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DATA CENTRES

Optimising existing estates in a world of diminishing returns

FOREWORD

Legacy data centres in Europe are underperforming, particularly in the mature markets of Belgium, France, Germany, Holland, Switzerland and the UK. With data a more critical element in business than ever before, and the increasing competitiveness of hosting and managed services, these assets require urgent attention.

As the uptake in cloud and co-location services grows, there is added scrutiny on the operation of legacy data centre services in areas such as security, utilisation, availability, environmental impact and cost. Companies are finding that their current data centre strategy is delivering neither the best possible performance nor value for money. As a result there is considerable pressure to outsource. However, it is usually not possible to outsource everything and strategies involving retaining and upgrading assets offer many benefits over alternative options.

Before making a decision it is essential to fully understand the options and where the best opportunities lie.

This white paper demonstrates that what is needed is a holistic assessment of business requirements to deliver lower costs and greater resource efficiency. This approach could lead to refurbishment and upgrade being seen as the best solution rather than new build.

A NEW ERA

What's next for legacy data centres?

Many organisations continue to depend on underperforming data centres which are often under-utilised, inefficient, expensive to operate and not matched to technology requirements.

Underperformance, although not confined to legacy assets, is frequently more pronounced in older data centres — and especially for institutions that have managed this asset in-house without it being a core business function. In Europe, for example, a number of telecommunications providers and banks invested in in-house facilities 10 to 15 years ago; this has now left them with a significant estate in need of upgrade.

Key trends affecting legacy data centres:

CONSOLIDATION

Over-capitalisation is a thing of the past. It is critical to match an organisation's technology needs with the infrastructure that has been installed.

VIRTUALISATION

High density computing is becoming increasingly prevalent, but can legacy data centres cope? A data centre from the early 2000s will have a conventional cooling system that was designed for an average heat load of 0.5–1.0 kilowatts (kW) per square metre, with a maximum heat load of 4 kW per rack. However, 2 kW per square metre and above are now typical, with individual racks outputting more than 20 kW.

AGILITY

Can the data centre cater for future technology and still perform? Part load efficiency is key. Drive for scalable solutions.

ENVIRONMENTAL IMPACT

Inefficient operation and poor part load performance adversely affect Power Usage Effectiveness (PUE), an issue that is increasingly coming under the spotlight as corporate social responsibility policies drive companies to lower their energy footprints. The Uptime Institute's annual survey found that in 2014, the average PUE worldwide was 1.7[1].

TECHNOLOGY IMPROVEMENTS

Legacy data centres need to look at a range of changes, from more efficient servers to free cooling technologies, from improved part load performance to low-loss electrical infrastructure.

FEWER ISSUES WITH LATENCY

Data centres can often be located in more remote locations, reducing real estate costs and freeing up prime space in city locations. This can also reduce operating costs as demonstrated by the increase in data centre build in cooler climates such as in Scandinavia.

INCREASING MARKET COMPETITIVENESS

The Cloud, changes to hosting services, co-location and greater flexibility in leasing arrangements have introduced a greater level of competitiveness to the market.

As institutions move towards Software as a Service (SaaS), Platform as a Service (PaaS)and Infrastructure as a Service (IaaS), the lack of IT hardware ownership means their leasing requirements reduce even further. The annual survey of the Uptime Institute shows slow but steady growth in the uptake of off-premises computing globally. In 2014, it found that 7 percent of businesses worldwide use the public cloud and 25 percent use a co-located data centre. In a year's time, use of the public cloud is expected to rise to 9 percent, with co-location rising to 26 percent.

