of the internet's global expansion in the 1990s, most of this computational power was located within the organisation it served, typically in the basement of a company headquarters or on a university campus. This trend was driven by the demand for easily controllable and sector-specific computational requirements.

The expansion of the internet and growth in digital activity led to huge increases in demand for computational power, and as the power demands of these activities grew, the priority for users shifted from computational reliability to efficiency. This in turn led to development of the data centre industry as we broadly know it today; large custom-built premises containing vast numbers of servers, designed to achieve economies of scale for the operators of these facilities.

Alongside growth in the number of computer devices found in a typical data centre, technological improvements enabled a staggering increase in the power density of the servers that power them. Ten to fifteen years ago, typical power density stood at around 2-3 kilowatts (kW) per server rack.[1] Now, racks with densities of 30kW and over are relatively commonplace.[2]

The development of cloud computing has shaped the industry further. To meet the enormous demands of cloud computing, the world's largest technology companies have recently embarked on a building spree of new 'hyperscale' data centres, often close to major population centres, designed to process and store huge amounts of data. The resulting growth in the power demand of these facilities has meant energy efficiency is a paramount concern and has led to innovation in cooling capabilities and power consumption technology. Consequently, these hyperscale data centres tend to be significantly more energy efficient – often 3 to 4 times more efficient – than on-premise data centres.[3]

Simultaneously, the growth of real-time digital applications such as gaming, streaming services and financial services trading, all of which require low latency, has led to the deployment of smaller data centres dispersed around the 'edge' of a network and typically positioned near fibre optic cabling, often on the outskirts of urban conglomerations.

The nature of data centres is also shaped by the rapid development of artificial intelligence applications and their adoption in sectors throughout the economy. The emergence of AI accelerates trends that have shaped the industry to date, with the training of AI systems requiring unprecedented amounts of computing power and data storage. But there are also some differences with traditional cloud providers, who need to be close to their markets and customers in order to reduce latency. Some 'AI factories' dedicated to training models do not demand very low level latency and therefore they do not need to be placed close to large metropolitan areas. Instead, these data centres tend to locate based on other advantages, such as plentiful energy and cooler climates.

The table below sets out how the function of data centres has determined their design and location:

Table 1: Summary of data centres by type

Data centre type	Overview
Enterprise	Owned and operated by companies for their internal needs. They typically support the organisation's operations and may house applications, databases, and storage solutions.
Co-location	These facilities allow multiple businesses to rent space for their servers and other hardware. Co-location providers offer infrastructure, power, cooling, and security, enabling clients to benefit from shared resources without the need to build their own data centres.
Edge	Comparatively small facilities located close to end-users to reduce latency and improve performance for applications like real-time data processing. They tend to be positioned on the periphery of cities and are increasingly important for supporting mobile applications and smart technologies.
Hyperscale	Massive facilities typically operated and wholly owned by major tech companies. They are significantly bigger than enterprise, co-location and edge data centres. A typical hyperscale data centre has at least 5,000 servers, 500 cabinets and 10,000 square feet of floor space, often with capacities of 50MW or more.
AI Training	Specialised facilities designed to support the computational and storage requirements of training artificial intelligence models. They are designed to meet the unique demands of artificial intelligence development, containing unprecedented computing resources to handle the training and deployment of complex machine learning models and algorithms.
Modular	Modular data centres are built from prefabricated modules that can be transported, assembled and tested on-site. This is typically less resource-intensive and faster to set up than a purpose-built data centre, and reduces risks arising from site issues, skills shortages and delays. Modules can be added or removed to meet capacity needs.

Why build data centres in the UK?

As outlined above, data centres play a key role in many digital tasks. But a common question that arises from this abstract summary is *why the UK specifically* should build data centres. British businesses, for instance, could simply buy up data centre capacity from existing facilities in other countries. There are several reasons why a strategy of effectively outsourcing data centre development to other countries would be a major strategic mistake.

Data centres underpin the entire digital economy

It is not an exaggeration to say that the compute capacity provided by data centres is the foundation on which the digital economy is built.

Data centres provide the infrastructure that enables all digital activity by government, business and citizens to take place. Without this, the online world as we know it would cease to function. Everything from social media to e-commerce, health records to mapping services, leading-edge AI models to cat videos on social media, requires computational power and storage provided by data centres. A number of experts interviewed for this report articulated the importance of these facilities, not only to the UK's economic health but to the functioning of a vast number of services enjoyed in society:

> *"You tap your Oyster card, that's going to a data centre somewhere. You're booking a flight, that's going to a data centre somewhere. A supermarket supply chain is efficient because of the data analysis and the constant live feed of data that is hosted in a data centre. Planes don't fall out of the sky because of data centres."*

Furthermore, the demands of the digital economy are increasing at an astonishing rate. In 2025, the world is projected to create over 180 zettabytes of data, compared to an expected 147 zettabytes of data in 2024.[4] The proliferation of the 'internet of things' underpinned by smart devices is set to continue to increase demand for compute. Globally, the number of data-related interactions per connected person per day is expected to be almost 5,000 in 2025, compared to just 85 in 2010.[5] In the UK, the number of internet users consuming data nearly doubled between 2005-2018.[6]

Without an expansion of the computational power contained within data centres, demand for online activities will outstrip companies' ability to supply them, leading to higher costs of digital services in the UK. Put another way, failure to build enough domestic data centre capacity runs the risk of UK businesses, research institutes or consumers being unable to access the compute they need. This is a very real possibility: Microsoft's CFO said on an earnings call in October 2024 that revenue growth in their cloud business was 33% but "demand continues to be higher than our available capacity."[7]

Data centres can generate significant economic benefits for the UK

Boosting the national economy

Market analysis suggests that the data centre sector in the UK was already worth £8.1 billion in 2023 and is expected to be worth £12.7 billion by 2032.[8] It currently contributes £4.7 billion in Gross Value Added (GVA), employs 43,500 people and boosts state coffers by £640 million a year.[9] Even looking only at the direct economic effects of data centres, there is already a significant prize on offer over the next decade. A November 2024 report by TechUK estimated that if the UK increases data centre capacity above its trend growth rate (from 10% to 15% annually) this could result in an additional £44 billion of GVA to 2035, with almost 60,000 new jobs created in the process and £9.7 billion of new tax revenue.[10]

To illustrate this further, the Engineering and Physical Sciences Research Council invested £466 million into high-performance computing infrastructure, notably the ARCHER supercomputer. This is estimated to have contributed between £3 billion and £9.1 billion to the UK economy in 2018 prices – a staggering cost/benefit ratio (Table 2).[11]

Table 2: Total economic impact of ARCHER supercomputer and related investments

Type of impact	Low estimate (£)	High Estimate (£)
Impact of UK scientific research and discovery	2.02bn	6.05bn
Impact of direct industry access	0.91bn	2.86bn
Impact of training and skills development	0.10bn	0.19bn
Total economic impact	**3.03bn**	**9.10bn**

Source: EPSRC

Job creation

The building and operation of data centres can create significant benefits for the areas they locate in. The most obvious impact is job creation. The construction of data centres requires significant capital investment and results in employment growth in both the general construction sector and in more specialised fields relevant to computing, as well as more traditional roles such as architects or lawyers. Once built, data centres require highly skilled labour to operate, often in technical fields such as electrical and mechanical engineering, compute infrastructure and software development. Whilst the numbers of employees required to operate data centres is often limited, the highly-skilled and highly-paid nature of the employment serves to create significant positive multiplier effects in which they locate.

The job creation effect of data centres should not be overstated, but it can be significant on larger projects: for example, a new data centre project in Blyth is expected to create 4,000 jobs, including 1,200 construction roles.[12]

Spillover effects

Data centre investment can also generate spillover effects into the wider economy. Companies investing in these facilities often spend on accompanying infrastructure improvements that benefit other businesses. For example, to transmit large amounts of data, data centre developers invest in enhancements to internet fibre cabling, which improves other users' internet speed and reliability. Alongside a €600 million investment into a large-scale data centre in Denmark, Google is investing into an intercontinental subsea internet cable connecting it with the United States, boosting connectivity for the entire country.[13] Data centres can also enhance skills in other sectors. For example, Ireland's construction industry has acquired significant expertise in building data centres, which has contributed to a significant increase in construction services exports there.[14]

Data centres also reinforce agglomeration effects – the benefits that firms can realise through locating near one another – across a region's digital sector. This could be through the development of local suppliers' technical, operational and managerial knowhow, which can improve worker productivity and business competitiveness. Additional data centre capacity may also attract firms to invest to benefit from better and cheaper digital services enabled by the improved digital infrastructure, with the effect of fostering an ecosystem of high value digital service industries. It is widely acknowledged that improved digital infrastructure can 'crowd in' other high value digital firms that rely on it, and partly explains why London, which accounts for 80% of the UK's data centre market, is the unrivalled centre of the UK's digital economy.[15]

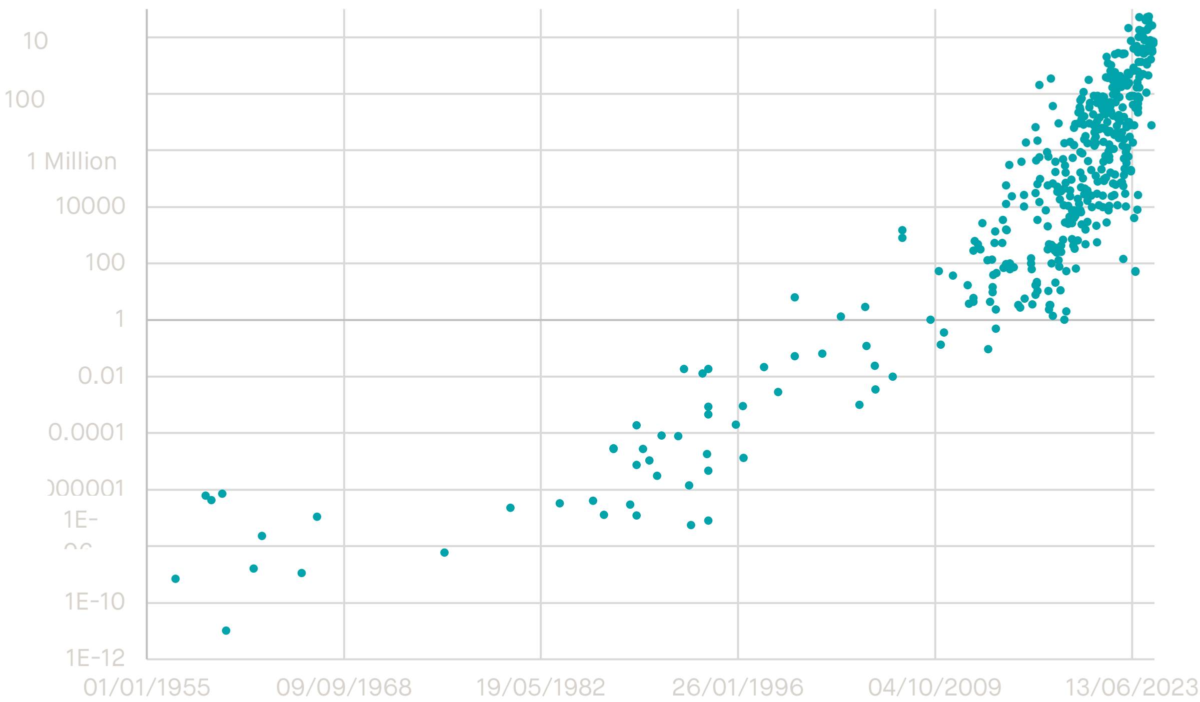
Data centres are vital for AI development

Given data centres' centrality to modern digital technology, there are significant economic opportunities to be had from expanding data centre provision in the UK. On top of the impacts described above, perhaps the most prominent role data centres can play is in the development of artificial intelligence (AI).

Developing frontier AI technology

The development, or 'training', of modern AI systems is based around machine and deep learning techniques to process large volumes of data, whilst continuously adapting parameters to optimise performance. This means the training process of AI technologies is extremely computationally intensive. And as AI technologies become increasingly powerful, the computational resources they demand grow in turn (note the log scale of Figure 1 below).

Figure 1: Computation required to train notable AI systems, by publication date:



Source: Our World in Data[16]

Similarly, the delivery of AI applications to users requires significant amounts of often low-latency computational power to be effective. 'Inference', the process that a trained AI model uses to draw conclusions from new data, typically needs to occur in real-time to ensure that applications such as driverless cars, autonomous factory robots and agricultural drones can operate. These large and growing computational requirements stemming from demand for AI products, in addition to the continued digitisation of society, mean that a considerable amount of data centre capacity, of a variety of types, is needed to support the development of cutting-edge AI technologies.

