techUK

The UK Data Centre Sector

The most important industry you've never heard of

Sector Overview
May 2020

Our data centre sector is a real UK success story: globally important and one of the world's largest markets; leading edge in terms of technology and expertise and delivering year on year growth. Data centres represent the physical manifestation of our digital economy; the internet does not float in a cloud but sits securely in servers. Our facilities provide the infrastructure that enables the UK to punch well above its weight in digital exports and services. The sector's only shortcoming is that nobody seems to have heard of it. These notes explain what data centres are, what they do, why they do it so well in the UK and why they matter.

I. Executive summary

What is a data centre?

A data centre is a building (or self-contained unit within a building) that houses computing equipment (primarily servers) along with associated components such as telecommunications, network and storage systems. A data centre is equipped with a guaranteed power supply and high bandwidth connectivity. Resilience is critical, so redundancy (duplication) of networks, power and other infrastructure is common to ensure continuity. Building management controls such as air conditioning maintain the environmental conditions for the equipment within a specified envelope of temperature and humidity, and advanced security systems ensure that the facility and its data remain secure.

What do data centres do?

Data centres consolidate IT functions for organisations. They transmit, receive, process, store and manage digital data and by doing so they support every conceivable part of our modern economy: business processes, Government services, telecommunications, transport infrastructures and social networks all depend on computers interacting in this way, exchanging digital information. Data centres enable an incredible range of activities across society and are now part of our critical national infrastructure whether we like it or not.

Economic contribution

Data centres underpin an internet economy that contributes over 16% of domestic output, 10% of employment and 24% of total UK exports[i] and is growing faster than any other in the G-20. Our sector is a real success story, is globally important and provides the technical infrastructure for financial services, aerospace, transport, healthcare, retail and utilities. Each new data centre contributes between £397 M and £436 M GVA per year to the UK economy[ii] while that of each existing data centre is estimated to lie between £291 M and £320 M per annum. Data centres are where our industrial strategy meets our digital strategy, although they weren't mentioned in UK government's 2018 Industrial Strategy or its 2017 Digital Strategy.

How many data centres are there?

The UK is a world-leading, globally important market for data centres, and we estimate that there are between 400 and 450 facilities that meet our definition above. Nearly 200 of these are run by commercial operators, who provide data centre services to third parties (termed colocation). The rest are in-house, supporting corporate IT functions and customer services for organisations like banks, retailers and universities (termed enterprise). These may be on-premises or remote.

Where are they and why has nobody spotted them?

70% of the UK's commercial data centre market is clustered in and around the M25. Manchester is the secondary cluster. Enterprise data centres tend to be spread more widely because they were built near head offices to support corporate IT functions or provide disaster recovery. The critical role of data centres is largely unrecognised in the UK because operators tend to keep a low profile (obscurity aids resilience), because they are largely business-to-business (with little public profile) and because they are privately funded, so this infrastructure has not required high profile, often contentious, public funding exercises like HS2 or Crossrail.

Data centre business models

Data centre operators offer a surprisingly wide range of services, from secure space and power to cloud applications, depending on the business model. The most common offerings include wholesale colocation where customers take whole halls with bespoke supporting infrastructure, retail colocation, where customers take racks or part racks for their servers in fitted halls, and cloud computing, where service providers can move workloads to optimise hardware use. Some cloud platforms are operated from hyperscale sites – large scale facilities increasingly sited near renewable power sources. High performance computing uses parallel processing to handle large complex datasets. Edge computing is the latest evolution and moves computing functions close to the end user, providing the near-instantaneous communications required for machine to machine applications.

Why is the UK special?

The UK may seem an unlikely home for a globally important data centre market and the world's second largest commercial cluster. The UK hosts also the largest commercial market in Europe by a significant margin[iii], although other countries are working hard to catch up. The UK's success probably relies on its ability to provide "power, position and ping". Power means a stable, high quality electricity supply and the UK grid is among the most reliable in the world, ranked third at the moment. Position means access to customers and the UK has long been regarded as an attractive destination for inward investors, especially as a location for multinationals to site their regional HQs at a gateway to the European market. Ping means connectivity and the UK also benefited (and still does) from world class connectivity.

These factors stimulated the development of the first data centre market in Europe which developed in London and, with the help of first mover advantage, soon grew to critical mass. Now the UK has not only the largest data centre market in Europe, but also the most varied in terms of offerings and the best professional services provision. London is also a very important factor in the UK's success.

Informally we attribute London's pre-eminence to three things: Age, Beauty and Experience: Age is first mover advantage: by being first, London attracted key players and around them a complex ecosystem has developed. Beauty is the attractiveness of London for investors and for skilled staff seeking a career in the sector. Experience is London's world class expertise in investment, finance, design, engineering, construction, technical brokerage, procurement, compliance and energy management.

Energy consumption and net zero

Data centres are electro-intensive and the UK's commercial sector consumes 2.89TWh of energy a year which equates to around 0.8 per cent of our UK electricity supply and about 0.3 per cent of primary energy[iv]. This figure approximately doubles when we include enterprise data centres (operated in-house by organisations like banks, retailers, local authorities and universities).

As a large electricity consumer with stable, predictable demand and significant embedded capacity the sector is well placed to support our transition to net zero. Besides being anchor customers for renewables (over 75% of energy used by the UK's commercial sector is certified 100% renewable), operators are poised to fund significant additional low carbon generating capacity. Some already have power purchase agreements in place and are trialling alternative technologies like fuel cells and battery storage. Moreover, data centres underpin the technologies that reduce carbon across the economy: dematerialisation, smart energy, smart transport, digitisation of government and business services, remote working and teleconferencing and of course the delivery of our Digital Strategy. Data centres also play a crucial role within the ICT sector - consolidating distributed IT functions into purpose built facilities reduces energy consumption by at least two thirds.

Evolution and history of the sector

The data centre sector has not sprung up overnight but instead has evolved from a need to consolidate and manage the growing volumes of digital data securely and efficiently. The sector originated back in mainframe computers and its future looks set to be a mixture of consolidated and distributed models – in cloud and edge respectively. Whatever the business model, we expect to see healthy sector growth for at least the medium term.

2. Definitions

What are data centres, what do they do and how many are there in the UK?

A data centre consolidates the IT functions that all organisations rely on and is a building, or part therof, in which digital data is managed, processed, stored and transmitted. It provides a secure, resilient, and controlled environment for IT equipment (servers and networks) and supporting infrastructure and is equipped with a guaranteed power supply and high bandwidth connectivity. Redundancy (duplication) of networks, power and other infrastructure ensures continuity. Building management controls such as air conditioning maintain environmental conditions for the equipment within a specified envelope of temperature and humidity, and advanced security systems ensure that the facility and its data remain secure. A data centre may be on-premises or remote. It may be operated in-house to support organisational IT functions or by a commercial third party provider. It may be dedicated to one organisation or service multiple customers.

Data centres support every conceivable part of our modern economy: business processes, Government services, telecommunications, transport infrastructures and social networks all depend on computers interacting in this way, exchanging digital information. They underpin an internet economy that contributes over 16% of domestic output, 10% of employment and 24% of total UK exports[v] and is growing faster than any other in the G-20. Our sector is a real success story, is globally important and provides the technical infrastructure for financial services, aerospace, transport, healthcare, retail and utilities. Each new data centre contributes between £397 M and £436 M GVA per year to the UK economy[vi] while that of each existing data centre is estimated to lie between £291 M and £320 M per annum. Data centres are de facto part of our critical national infrastructure - and where our industrial strategy meets our digital strategy, although they weren't mentioned in either policy document.

We estimate that there are between 400 and 450 recognisable facilities, around half of which are run by commercial operators, who provide data centre services to third parties. These are called "colocation" as businesses usually lease space in which to deploy their own IT hardware, "colocated" with the servers of other businesses. Reasons for outsourcing include security, resilience and cost: data centres are eye-wateringly expensive to build from scratch so for companies where data centres are not core business, outsourcing moves this to a specialist provider and also moves the financing from a capex to an opex model. Probably another hundred sites are run by telecoms operators and IT services providers. The remainder are hidden in-house, supporting corporate IT functions and customer services for organisations like banks, retailers and universities. These are known as "enterprise" facilities because they are dedicated to supporting the business; the enterprise. These may be on-premises or remote from the business. Many organisations mix and match – outsourcing mission critical activities but keeping more mundane functions in-house.

Some organisations do not consolidate their IT into data centres. Instead they run smaller server rooms on premises. These rooms (often little more than cupboards) are part of what is called the "distributed IT environment" and are not data centres. The aggregated energy consumption of lots of small-scale activity of this type is considerable, and distributed IT is also notoriously inefficient. Therefore it represents an area where very significant energy savings could be achieved so it has to be considered in any discussion about data centres.

There are no formal criteria that differentiate a data centre from a server room, but broadly speaking, a combination of power supply, resilience and server capacity are used. The parameters defining a data centre for the purpose of the Climate Change Agreement include a minimum power supply of 240KW, a floor area of over 200M^2 and emergency back-up power to allow continuous running (not just batteries to allow controlled shutdown).

