

MISSION CRITICAL POWER

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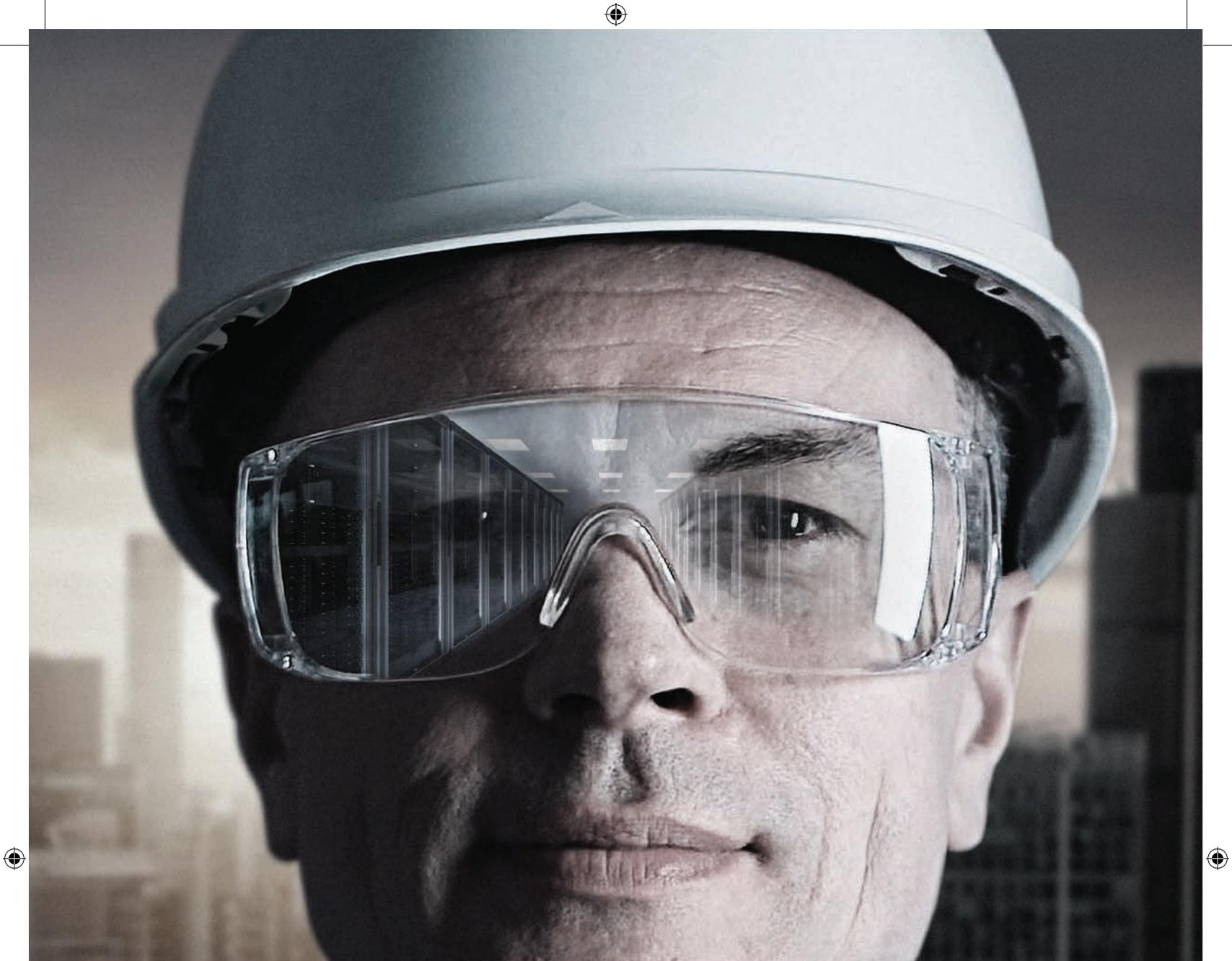


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THE FUTURE OF
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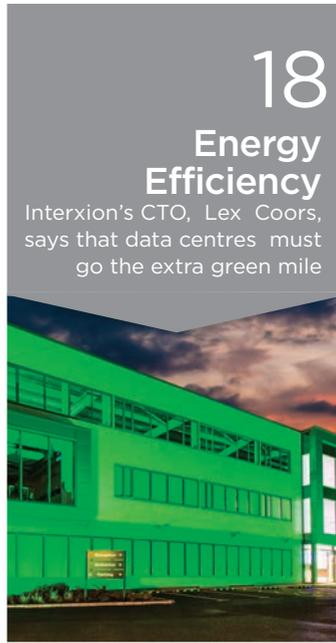
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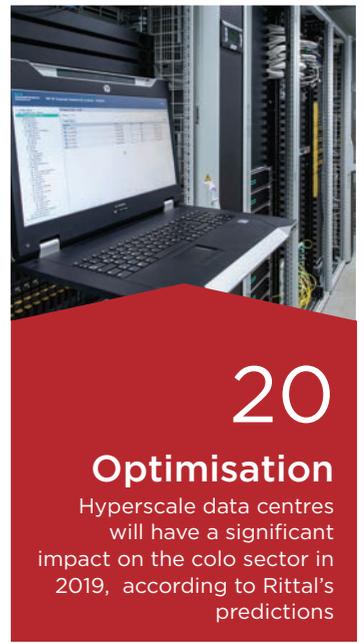
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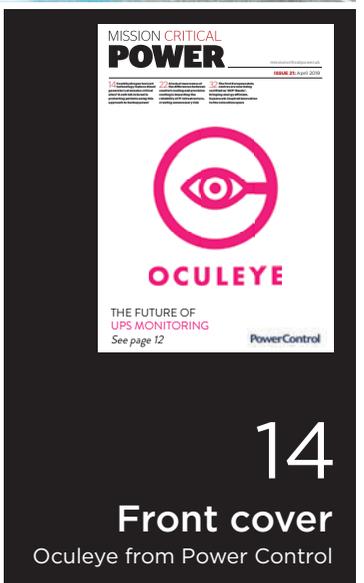
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Energising the industry

Latest analysis by Vertiv predicts that the move to 5G will increase total network energy consumption by 150-170% by 2026, with the largest increases in macro, node and network data centre areas. In fact, the impact of 5G and energy efficiency, in general, was high on the agenda at Data Centre World this year, with discussion regarding strategies and innovation coming to the fore.

Vertiv's Simon Brady observed that there are significant opportunities to make energy savings but data centre operators need to tackle the basics first; many are missing out on the 'low hanging fruit' and failing to implement best practice. John Booth, chair of the Data Centre Alliance's Energy Efficiency and Sustainability Group, and managing director of Carbon 3IT, also highlighted the importance of following best practice and recommended that data centres should follow the EU Code of Conduct, to optimise energy efficiency (<https://missioncriticalpower.uk/videos/>).

There is certainly significant room for improvement, but Data Centre World also offered an insight into the exciting work being undertaken to explore cutting-edge technologies, capable of reducing the sector's environmental impact, as well as important research projects such as the Boden Type Data Centre One, funded by the European Commission's Horizon 2020 programme. This innovative project will investigate opportunities for improved efficiency and cost savings, featuring 100% renewable energy, adiabatic cooling and modular design at its core. The findings from the pilot data centre could help drive improvement across the industry as a whole.



There is already a growing number of data centres that are challenging public perceptions of the industry, by taking innovative approaches to maximising energy efficiency and sustainability.

There is no doubt that pressure from government regulations, customer requirements, investors and other stakeholders is driving the industry towards more effective design and utilisation of technical space. In particular, developments such as free cooling and thermal optimisation technologies are helping the industry lower its energy consumption, while renewables and distributed energy sources are also gaining increasing interest.

A new entrant to the wholesale data centre market, Kao Data is among those adopting innovative approaches to power and cooling, to reduce their impact on the environment, resulting in the company being awarded BREEAM Certification for Excellence in Design. This sustainability assessment reflects the attention that has been paid to keeping a low carbon footprint, at the London One Campus, which is reported to be delivering an ultra-low, PUE of <1.2, even at partial load.

Lex Coors, Interxion's CTO, also believes that data centres can make positive environmental contributions through technological breakthroughs in energy efficiency, while attracting new business in the process. The qualities of energy efficiency and sustainability are now giving operators a commercial advantage, it appears.

While there is a great deal of work to be done to improve energy management, public attitudes towards the industry are starting to change. Data centres are now being recognised for their energy contributions to surrounding communities, particularly in mainland Europe, where there are a number of data centres that are opting to supply district heating schemes. One such example has included Nordic data centre operator Digiplex and Stockholm Exergi, which announced ambitious plans last year to use excess heat to warm the equivalent of 10,000 households.

Ultimately, while some of these efforts are dependent on public investment and infrastructure, there is an opportunity for data centres to become "part of the solution", whether it is participating in grid balancing, community heating schemes, or simply taking steps to reduce their energy use.

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Reliable power for a sustainable world

CyrusOne's London data centres move to 100% renewable energy

CyrusOne has announced that its London I and London II data centre facilities are now running on a 100% renewable energy tariff, a move which the company says will transfer energy annual usage equivalent to 52,000 households to zero-emissions sources.

Comprising a combined 23MW of IT power, both CyrusOne's London I data centre in Slough and its London II facility in Prologis Park, Stockley, are now served by Hudson Energy, an independent provider of electricity and gas to businesses across the UK.

CyrusOne has also confirmed that all new London data centre inventory, including the recently announced 9MW London III facility in Stockley Park, will run off renewable energy.

In addition to the reduction in carbon emissions, CyrusOne customers will benefit from reduced unit costs as a result of the competitive rates secured through the procurement process and exemptions from the Climate Change Levy.

"As large energy users in the UK, the data centre industry



CyrusOne's move to an all-green energy tariff is the latest in a wave of sustainable innovations

is in a strong position to effect change in terms of how green energy is priced and made available," said Tesh Durvasula, CyrusOne's president – Europe.

"Traditionally, green energy tariffs have been priced at a premium, but as more users demand their energy from renewable sources, the rates we can negotiate are decreasing rapidly.

"We continue to explore

ways to maximise the efficiency and resource usage in our data centres so that we can pass those benefits along to our customers."

The move to an all-green energy tariff is the latest in a wave of sustainable innovations at CyrusOne. More broadly across the company, water conservation has been a significant factor in how CyrusOne designs and builds

new data centres. In the US, for example, CyrusOne's hyperscale data centres use an air-cooled chiller technology with an integrated compressor and condenser that cools the closed loop of water. Filling the pipe with water just a single time is the only water consumption, with the permanent water supply provided by a single tanker truck.

Innovative data centre to pilot efficient design

Funded by the European Commission's Horizon 2020 programme, the Boden Type Data Centre One (BTDC) has been officially inaugurated in Boden, Sweden. The 500kW facility, which was built in less than five months, has been designed to demonstrate a range of innovative engineering principles, used to construct the most cost and energy efficient data centres with minimal environmental impact.

The project is being led by a consortium consisting of data centre engineering specialist H1 Systems, cooling manufacturer EcoCooling, research institute Fraunhofer IOSB, research institute

RISE SICS North and infrastructure developer Boden Business Agency.

Speaking to *MCP* at Data Centre World, Jon Summers, from RISE, commented: "This project is about gaining a better understanding of what we mean by energy efficiency and the cost around building data centres. We are piloting a data centre that is energy efficient and low cost at the same time, which is why there are certain elements that could be viewed as quite challenging to the industry."

The cornerstones of the concept Boden Type DC One are: efficient fresh air cooling, modular building design, the use of renewable energy

and a favourable location.

With the pilot data centre, the project stakeholders will be able to: validate that the concept meets the energy efficiency, financial reliability, and other targets in real operational environments; improve the design software tools for modeling and simulating the operation of the facility and cooling equipment; and demonstrate, through accurate simulation, that the prototype can be replicated in other European sites with less favourable conditions.

The findings from the project will be eventually be made available at: <https://bodentypedc.eu/one>

Backup power for Hinkley Point C

Rolls-Royce is supplying four MTU diesel generators to provide backup power to the new nuclear power station at Hinkley Point C in Somerset.

The diesel generators will be supplied from Rolls-Royce business

unit Power Systems; instrumentation and controls (I&C) systems from its Grenoble-based I&C business; and systems integration engineering from its Warrington and Derby-based nuclear teams.

The four generator systems, each providing power output of 3,600kW, will guarantee power to critical power station systems, in the event of any unplanned outage of Hinkley Point C's standing power supply.

News in brief

Name change for UPSL

Uninterruptible Power Supplies Limited (UPSL), a subsidiary of Kohler, and the exclusive supplier of PowerWAVE UPS, generator and emergency lighting products, has changed its name to Kohler Uninterruptible Power (KUP). Among the changes will be updates to its legal name, logo and website URL, which will change to www.kohler-ups.co.uk. UPSL's name change is designed to ensure the company's name reflects the breadth of the business' current offer, which now extends to UPS systems, generators, emergency lighting inverters, as well as 24/7 service, while highlighting its membership of Kohler Co.

Cool energy saving for Telefonica

During the Global Energy and Climate Change Workshop organised by Telefonica, Vertiv received the 'Best Energy Efficiency Solution' award for a project carried out at one of the largest locations in Colombia, the Celta Switch in Funza, near Bogota. The Vertiv Liebert FB4075 series features a 'Supersaver' system made up of 12 air handling units and a ring-shaped chiller, maintained simultaneously with an option of indirect free cooling. The free cooling option is engaged when the external temperatures are cooler than the data centre. "This design has allowed us to achieve a return on our investment within three years and we are expecting the resulting energy consumption savings to amount to about 40%," said David Ramirez de los Reyes, head of energy planning for Telefonica Colombia.

