So what have data centres ever done for us?

Introduction

Data centres are relatively new additions to our urban landscape. Hidden behind fences in boring looking buildings they often go unnoticed and it is easy to dismiss them. In reality, data centres are a fundamental – but unrecognised - part of our critical national infrastructure. Data centres underpin an incredible range of activities across government, business and society and are now part of our lives whether we like it or not. We have to face the fact that our digital economy and our highly networked society rely on data and connectivity being managed securely and efficiently. If we want to live connected lives then we need data centres.

Data centres enable and power service economies in the way that heavy industry used to power manufacturing economies. Due to the accelerating demand for digital data this sector is growing rapidly and generating skilled jobs and economic value. And as it grows, in turn it improves competitiveness and underpins growth in an astonishing range of businesses. Data centres are the agents of growth for the knowledge economy.

This nondescript building houses a state of the art data centre.
Photo: CapGemini

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Section I   Summary and key facts

The UK data centre sector is a spectacular success story: it has demonstrated rapid, sustained, and apparently recession-proof growth without government assistance and it has driven that growth and generated high value-add jobs throughout its complex supply chain. It is the sector that underpins and enables the digital economy so desired by politicians: Digital Britain, Smart Grid and G-cloud cannot function without data centres.

Data centres also support the very technologies that will reduce the carbon intensity of our economic activity – smart metering and smart grid, smart transport, teleworking, e-commerce and dematerialisation.   Moreover, by consolidating computing activities into purpose built facilities, data centres are an efficient alternative to traditional ways of managing corporate and government IT functions[1].

Key facts

- Data centres underpin and enable the digital economy
- Data centres are the only geographical hook connecting the digital economy to a physical location
- A single data centre generates multiple levels of economic activity
- Data centres contribute over 5% of GVA and turnover is growing at 15% per year
- Data centres support a complex and high value supply chain of products and services
- The UK currently dominates the European data centre market with around 60% of market share
- The UK data centre market is of global importance
- The increasing demand for digital data means that the UK sector is poised for further growth

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1 Moving from individual distributed servers to large, purpose built facilities reduces energy consumption by two thirds. Source: Google 2013 (see Endnote)

Section I   Summary and key facts

You might think that data centres do lots of things at an infrastructure or government or corporate level but they don't really do much that helps us in our day to day lives. If you think this you would be wrong. We are amazingly dependent on data centres. Every time you use the internet you need at least one data centre. If you use a smart phone the same applies, even when you aren't making calls. Your Kindle needs a data centre. Your Facebook presence relies on multiple data centres. A data centre will be involved when you go shopping – firstly to manage supply and distribution logistics and secondly, if you use a loyalty card, to record what you bought. A data centre is involved when you book a train ticket over the phone or online, when you use your Oyster card, when you take out a Boris Bike, when you navigate traffic lights, when you pay for a curry with your debit card and so on, dozens of times a day. This is the beginning of the digital economy and, judging by demand for digital services, most people like it.

Data centres don't exist because we want data centres. Computing is a derived demand, like transport. We don't indulge in ICT for the joy of looking at lots of strings of ones and zeros in the same way that most of us don't sit in a car on the M25 for the pleasure of the experience.   Transport gets us somewhere we want to go: ICT helps us to get stuff done. So we use ICT to run companies more efficiently, to increase productivity, to deliver government services like renewing our tax disc with less hassle, to communicate with each other more easily, to manage our houses or our finances or our social lives. Data centres underpin all this activity invisibly, securely and efficiently. This is what data centres do for us.

Section II   Introduction: what is a data centre and why do data centres matter?

What is a data centre?

Data centres store, manage or process digital data at scale within secure, specialised, resilient and self contained facilities. Essentially, a data centre consolidates any number of separate IT functions within a single operating unit, thus delivering economies of scale, improved performance and efficiency.

A data centre can be characterised as a building (or self contained unit within a building) that primarily houses computing equipment, plus telecommunications, network and storage systems. It is equipped with a guaranteed and resilient power supply and high bandwidth connectivity. It will have sophisticated security systems and building management controls to maintain required operating conditions for the equipment it houses.   Data centre functions are performed by servers (computers that are usually assigned to specific roles as opposed to personal computers which are more generic). For a more detailed explanation of what a data centre is see "Er, What IS a Data Centre?"

Why data centres matter

Data Centres matter because they drive growth, generate employment and will deliver the digital economy. The data centre sector represents very significant economic value, contributing over 5% of GVA. It is growing rapidly with companies reporting turnover increasing by over 15% per year and long term growth potential. Data centres generate high value-add technical and engineering jobs and provide the kind of cloud operations and services that will enable our transition to an efficient, digitally enabled future.

As many observers have commented, ICT and digital services are the key to growth in developed economies: OECD stated in 2010[2] "Information and communication technologies are a key enabler of green growth in all sectors of the economy. They are a key part of government strategies for a sustainable economic recovery". The OECD's findings are supported by commentators like the Boston Consulting Group and the London School of Economics, both of whom evaluate the enormous economic potential of the internet and digital services[3].

