intellect
REPRESENTING THE UK TECHNOLOGY INDUSTRY

Data centres
The backbone of the UK economy

Contents

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BT
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About Intellect's Data Centres Group
Intellect is the UK trade association for the IT, telecoms and electronics industries. Intellect's Data Centres Group is the partnership between Intellect and the UK Council of Data centre Operators (UKCDO), and represents the collective voice and position of all members with an interest in the UK data centre industry. The group represents both suppliers and users of data centres, from data centre operators to real estate companies via central and local government.
For further information, visit www.intellectuk.org/datacentres

Executive summary

This paper aims to illustrate the importance of data centres across all sections of the UK economy, and how their growth is key to the post-recession recovery of the UK, public service reform, and the transition to a low-carbon economy. It also summarises the key issues facing the industry today, and makes recommendations to Government, regulators and industry on what cohesive action could help tackle these most efficiently. Data centres underpin the UK's IT industry, and its ability to sustain the rest of the UK economy. As we move deeper into a Knowledge Economy, our reliance on IT and data centres to deliver solutions and services will only increase, particularly as the cloud computing business model becomes more prevalent. Each and every sector - from Government to financial services, via manufacturing and telecoms - relies on data centres, not only to run efficiently, but to survive. They are indispensable to projects and initiatives across both the public and private sectors, such as the National Programme for IT, the National Identity Scheme, smart metering and smart grids, to the London 2012 Olympics, the Oyster card and online banking. A lack of appropriate investment in data centre infrastructure can have wide ranging impacts on businesses and the customers they serve. In parallel, the proliferation of IT is enabling energy efficiencies across all sectors of the economy. Optimal use of IT and data centres could deliver global emission savings of approximately 7.8 Gt of carbon dioxide equivalent ($GtCO_2e$) by 2020 - equivalent to carbon savings five times larger than the total emissions from the entire IT sector, and to €600 billion of cost savings.

Yet the issues facing data centres are complex and numerous. Data centres effectively house every organisation's critical applications and information, but this criticality is not always reflected in organisational structures, or the way the industry is perceived externally. Organisations often lack a cohesive data centre strategy, meaning that data centre needs often fall by the wayside. Nonetheless, the need for data centres is very real: IDC expects the number of servers worldwide to increase by almost 18% per annum until 2020 - an increase from 18 million (in 2008), to 122 million. This demand is fuelled by an ever increasing IT footprint, brought about by applications growth and new business models such as cloud computing. Demand for data centres is therefore unlikely to dampen, despite an economic recession.

This context of growing reliance on data centres comes at a time when the industry is facing multiple challenges. Energy costs in the UK are increasing, while availability is decreasing; environmental requirements are unwittingly inhibiting the industry's ability to enable carbon emission savings in other sectors; and planning limitations are on the increase, as data centre space in desirable locations (mainly conurbation areas) becomes a rarity. As a result, businesses across the UK need to balance their business requirements and ambitions with the costs and barriers associated with data centre provision, or look further afield to continental Europe to satisfy their growing needs. This threat to the UK's competitiveness must be addressed if UK plc is to emerge stronger from the recession.

The industry is taking steps towards addressing these problems. Energy efficiency is at the top of data centre users and suppliers' agenda, and technology developments such as virtualisation, new cooling mechanisms and server developments are enabling good progress. However, there is still a need for cohesive action. Intellect recommends the establishment of a regular dialogue between industry and Government on policy developments (particularly in the environmental, energy and planning policy spaces), to discuss and establish best practice, and improve the industry's performance. These steps will enable IT provision to become truly embedded in the process of policy-making, to the benefit of Government, users, industry, and the overall economy. Intellect's Data Centres Group would welcome the opportunity to provide a sounding board for Government and regulators when developing their approach to the data centre industry.

KEY MESSAGES

- Data centres are vital to the resilience of public services and the competitiveness of UK businesses. The economy's reliance on data centres will grow in line with the growth of data volumes and applications.
- They also significantly contribute to the whole economy's energy efficiency.
- Energy availability and cost, planning constraints and strict environmental regulation are threatening the industry.
- But policy-makers can help data centres sustain the economy by improving the dialogue with the industry, and considering its requirements in legislative and regulatory decision.

KEY PROBLEMS

- The data centre industry's purpose and value is not widely understood or recognised.
- The lack of communication between policy-makers and the data centre industry is damaging the industry's ability to meet the UK's needs.
- The industry is facing problems caused by energy cost and availability, planning constraints and environmental restrictions.
- These issues are endangering the UK's competitiveness, and may cause the industry to move offshore.

Setting the scene: the aim of this paper

The data centre industry faces four significant problems:

1. The data centre industry's purpose and value - its importance to the UK economy - is neither widely recognised, nor understood.
2. The industry is restricted by energy prices and availability, planning constraints and environmental regulation.
3. These issues, alongside the lack of communication between policy-makers and the industry, are damaging the industry's ability to sustain the UK economy.
4. This in turn is threatening the UK's security, resilience and competitiveness, and may prompt the industry to move offshore.

This paper is aimed at all public sector stakeholders and regulators whose decisions impact the data centre industry, including central and local government, the UK Energy Commission, and the Tripartite Authorities (The Bank of England, the Financial Services Authority, and HM Treasury). It seeks to:

- inform this audience by setting out the above problems in greater detail, and clarifying the complex structure of the data centre industry; explaining the vital role played by the industry in supporting both the public and private sector; highlighting some of the problems facing users and operators; and preparing stakeholders for the future needs and demands of the industry.
- encourage policy-makers to work with industry to solve these problems, by offering a number of recommendations as to how these issues can be overcome.

This paper aims to provide decision-makers with the necessary information and evidence to understand the importance of the role of data centres. By this, we hope to promote greater collaboration between stakeholders in the drive towards sustaining the resilience and competitiveness of businesses and the public sector throughout the country.