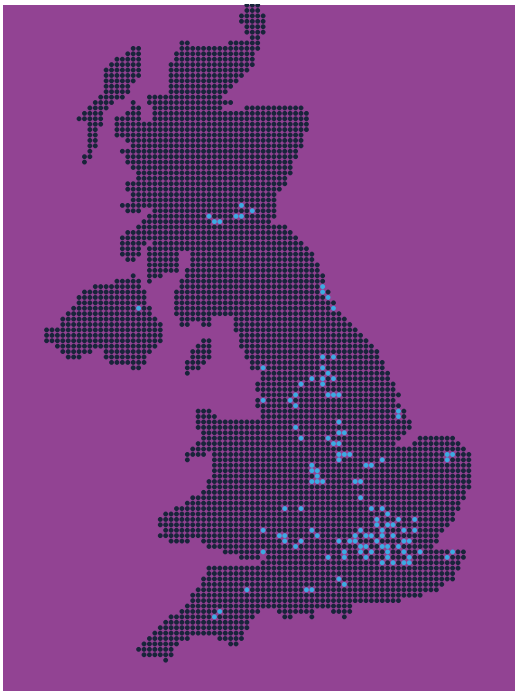
The fuzziness of the definition is one of the reasons that nobody agrees on how many data centres there are in the UK. If we broaden the definition to include server rooms and individual server cupboards then our figure of 400 could easily jump by a factor of ten.

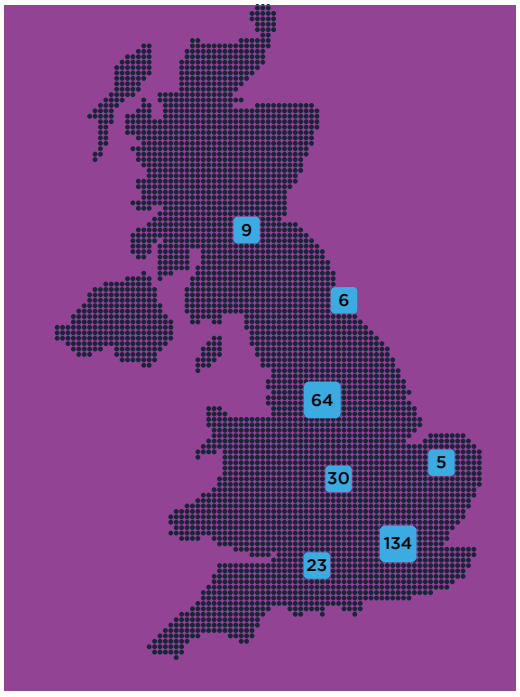
3. Data Centre Distribution

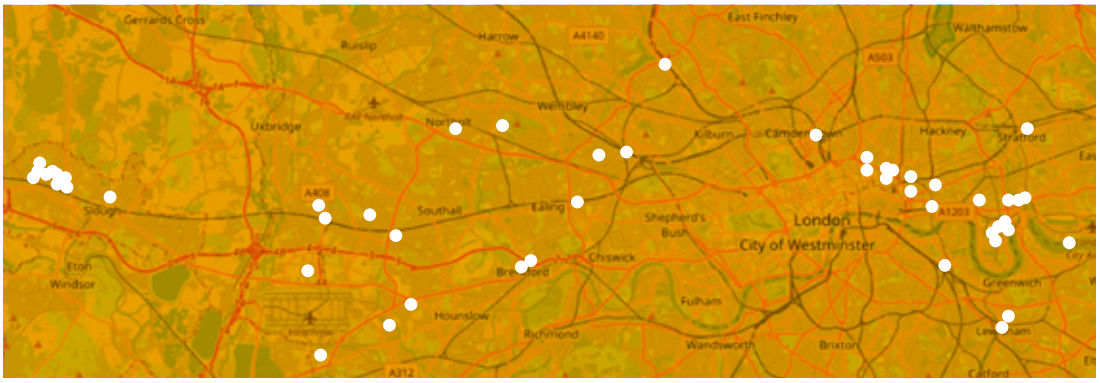
Data centres rely on three things: “power, position and ping”. Power is electricity, position means being accessible to customers (and varies depending on business model) and ping means connectivity. Commercial data centres were originally built around internet exchanges and trading platforms to benefit from very high transmission speed (known as low latency). Financial services like trading and banking still require this, but other services like consumer cloud do not, so data centres underpinning these activities can be anywhere and increasingly tend to be located near to renewable, under-used power sources. That accounts for much of the rapid growth we have seen in Scandinavia, driven largely by these consumer-facing cloud providers.

Within the UK, colocation (commercial) sites by and large are heavily clustered, with about 70% of the UK market in and around the M25. The second largest cluster is in Manchester. Smaller clusters and individual sites add further capacity and may also serve regional markets or provide disaster recovery. The Scottish Government is actively promoting data centre developments and investing in improved connectivity. See “A Digital Strategy for Scotland”.

Enterprise sites, because they service a single business, tend to be located near head office. For example, sites were built in Norwich for Norwich Union and Halifax for the Halifax Building Society, though in many cases the original owners now outsource their data centre requirements and many such sites have been sold and now operate in the commercial market.







4. Data Centre Business Models

The main data centre business models are explained below but it is important to remember that there is a lot of overlap between them and that individual operators may provide multiple business offerings.

In-house (enterprise)

Enterprise data centres are dedicated facilities supporting the corporate IT functions of organisations like government departments, universities, retailers and banks. They are usually close to headquarters, although some were established as disaster recovery sites and are situated more remotely for reasons of resilience. Universities, banks and telecoms providers have tended to operate their own facilities. Government has mixed and matched between in-house and outsourced. We also class system integrators, IT and managed service providers as enterprise operators because they often operate their own data centres to deliver an end to end IT service for customers.

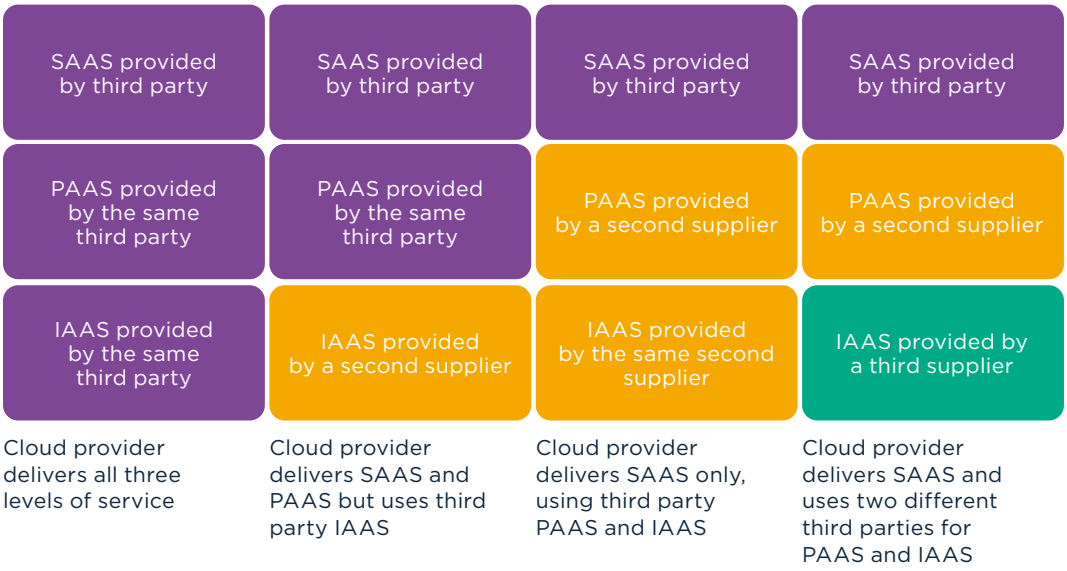
Colocation ("colo")

In the UK we have a very large colocation market, with the second largest cluster in the world focused around London, primarily to take advantage of faster connectivity and of a large and complex business ecosystem. As mentioned earlier, colocation (or "colo") sites provide secure, serviced data centre space to all sorts of organisations from supermarkets to public bodies within which they locate their own servers. Many cloud service providers take space in colocation facilities, although some use their own data centres. Colo providers can supply wholesale space – where contracts are large and the customer determines most of the details of the fit out - or retail space that is fully fitted and ready for servers to be installed. Increasingly, operators are offering a mixture of services to match customer requirements, so the traditional boundaries between business models are blurring. In fact, some of the larger providers are moving towards a business model where they offer the full suite of services, from wholesale to cloud, and by doing so can service the entire business ecosystem. We informally describe the layered structure of data centre business models as a sherry trifle.

Cloud

Simplistically, cloud computing is the result of changes in technology and business models over the last decade. A gradual move away from buying products and towards service delivery has characterised the technology sector, with IT functions increasingly offered as packages or as "pay as you go" services. Cloud services tend to be categorised as infrastructure (IAAS), platform (PAAS) and application (SAAS). Cloud allows for consolidation, which concentrates IT functions into purpose-built facilities and uses virtualisation, which enables workloads to be shared – and moved - between servers in different locations. This makes best use of available capacity and improves utilisation (how busy the servers are) in turn improving IT efficiency and delivering economies of scale. Because there are sensitivities about moving workloads and security, services include private cloud, where certain applications are kept within the customer organisation's network, public cloud, where applications and services are hosted externally and hybrid cloud – a mixture. Cloud providers may build their own data centres from where they service governments, businesses and individuals, or they may take space in third party, commercial (colocation) facilities.