Given the fundamental role AI is beginning to play in consumers' lives and across industries, a considerable prize awaits businesses that are able to develop world-class AI products for export to world markets. For the UK, a burgeoning domestic AI sector that sells AI models or products across the globe represents an invaluable opportunity to boost the country's prosperity.

The UK's AI market is expected to be worth £802 billion by 2035, up from around £17 billion today.[17] Over the last decade, the number of UK AI companies has increased more than 600%.[18] The direct economic effects of this expansion are already being felt: the UK has an estimated AI workforce of more than 360,000 and contributed £3.7 billion to the economy in 2022.[19] Noting the infancy of AI technology today, it is easy to imagine the potential economic gains delivered through a thriving domestic AI sector, and enabling adoption and fostering the development of world-leading AI exporters will likely be key to achieving sustained economic growth.[20]

Sufficient compute capacity isn't the only prerequisite for a thriving AI ecosystem. But without physical infrastructure, domestic development of AI technology will be constrained. If companies at the forefront of AI technological development can't access compute in the UK cheaply and easily, they will be motivated to locate in areas where they can, bringing talent and finance with them to the detriment of the UK's economic competitiveness. One leading science and tech policy analyst interviewed for this research was clear:

> *"If you want to succeed in AI, particularly at the frontier… you need a lot of data centres."*

Supporting the adoption of AI throughout the economy

As a general-purpose technology, the adoption of AI is seen by many as a key engine of economic growth. The opening remarks of the UK's National AI Strategy described the technology as having the potential to "rewrite the rules of entire industries, drive substantial economic growth and transform all areas of life".[21] We can already see several channels through which this is taking place.

AI can plausibly deliver a significant increase in labour productivity due to innovative technologies assisting workers to create more output for each given hour worked. One recent study has found that the use of generative AI by highly-skilled workers can improve performance by nearly 40% compared with workers who don't use it.[22]

The widespread use of AI within the public sector can drive up efficiency, helping to shore up public finances and reinforce economic stability. A recent SMF paper examining how AI could benefit public services found that AI and automation procedures could save 8.12 million hours, or more than 4,300 working years, by deflecting or streamlining caseload at the DWP and HMRC.[23]

AI also holds the potential to create entirely new products, markets and industries, and to diffuse innovation throughout the economy. Whilst there is disagreement over the extent of economic gain that will arise from AI, there is a broad consensus that it could have a transformative effect. The technology is already being used to help scientists develop better drugs, improve business management and enhance the quality of education in classrooms.

All this points to AI as a key driver of growth. Globally, it has been estimated that generative AI could drive as much as a 7% increase in global GDP over a ten-year period.[24]

Box 1: AI in practice – Advancing drug discovery and development

One of the most promising areas where AI could deliver huge benefits for the UK is in the pharmaceutical industry, particularly in the field of drug discovery and development. Machine learning models can help identify promising targets and compounds and automate the optimisation process that refines these into drug candidates.[25] This reduces the cost of clinical trials, can improve the efficacy and safety of drugs given to patients, and can speed up the process of drug discovery significantly, potentially reducing the time taken to identify drug candidates from years to months.[26] Alongside significant economic rewards for the companies that can bring novel drugs to market, accelerating the creation of new medicines has obvious benefits for humanity.

There are many UK-based companies active in this field. One exciting case study can be found in the work of PharmEnable, a Cambridge-based firm that employs AI technology to develop innovative small-molecule medicines to tackle diseases in challenging areas such as oncology and neurology. Their platform has enabled the company to explore previously inaccessible targets, leading to the discovery of new drug candidates with improved selectivity and reduced side effects.[27]

Meeting national security needs

Countries that can develop frontier-level AI technology could plausibly enjoy significant strategic advantages over adversaries. Those that invest most effectively in AI might end up with the strongest economies as they reap the benefits of AI through higher growth and prosperity. More radically, such countries could develop offensive and/or defensive capabilities that effectively give them military supremacy, or a sufficient speedup in research and scientific progress to achieve technological supremacy. In 2018, Ian Hogarth coined the phrase 'AI Nationalism' to describe a new kind of geopolitical arms race centred around developing AI capabilities, pointing out that there are signs that this arms race has already begun and arguing that competition between states to develop frontier AI technology is likely to increase in the coming years.[28]

The UK is unlikely to match the US or China in the amount of resources it can throw into developing such technologies. Nor are we arguing that geopolitical competition over AI, which can be a global public good, is a positive trend. But we do argue that the UK needs to be pragmatic about the national security challenges that a looming era of AI Nationalism represents. By investing in domestic compute capacity, the UK can reduce its reliance on other countries to perform key data centre functions and better support the development of domestic AI industries, both of which will be important to bolster the UK's national security in the AI era.

The upside of data centre development outweighs the downside

All of the above makes building data centres a critical endeavour of advanced nations in the 21st century. The development of new technologies such as AI is inherently highly uncertain. But even if the bear case for AI is correct, and AI progresses slowly over several decades, then data centres will continue to underpin the digital economy and provide economic benefits to the UK; if nothing else, they will generate jobs and tax revenue. If the bull case for AI pertains, and the technology develops rapidly and reshapes large swathes of society in the process, then data centres will be an indispensable part of the UK's infrastructure, if it is to remain economically relevant and secure in a radically changed world.

Focus of this report: a data centre strategy for the UK

In January 2025, the Department for Science, Innovation and Technology (DSIT) published the AI Opportunities Action Plan,[29] which provided a blueprint for the government's strategy on AI development and adoption. Acknowledging the UK requires "world-class computing and data infrastructure" to seize the opportunities that AI presents, the report's first recommendation is for government to set out "a long-term plan for the UK's AI infrastructure needs".

The Action Plan sets an encouraging pro-innovation direction for the UK's AI sector. But as the UK moves to implement the plan, there is a need for specific, achievable policies to do so. This report therefore builds on the Action Plan by setting out policies that can support the plan's objectives in the short, medium and long term. To that end, it is ordered as follows:

- **Chapter One** details the current state of the UK's data centre market, providing evidence that the UK is falling behind rivals in terms of available compute capacity and explaining the importance of having a strategic approach to data centres.
- **Chapter Two** examines the factors relating to energy that are limiting the growth of the UK's data centre market and provides policy recommendations to address them.

- **Chapter Three** examines the factors relating to the planning system that are limiting the growth of the UK's data centre market, and provides policy recommendations to address them.

CHAPTER ONE – THE UK'S CURRENT POSITION

The UK is a European leader in data centre capacity, but this position is at risk

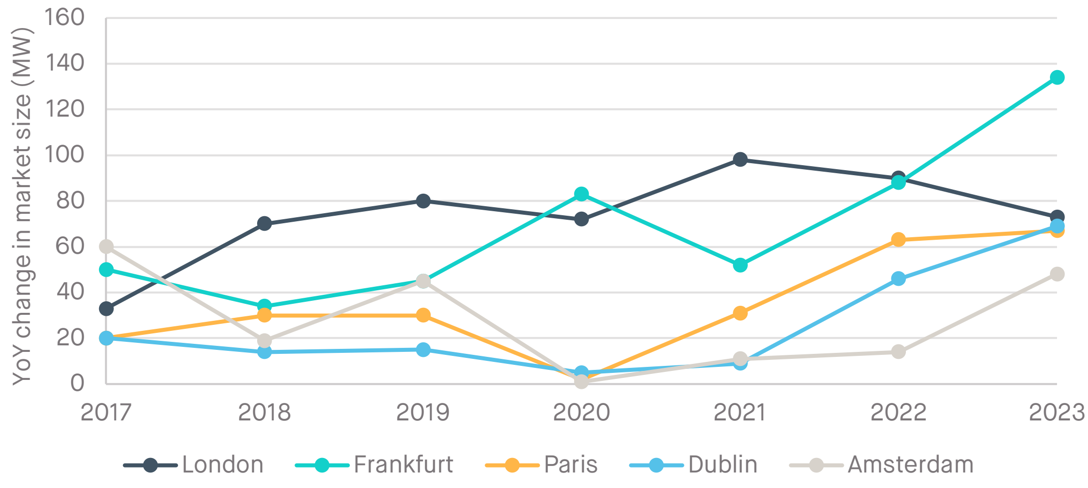
The UK has the largest data centre market in Europe measured in capacity, centred in and around the M25. London alone is host to over 1,000MW of data centre capacity, representing around 80% of the UK's total.[30] Overall, the UK boasts an estimated 500 data centres, a number only behind the US, which has over 5,000, and Germany, which has a similar but slightly higher number than the UK.[31]

While the UK is in a strong position, this is not guaranteed indefinitely. The London market recently saw three consecutive years of falling additional supply, reflecting difficulties securing power availability.[32] This has already resulted in London seeing the biggest increase in average co-location data centre rents in the past year.[33]

Although the UK is not unique in having challenges growing data centre capacity, there are signs that other European markets are starting to catch up to London. Frankfurt, another established data centre hub, has 1024MW of capacity in the pipeline compared to London's 962MW[34] and in 2022-23 added 134MW of capacity while London added 73MW.[35] Paris, too, has grown rapidly, adding 150MW of capacity between Q1 2023 and Q1 2024.[36] Both of these are part of the 'FLAP-D' markets – Frankfurt, London, Amsterdam, Paris and Dublin – that are widely considered to be the leading data centre markets in Europe.

As Figure 2 below shows, in recent years London has often led the FLAP-D markets in terms of market growth in absolute terms, consistently adding between 70MW and 100MW a year since 2018. However, in 2023 Frankfurt considerably outstripped London's growth, while Dublin and Amsterdam – two markets that have experienced a moratorium on data centres – have begun to rebound in terms of market growth and are converging on the UK's growth rate for expansions in data centre capacity.

Figure 2: Market growth in FLAP-D markets, 2017-2023 (additions to MW supply):



Source: JLL EMEA Data Centre report, Q1 2024

This is not to say that data centre growth in London is stalling. In 2025, London's data centre supply is expected to grow by 17%, or around 160MW of new capacity.[37] However, growth in other markets is expected to be faster in 2025. For example Frankfurt is forecast to see 26% growth, while the Paris market could expand by 18%.[38]

UK's failure to add sufficient data centre capacity puts its ambition of becoming an 'AI Superpower', and wider economic progress, at risk

Currently, the UK enjoys an influential position in the era of AI. There are a high number of AI startups in the UK – an estimated 727 AI startups between 2013 and 2023, behind only the US and China[39] – several world-leading centres of expertise on AI, and a high number of citations on advanced AI research. The AI Action Plan highlighted that the UK is the third largest AI market in the world, and Tortoise Media's "Global AI rankings" put the UK in 4th place in 2024, behind the US, China and Singapore (down from 3rd place in 2021).[40] [41] [42]

But this position is precarious. While the UK performs well on 'intensity' in Tortoise's AI Index – which measures a country's AI capacity relative to the size of its population and economy – there are some other countries, such as Israel, Switzerland and Finland, which punch above their weight to a greater extent than the UK does. Indeed, not only did the UK fall behind Singapore in the 2024 index, but the gap between France, the country most competently vying with the UK to be Europe's leading AI economy, narrowed significantly.[43] [44]

More specifically, infrastructure is the Achilles heel of the UK's AI ambitions. According to the Global AI Index, while the UK ranks strongly on talent, operating environment and research – ranking 4th in the index on each – it ranks 17th in terms of infrastructure.[45] In particular, it ranks poorly in terms of supercomputer capacity and digital connectivity.

Given the growing computational demands associated with the rise of AI, failure to build sufficient data centre capacity threatens the growth of the UK AI sector. This much has already been recognised by the UK government. The Independent Review of the Future of Compute,[46] published in March 2023, found that:

> *"Existing compute capabilities are not fit to serve all users, particularly AI users, and are falling behind those of other advanced economies. As of November 2022, the UK had only 1.3% share of the global compute capacity and did not have a system in the top 25 of the Top 500 global systems."*

At the time of writing, in January 2025, this is still the case. The UK's ARCHER2 system currently ranks 62nd in terms of the world's most powerful systems, a result of what one expert interviewee described as "paltry" government investment in AI compute to date.[47] We do not argue in this report that the UK should aim to outdo behemoths such as the United States and China. But comparable countries, such as Spain, Germany, the Netherlands and France are nevertheless pulling ahead of the UK on compute. Overall, the UK possesses only 1.4% of global compute capacity, ranking tenth globally behind countries such as Italy, Finland and Russia.[48] To put this in context, the UK was placed third in the world on this metric as recently as 2005.[49]

Ensuring sufficient compute capacity is paramount if the UK wants to make the most of the opportunities of AI and the broader digital economy. At the frontier, compute capacity is vital to facilitating groundbreaking scientific and medical discoveries. But even in the everyday economy, it is needed for a wide variety of digital transactions such as using public transport or making online purchases. The Review even went so far as to state that:

> *"Without intervention, not only the government will not be able to realise its economic, scientific and technological ambitions, but the UK's internationally recognised strengths in science and technology will risk fading away."*

What should we make of the UK's overall position? Below is a graphical overview of what we see, in simple terms, to be the strengths, weaknesses, opportunities and threats to the UK's position when it comes to AI and the digital economy.