Predicted growth in 'smart energy'

Data centres could be more energy efficient and make better use of their infrastructures if existing and emerging smart energy technologies were in greater use, according to the Uptime Institute. A new report, *Smart Energy for the Data Centre*, claims that the data centre industry will strongly embrace smart energy, but it will "take time".

According to the report, smart energy technologies go beyond many energy management or energy monitoring systems; they not only measure, report, and analyse power use and energy resources, but they switch power and move loads.

The Uptime Institute concludes that smart energy systems promise "greater efficiency and use of capacity,



Smart energy systems promise greater efficiency

reduced maintenance, more granular control of redundancy, and greater real-time management of resource use".

The Uptime Institute argues that smart energy technologies could effectively end the clear physical differentiation between 2N configurations and less-expensive N+1 configurations. UPSs are also expected to become smarter

and support more functions. In addition, they will be linked to the grid and cloud services for two-way resource and data sharing.

However, smart energy management for data centres is still in its infancy. Deployment will be slowed and complicated by "technical, cultural, organisation, and economic factors".

Huawei to move to Open Rack

Huawei Technologies has announced plans to adopt Open Rack in its new public cloud data centres worldwide.

The move is designed to enhance the environmental sustainability of Huawei's new public cloud data centres by using less energy for servers, while driving operational efficiency by reducing the time it takes to install and maintain racks.

The Open Rack initiative proposed by the Open Compute Project (OCP) seeks to redefine the data centre rack.

It is the first rack standard that is designed for data centres, integrating the rack into the data centre infrastructure; a holistic design process that considers the interdependence of everything from the power grid to the gates in the chips on each motherboard.

Adopted by some of the world's largest hyperscale internet service providers such as Facebook, Google and Microsoft, Open Rack is helping to lower total cost of ownership (TCO) and improve

energy efficiency in the scale compute space.

"Huawei's engineering and business leaders recognised the efficiency and flexibility that Open Rack offers, and the support that is available from a global supplier base. Providing cloud services to a global customer base creates certain challenges.

"The flexibility of the Open Rack specification and the ability to adapt for liquid cooling allows Huawei to service new geographies," stated Bill Carter, CTO for the OCP Foundation.

Dublin overtakes London with 25% of the EU hosting market

A new report from Host In Ireland in association with Bitpower has highlighted Ireland's new position as the 'Data Isle' of Europe, with Dublin now recognised as holding the largest market share of hosting facilities in Europe

Ireland's position as a data hosting location is currently at its strongest, with 53 data centres in operation and a capital investment spend of more than €1bn in 2018, a new report by Host In Ireland reveals.

The report drew on a recent industry update by Jones Lang LaSalle (JLL) revealing that Dublin is now the leading destination for hosting facilities in Europe. With 25% market share of the European data market, the Dublin metro area surpassed London by 1%.

The Host In Ireland Quarter 4 2018 Report also revealed that:

- 16 new data halls became operational in 2018
- 28 new data centre facilities are currently in development (either under construction or with approved planning)
- A further €5bn capital investment is expected within four years

There are now 53 data centres in Ireland, with 600MW of grid-connected power capacity. While hyperscale remains the dominant datacentre type, with 72% of capacity, the colocation wholesale market has grown from almost zero to 13% in the past three years.

Speaking about Ireland's new status as Europe's 'Data Isle', Host In Ireland president Garry Connolly said: "We are extremely proud of Ireland's new status as the 'Data Isle' with 25% of the total hosting market share in Europe. It is becoming increasingly evident that data is an industry of real substance, providing the Irish



Google is among the hyperscalers that have located facilities in Ireland. In 2018, the company announced a €150m expansion of its data centre in Dublin

economy and companies with growing import and export opportunities.

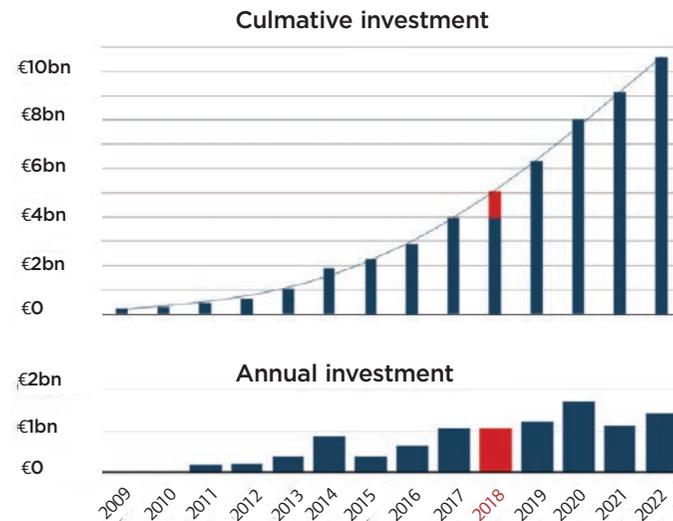
"The level of investment into Ireland from the hosting industry has brought about

substantial opportunity for many Irish companies in recent years. Some have seen significant growth enabling them to export their skills and services across Europe, US and Asia.

"Ireland is now seen as a hosting industry leader, not just due to the size of the market share we currently hold in Europe, but because of the hard work, skill and expertise built up by Irish companies and individuals in recent years which is now recognised internationally."

Recent research shows data centres continue to provide significant economic and job multiplier benefits in terms of employment and the economy. A report from the IDA demonstrated that 700-plus Irish companies benefitted from 90% of expenditure from data centres investment in Ireland.

Further to the direct economic and employment benefits, data centres act as a facilitator to unlock greater benefits across a €71bn global technology services export market. ●



Construction investment 2009-2022. Source: Ireland's Data Hosting Industry 2018 Quarter 4 Update

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What's 'mined' in a Bitcoin mine?

Ian Bitterlin argues that any suggestion that Bitcoin mining facilities show the future of data centres is impossible to justify

The hype surrounding Bitcoin mining has been growing, along with claims for a sea change in data centre design and has long fascinated me.

Basically, the search for facilities, or at least for suitable locations for facilities, has focused on Scandinavia, the main criteria being the provision of power capacity – with 50MW+ often seen. A quick internet search will produce images of sheds with industrial shelving racked and stacked with old-looking server hardware, no cabinets or cold/hot aisles, apparently without UPS, precision cooling or emergence power generation – more like an ICT scrapyard in a shed. I have not heard of one 'mine' searching for a UK home, maybe on grounds of cost or availability. So, what is going on?

We have been increasingly bombarded by hyperbole about 'virtual' and 'crypto' currencies, including the original Bitcoin, and, in some form of connection with them, the concept of Blockchain. However, I don't see a link between crypto-currency, which aims to bypass (if not replace) the global banking system, and Blockchain, which appears to be an 'improved' IT software transactional process that is adaptable

to many applications – so, in this article I am going to concentrate on Bitcoins and the high-power data centres that 'mine' them.

No digging dirt or sinking shafts is involved and Bitcoin 'mining' in this respect means

“

The lack of traceability and avoidance of any banking system makes it a perfect system for money-laundering

'producing' and issuing a digital-tag/certificate that shows ownership and can be transferred from one owner to the next, as a payment.

Before we go any further, let me say that we already have 'virtual' currencies and have had them for a very, very, long time: Consider a UK £20 banknote. Its 'worth' is £20, right? Yes, because I think so and you think so and it is issued by the Bank of England (or Scotland etc) which prints on it 'I promise to pay the bearer on demand the sum of twenty Pounds'. It carries a unique serial number, the proud signature of the chief cashier, and is printed to make counterfeiting hard. If I owe you money, I can pay you in notes,

or nickel coins etc, that we both believe are at face value.

However, what is their intrinsic, as opposed to perceived, value, or the cost of their production? A tiny fraction of the face value and probably a fraction of a penny.

The last time we had a hard-currency was when the coins were minted in silver or gold and their face value was the same as the actual value and they needed no 'back-up'. They were checked for value by the recipient by weighing them and you could cut them in half or quarter to obtain 'small change'.

Banknotes are a virtual currency backed by the value of gold reserves held by the country of issue. The higher





The lack of traceability and avoidance of any banking system makes it a perfect system for money-laundering and all the other nefarious activities. There is no doubt that a lot of people have made a fortune out of trading Bitcoins – as always at the expense of many (many) more losing their shirt – and if you like risk and can afford to lose then get in. Just remember that the only reason why someone might recommend it to you is because they have one to sell.

The ‘value’ has been volatile as you can see in any internet search, but that very volatility has contributed to the profit-hype. In December 2017, one Bitcoin was worth \$3,807 but then profit-taking caused it to collapse. Even as recently as July 2017 it was \$1,748 but today is only worth \$139 – somewhat different from the market price of gold. If you are a gambler then perhaps the current low price is an

hardware that is lightly loaded) and even a hydro-dominated utility will deviate from that power quality with an MTBF of 500 hours (one significant ICT disruption every three weeks) simply from grid maintenance and switching the grid around.

Some form of power quality improvement (usually via UPS) is essential for continuous business, regardless of the location.

So how does a Bitcoin mine operate servers without UPS? What is the computing load that survives interruption?

A similar argument, but perhaps more understandable, exists for emergency power generation. Most utility-based power interruptions are less than 3s but a significant number are longer than 10s – perhaps 0.4/year in London and 0.2/year in somewhere like Norway (the only hydro-based 100% renewable utility in Europe).

A great example of thinking

pollen, insects or chemicals that might call for a shutdown? The remote Scandinavian forest locations team with insect life for the very brief summer season and direct air can be highly problematical. Again, a source of unplanned outage that Bitcoin mines can, seemingly, take in their stride?

Lastly, from what I have seen, a location requirement of high connectivity bandwidth does not appear to be as important as power capacity – so what is being computed, stored or received/sent?

All things considered, any suggestion that Bitcoin mining facilities show the future of data centres is impossible to justify.

These questions all lead me to asking only one: what is being ‘mined’ in such a facility? What data, what software, what firmware?

A Bitcoin digital certificate is issued simply on the energy (kWh) expended in ‘mining’ it.

“ A Bitcoin digital certificate is issued simply on the energy (kWh) expended in ‘mining’ it. The ICT hardware computes nothing. No useful application is run, nothing is stored, nothing is processed or regurgitated. Energy is just turned into heat and dumped

opportunity, but caveat emptor.

I am more interested in examining the ‘mining’ of Bitcoins in dedicated data centres.

The low energy costs and active government incentives (discounted energy costs and/or lower corporation tax etc) has created a demand for certain locations, while other criteria are based on low PUE and a cold climate, with clean air that negates the need for refrigeration-based cooling.

This has made the Scandinavian region an appealing location for such dedicated data centres, but is power available enough to preclude the application of UPS? Certainly not. Modern server hardware requires a maximum ‘zero-voltage’ power supply of 10ms (as little as 6ms and no longer than 25-30ms for some

that hydro-power means that you can save capex on emergency generation is the well-publicised Microsoft facility in the US that, after two years of operating without, changed its mind and retrofitted gensets. Again, the question arises – what type of compute load can withstand an unplanned outage?

Then we have the most understandable feature of the Bitcoin mines – very wide envelopes of thermal management, pushing ASHRAE allowable temperature and humidity/dew-point to the limit and not being concerned at all with corrosion caused by poor air quality.

Direct air cooling without any recirculation or backup seems to be all that is claimed to be needed. But what about extremes such as smoke,

The ICT hardware computes nothing. Nothing is stored, nothing is processed; energy is just turned into heat and dumped. Curiously, the number of Bitcoin facility location searches drops to almost zero when the Bitcoin price drops or the power cost goes up.

Ultimately, the value of a Bitcoin does not reflect the cost of energy expended in its ‘production’. In my opinion, it appears to be a scheme that enables cross-border financial transactions to be made under the radar of the usual financial and legal regulation of the international banking system – unless any reader can enlighten me further as to what is ‘mined’. Furthermore, how does it survive power glitches and other outages without loss of data? ●

the reserves, the more the currency is trusted for global trade. Of course, we have now diluted the ‘gold reserve’ theory and most currencies have been ‘quantitatively eased’ by printing more and feeding the economy with cash in the hope of reflation business with lower interest rates etc. That means that ‘hard-currency’ has been getting more ‘virtual’ as time goes by.

So what is the attraction of a digital currency? This is best answered by a ‘fact’ I read last year: 60% of all Bitcoin transactions were cross-border and illegal. Whether or not the percentage is accurate is hardly relevant, the principle is clearly believable.