OUTSOURCING

Proportion of outsourced data centre space in Western Europe

	2013	2014	2015	2016	2017	2018
In-house	84%	82%	79%	76%	72%	69%
Outsourced	16%	18%	21%	24%	28%	31%

Source: BroadGroup

Outsourcing or relocating a data centre can be an attractive option, but the operational constraints, costs, complexity and risks may outweigh the benefits. In some cases the functions and architecture necessitate local processing and, in others, security requirements dictate an in-house data centre provision. Often most important are the financial and accounting implications. Depending on the point in the lifecycle, it may be significantly cheaper to 'sweat the assets' and keep them running, than outsourcing. There may also be preferences for or against operational versus capital expenditure depending upon budgeting and management decisions. This is particularly true if two sites are required to run simultaneously for a period of time while functions are gradually migrated between sites. The complexities of migration should also not be underestimated and can be a barrier to change — see later section 'Delivering a successful upgrade'. Finally, finding an appropriate new site for a data centre may also be problematic, especially if the proposed site lacks the appropriate power supply and connectivity.

CHALLENGES

The main issues faced by today's data centres

The consequences of failing to address an underperformance are significant. They include, chiefly, risks to business continuity, unnecessarily high operating costs and the opportunity cost of not maximising data centre utilisation and performance.

BUSINESS CONTINUITY RISK

The threats posed by underperformance

Data centre downtime is a very real problem. As data centres age, there is an increasing risk of equipment failure, and the consequence of that failure can have major implications.

Indeed, if an outage does occur, the impact on business continuity can be severe. Impacts could range from key members of staff losing access to email to core activities being disrupted, such as an investment bank not being able to trade. This disruption could damage reputation, leading to loss of customers and future revenue. Further costs could be incurred to limit and repair any possible fall out, for instance through public relations initiatives.

Recent research on data centres in the US indicates how susceptible to failures the facilities can be. A survey of more than 450 data centre professionals in the US in 2013 by Emerson Network Power and the Ponemon Institute found that some 91 per cent had experienced an unplanned data centre outage in the past 24 months. Approximately half were as a result of equipment or systems failure, and of these over 80 per cent were as a result of cooling or power failures. Moreover, the study quantified the cost of an unplanned data centre outage at slightly more than $7,900 per minute[2]. By understanding the modes of failure, the associated probability of downtime and what the business implications would be, organisations can understand the probabilistic cost implications and measure the return on investment to mitigate these risks.

OPERATING COSTS

The financial impact of poor provision

There are two main aspects to this: firstly the inefficient operation of the data centre itself, and secondly the expense of having in-house teams dedicated to operating and maintaining data centre infrastructure and IT provision that could be outsourced to specialists.

Inefficient operation:
Inefficiency means, above all, increased operating costs. But there are further consequences depending on the business. For example, data centre operators may find that they are not competitive compared to rivals, while companies running a data centre in-house or outsourcing could fail in their corporate social responsibility commitments, such as lowering their carbon emissions. Moreover, this responsibility is increasingly becoming a statutory requirement. It is clear that there is considerable scope to run legacy data centres more efficiently, lowering operational costs and delivering significant benefits to the business.

Legacy data centre operators are typically faced with:

– Legacy design Data centres built around ten or more years ago were designed chiefly for resilience rather than efficiency, in line with the salient concerns of the time. This led to a tendency to provide excess redundancy, over-capacity and, as a result, over-specification and under-utilisation. This means that a large number of legacy facilities are not operating at maximum efficiency. In contrast, modern data centres typically deploy only the infrastructure required to meet the IT requirement and nothing more.

– Aging infrastructure Legacy power and cooling equipment is often inefficient compared to the modern equivalent solutions. Maintenance regimes on aging plant can become onerous and expensive, adding to the financial burden. Legacy systems carry the risk of failure and, ultimately, obsolescence. The older the technology, the lower the chances are of finding replacement parts or personnel with systems knowledge.