Figure 3: Summary of strengths, weaknesses, opportunities and threats to the UK's position on AI and the digital economy:

Summary: developing a strategic approach to data centres

The UK's approach on developing data centres to date has largely relied on attracting market investment and approving projects on a local, case-by-case basis. It has done this well; after all, the UK boasts Europe's largest data centre market. However, the lack of a strategy for data centres until recently has arguably contributed to the concentrated, regionally lopsided distribution of data centres in the UK. Currently, it is contributing to power bottlenecks and delays to projects.

Fortunately, this looks likely to change with the advent of the AI Opportunities Action Plan, which recognises the importance of compute capacity to support AI objectives and links data centres to key strategic and economic benefits, which we have outlined in the previous chapter. Crucially, the Action Plan recognises that the UK cannot rely solely on its strengths in research and talent to maintain its position in the global AI ecosystem; it needs to ensure there are strong foundations in the form of compute infrastructure to make the most of the opportunities in the decades ahead.

However, the UK does not have time to waste in putting its Action Plan into practice. As Box 2 below shows, the UK is far from being the first country to set out a strategy on data centres and compute. Indeed, Norway has had a national data centre strategy in some form since 2018. In blunt terms, the UK is late to the game when it comes to strategically developing compute capacity and linking data centres to key national objectives.

Box 2: What are other countries doing on data centre strategy?

The world's first national data centre strategy was launched by Norway in 2018,[50] followed by a second in 2021.[51] Norway has aimed to attract data centre investment to boost its economy by leveraging its strengths as a leading renewable energy producer whilst improving connectivity and streamlining the process for grid connections.

Since then, numerous other countries have followed suit. Canada has recently launched its Sovereign AI Compute Strategy, which will invest up to $2 billion to grow Canadian AI champions; build public computing infrastructure; and provide affordable access to compute capacity for SMEs through an AI Compute Access Fund.[52] Of this, $700 million will be dedicated to leveraging investments from industry, academia and the private sector to build data centres that demonstrate a sufficiently high return on public investment.[53]

Singapore has also recently announced that it will release 300MW of additional data centre capacity as part of its "Green Data Centre Roadmap",[54] which aims to shape the data centre market there by strongly incentivising greener data centre builds.

Similarly, Ireland's government – while limiting data centre development due to grid constraints in the country – has nevertheless also set out the principles on which it will favour further data centre development, including economic impact, co-location/proximity to energy supply, adding renewables to the grid, and providing community benefits or opportunities for SMEs.[55]

In this chapter, we have been clear on importance of a strategy, now embodied in the AI Opportunities Action Plan, to make the most of the UK's strong current position at the outset of the AI era and address the most glaring weaknesses – specifically, a lack of compute capacity. In the next chapters, we will set out specific interventions that can help to further the Action Plan's objectives, focusing in particular on energy and planning policy.

CHAPTER TWO – SOLVING THE ENERGY TRILEMMA

The electricity demands of data centres are significant and growing

The computation that powers the world's digital activity needs a large amount of electricity to function. The more extensive the computation is, the more power is needed. To avoid IT components becoming dangerously overheated, a lot of electricity is spent on keeping data centre facilities as temperature controlled, optimised environments.[56]

Improvements in energy efficiency have moderated the growth in electricity required, but the power demands of data centres today are vast, nonetheless. Across the world, data centres and the transmission networks that connect them, each account for 1-1.5% of global electricity consumption.[57] In places with high concentrations of compute infrastructure, the proportion of electricity generation consumed by data centres is higher still. For example, Ireland's data centres use almost a fifth of its generation capacity.[58] In the UK, data centres account for 2.5% of the UK's total electricity consumption.[59]

As the demands of computation grow in scale, the amount of electricity data centres require is set to rise dramatically in the coming years. In the UK, data centres' electricity consumption could amount to just under 6% of the country's total by 2030. Forecasting further ahead is naturally less certain, but the UK's Energy Systems Operator predicts that annual data centre electricity consumption could grow to as much as 35 TWh by 2050, which would be nearly ten times what it is today.[60]

Data centres face a trilemma in meeting their power needs

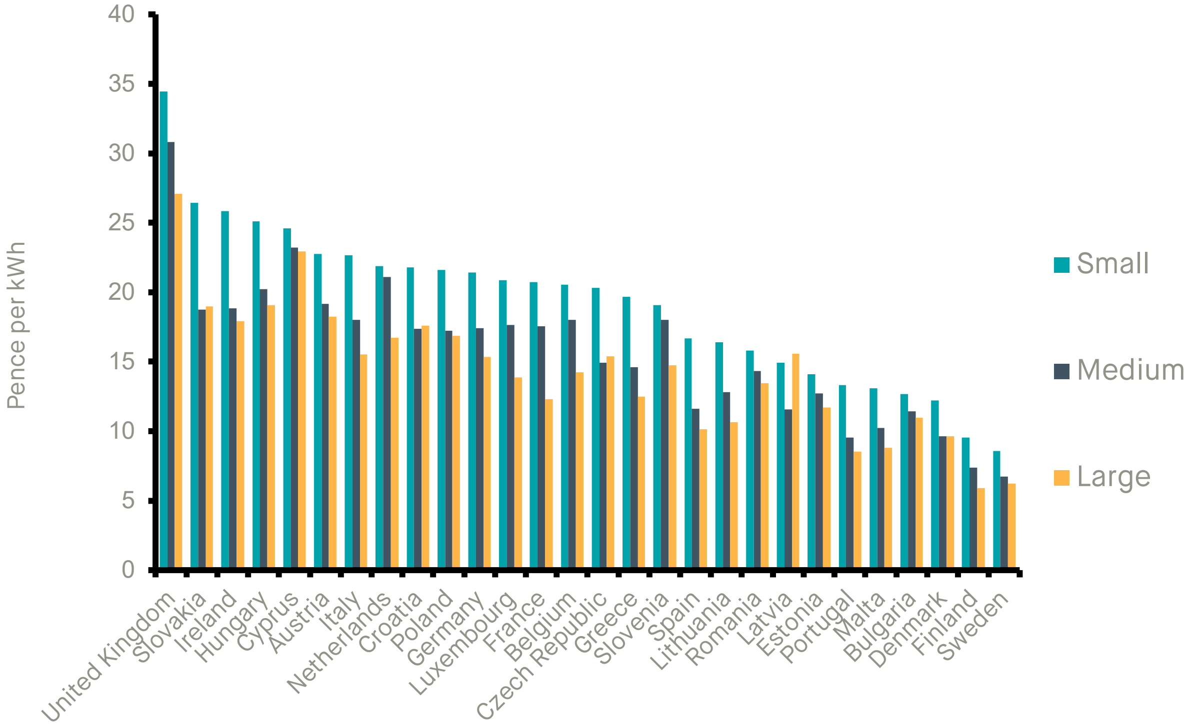
Amidst large and growing power demands, data centres face a trilemma between energy cost, energy availability, and sustainability. How well a country meets each of these three objectives shapes how attractive it is to those wishing to develop and operate compute infrastructure. Unfortunately, the UK is navigating this trilemma poorly.

High energy costs

For their operations to be competitive, the electricity supplied to data centres must be low-cost. Given the sheer amount of electricity required, particularly for data centres facilitating AI development and inference, it is the greatest operational expense that these facilities face. Therefore, the price of electricity can have significant implications for the economics of this sector.[61]

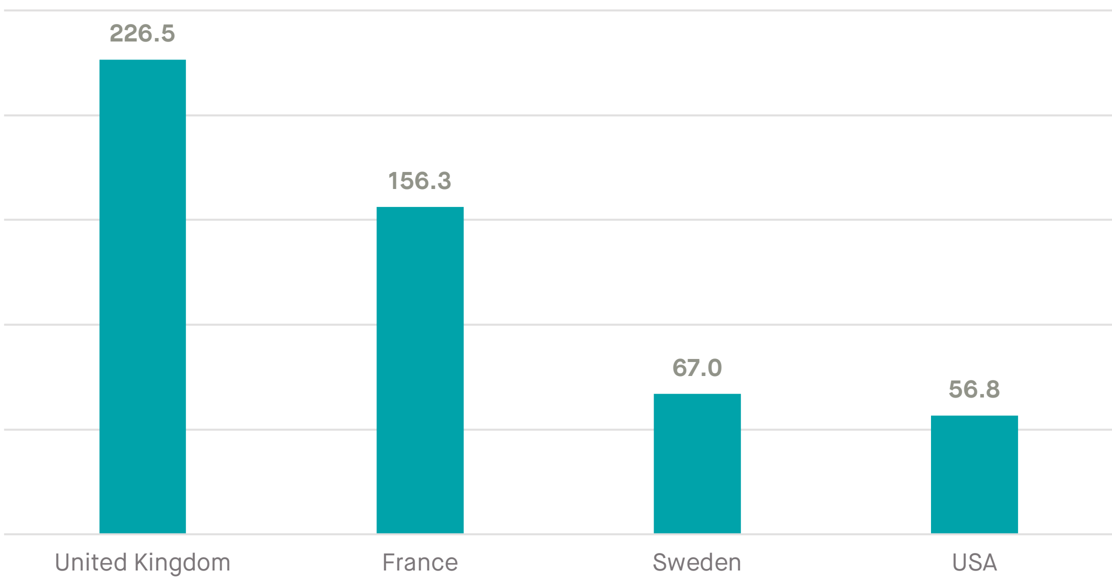
The UK's cripplingly high energy costs is consequently representing a significant issue stunting the growth of the UK's data centre sector.[62] Industrial consumers in the UK face electricity prices 46% above the International Energy Agency country median; around 1.5 times as much as what the same businesses face in France, 3.5 times more than in Sweden and nearly 4 times more than in the United States.[63] As Figure 4 depicts below, the UK's industrial electricity prices for small, medium and large users are higher than in every EU country, and Figure 5 illustrates how these high energy prices makes the UK a less competitive location for operating compute infrastructure.

Figure 4: Average industrial electricity prices in the EU27 plus UK (small, medium, large) including taxes / subsidies, 2023:



Source: Department for Energy Security and Net Zero

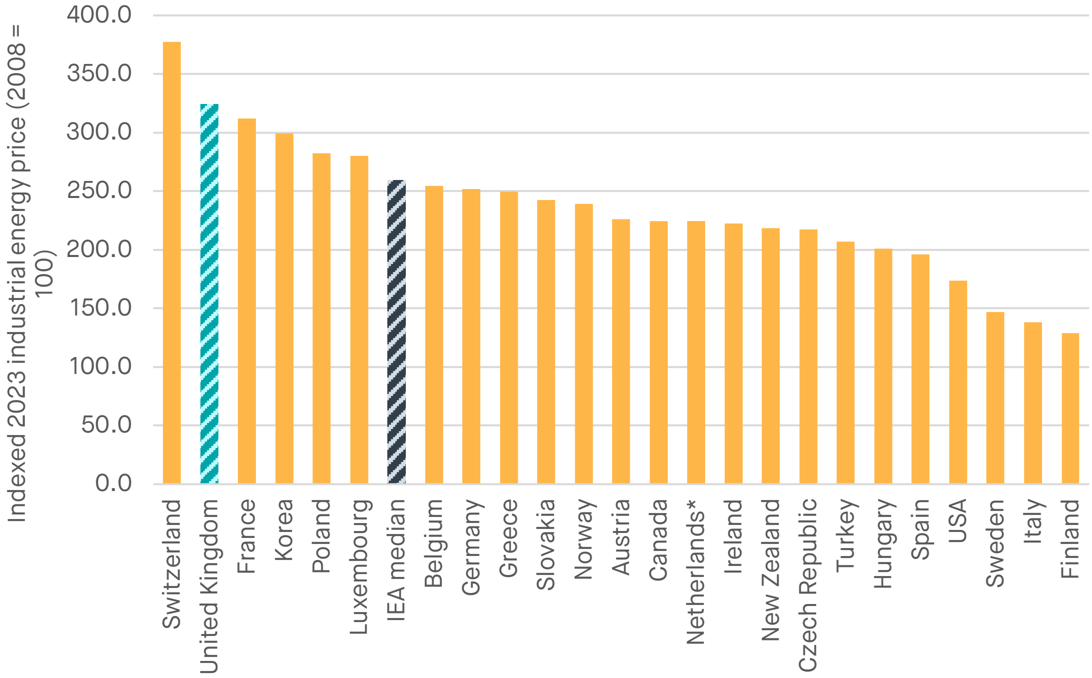
Figure 5: Estimated annual electricity costs (£, millions) for 100MW data centre, selected countries, 2023:



Source: Department for Energy Security and Net Zero, SMF calculations

This problem is getting worse. As Figure 6 below shows, since 2008 industrial electricity prices have risen more sharply than in any of the UK's peer economies, and well above the median for IEA countries (only Switzerland experienced greater increases in the price of industrial energy). Much of this relative increase in energy costs has occurred since 2021.