2 OECD, Greener and Smarter, ICTs, the Environment and Climate Change, September 2010
3 See the Boston Consulting Group, The Internet Economy in the G20, the $4.2 trillion growth opportunity", March 2012; LSE / ITIF : The Digital Road to Recovery , April 2009

Section II   Introduction: what is a data centre and why do data centres matter?

Data centres are not simply large highly-automated, power hungry sheds. They are rapidly becoming the only physical entities that anchor the digital economy to a geographical location and are the engine rooms of the knowledge economy. As well as supporting critical national infrastructures, government operations and security, they underpin corporate IT services, e-government, knowledge management, digital media, financial services, mobile computing, social networking, internet access, online shopping and gaming. They also deliver all the technologies that enable a low carbon economy, such as smart grid, intelligent transport systems, smart buildings and smart cities. They even facilitate a whole range of virtual substitutes for carbon intensive activities, such as virtual presence and transport substitution technologies, e-commerce and digital access to creative content through digital downloads. To see how data centres are an essential, but invisible, part of our daily lives read "Data Centres: A Day in YOUR Life".

Data should be regarded as one of the key utilities of the 21st century, along with energy and water. In the same way that governments prioritise the efficiency and security of their energy supply and distribution, they must recognise in data centres a key technology, resource and skill set that should be retained within national and economic borders. All high tech manufacturing and knowledge economies are dependent upon ICT and on data centres in particular.

Data centres also encourage inward investment in the UK and the sector has already been identified by UKTI as a key priority sector for inward investment. David Cameron said in July 2010: **"Attracting and retaining inward investment is hugely important for our economic recovery. We are determined to deliver the pro-business environment investors need."** We now need to make this aspiration a reality and ensure that the UK continues to be the location of choice for those who provide data centre services.

Section III   Data centres and growth

Source: Euro-IX
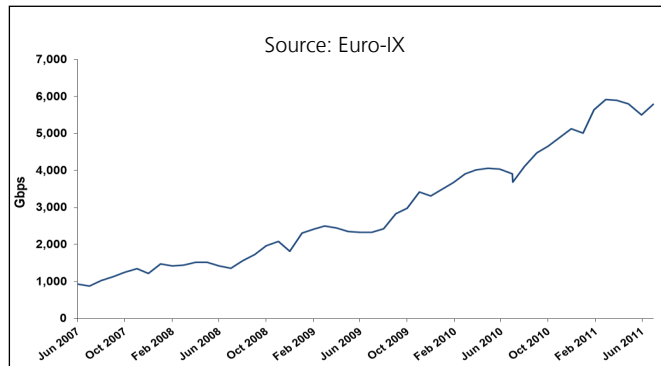
The growth in data centres is due to the global demand for data. This demand is growing almost exponentially and will continue to do so, almost regardless of what happens in the wider economy, over the next few years. So the sector is ripe for growth just at the moment when the rest of the economy is struggling. It is probably the only sector in the UK where the growth rate can compete with that of China. Many operators report over 15% growth per annum, some report 25%.   Sentrum, for example, started in Woking in 2007 and was sold to DRT for $1.1bn in September 2012. The area of colocation (colo[4]) data centre space in London has grown threefold in the last ten years[5].

Data Centres do not grow in isolation. A single data centre can provide the IT function for thousands of businesses. Some people are selling or re-selling IT space, many people are selling services to third parties, some people are using the data centre to manage their own or other people's applications which range from fleet logistics to web hosting. The data centre provides the basis for a business cluster and economic value is added at every level. The following two charts show first order growth in the UK data centre sector (left) and second order growth in data centre customers (right).

Data centres also contribute to growth across the wider economy because the digital services they provide improve efficiency and make their customers more competitive, irrespective of their area of business. Data centres are also a key component of the wider cloud computing ecosystem and present an opportunity for the UK to capture the full economic value, efficiency gains and growth potential of the transition to cloud.
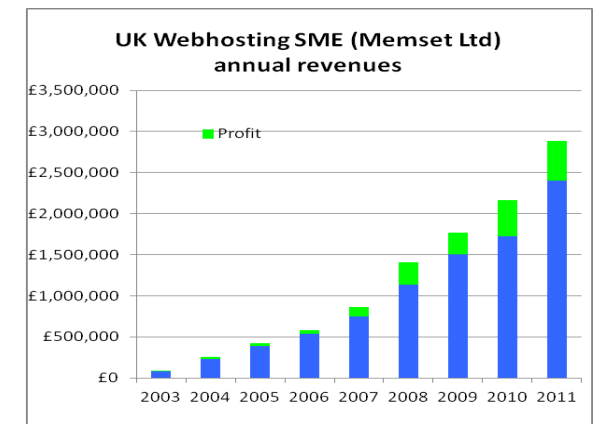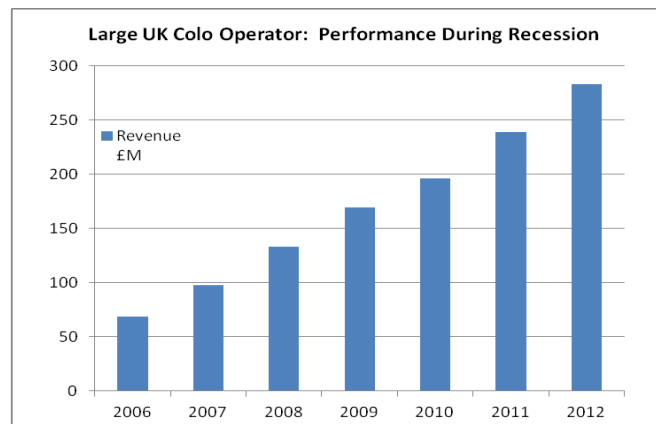
4 Colo data centres are data centres that sublet space to other operators (see below)
5 Source, CBRE 2012

Section IV   Data centres and employment

Data centres provide two kinds of employment – direct and indirect. Direct employment includes 1) the construction phase 2) the management of the data centre infrastructure and 3) the management of the ICT services and hardware housed within that data centre.