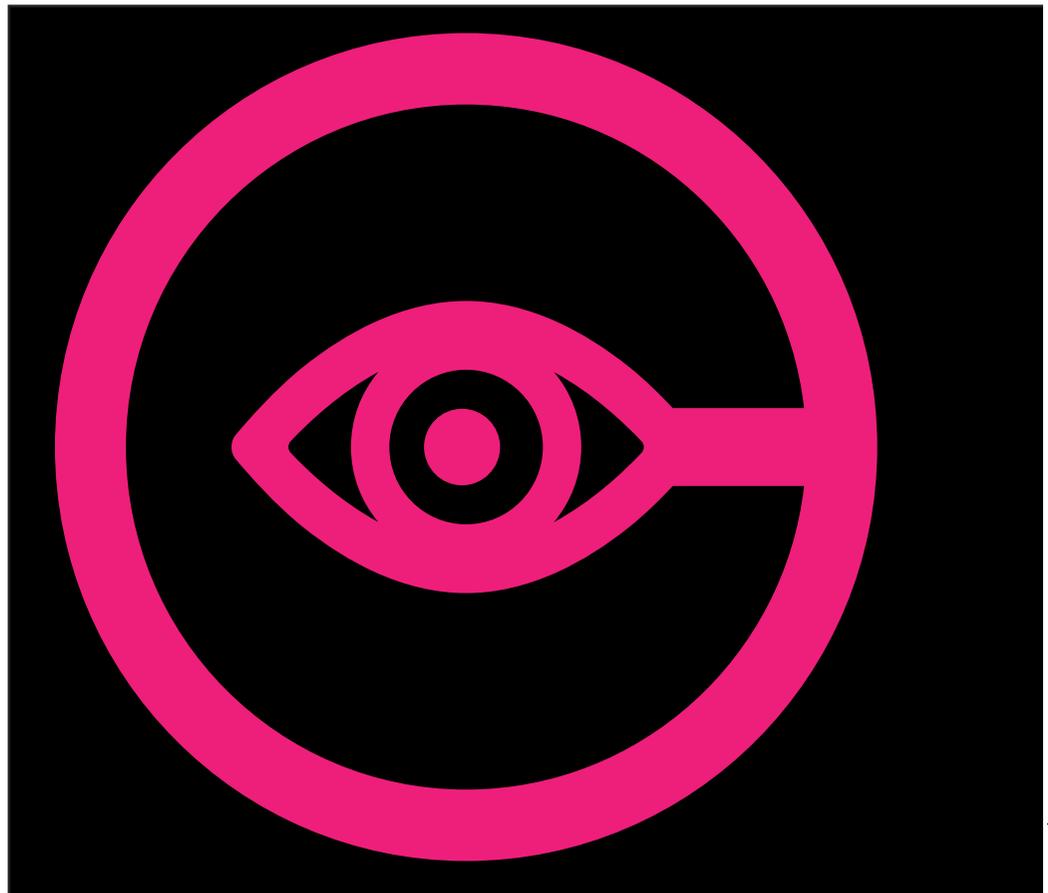
Power technology trends for 2019: driving improvements in efficiency and resilience

The latest trends in battery and UPS technology are reducing costs, improving resilience and driving efficiency. Power Control is responding to these market developments with the launch of a range of cutting-edge solutions and new partnerships, aimed at meeting the increasing demand for energy efficient technologies.

The need to balance resilience, efficiency and cost savings in mission critical sectors is driving some key technology trends around battery storage, UPS systems, and intelligent monitoring. Among these trends is an increasing interest in lithium-ion battery technology. According to market reports, the lithium-ion battery market is forecasted to grow from \$36.20 billion in 2018 to \$109.72 billion by 2026, at a CAGR of 13.4%. (Source: Reports & Data, March 2019).

“This increasing demand for lithium-ion battery technology is being driven by the falling costs of the technology, but we are also seeing increasing interest in peak shaving activities,” says Power Control’s director, Rob Mather. “During peak hours, facilities can put a percentage of the load on to battery; UPS manufacturers are now facilitating this ability using a variety of methodologies. Using this technology, businesses can help reduce the pressure on the grid quite substantially, while saving on energy costs. In addition, they can also earn revenue through fast response schemes,” he continues.

Mather explains that, to participate in these types of demand-side response schemes, lithium-ion batteries are required for their cycling ability – VRLA batteries are not designed to withstand this type of demanding activity.



New battery technology

To address this increasing demand, Power Control has announced the release of a high performance, space saving, lithium-ion range of backup power solutions. Developed and engineered by one of its partners, leading UPS manufacturer CertaUPS, the company’s new lithium-ion range provides complete resilience for sensitive loads and includes hot swappable battery design, allowing for engineering work to be quickly undertaken without the need for shutdown.

These compact systems offer three times the energy density and double the expected design life when compared with traditional VRLA batteries. Available in 1U, 1000VA and 2U 1000VA to 3000VA, the new systems are ideal for server racks where space is at a premium.

“The most significant factor driving increased uptake of lithium-ion battery technology is the reduced footprint – you can reduce the space needed for battery storage by between 30% and 50% by switching to lithium-ion, freeing up significant floor space for core business operations,” Mather points out.

Although the initial purchase cost of lithium-ion systems remains higher than VRLA, Mather is keen to highlight the importance of considering the long term TCO: “Lithium-ion UPS solutions are lighter, smaller, offer longer life, improved power density

and require significantly less maintenance,” he comments. “Furthermore, lithium-ion can operate at higher temperatures, so you can make significant savings on the cooling.”

There are also other advantages in terms of delivering resilience, according to Mather. He explains that the lithium-ion UPS solution comes with leading-edge operational features, including programmable outlets, which allocates less essential load to the critical load in an extended mains outage.

Increasing resilience of UPS operations

There are other technology trends that are also helping to improve resilience for mission critical sites. The latest UPS monitoring software from Power Control – Oculeye – gives a global view of remote facilities from a single, secure platform, keeping mission critical sites one step ahead. The technology offers significant advantages in terms of optimising the performance and condition of critical UPS systems, through trend analysis. This ensures any issues can be quickly anticipated before they can become a problem.

“A site may be experiencing frequent spikes in power, at certain times throughout the day, and trend analysis – via our monthly report – will highlight this,” explains Mather. “It could indicate that there is a problem on site and it allows one of our engineers to investigate the potential cause.

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Without the monitoring software in place, potential issues may be missed.”

The system is also multi-vendor compatible, which is an important feature as there is often a variety of different manufacturers’ UPS systems across an estate.

“All too often, there is no centralised method of monitoring these,” explains Mather. “The site can choose to have individual vendors carry out maintenance, if preferred, but our system allows the facility operator to retain complete control and have total visibility across all of their systems. It eliminates the need to have multiple, proprietary monitoring systems from each of the vendors.”

He adds that with the move to hybrid IT architectures and increasing proliferation of ‘Edge’ facilities, there will be an increasing need to manage unmanned sites. This system gives the option to provide visibility of remote power assets and real-time tracking.

There is also a great deal of interest in UPS monitoring at hospital sites, according to Mather. Power Control is working with a large number of Trusts, as hospitals increasingly outsource critical maintenance to more specialist providers.



The monitoring technology allows the company’s engineers to quickly respond to any issues ensuring the continued reliability of the UPS systems serving theatres and other areas, where power continuity is critical for patient safety.

The software also allows Power Control to conduct load analysis. By collecting data over a period of months, the company can advise customers on whether their UPS is over sized enabling potential cost savings to be achieved.

Increasing demand for modular UPS

Another emerging trend is the increased interest in modular UPS, according to Mather: “You can achieve greater efficiencies at lower loads, but you can also scale up as your requirements evolve. For example, a new data centre may want to scale up, as its demand increases, to avoid over-sizing the UPS, while more established facilities may also want to scale down as clients’ requirements reduce. This may coincide with clients upgrading their servers and ancillary equipment, therefore creating overall efficiencies in terms of their power demands. Ultimately, the ability to scale-up or down allows a facility to operate at peak efficiency,” Mather explains.

Recognising the importance of this market

trend, Power Control has become the UK modular UPS partner for Legrand. With a company history dating back to 1865, Legrand has grown aggressively to become the multibillion-pound business that it is today. It is the largest global manufacturer of switches, sockets and cable management. Over the last decade Legrand has widened its product portfolio to include UPS, which has been in direct response to the need for more energy efficient technologies.



Legrand is the fourth largest global UPS manufacturer and as its reputation in the backup power world gathers pace, it has chosen to align itself with some of the most renowned industry specialists. Its partnership with Power Control will enable it to offer more comprehensive, nationwide service support for all of its three phase UPS solutions.

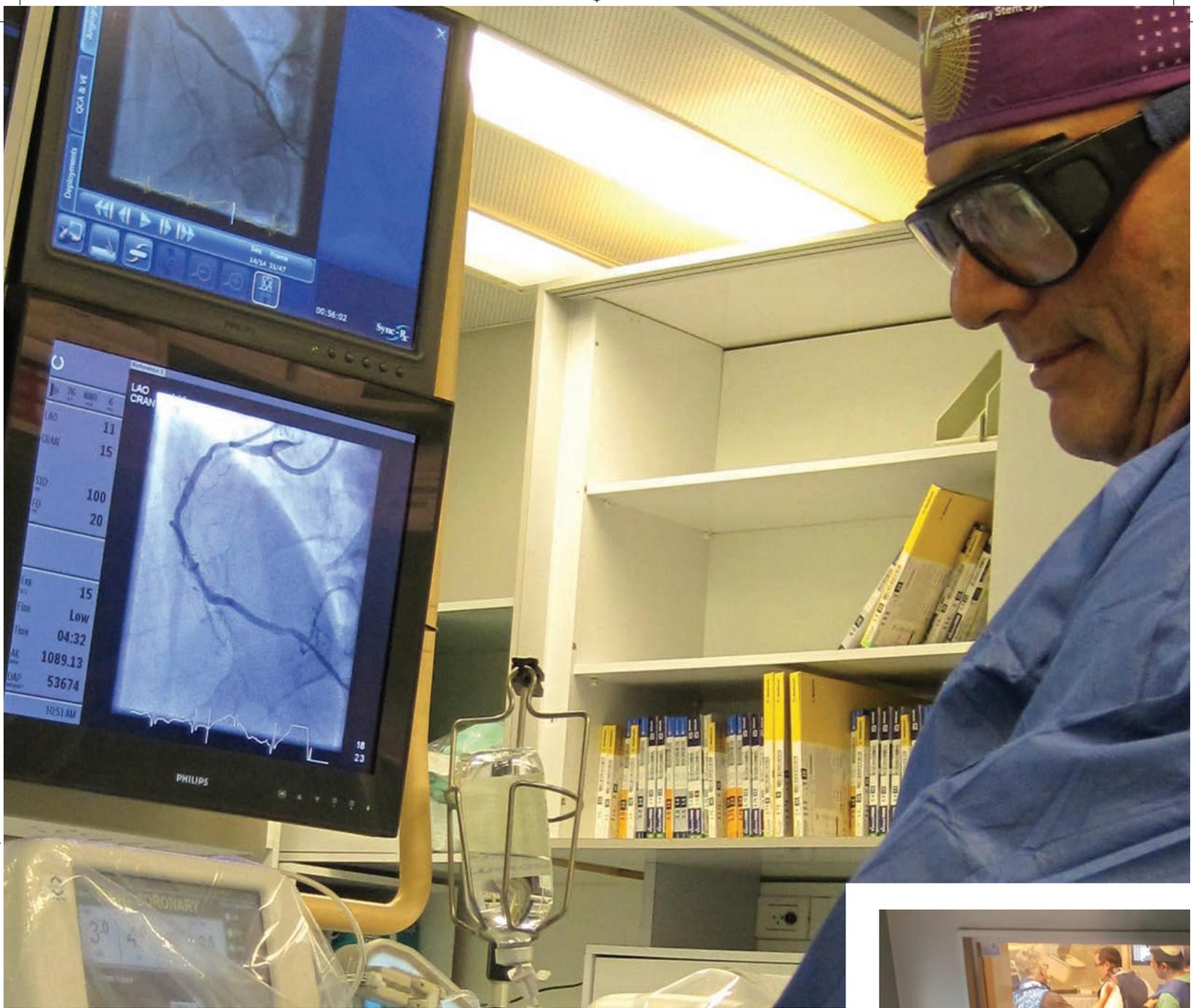
Based in central England with its own engineers positioned nationwide, Power Control will be providing additional technical support for Legrand.

Commenting on the partnership, Legrand technical sales manager Jonathan Tookey says: “Power Control is an extremely influential market leader across the entire power protection spectrum. Their reputation for exceptional service and technical experience is the reason Legrand has chosen to partner with Power Control.

“Over the coming months both companies will be working together and sharing cross training opportunities to ensure that a fully cohesive service is delivered to our clients. Power Control’s engineering team will receive in-depth product training at our headquarters and will be supported directly from our manufacturing site. Legrand has ambitious growth plans for its UK UPS division and we are confident that our partnership with Power Control will help us achieve our goals.”

Power Control has over two decades of experience and forged valuable relationships with leading contractors, consultants and UPS manufacturers. The company has an extensive single and three phase UPS product portfolio. It includes leading edge standalone and modular technologies, which are all fully supported by in-house project management and nationwide maintenance services.

For further information, visit www.powercontrol.co.uk, email info@powercontrol.co.uk or call 0800 136993



Getting to the heart of sustainable power

Could hydrogen fuel cell technology replace diesel generators at mission critical sites? A cath lab in Israel has already moved to this alternative source of backup power in a bid to improve patient safety

Hospitals could now benefit from a new approach to ensuring resilience in the event of outages, with the use of hydrogen fuel cell technology. Overcoming some of the weaknesses of conventional backup power systems, this technology is claimed to have the potential to deliver significant savings to healthcare providers while

improving patient safety.

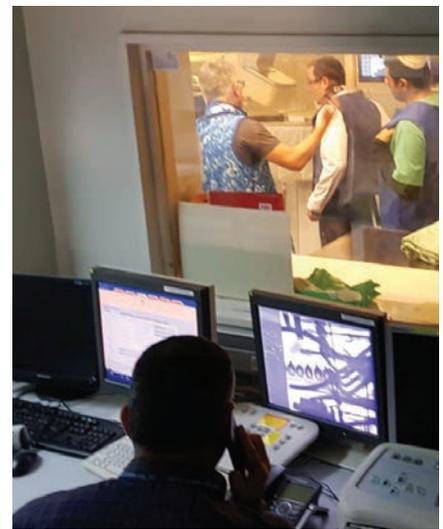
GenCell, whose fuel cell technology has been used to power the American and Russian space programmes, has commercialised a system that is capable of providing backup to hospital assets on an indefinite basis. In Israel, this futuristic approach is now taking off, with applications finding their way into the most critical areas of patient care, where loss of

power could result in potential harm to patients, during high-risk, complex procedures.