Figure 6: Relative increase in industrial electricity prices since 2008 for selected countries, indexed 2023 (2008 = 100):



Source: GOV.UK "International industrial energy prices", SMF analysis. UK is shown in turquoise; IEA median in darker blue. Netherlands data is from 2022, the latest year available.*

High energy costs make the UK an unattractive location to invest in compute capacity. This risks leading investment away from the UK and towards competitor markets at the expense of UK economic growth. The experts interviewed for this work unanimously agreed that the UK's energy costs are a significant constraint on the country's ability to develop compute infrastructure. One can be quoted as such:

> *"Where the commercials come in, it's the cost of energy [that's the problem]. So what we're seeing is… UK-based cloud providers are buying and getting funding from the UK, but then building overseas… They're building either in Iceland or in Denmark or in Norway, where you're paying 18 times less for energy than you are in the UK… I think if the UK wants to attract people to build and research in the UK, they're going to have to be able to access the resource at an appropriate price."*

Slow grid connections

Data centre operators seek sites where there is enough electricity flowing through the grid to allow facilities to be developed quickly. Without available grid capacity or the potential to generate electricity on-site, data centres cannot be built and operated. The speed at which potential developments can connect to the grid is significant; if there are long wait times to access electricity, developers will relocate to areas where it is quicker to do so.

But the UK's electricity supply is limited compared to peer economies, with per capita electricity generation in the UK two-thirds of what it is in France and just over a third of what it is in the United States.[64] Limitations in electricity supply vary sharply by region, meaning that in several areas of the UK there are significant barriers on the ability of the electricity network to supply electricity to energy-intensive activities. Most often this is due to outright capacity constraints, where the grid's infrastructure cannot handle the volume of electricity being consumed; the demand for electricity exceeds the grid's ability to supply electricity.[65] One expert interviewed for this research helpfully described the nature of the UK's grid infrastructure problems:

> *"We have got to the point now where there isn't any available capacity [for] that infrastructure to be able to transport any more power, because it's got to its maximum kilowatt capability, so they're having to upgrade it and build new ones. And the time frame it takes to build those new ones with the type of equipment that they're having to order is really challenging. It's really expensive, and it takes a long time to manufacture, and a lot of it is quite bespoke... so it does take a long time."*

In the most capacity constrained parts of the country, data centre developments are being significantly delayed due to an inability to deliver the amounts of electricity they require. Grid infrastructure must be improved to allow more power to be transmitted from the place it is produced to the place it is needed, and these complex, capital-intensive infrastructure improvements often take time. In parts of West London where an influx of requests for grid connection from data centres has ramped up demand, the construction of housing projects has been delayed until 2035 because the electricity grid has run out of capacity.[66] Whilst data centres are in no way solely responsible for this strain on the grid (there are many other large users contributing to demand), this case illustrates the unavoidable trade-offs that substandard grid infrastructure imposes on different sectors throughout the economy.

This is not a problem confined to the UK. Amsterdam banned all new data centre developments in 2019. Whilst the ban only lasted a year, a permanent dent in the city's data centre growth has been reported.[67] Similarly, a 'de facto' moratorium on new data centres was imposed in Dublin in 2022, with Ireland's electric power transmission operator announcing that it might not be able to connect new facilities until 2028.[68]

Limited availability of electricity, particularly in constrained areas, is likely to become a standout issue stunting the development of the UK's compute infrastructure. Data centre operators looking to build new facilities will divert UK investments to other jurisdictions if they are unable to get a grid connection and start operating in a commercially feasible timeframe, and the benefits of such investments will be captured by countries that can offer quicker development timelines.

> *"The core problem in the UK is one of power, the availability of power and the ability of the national grid to actually support high power density type applications, which is a problem in many parts of the UK. And as inference starts to get rolled out and deployed in other parts of the UK, it could well be that the national grid doesn't always have power for those parts of the UK which may require it."*

Ensuring clean energy

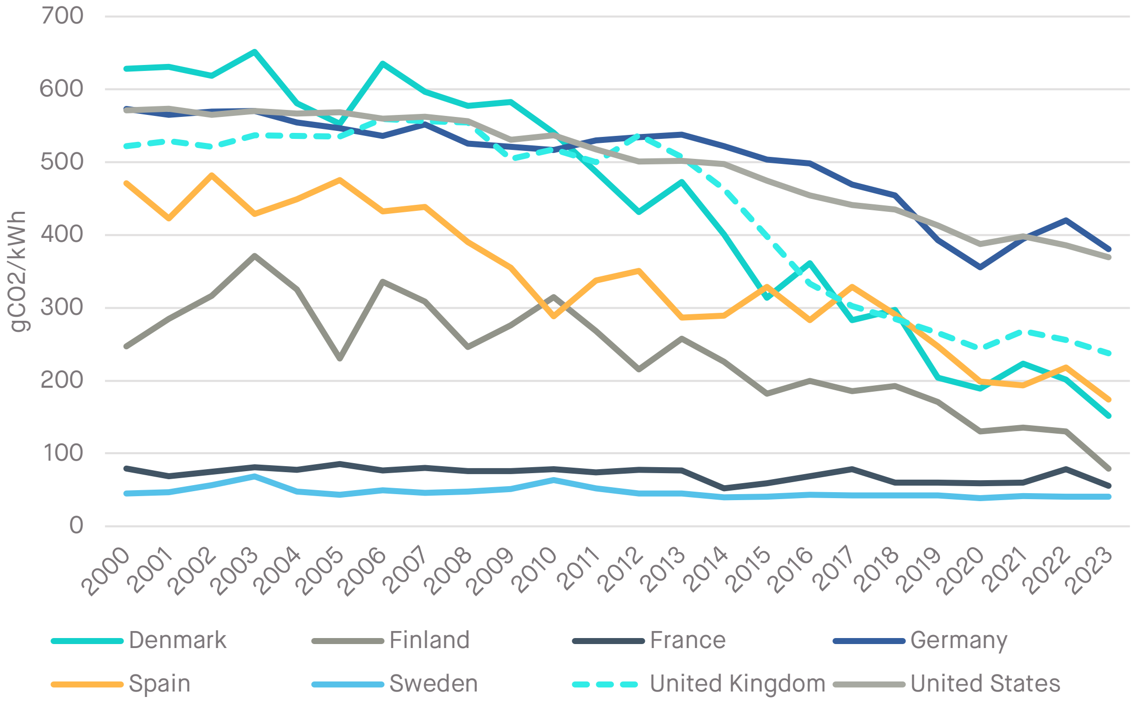
The third requirement of the electricity used to power data centres is that it comes from non-carbon sources. There have been growing concerns that there is an inevitable trade-off between achieving climate goals and allowing the development of AI to continue at pace.[69] It is therefore viewed as imperative that the electricity used to supply the UK's compute does not originate from fossil fuels.

The importance of data centres sourcing clean energy for their operations is partly down to government policy. In October 2021, the government set an ambition for all electricity generation to be decarbonised by 2035, and the new Labour government committed to bringing that target forward by five years, with its clean energy by 2030 manifesto pledge.[70] [71]

But clean energy is also a key requirement imposed by firms that operate data centres and those that use their services. Many of the largest technology companies have set themselves stringent climate targets. In 2020, Microsoft announced that it aims to be carbon negative by 2030, while others have similarly ambitious targets to reduce the amount of emissions produced from their operations.[72] [73] Some, such as Amazon, have met with success in achieving 100% renewable energy goals.[74] Due to the heft these companies play within the global technology ecosystem and their role as corporate purchasers of renewable energy, it is a prerequisite for inward investment in UK data centres that the power that feeds them is non-carbon.

However, whilst the UK has made significant progress in decarbonising its electricity grid, progress has stagnated in recent years and the UK's electricity remains more carbon-intensive than other nations vying to attract investment in compute (Figure 7). For example, each unit of electricity generated in the UK in 2023 emitted over four times more carbon dioxide than each unit generated in France.[75]

Figure 7: Carbon intensity of electricity generation, selected countries



Source: Our World in Data

Furthermore, the average carbon intensity of the UK's electricity generation as shown above is likely to underestimate the true carbon intensity of the majority of UK data centres' electricity consumption. This is because the vast majority of UK data centres are located in the South East of England where the carbon intensity of electricity is higher than regions further north, where there is greater concentrations of renewable energy generation.[76] For example, assuming the same level of electricity consumption, a data centre in Slough would be responsible for over 13 times as much carbon dioxide emissions as one located in the North East of England in 2023.[77]

The UK's failure to decarbonise its electricity generation to levels seen in peer economies not only has an impact on the county's net zero ambitions but also has negative implications for the country's attractiveness as a place to develop compute capacity and build high-value technology businesses.

Failure to address the UK's energy problems will constrain compute

A firm insight from the expert interviews conducted for this research was that the UK's failure to address this trilemma of cost, availability and sustainability was the most pressing issue hobbling the growth of the UK's compute capacity and, as a consequence, its ambitions to be a 'global AI superpower'. Whilst there was widespread agreement that energy costs represent the most damaging immediate problem for data centres, the three issues combine to make the UK increasingly unattractive to build large compute operations. One expert we interviewed summarised how the combination of these difficulties was making the UK an unappealing destination to invest in compute infrastructure:

> *"The density of power required in order to run data centres means the UK is being challenged because we don't have that sort of capacity available in this quite niche timeline. We equally don't have the power price points that you can see in the Nordics, for example... When it's only 20% of the cost to run it in another geography, that's where all that business is going... It's cheap power, it's abundant. They've got very green sustainable power as well. And that's sort of the key thing that our clients are looking for."*

There are several approaches to fix the UK's energy problems

For the UK to become a more attractive place to build and operate data centres, policymakers must better navigate the energy trilemma. There are several approaches that the UK could follow in order to achieve this goal, and the following section sets out ways to do so over the short, medium and long term.

Long term: investments for clean energy abundance

Significant investment in the country's energy infrastructure to achieve a state of clean energy abundance is what's ultimately required to address the energy problems squashing the data centre sector. A joint 2022 paper from Ofgem and BEIS forecasts the UK's electricity demand in 2050 to be roughly double what it was in 2020, whereas others predict that an increase of five times is more likely.[78] [79] And if we consider the potential ten-fold growth in data centres' electricity consumption that could take place by 2050, the strains on the UK's electricity system become evidently unmanageable without huge increases in generation capacity.[80]

Nuclear will be key to delivering energy abundance, particularly for data centres

Investment in nuclear energy will be particularly important in delivering energy abundance, as it is the only technology the UK can feasibly use to deliver abundant, cheap and reliable clean electricity generation.[81] [82]

Nuclear power plants are the most land-efficient form of generation, requiring 50 times less land compared to coal, and 18 to 27 times less than solar PV per unit of electricity.[83] And whilst the construction of nuclear plants is a carbon-intensive undertaking, the sheer volume of electricity they produce means than each unit of electricity is considered emission free.[84] Because of this scale, nuclear-produced electricity is also cheap. Furthermore, nuclear power avoids the biggest problem that solar and wind power face: it produces constant amounts of electricity across the day and year, an important attribute given the intermittent nature of other dominant forms of non-carbon generation.