This paper presents the following five key messages:

1. **Data centres are vital to the resilience of public services and the competitiveness of UK businesses.** The entirety of UK plc runs on data centres, which are vital to the sustainability of the Knowledge Economy. The surge of the Knowledge Economy - encompassing sectors such as financial services, business services and creative services - is indicative of the world's increasing reliance on IT to provide services and solutions that ultimately produce prosperity. In 2007, the Knowledge Economy employed 41% of all workers by occupational classification, and by 2010, it will contribute 50% of our GDP. Data centres are therefore a major cornerstone of the UK's GDP, driving productivity and growth, and providing an important basis for the UK's competitive advantage, for example through projects such as Digital Britain.
2. **The economy's reliance on data centres will intensify over the coming years, in line with the development of the Knowledge Economy.** Growth in data and application volumes, and the developments such as cloud computing (a style of computing in which resources are typically provided "as a service" over the internet: businesses buy their resources from the 'cloud', which in practice represents the data centre industry) or hosted services, mean that data centres will become even more valuable in the future.
3. **Data centres also significantly contribute to energy and carbon efficiencies throughout the economy.** While data centres are responsible for an estimated 2.2-3.3% of UK's total electricity consumption[1], the IT that is dependent on those data centres plays a vital role in reducing the carbon EMISSIONS of those other sectors responsible for the bulk of ELECTRCITY CONSUMPTION. The cross-sector energy efficiencies enabled by IT could deliver global emission savings of approximately 7.8 Gt carbon dioxide equivalent ($GtCO_2e$) by 2020 - equivalent to carbon savings five times larger than the total emissions from the entire IT sector, and to €600 billion of cost savings.[2]
4. **The importance of data centres necessitates that users and operators be considered a cohesive industry, and consulted accordingly.** Though the pervasive and complex nature of the data centre industry means there is yet no clear ownership of the industry's strategy, it does not lessen the need for data centre suppliers and users to be involved in policy-making across the broad spectrum of sectors it affects.
5. **Policy-makers should establish a regular and sustained dialogue with the industry, particularly on issues such as energy, planning and environmental policy.** Through this dialogue, policy-makers and industry can develop common standards and best practice, which will enable the industry to operate as effectively as possible.

1 Anson Wu, Market Transformation Programme figures based on projected 2007 server energy consumption as a proportion of 2006 total UK electricity consumption (excluding transport), updated from 2005 DUKES energy consumption.
2 'SMART 2020: Enabling the low carbon economy in the information age', a report by the Climate group on behalf of the Global eSustainability Initiative (2008).

Background: untangling the data centre industry

What is a data centre?

Every organisation has a data centre, although it might be referred to as a server room or even a computer closet. The term 'data centre' includes all buildings, facilities and rooms which contain servers (computers), server communication equipment, cooling equipment and power equipment, and provide some form of data service (eg large scale mission critical facilities all the way down to small server rooms located in office buildings).[3] Effectively, data centres are the location of every organisation's critical applications and information. Data centre infrastructures operate 24 x 7.

Source: SunGard Availability Services

Why do we need data centres?

We need data centres to store the growing amounts of data and information owned by Government, businesses and individuals in the UK. Today's economy is characterised by a consistent increase in the volume of data and applications, exemplified by the growth of the internet and services reliant on IT more generally. Growth stems from a number of areas:

- transaction growth (see Figure 1), such as online purchasing, online banking etc.
- storage growth, such as file saving, printing and sharing and home-working
- new media and application development, such as BBC iPlayer, YouTube etc.
- convergence, such as 3G data and roaming
- record-keeping

For many companies, particularly smaller ones, IT equipment was traditionally installed in a purpose-built room in a corner of the office. However, servers in office buildings face space and power limitations, and are increasingly unable to keep up with growing data requirements. Moreover, businesses are increasingly turning to cloud computing instead of running applications from their own desktops and office server closets. According to Gartner Dataquest, the volume of servers shipped per year rose from 4m to 8m in the five years to 2008, and during the next few years, compound growth is expected to reach 5% a year. As a result, IT systems are increasingly being moved to purpose built facilities better able to handle such volumes. Organisations can store their data in their own data centre, have their data hosted by a data centre operator, or have it fully managed by a service provider.

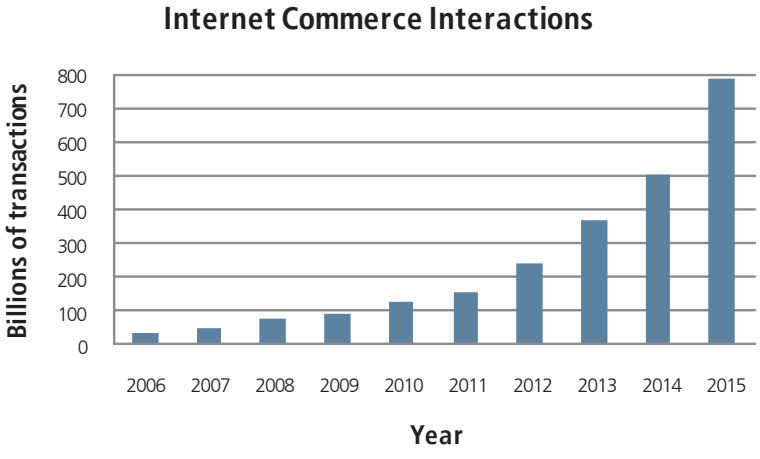


Figure 1 Growth in the volume of internet commerce interactions
Source: IDC

3 European Commission, Code of Conduct on Data Centres Energy Efficiency (October 2008).

What does the industry look like?

Every sector of the economy relies on data centres (we explore this further later on). At a more granular level, a variety of stakeholders influence data centre requirements at a organisational level, but there is rarely a single individual responsible for data centre strategy, as figure 2 shows.

In information-intensive organisations, decisions affecting the nature of data centres are made at many levels, and as a result, overall responsibility falls between the gaps, preventing a cohesive company-wide data centre strategy.

For example, business heads of department will set their application and data requirements, while an IT manager needs to manage these within the available resources. An application developer will impact the organisation's data requirements by setting the level of programming; meanwhile, those responsible for server infrastructure decide on equipment purchases, and the facilities director chooses the location of the data centre(s), their power supplies, and makes judgements on predicted demand levels.