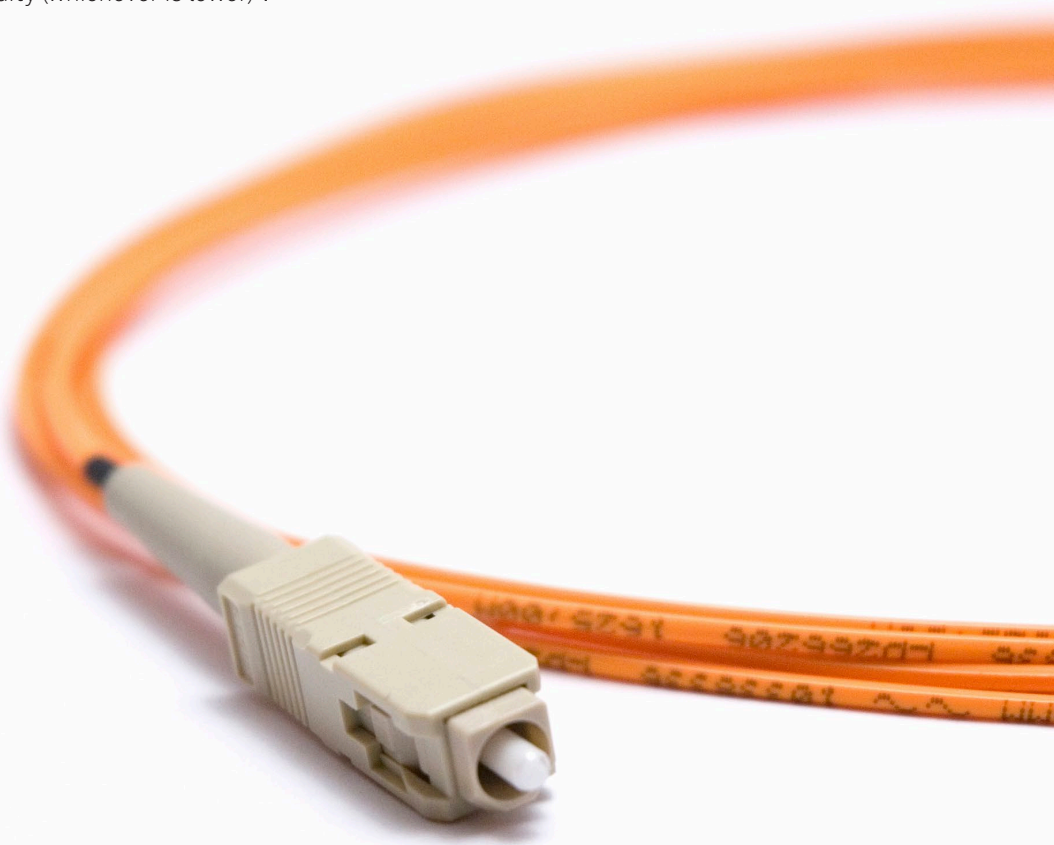
– Inappropriate set points Many data centres are expending energy unnecessarily in maintaining overly cool environments either because they were commissioned to historical design criteria long since superseded or because of poor commissioning. In many cases, units are set at excessively low levels to compensate for poor airflow management.

A similarly over-cautious approach is often taken to humidity control. It is common to see a data centre set at 22 °C and 50 per cent relative humidity — conditions which in most climates would require considerable energy to maintain. However, best practice suggests that it is acceptable for both temperature and humidity to vary within a far wider band than previously thought.

The American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) recommends in its latest guidelines that temperatures for data centres be set between 18 °C and 27 °C (the recommended levels) and can be allowed to exceed these limits for short durations (the allowable levels). In addition, the guidelines recommend that humidity can be higher, a dew point of 5.5 °C up to 15 °C dew point or 60 per cent relative humidity (whichever is lower)[3].

Operational and maintenance costs:

The costs of employing teams to operate data centre and IT systems is significant and is usually not an organisation's core function. Teams are required to monitor the data centre, react to issues, support the IT, mechanical and electrical infrastructure, and manage change. Further management bandwith is consumed in supervising and coordinating all of these teams, an overhead which is often disregarded but one that must be considered when developing an effective strategy.



OPPORTUNITY COSTS

How the right data centre strategy adds value

With the demands on data centres having changed over the past decade, many facilities are not meeting the needs of business. This creates substantial opportunity costs, especially if the data centre is in an expensive, prime location. It is essential to understand the needs of the business and what is required in terms of infrastructure solutions to support these needs. On this basis a tailored strategy can be developed.