These attributes make nuclear power particularly attractive for powering data centres, which require their electricity to be clean and price competitive. They also require highly reliable and 'always on' sources of electricity. The baseload nature of nuclear generation is the only clean form of power that can meet these needs at scale.[i] This explains why there has been a recent flurry of interest in nuclear generation from businesses whose activities are underpinned by large-scale compute.[85] For example, in 2024 Microsoft signed a power-purchase-agreement with Constellation Energy that will see the power company restart a reactor at the Three Mile Island nuclear power plant in Pennsylvania.[86] [87] Google, Meta and Amazon Web Services similarly have plans to deploy nuclear to power computation in the coming years.[88]

Government policy on nuclear is under-ambitious and misguided

The UK government is aware of the virtues of nuclear energy and its importance in the context of future demands on the UK's electricity system. Indeed, the government's 2022 Energy Security Strategy, which set out an ambition to quadruple nuclear power capacity to 24GW by 2050, portrayed nuclear as critical to the UK's energy needs:[89]

> *"Nuclear energy is the only form of reliable, low carbon electricity generation which has been proven at scale… We can only secure a big enough baseload of reliable power for our island by drawing on nuclear".*

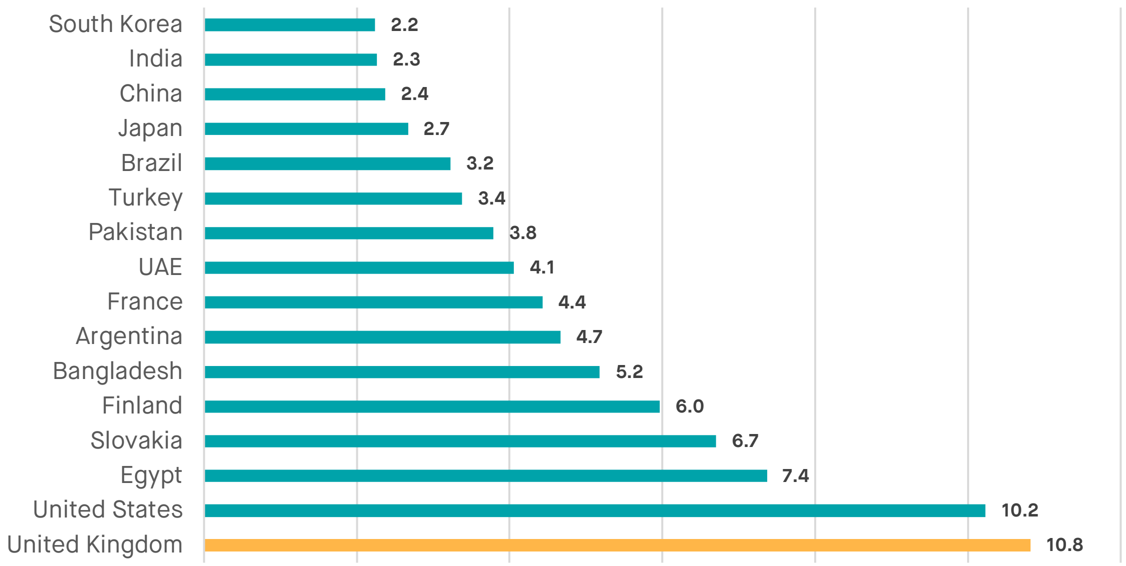
However, there significant problems with the government's current approach to nuclear energy.

Firstly, the government is underestimating the extent of nuclear power that needs to be delivered. Quadrupling nuclear generation sounds a lot, but this comes amidst falling supply from other sources, notably natural gas generation. In fact, nuclear generation is currently falling, with two reactors scheduled to cease generation before Hinkley Point C comes online around 2030.[90] As more intermittent renewable generation is added to the energy mix, there is a growing need for nuclear to contribute to the stability of the electricity grid.[91] This means that the government's current plans for expansion pale in comparison to what is required. Evidence suggests that the UK will need around 61 GW of nuclear energy by 2050 under the most cost-effective pathway to net-zero.[92]

The greatest failure of UK nuclear energy policy is the approach to how it is delivered. Whilst a common critique of nuclear power is that it is expensive, this is in large part a product of UK government policy and is not the norm around the world (see Figure 8 below), with the International Energy Agency (IEA) finding nuclear to be the low-carbon technology with the lowest expected costs in 2025.[93]

[i] Hydropower and geothermal energy can provide non-carbon electricity that can be considered 'baseload' in nature, yet neither is likely to be able to be delivered in the UK at the scale required in the next few decades.

Figure 8: Cost of building nuclear power by country, average construction costs (inflation-adjusted million GBP) per MW for all plants with reliable cost data built since 2000:



Source: Britain Remade[94]

A burdensome regulatory regime partly explains why building nuclear in the UK is so expensive.[95] But the greatest problem is a 'feast and famine' approach to building nuclear: instead of setting up a pipeline of projects, reactors are designed and developed in isolation. This has several implications for the nuclear industry. Without replacement work lined up, businesses and skilled workers are motivated to move to countries where a steadier stream of work is available, and complex supply chains can be damaged.[96] And building nuclear power plants one by one means there is limited opportunity to realise economies of scale and reduce costs.[97]

Government should move towards a fleet-based approach to large -scale nuclear and support the development of Small Modular Reactors

For the reasons outlined above, the UK sees the highest cost of building nuclear power of anywhere in the world. For the same reasons, South Korea develops nuclear power at a fraction of the cost in Britain. It does this by building reactors in 'fleets', i.e. 8-12 reactors in a row, to benefit from economies of scale and 'learning by doing'. Both France and China have followed a similar approach of fleet builds, and both have seen considerable reductions in the cost of nuclear energy development.[98] [99] By moving towards a fleet-based approach to the building of large-scale nuclear plants, policymakers can help lower development costs substantially and enable significant increases in competitively-priced electricity generation.

The development of Small Modular Reactors (SMRs) also poses an opportunity to decrease the costs of nuclear energy generation in the UK. SMRs are nuclear reactors that have a power capacity of up to 300 MW(e) per unit, about one-third of the generating capacity of traditional nuclear reactors. Their modular nature means components can be factory-assembled and transported as a unit to a location for installation.[100]

SMRs offer numerous benefits over traditional nuclear, including quicker development timelines and the ability to be sited in areas not suitable for larger nuclear power plants. Through factory assembly and repeat manufacturing of units, SMRs will also be substantially cheaper than building large nuclear plants; SMRs are projected to cost less than £2 billion compared to the tens of billions price tag attached to large plants.[101] The developers of SMRs seek to realise the same economies of scale as South Korea and others have done through building large nuclear in fleets, but with smaller and many more reactors.

As SMRs employ established nuclear technology – only on a smaller scale - their development in the UK is a realistic prospect. In fact, SMRs were first used to power submarines and ice-breaker vessels in the 1950s. They are already in operation in Russia and China, with other SMRs under construction or in the licensing stage in Canada, South Korea and the USA.[102] [103] In the UK, the government has stated that SMRs could play an important role alongside large nuclear as a low-carbon energy source, and designs from several companies are proceeding through the Generic Design Assessment, the regulatory process by which new reactors are permitted.[104]

Due to their ability to provide large amounts of reliable and clean power at a competitive price, SMRs could be highly applicable in meeting data centres' electricity needs.[105] Given the relatively low cost of SMRs, tech firms and data centre providers could seek to co-locate them alongside their computing operations. Many are already making plans to do so. Software company Oracle has announced plans to use three SMRs as part of its proposals to build an AI -focused data centre, and Google announced it will purchase nuclear energy from multiple SMRs to be developed by US-firm Kairos Power.[106] [107]

Yet whilst this shows the potential for the UK to use SMRs, the UK is now at risk of falling behind. In February 2025, the government introduced reforms to planning rules to make it easier for firms to build SMRs across England and Wales.[108] Whilst this is a welcome move, the UK is still a long way from the widespread deployment of these power plants. The GDA of the Rolls-Royce SMR is currently scheduled to finish in December 2026, with little prospect of SMRs being delivered even 5 years after that.[109] If rivals pull ahead in their ability to generate abundant levels of cheap and clean energy, the relative disadvantages data centres face in Britain will get worse, and the UK's AI and technology sector will suffer considerably as a result. As such, it is critical that the government develops a clear strategy to speed up the development and deployment of SMRs.

Policy recommendation: the government should set more ambitious targets on nuclear energy, take a fleet-based approach to the provision of large scale nuclear and support the development of Small Modular Reactors

Given the centrality of nuclear to achieving clean energy abundance, the UK needs a strategy that can deliver extensive, affordable nuclear generation.

The first component is a greater level of ambition on the role of nuclear power. Whilst we do not offer a specific GW capacity target, the existing target of 24GW by 2050 is insufficient and should be significantly higher by mid-century.

Secondly, the government should adopt an approach of building nuclear reactors in fleets, committing to build roughly a dozen reactors with the same proven design in one pipeline of work. This approach is the most effective way to safely reduce the cost of large nuclear projects.

Finally, the government should publish a policy statement signalling support for SMRs in the UK by making it clear that the government will facilitate their deployment, for data centres and other infrastructure. Importantly, it must make the rules on where SMRs can be located more lenient to allow them to be sited near urban or industrial areas.

Medium term: electricity market reform

While mobilising investment for clean energy abundance is of paramount importance – it is the only durable solution to the UK's energy woes – doing so will take considerable time. New nuclear reactors are unlikely to add significant capacity until at least the mid-2030s. In the next few years, however, there is a large risk that the UK will squander its relative lead in digital technology and AI to countries with a more forgiving energy situation. Hence more immediate reforms are required to alleviate the energy challenges data centres face.

There remains an option that could be achievable in a shorter timeframe and have a positive effect on the UK's energy challenges: reforming the wholesale electricity market from a system where prices are set nationally to one where prices are determined according to the location where electricity is consumed.

This section sets out the case to move to a system of 'zonal locational pricing' of wholesale electricity in Great Britain.[ii]

[ii] Northern Ireland's electricity sector falls beyond our purview because it forms part of the Single Electricity Market on the island of Ireland.

An overview of the wholesale electricity market in Great Britain

Within Great Britain, there are two layers of the electricity market: the wholesale electricity market, which manages the sale and purchase of electricity between suppliers and generators, and the retail electricity market, where suppliers sell electricity directly to consumers.[110] Our focus is on the wholesale electricity market, because its structure has the greatest impact on the nature of electricity generation.

Within wholesale electricity markets there are two main ways to calculate the prices paid between generators and suppliers:

- National pricing systems are those where prices do not vary by location. Great Britain, along with countries such as France, Germany and Poland, employ the national pricing model. This model has a single market zone where buyers and sellers can contract directly at a price agreed in private. This means that at any given moment, there's one price for wholesale electricity across the country.
- Locational pricing systems are those where prices do vary by location. Some divide their markets into regional price "zones", as is the case in countries like Australia, Italy and Sweden, and some price electricity at more granular "nodes", as is done in New Zealand, Singapore, and some markets in the United States.[111]

Nationally determined electricity prices make electricity more limited, expensive and carbon intensive than it needs to be

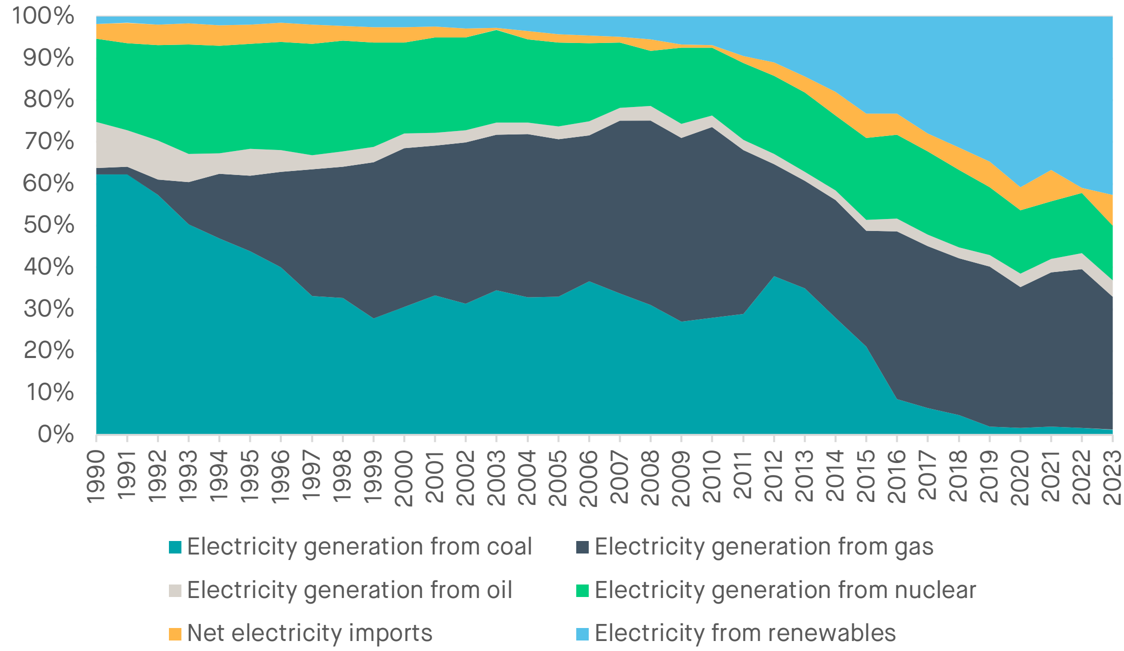
Market design has not changed with the times

A major reason why the UK's electricity supply has become so constrained and prices have risen so sharply is that the structure of the electricity market has not evolved in line with transformations that have taken place over recent decades.