For the construction phase, a single large data centre represents around £100M of inward investment just for the build. Of this, 20% is for the shell and 80% is for the electrical and mechanical infrastructure which requires high end engineering and technical skills at all stages from design to implementation.

Data centres can be located in areas where there are few opportunities for skilled jobs or genuine career progression. Major facilities exist for instance in Sunderland and Newport. Data centre operators in Slough and London (Equinix, Telecity and Telehouse, among others) have set up their own apprenticeships to give young local people technical and business skill-sets.

"If we are to encourage technology companies from overseas to expand into the UK, rather than other countries, it is vital that they have the infrastructure here to enable them to run their businesses. We need to have the infrastructure in place now as these are fast-moving companies that don't wait for markets to catch them up. The UK needs additional data centre capacity to meet this need for not only niche technology companies, but the data centre providers themselves."
UKTI, Jan 2012

"A thriving data centre base is critical to a thriving digital and ICT market"
UKTI, 2012

The total investment over the 15 year life of a data centre is around £1bn (sample investment in SE England £1150m, UKTI figures 2011). This simply relates to management and maintenance of the infrastructure (i.e. the running costs of the building) and does not include the hundreds of millions of pounds of IT hardware that it houses and its associated supply chain, or, more importantly, the economic activity that is enabled and supported by this data centre, or other spill-over effects. These are dealt with below.

Indirect employment
Indirect employment generated by data centres is much more significant than direct employment but harder to measure. Data centres generate two forms of indirect employment: the first relates to the creation of jobs in the supply chains that serve the industry. The second form of indirect employment generated by data centres includes clustering and co-location.

Section IV   Data centres and employment

Indirect employment through the supply chain:

A data centre sector sits at the heart of a complex ecosystem. The construction alone involves three separate supply chains: the supply chain involved in the physical building, the supply chain involved in implementing the communications infrastructure (sometimes known as "holes and poles") and the supply chain involved in the provision, management and maintenance of the ICT equipment that is housed in the data centre. But data centres also generate indirect employment because they demand a wide range of high value-add professional services. These include:

- Location consultants and location finders
- Planning consultants and planning advocacy services
- Real estate companies who sell data centre capacity and negotiate deals
- Data centre search and selection companies
- Lawyers and contract negotiators
- Specialist accountants, finance consultants and providers
- Energy managers and energy consultants
- PR and media consultants
- Industry associations, professional bodies and standards bodies
- Conference organisers and specialist publishers

Indirect employment through clustering and co-location

"Attracting computer centres ….creates jobs to build, operate and service, they pay property taxes that provide economic stability to the counties and schools where they are located, and they attract suppliers and support infrastructure firms that are drawn to locate nearby."
Mike Brown, former Microsoft CEO, 2009

"In terms of economic impact, we have seen first hand through our clients that these datacentres result in hundreds of millions of pounds in new investment in construction, construction jobs and new equipment, as well as on-going well-paid employment at the centres themselves. In addition, support goods and services for the data centres and their permanent employees create additional secondary employment. UKTI, 2012

"One member of the data centre supply chain is DataRacks, a family owned and run business in Cambridge manufacturing racks for data centres. It started as a spin-off in 1988, producing its first rack in 1989. DataRacks is the third largest engineering employer around Cambridge and the third largest UK owned rack manufacturer".

There are two reasons why we benefit from clustering and co-location in the UK. The first is that companies investing in data centre infrastructure tend to locate additional corporate functions in the same place, and this clustering is augmented by competitors, customers and "co-petitors" who perceive these locations as potential hubs for a range of associated activities.   The second reason is that some data is location-specific and there is interdependency between customers and their data centre provider. These are explained overleaf.

Section IV   Data centres and employment

Location independent data: clustering and co-location around data centres:

Companies tend to cluster, or co-locate[6], other corporate functions around their data centre locations. For instance, in 2011, Google invested $120M in a new data centre in Singapore. The Singapore government sees this as a very significant investment into the area despite the fact that this data centre will be staffed by only a small team of technicians and computer engineers. Having identified Singapore as a suitable location for its data centre operations, Google is concentrating other corporate activities here and Singapore is now Google's Asia-Pacific headquarters. In fact, one in five employees of Google's Asian operations is now based in Singapore. Singapore now houses roughly 50% of Southeast Asia's data centre capacity, which is expected to grow significantly over the next few years. Commercial data centre space in Singapore is forecast by BroadGroup to grow by 71% over the next five years. Singapore is about the size of the Isle of Wight.