Running below capacity is a widespread issue. If a data centre is running at 50 per cent capacity, it has the ability to power and cool twice as much equipment than it currently houses. For a co-location provider, such a data centre would create an opportunity cost in the form of the profit lost through not using half of its capacity. For a business renting or operating a data centre in-house, the opportunity cost is created through the failure to utilise spare capacity, which could be used by another part of the business, made ready for future business needs as the volume of data to process grows, be repurposed or sublet to a third party.

Aging data centres also suffer from a lack of flexibility. Newer centres are being built in such a way as to remain agile enough to meet the fast-changing requirements of technology. Older facilities face the opportunity cost of not being able to adapt as easily to the latest needs.

In both of these scenarios, opportunity costs increase if the data centre is located on a prime piece of land. If the site is costly to lease or was expensive to buy, the investment could be underperforming. With latency constraints reducing, there are opportunities to move these to less expensive locations, outside of urban locations, with lower rental and power costs.

Often these issues stem from a misalignment between the IT team and the operations team. If a decision is made to address data centre problems by co-locating, or replacing the existing facility with a new one, failing to explore the option of upgrading the existing site instead could be an important missed opportunity.

Collaboration between the IT and facilities teams is critical in understanding the options and making the best decision for the business. An upgrade could cost under 50 per cent of a new build project, while delivering equivalent benefits. As a result, legacy sites frequently offer compelling opportunities.

Overall, the opportunity costs associated with failing to understand and address an underperforming data centre appropriately are significant.

SOLUTIONS

The smartest ways to achieve optimal performance

To provide smart, bespoke solutions, it is imperative that business needs are identified, that the existing estate is fully understood and all options are considered, including an upgrade of existing facilities.

The major business benefit associated with upgrading an existing asset is that very significant capital spending savings are possible. An upgrade, if properly executed, can cost less than 50 per cent of the expenditure required for a new build project and result in significant efficiency improvements, often paying back in two or three years, as well as saving substantial carbon emissions.

In the case of an upgrade, as compared with a new build, an existing site will already be supplied with power by a utility provider, eliminating the costs of bringing in power to a new site. An existing data centre will also already have the IT infrastructure and building required. For a data centre that is, and must remain, located in an area where space is at a premium, there will be intense competition to find a comparable site, so it may be beneficial to retain the existing site.

When comparing an outsourced solution, whilst an organisation developing and deploying cloud or co-location data centres will be able to build and operate their facilities more cost effectively than a company doing the same in-house, they may not be able to offer rates that could compete with an upgrade.

DETERMINING THE RIGHT DATA CENTRE STRATEGY

Each solution for an underperforming data centre should be unique to the particular features of the facility and the specific business needs and goals of the owner (or user) of the data centre. To establish the optimal approach, any project must begin with a thorough assessment of the requirements of the business; due diligence must then be carried out on the options for meeting these requirements. It is crucial that both the IT and engineering/operations teams are engaged, to understand both the IT and infrastructure assets, and to provide a truly holistic approach; this will often require championing at director or board level.

When creating a bespoke solution, an 'ideal' baseline should be determined which identifies the optimal architecture. This will likely be a hybrid solution in which some elements are held in-house, while others are outsourced. It is important that this be developed without considering the constraints of existing systems, and making the best use of the real estate assets available. A critical consideration is resilience, which needs to be application specific and not generic across all of the equipment/estate. The critical nature of the functions performed varies and the infrastructure of the equipment supporting this should flex accordingly.

The major business benefit associated with upgrading an existing asset is that very significant capital spending savings are possible.