When the electricity market was liberalised in the early 1990s, the way electricity was produced was vastly different to today. Baseload fossil fuel and nuclear power plants contributed almost all – over 96% - – of the UK's electricity generation in 1990 (see Figure 9 below).[112] At this time, it made sense to have a national price, because there was little variation in the availability of electricity between the UK's regions.

In the years since, the nature of electricity generation in the UK has undergone a rapid transformation, with renewables such as wind and solar power making up an ever- greater share of the UK's electricity mix. In 2023, these sources of power made up over 40% of the UK's generation capacity, and with efforts to decarbonise the electricity grid set to accelerate in the run up to Labour's 2030 clean power target, this figure is set to rise considerably further in the immediate future.[113] [114]

Figure 9: Proportion of UK electricity production by type, 1990-2023:



Source: Our World in Data

The rapid growth of renewables is an environmental policy success; whilst the UK's electricity remains more carbon intensive than several comparator countries, few other large nations have decarbonised their grid so sharply over such a short period.[115] But the UK's national pricing model has made electricity more constrained and expensive than it otherwise could be.

This is largely because of where much of the UK's renewable generation capacity is located. Wind power makes up the greatest source of renewable energy generation in the UK, mainly in the form of offshore turbines in the North Sea.[116] This is partly because of government policy, which until July 2024 favoured the development of offshore wind through the imposition of a de facto ban on the development of onshore wind in England.[117] But the main reason is that wind speeds in peripheral places (e.g., offshore) tend to be much greater than they are in the country's interior, where there is most demand. For onshore wind, the most favourable wind speeds are found further North and typically on elevated terrain away from major population centres.[118] For example, Scotland, which contains just 8% of the UK's total population, is home to 64% of the country's operational onshore wind capacity.[119]

Consequently, increasing amounts of the UK's electricity is produced in places far away from where it's needed. Due to physical transmission constraints, the network cannot easily transfer power from one region to another.[120] As the government's review of electricity market arrangements acknowledges:[121]

> *"This emerging system, where the location of supply and demand is increasingly at odds, is putting additional strain on network infrastructure in the form of greater periods of network constraints - times when parts of the network are at capacity and physically incapable of transporting additional*

energy from one point to another (e.g. from North Scotland to Southeast England)."

A national price for electricity is no longer fit for purpose

In this context, a national price for electricity fails to capture local differences in the supply and demand for electricity, leading to an inefficient locational allocation of both generation and consumption.

On the generation side, the current system of nationally set prices means developers focus on maximising generation resources, taking less account of the cost of transporting output to market. It leads wind farms to be built where there are the highest wind speeds, not where power is most needed. This requires huge sums of money to be spent on transmission lines to connect generation to demand, adding costs for all users.[122] It also leads to significant spending on 'constraint payments' to renewable energy operators, where generators are paid by NESO to switch off because of a physical inability to transfer electricity to where it's needed.[123] Constraint costs have risen significantly in recent years, from around £0.7bn in 2018/19 to £1.8bn in 2022/2023. These costs are predicted to reach more than £3bn per year by 2028.[124] In more than 85% of cases where wind farms are requested to shut down, gas plants located in more useful locations are requested to increase generation, pushing up carbon emissions as a result.[125]

From the consumption perspective, national electricity prices means large users of electricity do not incur the real costs of consuming electricity in a given location, muting the incentives for users to locate where there is more available electricity. This adds strain to the grid and contributes to aforementioned issues where developments in certain areas are blocked altogether due to demand outstripping supply.

How locational pricing would work

Introducing a system of locational pricing would see Great Britain split into a number of zones, as is the case in markets such as Italy, Norway, Denmark, and Sweden.[iii] [126] Within each zone the same process of wholesale price setting would take place as is currently done at the national level, and each zone clears with its own price that reflects supply -and -demand conditions within the zone.[127] Policymakers have to define the number of zones and their boundaries, but experts consider a range of between seven and twelve zones for Great Britain as the most feasible approach.[128]

[iii] This report only considers reforms that introduce a system of zonal locational pricing, solely because the government has discounted nodal pricing due to the impacts it would have on investor confidence and the deliverability of our 2035 decarbonisation targets. Source: https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements-rema-second-consultation

Zonal pricing would generate large economic benefits and help the UK to address the energy challenges limiting data centre growth

By better reflecting local conditions of supply and demand, locational pricing would have two main effects:

1. Incentivise large users of electricity to locate in areas where there is greater supply, putting less pressure on highly constrained parts of the grid.
2. Incentivise generators of electricity to locate in areas where there is limited supply and therefore higher profit margins, adding capacity to highly constrained parts of the grid.

For data centres, this will create price signals that encourage them to locate outside of capacity-constrained areas, notably the South East. This would benefit data centres that do not require low latency and are agnostic over their location - particularly 'AI factory' type data centres, which can consume cheaper energy in less constrained parts of the country. But it would also serve the data centres whose clients require low-latency data services and therefore must locate in high -demand areas of the UK. This is because the reallocation of location-agnostic users away from high -demand areas, alongside the increased local generation incentivised by this reform, would serve to make electricity more available and therefore cheaper than would otherwise be the case. More broadly, a more efficient siting of generation and demand will bring savings for all users through reduced constraint payment and grid upgrade costs.[129]

Evidence of the benefits of zonal pricing

As part of its multi-year review into electricity market arrangements, the government is examining whether zonal pricing could provide more affordable, secure and cleaner energy. Evidence suggests that substantial economic benefits could be generated through moving to zonal wholesale electricity pricing.

One modelling exercise commissioned by the Department of Energy Security and Net Zero found that whilst the scale of benefits realised from locational pricing would be shaped by a range of implementation choices, these would amount to tens of billions of pounds from 2030 to 2050.[130] Similarly, an Ofgem analysis of options for locational pricing found that over 2025-2040, net consumer benefits range from £15 billion to £31 billion.[131]

On the consumer side, research carried out by Octopus Energy explored locating a large new data centre with fixed demand in Aberdeen rather than Slough, finding that locating in Scotland under locational pricing would save the data centre 65% on their electricity costs.[132]

A review of evidence from international markets found no indication to suggest that zonal markets harm investment in low carbon generation compared to uniform or nodal markets. Norway, Sweden, Italy, and Denmark have all seen significant growth in renewables and all enjoy considerably cheaper energy the UK does.[133]

Furthermore, research indicates that the benefits derived from locational pricing for one region do not come at the expense of others. A report by the UK's Energy Systems Catapult found that zonal pricing in Great Britain would bring benefits to consumers across the country, but that the biggest gains would occur in the northern reaches of Great Britain.[134] Greg Jackson, CEO of Octopus Energy, has argued that it would give Scotland the cheapest electricity in Europe.[135]

Whilst estimates of the economic benefits vary according to the assumptions and methods used, moving to a model of locational pricing would help ease the energy challenges suppressing the UK's compute infrastructure, and boost the wider economy through lower energy costs and a more efficient, less carbon-intensive energy grid.

There are well-founded concerns over electricity market reform, but the benefits of locational pricing outweigh the costs

Critics of locational pricing contend that it would not lead to a realisation of the benefits outlined above, but rather to more constrained, costly and carbon-intensive generation.

Users in high-cost areas will suffer

One of the main arguments against locational pricing is that large users of electricity have a limited ability to relocate on the basis of changing price signals, and that firms in high demand areas who are tied to a particular location will be rendered uncompetitive as a result. The assumption behind this criticism is that a nationally set wholesale price for electricity means prices are artificially high in some parts of the UK (e.g. Scotland) and artificially low in others (e.g. London and the South East), and that if prices reflected real conditions of supply and demand the prices would fall in some areas and rise in others.

It is true that some users will not have ability to move. A key insight from interviews with professionals in the data centre sector is that, because of the concentration of fibre networking around London and the South East and the need for network resilience[iv] built into data centre operations, it is simply unfeasible for many operators to relocate from the cluster that exists in and around the M25. One executive of a data centre company explained how:

> *"You can change the price signals data centres face when it comes to energy costs, but this will do little to shape their location choices without fundamental redrawing of fibre networks."*

Whilst this may be the case, even users who can't easily relocate benefit from the fact that others will, meaning there is more electricity left in constrained areas for those who remain. Even if no data centres have the ability to move, they would still

[iv] For data centres, resilience refers to the ability to remain operational during unexpected disruptions, such as power outages or cyber-attacks. Network resilience is an important component of this, and often requires that data centres have multiple network connections to ensure that a single point of failure doesn't affect all of the network connections.

benefit from large users in other industries doing so. Furthermore, as evidence cited earlier suggests, the concern that some regions lose out from other regions' gain is likely to be overstated due to reduced network transmission costs bringing benefits to all parts of the country.[136]

Generators have little ability to relocate to balance out the grid

There is also scepticism over the ability of generators of renewable electricity to move closer to areas where electricity is in greatest demand. Wind speeds in the North and in the waters surrounding the UK tend to be much greater than they are in the South and on land. Put simply, generators argue that there are inescapable factors explaining why generation is far away from demand, something locational pricing will be unable to fix.[137]

Much of the UK's electricity generation is located far away from demand because of higher wind speeds around the periphery of the country, but this is partly incentivised by a nationally set price of wholesale electricity which masks the costs of getting electricity to where it's needed. The existing system is essentially providing a subsidy to produce electricity where there's little demand for it. Locational pricing would attract energy-intensive industries to places of high energy generation potential, and generators to areas of existing high demand, rather than providing inefficient subsidies to generators to create energy in areas that are of little use to consumers of electricity. Furthermore, whilst there admittedly isn't as much generation potential is Kent as there is in the North Sea, there is still lots of potential to create renewable energy (e.g., by incentivising users to put solar panels on their roofs), and plenty of scope to use non-carbon nuclear power.

Locational pricing will stagnate investment in renewables and hinder efforts to Net Zero

One of the principal concerns is that locational pricing will create uncertainty for investors that will increase in the cost of capital, raising the cost of renewable energy investments and hindering the UK's progress in achieving Net Zero. How the cost of capital for renewable energy projects changes as a result of moving to locational pricing has been identified as a key uncertainty influencing the degree of benefits this reform can create.[138] One report found that the greater uncertainty for investors under locational pricing could translate into increases in the cost of capital of between 2 to 3 percentage points.[139]

Though there is considerable uncertainty over how the cost of capital will be affected by moving to locational pricing, policymakers have tools at their disposal to mitigate this problem. For example, the government can commit to honour legacy contracts in order to provide certainty over revenue streams under the current market design. Similarly, measures such as Financial Transmission Rights, Regional Trading Hubs and reforms to Contracts for Difference (CfDs) scheme design, can help market participants manage risks.[140] Indeed, Ofgem's assessment of locational wholesale pricing for Great Britain concluded that there is "no obvious risk of a significant increase in the cost of capital from locational pricing at a GB-wide level."[141] Furthermore, evidence from overseas suggests that markets that have introduced locational pricing haven't seen reduced investment in renewable energy. Texas, which has had a system of locational pricing for over two decades, is switching on 31 times more renewable energy generation per person than the UK is.[142] [143] A recent study examining markets across the US, Europe and New Zealand that use locational pricing found no causal evidence that locational pricing pushes up the cost of capital.[144]

The UK government should direct the relevant agencies to implement locational pricing for the electricity grid in Great Britain

Whilst policymakers should be aware of the costs and risks associated with locational pricing, these costs will be outweighed by the benefits given good implementation. Reforming Great Britain's electricity pricing to better reflect local conditions of demand and supply will help make electricity less constrained, cleaner and cheaper than is currently the case.[145] For the data centre sector, it is the only policy approach in the short to medium term that can address the three main energy challenges preventing the development and operation of compute infrastructure.

Policy recommendation: the government should introduce zonal pricing for the wholesale electricity market in Great Britain

The government should direct the NESO and Ofgem to undertake wholesale electricity market reform to introduce a system of zonal pricing for electricity in Great Britain. Reforms must be clearly explained to stakeholders, carried out over a clearly defined timeframe, and include measures that can mitigate investment uncertainty that may deter investment in electricity generation. Importantly, the government must consider the how CfDs can be designed within zones to maximise benefits and minimise risk stemming from this reform.

Short term: targeted discounts on data centres' energy costs

While there is a strong case for electricity market reform, this too will take several years to implement. In the meantime, the most immediate step the government could take to address the UK's extremely high energy costs is to provide data centres with relief from high energy costs.