"The big difference in functional economies (those that are growing thanks to a competent government such as Singapore or Germany) is that data centres are recognised as a key technology, resource and skill set that should be retained within national and economic borders. Our government need to recognise that a high tech manufacturing and knowledge economy is hugely dependent upon ICT and data centres.

Clustering delivers economic benefits that have no direct link to the data centre. Data centres drive significant investment in local communications infrastructure which in turn draws in other businesses. Without the catalyst of the data centre the network infrastructure would not be upgraded.

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6 In this context, co-location refers to clustering. This is different from the definition of colocation when used to describe a data centre. A colocation, or "colo" data centre is one in which the operator provides the infrastructure including guaranteed power, connectivity and resilience, and customers install and manage their own IT equipment.

Section IV   Data centres and employment

Location specific data

Some data centre customers do need to be close to their data: such customers include financial services organisations whose trading operations require low latency (very high speed transactions that require the kind of connectivity that can only be met by a combination of proximity and high bandwidth) and organisations dealing with very large quantities of digital data, eg creative content or media businesses. Government departments are often required by legislation to keep sensitive or personal data within nation state boundaries to ensure that this data is not processed or managed in regions with different (i.e. less exacting) regulatory requirements for data protection, or for other reasons of national security.

> "In addition, our large financial services sector… makes use of the low latency offered by key datacentre players. Without access to this key infrastructure, our financial services sector would not have grown to be the world-leader it is."
> UKTI, 2011

While it is hard to quantify the proportion of data that is location sensitive, it is safe to say that it is the minority. However, the issue is not really the proportion of data that is handled in this way, but who owns that data – and how they make their own corporate decisions about location. Many of these customers are themselves knowledge businesses that are location agnostic (they have considerable choice in terms of where they locate their operations). If data centre capacity moves, they will follow it.

Section V   Data centres and investment

As we mentioned above, a data centre is a non-trivial investment involving hundreds of millions of pounds of construction, engineering and telecommunications infrastructure even before the first piece of IT equipment is installed. Over its 15-20 year life investment is likely to top £1bn.

Data centre development in the UK represents significant investment value, both from UK operators expanding their activities or building new sites and from inward investment by multinationals.

The UK is an attractive location for data centre activity because of its geographical location between Europe and the US, its excellent connectivity and its temperate, cool climate.

The analysis below shows that data centre investment in the UK was $3.35bn (£2.1bn) in 2012.

This is second only to that of the US at $3.5bn (£2.18bn) and marginally ahead of China, which spent $3.1bn.

Section V   Data centres and investment

Data Centre investment and growth, DataCenterDynamics, 2012

Rank	% growth in facility profile 2011-12		% growth in investment 2011-12		US$ (billion) value of investment 2012	
1st	Turkey	60%	SE Asia	118%	Western USA	3.5
2nd	Brazil	45%	Turkey	74%	UK	3.35
3rd	Colombia	40%	Russia	59%	China	3.1
4th	Argentina	36%	Australia	54%	Eastern USA	2.9
5th	Russia	29%	Central USA	50%	Central USA	2.8
6th	China	28%	Middle East	47%	Germany	2.6
7th	Mexico	17%	China	44%	Australia	2.45
8th	Germany	16%	India	43%	Brazil	2.15
9th	Benelux	14%	Brazil	43%	France	1.95
10th	Nordics	14%	Italy	35%	Italy	1.95
11th	Eastern USA	13%	Nordics	31%	Canada	1.9
12th	Italy	13%	Germany	26%	SE Asia	1.9
13th	India	12%	Argentina	2%	Mexico	1.8
14th	Central USA	12%	UK	25%	Turkey	1.8
15th	SE Asia	11%	Western USA	23%	Russia	1.65
16th	Australia	11%	Eastern USA	23%	Argentina	1.6
17th	Canada	10%	Colombia	19%	Benelux	1.55
18th	Middle East	9%	Benelux	16%	India	1.5
19th	France	7%	Mexico	115	Middle East	1.5
20th	Spain	6%	France	10%	Spain	1.35
21st	UK	5%	Spain	9%	Colombia	1.2
22nd	Western USA	3%	Canada	8%	Nordics	0.95

It is not all good news, however. One concern is that while the level of investment is high, the rate of increase in growth in the UK is stalling in the face of uncertainties about UK energy and climate change policy, and some observers consider that there is a risk that, over time, the UK could lose its competitive advantage and dominant position in this market.

## Section VI   The UK as a location for data centres

The UK is a perfect location for data centres from a communications point of view. With unparalleled connectivity westward to the USA and eastward into Europe, it would be hard to improve the UK's strategic position. Other European nodes like Amsterdam and Frankfurt may have better eastbound connectivity but cannot match the UK's bilateral connectivity.

The UK is also a good location from the skills perspective, perhaps because the sector is so well established here and because it dominates the European market.

From a climate perspective the UK is also an ideal location, as the figure opposite demonstrates. This 2012 chart from the Green Grid shows the best European locations for data centres on the basis of average air temperatures. Almost all of Europe shares the optimum environmental conditions for data centres because lower average air temperatures increase the proportion of free air cooling that is available.