The first installation of its kind was completed at the Hillel Yaffe Medical Centre in Israel, within the cardiac catheterisation unit. The project was executed together with healthcare service provider and GenCell distributor Medtechnica, and included delivery of a

hydrogen-based GenCell G5 Long-Duration UPS.

Preventing even the slightest interruption to power flow eliminates any possibility of damage to delicate equipment, crucially avoiding equipment downtime and interruptions to surgical procedures. The key driver for introducing the G5 solution was to optimise operations in the intensive care coronary unit (ICCU), where





long, complex catheterisation procedures involving sophisticated equipment require imaging devices and computer peripherals with high power load demands.

The hospital sought a fail-safe backup solution that could absorb these short but intense peak loads, by installing the G5 with its fully redundant grid configuration and internal energy bridge feature that delivers dynamic load capacity.

As a result, Hillel Yaffe has successfully eliminated any concerns that power spikes will interfere with surgical operations. The ICCU now enjoys a smooth and constant flow of electricity, ensuring the highest levels of power reliability.

Ronen Edry, Hillel Yaffe Medical Centre's chief engineer, explains: "We are aware that the imaging apparatus we employ can cause power spikes that may initiate a lengthy reboot

16.5%

The percentage of opex spent on energy by mobile operators – set to double with the introduction of 5G

Yaffe plans to install additional units to backup other sensitive and critical medical devices and systems. This effectively creates a microgrid within the facility that will increase its independence from the grid and ensure smooth and uninterrupted power for further improvements to patient care across other departments.

Replacing diesel

According to GenCell president Gil Shavit, the project signifies an important step for medical and other public service institutions seeking to transition to clean energy and render diesel obsolete:

batteries are not yet capable of operating for a very long duration and are large consumers of valuable real estate. To provide backup for a 12-hour outage using batteries, for example, a hospital would need to use 10% of its real estate. This is where the hydrogen solution comes in – a 50 litre tank (around the size of a standard oxygen cylinder) can offer backup in an outage yet requires just a few square metres of space; this solution is capable of replacing a large foot-print of batteries."

GenCell also points out that battery-based solutions usually provide up to 6-8 hours of electricity although many power failures last longer, especially during extreme weather. The GenCell power solution can provide power as long as hydrogen fuel is available. With just six cylinders, the hydrogen fuel cell technology will deliver more than 15 hours of 5kW backup power.



Preventing even the slightest interruption to power flow eliminates any possibility of damage to delicate equipment, crucially avoiding equipment downtime and interruptions to surgical procedures



By installing the Gencell G5 solution, Hillel Yaffe Medical Centre has successfully eliminated any concerns that power spikes will interfere with surgical operations

procedure for its supporting IT equipment. If this were to take place during a catheterisation process, it would delay the surgery by several minutes with potential risk to the patient. This was a key factor in our decision to deploy the G5."

Edry continues: "The reliability of regular power now enables our staff to carry out medical procedures with full confidence and peace of mind – undoubtedly, this has resulted in better patient care."

The GenCell G5 is now regulating energy for all the cardio-cath medical operations, reducing patient disruption, improving care and, in extreme conditions, minimising the likelihood of power issues resulting in risk to life.

Following the success of its initial installation, Hillel

the GenCell G5 backup power fuel cell is ideal for hospital applications as it produces no emissions, noise or vibrations, and is suitable for indoor and outdoor use.

"In most cases, hospital assets are backed up by UPS and battery-operated systems, then the expectation is for diesel generators to kick-in, in the event of an outage," Shavit says.

"These diesel generators should be tested at frequent intervals, but there is now increasing pressure to reduce CO₂ emissions. This means that there is a drive to minimise the use of diesel gen sets – in the future, they will be taken out of the equation altogether."

Shavit continues: "There needs to be a substitute for diesel, for environmental reasons, but conventional

Unlimited power source

In fact, the long-duration UPS has the potential to provide an unlimited source of backup power – when one hydrogen cylinder runs low, the system can simply swap to another full tank, and empty cylinders can be replaced on a continuous basis. The gas is also easily supplied alongside other medical gases, as part of the hospital's existing supply chain.

"Hospitals are comfortable with this technology as they are already accustomed to managing a variety of medical gases. They have their own gas security officers that are very well educated in hydrogen safety. They understand that hydrogen is safer than propane and diesel, but it must be kept outside in a designated area," Shavit comments. »

In fact, hydrogen is 57 times lighter than gasoline vapour and 14 times lighter than air.

“This means that in the event of a leak, hydrogen rapidly rises into the atmosphere at a speed of 45mph (20m/s) or 2,100 cu ft per minute (60,000 l/min). Rather than pooling to cause an explosion, it quickly dissipates and/or burns,” he says.

Cost of ownership

Shavit points out that the total cost of ownership is lower, when compared with the conventional approach, particularly when the costs of maintaining diesel gensets are taken into consideration. There is no need to manage the quality and replacement of diesel, which is a complex and costly undertaking.

Furthermore, the GenCell solution has minimal moving parts, redundant internal systems and is highly resilient to extreme temperatures, humidity and air salinity.

An IOT management system provides remote monitoring as part of an ongoing service provision.

“This solution can deliver a huge saving to hospitals,” says Shavit “People care about being green until it costs them money. If you want to be



The GenCell G5 Long-Duration UPS provides a potentially unlimited source of 5kW backup power for telecom, healthcare and niche industrial markets

green, you also have to show a cost saving to make it a viable investment.”

He adds that hydrogen fuel cell technology also has the potential to overcome some of the barriers to participation in demand-side response (DSR). Emissions from diesel gensets have proven a hurdle for hospital sites wishing to explore potential revenue generating opportunities through DSR.

“A diesel generator will

take one to two minutes to synchronise to the frequency of the grid. If it is not synchronised it can cause serious problems. However, our system is always in phase and in frequency, so it can kick-in in just one millisecond,” adds Shavit.

“This approach to DSR is also totally CO₂ free.”

He explains that the long-term strategy is to replace diesel assets one generator at a time, in a staged approach.

This way, the hospital can become comfortable with the technology, before rolling it out across the rest of the site.

As well as working with hospitals, GenCell is also seeing strong demand from utilities for fuel-cell-based solutions, including long-duration backup generators for substations.

Shavit explains that many utilities are looking to microgrids to solve a variety of challenges, including compliance with environmental legislation, relieving pressure on overworked grids and meeting future energy demands.

Telecoms providers are also turning to hydrogen fuel cells for clean, reliable and cost-efficient power. In 2018, mobile operators across the globe spent 16.5% of their annual opex, on energy. With the introduction of 5G, this financial and environmental burden is expected to double.

Shavit revealed that GenCell is also setting its sights on large-scale data centre installations in the future. As mass production is ramped up, the cost of having a microgrid system, comprising dozens of units, will come down, making this an affordable and resilient option for the sector. ●

European technology award recognises fuel cell potential

Based on its recent analysis of the European fuel cells market, Frost & Sullivan has recognised GenCell with the 2019 Europe Enabling Technology Leadership Award for its fuel cell solutions.

Each year, Frost & Sullivan presents this award to a company that develops a pioneering technology that not only enhances current products but also enables new product and application development. The award recognises the high market acceptance potential of the recipient’s technology.

GenCell has two backup power products, the GenCell G5 Long-Duration UPS and the GenCell G5rx. GenCell designed the G5 to deliver backup power for long periods to mission-critical applications that cannot be adequately served by short-duration uninterruptible power supply solutions. On the other hand, the G5rx provides immediate power to utility substation automatic circuit reclosers and is capable of handling lightning strikes, surges, or objects getting stuck in power lines until the grid becomes operational again. In addition to fuel cell power benefits, the G5rx

specifically meets the unique requirements of utilities, including their substation energy profiles and safety and seismic standards.

Designed and built from the G5 platform, GenCell recently launched the A5 off-grid power solution to supply primary power to users beyond the grid. The A5 incorporates a technology that overcomes current hydrogen infrastructure limitations by creating hydrogen-on-demand from ammonia. It is the world’s second most-produced inorganic chemical, with more than 200 million tons of ammonia produced each year and distributed globally via pipelines, tankers and trucks, making it readily available and inexpensive. As a result, the GenCell A5 significantly reduces operating costs compared with diesel generators.

“GenCell’s technology overcomes the obstacles that have historically prevented mainstream fuel cell adoption. Importantly, it developed many patented technologies to reduce the capital and operational expenditure for its fuel cell power solutions,” says Manoj Shankar, senior research analyst at Frost & Sullivan. “Some of these solutions include employing a non-platinum catalyst, establishing mechanisms for applying ambient air as an oxidiser, and introducing lower-cost fuels, such as industrial-grade hydrogen gas or anhydrous liquid ammonia.”



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Demonstrating green practices can be a notable business differentiator for service providers looking to sell services to the European market. Europeans care strongly about sustainability: slightly more than eight in 10 EU citizens felt that environmental impact was an important element when deciding which products to buy.

An example of this practice is Taxi Stockholm – which has an initiative to be completely free by 2025, an initiative that extends to its data centre and IT service provider Devinix as well.

So, for companies that are trying to take advantage of the European market, colocating in data centres committed to both using green technology and innovating new efficiency measures is a way to distinguish themselves from their competitors.

At Interxion, energy efficiency is a company-wide policy, with energy-saving measures built right into its data centres. For more than 20 years Interxion has pioneered energy-saving designs and harnessed everything from arctic winds to underground aquifers to the Baltic Sea to reduce its energy use and as a result reduce its carbon footprint.

For data centre providers, much of the daily operations involve ensuring the equipment is kept cool to ensure customers' mission critical applications are kept running 24/7/365. Interxion is innovating and implementing advanced energy-efficient cooling technologies: for example, free-cooling reduces the use of electricity that is still predominantly produced from conventional fuels.

These energy efficiency measures are examples of Interxion making a positive environmental contribution for its industry and its customers.

In addition to energy efficiency, Interxion pioneered the use of 100% sustainable energy sources, including water,



Advancements that go the extra green mile



Data centres can make positive environmental contributions through technological breakthroughs in energy efficiency, while attracting new business in the process, believes Lex Coors, Interxion's chief data centre technology and engineering officer

solar and wind to power its data centres across Europe.

Between 2017 and 2019, the company chose to redeem all of its data centres' electricity usage in the form of renewable energy produced in Europe, either via supplier's green tariffs or Guarantees of Origin.

Interxion has played a critical role in the sustainability efforts of its host cities.

A notable example is Stockholm: in the 1970s, Stockholm took energy efficiency to a new level by building infrastructure that reused excess heat to warm households in the city. Interxion is a key partner in a groundbreaking initiative with Stockholm Exergi to

transfer excess heat energy into residential heating.

In 2018, Germany's two biggest TV networks travelled to Interxion's Stockholm facility to film documentaries about the city's power-saving technology with hopes that other countries or cities will soon adopt similar practices.

In Denmark, Interxion has developed groundwater cooling as an energy-saving measure. Previously, cooling in the summer months had been based on traditional refrigeration machines that used a lot of power.

Interxion worked with the city of Ballerup to develop a groundwater-based cooling system that can replace the

traditional refrigerants with geo-energy. The result is a system that, summer and winter, can always provide sufficient cooling while significantly reducing energy consumption.

Denmark and the whole Nordic region have evolved into Europe's leaders in energy efficiency. Not only are Interxion's Nordic facilities designed specifically with by-products such as excess heat in mind, they are among the only data centre providers covering the whole of Europe with 100% sustainable energy.

Hyperscalers such as Apple and Google have applauded the Nordics for their energy efficient data centres.

The great supply of power

Data centres are now embraced for their energy contributions to surrounding communities



“

Ireland's temperate climate makes it perfectly suited for free-air cooling, which uses approximately 40% less electricity than typical cooling

sustainable energy: 26% of the energy that Ireland produced in 2016 came from sustainable sources. It also possesses the third-highest wind penetration in the world. In fact, Ireland has set a target of having 40% of all its energy generated from renewable sources by 2020. It is quite ambitious but completely reachable.

As well as sustainable energy, Interxion's Ireland data centres are making major contributions in energy efficiency.

Interxion has pioneered new approaches to data centre design and management, including improvements around power usage effectiveness and a modular approach to data centre design.

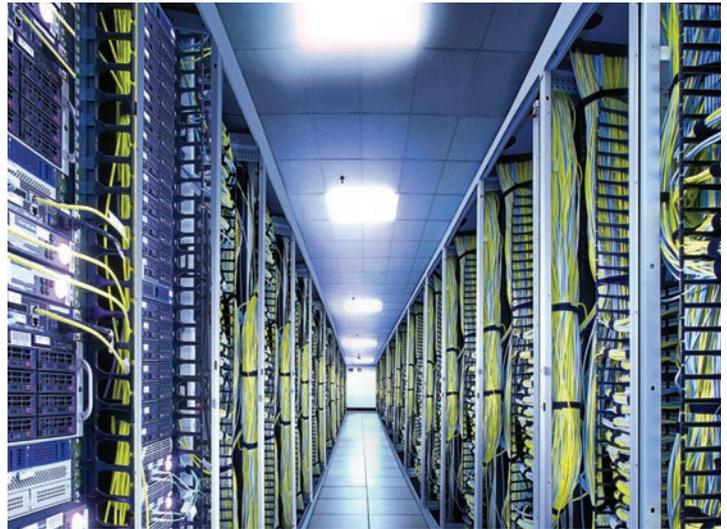
Interxion even designed its newest Ireland data centre DUB3 with a specific focus on energy-saving modular architecture, incorporating cooling and maximum efficiency components.