Cloud: different levels of service may rely on different providers
IAAS: Infrastructure as a service, PAAS: Platform as a service
SAAS: Software as a service



Hyperscale

In other countries like Ireland and in Scandinavia large US cloud companies – known as "hyperscale" operators have become dominant. They tend to acquire land parcels to develop large data centre campuses and favour locations with low cost, renewable power and plenty of suitable development space. These operators are present in the UK market but rather than acquiring land and building they tend to contract for space within colocation facilities, perhaps due to lack of available land in suitable locations. Although hyperscale companies like Amazon, eBay, Facebook and Google are primarily known for their consumer offerings (which is why they are household names), they may also provide cloud services to businesses and government.

High performance computing (HPC)

High performance computing, sometimes referred to as supercomputing, requires bespoke IT hardware and tends to take place in specialist facilities. HPC uses parallel processing for complex research projects and large-scale modelling exercises where very large datasets and/or multiple variables are involved. Weather forecasting and bioinformatics are typical HPC applications. National governments are very interested in financing, building and otherwise supporting HPC facilities because they view this kind of computing resource as essential infrastructure to enable national level research programmes.

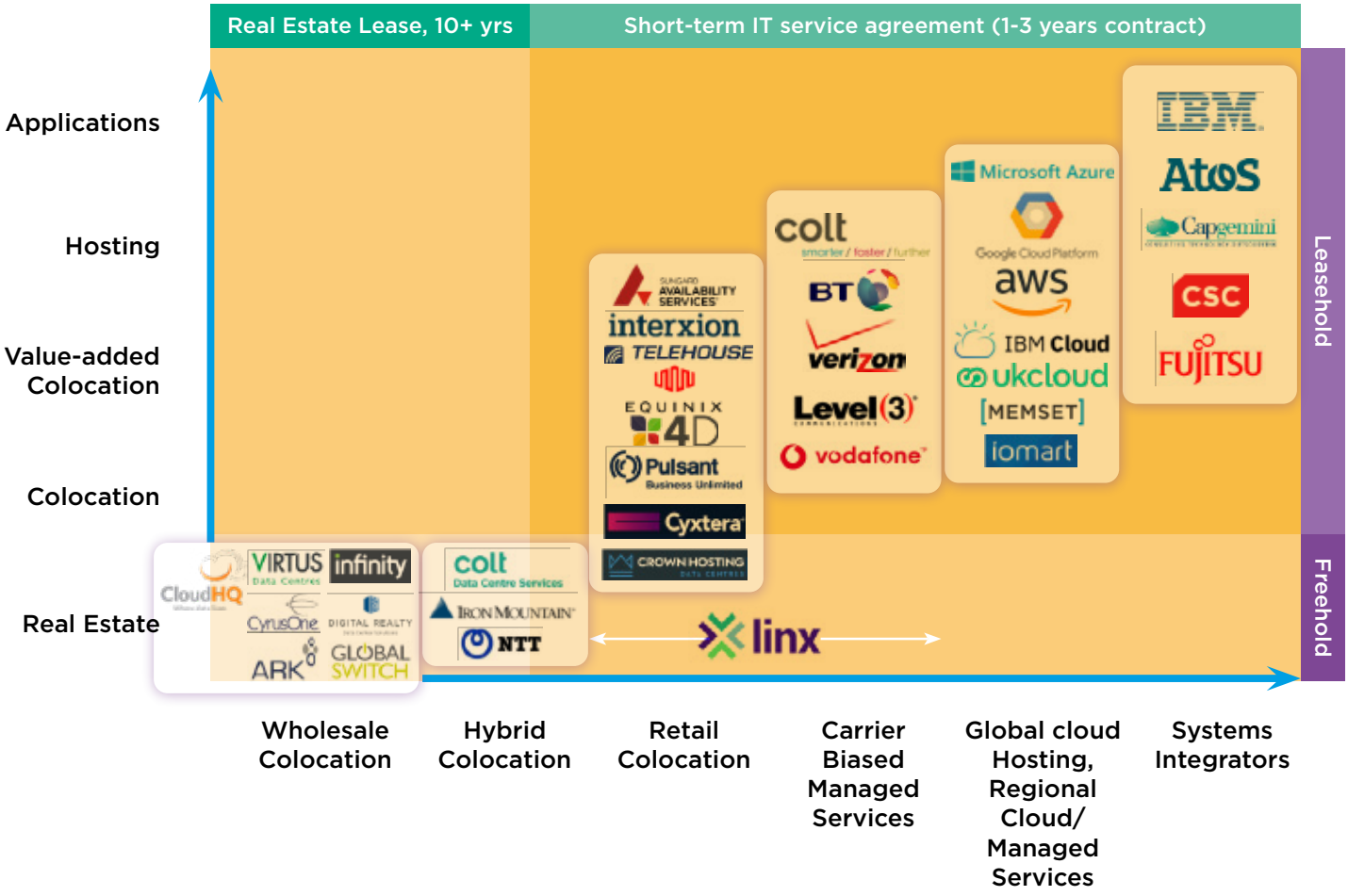
Edge

Edge computing is a move away from consolidating IT functions in large data centres, back towards a more distributed model. In an edge scenario, the data processing activities take place around the periphery of the communications network, near to the actual user. So instead of being centralised remotely, computing power, data and applications are close to where they are needed. Edge provides local, ultra-low latency computing power for IoT applications like autonomous vehicles and other machine to machine interactions. Currently, most discussion is on the need for edge computing to enable us to exploit the capabilities of the 5G network – the next generation of mobile phone infrastructure. Edge and 5G will coevolve[vii] .

A note on distributed IT

Distributed computing, where IT functions are spread around premises in cupboards and server rooms, is not a data centre business model – it is the antithesis. Moreover it is a hopelessly inefficient approach to ICT in which aggregate energy use, while significant, is hard to account for. Consolidating such activity into purpose-built facilities reduces energy consumption by at least two thirds. The same savings can also be delivered when smaller data centres and server rooms are consolidated and outsourced. See box.

The Eureca project analysed 350 small public sector data centres and server rooms across Europe and concluded that consolidation and outsourcing would deliver the most significant energy savings, rather than individual incremental improvements. The project also discovered widespread shortcomings in energy stewardship: PUE averaged around 4, utilisation was around 20% and servers were not being upgraded: 40% of servers were over 5 years old and this cohort was consuming 66% of electricity while only delivering 7% of compute. See www.dceureca.eu



Data centre services in the UK: Who does what?

This diagram, which we developed with the help of CBRE, identifies some of the operators active in the UK at present, and where they fit – very approximately- within the spectrum of data centre services. This is only indicative: the intention is just to present the range of activity and demonstrate that data centres don't all do the same thing.

Notes:

Many operators, for example Iomart and Crown Hosting, offer a broader range of services than implied here and LINX (London Internet Exchange) provides interconnection services across multiple business models.

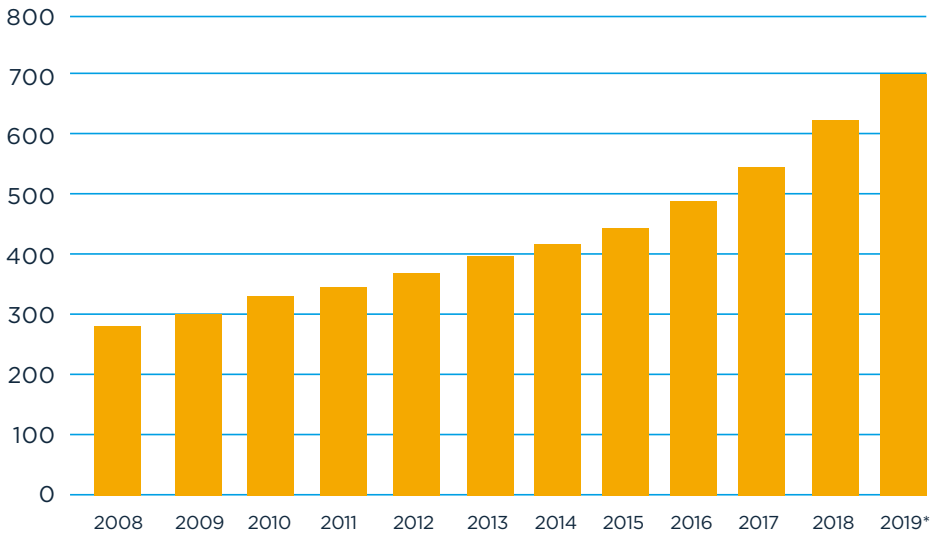
Large (global) cloud service providers (CSPs) may operate their own data centres or take space in third parties, particularly within wholesale colocation. CSPs will often use colo facilities to scale initial operations and then look to build their own facilities over time.