So it is a bit of a myth that Scandinavia and Iceland are better for data centres because they are cooler. Essentially the UK has the same advantages of climate as Scandinavia, without the risk of frost damage to supporting infrastructure that occurs in very high latitudes.

Scandinavia does, however have an abundance of competitively priced low carbon energy but it does not have the same advantages of connectivity as the UK.
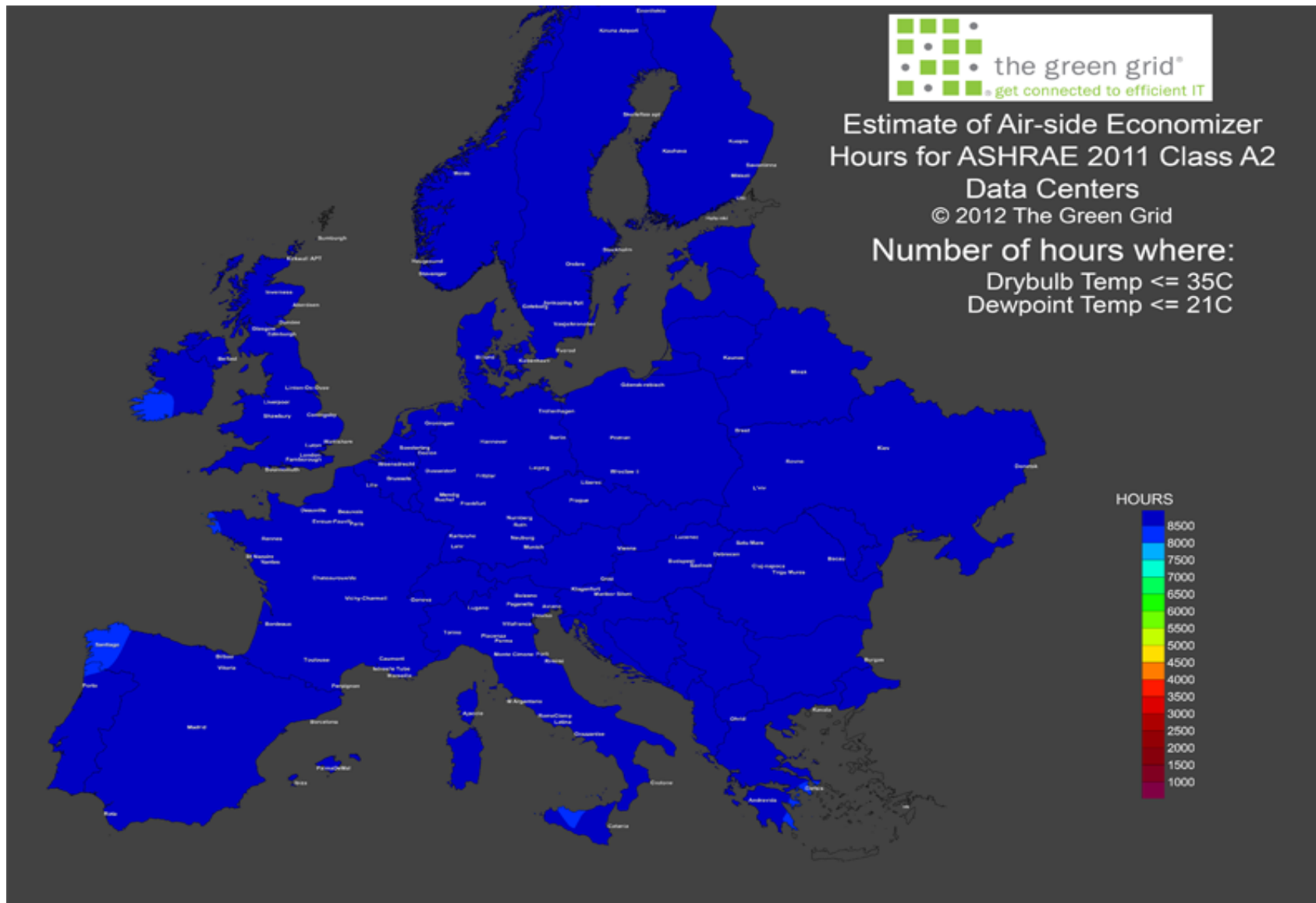
Section VII   What are other national governments doing to attract data centres?

Some countries have recognised that the provision of competitively priced data centre services drives inward investment from other companies and growth. Singapore, for instance, is planning what is likely to be the world's first dedicated Data Centre Park (DCP) in order to attract world-class financial services, internet and media companies to set up or expand their regional operations in the city-state. Scandinavian countries offer exceptional energy prices, many countries offer significant tax breaks (US, Ireland), other countries offer state of the art fibre connectivity (Netherlands and Luxembourg).

European countries such as Ireland, Belgium, the Netherlands, France, Germany, Iceland, Sweden and Finland are aggressively marketing themselves as ideal data centre locations. France for example explicitly recognised the importance of data centres to economic growth and orchestrated an inward investment campaign in 2009. The results were "100 data centers in France to date, digital economy accounting for 4-5% of GDP, 25% of growth, 3% of jobs and 16% of investments". Ireland, with attractive corporation tax, has attracted a host of global cloud providers.