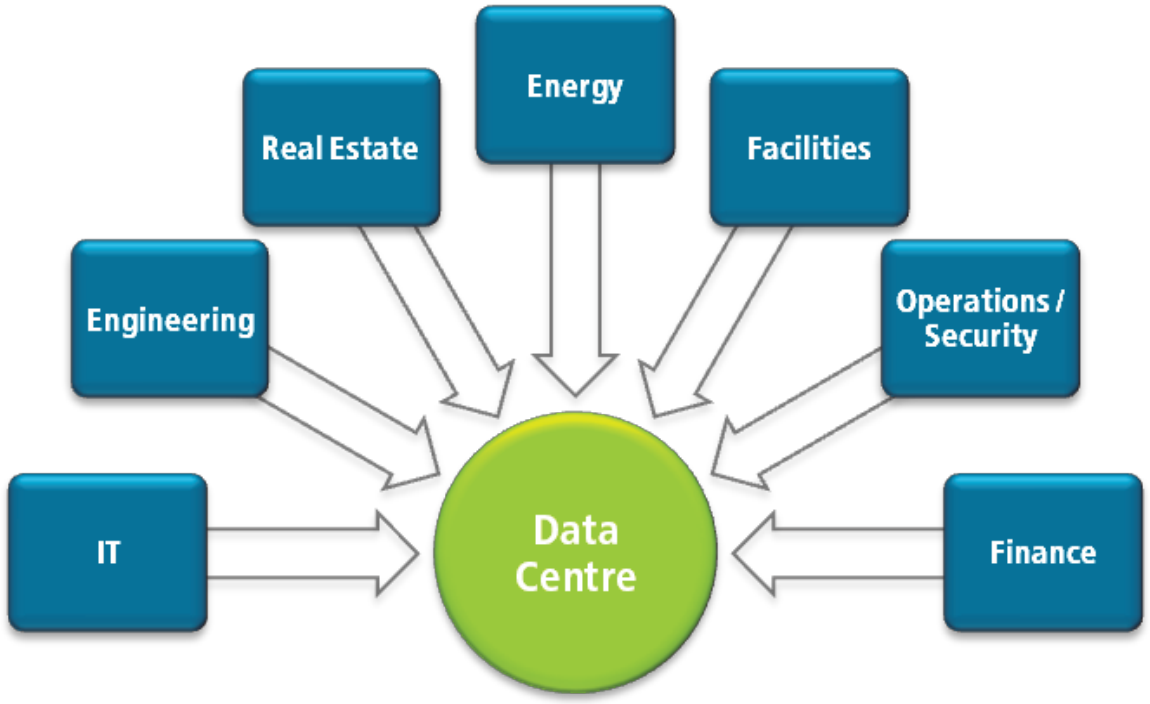


Figure 2 Departmental involvement in the data centre industry

Departments often make decisions impacting the data centre requirements independently of each other. For example, a sales manager can decide to change transactions from overnight to real-time clearing, or a financial analyst may want to store several copies of the same data - without thinking about the impact on data centre costs.[4] In fact, there can often be conflicts between departments, caused by individuals optimising for their own interests.

Different sections of an organisation can have diverging interests and concerns, which can make the data centre strategy even more confused. For instance, security or resilience issues can clash with environmental goals. Even where the ownership of the data centre strategy is clear within an organisation, the owner is not a consistent person across all companies within a sector, let alone between sectors. This muddled structure should not conceal the fact that all these stakeholders influence the provision of data centres.

4 The McKinsey Quarterly, 'Data centres: How to cut carbon emissions and costs' (November 2008).

Where are data centres located?

With the exception of applications dependant on extremely low latency (the delay between the initiation of a request for data and the beginning of the actual data transfer), a data centre could be located anywhere in Europe and provide an almost identical level of service - though if the data centre is located outside of the UK, the implications for data protection and information security become significant.

From a theoretical perspective, the location of a data centre is determined by a number of factors, including physical security, the supply of power, fibre, flood avoidance and terrorist targets, among other things. Each factor is weighed according to the type of data centre needed and the criticality of the data and applications being stored. Figure 3 illustrates where many data centres are located across England.

Though the map is not an exhaustive illustration of all data centres (many public sector data centres are omitted), it does show that the majority are located in or near conurbations, particularly within the M25 (yellow circles show 10, 25 and 100 miles radius from the City of London). This is historically due to the availability of multiple communications providers and the proximity of the financial markets.[5] More recently the presence of the London Internet Exchange, LINX, which offers a high level of national and international peering and connectivity to the internet, has increased the pull towards the capital.

However, many businesses also wish to host their data near the running of their day-to-day operations: the idea that their data is 'near' is often reassuring to the many businesses that rely so heavily on it (this phenomenon is colloquially known as 'server hugging').

Furthermore, many businesses invest in storing multiple versions of their data in different locations, as a 'back-up'. In the event of one of their data centres failing, the organisation can rely on the other to ensure business continuity.

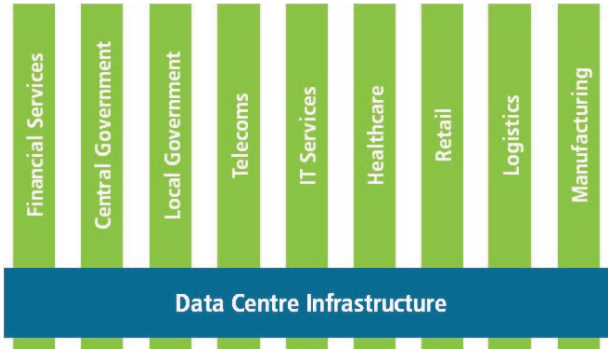
Figure 3 Examples of data centres England (as of November 2008)
Source: SunGard Availability Services

The location of an organisation's second data centres therefore strikes a balance between the desire to be able to reach the data quickly (though effectively, geographical location makes little difference, as an application can be presented to a user practically anywhere in the world without a noticeable latency), the need to ensure that the synchronisation of data replication is not affected, and the desire to host the second data centre far enough from the first, that it might not be impacted by the same event that caused the first to fail.

The implications of the location of data centres, and in particular the clustering in London and the South East, are important. Not only is space less available in these areas, but energy supply and distribution infrastructure is also constrained, and land more expensive. Moreover, there are few renewable energy sources in Southern England; even where green solutions exist, these are not necessarily cheaper solutions. The implications of the geographical location of data centres will be discussed later on in this paper.

5 With automated trading platforms in financial markets applications, a one millisecond improvement in latency can generate £100 million a year. For this reason, financial services institutions want at least some of their applications hosted as close as possible to the market data feeds and served by multiple high capacity communications links.

Every business, and every consumer, relies directly or indirectly on data centres - and this reliance will increase in line with productivity and competitiveness. As the essential backbone ensuring the smooth running of the vast majority of services, particularly as we become increasingly reliant on technology, they underpin business continuity, and more generally, the security and resilience of the country. As the following examples illustrate, data centres are vital in securing business continuity for UK plc, but also for running essential public services: they represent a key strategic asset. Financial transactions, access to health records and military security applications require complete certainty of round-the-clock operation. In a context of increasingly diverse cyber threats on military and critical infrastructures such as water, power or air traffic control systems, and threats against the consumer, the role played by data centres in maintaining the country's resilience and supporting a healthy economy should not be underestimated. The chart below illustrates the extent to which data centres are critical to the economy.