Interxion's sustainable facilities have changed the conversation around data centres. Once feared as a source of pollution, data centres are now embraced for their energy contributions to surrounding communities.

Enterprises that wish to boost their business in energy-conscious Europe have also embraced data centres equipped with green technology.

With such enormous benefits to the data centre industry, environment, and local communities, it is easy to imagine Interxion's green energy initiative is a win for all. ●

Intelligent grid connections



Stephen Jones, Head of Business Development for the Distributed Energy Sector for ABB Power Grids, shares insight into intelligent grid connections following his presentation at Data Centre World in ExCeL.

According to industry experts, 90% of all the data that exists in the world today was created in the past two years. And with rapid growth of connected solutions and the Industrial Internet of Things, our reliance on data centres is growing fast.

In turn, data centres rely on always-on power to maintain the data services that support real-world business.

That's where intelligent grid connections come in. These offer improved reliability, interoperability and real-time performance management through digital substation technologies.

Digital substations make use of ultra-fast communication over fibre optic lines instead of the traditional networks of copper signal cables in conventional substations. Not only does digital communication eliminate the need for regular testing and maintenance, but eliminating copper cable also enhances safety as there is no risk of electric shock from fibre optic cable as it does not carry current.

The other major benefit of digital substations is that their integrated sensors and diagnostics kit gathers and

analyses data around the clock. In turn, operators can optimise performance and reduce risk of outages.

One challenge that many data centre operators face when establishing a new facility or expanding an existing one is the long lead times that may be experienced when ordering a new grid connection. While this work is often carried out by distribution network operators, their new connections teams are well subscribed and as a result, Ofgem brought competition to the market in 1997 to reduce lead times.

ABB Power Grids is one of a select group of companies accredited to create new grid connections at all levels from 11kV to 132kV. We have specialist teams that can deliver new connections on a turnkey basis, taking on all tasks from securing permission and drawing up cable routes to supplying equipment, installation and commissioning.

The result is that data centre operators can plan their business growth with confidence.

Learn more at abb.com

Sources
<https://www.abb-conversations.com/2018/08/making-the-most-of-data-with-data/>
<https://new.abb.com/abb-ability/infrastructure/data-centers/intelligent-grid-connection>
 Previous FFWD stories on [contestable connections](#)

40%
 Ambitious target Ireland has set for energy generated from renewable sources by 2020

from sustainable sources such as hydro and wind power combined with the cold climate makes the Nordics an ideal place for building sustainable data centres. Due to this, and a fast-growing market in northern Europe, Interxion is seeing an increased number of hyperscale data centre projects emerging in both Denmark and Sweden.

Green-laden Ireland is another region in Europe where energy efficiency is thriving. The Emerald Isle's temperate climate makes it perfectly suited for free-air cooling, which uses approximately 40% less electricity than typical cooling methods.

In addition to energy efficiency, Ireland is a leader in



Rittal has issued predictions for the data centre sector as the industry moves towards greater AI-based monitoring capabilities and the processing of data in real time with edge computing. Hyperscale data centres will drive the cloud market and streamlined cooling technologies will boost energy efficiency in data centres.

Meanwhile, Nordic countries are continuing to offer attractive locations for cloud-based data centre facilities for those looking to cut costs.

The top five key trends that data centre operators need to watch for are as follows:

Trend 1: Data centres will acquire greater AI-based monitoring capabilities

IT data centre specialists will require assistance systems featuring artificial intelligence, or they will soon find it impossible to operate large and complex IT systems in a fail-safe way.

According to the IDC, by 2022, half the components within large data centres will include integrated AI functions

The future impact of the hyperscale data centre

There will be more than 600 hyperscale data centres worldwide by 2020, which could have a beneficial impact on the cloud market, according to Rittal. Artificial intelligence will grow in acceptance and there will be a greater focus on energy efficient technology

and therefore be operating autonomously. Essentially this means that administrators will be reliant on predictive analytics and machine learning – designed to provide predictive fault forecasts and support optimised load balancing – to ensure maximum reliability of their data centres.

Trend 2: Processing the flood of data in real time with edge computing

We are on the cusp of the roll-out of the 5G mobile communications network. With the many transmission masts, this means that the mobile communications infrastructure

will have to be expanded through edge data centres.

It will also increase the amount of data that network operators and other companies have to process. CB Insights forecasts that every user will generate an average of 1.5GB of data per day with an internet-enabled device by 2020.

Decentralising IT infrastructure through edge data centres means data can be processed at source, leading to low latency and enabling real-time applications for the control of industrial robots or autonomous vehicle systems. Edge data centres are connected to the cloud to

deliver additional data analysis.

Essentially, businesses now need to examine how to expand their IT capacities flexibly over the next couple of years and how to evaluate edge concepts with this in mind.

The general trend towards standardisation is another key factor in achieving the fast deployment time and scalability that the market is demanding from data centres.

Trend 3: The cloud market will benefit from hyperscale data centres

Acceptance of the cloud continues to grow, and is particularly prevalent

across mechanical and plant engineering. At the same time, investments in hyperscale data centres are increasing globally, an indication of the further spread of the cloud as an operating model.

Researchers at Synergy Reach expect that there will be more than 600 hyperscale data centres worldwide by 2020 – currently, the number stands at approximately 450.

This is why Rittal recommends that IT managers now consider how to balance their on-site edge (or core) data centre and cloud resources, to optimally support application hosting and high availability in line with their corporate strategy.

Trend 4: Optimised technologies will increase energy efficiency

Alongside high availability, energy efficiency is seen as the second most important management issue when it comes to operating a data centre.

The energy efficiency of new data centres has improved by roughly 60% in the past decade according to think tank, the Borderstep Institute. At the same time, however, energy requirements have continued to rise as IT capacities have grown. For data centre managers, optimising the energy usage of their entire data centre should be the number one priority in the coming year. Hybrid cooling units that integrate free cooling with refrigerant-based cooling are one example of new approaches to cost optimisation.

Trend 5: the nordic countries' locations will help to cut costs

The Nordic region has become an attractive location for cloud and co-location providers. Countries such as Denmark, Finland, Iceland, Norway and Sweden offer renewable energy sources, a climate favourable to data centres, very good internet

“Alongside the trend toward greater standardisation, we will see companies expanding their IT infrastructure in a more decentralised way in 2019

connections and a high level of political and economic stability.

Analysts expect the turnover of data centres in the region to grow by 8% per year until 2023. One famous example is Norway's Lefdal Mine Datacentre (LMD), with which Rittal is a strategic and technological partner.

LMD sources its electrical power entirely from renewables while the cooling system uses local sea water. As a result, the facility achieves a power usage effectiveness (PUE) of 1.15 and operating costs for customers are low.

“Alongside the trend toward greater standardisation, we will see companies expanding their IT infrastructure in a

more decentralised way in 2019. This will support the digital initiatives that now form an integral part of a successful corporate strategy. “One way of doing this is through edge data centres, which can be put into operation very quickly and on the company's premises as IT containers for instance, and which thus support the digital transformation in all branches of industry.

“Rittal is offering an array of solutions for edge infrastructures, ranging from rack solutions to turnkey IT containers with cloud connections,” says Andreas Keiger, executive vice president, Rittal Global Business Unit IT. ●

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Poorly specified cooling technology can result in erratic climate control, increased operating expenditure and costly disruption to IT operations.

With emerging trends such as 5G, IoT, automated vehicles and digitisation in the industrial sector, there will be a dramatic increase in remote edge data centres and small, localised server rooms – reliability will be critical. But are installers of cooling solutions prepared for these developments?

A lack of awareness of the differences between comfort cooling and precision cooling is impacting the reliability of IT infrastructure, resulting in serious consequences for businesses.

Around half of businesses currently install comfort cooling in small server rooms instead of the correct precision cooling. This is a common mistake; there is a need for education on the importance of precision cooling in delivering resilient IT operations. We are frequently called in to replace inappropriate units installed in technical spaces.

Comfort cooling units are designed for cooling people in offices and retail environments. This type of cooling technology is intended to operate for short periods of time (of around five hours per day, five days per week) and the typical life expectancy for a unit is around five years. Precision cooling, on the other hand, is designed for use in technical environments, 24 hours per day, seven days per week, and the typical life span is much longer – usually between 10 and 15 years.

Temperature accuracy

Stulz UK's precision air conditioning units ensure optimum temperature accuracy with maximum tolerances of $\pm 1^\circ\text{C}$ and are designed to dissipate isolated thermal loads even from distant corners of the room. Comfort units, on the other hand, can normally deviate from the set value by as much as $\pm 3^\circ\text{C}$. This is

significant as information and communication technology only works reliably and without faults within a relatively narrow temperature range.

There are other important differences that also need to be understood, however.

Comfort cooling units, as part of their design, are

Poor cooling knowledge leads to risk

A failure to understand the difference between comfort cooling and precision cooling is resulting in poorly specified equipment – leading to higher costs, IT failures and increased business risk, warns Stulz UK's Phil McEneaney



designed to cater for latent heat. Environments that are populated by people (as opposed to technical equipment) produce this type of heat, which contains moisture, while technical spaces (such as server rooms) radiate pure heat – referred to in the industry as 'sensible heat'. A comfort cooling unit

will have a typical sensible heating ratio of between 0.5 and 0.6, while a precision unit will have a sensible heat ratio of 1.

Comfort cooling units, which are designed to remove the moisture produced in retail and office spaces, can use up to 50% of their energy for dehumidification. This is an important difference – precision air conditioning units convert more than 95% of the energy used exclusively into cooling capacity. Therefore, the technology required to achieve this pays off quickly in terms of lower operating costs.

A comfort cooling unit rated at 10kW, with a sensible heat ratio of 0.5, will only deliver 5kW of sensible cooling. A precision cooling unit, with a heat ratio of 1, on the other hand, will deliver the full 10kW. This means you may need to specify two comfort cooling units to deliver the same capacity as one precision cooling unit.

Total cost of ownership

There are significant risks associated with inappropriate use of comfort cooling units, which installers need to be aware of. Unlike comfort air conditioning units, precision units feature strictly controlled and accurate dehumidification (tolerance $\pm 5\%$ relative humidity), as too much humidity can lead to condensation and corrosion, while too little can cause static charges, data loss and damage to hardware.

If you are removing moisture from the air, via a comfort system, you must be aware that the air will become drier and this can lead to static build-up in the technical space. These static shocks can be quite powerful and lead to failures of sensitive electronic equipment. We have seen instances where comfort cooling units have been specified, and the client has had to purchase additional equipment to add moisture to the room.

Humidification units add an extra layer of cost to the

original installation and are very expensive to run – which ultimately increases the total cost of ownership of comfort cooling solutions.

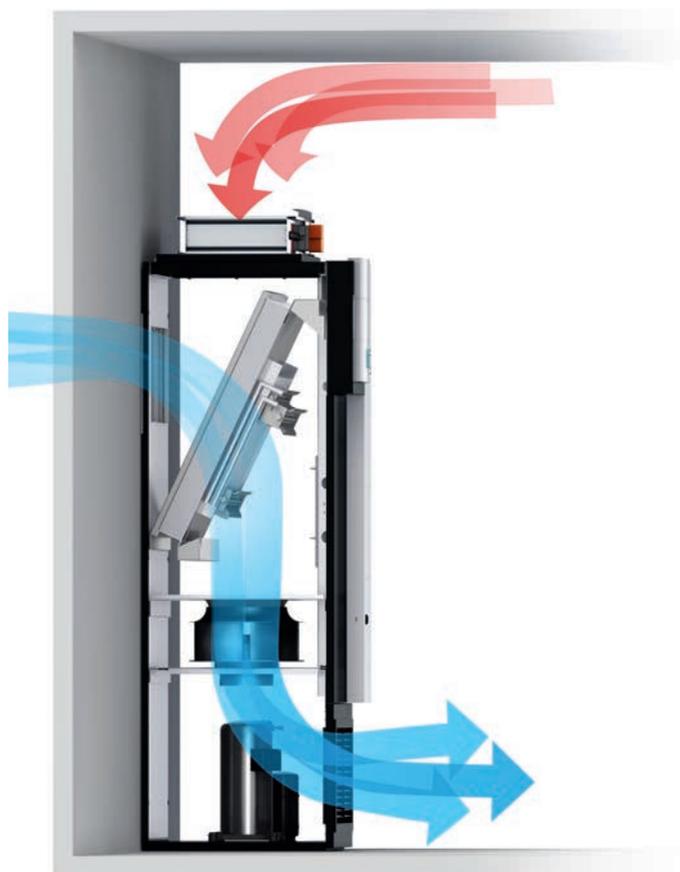
Other factors also contribute to increased expenditure – a replacement compressor may be needed after as little as three years if the unit is run day in, day out, as comfort units are not designed for this level of continuous operation.

Precision cooling units with EC fan technology can also offer further savings in running costs, however. The technology consumes up to 30% less energy than a conventional 3-phase fan; precision units (such as the MiniSpace EC range) can also run in energy-saving partial load mode and have a high motor efficiency of up to 92%.

It is a false economy to prioritise capital outlay when specifying air-conditioning units: if you install a solution that is not appropriate for the technical environment, you will have issues. Effectiveness needs to be the primary consideration, along with the long-term operating costs.

Operating features: comfort vs precision

It is important to note that comfort cooling systems also perform ‘oil return cycles’, which override the set temperature controls and can lead to intermittent falls in temperature. While this is less of a problem in server rooms, it can present issues in environments such as laboratories, where precise temperatures are critical to the integrity of the testing processes. Precision cooling units do not need this operating feature and therefore



Stulz air distribution with speed-controlled EC fan technology. Opposite page: Stulz MiniSpace EC precision cooler unit

do not present an operational risk in this way.