The Icelandic government has actually changed its legislation and taxation regime to make it a more favourable location for data centres and encourage inward investment from this sector. In recent interviews with data centre operators, the Isle of Man government asked what regulations it needed to change to make the IoM a more attractive location for this sector.

> "Nowadays, 25% of world growth comes from the digital economy. But even virtual services need real physical infrastructure in the form of a data center. This market is currently growing by over 16% to $35bn in the next year. This growth is driven by a strong demand for outsourcing data center services and will necessitate new facilities construction, and extension and upgrade of current facilities".
> French government statement, 2011

Inward investment opportunity

As mentioned above, $35 billion will be invested in data centres around the world over the next 12 months[7] alone, of which, 25% will be in Europe. The UK has historically been the location of choice in Europe for data centres and has around 60% of the European data centre market is indeed located here. If the UK continues to be an attractive location for data centres this would equate to around $5 billion of inward investment into the UK over the next 12 months.

> "A strong and thriving data centre market is a critical component of a strong and successful digital economy. As companies strive to provide this infrastructure and develop energy efficient and commercially successful businesses the current policy is a real barrier to future success and investment. Energy efficiency is at the very core of all data centre operations and is critical to success in this market. The current legislation does not reward consolidation into this energy efficient environment but rather punishes the very growth and efficiency that is at the heart of these companies' plans"
> (UTKI, January 2012).

7 DataCenterDynamics, November 2011

Section VIII   Conclusion: so what HAVE data centres ever done for us?

The Data Centre sector is one of the UK's real success stories, where innovation has actually been converted into business growth and economic benefits. Here are some of the things that data centres have done and will continue to do for us.

- Data centres are the physical manifestation of the digital economy so desired by politicians and other policy makers. They enable initiatives like Digital Britain and smart grid and the move to G-Cloud.
- Data centres are the only geographical hook connecting the digital economy to a physical location.
- As well as supporting critical national infrastructures, government operations and security, data centres underpin corporate IT services, digital media, financial services, mobile computing, social networking, internet access, online shopping, gaming, e-government services and knowledge management.
- Data centres support the very technologies that will reduce the carbon intensity of our economic activity – smart grid, smart transport, teleworking, e-commerce and dematerialisation.
- By consolidating IT function into purpose built facilities, data centres make energy use in the ICT sector more transparent, more accountable and more efficient.
- Data centres provide essential but invisible support to our everyday activities, including obvious things like using a smartphone or the internet or sending email, and less obvious things like doing shopping in Sainsbury's, catching a train or tube. Often without realising it we now rely on data centres for even the most mundane activities.
- The data centre sector has demonstrated spectacular and sustained growth, in the teeth of a recession, and without any government assistance. The increasing demand for digital data means that the UK sector is poised for a further phase of rapid growth.
- The sector is not delivering isolated growth: it relies on a complex supply chain and is therefore fostering growth and generating high value-add jobs in other economic sectors such as engineering, telecoms, finance, energy consultancy, legal and professional services.
- A single data centre generates multiple levels of economic activity and can house the IT function for thousands of businesses.
- Data centres invest in state of the art communications infrastructure and by doing so, upgrade local communications networks which in turn draw in businesses.

Section VIII   Conclusion: so what HAVE data centres ever done for us?

- Data centres can be located in areas where there are few opportunities for skilled jobs or genuine career progression.   Major facilities exist for instance in Sunderland and Newport.   Operators have even set up apprenticeship schemes to give young local people technical and business skill-sets.
- Data centres are perfectly positioned to drive export-led recovery. The UK already exports data centre expertise – planning, consultation, energy management, engineering and IT and a huge range of digital services.
- Data centres have placed the UK in a position of competitive advantage for supplying digital services.
- The UK currently dominates the European data centre market with around 60% of market share, spread between about 250 to 300 major sites with a combined power demand of 2-3TWh per year.
- Other national governments have recognised the strategic importance of data centres and are actively encouraging inward investment by data centre operators and service providers.

However, the continued success of the sector will depend on an intelligent energy policy regime that will drive efficiency without penalising growth. We also need to ensure that the energy used by computing activity is transparent and accountable; so we need to encourage the continued consolidation of computing activity into purpose built facilities. We need to encourage and support the UK as a centre of data centre expertise and a global leader in the provision of digital services. Data centres do a lot for us. Now it is time that we made sure that they can go on doing so.

Appendix A   What's so special about data? Mobility, tradeability and carbon leakage

Mobility and tradeability

Digital data is quite literally the most mobile commodity on earth.   Abundant network capacity means that data can be moved around the world at negligible cost. In other sectors, manufacturing a product overseas may benefit from lower manufacturing and labour costs but there are usually some additional costs attached to importing that commodity (eg transport). The higher these costs, the less tradeable the commodity. Digital data managed or processed overseas – (i.e. offshored), can be accessed at the same costs as data managed or hosted in the UK because data is so easy to move about. A business could base all its data processing and management functions in a data centre in Iceland, Amsterdam or Singapore and could remotely access its data at no greater cost than if that data centre were in their own basement. So they can benefit by buying the services they need from the most competitively priced operator irrespective of where they are located. So digital data is an extremely tradeable commodity – probably the most tradeable commodity in existence.