Where our reliance on data centres does not stem from necessity, it often arises out of regulation or legislation. In some instances, the growth in the volume of data satisfies a legal obligation, rather than being a natural symptom of the growing Knowledge Economy. For instance, pressures to store data have been amplified by the Sarbanes-Oxley accounting data legislation[6]; de-duplication (of emails for example) is seen to alter data, making it inadmissible in court or unusable for compliance purposes: as a result, a legal obligation exists for organisations to store several versions of the same data, piling pressure on data centres to store increasing volumes of data. For both data protection and public confidence reasons, this data needs to be kept in the UK, rather than overseas.

The impact of data centres across vertical market areas

1. Public sector

Data centres provide the backbone to the public sector's current infrastructure and services, and also shape the development and implementation of new policies and projects.

Data centres are fundamental to the smooth operation of all public services, such as hospitals and postal services, particularly in the context of the transformational government agenda. For example, data centres are vital to the success of the National Programme for IT (NPfIT), an initiative to move the National Health Service towards a single, centrally-mandated electronic care record for patients and to connect general practitioners to hospitals, providing secure and audited access to these records by authorised health professionals. Data centres are instrumental in protecting the availability of these critical healthcare services.

KEY FACTS AND FIGURES

Despite first generation virtualisation and other efficiency measures, data centres will grow faster than any other IT technology, driven by the need for storage, computing and IT services.

If growth continues in line with current demand, the world will be using 122 million servers in 2020, up from 18 million in 2008 - an increase of 700%.

IDC analysts predict 83m servers will be needed in 2020 if virtualisation effects are included.

In 2002, the global data centre footprint was 76MtCO2e, making it the fastest-growing contributor to the IT sector's footprint, at 7% pa in relative terms.

The average data centre consumes energy equivalent to 25,000 households.

Data centres are responsible for an estimated 2.2-3.3% of UK's total electricity consumption.

6 The Sarbanes Oxley Act (2002) is US federal law that states that all business records, including electronic records and electronic messages, must be kept for five years.

1. Public sector

Data centres are also essential to Local Authorities. They enable the IT resources required to reduce avoidable contact - one of the National Indicators assessed within the new performance management framework agreed between DCLG (The Department for Communities and Local Government) and the Local Government Association.

As well as being central to recent developments, such as Transport for London (TfL)'s Oyster card, data centres will also play a vital role in ensuring the viability of potential forthcoming projects, such as the London 2012 Olympics, and the successful deployment of the National Identity Scheme in the UK. Data centres will underpin the IT solutions necessary to ensure the success of London 2012, by for example ensuring that the appropriate security measures are in place; that Transport for London is able to cope with the increase in passengers on the network, and supporting programmes such as TfL's journey planner website.

Similarly, the success of the National Identity Scheme relies on the Government being able to secure enough data centre capacity to host the IT systems and data of 60 million individuals, in time for the deployment of the scheme.

2. Financial services

London is the world's largest financial centre[7], and the highly computerised financial services industry is wholly reliant on data centres. All trades need to be backed up, and nowadays, much of customers' confidence in the banking sector depends on the uninterrupted ability to access accounts online, for example. Data centre infrastructure, IT services and power stability allow customers to access their accounts at any time, which helps underwrite the credibility of an institutions, especially in these uncertain economic times. Appropriate investment in infrastructure and services can equip institutions to deal with unexpected surges in demand, for instance, similar to that experienced by Northern Rock in 2007.

Looking to the future, the financial services industry's dependence on data centres will only grow. Indeed, increasing levels of regulatory oversight and banking reform, partly in response to the economic downturn, are likely to require institutions to increase rather than decrease their processing and storing capacity.

3. Utilities

Smart meters are the next generation of electricity and gas meters, enabling consumption to be identified in greater detail than with a conventional meter, and communicated via a network back to the local utility. Should smart meters be rolled out to businesses, and subsequently domestic households, as is currently planned by the Department for Energy and Climate Change, data centres would have to host a significant amount of data, likely to be updated in real-time or near real-time, making estimated billing a thing of the past. New functions and services such as this one will create new dependencies on data centres.

4. Retail

The retail sector holds data relating to a number of functions, including stock management (via radio-frequency identification), supply monitoring, online sales, and targeted marketing. Moreover, as the presence of the retail sector on the internet increases, so too will the industry's reliance on data centres to sustain its business model. Online shopping, for example, delivers convenience and economy to customers, and is vital to ensure a retailer's competitive position in the market. It also enables reductions in congestion, energy consumption, and carbon emissions.

Those retailers who make the most of IT invariably perform better. In a survey by consumer behaviour analyst Harris Interactive for example, internet users frustrated by faulty online services were found to have no time to waste on glitches and delays. A potential £11.9 billion was lost by online retailers in unsuccessful transactions.

5. Telecommunications

Telecommunication companies encounter significant amounts of data through a variety of channels. They store data relating to their customers, billing, various configurations and network information, and Internet Service Providers (ISPs) cache (in other words, duplicate) data locally, to reduce pressure on international bandwidth. As a result, the telecommunications industry is very reliant on data centres. This reliance is likely to increase with the growth of data-intensive applications such as the BBC's iPlayer.

From March 2009, following the 2006 European Data Retention Directive, all ISPs began keeping data about e-mails sent and received in the UK for up to a year. The content of individual e-mails is not kept by the authorities, but the timing and number of each communication is stored. This has further implications for data centres, who need the capacity to store such significant volumes of data.

7 The Global Financial Centres Index, March 2009.

6. Technology

As well as forming much of the basis for the resilience of other industries, data centres are of course vital to, and drive, the technology industry itself: many technology companies own and host data centres for themselves and for their customers; those that do not host data centres rely heavily on them to run the IT hardware, software and services they offer. Global spending on IT is in the region of £8.9 trillion each year.[8] The IT sector contributed 16% of global GDP growth from 2002 to 2007, and the sector itself has increased its GDP share from 5.8 to 7.3%. The IT sector's share of the global economy is predicted to jump to 8.7% from 2007 to 2020.[9] A high proportion of this is spent on servers, so the data centre industry, as well as supporting the Knowledge Economy, represents a significant sector in itself. As the IT sector grows, demand for data centres will intensify further.