This landscape tends to change rapidly so is just a snapshot in time: For example Iomart has acquired Memset and Digital Realty and Interxion have merged.

5. Why has the UK been such a success story?

Growth rates

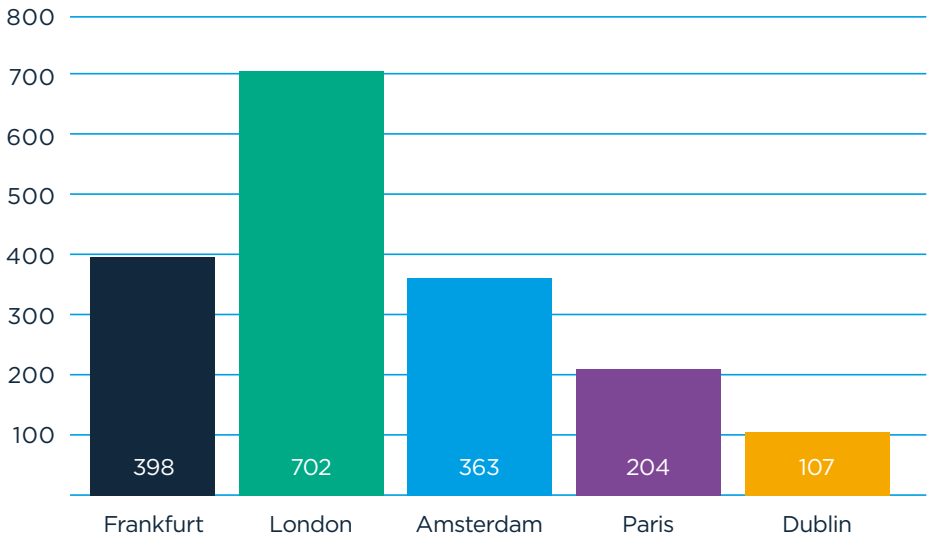
The UK's commercial data centre market has delivered the kind of year-on-year growth that most sectors can only dream of. The adjacent chart shows the growth of the London colocation (commercial) data centre market since 2008. MW of provisioned power is used here as a proxy for space and facility numbers. However, in recent years we have seen a strong trend towards the development of fewer, much larger facilities as the market matures and consolidates.



Growth rates since 2008, London Colocation data centre market, using MW of take-up as a proxy. Note that this does not equate to energy consumption. Source CBRE

European market dominance

The UK market is the largest commercial market in Europe by a significant margin, although other countries are working hard to catch up. Figures from CBRE and other analysts tend to compare growth of supply and demand in the main metropolitan markets: so London is compared with Frankfurt, Amsterdam and Paris rather than comparisons being drawn at nation state level. Dublin is a recent entrant and has been exceptionally successful in attracting large cloud providers as well as colocation operators, so is now included in recent figures. This "FLAP-D" data is a good proxy for the broader commercial data centre market in Europe.

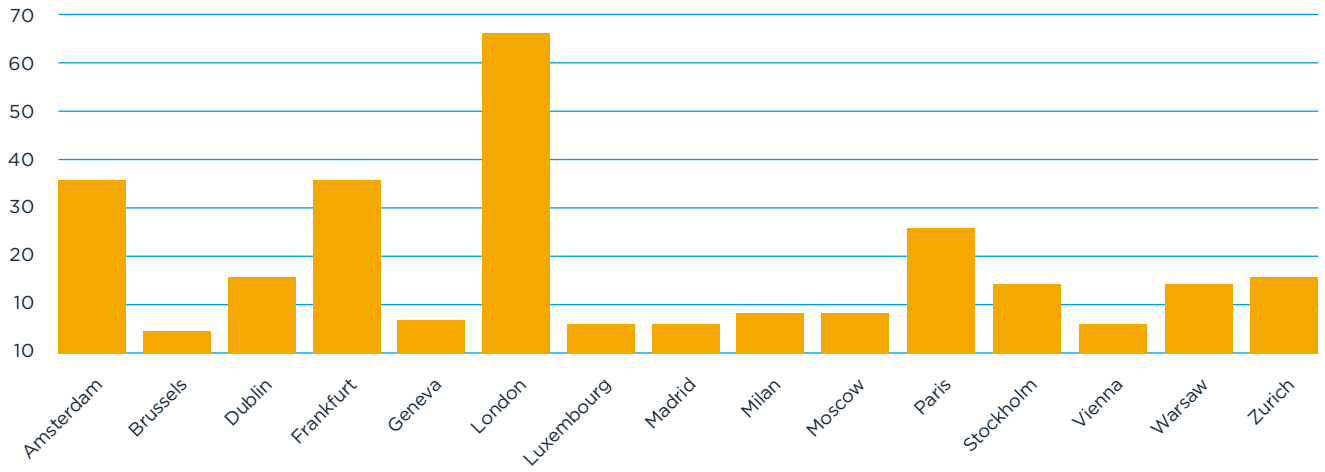


UK dominance over other EU markets (data centre supply, using MW of take-up as a proxy.

Note that take-up is NOT the same as energy consumption but is a good indication of final site capacity)

If we look more broadly at other European cities it is clear that the FLAP markets, particularly London, Frankfurt and Amsterdam, stand out. These figures don't include all data centres in these locations but are indicative of market conditions.

Colocation numbers: European cities



The figures here only represent a proportion of the market but act as a good proxy for market trends.

What's special about the UK?

At first glance the UK may seem an unlikely home for a globally important data centre market and the world's second largest commercial cluster. UK government has been very slow to recognise and support the sector that underpins our digital economy and enables so many of our key policy agendas. The UK also achieves very mixed scores against the conventional factors cited by inward investment agencies (access to cheap (preferably renewable) power, available land, ease of planning, taxation regimes, data adequacy, local and national incentives, available skills and a stable policy environment). Energy costs are also unattractively high. Those responsible for implementing our planning regime are not always conversant with the unique characteristics of a data centre build and financial incentives are thin on the ground. Nevertheless the UK is a world leading data centre market, globally important, and the sector is a real business success story for the UK. Why?

We mentioned above that data centres rely on "power, position and ping". Power means a stable, high quality electricity supply and the UK grid is among the most reliable in the world, ranked third at the moment. So electricity may be expensive but supply is unlikely to fail. Even with the UK's planned exit from the EU's single energy market, and consequent changes in trading arrangements, Brexit is not predicted, either by government or by energy market players, to have a disruptive effect on security of supply, although there are impacts on costs (see below).

Position means access to customers and the UK has long been regarded as an attractive destination for inward investors, especially as a location for multinationals to site their regional HQs at a gateway to the European market. Many of these were digitally dependent blue-chip companies that represented a new, sophisticated, demanding and well-funded customer base for digital services.

Ping means connectivity and the UK also benefited (and still does) from world class connectivity. These factors stimulated the development of Europe's first data centre market here. With the help of first mover advantage, this soon grew to critical mass. Today the UK has not only the largest data centre market in Europe, but also the most varied in terms of offerings and the best professional services provision. The UK also has a flexible labour market compared to other EU nation states and is large enough to be recognised as a centre of excellence and offer a wealth of opportunity for professional development.

External perceptions

The UK still performs relatively well against broad based indices like I-DESI, the International Digital Economy and Society Index (which measures the digital economy performance of EU28 Member States and the EU as a whole and ranks the UK 5th). In Forbes' Best Countries for Business (which assesses business climate and ease of capital investment) the UK was placed top. The World Economic Forum Global Competitiveness Report ranks the UK 9th out of 141 countries in 2019, down 1 place from 2018.

…and London

London is a key factor in the success of the UK data centre market. When we say that the UK is home to the second largest data centre cluster in the world what we really mean is London. London is dominant in Europe with over 40% of the Tier 1 capacity. London is a major global financial and business centre and the data centre sector has benefited from the presence of demanding customers, which led to a coevolution in technical and operational capabilities. The fact that London has a world class financial sector and a world class data centre industry is no coincidence. London also has world class connectivity and it is still hard to find anywhere else with its market reach in terms of speed and bandwidth. London also has diversity in its offerings – multiple suppliers and options for every imaginable business model – a truly competitive market. Like the UK at large, London seems to be doing well in rankings – rated most innovative city in Europe for example: https://www.hubspot.com/european-tech-scene.

Informally we attribute London's pre-eminence to three things: Age, Beauty and Experience: Age is first mover advantage: by being first, London attracted key players and around them a complex ecosystem has developed. Beauty is the attractiveness of London for investors and for skilled staff seeking a career in the sector. Experience is London's world class expertise in investment, finance, design, engineering, construction, technical brokerage, procurement, compliance and energy management.

Why does it matter? The economic value of digital infrastructure

Business analysts and economists have long emphasised the economic importance of digital infrastructure as a catalyst for growth. Back in 2009 LSE reported that "investments… in digital infrastructures will have a greater positive impact on jobs while at the same time laying the groundwork for sustained productivity and innovation" in their paper "The UK's Digital Road to Recovery". This may be because digital infrastructure has the capacity to support multiple layers of economic activity or because it reduces the cost of, and therefore de-risks, innovation.