This tradeability means that the sector is extremely vulnerable to both overseas competition and carbon leakage.

Overseas competition

Overseas competition is sometimes categorised by the dominance of imported goods in a particular market. In a digital economy, overseas competition is not characterised in quite this way because the concept of national boundaries is harder to apply to the movement of digital data. An email to a US colleague doesn't pass through customs in the way that a container of timber would. That means that there is no restriction in terms of trade or tariff barriers to the movement of data internationally.

Appendix A   What's so special about data? Mobility, tradeability and carbon leakage

Carbon leakage

The data centre sector is extremely vulnerable to carbon leakage. This is because it is one of the most energy intensive industry sectors and as a result, energy costs are a significant proportion of operating costs: Data centre operators report that the cost of power is between 25% and 60% of their total operating costs. This means that when choosing where to locate or expand their operations, energy costs are a much more important consideration than they would be in a conventional business. Energy costs dwarf labour or transport costs, for instance. Because of this disproportionate focus on energy costs, the data centre sector is currently exposed to two levels of carbon leakage.

Firstly, data centre operations located outside the EU are not subject to EUETS or any European legislation and may well be located in emerging economies such as India or China, both of which have much more carbon intensive power supplies. Current carbon legislation in the UK actually encourages companies to locate data centres in such regions although such a move would actually lead to a net increase in global emissions.

Carbon leakage is also an issue between the UK and the rest of the EU. Although the EU is covered by EUETS, other countries do not apply equivalents of the CCL (Climate Change Levy), CRC (Carbon Reduction Commitment Energy Efficiency Scheme) or carbon floor price. In an industry where energy forms a disproportionate part of operating cost, the incremental additional burden of these policy instruments will inevitably be an economic factor in decision making and as a result, drive businesses offshore.

Appendix B   Challenges

Key Challenges

- Data centres compete in a highly commoditised global market place
- Digital data is the most mobile commodity in existence
- Unilateral energy policy measures are putting the UK's competitive advantage at risk because they are costly and ineffective
- Operators identify energy policy as a factor in their strategic decision making process
- The risk takes the form of attrition as expansion and investment decisions cease to favour the UK and older facilities are decommissioned
- To maintain its dominance, investment in the UK should exceed £5bn but in 2012 was only £2.1bn
- The UK urgently needs an energy policy framework that rewards efficiency instead of punishing growth

The continued dominance of the UK sector relies on an intelligent policy regime that will drive efficiency without penalising growth. We also need measures that encourage the continued consolidation of computing activity into purpose built facilities whose energy use is efficient, transparent and accountable.

The current UK energy policy framework does none of these things. There is growing concern that at a time when other economies are doing all they can to encourage inward investment from this sector, the UK sector is uniquely burdened by poorly designed taxes which penalise growth by focusing on net reductions rather than carbon productivity and discourage the efficient consolidation of computing resource.

Poorly designed energy and climate change policy has two effects. Firstly it discourages inward investment in the UK. Secondly it makes UK-based operators less competitive than their counterparts overseas. In the longer term we risk the gradual attrition of the UK data centre sector.

Inward investment
When knowledge businesses think about where to locate a new operation or expand an existing one, they will take into account the data centre services available in each location, along with a range of other factors. So if UK data centre prices are uncompetitive compared to other centres in Europe, then we could see a gradual stream of customers heading to other destinations. For instance, financial services companies may choose to strengthen their operations in Frankfurt or Amsterdam rather than in London.

Appendix B   Challenges

Over the next few years many companies will be considering where to locate the next generation of energy efficient data centres. As mentioned above, data is now quite literally the most mobile commodity on earth and this means that operators tend to make these decisions dispassionately, based on factors like energy costs, connectivity, regulatory regime and available skills.   The UK has traditionally been the prime European location for data centres but has now dropped below Germany[8].   Although energy costs in the UK are not the highest in Europe, regulatory approaches like the CRC create uncertainty which acts as a significant barrier to inward investment. Even if, on balance, the UK is only marginally less attractive than other locations, investment decisions will be made in favour of those other locations.

Multinationals have explicitly stated that they are looking at other sites in Europe in preference to the UK due to the CRC. Google, for example, has invested $4.2bn in new data centres over the last year, none of which have been in the UK (European locations include Belgium and Finland).   Microsoft has declined to invest in the UK due to CRC and HP is looking at other European locations. Energy taxation was also a major factor in Terremark's decision to opt for Amsterdam rather than London for its flagship European data centre.

> "Terremark snubs London for main European datacentre"
> ZDNet, 22/9/11

> "I would say the key thing here is uncertainty, a data centre is a massively expensive 25 year combined real estate - infrastructure - IT investment and having a government which endlessly prevaricates and threatens some new regulatory burden every 5 minutes is an incentive to invest elsewhere. .. You simply cannot accept this risk on an investment of data centre size."

Moreover, companies teetering on major UK investments are hesitant to commit themselves until the climate change policy landscape improves in terms of certainty, coherence and competitiveness. We are currently losing hundreds of millions of pounds of inward investment to the UK, investment that generates its own supply chain of high-end engineering, technical and professional jobs.