Data centres also sustain R&D in technology. BT, for example, has data centre capacity focused on supporting its research and development programmes.

The impact of data centres across horizontal practices

1. New business models

Software-as-a-Service (SaaS) is a model where an application is hosted as a service, and provided to customers across the internet. Many of the benefits of SaaS are immediately obvious: by eliminating the need to install and run the application on the customer's own computer, the customer is no longer responsible for software maintenance, ongoing operation and support. However, as more and more businesses adopt this model, and SaaS becomes increasingly prevalent, the pressure on the internet and the need to eliminate down-time will increase. As the use of SaaS expands, the implications for UK plc are significant. More generally, cloud computing is also likely to boost businesses' reliance on data centres.

2. Flexible working

As high speed internet connectivity becomes ubiquitous, new technologies such as Hosted Virtual Desktop enable home-workers to securely access data, applications and telephony services that were previously only available to large organisations within an office environment. Progressive organisations can use this technology to employ staff on a flexible basis, for example enabling mothers to return to employment on a flexible part-time basis. It also enables knowledge workers to operate from home on a regular basis.

8 'Cost model: Data centres', Simon Rawlinson and Nick Bending (November 2008).
9 'SMART 2020: Enabling the low carbon economy in the information age' (2008).

Data centres: the backbone of energy efficiency across other sectors of the economy

As well as enabling all of the above sectors and services to function, data centres are also responsible for driving down the carbon footprint of their users. As well as enhancing existing processes, enabling new ways of working and new projects to be implemented, IT provision can help create a lower-carbon economy[10], potentially delivering carbon savings five times larger than the global IT industry's own carbon footprint by 2020.[11]

While there is obviously considerable scope for improving the energy efficiency of data centres themselves (we discuss this later on), data centres are key enablers of greater energy efficiency in other sectors, by enabling new ways of operating, living, working, learning and travelling: the SMART 2020 report identifies several opportunities for reducing emissions, including dematerialisation (of public service delivery, such as e-government), smart logistics, small buildings and smart grids (which rely on smart meters, mentioned earlier).

For example, data centres allow flexible working, without the duplication of information: staff can work from home, thus lessening congestion for example[12]; and they can access their documents remotely, without having to print them all off beforehand to take home with them. Larger scale teleworking, for instance, could lead to global emission savings of up to 260 $MtCO_2e$ each year.

The UK has some demanding carbon emission reduction targets to meet, and data centres will play a vital albeit indirect role in helping achieve these.

Table 1 Examples of functionalities enabled by data centres

Data centres enable the 24/7 availability of...	
Critical healthcare services and access to records	Online banking facilities
Air traffic control systems	Online shopping facilities
Military security applications	Online file-sharing (such as photos)
Applications such as BBC iPlayer, YouTube etc.	Software-as-a-Service

RECOMMENDATION

The UK is increasingly dependent on data centres. Regular dialogue with policy-makers and appropriate consultation of the industry will enable the development of more effective regulation and legislation which takes into account the capacity, needs and impact of the industry. Crucially, all attempts to regulate the industry should be done in partnership with the private sector. Central Government should take the opportunity, in considering its own requirements for data centres, to lead by example and establish best practice or common standards for data centre operation that balance the requirements for security, environment and resilience. The standards required should reflect the taxonomy of the IT services to be delivered.

10 'High Tech: Low Carbon; The role of technology in tackling climate change', Intellect (February 2008).
11 'SMART 2020: Enabling the low carbon economy in the information age'.
12 The Department for Transport study 'Smarter Choices' reported that teleworking reduces commuting car mileage travelled by teleworkers by 48-77%.

Data centre operators currently have to juggle a number of competing requirements, in order to maintain the level of service required to sustain the UK economy, as illustrated in figure 5. A number of these requirements threaten the data centre industry's ability to run as efficiently as possible, and in turn could damage the resilience of the country as a whole, as well as dampen the UK's competitive advantage.

The origins of the demands and constraints on the industry are multiple, and have arisen as a result of both external and internal factors. Nonetheless, a concerted joint effort should be made to ensure that the UK remains a desirable location for data centres, or the attractiveness of continental Europe may prove too strong a pull.

Organisations are performing increasingly complex analyses, and consumers demanding real-time access to their accounts. This, coupled with changing working methods and environment, and the development of new media is fuelling demand for computing, storage and network capacity increases.

This upward push on demand for technology-intensive services will mean increased energy requirements, and increased demand for space to build data centres, as the underlying growth in demand for IT services to the business and consumer is likely to withstand the economic downturn. For the first time in the evolution of IT systems, planning constraints, energy availability and cost have become a drag on the ability to increase computing power.