And in terms of investment, Ernst & Young commented in 2018 "Digital is driving growth …. Digital FDI projects increased from 881 in 2016 to 1,172 in 2017 across Europe, an increase of 33%, more than three times the rate of overall market growth. UK digital projects increased from 261 in 2016 to 320, a 23% rise, and accounted for almost all of the total growth in UK projects, compensating for declines in other sectors. But this is not just a growth story: digital is changing the shape of FDI, bringing new dynamic businesses to Europe. We estimate that in 2017, around 57% of the digital projects announced in the UK have 10 employees or less with the overwhelming majority of the projects being located in and around cities with worldranked universities."

6. What's happening in the rest of Europe?

We have already talked about the UK market in comparison to the rest of Europe and the dominance of the large, well-established metro markets (London, Frankfurt, Amsterdam, Paris and Dublin, or FLAP-D). The chart below typifies the speed of growth in these locations, where we have seen a trend towards fewer, larger developments.

COLOCATION MARKET SUPPLY

- There has never been so much development of colocation data centres in Europe
- The four largest markets grew by 25% in 2019
- c.100MW of new capacity was brought on in London alone in just Q4 2019
- Dublin will see significant new schemes in the coming year(s)
- Data centres are being built larger than ever to capture the increased scale of end-user deployments

5 Largest New Data Centres in Europe 2019 (MW)

Operator	Facility	Rank
NTT e-shelter	Dagenham 1	30
CyrusOne	Amsterdam 1	27
VIRTUS	LON7	24
CyrusOne	Frankfurt III	22
NTT e-shelter	Amsterdam 1	20
		123 MW

Source: CBRE

However, there are notable developments outside these locations. Scandinavia is well placed to attract large hyperscale operators and although working from a small base, data centre markets are developing very rapidly in Sweden, Norway, Finland, Denmark and Iceland. These countries are competing fiercely for operators and investors to locate facilities and we have seen significant concessions made by nation state governments in the form of energy tax reductions, inward investor support and planning assistance. In Ireland, European head office location for many large cloud providers, data centres are now classified as infrastructure developments. In Sweden one regional initiative of note is Lulea, a post-industrial location close to the arctic circle, which has reinvented itself as a data centre hub and centre of excellence, welcoming investment from cloud operators, hosting a research facility and a technical university.

It is worth mentioning that the UK market and other traditional metro markets (Frankfurt, Paris and Amsterdam), differ from the Irish and Scandinavian business models. The former all host financial centres and data centres have coevolved with these and other digitally dependent industries, providing the infrastructure for their customers to deliver and export services. In newer markets like Dublin and Sweden, it is the operators themselves (e.g. Facebook, Apple, Microsoft and Google) that are selling software and software-based services. In 2018 Ireland exported €86.2 Bn/year in computer services, 48% of its total services exports of €180.1Bn. Around 20% of that, or €18bn, is estimated to be SAAS (software as a service) from the data centres alone[viii] .

7. Sector energy consumption

Data centres are electro-intensive and the UK's commercial sector consumes 2.89TWh of energy a year which equates to around 0.8 per cent of our UK electricity supply and about 0.3 per cent of primary energy[ix]. This figure approximately doubles when we include enterprise data centres (operated in-house by organisations like banks, retailers, local authorities and universities). We have to estimate this because enterprise data centre energy use is captured within corporate reporting and not accounted for separately.

The UK sector has a Climate Change Agreement (CCA) which provides invaluable data on the energy used by the UK's commercial data centre sector. The UK is the only country in the world where sector energy consumption is measured robustly: elsewhere it tends to be estimated or modelled. The CCA is currently restricted to colocation providers which means that we cannot capture enterprise energy data. The result is that we have excellent data but only for part of the market.

What is a CCA?

A Climate Change Agreement (CCA) is a voluntary scheme with the dual purpose of protecting energy intensive sectors subject to overseas competition and driving improvements in energy efficiency.

Participants are eligible for a discount on the Climate Change Levy (an energy tax) in return for meeting efficiency targets. The CCA scheme has been in place since 2001, its second phase running from 2013 to 2023. The data centre sector joined the scheme in July 2014 and there are currently over 150 participating sites.

See links at end of document for more information on the CCA plus sector progress reports against efficiency targets.

In energy terms we also have to consider distributed IT as studies tend to lump it in with the in house / on premise data centres – despite the fact that distributed IT is the opposite of the consolidated approach that a data centre provides! Research currently suggests that on-premises, either distributed or in form of recognisable data centres, accounts for up to 72% of data centre activity[x] . The same studies predict that this will reduce to around 10% within the next decade as more organisations outsource to cloud and other third parties.

So a very rough estimate suggests that the energy consumption of UK data centres could be approaching 6TWh a year, and when distributed IT is factored in, this may be creeping towards the 9 or 10TWh figure. That would bring total consumption to about 3% of electricity use, representing around 1% of our primary energy supply.

Reporting energy use: How are we doing?

Commercial (colocation) sector:
- ~95 per cent of operators reporting
- ~98 per cent of energy is reported.

There is a tail of smaller operators and new sites, but coverage almost complete.

Enterprise operators: Large companies report emissions and reporting requirements have expanded under SECR. but there is no systematic way to identify the data centre component.

Distributed IT: no data

The Donald Rumsfeld Conundrum

Our understanding of data centre energy use can be characterised by Rumsfeld's categorisation of Known Knowns, Known Unknowns and Unknown Unknowns. The commercial sector is a known known – measured and audited. We also have good enough knowledge of enterprise facilities to be able to estimate energy use – so that is a known unknown. However, distributed IT, lurking under the radar, is our unknown unknown and hard to put a figure on. The solution is to consolidate and/or outsource it to efficient, purpose-built facilities where energy use is transparent, reported and accountable.

Speculation and mythologising

As a result of these uncertainties data centre energy use, both past and future, has been the subject of considerable speculation. Early academic and government studies made outlandish projections. These, although dated and often discredited, have formed the basis of further work and observers have also confused scenarios ("if this...then that") with predictions ("we're here...this is where we are going").

There has been too much modelling, too many assumptions and not enough measurement. Nor has there been enough sense-checking: one claim suggested that UK data centres consumed 320TWh of electricity a year – despite the fact that the UK only generates 330TWh of electricity a year in total! There have been other schoolboy errors – all too often electricity is confused with energy: the percentage of our electricity supply that data centres use equates to a much smaller share of total energy: electricity represents less than 20% of the UK's energy consumption[xi].

Agendas have also played their part: dire news sells copy, alarmist energy demand predictions "justify" policy action and commercial solutions. This has also been exacerbated by the sector itself because, despite the best intentions, the layered business model can easily result in the same energy being reported multiple times. The habit of "megawatt waving", where operators compare their power provisioning (the maximum amount of power they are entitled to draw - but never do) has not helped either, because these numbers are confused with what they actually consume, which is a small fraction of what they provision for. The debate is set to continue but in the meantime the International Energy Agency (IEA) provides useful global estimates for data centre energy use at around 200TWh, with transparent methodology and assumptions (see: https://www.iea.org/data-and-statistics/charts/global-data-centre-energy-demand-by-data-centre-type).

We also need to undertake the more complicated exercise of setting the right system boundaries when attributing energy and carbon to ICT functions. At the moment we don't make any allowances for energy consumption by data centres or by IT service providers resulting from ICT being deployed to deliver savings elsewhere in the economy. For instance, a logistics solution that reduces fleet miles will add an energy increment to the processing data centre but the credit for the reduction is attributed to the transport sector – not to the ICT sector. Current estimates suggest that ICT can deliver a 15-20% reduction in global emissions if applied intelligently across the economy.

The IEA's Digitalisation and Energy report sets out some of these potential areas. In transport, for example they suggest that the full deployment of digital solutions could reduce energy consumption of road freight by 20-25% globally, through a combination of GPS and real time traffic information, route optimisation, onboard monitoring and eco driving, vehicle connectivity and load data sharing to minimise trips.