Concurrently, a 'best-fit' solution should be developed which identifies the optimal architecture given existing constraints and limitations. These can then be compared to provide a holistic view of the options available and to identify the likely outcomes. In establishing these reference points, a number of factors should be considered:

BUSINESS RISK

- The increased risk of failure from an aging infrastructure
- The risk of failure during a migration/system upgrade
- Service level agreements

CAPITAL COSTS

OPERATING COSTS

- Energy costs (differences in efficiency)
- Maintenance and staffing costs

INTANGIBLES

- Level of customisation, tailoring to business requirements
- Flexibility, agility and future proofing

BUSINESS PLANNING

- IT strategy: data requirements and growth forecasting
- Financial constraints, tax implications and cost of capital
- Wider real estate strategy
- Lease agreements
- Value of repurposing existing data centre assets

COMPANY COMMITMENTS

- Brand image
- CSR
- Carbon neutrality

SECURITY

LATENCY ISSUES

LEGISLATIVE REQUIREMENTS AND INDUSTRY PRESSURES

The options can then be assessed, given the specific business requirements and the importance placed on the factors above. For example, if the primary goal is to reduce carbon footprint, an assessment must be made of the feasible measures to improve the efficiency. The measures could range from relaxing set points or replacing a piece of legacy equipment (relatively simple steps, which could be achieved through an upgrade project), to installing an entire new cooling system, building a new facility or co-locating.

If the goal of the project is, in contrast, to expand the volume of space a data centre offers to clients to buy or rent, the space that an upgrade versus a new build could create must be assessed. The potential for what the upgrade can achieve will depend not only on size, but on the specific configuration of the existing site. For example, if the existing site lacks flexibility — and certainly today's new data centres are designed to be more flexible than in previous years — the upgrade may need to be more extensive and it may be that a new build makes better business sense.

Organisations may also be concerned with minimising their embodied carbon footprint — the CO_2 emitted during the extraction of building materials, production of building supplies and the construction process itself. These organisations are likely to find that upgrading an existing site is a more attractive option since it makes more efficient use of materials and requires less construction work.

The business case for an upgrade and the specification of the upgrade should also depend on the level of resilience the data centre requires. Some sites need to be more resilient than others, meaning that a solution could provide different levels of resilience across the estate.

DELIVERING A SUCCESSFUL UPGRADE

With an upgrade often being at least part of the optimal solution, it deserves special consideration. It is essential that the project is managed and delivered by a highly specialised team. The project will be particularly complex and sensitive, entailing multiple risks because the work will take place within a live site and involves business critical infrastructure.

There is a wealth of information on managing successful migrations but the key is to mitigate risks through expert design and programming of the project, ensuring effective communication throughout and engagement of key stakeholders. In particular the design team and contractor must be experienced in data centres and aware of all the risks, and the company must adopt a highly systematic approach to carrying out the works.

With the right level of expertise, a data centre upgrade can be delivered in a risk-controlled, cost-effective way that will ensure business benefits in both the long and short term.

A data centre upgrade can be delivered in a risk-controlled, cost-effective way that will ensure business benefits over the long term.

The UK's data centres are already under pressure and the demands placed upon them will only intensify in the years ahead.

CONCLUSION

The UK's data centres are under pressure and the demands placed upon them will only intensify in the years ahead. With a significant proportion of the estate either not built or not configured to best cope with current demands, data centres face critical challenges. These challenges are principally threats to business continuity, unnecessarily high operating costs and the opportunity costs of an infrastructure strategy that fails to fully meet the demands of the business (or businesses) that rely on the data centre.

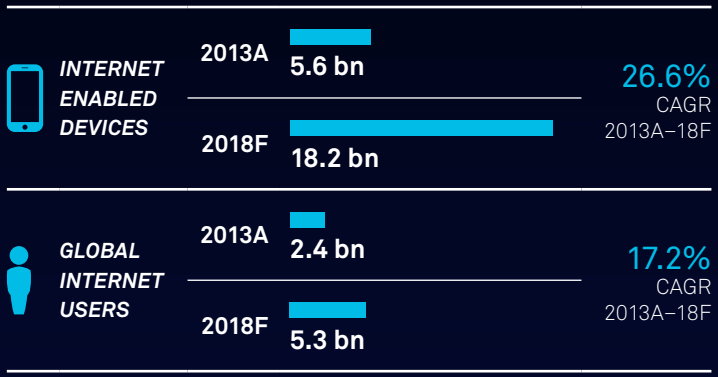
While there may be pressure to address these issues by taking the decision to outsource, the best approach will be based on a holistic assessment of business needs and how best to meet them with a bespoke solution. Such an assessment may show that a more nuanced strategy — potentially including upgrade or new build projects combined with some degree of outsourcing — will deliver the greatest business benefits. Certainly, the fact that upgrading a data centre could cost less than 50 per cent of a new build project makes it an approach worth considering.