In addition, there is no ‘fall off’ in capacity on long pipe runs, which presents another advantage over comfort cooling systems. Pipe runs can affect the efficiency of the cooling system, so this is an important consideration when specifying a solution.

Also, the water collected by comfort cooling units needs to be disposed of and pumped to a drain – this presents further challenges, as there is a potential risk of leaks or flooding in the server room, which could

result in significant damage to electronic equipment.

Air filtration is another important factor when comparing comfort versus precision cooling. Precision air conditioning units (such as those manufactured by Stulz), filter and circulate three times the amount of air as comfort units with the same rated capacity.

Other differences are also important to note – for comfort cooling applications, it is less important for the filter to be highly effective in removing small particles; dust circulation has no detrimental effect in a non-technical environment.

In server rooms and technical spaces, it is crucial to prevent particles being blown or sucked into technical equipment, as this can shorten the lifespan of IT assets.

Advanced precision cooling units can provide continuous monitoring and control of air filtration to ensure high availability. In the case of Stulz UK’s MiniSpace EC range, an alarm notification can be raised via mobile phone or through the building management system. This helps businesses ensure the resilience and availability of their IT operations at all times.

Conclusion

Ultimately, rooms subject to high thermal loads need constant climatic conditions in order to work reliably. Fluctuating temperatures, humidity and dust jeopardise both function and data stocks.

Precision cooling technology is specifically designed for server rooms and technical environments where reliable thermal optimisation and high availability are crucial business imperatives.

With an increase in remote edge data centres and localised server rooms, predicted in the near future, it will become particularly important to understand the differences between ‘precision’ and ‘comfort’ when applying cooling for these systems.

Many specifiers and installers fail to appreciate the impact of employing inappropriate cooling technology until it is too late; there is an urgent need for further education to avoid costly mistakes and to prevent the risks associated with poor climate control. ●

“ Unlike comfort air conditioning units, precision units feature strictly controlled and accurate dehumidification (tolerance +/- 5% relative humidity), as too much humidity can lead to condensation and corrosion, while too little can cause static charges, data loss and damage to hardware – **Phil McEaney, Stulz UK**



With strong market drivers and demand for more distributed IT architecture to support emerging technologies, the shift to edge represents one of the most profound opportunities to modernise today's legacy infrastructure and data centre ecosystem. However, there is still a great deal of confusion around what 'the edge' actually is, according to Kevin Brown.

"On the one hand, we are saying this is the next multibillion-dollar business and on the other, we are saying 'what is it?'" he comments. "In 2012, Cisco introduced the concept of Fog Computing [a standard that defines how edge computing should work] and this is when we really started talking about 'the edge'. This was around seven years ago, yet we are still trying to agree a definition. It is pretty complex, we don't know exactly what it is going to look like, or what the opportunity is, but we know it is going to be big."

Schneider Electric predicts there will be three types of data centre in the future: large, centralised cloud data centres; regional edge data centres of about 1-5MW, servicing local areas; and 'local edge' sites, which may be anything from one rack up to around 100kW of IT.

"What seems certain is the new hybrid computing architecture will require a more robust edge infrastructure. Users are now asking how fast an app will load on their device, not just if it will load, and they expect responsiveness," says Brown.

The local edge infrastructure will be widely dispersed and will need to be effectively managed to ensure resilience, which will present significant challenges. Brown argues that, when we discuss resilience, according to the Uptime Institute's Tier system, we talk in percentages of uptime. In his view, this can give a false sense of security; the difference between '99.98 uptime' for a Tier III data centre and '99.67 uptime' for a Tier I data centre doesn't sound like a huge difference. However, it is



Making 'the edge' mission critical

Should edge data centres be treated as mission critical sites and how can we make this a reality? Kevin Brown, CTO of Schneider Electric's IT Division, warns that the edge will need to become a lot more resilient in the future, but there are significant challenges ahead. Louise Frampton reports.

much more meaningful when you compare hours of downtime – ie 1.5 hours vs 29 hours.

"I would argue that edge data centres are mostly Tier I. We have got pretty good at building large data centres for Tier III... The challenge arises when you connect these together. If you take a centralised data centre with a downtime of 1.6 hours

per year, and connect it to a local edge data centre, running at Tier I, the availability for the person that is dependent on that edge data centre goes down. It is worse than Tier I when you do this – it goes from 29 hours of downtime for the local edge data centre to 31 hours. In fact, many edge data centres are worse than Tier I.

"A lot of chaos happens. There are no local staff taking care of them. I visited a Tier III data centre and had an armed guard following me around. Yet, if I visit a retailer with an edge data centre, the janitor has access into the closet... this is playing out in real time."

Brown warns that we need to start treating edge sites as



He says that Schneider Electric is already making progress in terms of an integrated 'eco system' and has been working closely with HPE, Scale Computing, Cisco, StorMagic and Dell EMC on delivering resilient edge data centre solutions, including a standardised and robust micro data centre that can be monitored and managed from any location.

The Micro Data Centre (DC) Xpress allows IT equipment to be pre-installed by the customer, partner or integrator before shipment, and features complete data centre physical infrastructure and management software in a self-contained and secure enclosure. These micro data centres are also certified by leading converged and hyperconverged IT vendors.

Users of distributed IT

even whether the user can get the IP address – the problems can range from very complex issues to the very basic," he continues.

Need for effective management tools

Brown argues that management tools must move to a cloud-based architecture. This will allow thousands of geographically dispersed edge sites to have the same level of manageability already provided for large data centres.

"With a cloud-based architecture, you can pay-as-you-grow and start with what you need. It's easy to scale, upgrades are automatic, and it has up-to-date cybersecurity. Most importantly, this approach enables access from anywhere, at any time, from any device," Brown explains.

IT Expert allows secure, monitoring and visibility of all IoT-enabled physical infrastructure assets, including power and cooling – anywhere, at anytime.

The solution addresses the data centre industry's need to simplify how data centres, distributed IT and local edge environments are managed. Providing proactive recommendations and consolidated performance and alarming data, the solution can reduce alarm noise and improve overall site resiliency.

"It is no longer just on-premises staff that can see the data. Experts from Schneider Electric, managed service providers, IT vendors and everyone in the eco system can look at the exact same data at the exact same time.

"This is the power that comes

“ I visited a Tier III data centre and had an armed guard following me around. Yet, if I visit a retailer with an edge data centre, the janitor has access into the closet... this is playing out in real time

Kevin Brown, Schneider



mission critical data centres. Although this presents a challenge, there are three aspects that contribute to making the edge more resilient:

- An integrated ecosystem
- Management tools
- Analytics and AI

Physical infrastructure vendors, the IT equipment manufacturers, system integrators and managed service providers will have to work together differently in the future, particularly in terms of the supply chain. Solutions will need to be delivered to site fully configured.

"All of it needs to come together with a thorough understanding of the customer application and be delivered at multiple locations worldwide, leveraging existing staff. This is part of the challenge," comments Brown.

architectures are also faced with the issue that they have no expert, onsite IT staff to deal with the issues that can arise across multiple, dispersed locations.

"Customers say that they receive so many alerts that they don't know what to do with them; they don't know which ones are important.

"It is one thing when you are in a big data centre, when you have lots of highly trained staff running a networked operation, with 10 screens up on the wall and educated people sifting through the data. They understand what is going on. But it is a different scenario when you have 3,000 micro data centres – it can be a nightmare; no one knows what they are doing," comments Brown.

"There are issues over who is accessing the equipment and

He adds that multiple players in the ecosystem can see the same data and work from the same exact dashboard at the same time.

Ultimately, end users want to know they have a problem before it is too late, and this is the potential of predictive analytics.

However, edge data centres need to be managed holistically as opposed to being managed as a collection of individual devices – ie the UPS or the PDUs. At the same time, it is important not to lose the granularity of the data.

Brown reveals that Schneider Electric is addressing the need for management tools with the introduction of a cloud-based data centre infrastructure management (DCIM) solution that facilitates resiliency optimisation. EcoStruxure

with it. Everyone is working from the same data set. It is also the only way you can move to machine learning and artificial intelligence; you need a large enough data set," says Brown.

He outlines four key ingredients for artificial intelligence:

- A secure, scalable, robust cloud architecture
- A data 'lake' with massive amounts of normalised data.
- A talent pool of subject matter experts
- Data scientists to develop the algorithms

"It is our experience that once you have these ingredients, which provide a solid foundation, you can start doing something interesting. You can become more predictive and help data centre operators know when there's a problem before it occurs," Brown concludes. ●

Need for speed: prefab market gaining momentum

Prefabricated data centre solutions are growing in popularity, but operators are demanding the same levels of resilience and Tier certification that they are accustomed to with traditional data centre builds. Louise Frampton reports

The Uptime Institute reports that prefabricated and modular data centres are on a growth trajectory as organisations strive to bring business services closer to their constituents. Other market intelligence appears to substantiate this view, with the modular data centres market expected to grow US\$800m by 2022, at a high compound annual growth rate of 23%.

To address this demand, Schneider Electric has been working with the Uptime Institute to deliver solutions that meet the requirements for cost-effective deployment as well as resilience.

Part of Schneider Electric's EcoStruxure for Data Center architecture, Tier-ready reviewed designs are now available as a 90kW Tier II All-in-One module and a 500kW Tier III multi-module

solution for 400V regions. Each reference design includes comprehensive technical documentation, schematics, layouts and equipment all reviewed and approved by the Uptime Institute.

The Tier-Ready design review programme has been developed to help improve the process from design to deployment for customers who are pursuing full Tier certification for their prefabricated modular data centres.

"Prefabrication makes the whole process simpler and dramatically reduces costs for the end-user," explains Scott Neal, global product marketing

director, prefabricated data centres, Schneider Electric. "We expect to see an increase in uptake of this approach and are already seeing a lot of interest. The prefab market is being driven by the need for speed, standardisation and higher quality."

Prefabricated solutions can be delivered in as little as 16 weeks, depending on the size of the unit, and this speed of deployment is a key benefit for colocation providers seeking rapid growth. The modular nature of prefabricated facility modules also enables scaling and right-sizing to actual data centre loads. Right-sizing has

50%

Potential electricity bill savings that can be achieved by right-sizing data centre infrastructure

the potential to eliminate up to 50% of the electrical bill in real-world installations, according to Schneider Electric's calculations. This, in combination with current power and cooling distribution technologies, is claimed to result in TCO savings of nearly 30% compared with a

“

Large retailers, industrial sites, the mining sector and even hospitals are looking for a simplistic approach. They are finding that they need to put a data centre where they have never had one before and it needs to be robust

traditional data centre (27.2% capital cost and 31.6% operating cost).

Whether deployed for edge sites or medium to large colocation providers, prefab solutions cannot afford to compromise on security or resilience, however.

“Services must be delivered with the same level of mission critical performance seen in larger data centres, but at a dramatically smaller scale, which can be deployed in a fraction of the time, all without incurring the traditional risk associated with remote infrastructures,” comments Uptime Institute chief revenue officer Phil Collerton.

“The Tier-Ready design review programme dramatically simplifies and speeds up the Tier certification process,” he adds.

With the prefabricated modular data centre market showing strong growth and increasing demands for more critical power with shorter lead times, Schneider has expanded its range of prefabricated power modules and skids from 625kW up to 1.25MW in 400V regions. The customisable designs feature the latest high efficiency Galaxy VX UPS with Li-ion battery options, Prisma LV switchboards, and are all EcoStruxure ready.

“Large retailers, industrial sites, the mining sector and even hospitals are looking for a simplistic approach. They are finding that they need to put a data centre where they have never had one before and it needs to be robust,” Neal explains.

“A prefab structure makes this easy. Hospitals are increasingly reliant on digitisation, for example, but the space to accommodate new data centre infrastructure just isn’t there. Locating the data centre outside of the hospital building, through a prefabricated solution, means that valuable space can be kept free for patient care.”

Schneider Electric points out that traditional designs almost always intentionally incorporate excess capacity

Figure 1: Breakout of major capex cost savings when comparing traditional to modular

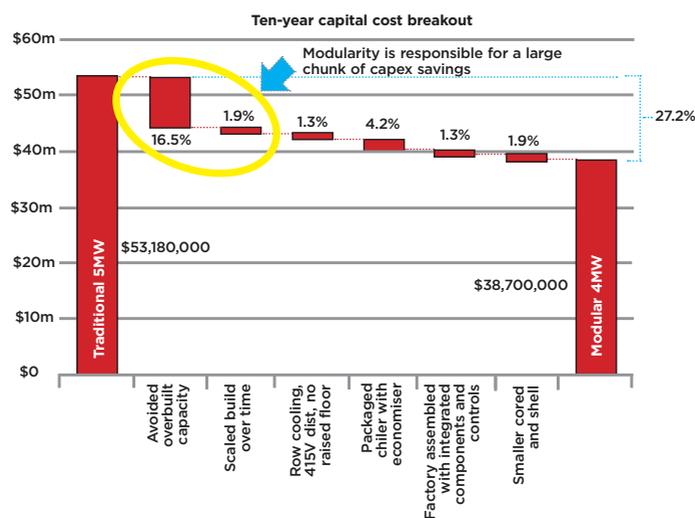
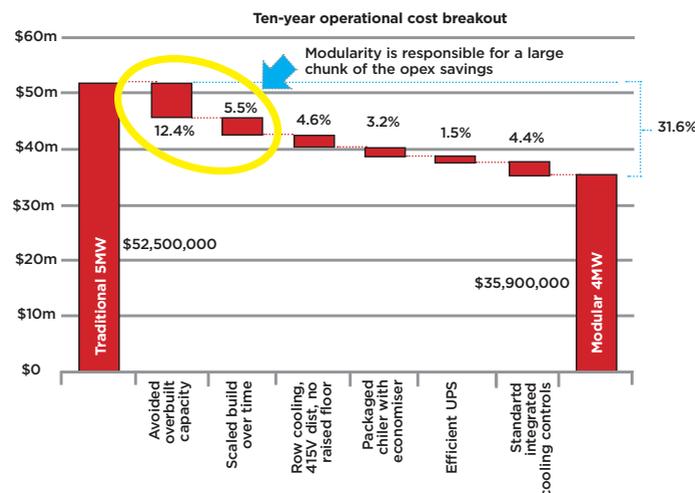


Figure 2: Breakout of major opex cost savings when comparing traditional to modular



Figures 1 and 2 illustrate a capex difference of 27.2% and an opex difference of 31.6% between a data centre with traditional infrastructure and operational practices, and a data centre with prefabricated facility modules designed and implemented with best practices. Source: Schneider Electric - Data Center Science Center

Right: Schneider has expanded its range of prefabricated power modules



higher upfront capital costs and a chronically inefficient data centre.