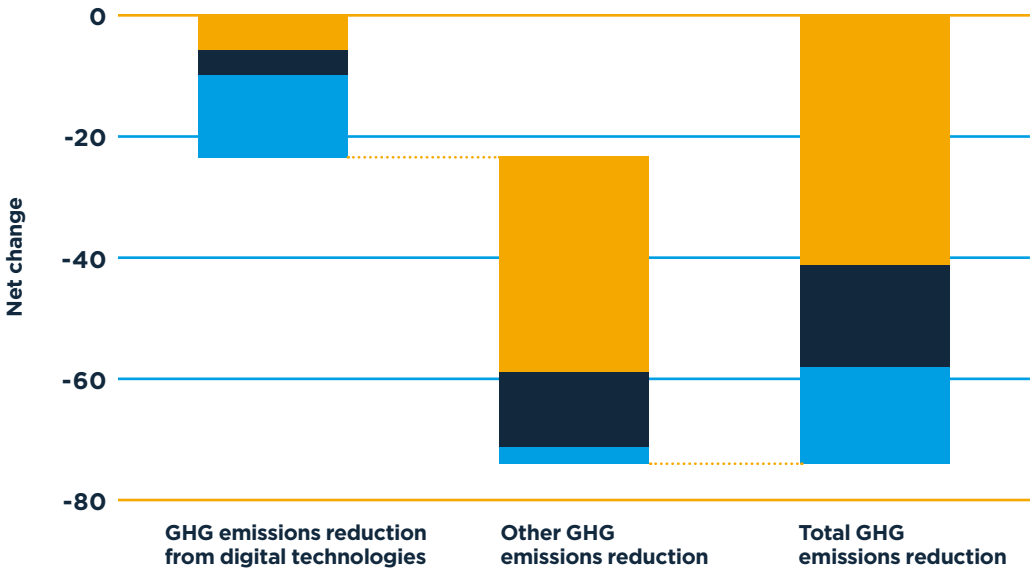


Chart reproduced from IEA "Digitisation and Energy", showing impact of digitalisation on GHG emissions in road freight, 2015-2050

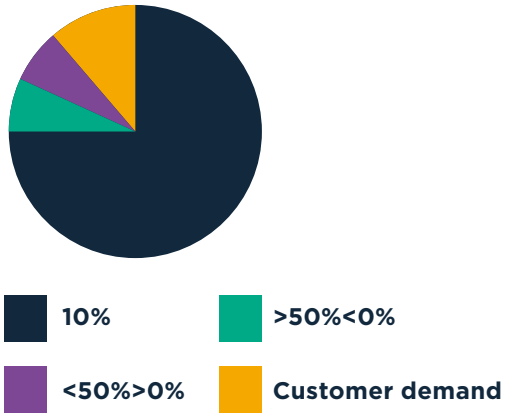
8. More on energy: renewables and energy flows within the sector.

Renewables consumption

The UK data centre sector is already a major anchor customer for renewables, with over 75% of the commercial sector's energy comprising 100% certified renewable and a further 10% purchased according to customer demand, which increasingly tends to be renewable. In general the ICT sector compares well with other industries[xii]. Greenpeace has been monitoring this with their #ClickClean campaign.

Large cloud operators are going further and choosing locations on the basis of renewable power supplies – the recent expansion in the Scandinavian market is largely attributable to this. In the UK there are few examples although several facilities are being established next to EFW plants. Some operators are trialling fuel cells and battery storage.

Renewable power purchased as proportion of overall electricity



The most significant recent development, however, is the appetite for power purchase agreements (PPAs). PPAs are contracts between customer and generator and stimulate additional renewable capacity by providing long term funding for utility scale renewable projects. Google is leading the field here with 34 agreements in place since 2010 and is the world's largest corporate renewable energy purchaser. We anticipate that these agreements will become more widespread, but this will take time, because PPAs are non-straightforward and require considerable expertise.

Data centre energy growth

We mentioned above that data centre energy use has been the subject of much speculation, with observers from media and academia projecting that an explosion in digital data will drive an explosion in data centre energy use. While data centre energy consumption is growing incrementally for the reasons given below, factors like Moore's Law (processor efficiency doubles around every 18 months), virtualisation, cloud computing and infrastructure improvements have meant that the energy required to process a given amount of data has reduced by around seven orders of magnitude over the last 30 years. So while the sector has to expand capacity to accommodate growth, we don't anticipate an explosion in energy demand[xiii] . Moreover, there are sound economic and societal reasons why that cannot happen: if energy use escalates, existing business models would no longer work and the market would apply its own constraints. Imagine the impact of applying even a small charge to every social media post or interaction.

Communications and coffins

It is worth mentioning Jevons and the difference between price elastic and price inelastic commodities. Communications are price elastic: the cheaper they are, the more we do. Compare coffins, where the demand will not be dramatically influenced by price. Freemium and advertorial business models in the sector have made many digital activities free at the point of use. This has been extraordinarily successful in driving rapid innovation and business growth, but they depend on the underlying activity being cheap which in turn depends on energy efficiency. If it becomes more energy intensive a charge will have to be applied to the user. The disadvantage of a freemium or advertorial model is that until that point, the user receives no signal about the energy impact of their online activity.

9. Growth drivers and mitigators

What is driving growth in the energy consumption of the UK's commercial data centre sector?

The answer is "lots of things" and we should be pleased to see that data centre capacity is growing because it is an indication that we have a thriving digital economy. The main reasons can be categorised as follows:

1. Increasing digitisation of business processes and growth of digitally dependent companies
2. Government digitally dependent policy agendas such as superfast broadband, smart grid etc.
3. Technological developments such as IoT, autonomous vehicles etc.
4. Consumer preferences – online transactions and social networking.
5. Consolidating and/or outsourcing existing distributed IT functions
6. Enterprise sites decommissioned and repurposed as colocation

It is important to understand the net effects of this growth in data centre capacity, which are not always obvious. As mentioned above we need to be aware that some growth in data centre energy consumption is the result of the increased deployment of ICT-enabled efficiency and productivity measures that deliver much larger savings elsewhere in the economy. While this is hard to account for accurately, we need to keep it in mind. The diagram below shows indicative changes in energy impacts resulting from the data centre growth drivers and the efficiency measure mentioned above.

Growth drivers: increase in demand for digital data driving data centre growth	Energy used by commercial DCs	Energy used by ICT sector	Net energy impact over wider economy
Digitisation of business	^	^	v
Digital policy agendas	^	^	v
Technology: IOT /M2M	^	^	v
Consumer preferences	^	^	?
Consolidating distributed IT	^	v	v
In-house /enterprise DCs repurposed as colo	^	v	v
Efficiency Drivers (These mitigate growth in data centre energy consumption)			
Moore's Law	v	v	v
Virtualisation / utilisation / cloud	v	v	v
Infrastructure improvements	v	v	v

10. Potted history of the UK market

Data centres have been around for several decades: large IT companies like IBM and telecommunications providers like BT and Cable & Wireless established facilities as far back as the 1980s. Financial services businesses followed soon afterwards, building to their own specification (and often massively over provisioning because they had not anticipated the efficiency improvements that could be achieved through technological developments in IT hardware). Most organisations initially kept data centre functions in house but data centres are expensive to build and operate and can be a distraction from core business activity.

A new type of provider – colocation - offered an opportunity to outsource data centre activities and replace a capex burden with a leasing model. Organisations seeking ways to store, process and transact increasing volumes of digital data created enough demand for a new industry. The resulting market evolved to offer every level of service from bare space to a fully integrated IT function.

Government data centres are worth a mention: for over a decade from the late 1990s, Departments often relied on system integrators for a full suite of IT services, but moved away from these big inflexible contracts from 2010 after a string of costly and high-profile project failures (plus a recession). At the same time there was a similar move away from in-house government data centres after they were described as achieving "resilience through prayer". Cloud services were adopted wherever possible (through GCloud). Other functions, including legacy activity unsuitable for migration, were moved into colocation (Crown Hosting -see box) where efficiency, flexibility and security standards could be guaranteed.

Crown Hosting: A joint venture between Cabinet Office and Ark data centres, public sector bodies can outsource, consolidate or simply lift and shift their data centre functions. Pre-tendered, flexible and with no lock-in, this approach removes the need for procurement exercises. State of the art efficiency guarantees Power Usage Effectiveness (PUE: the ratio of energy delivered to the site to that used by the IT) between 1.15 and 1.2, down from the 2013 government average of over 2.5.

Result: in the first four years the volume of business was nine-fold what was expected and £1.5Bn in savings was achieved, dwarfing the £105M that had been anticipated for the 7 year life. Crown Hosting has now been extended for a further four years.

Many IT contracts are still handled by system integrators but they have tended to diversify offerings and often include colo and cloud within their portfolios. These providers often mix and match their data centre estates – operating some sites themselves but supplementing this by leasing space, usually from wholesale colo providers.

Although the data centre market is constantly evolving, two significant trends have been transformational over the last few years. Firstly the proliferation of cloud: rather than leasing server space that might not be fully utilised, cloud infrastructure, platforms and applications can be purchased on a pay-as-you-go basis. When using cloud applications, customers no longer tend to own the servers they run on, thus freeing up capex. They are the responsibility of the cloud providers who are strongly incentivised to minimise energy use and can benefit from economies of scale.

The second development is explosive growth in the consumer market for digital services. The consumption of online applications and digital services by individuals, as opposed to organisations, has increased very significantly over the last five years. Consumers therefore represent the fastest growing market sector and this is having a profound impact on the market as a whole.

60 seconds on the internet

This 60 second snapshot demonstrates the growth in consumer uptake of digital applications and services. Reproduced by kind permission of VIRTUS

At a simplistic level, computing models seem to oscillate between consolidated IT and dispersed IT. In the early days of mainframes, organisational IT functions were consolidated in behemoths that lived in their own near-sacred rooms and computing was the preserve of very large corporations, government and research institutions. It was only with the introduction of the IBM 360 that computing functions could be performed by normal businesses on their own premises – a more distributed approach. Computing became available to everyone with the advent of the Personal Computer (PC) and spread to homes as well as businesses. Within organisations, this gave rise to the issue of controlling and coordinating IT between all these individual units. So data centres developed: many organisations built their own but for others, especially where ICT was not core business, an outsourced model improved security, reliability and operational efficiency - and reduced capex. Hence the rise of the commercial or colocation data centre market. However, instead of IT being consolidated into one vast machine, multiple servers do this job, each of which has vastly more computing power than the original mainframes (a single smartphone today has more than a million times more computing power than that used to put the first man on the moon). Around 2010 grid computing emerged as a potential route to have the best of both worlds, accessing distributed computing resources to provide capacity for data processing activities elsewhere. Grid computing did not materialise as envisaged and instead we have cloud. Now Edge computing presents another route towards at least a partially dispersed model.