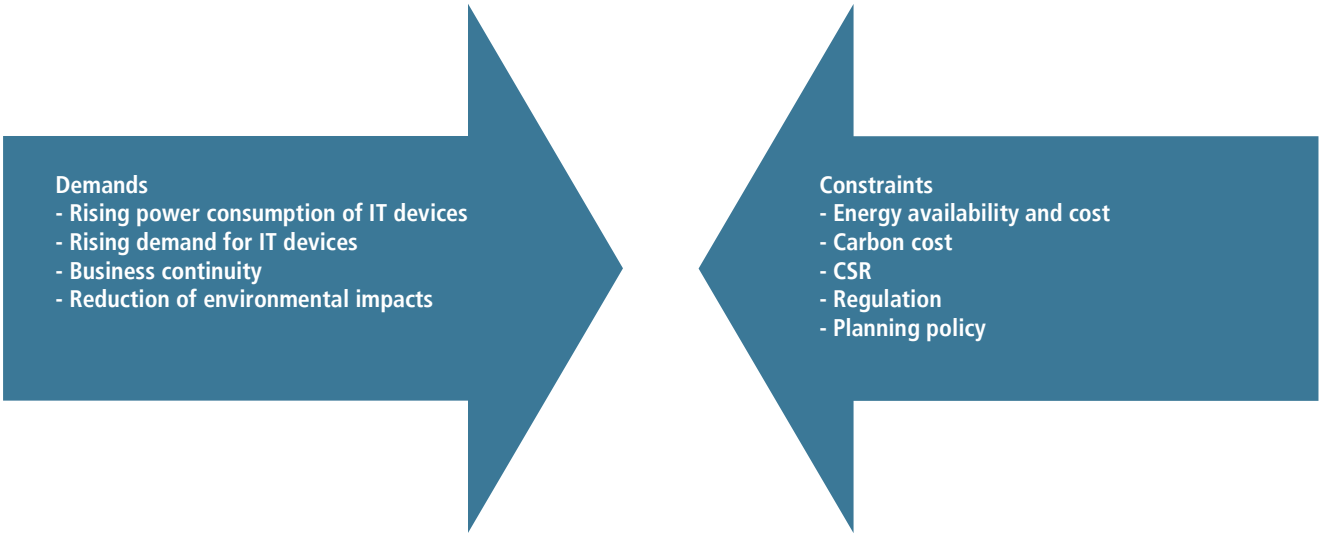


Figure 5 Demands and constraints on data centre operators

Energy policy

As we have seen, data centres are responsible for an estimated 2.2-3.3% of UK's total electricity consumption[13], and demand is increasing. As a result, the density of processors will increase and require more power and generate more heat, which, in turn, will require a greater amount of cooling. Although leading processor vendors can create lower voltage processors and design more balanced chips, this will simply slow the rate of increased power consumption rather than actually reduce power consumption.

The data centre industry is therefore faced with having to accommodate an increasing number of IT devices; these devices are themselves consuming an increasing amount of power, in a context of rapidly diminishing energy availability, and fluctuating energy costs. The effects of this are clear: Gartner research, while confirming that the UK data centres' underlying energy consumption will increase over the next seven to ten years, shows that this lack of energy will be largely responsible for a shortage of appropriate data centres for 50 percent of companies during the next five years.[14] Figure 6 illustrates how energy costs are also affecting data centre provision. The trend is similar worldwide.

The impact on UK businesses is significant. Already having to cope with the burden of a recession, the chronic shortage of power is likely not only to have a detrimental impact on business as their balance sheets are dented by energy prices, but also to cap business expansion. Furthermore, those organisations that require the most resilience are the worst hit.

Data centres are vital to the resilience of UK plc, but the higher the resilience:

- the more space is taken up by plant and machinery
- the more redundant equipment there is, so the less power efficient the data centre is
- the more the data centre costs to build and operate

Furthermore, power required by the London 2012 Olympics may push the grid to breaking point. While demand for data centre energy is a priority for many organisations based in London, London's electricity suppliers have already reserved substantial amounts of power to build and run the games.

'Energy cost and carbon tax issues will have an important effect on data centre development'

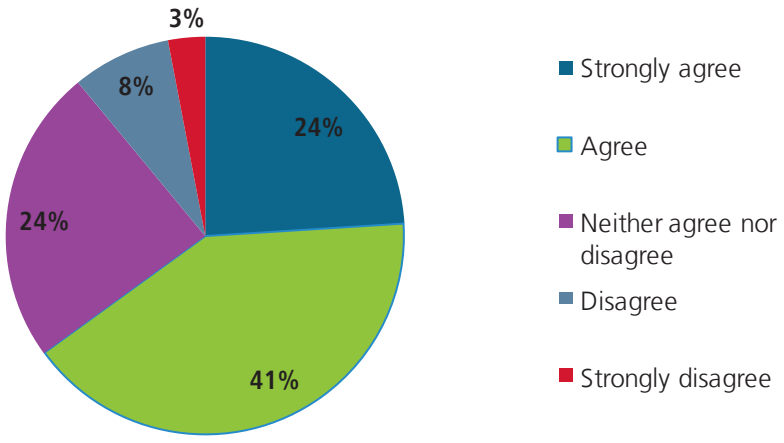


Figure 6 The importance of energy cost to data centre development
Source: The Jones Lang LaSalle Data Centre Barometer Survey, March 09

13 Anson Wu, Market Transformation Programme figures
14 Gartner, 2007

The lack of energy availability is constraining the expansion of businesses, and downtime is threatening current business capacity. After IT hardware failure, power failure is the second most likely reason why companies invoke their disaster recovery plans.[15]

As table 2 shows, power failures can have significant negative impacts on businesses.

Table 2 Examples of data centre-related outages caused by power failures

Organisation	Date	Description
eBay	June 1999 - May 2005	The online auctioneer eBay has experienced several power outages in its web hosting facility, the most recent one in 2005. Its most severe in 1999 resulted in the entire auction service being down for 22 hours, costing almost $4m in lost revenue and a loss of $5.7bn in market capitalisation.[16]
NPfIT	September 2006	In 2006, a 45-minute data centre power outage, and problems restarting systems, left 80 NHS trusts unable to access the NPfIT systems for up to five days.
Sainsbury's	July 2008	High street giant Sainsbury's experienced several problems with its online operation last summer. The supermarket's website was down for over an hour during which customers and browsers were unable to access the website's home page at all. A power outage at the company hosting the retailer's website was responsible for the glitch.
Lastminute.com	July 2008	Business was interrupted for 11 hours when their website went off-line. Colt - lastminute.com's communications supplier - ran checks at all 18 of its data centres in Europe to find and cure the problem, and identified a power outage at the Colt data hall which hosts the travel firm's equipment.
Cahoot	October 2008	Customers were unable to access their accounts for over 24 hours due to a power failure affecting the data centre.

As a result of the power dearth, data centre operators have begun buying more power than they currently need, to insure against future limitations. Obtaining power after a data centre is already in place is more difficult and costly, so pre-emptive action is often necessary. In November 2007, for instance, data centre operator Interxion signed a contract with electricity suppliers EDF for 13 megawatts (MW) of power - even though as of May 2008, Interxion was only using 4.5 MW.[17]

Similarly, a large investment bank installed an infrastructure capable of drawing 60 MW. It reserved 35 MW of power, but to date has drawn less than 5 MW since taking on the building in 2003. This illustrates how in the light of limited energy availability, organisations are forced to make costly and environmentally detrimental decisions to ensure that their data centres fulfil their primary objective - round the clock operation and resilience.

RECOMMENDATION

A data centre energy taskforce should be established with Government, the energy regulator Ofgem, National Grid and network operators. This taskforce should work towards ensuring that data centres have access to the power they need to ensure resilience and business continuity.

15 SunGard Availability Services: 13% of 1059 invocations in the UK to date have been due to power failure.
16 'Coping with E-Business Emergency', InformationWeek, 6 September 1999.
17 Information Age, 'Energy lockdown' (May 2008).