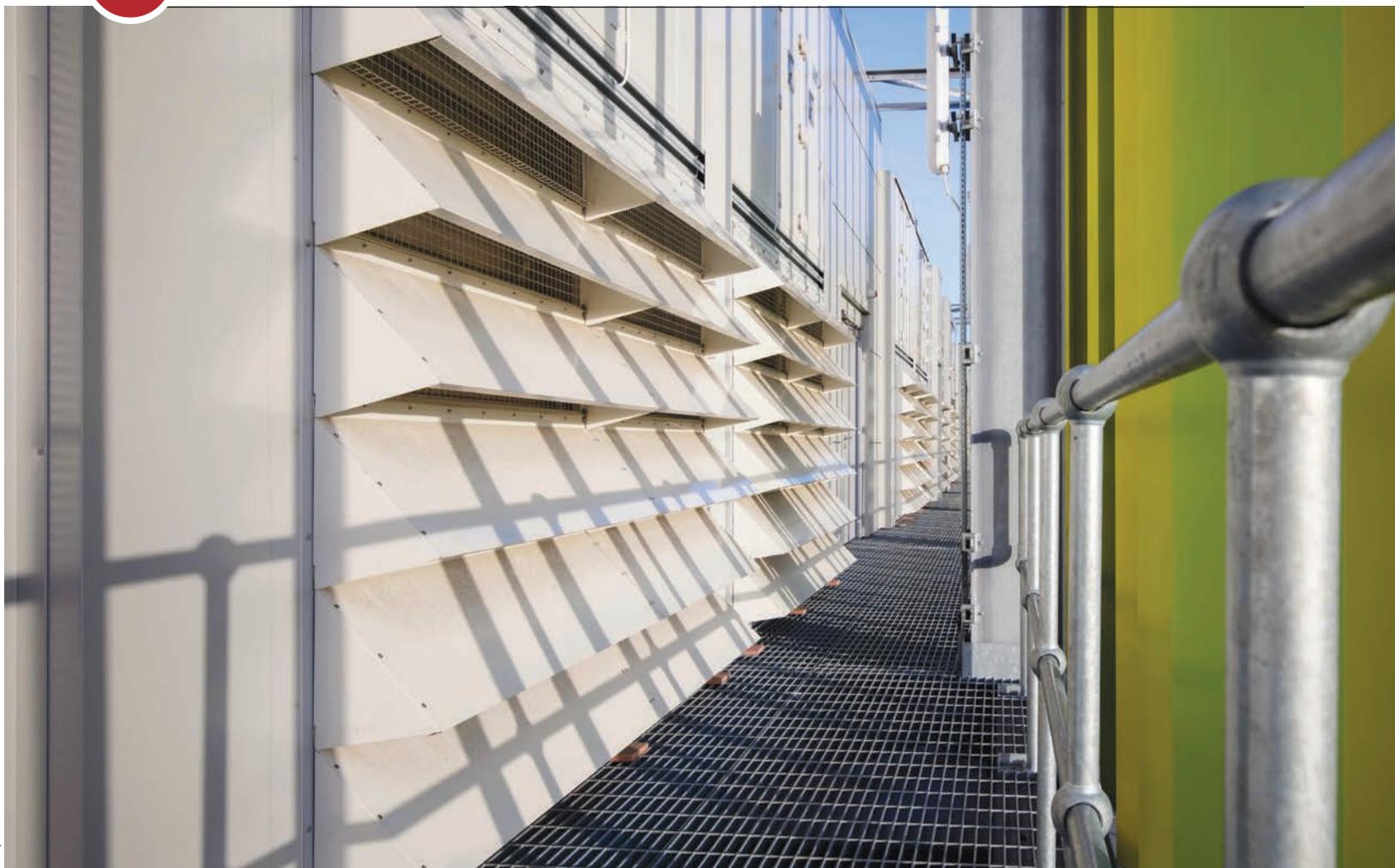
The proper deployment of prefabricated facility modules, on the other hand, eliminates this wasteful over-sizing tendency, because standardised, modular architecture makes adding or reducing capacity to meet real-world, dynamic demand much easier.

Ultimately, prefabricated design resolves many issues for many industries, according to Neal, but what sets the Schneider solution apart is the breadth of capabilities that are being integrated into the prefabricated portfolio – from power and cooling, to software and monitoring services.

“In 2018, we have seen a large adoption rate and the data centre sector is now seeing this as a viable option... the big growth is largely being driven by the mid-scale, up to the hyperscale, but adoption is also being seen with edge platforms,” comments Neal.

He adds that the growth in adoption has been on a global scale (although the main focus has been within North America). However, there has been a particularly rapid increase in Asia, which has surpassed expectations. Many colos are expanding into the Asian markets and using prefabricated solutions to support their growth in the region.

Power modules, in particular, are helping to manage this expansion, in terms of infrastructure. Even where the IT space retains a traditional approach, power is being moved outside of the building, Neal concludes. ●



Earlier this year, Kao Data announced the opening of Kao London One, the first of four data centres to be built at the Kao Data Campus in Harlow, Essex. As part of the data centre's energy efficiency design, the latest innovative free cooling technology has been installed.

A new entrant to the wholesale colocation data centre market, KAO Data made the decision early on to appoint as lead contractor the highly experienced M&E design and build contractor JCA Engineering. This decision allowed a highly collaborative working relationship to develop.

Paul Finch, COO at Kao Data, comments: "Unlocking the free-cooling capability of Kao Data Campus was a key strategy to enable us to build a fully resilient facility which could provide a flexible response to customer requirements while delivering a class leading, ultra-low 1.2 PUE at all ITE loads."

With guidance from JCA,

Driving down PUE with free cooling innovation

KAO Data, a recent entrant to the colocation market, is optimising its cooling efficiency and meeting challenging PUE targets, with the installation of innovative free-cooling technology

Kao Data investigated the opportunities for free-cooling alternatives for its campus IT halls. FläktGroup has a long relationship with JCA Engineering, in consultancy, design and implementation of large volume, air handling systems (AHU), chiefly with the DencoHappel product lines.

Discussing the journey to a free-cooling IT space, JCA Engineering managing director Tom Absalom says: "JCA quickly gained the confidence of Kao Data's senior management, as both sides were working towards a common goal, which at

the time was unusual in the UK data centre market – one where mechanical cooling was eliminated from the design."

The FläktGroup AHU design team worked closely with JCA and Kao Data to develop an efficient free-cooling system that offers the flexibility to provide a controlled environment within the technical space of the 8.8MW data centre that was able to meet server manufacturer warranty requirements.

To determine the most effective cooling solution, FläktGroup analysed the potential IT load variables across the data centre IT space.

With a potential energy load of 2.2MW per data hall, the client was focused on delivering the vast-majority of that energy to IT use, and not detracting from the energy envelope to power refrigerated cooling systems.

Power is the single largest operational cost within a data centre, and the mechanical cooling system is usually the biggest percentage of that – often higher than the energy used to run the servers and other IT equipment.

According to Yan Evans, global director of data centre solutions at FläktGroup: "Understanding the client's varied requirements including

KAO Data's campus has been designed for maximum efficiency

“Unlocking the free-cooling capability of Kao Data Campus was a key strategy to enable us to build a fully resilient facility which could provide a flexible response to customer requirements while delivering a class leading, ultra-low 1.2 PUE at all ITE loads

exceptional EER (energy efficiency ratio) values.

Now operational, phase one of the Kao Data campus, has implemented N+1 Indirect Evaporative Cooling (IEC), using 13 Adia-DENCO AHUs, providing highly efficient climate control within the Kao Data London One

data centre. This configuration enables concurrent maintenance of the IECs and also offers the required resilient backup capability in the unlikely scenario of a unit failure.

To maximise the internal space for IT equipment, the cooling systems are mounted externally on the building adjacent to the IT hall. The system is installed with dampers, weather guards and a weather roof to protect the equipment from the environment. In this wall configuration, any air that enters the unit is returned to the same side.

Each IT hall is approximately 9,500sq ft and the 13 AHUs provide a net cooling capacity of 2.2MW (N) and airflow of 13.5m³/sec per unit into the data centre.

The installed units use reverse osmosis water, which allows for the water to be reused for adiabatic cooling several times. This dramatically reduces flush cycles from every hour to typically once a week. This,

combined with intelligent control software, allows for water use to be minimised, improving WUE (water usage effectiveness) at the Kao Data Campus.

Within the IT halls, customer cabinets are in enclosures and use hot aisle containment, which enables higher density racks – up to 20kW – to be optimised using IEC cooling technology.

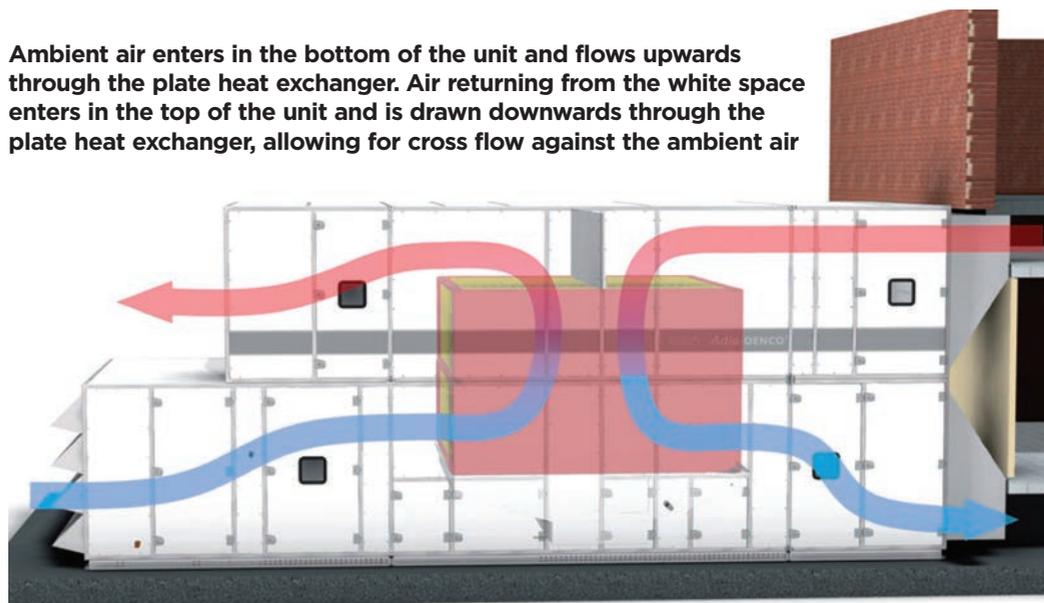
The cooling infrastructure is designed around a conservative temperature differential of 12°K. Applying the combined expertise of Kao Data, JCA and the FläktGroup design team to the IT cooling system has enabled a reimagining of the equipment needed and has greatly reduced the mechanical complexity of the data centre.

This subsequently has positive effects such as increased energy efficiency (the Kao Data London One data centre operates with an ultra-low PUE <1.2 even at partial load), significantly reduced maintenance requirements and increased system reliability. ●

energy efficiency, reduced environmental impact and cost of operations. Our solution was based on Adia-DENCO evaporative cooling units, which are able to cool data centre environments without mechanical refrigeration equipment, such as compressors, while still achieving all three of the metrics set by Kao Data.”

Adia-DENCO uses local climate conditions for enhanced energy efficiency operation. Adiabatic cooling, coupled with large plate heat exchangers, enables energy efficient customers such as Kao Data to achieve

Ambient air enters in the bottom of the unit and flows upwards through the plate heat exchanger. Air returning from the white space enters in the top of the unit and is drawn downwards through the plate heat exchanger, allowing for cross flow against the ambient air



A new lease of transformer life: five reasons to retrofill

Catastrophic transformer fires and downtime could be avoided if critical sites move to the use of ester fluids. Midel's Barry Menzies presents the case for making a change

Factories, hospitals, universities and airports are all very different facilities with very different energy demands, but they have at least one thing in common: for each of them there will be someone lying awake at night worried about transformer failure.

The recent Midel Transformer Risk Report (TRR) indicated that more than 80% of professionals working with transformers worry about a failure, with half predicting a significant effect on operations in the event of one.

With safety and business continuity in the balance, it is vital for asset managers to ensure their transformers remain fit for purpose as they age, and as the demands placed on them (and the built environment around them) increase. However, replacing a transformer can be an expensive and disruptive process. If only there was a way to upgrade or prolong the life of a transformer in situ...