Evolving data centre business models: simplified

Pre 1970	1970s	1980s	1990s	2000s	2010s	2020s
Mainframes	**IBM 360**	**BBC Micro/ IBM PC**	**Managed Services**	**Growth of Colocation**	**Age of hyperscale**	**Birth of Edge**
Research Programmes, Universities, Large corporations	Computing accessible to smaller companies, Computer Service, Bureaux: pro data centres	Computing accessible to everybody	Monolithic end to end contracts with IT service providers	Growth of outsourced data services	Consolidation from distributed IT to colocation and from devices to cloud	Enabling 5G and low latency IOT
						
Consolidated model	Consolidated model	Distributed model	Hybrid model	Hybrid model	Consolidated model	Hybrid model

Looking ahead

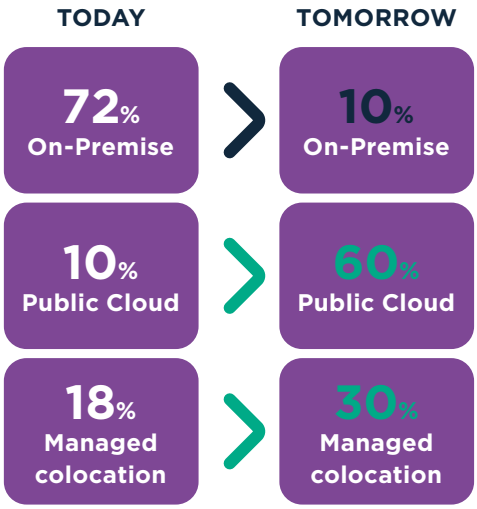
Predicting the future in the ICT sector is tricky, but the clearest trends are towards increased outsourcing to cloud, market consolidation and fewer, but much larger, individual transactions, leading to a net increase in uptake.

IT Consolidation

Predictions from Gartner suggest that on-premises IT will largely become a thing of the past within the next decade. That is positive news from a sustainability perspective because on-premises distributed computing is notoriously inefficient. The result will be net savings. Elsewhere we expect to see continued growth driven by policy agendas, digitisation of services and consumer preferences.

Market Consolidation

Our data centre market is still immature and as a result there is also market consolidation through significant M&A activity which looks set to continue at least into the medium term.



Figures refer to the global data centre market
Current and Future Market Trends (Source, CBRE)

New location drivers

We also expect to see renewable power availability becoming more important, and in some cases eclipsing connectivity, as a factor for investors and operators when choosing locations to develop new sites or expand existing ones. This may result in the movement of more high-performance computing and cloud to regions where there is plentiful renewable energy. The primary factor for locating data centres has traditionally been connectivity, which is one of the reasons that London has been such a successful market. However, we are increasingly seeing data centres located on the basis of the availability of renewable power, especially where supplies are under-used.

Demand Drivers

The things that drive demand for data centres services are changing. Over the last decade we have seen the rise of one new set of customers – consumers, and associated growth in consumer-facing cloud platforms and providers – Amazon, Google, Facebook, etc., although some also have very extensive offerings in the business space. In the future a new category of demand driver seems set to emerge, in the shape of things. We are some way from monetising the internet of things, and the kind of instantaneous, peer to peer connectivity that will be needed to enable autonomous vehicles and dynamic traffic management will in turn required a different type of data centre: Edge. Edge computing may have the potential to fulfil the requirements of this new market, but whether Edge has a disruptive effect on the more established parts of the market is hard to see. This is because Edge serves a new customer type: things. Most observers think that it is more likely to be “as well” than “instead”.

11. Summary: UK data centre market – past, present, future...

Past: A decade or two ago things were relatively simple: government and business largely did their own thing but outsourced some functions, primarily to IT service providers. Academia ran things in-house and there was no consumer market.

Present: Government and business outsource much more activity to third parties, either cloud or colocation. There is a lot more digital data to manage, process, store and transmit. This increase is driven by policies like the Digital Agenda, superfast broadband, smart grid, by the digitisation of government services and business processes, by e-commerce. Generally academia has not followed the outsourcing trend and appears to retain most activity in-house, perhaps because the presence of high-performance computing on campus is considered an important asset. The most significant entrants to the market are consumers, who have driven an explosion in demand for digital content and digital services, and consequently driven a suite of large and rapidly growing consumer-facing cloud service providers. These companies may build their own facilities, they may lease space in colo facilities, or they may offshore activity.

Future: Looking ahead in an industry characterised by disruptive technology is tricky. What we can say confidently is that it will change. We expect increased use of cloud, diminishing levels of in-house activity, movement of some high-performance computing and cloud to regions where there is plentiful renewable energy. The future may present an even larger new category of demand driver: things. Edge computing may have the potential to fulfil the requirements of this new market, but whether Edge has a disruptive effect on the more established parts of the market is hard to see. It's more likely to be "as well" than "instead".

Data centre customers: how services are changing

Type of customer	Previously served by...		Now served by...
Academia	In house data mainframe / Data centre	>	In house (enterprise) data centre
Government	In house mainframe / IT service provider	>	Outsourced to colocation or cloud
Corporations	In house mainframe / Distributed IT	>	Enterprise data centre / colocation / cloud
SMEs	Service Bureau / Distributed IT	>	Colocation / Cloud
Consumers	Distributed IT	>	Cloud
Things		>	Edge

12 ADDENDUM: COVID-19 and data centres

It would be strange to issue a sector overview in May 2020 without mentioning COVID-19, so this addendum provides a brief summary of the sector's response. Links to relevant resources are provided in the further information section at the end of this document.

COVID-19 has presented challenges to business continuity across the entire economy and data centres are no exception. Fortunately, the sector has a number of characteristics that aid resilience such as high security with all movements to, from, and within facilities tracked; highly automated operations; a very strong focus on business continuity and risk management, plus low levels of human traffic. At time of writing, there are no reports of significant data centre outages attributable to COVID-19, but operators do not see this as cause for complacency: on the contrary; careful planning and relentless vigilance continue to be essential.

Impact on demand

The spread of Covid-19 meant that the demand for digital communications, and therefore for the data centre services that underpin them, has risen sharply: Europe's largest internet exchanges have seen record traffic[i] as more and more people moved to remote working and teleconferencing with tools like Zoom and Microsoft Teams. At school, pupils switched to remote learning through Google Classroom and similar applications. Online shopping for food and other commodities rocketed, with many supermarket delivery services at capacity. For people self-isolating, especially those living alone, tools like Skype and WhatsApp have helped keep them connected to friends and family. Internet communications, underpinned by data centres, have also enabled government to share the latest information and advice to individuals, especially those in isolation.

Behind those obvious interactions, data centres also enable supermarkets to resupply, retailers and banks to process financial payments, delivery companies to manage logistics, government to govern and businesses to function. It was critical that data centres, and the digital services they support, continued to work when so much physical activity was suspended.

What did techUK do?

As soon as formal restrictions on movement looked likely in the UK, techUK approached Government to ensure that the critical role of data centres was understood, and to request that staff working within the sector would be allowed to travel and access sites in the event of a lockdown. That request was made to DCMS, the Department for Digital, Culture, Media and Sport. There was an immediate response and as a direct result, "data infrastructure" was included in the list of key workers published by Cabinet Office on the 19th March 2020. DCMS set up a dedicated mailbox and established a specialist team, the Data Infrastructure Resilience Team, to work with the sector, build a knowledge base within Government and ensure that data centres were factored into policy decisions on issues like lockdown exemptions, testing and quarantine. As the collective voice for the sector, techUK became the two-way point of contact between Government and UK operators.

What precautions have operators been taking?

The key priority for operators has been balancing employee safety whilst ensuring that facilities remain adequately staffed. Long before formal restrictions were in place, operators applied a range of precautions to limit the spread of infection. These included new guidelines, procedures and upgraded security controls. Intra-company communications were stepped up and reporting lines shortened. Precautions on site included shift segregation, restrictions on visitor access and on movement between sites, reduction in or elimination of shared workloads and both domestic and international travel constraints. Smart hands and other remote support were stepped up, non-essential maintenance deferred, security controls adapted and screening introduced. In some cases visitor temperatures were taken and non-medical grade PPE distributed, usually to reception and frontline staff only. Level and frequency of cleaning have been increased and sanitisation measures implemented. Post contamination cleaning arrangements have been set up for immediate deployment. Non-operational staff have been working from home, often since February or even January in some cases.

At sector level, techUK established a sector information hub and has been running regular calls for operators to share best practice and get the latest updates from DCMS. Operators have been comparing notes on how they are identifying and managing these Covid-19 risks and on the precautions they are putting in place. Competitors are working together to share information on procedures to limit infection, on quarantine, on decontamination routines, on HR and supply chain issues, on security of utility supplies and other operational matters.