Environmental considerations

Because of the growth in demand for IT products and services, the data centre industry's carbon footprint is expected to grow. Government and environmental groups are rightly concerned about the environmental impact of data centres. However, this is a concern also shared by data centre operators - not least because of the growing cost and limited availability of power. Nevertheless, a number of the environmental requirements placed on the industry are increasingly burdening its ability to support the UK economy.

The Carbon Reduction Commitment (CRC), beginning in January 2010 and covering large businesses, is the first mandatory carbon trading scheme. The scheme is compulsory for organisations using more than 6,000 MWh per year of electricity. Any data centre larger than 5000 sq ft is almost certain to fall into this category. However, the ownership of the liability remains confused: as smaller players (operating data centres of less than 5,000 sq ft) do not have carbon credits to pass on to those they outsource to, large providers are likely to have to foot the cost of the CRC, despite the fact that they may in fact be reducing overall electricity consumption through economies of scale.

As a result, the industry must come to terms with a paradox. The enabling effects of data centres are significant, as mentioned earlier. Data centres exist to house IT equipment whose purpose is to deliver IT services to support UK organisations' business processes - the infrastructure is not an end in itself, and so the purpose of the data centre should also be kept in mind when reviewing its environmental impact. Indeed, many businesses look to IT systems to reduce their environmental impact in other areas. This leads to a contradiction: the data centre industry is heavily penalised, despite being the prime enabler of more environmentally-friendly business (by for example making online transactions possible).

The industry is however looking at solutions to increase its energy efficiency - we look at these in the next chapter.

RECOMMENDATION

Environmental policy-making should consider the net impact of the data centre industry as a whole, or risk 'biting the hand that feeds' - the IT industry's role in enabling the move to a lower carbon economy has been well espoused in a number of reports referred to throughout this paper, and punitive carbon-related measures impacting the data centre industry would likely lead only to a costly false economy, and potentially encouraging the industry to offshore.

Planning policy

In line with increasing levels of data, demand for new purpose-built data centre space in the UK is high, for a number of reasons:

- the growth in data and servers is increasing the power load beyond the capability of legacy data centres;
- power supplies to existing office buildings are unable to cope with the increased power consumption required by air conditioning, more power hungry PCs, more peripheral devices and increasing occupancy levels associated with smaller desks and paperless offices;
- many legacy data centres cannot cost-effectively deliver higher levels of resilience;
- economies of scale: as the power requirement increases, so does the need for space to house all the plant and machinery, and the more difficult it is to cool the equipment. It is also more difficult to achieve the planned design goals for power density and reliability. The smaller a data centre, the less cost-effective: fixed costs, irrespective of size, mean that larger data centres are more efficient and economically sustainable.

It is too early to say what the impact of the current economic climate will be on data centre demand in the UK. There is currently demand in the UK for over 1.1 million sq ft of data centre space, yet only 64,000 sq ft are available.[18] CBRE research has found that the data centre market has so far been less affected that the wider real estate market, and take-up for 2008 reached similar levels to those seen in 2007, which was a record year.[19]

As a result, a buying 'rush' is taking place, especially around London where the financial districts and Olympics are already severely restricting the available space. Figure 7 looks at what sectors this demand emanates from.

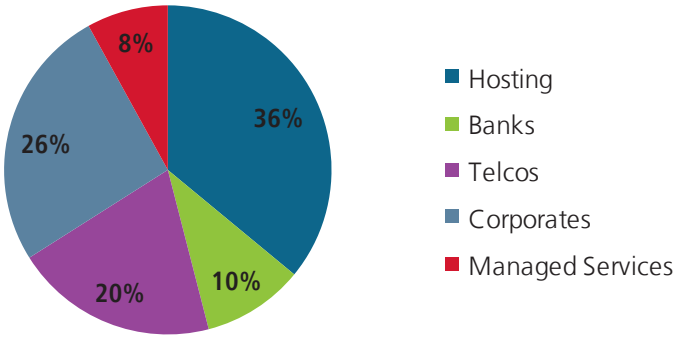


Figure 7 Active data centre space requirement in 2008, by sector Source: Jones Lang LaSalle

Delays and restrictions on operators' ability to build new data centres is likely to damage competitiveness and stifle economic growth, which in this economic context is particularly significant. Under these circumstances therefore, it is possible that UK plc might begin to look globally, and certainly to continental Europe, to host data. This of course has important implications for those jobs provided by the data centre industry in the UK - but perhaps more significantly, as data moves towards the continent, the prospect of businesses following their data is even more daunting, and would deal a significant blow to the UK economy.

RECOMMENDATION

Central Government should clarify guidelines for the industry around planning regulation. These guidelines should be reassessed in the light of the importance of data centres to the country's competitiveness.

18 Jones Lang LaSalle, Jan 2009. Space currently available refers to space which is ready to go, i.e. plug and play. Excludes potential developments, development sites and co-location properties.
19 CBRE Q3 08 Data Centre Market Review.

The industry is working towards a number of solutions to lessen the impact of the challenges it faces. However, while the industry can take steps itself towards tackling these, it is also important that Government understands the areas where it might be inadvertently restricting the industry's ability to perform as efficiently as possible.

The industry is taking a number of steps to increasing energy efficiency, including the following:

- efficiencies of scale are being achieved through consolidation: centralising and rationalising data centres, servers, applications, management tools, and network infrastructure into fewer, standardised, more manageable data centres and platforms. This has in many ways been aided by virtualisation, which is discussed below;
- IT manufacturers are beginning to develop low-energy equipment;
- infrastructure is increasingly being built nearer to renewable energy sources;
- new practices are being deployed, such as free cooling (which involves using outside air to cool a data centre), and wider use of more efficient water or CO_2-based cooling; better management of airflow; and challenging temperature standards; Currently, computer room temperatures are required to be maintained at about 22°C. However, the international technical society ASHRAE suggests that servers can be safely run at 27°C, so there is plenty of scope for increased efficiency;
- new business models are also impacting the energy efficiency of data centres: virtualisation, for example, effectively allows data centre capacity to be shared, by drawing on unused portions of servers to run pieces of applications. Virtualisation of the server architecture therefore provides an opportunity to maximise server use. Given that during any 24-hour period, anywhere between 90-94% of available computing power remains unused[20], there is significant room for improvement. The ability to reduce the number of servers necessary will also prove beneficial in easing the demand for data centre space.

These improvements will reduce the growth of data centres' carbon footprint. As Figure 8 shows, the new energy saving techniques and approaches the data centre industry is exploiting could potentially offer a 40% reduction against a projection of data centre carbon footprint in 2020 based on current techniques.