A simple approach would be capping the price of energy that data centres pay. The government has carried out this sort of intervention before. For example, in 2024 the British Industry Supercharger scheme was launched to provide exemptions from electricity costs for sectors like steel, metals and chemicals, to make several hundred energy-intensive British firms more internationally competitive.[146] This is a crude approach, however, which risks subsidising polluting forms of energy and distorting markets.

An alternative could be to provide data centres with tax incentives where they are sourcing clean energy from physical Purchase Power Agreements or using on-site generation.[v] Doing so can help make the UK a more attractive destination for data centres in the short term by lowering energy costs; incentivise data centres to source clean energy; and incentivise them to develop on-site solutions to reduce strain on the grid.

The specific design of tax incentive depends on what objective is prioritised: a tax credit on PPAs (a 'procurement credit') is broad-based and offers flexibility to data centres in terms of how they source clean energy, which is suited to facilitating large-scale renewable energy adoption. If the main goal is reducing grid strain, a 'production credit' targeted specifically at on-site generation and private wire systems would be more appropriate. A hybrid system is possible, with a lower rate of tax credit for PPA agreements and a higher rate for on-site generation to reflect the higher upfront costs of building such a system and the desirability of reducing grid strain.

To ensure tax credits are supporting investment into renewable energy, the government should develop an official measure of additionality for Purchase Power Agreements (PPAs). 'Additionality' essentially means that the PPA has added renewable energy capacity to the grid that would not have existed without the agreement. This could be based on benchmarks such as the proportion of a renewable project that is financed by the PPA; the proportion of the project supported by existing government subsidies such as Contracts for Difference; whether the project was already built before the PPA was agreed; and the likelihood of the project getting financing in the absence of the PPA.

In the longer term, the Government could work to develop an agreed approach to 'emissionality'. Emissionality differs from additionality insofar as while additionality asks how much renewable capacity has been added to the grid, emissionality looks at how much fossil generation has been displaced from the grid. It is therefore more location-dependent. The advantage of using emissionality is that it offers a more accurate picture of how much a project is contributing to grid decarbonisation, however it adds complexity to the difficult-to-measure concept of additionality.

[v] There is a difference between 'physical' PPAs, and 'virtual' PPAs. A physical PPA is an agreement in which a power generator sells the physical electricity to a buyer through the electrical grid at a fixed price per MWh for the duration of the agreement, whereas a virtual PPA is a financial agreement where no power is physically traded, the PPA just serves as a financial hedge. Virtual PPAs can be complicated agreements. As such we recommend that the government only assigns tax credits to the physical sort.

Policy recommendation: tax credits for green physical PPAs and onsite generation

The government should develop an official measure of additionality. Where additionality can be established, the Government should offer tax credits based on the amount of renewable output being produced. This could take the form of a lower rate for general Purchase Power Agreements – incentivising clean energy procurement – and a higher rate of credit for onsite, private wire generation, to more strongly incentivise clean energy generation that also reduces strain on grid capacity.

Summary

In the table below, each of the main policy options for the short, medium and long term are assessed against how well they address each aspect of the energy trilemma.

	Cost	Sustainability	Availability
Short term: tax credits for PPAs and onsite	Tax credits can make energy for data centres cheaper in the short run.	If designed correctly, tax credits aimed at clean generation can provide marginal incentives to invest.	This approach does not directly address the fundamental problems of insufficient energy supply, though it may make onsite generation more viable for some projects.
Medium term: locational pricing	Evidence suggests that locational pricing will bring economic benefits through lower costs to electricity consumers and lower transmission/constraint costs.	By incentivising more efficient allocation of generation and consumption, locational pricing can reduce waste in the grid.	While the evidence on the cost of capital is uncertain, there will be stronger price signals for generators to locate where they are needed.
Long term: fleet-based nuclear, SMRs	Nuclear can be cheaper than it currently is, which will make energy more affordable in the long run.	Supporting nuclear power can facilitate clean energy abundance – ensuring not only sustainable, but plentiful, cheap and reliable energy.	Nuclear power is crucial for data centres given its clean, baseload characteristics. Maximising the conditions for nuclear will ease energy constraints on data centres.

CHAPTER THREE – SPEEDING UP PLANNING PERMISSION

The UK's planning system is holding back data centres

Alongside energy constraints, another significant obstacle is the planning system. In recent years, several high-profile data centre projects were initially refused planning permission. For example, in late 2023 a proposal for a £1 billion data centre in Abbots Langley, Hertfordshire, which would have provided 96MW of capacity, was refused permission on environmental grounds.[147] Another significant data centre project located in Iver was refused planning permission by the local authority.[148]

Both of these projects have since been 'called in' for review by the national government, with the project in Iver ultimately gaining planning permission. This is a positive step. However, this ad-hoc process and the need for major investment projects to be 'saved' by central government is a symptom of significant issues with the planning system.

Box 3: How the planning system works for data centres

There is no 'one size fits all' approach to planning consent for data centres in England and Wales, which typically need to obtain planning permission from the relevant local authorities which have jurisdiction over the proposed site.

Developers are generally required to address concerns around land use, energy consumption, noise, visual impact and community impact. Frequently, data centres need to produce a full environmental impact assessment (EIA), submitted alongside the planning application. They may also be required to enter into a Section 106 agreement, which places obligations on the developer to alleviate the impact of projects. For example, a data centre in the London Borough of Newham has been asked to contribute around £4 million to the council's data economy programme.[149] Data centres also need to engage in stakeholder consultation with local groups and residents. Statutory guidance states that this process should take 13 weeks for a major development, and 16 weeks for developments subject to an EIA.[150]

However, the specifics can vary: for example, one application for a data centre in Broxbourne had stringent requirements to put in place a scheme of carbon offsetting, while planning officers for an application in Sheffield did not exhibit such concerns.[151] Different local authorities may also apply a different 'Use Class' to data centres. The Use Class system defines what a property can legally be used for and is intended to prevent inappropriate land uses in areas where this may cause harm.

There is some limited national oversight in the form of National Planning Policy Framework (NPPF), which sets out the government's overarching planning policies for England. Until late 2024, the NPPF did not make any mention of data centres, meaning there was no guidance for local planners.

Recently, the NPPF was amended to explicitly reference data centres and emphasise that planning policies should identify suitable locations for them.[152]

The current planning system is ill suited to the UK's ambitions to build compute capacity in the AI era for several reasons. To summarise, the key issues on the planning system for data centres are around:

- A local, case-by-case approach to permitting data centres which is out of step with data centres' national importance.
- Lack of clarity on what a data centre is and what it requires.
- Scope to better address local objections.
- Weak incentives to develop on brownfield sites.

The outcome of these problems is that it takes a long time, typically many months and at times several years, to receive permission to develop data centre facilities.

A local system for a national issue

The local level at which data centre proposals are typically decided is arguably in tension with the national significance of compute capacity for the UK's economic and AI-related goals.

There are already signs the government is recognising this. The government has used powers under the Town and Country Planning Act 1990 to 'call in' two data centre proposals that had been refused planning permission, recovering the applications and leaving the final decision to the Secretary of State.[153]

Recent changes in policy also reflect a shift towards a more national, strategic approach to data centre planning policy. Data centres have been classified as Critical National Infrastructure, which makes it easier for the government to support the sector in the event of critical incidents.[154] The government has previously explored measures that would enable data centres to be consented under the Nationally Significant Infrastructure Projects (NSIP) regime, an alternative route to secure planning permission from the Secretary of State rather than the local authority.[155]

Box 4: What is the NSIP regime?

The NSIP regime, underpinned by the Planning Act 2008, is designed to streamline the planning process for nationally significant infrastructure projects depending on their size and function. Projects covered by the NSIP regime include:

- Energy generation such as wind farms, solar farms, nuclear power plants, gas storage facilities. Generation is classified under NSIP if it exceeds a capacity threshold (e.g. 50MW for onshore solar farms, 100MW for offshore wind farms).

- Energy transmission infrastructure such as power lines and gas pipelines.
- Transport links such as airports, highways, railways or harbours.
- Water/wastewater facilities such as dams, reservoirs, treatment plants.
- Hazardous waste facilities.

Unlike typical planning applications dealt with by local authorities, NSIP projects require a Development Consent Order (DCO), which is overseen by the Planning Inspectorate on behalf of the relevant Secretary of State, who ultimately has the final decision on an application. A DCO effectively 'bypasses' local authorities as decision-makers in a planning application, though local authorities can and do have input into a DCO process. Additionally, a DCO can grant powers to compulsorily acquire land.

The Secretary of State's decision to grant a DCO is informed by the National Policy Statements, which set out the government's objectives for nationally significant infrastructure.

The NSIP regime was originally introduced to ensure swift approval for major projects. But the timespan to obtain DCOs increased from 2.6 years to 4.2 years between 2012 and 2021.[156] In part, this is due to the sheer volume of documentation involved in an NSIP process; some applications have generated over 90,000 pages of documentation, with one wind farm application producing 1,961 separate documents.[157] [158]

Pre-consultation requirements add considerable time to the process. The Planning Act 2008 stipulates that pre-consultation from NSIP applicants is a legal duty,[159] rather than merely recommended good practice as is the case with regular planning applications. There is no set process or timeframe; government guidance rejects a 'one size fits all' approach and leaves open the possibility of multiple rounds of pre-consultation. This creates incentives for applicants to be conservative at the pre-application stage. The average timeframe for a pre-application stage is 2 years[160] and for many projects it will be longer.

Even once pre-application and documentation has been navigated, there are issues with capacity to make NSIP decisions promptly. In 2023, over half of decisions had delays, with the average delay being 9 months.[161]

There are signs that developers often avoid the NSIP process altogether. Many solar farm projects bunch just below the 50MW threshold at which solar farms count as NSIP, indicating some degree of market distortion being caused by the NSIP threshold.[162] This was identified as an issue in the government's NPPF consultation,[163] which prompted proposals to increase the limit at which solar farms are classified as NSIP projects up to 150MW.[164]

Admittedly, there have been efforts to address these issues. In June 2021, the government launched an operational review of the NSIP process, followed by an action plan that identified a set of reforms to make the process faster. These included enhancing pre-application services, a new 'fast track' consent route and making updates to National Policy Statements.[165] As of January 2024, new National Policy Statements for energy infrastructure (covering NPSs EN-1 to EN-5) have come into force, [166] with the exception of nuclear power.[167]

The point is that a move to bring data centres under the aegis of the NSIP regime is not without its drawbacks. Notably, the AI Opportunities Action Plan identified 'AI Growth Zones' – areas with accelerated planning processes aimed at building strategically important data centre clusters – as a still more radical option. Culham Science Centre in Oxfordshire was identified as an initial location for a pilot. This is an encouraging focus, and such urgency is needed to develop strategic compute capacity at speed.

While the Action Plan correctly identifies the need for Growth Zones, there is still a need to consider implementation – what goals they should prioritise, what planning levers can be used to ensure a rapid process, how site selection and regulation should work, and so on.

The first question is around what objectives Growth Zones should prioritise. The Action Plan identified contributing to local needs and channelling investment into post-industrial regions as significant priorities. This is an important objective, however it should not be the only goal for Growth Zones. We see the appropriate high-level objectives for AI Growth Zones as including:

- Helping to develop national 'AI champions' by facilitating model training
- Facilitating leading scientific research
- Providing access to compute capacity for start-ups, SMEs and research institutes
- Providing significant economic benefits and inward investment to regions outside of London and the South East

Turning to planning, Special Development Orders (SDOs) are an existing planning consent route that are well-suited to Growth Zones. SDOs allow the government to grant planning permission in a designated area for specific types of development without the need for each individual project to produce a planning application. Essentially, it is a form of 'zoning'[vi] which bypasses much of the usual planning procedure seen in England and Wales. SDOs are a relatively radical planning option and are seldom used. But they have been deployed to great effect to regenerate areas such as the Cardiff Bay Area in the 1990s.[168]

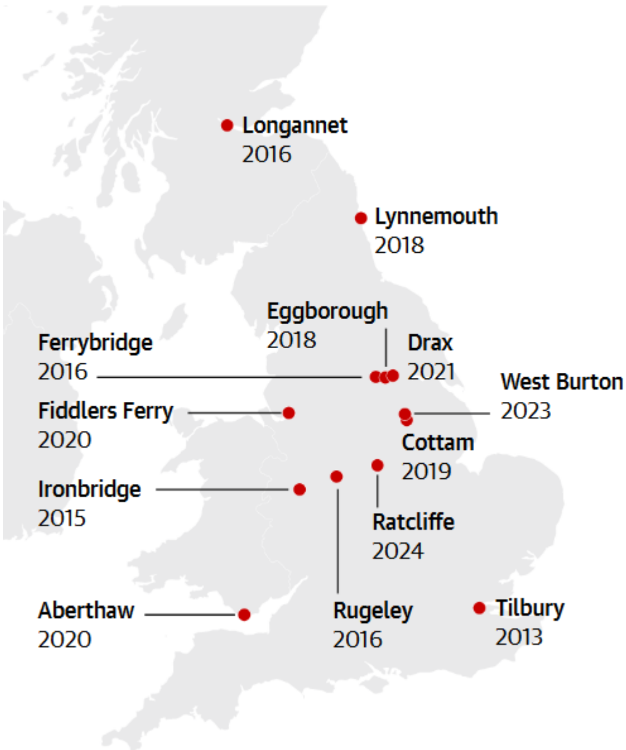
[vi] Zoning is an approach to planning commonly used across much of the Western world. The system provides semi-automatic permission to develop land. Zoning regulations typically control the permitted land use in an area, the size of buildings and the density.