Recovery

For some time, data centre managers have been considering how they will return operations to a more normal footing as restrictions on movement are relaxed. This will be slow: operators are not simply going to drop their precautions overnight, irrespective of the degree to which public restrictions on movement are relaxed. Most will implement a phased return, rolling back access restrictions and stepping up maintenance by degrees. The vast majority of existing precautionary measures will be retained and many new ones will be implemented.

However, recovery presents a number of additional challenges. Many of the measures taken involve additional cost or contribute to a growing backlog. Maintenance deferrals and access restrictions cannot be sustained in the long term so operators have to tackle this backlog as part of their recovery process. Their second major task is to recover operations to meet the new normal - and ensure they can prosper in the changed business conditions that our post-COVID world may impose.

Relationship with government

COVID-19 has had a profound impact on the policy dialogue between the UK data centre sector and Government. While the sector has always engaged with individual departments on specific areas of policy, data centres have not, to date, enjoyed the attentions of a sponsoring department. The COVID-19 pandemic catalysed a closer level of cooperation and the sector's relationship with Government is now being reappraised. The Data Infrastructure Resilience Team is in place for 12 months and will make recommendations on the best way for UK government to support the sector in terms of resilience and competitiveness. This is an important opportunity for operators to work productively with government to ensure that data centres continue to provide the state-of-the-art digital infrastructure needed to support the UK's digital economy moving forward.

[i] Recent stats on European internet exchange traffic can be found here: https://blog.cloudflare.com/on-the-shoulders-of-giants-recent-changes-in-internet-traffic/. The German commercial internet exchange in Frankfurt (DE-CIX) is currently setting world records for traffic. Widely covered in the trade press with one record broken around 11 March and a further record broken on 17th March 2020. Typical coverage includes: https://www.de-cix.net/en/about-de-cix/media-center/press-releases/de-cix-sets-a-new-world-record and https://www.controleng.com/articles/internet-exchange-world-record-achieved-at-frankfurt/

Operational vs Economic risks – data centres

Why data centre business continuity matters

Because data centres provide digital infrastructure, the impact of an outage is not limited to the data centre business: it has a ripple effect that can be very wide.

This is why data centres focus on continuity of service: the value of the data centre business is usually dwarfed by the value of the businesses it supports.

Take a bank for instance, a typical data centre customer. Interruption in service in the data centre might mean both interruption in trading for the investment arm and no transactional services for hundreds of thousands of customers, individuals and other busiensses.

13. Further reading

Our data centre programme pages: https://www.techuk.org/focus/programmes/data-centres

Data Centres for Tiny Tots

- Ten myths about data centres
  https://www.techuk.org/insights/news/item/15255-ten-myths-about-data-centres
- Data centres: engines of growth
  http://www.techuk.org/images/programmes/DataCentres/engine_of_growth_FINAL.pdf
- Data centres: a day in YOUR life
  https://www.techuk.org/insights/reports/item/274-data-centres-a-day-in-your-life
- Er What IS a data centre?
  https://www.techuk.org/images/documents/Data_Centres_-_CCA/Note_03_Er_what_is_a_data_centre.pdf
- So what have data centres ever done for us?
  https://www.techuk.org/images/programmes/DataCentres/So_what_have_data_centres_ever_done_for_us_FINAL_2013.PDF

Energy, renewable energy, energy stewardship, metrics and standards

- Data Centre Energy Routemap
  https://www.techuk.org/insights/reports/item/16263-data-centre-energy-routemap
- Lost in Migration: Attributing carbon to the Cloud
  https://www.techuk.org/insights/reports/item/16253-attributing-carbon-to-cloud
- Data centre performance metrics:
  https://www.techuk.org/images/Data_centre_performance_metrics_for_Tiny_Tots.pdf
- Data centre standards map:
  https://www.techuk.org/insights/news/item/15702-mapping-data-centre-standards
- Emergency Generation in Data Centres:
  https://www.techuk.org/images/techUK_TechCttee_Briefing_Emergency_Generation_1701.pdf
- Data Centres and Power: Fact or Fiction?
  https://www.techuk.org/insights/reports/item/275-data-centres-and-power-fact-or-fiction
- CCA first findings report:
  https://www.techuk.org/insights/reports/item/2773-climate-change-agreement-for-data-centres
- CCA Report against first target:
  https://www.techuk.org/images/CCA_First_Target_Report_final.pdf
- CCA Report of progress against second target:
  https://www.techuk.org/images/CCA_Second_Target_Report_04.pdf

Compliance, regulation

- Data Centre Compliance Healthcheck
  https://www.techuk.org/insights/news/item/15038-updated-compliance-healthcheck
- NOx: Implications for data centre operators
  https://www.techuk.org/insights/meeting-notes/item/15083-nox-implications-for-data-centre-operators
- MCPD and SGC briefing
  MCPD and SGC Guidance Notes for Data Centres:
- Generator emissions compliance roadmap (cones of pain):
  https://www.techuk.org/images/generator_emissions_roadmap_FINAL.pdf

- Data centres and environmental permitting regulations
  https://www.techuk.org/insights/reports/item/12427-data-centres-and-environmental-permitting-regulations

COVID-19 and data centres: relevant links at point of

- Data centres and COVID-19: information hub
  https://www.techuk.org/covid-19-information-hub/data_centres
- Dossier of outputs on data centres and COVID-19 (links to briefings and overviews on mental health, recovery planning, quarantine, testing, precautions, CNI status, risks, footfall and FAQs)
  https://www.techuk.org/insights/news/item/17703-data-centres-and-covid-19-our-dossier
- Data centres and COVID-19: Position statement, May 2020
  https://www.techuk.org/insights/news/item/17656-data-centres-and-covid-19-position-statement
- Overview of techUK actions for the sector:
  https://www.techuk.org/insights/news/item/17608-data-centres-and-covid-19

techUK's data centre programme

- What's the Point of Us?
  https://www.techuk.org/images/Whats_the_point_of_Us_2020.pdf
- Overview of programme activity Q1 2020
  https://www.techuk.org/insights/reports/item/17556-latest-data-centre-programme-overview
- Overview of programme activity 2019
  https://www.techuk.org/insights/news/item/272-data-centre-programme-overview

Endnotes

[i] Frontier Economics 2017: The UK Digital Sectors After Brexit:
https://www.techuk.org/insights/news/item/10086-the-uk-digital-sectors-after-brexit

[ii] https://digitalrealty.box.com/s/bserfy44rne36jxupnnnirdcbwdcvp7f

[iii] See CBRE: https://www.cbre.com/research-and-reports/Europe-Data-Centres-Q4-2019

[iv] Primary energy is the total supply of energy to the UK. Some of this is used to generate electricity and currently around 2.5KWh of primary energy is needed to produce 1KWh of electricity. Only a minority of our primary energy supply is used for electricity generation, the majority is used as fuel or for other forms of direct combustion. Some is used for chemical feedstocks but that is not included in this total because it does not constitute part of our energy supply.

[v] Frontier Economics 2017: The UK Digital Sectors After Brexit:
https://www.techuk.org/insights/news/item/10086-the-uk-digital-sectors-after-brexit

[vi] https://digitalrealty.box.com/s/bserfy44rne36jxupnnnirdcbwdcvp7f

[vii] See observer comments on the coevolution of Edge and 5G: https://www.vipadigital.com/5g-edge and
https://www.techuk.org/insights/opinions/item/15491-5g-not-just-4g-on-steroids

[viii] Source: Host In Ireland, 2020

[ix] 2018 figures from the data centre climate change agreement.

[x] Broadgroup, uptime Institute and CBRE figures are broadly aligned, estimating between 55% and 72% of activity currently in house and all identifying strong trends towards outsourcing.

[xi] See DUKES 2019: Digest of UK Energy Statistics: Electricity comprised 17% of final energy demand in 2018.

[xii] This is supported most recently by the following study by Lawrence Berkeley National Laboratories: Recalibrating global data centre energy use estimates; Eric Masanet, Arman Shehabi, Nuoa Lei, Sarah Smith, Jonathan Koomey: https://science.sciencemag.org/content/367/6481/984

[xiii] Recent stats on European internet exchange traffic can be found here: https://blog.cloudflare.com/on-the-shoulders-of-giants-recent-changes-in-internet-traffic/. The German commercial internet exchange in Frankfurt (DE-CIX) is currently setting world records for traffic. Widely covered in the trade press with one record broken around 11 March and a further record broken on 17th March 2020. Typical coverage includes: https://www.de-cix.net/en/about-de-cix/media-center/press-releases/de-cix-sets-a-new-world-record and https://www.controleng.com/articles/internet-exchange-world-record-achieved-at-frankfurt/

techUK represents the companies and technologies that are defining today the world that we will live in tomorrow. Around 850 companies are members of techUK. Collectively they employ approximately 700,000 people, about half of all tech sector jobs in the UK. These companies range from leading FTSE 100 companies to new innovative start-ups. The majority of our members are small and medium-sized businesses.

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