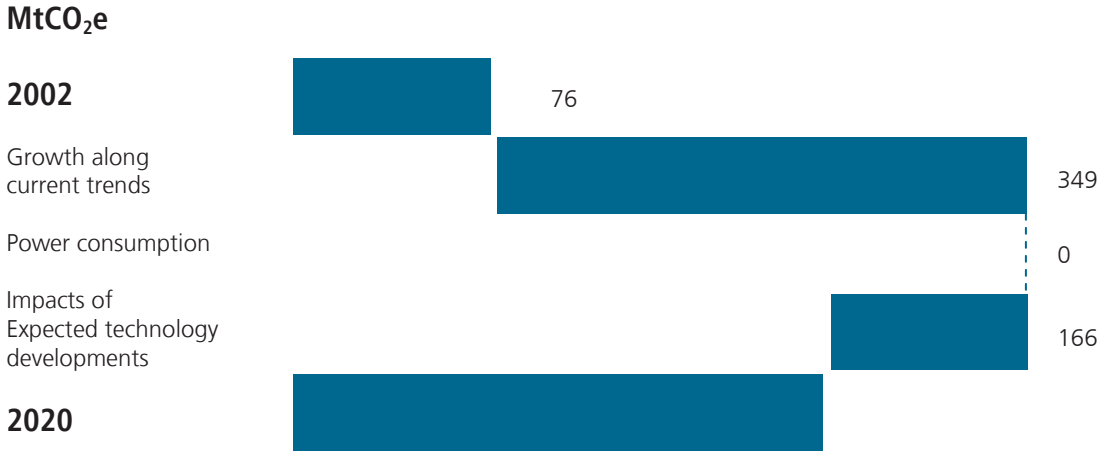


Figure 8 The global data centre footprint
Source: 'SMART 2020: Enabling the low carbon economy in the information age' (2008)

20 On average, only 6% of server capacity is used, according to a study by McKinsey and the Uptime Institute.

As we have seen, based on IDC estimates until 2011 and trend extrapolation to 2020 (excluding the impact of virtualisation), the number of servers worldwide would increase from 18 million to 122 million. All things being equal, we could therefore expect the global carbon footprint of data centres to increase over five fold. However, savings of 166 $MtCo_2e$ (~40%) are expected thanks to increased adoption of virtualisation, smart cooling and a broader operating temperature range. With regards to power consumption, no overall increase is forecast, as the increase in processing demand is expected to be offset by the development of new server technologies by 2020 that will increase energy efficiency.[21]

Alongside these improvements driven by industry, regulatory developments in the field of energy efficiency are also taking place. In the United States, the Environmental Protection Agency has proposed that large data centres use energy meters as a first step towards creating operating-efficiency standards. The European Union, meanwhile, issued a voluntary code of conduct in October 2008, outlining best practices for greater energy efficiency.

Among other things, the code actively encourages the use of resource sharing grids and virtualised platforms, and suggests that senior business approval be sought for any new services that require dedicated hardware. In parallel to this, it encourages energy efficient software and hardware and suggests that the performance per watt of IT devices be a primary concern during tender processes. The code also suggests that air temperature should be reviewed, and rack air flow management implemented. The data centre industry has been largely supportive of these suggestions, and Intellect also approves of this initiative. The industry is also developing a set of metrics to assist in it in managing its carbon footprint, alongside the Carbon Trust and British Computer Society (BCS).

RECOMMENDATION

In parallel with the industry's own efforts to reduce its carbon footprint, the Government should do more to create a fiscal and regulatory environment that will encourage faster and wider adoption of IT. Financial incentives (such as enhanced capital allowances) should be established to encourage the adoption of energy-saving technologies and concepts.

21 This net zero increase is due to the adoption of volume servers which incorporate technologies such as multi-core/multi-threading microprocessors with more sophisticated power-state sensing and management.

What next?

We have laid out the case for action in the previous pages. The data centre industry is making good progress towards juggling the demands and constraints placed upon it. However, in order to maximise the industry's performance, the data centre industry, Government and the customer community need to work more together effectively. If IT clients remain conservative in their approach when procuring their data centres, taking a 'safety first' stance to the detriment of energy-related considerations, the industry will struggle to meet the demands of UK plc, which will suffer as a result, no matter what efficiency measures data centre operators attempt to implement. Similarly, with an improved understanding of the data centre industry, the UK Government can ensure that its policies do not inadvertently counter the industry's ability to secure the resilience of businesses across the nation.

Intellect has made the following recommendations:

- the UK is increasingly dependent on data centres. Regular dialogue with policy-makers and appropriate consultation of the industry will enable the development of more effective regulation and legislation which takes into account the capacity, needs and impact of the industry. Crucially, all attempts to regulate the industry should be done in partnership with the private sector.
- Central Government should take the opportunity, in considering its own requirements for data centres, to lead by example and establish best practice or common standards for data centre operation that balance the requirements for security, environment and resilience. The standards required should reflect the taxonomy of the IT services to be delivered.
- a data centre energy taskforce should be established with Government, the energy regulator Ofgem, National Grid and network operators. This taskforce should work towards ensuring that data centres have access to the power they need to ensure resilience and business continuity.
- environmental policy-making should consider the net impact of the data centre industry as a whole, or risk 'biting the hand that feeds' - the IT industry's role in enabling the move to a lower carbon economy has been well espoused in a number of reports referred to throughout this paper, and punitive carbon-related measures impacting the data centre industry would likely lead only to a costly false economy, and encourage the industry to offshore.
- Central Government should clarify guidelines for the industry around planning regulation. These guidelines should be reassessed in the light of the importance of data centres to the country's competitiveness.
- in parallel with the industry's own efforts to reduce its carbon footprint, the Government should do more to create a fiscal and regulatory environment that will encourage faster and wider adoption of IT. Financial incentives (such as enhanced capital allowances) should be established to encourage the adoption of energy-saving technologies and concepts.

With an improved understanding of the industry structure, and the issues it faces, IT provision can become truly embedded in the process of policy-making, to the benefit of Government, users, industry, and the overall economy. Intellect's Data Centres Group would welcome the opportunity to provide a sounding board for Government when developing its approach to the data centre industry.

For more information, please contact datacentres@intellectuk.org

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REPRESENTING THE UK TECHNOLOGY INDUSTRY

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