The potential for SDOs is often discussed in the context of housebuilding, for example, to be used for urban extensions to economic hubs like Cambridge.[169] But they could, in theory, be used to streamline larger scale and more complex data centre developments, particularly those that involve co-location with energy generation and other land uses.

In terms of site selection, given the complex technical requirements of data centres, potential sites for Growth Zones would need to have several features to be suitable for development, including but not limited to: proximity to existing grid infrastructure; large-scale renewable energy generation or potential for this; areas of brownfield land with potential for development; and sufficient network connectivity. Other more future-facing considerations might include the potential for integration into heat networks or the siting of Small Modular Reactors.

Former power stations are one type of site that holds promise for large-scale development. Such sites have many attributes that data centres require, being originally designed for high power usage and with transmission infrastructure or proximity to water sources. There is already interest from data centre providers in developing on these sites: Microsoft plans to develop on the former power station sites of Eggborough and Skelton Grange, located near Leeds, from 2027 while another data centre campus worth £1.9 billion is planned to be built near Didcot.[170] [171] In the US, Amazon is planning to build a data centre campus on the site of the former Birchwood power station in Virginia.[172]

Figure 10: Map of former coal-fired power stations in Great Britain, year closed/ changed to new fuel source:



Source: The Guardian[173]

Former power stations are one promising area of focus for potential use of SDOs to facilitate large-scale data centre zones. But they are not necessarily the only ones, and there may be other sites which today do not have the facilities required to host a data centre cluster but could be developed to provide new capacity for the UK's data centre sector. Examples include former steelworks and ports (where the shipment of nuclear material or other fuel is easier).

While the new UK Sovereign AI unit, recommended in the Action Plan, should ultimately allocate sites for Growth Zones, the recently established Great British Energy could play a useful role in identifying suitable sites. Its broad remit makes it a suitable institution for this task: it is involved in energy project investment and development, and indeed is already involved in identifying and leasing suitable seabed sites for marine energy projects.

There are numerous considerations about regulation as well. Broadly, Growth Zones should follow a principle of 'deemed consent' – simply put, that projects are given planning consent so long as they meet minimum standards. Setting out what the parameters of deemed consent in Growth Zones will be is something that can provide investors with certainty, encouraging them to partner with the state on Growth Zones. These parameters need to set out what standards are required for data centre design, renewable generation and nuclear reactors.

There is also scope to streamline the process of Environmental Impact Assessments. In Spain, some renewable projects are able to skip an EIA process if they are of sufficient generation capacity, projects are in an area of 'low' or 'moderate' environmental sensitivity, grid connection lines are below 15km in length and there is no objection within two months.[174] Some adaptation of this framework could be applied to Growth Zones whereby the relevant Secretary of State sets parameters which, if met, would obviate the need for an EIA.

Policy recommendation: implementing AI Growth Zones

The newly-established Great British Energy should work with relevant stakeholders to identify sites for AI Growth Zones where there is scope for the following:

- Large scale renewable energy generation
- The siting of Small Modular Reactors
- Existing grid infrastructure with sufficient grid capacity
- Proximity to demand for low-latency services
- Development on brownfield land
- Potential to integrate data centres' excess heat into district heat networks

To attract investment and ensure rapid build-out, these zones should have a simplified planning process. Land within the zones should be designated by the Government with Special Development Orders to circumvent regular planning procedures. There are many ways of implementing this in practice, which should include:

- An approach of 'deemed consent' whereby projects receive a default yes so long as they reach certain standards.[vii]
- Provisions to allow data centres and accompanying energy infrastructure to be approved together in a single sign-off.
- Stringent time limits (for example, up to three months) on objections/challenges to projects.

Outside of Growth Zones, there will still be a need to speed up consenting times. Restoring the NSIP process to its previous timescales, as outlined above, is important. Another potential approach could be to develop a 'planning passport' for data centres. A new planning passport is being developed for residential developments. Under the scheme, proposals that meet high standards for design and quality will be expedited through the planning process with a default 'yes' decision. A similar framework adapted to data centres could be used to incentivise data centres with strong green credentials or that can provide services to the local community such as heat export.

Policy recommendation: data centre planning passports

For proposals outside of Growth Zones, a new planning passport for data centres should be developed. This scheme would offer expedited planning processes for data centre proposals meeting pre-approved standards. Core standards could include data centres that:

- Are highly energy efficient, with better than average PUE ratings. A default benchmark PUE below 1.3[viii] could be set, with variations for season and data centre size given that a low PUE is harder to achieve in warmer months or for smaller data centres.
- Will run on 100% clean energy, with a particular focus on developments looking to develop a green off-grid energy solution -

[vii] Nuclear reactor designs that are recognised by either the Office of Nuclear Regulation or international regulators should be permitted. Environmental requirements could also be specified within the zones, allowing datacentres to avoid the need to do an Environmental Impact Assessment if they comply with these conditions.

[viii] In 2024, the global average PUE for data centres stood at 1.56, so a PUE of below 1.3 is a stretching target. However, state of the art data centres today can achieve PUE of 1.2 or even lower.

i.e. a dedicated microgrid/ private wires setup comprising renewable energy sources or SMRs.
- Will provide heat networks to the local area to heat homes, swimming pools etc. This could be benchmarked through a minimum waste heat recovery percentage.

Several approaches could facilitate a fast-track process. One is producing a National Policy Statement for data centres to provide clear national guidance. There should also be standardised technical review processes and documentation packages for applicants, as well as parallel processing for different consent elements. Certain design elements and technologies could also be placed onto a pre-approved list.

In short, the UK needs a planning approach to data centres that reflects their significance to national objectives. Taken together, these changes would facilitate a much more mission-oriented approach to the highest-priority sites while streamlining processes for other large data centre developments.

Poor definitions and inconsistency for local applications

While significant developments go through national planning routes, smaller developments could benefit from a more streamlined process for local-level applications.

At root, the planning system lacks a clear definition of what a data centre is and what its requirements are. Although planning use classes were updated in 2020,[175] there is still no dedicated use class for data centres. Many local authorities have been classifying data centres as 'B8' land – designated for storage and distribution. But several issues with this classification are apparent. Data centres do in a sense store electronic data, however their power requirements and operational needs are considerably different to typical warehouses. Alongside storage, data centres also maintain and upgrade equipment and facilitate services for clients. In the case of AI data centres, they are pivotal not just for storage but also for training AI models and facilitating data analysis. Even data centre buildings themselves may not be consistent with usage as warehousing and storage; in one planning decision in Wychavon District Council, the planning officer noted that because entrances to the proposed data centre would be a metre above ground, the building would not be suitable for any conventional storage or distribution function.[176]

Given the shortcomings of a 'B8' designation, other local authorities have preferred to use the 'sui generis' use class – effectively, sites that do not fit neatly into any of the other planning use classes. Differing practices among local authorities regarding what use class to use reflects a lack of consensus over the nature and requirements of a data centre, highlighting weak guidance for local planners and adding uncertainty and complexity to planning applications.

Fortunately, the recent changes to NPPF guidance provide a much stronger national steer on data centres and grid connections. However the lack of a specific use class for data centres still means that the planning system, at root, lacks clear guidance on the nature and requirements of data centres. The Action Plan has recognised this as a barrier facing data centres in the planning system and recommended a single use class. Introducing this would be an important step in addressing the issues with the local level of planning for data centres.

Policy recommendation: a single use class for data centres

For data centres going through a standard planning application at the local level, a single use class for data centres should be introduced. Ideally, this should be implemented by creating a new use class tailored to the characteristics and needs of data centres, providing local planners with clear guidance. Short of this, data centres' position under existing use classes needs to be clarified.

Capacity is also a problem that is hindering local authorities' ability to consent planning applications swiftly. Between 2013 to 2020, it is estimated that a quarter of planners left the public sector.[177] In 2024, the District Councils Network found that 84% of district council planning departments were struggling to recruit and retain staff.[178] Two thirds of local authority planning and placemaking professionals think teams do not have the capacity to meet their authority's strategic objectives.[179] Most worryingly, only one in 10 council planning departments are fully staffed.[180] Any efforts to facilitate smoother planning consent for data centres therefore need to reckon with low planning capacity within local authority planning departments.

Policy recommendation: a planning capacity action plan for local authorities

The government should set out an action plan to address planning capacity in local authorities, setting out a clear aim to increase the proportion of planning departments that are fully staffed and able to meet their local authority's strategic objectives.

To provide support to local authorities in the shorter term, government could set up dedicated Planning Hubs, comprising specialists in different types of major infrastructure, to advise local planners on data centres and related developments.

Addressing local objections

While planning processes can be streamlined, objections to data centres can still complicate planning permission; although data centres do provide an economic boost to the country and region, local leaders can still have strong political incentives to oppose data centres. This can even affect national infrastructure proposals, as strong local opposition to major infrastructure projects can increase – and has increased – the political cost of undertaking such projects.

Up until the Second World War, local governments had a direct stake in significant infrastructure projects in their area because they retained 100% of the revenue from non-domestic rates. So as well as the full downside from infrastructure being built there, the local authority would – at least in terms of tax revenue – also capture the upside. But the current business rates system only offers local authorities a 50% retention rate, and even that is temporary.[181]

Allowing 100% business rates retention would see the tax revenue uplift to local authorities double, providing a much stronger financial incentive for local authorities to consent planning applications and also providing them with greater means to address local concerns. To illustrate the size of this incentive, Virtus' Stockley Park data centre campus comprises four data centres, which combined will pay around £7.9 million in business rates every year under the business rate multipliers for 2024-2025.[182] This means that if retention were to go from 50% to 100%, Hillingdon local authority would stand to gain almost £4 million in revenue annually. To add context, a Band D property there will pay £1,335 a year in Council Tax[183] – in other words, the Business Rates uplift would be equivalent to the revenue the council gains from almost 6,000 Band D homes.

Policy recommendation: full business rates retention on data centre developments

Local authorities should be allowed to keep 100% of business rates revenue from the new data centres they have permitted to be built within their council area, on a permanent basis. Here we focus on data centres, though this idea could be extended to other forms of nationally significant infrastructure.

Facilitating brownfield development

With land scarcity an increasing issue, data centre developers are increasingly looking to brownfield development as a way of securing sites. This can limit costs and result in a faster deployment. However, many sites have to be extensively retrofitted due to structural limitations, energy inefficiency or difficulties meeting modern data centre standards. With large increases in rack density, the challenges of retrofitting existing facilities to AI-ready standards have grown considerably.

This means remediation work can be expensive and protracted, potentially deterring investment. Furthermore, viability for sites is not a guarantee, which entails a risk that investment in remediation could end up going nowhere.

There is a tax relief aimed at remediation costs: the land remediation tax relief, which provides a deduction worth up to 150% against Corporation Tax on qualifying expenditure to clean up contaminated land. However, between 2017 and 2021, there have only been between 1500 and 1800 claimants per year.[184] A claimant must also establish that the land is both derelict and contaminated. 'Derelict' land is defined as not in productive use since April 1998 and where it cannot be put back into productive use without removing buildings.[185] 'Contaminated' applies only if relevant harm is being caused, or there is a serious possibility that it will be caused.[186]

Land remediation relief is limited in scope. A clearer signal could be provided through the 'full expensing' regime, which allows companies to deduct the cost of plant and machinery from their Corporation Tax bill. Currently, it does not apply to investment on brownfield sites. Bringing brownfield investment into full expensing has the advantage of simplifying tax reliefs for data centres and helping to make marginal investment decisions for developing brownfield land more viable.

Policy recommendation: full expensing for brownfield sites

Full expensing should be extended to brownfield sites. Currently, full expensing only applies to new and unused plant and machinery. However, it cannot be used for acquiring or developing brownfield sites.

Doing so would simplify the relief system for brownfield land and potentially send a much clearer signal to developers, including data centres, that such relief is available.

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