Identifying and delivering the strategy that will result in maximum business benefits is a specialist task. From assessing the needs of the business to analysing the options for meeting them and then delivering the project, considerable depth of expertise and experience is required.

CASE STUDY
DATA CENTRE BOOM

There are a number of compelling and diverse drivers behind data centre usage ranging from mobile to video to Internet applications.

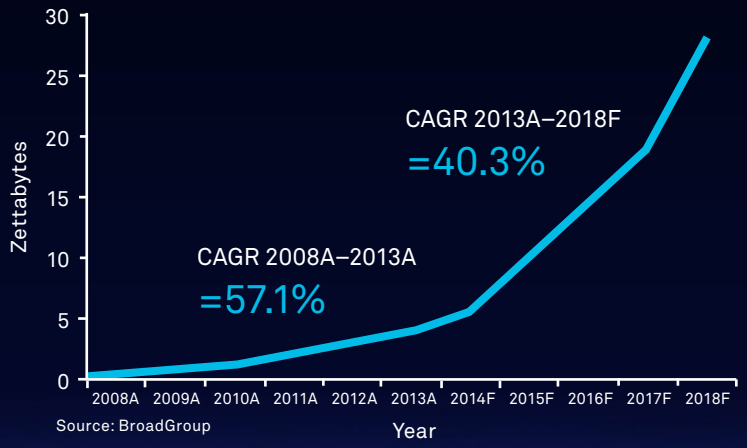
FORECAST GROWTH IN INTERNET ENABLED DEVICES AND GLOBAL INTERNET USERS



Source: BroadGroup

A - actual
F - forecast

TOTAL GLOBAL DATA CREATED ANNUALLY



Source: BroadGroup

EVERY 60 SECONDS…

According to Domo, a business intelligence company, every minute of every day sees no less than 204 million emails sent. In that same minute, Google will receive more than 4 million searches and Amazon will transact US$83,000 of online sales.

204,000,000

EMAIL MESSAGES SENT

4,000,000+

SEARCH QUERIES RECEIVED BY GOOGLE

48,000

APPS DOWNLOADED FROM THE APPLE APPSTORE

72

HOURS OF NEW VIDEO CONTENT UPLOADED TO YOUTUBE

277,000

TWEETS SENT VIA TWITTER

2,460,000

PIECES OF CONTENT SHARED ON FACEBOOK

Source: Domo

CASE STUDY
COMPARING SOLUTIONS

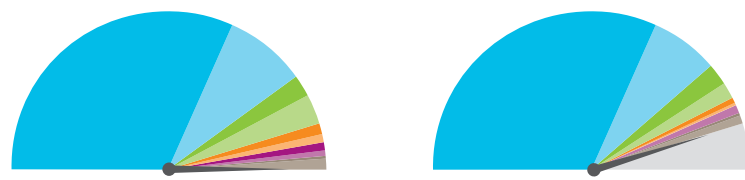
Don't compare apples with oranges: understand how your current data centre estate can be optimised for your business needs when comparing with new facilities or outsourced solutions.

Too often organisations compare their existing facilities with new build data centres or outsourced solutions without considering optimisation initiatives that can be undertaken for very little capital expenditure. These initiatives can have significant impact on efficiency, can increase cooling provision and, when coupled with an IT strategic review, can provide opportunities for expansion or consolidation of facilities. The diagrams below show the reduction in Power Usage Effectiveness (PUE) that can be realised by following a simple efficiency audit. The initiatives undertaken in this case were as follows:

- **Airflow optimisation:** reconfiguring racks into hot and cold aisles, installing blanking plates and in some cases installing 'butchers curtains' to contain the cold aisles
- **Set point adjustments:**
  - Following the above, the air supply temperatures could be increased by 4°C in line with ASHRAE best practice
  - Airflow of the computer room air handling (CRAH) units was decreased to take account of redundancy and utilisation rates
  - Chilled water temperatures were raised — this allowed significantly more free-cooling
  - The chilled water system was rebalanced resulting in a lower pump set point
- **CRAH unit filters** were replaced with models with lower pressure drop but equivalent efficacy
- **Fresh air supply volume** was decreased and the supply air temperature and humidity tolerances were relaxed giving significant savings in fan power, cooling and humidification
- **Electrical plant cooling:** the temperature criteria was relaxed while maintaining acceptable conditions for the uninterruptable power supply (UPS) batteries
- **Lighting:** passive infrared sensors (PIRs) were installed in the data hall areas

A study showed that a PUE of 1.32 was achievable by upgrading the controls systems and replacing the chillers and the UPS, but despite a three-year payback, this was not carried out due to financial constraints and prioritisation of other projects.

	Before		After	
	PUE Build-up (MW)	Percentage	PUE Build-up (MW)	Percentage
IT load	1.00	64.2%	1.00	64.2%
Chillers	0.26	16.6%	0.22	13.8%
UPS	0.07	4.5%	0.07	4.5%
CRAC fans	0.10	6.4%	0.05	3.2%
Pumps	0.03	1.9%	0.02	1.4%
Fresh air	0.03	1.6%	0.01	0.6%
Lighting	0.02	1.4%	0.00	0.3%
LV distribution	0.02	1.0%	0.02	1.0%
Transformers	0.01	0.8%	0.01	0.8%
Miscellaneous	0.03	1.6%	0.03	1.6%



Total	**1.56**	**1.42**
Saving	Annualised saving of **140 kW** power, saving 1,277 MWhrs, £147,000 and 518 Tons CO_2 per MW of IT deployment.	

CASE STUDY
TIGHTENING OF STATUTORY REQUIREMENTS AND LOCAL REGULATIONS

There is a lot of uncertainty when it comes to future regulation of data centre deployment and efficiency. The industry as a whole recognises the importance of data centres in combating climate change, exemplified by the wide-spread support for the EU Code of Conduct, the Green Grid and other 'Green Initiatives', but there is little in the way of regulatory pressures at this time.

To further muddy the waters, there is a great deal of debate as to how the industry should be regulated particularly with regards to Carbon Reduction Commitment. However, the scale of energy consumption and the growth of the industry guarantee that this will not be the case forever and this should be considered when developing a long-term data centre strategy.

In particular organisations need to be aware of specific local regulations when developing their strategy. For example, the Municipality of Amsterdam sets minimum PUE requirements for new build (and upgraded), and existing data centres.

In addition to these regulations, organisations may also face self-imposed requirements such as carbon neutrality commitments or CSR initiatives; brand and reputation are also driving efficiency improvement for organisations that are committed to publishing their performance metrics.

GLOSSARY

Cloud — A storage platform available to the public that is managed by a third party.

CRAH Unit — Computer Room Air Handling Unit

Heat load — The power consumed by the servers is converted in to heat which then must be cooled by the data center infrastructure; this is the heat load

High Density Computing — IT deployment with high processing output installed in a small footprint, resulting in a concentrated heat load in the data centre

IaaS — Infrastructure as a service — a model in which the equipment used to support operations, including storage, hardware, servers and networking components are hosted by a vendor or service provider and made available to customers over a network, typically the Internet. The customer is responsible for configuring this 'virtual' hardware.

PaaS — Platform as a service — a model in which a computing platform and a solution stack are hosted by a vendor or service provider and made available to customers over a network, typically the Internet.

Power Usage Effectiveness (PUE) — A metric that shows the volume of energy that goes into the data centre versus how much of that energy is used to power IT equipment. A PUE indicates that half the energy supplied to a site is used by the IT, the other half are losses associated with the cooling or power distribution within the building. Correspondingly, a PUE of one is optimal.

SaaS — Software as a service — a model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet.

The Uptime Institute — A respected education and research body for data centres.

UPS — Uninterruptible Power Supply

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About AECOM
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