It is also worth noting that branded multinationals may be hesitant to attribute their reluctance to invest in the UK to carbon taxation for fear that their objection to a tax that punishes early adoption, energy efficiency and growth will be confused with an objection to carbon taxation generally. Secondly, these multinationals don't really care where they locate their operations;- they will not harangue policy makers to improve conditions because they don't need to – they can go elsewhere.

> "In total we have 3 opportunities for new sites in the UK.. As a result of our expected power consumption we are very aware of the impact that the CRC and CCL will have on our business and growth plans. The uncertainty of these schemes has impacted our business plans to date (and therefore growth) and will continue to do so until there is a resolution from Government and a clear way forward for data centre owners."
> e-Shelter

8 DataCenterDynamics, 2011

Appendix B   Challenges

The majority of data, the data with all the growth potential, which delivers business services, e-banking, e-commerce, social networking and a whole range of other rapidly expanding activities, not to mention cloud computing, is not location specific and can be stored and processed anywhere. It is this data that is most at risk of moving away – and it will, by diminishing inward investment and by gradual attrition of UK capability as location agnostic operators review operations or decide to expand elsewhere.

Impacts on the UK: existing data centre sector

A minority of data is location specific, such as public sector data which we wish to keep in the UK for security and data protection reasons. For those location dependent data centre customers (such as local or central government and agencies) who cannot relocate at will, uncompetitive prices for UK data centre operations and services add bottom line costs.

A disadvantageous investment climate for data centres in the UK will also have a negative effect on our domestic industry, because it adds bottom line costs for UK operators that do not apply to their competitors. This does not mean that our existing UK operators will all pack up and leave en masse:- those who have made major investments are unlikely to abandon them. Some niche operators specialise in providing services for location specific data which cannot be moved offshore and those operators will therefore continue to invest in the UK provided their customers remain here (see comments on location dependent data).

What it does mean is that when the time comes for strategic review or reinvestment, all location factors will be re-evaluated. Unlike traditional industries, knowledge businesses like data centres are more likely to lease than own their real estate and with high refresh rates in technology, are not as strongly tied to their physical assets as other energy intensive industries. We know that UK firms have shelved plans to build new facilities in the UK, preferring to lease space from abroad, and that the expansion plans of some UK operators now favour offshore locations at the expense of new sites in the UK. What we risk therefore, in terms of our existing industry, is long term attrition and the erosion of supply chain skills and capabilities as valuable clusters are created and augmented elsewhere.

Annexe C   Case studies

Case study 1: Award winning UK SME Memset

"We already have a smattering of international clients without trying. Even at our scale we can compete in the global market since cloud-based workloads are so portable (the counter-point to the threat of it being moved elsewhere). However, the thing we have that makes us clever is also mobile: software. What makes us special is our massively automated infrastructure management system. We intend to go to the global market as a service provider and are ready to take the next step - building our own (super-efficient) data centre. The reason we want to build our own is that we see price becoming increasingly sensitive and wish to apply our innovations to the entire stack. But we are delaying. It is not the money - we've £1m in the bank and leasing companies that are quite happy to lend against chunky assets like data centre M&E plant – it's uncertainty. A big part of that uncertainty is the regulatory environment in the UK. If we are going to make a substantial investment we want to be sure it is in a place where we will be able to remain competitive. Instead, we are renting some data centre space in the US, continental Europe and Singapore and starting to build more of a global infrastructure footprint. It will undoubtedly make sense to eventually incorporate subsidiaries in the US and elsewhere if we follow this course of action - meaning that although we might be headquartered in the UK the infrastructure and revenue (thus tax) growth would be elsewhere. Then it would only be a matter of time before I moved out to Silicon Valley too."

Case study 2: Learning from other sectors: Pharmaceuticals in Germany

Germany was a global leader in pharmaceuticals until 1996, when there was a shift from "wet laboratory" technology to bio-informatics. The industry had to make massive reinvestment in its technology base and chose to do so outside Germany, largely in places where , although manufacturing and staff costs were similar, there was a less restrictive regulatory environment. Within six years the industry had severely dwindled in its homeland. In terms of data centres, we are facing a similar transitional period as we move to cloud, and all the major operators will be looking for sites for their cloud operations.

Endnote (refers to page 2 footnote)
See Google's comparison of PUE for distributed and consolidated computing. PUE decreases with increased consolidation of computing resource. Typical PUE for single units is over 2.5 compared to a PUE of 1.1 for large data centres.
**http://www.thegreengrid.org/en/Global/Content/
TechnicalForumPresentation/2013ForumGoogleDataCentersABehindtheScenesLookatInfrastructureandInnovations**

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Other publications in this series or discussed above include:

- Er, What IS a Data Centre?
- Data Centres: A Day in YOUR Life
- Date Centres and Power: Fact or Fiction?
- Buying a Hat Online (by Ian Bitterlin)
- Data Centre Business Models: The Sherry Trifle

Generic publications relevant to this topic include:

- Data Centres: The Backbone of the UK Economy
- We Need to Talk About Jevons (final draft, publication imminent)
- Evaluating the carbon impact of ICT: The Answer to Life, the Universe and Everything
- High Tech: Low Carbon

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