Enter retrofilling

Retrofilling is the process of draining and replacing the transformer's insulating liquid. Typically, the liquid being replaced is mineral oil – the go-to transformer fluid for much of the market due to its low price and adequate performance in most business-as-usual scenarios. The replacement is usually an ester fluid, which offers a number of advantages. Generally,

any distribution network level transformer previously filled with mineral oil can be straightforwardly retrofilled with an ester fluid (some technical considerations apply). But what are the reasons to do so?

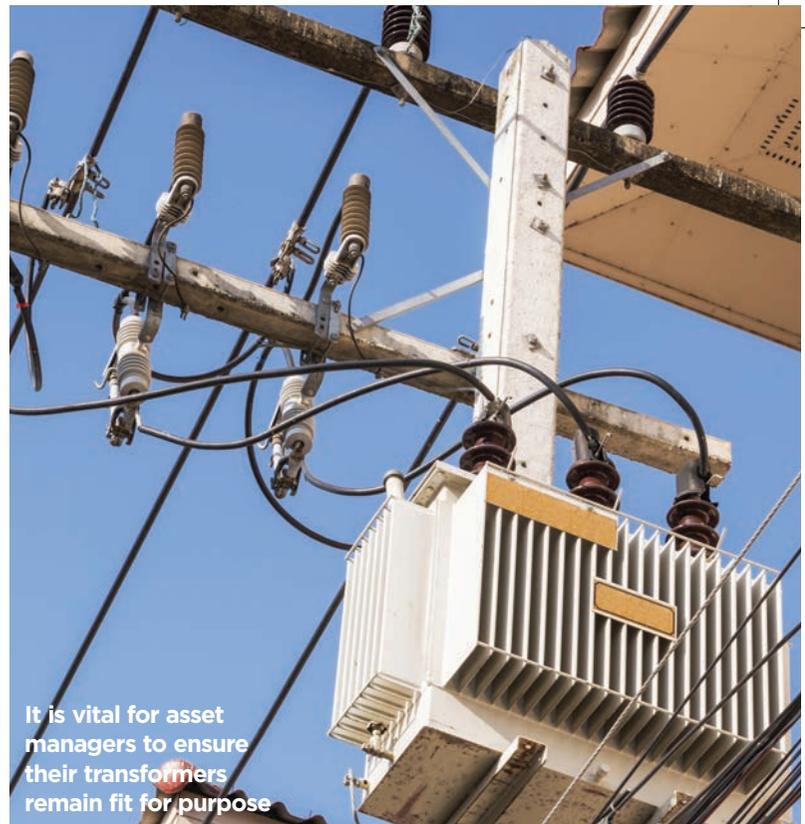
Reason one: safety, safety, safety

Mineral oil has a relatively low fire point at 170°C, at which point it can potentially ignite and cause dangerous pool fires if the transformer ruptures, as evidenced by the host of transformer fire videos on YouTube or Google.

Ester fluids, by contrast, are K-class fire-rated, meaning their fire points are at least 300°C, drastically reducing fire risk.

Even in the event of a failure, ester-filled transformers will not cause pool fires. As such, retrofilling with esters can provide a major safety upgrade – the number one concern of any asset manager. This is especially important for transformers in sensitive locations, such as within hospitals, in the proximity of flammable materials, or near the general public.

You might wonder why mineral oil would have been used in these locations in the first place (we have even seen a mineral oil transformer in the



It is vital for asset managers to ensure their transformers remain fit for purpose

basement below a maternity ward – it has since been retrofilled with ester fluid). It is a matter of awareness and education; the fact is, in past decades there were few well-known alternatives to mineral oil, making it the only option by default. However, attitudes to risk change and esters are now well known and widely available.

Retrofilling, where technically possible, is a cost-effective way to improve safety compared with replacing the transformer. When it comes to safety, the bottom line is that ester fluids are an accepted technology, so the decision to use mineral oil in a transformer is a decision to accept a higher degree of risk.

Reason two: asset life extension

Another major concern of any asset manager is to prolong the life of their assets and thereby extract maximum value from them. Transformers are expensive and having to replace one before it is absolutely necessary is a difficult proposition to make to the finance director.

Retrofilling with esters can help by prolonging the transformer's lifespan (and in some cases enabling the transformer to operate under increased load). One of the key

factors that drives ageing in transformers is water, which can ingress from the atmosphere, or be produced during paper ageing processes. This water then accelerates the degradation of the solid insulation material. Esters, however, have a far higher moisture saturation point than mineral oil, meaning they can absorb more water.

This effectively keeps the solid insulation drier, which reduces its rate of degradation, thereby slowing down the paper ageing process and prolonging transformer life. In theory, esters can give a 5-7 times increase in insulation longevity in this way. It is realistic to expect insulation life extension of between 25 and 50% (if not more) – music to a finance director's ears.

Reason three: a powerful financial case

There are other financial benefits to retrofilling beyond asset life extension, too. One is concerned with insurance. Certain insurers such as FM Global have studied the risks related to transformer fluids and now specify what they call "less flammable fluids" in certain circumstances, rather than mineral oil.

As such, retrofilling with esters may be the difference between a policy renewal being approved or

“For almost any company operating one or more distribution network transformers filled with mineral oil, the case for retrofilling with ester fluids is compelling

rejected, or open up more choice between insurers on the market. In some instances, it may even lower premiums.

Secondly, retrofilling can be useful from an accounting point of view. Along with finance directors, asset managers must always play a juggling act between capital and operational expenditure (capex and opex). If upgrades are required to the transformer fleet, but there is insufficient capex budget to replace all transformers, others can potentially be retrofilled from the opex budget, thereby delivering the benefits of ester fluids immediately, without capital outlay. Both benefits should be attractive to any finance director.

Reason four: better for the environment

Another drawback of mineral oil is that it is both toxic and non-biodegradable. In the event of a leak it can damage the local environment.

For transformers placed near fragile ecosystems or water sources, such damage

can potentially be significant. As with health and safety, our society-wide attitudes to risk have evolved in the decades since many of these transformers were first installed. While these risks may once have been deemed acceptable, they are less likely to be now.

For any transformer-operating firm with a robust CSR programme or other commitment to the environment, retrofilling with non-toxic, biodegradable esters is an appealing option. For example, in the 1990s European utility Vattenfall embarked on a transformer retrofilling initiative in Berlin.

The city presents very specific challenges for transformer installations since much of it is zoned as water protection areas, requiring safeguards regarding spillages of hazardous materials, including mineral oil. To date, more than 1,200 distribution transformers in the city have been retrofilled with ester fluid.

Reason five: bolstering reputation

Improving health and safety

and environmental performance with ester fluids are worthy goals in themselves. However, there is extra value to be had in the reputational boost these efforts offer. A proactive communications campaign built around a retrofilling programme can help a company boost its reputation to its customers and other stakeholders.

Conversely, there is a significant reputational risk that comes with a major safety or environmental incident. It may seem 'softer' than the hard numbers of the financial argument, but a responsible board will be mindful of such events damaging the company – not to mention any negative impact it may have on its business performance.

Ready to retrofill

It is true that all transformers will eventually need replacement, whether they are retrofilled or not, and a company may have its own reasons for investing in new assets rather than extending the life of the existing fleet. However, since

retrofilling brings so many benefits, why not extend asset life with ester fluids, especially when doing so is likely to more than offset the investment?

The actual retrofilling process is minimally disruptive, and can often be completed in eight to 12 hours – easily within the timeframe of most planned maintenance schedules. Normal production or operations are usually hardly affected. It is a simple, proven process with minimal risk involved, if all safety procedures are observed, and is usually performed by experienced oil service contractors.

For almost any company operating one or more distribution network transformers filled with mineral oil, the case for retrofilling with ester fluids is compelling. For a relatively low investment per transformer, the company can bolster its business continuity strategy and enjoy major safety, environmental and financial benefits by giving their transformers a new lease of life. ●

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European data centres get 'OCP-Ready'

Best practice open source design principles are being rolled out across the data centre sector as part of a hyperscale inspired initiative aimed at saving energy and reducing costs. Louise Frampton reports

In 2011, Facebook shared its designs with the public and, along with Intel and Rackspace, Goldman Sachs and Andy Bechtolsheim, launched the Open Compute Project (OCP). The OCP Foundation has gone on to promote open source data centre design through its Data Centre Facility Project, focusing on the key areas of efficiency, openness and scalability.

Today, there is growing interest in OCP, and the technology and tenets on which the project are based are now finding their way into facilities outside of the hyperscale space. According to a recently published survey by IHS Markit, the government sector passed financial institutions in non-board OCP spending in 2017. The automotive and manufacturing sectors are

expected to have the highest five-year CAGR, while healthcare is now in the early stages of OCP adoption.

Overall, predictions for the immediate future are optimistic – the EMEA region has been identified as a primary region for OCP technology growth, with a forecast 59% CAGR over the next five years.

The survey also notes that the drivers of adoption of OCP are growing more diverse – cost reduction and power efficiency are still the biggest reasons for adoption, but the market is now realising that feature flexibility and conformance to specifications approved by OCP provide a measure of 'comfort' to the market.

OCP Foundation CTO Bill Carter believes that the key to the project's strategy has been the roll out of best practice

which can be adopted across any type of data centre – from the traditional, on-premises data centre, to the colocation provider and hyperscaler.

"We have quickly learned that no two data centres are designed the same, and their workloads and business sizes are not the same," he says.

"One shoe does not fit all, so we have focused on offering different options. One of these options is the new 21-inch wide, Open Rack design, but we continue to do a lot of work with the EIA 310 19-inch rack – there is a lot that can be done to make this efficient and scalable. Around half of our products are built around this standard."

Carter adds that the project has not been without its challenges: "Taking a Facebook design and scaling it around the world isn't easy. There are only

a handful of customers that can do that. But we have realised that it is possible to design a modified facility that simply implements the best practices of the industry.

"Regardless of what equipment goes in, there are best practices around power delivery, cooling technology, operations, air handling and network distribution topology, and fire and safety systems. When these best practices have been implemented in their entirety, they have worked well for Open Rack, but also for any other rack architecture and in any type of cloud environment."

The OCP data centre facility group has been refining the wealth of knowledge accumulated by the industry and using it to create a checklist of best practices, with the aim of maximising



The OCP data centre facility group has been refining the wealth of knowledge accumulated by the industry to create a checklist of best practices

you build your system at a local integrator's facility, then ship it to your facility, your operational expenses are significantly lower, as it reduces the need for manpower and specialist test equipment on site. To achieve this, you need the right-sizing for your elevators and dock doors, and the correct weight loading for your raised floors."

"This best practice checklist is the right thing to do, regardless of whether a data centre adopts Open Compute or any of the rack architectures that we have in our portfolio," continues Carter.

At the recent OCP Global Summit, two European data centre operators were announced as having achieved OCP-Ready status – KAO Data, based at Harlow, in the UK, and Switch Datacenters from Amsterdam, in the Netherlands.

Kao Data's London One 8.8MW facility has been designed to maximise the mechanical performance and

envisaged as the UK's first wholesale colocation data centre to be aligned with the hyperscale principles that target efficiency and effectiveness across the entire building and site."

Thibault adds: "The achievement represents the laying of the design foundations by Paul Finch and the team at the start of the project and latterly the assistance provided by Mark Dansie and Brevan Reyer of the Data Centre Facility project under the stewardship of Steve Helvie of OCP. Everyone can now find their way to Kao Data from the OCP website (visit opencompute.org and click on Marketplace/OCP-Ready)."

Switch Datacenters' AMS1 site has also demonstrated that it complies with all site requirements for a colocation service provider to be able serve OCP customers and their hardware in its facilities. Using a patented own design, Switch

game-changing trends, and innovation is for us the only answer to grow. That is why Switch Datacenters is eager to cooperate and share our knowledge and learnings in an open community, like the global OCP community, and we welcome believers in OCP technology to our Amsterdam facility."

So, is OCP for everyone? Carter believes that the open source has something to offer all data centres:

"Everything you need is available in the open source model. There is no reason why it cannot be adopted by anybody. It is very scalable, from the traditional enterprise data centre to the hyperscale environment."

He adds that the OCP community is adding more and more solutions providers and integrators around the globe: "This means you can build a solution from more than one



Taking a Facebook design and scaling it around the world isn't easy... but we have realised it is possible to design a modified facility that simply implements the best practices of the industry



mechanical performance, as well as thermal and electrical efficiency. In total, 80 items are included on the checklist – against which the participating facilities must conduct a self-assessment. If they are confirmed as being compliant, they are then recognised as being 'OCP-Ready'.

This includes the capability to deliver power in a higher voltage, Carter explains: "These data centres are able to demonstrate they can deliver 415V or 480V, 3-phase, directly to the racks. This can benefit the entire industry."

He adds that there are other benefits associated with OCP design, in terms of energy efficiency and cost savings: "Specifying a minimum load for the dock allows for fully configured racks to be delivered and this facilitates cost savings. If

thermal and electrical efficiency of OCP servers and other equipment (see page 28), while providing access and equipment pathways for the largest OCP equipment throughout the data centre. The campus achieved OCP compliance across the five core areas (power, cooling, IT space layout and design, facility management and control, and facility operations). It also achieved over 75% in the 'Optimum' category, which means that the systems go beyond the base requirement, ensuring compliance with emerging standards.

Gerard Thibault, CTO at KAO Data, comments: "The recognition of the Kao Data facility as being OCP-Ready is a validation of the company's philosophy of being 'the home of innovation'. The Kao Data London One facility was

Datacenters is among the greenest data centres in Europe with a PuE of <1.15.

In October 2018, Switch Datacenters, Rittal and Circle B also jointly announced the opening of the first European Experience Centre for OCP technology, located in the AMS1 site of Switch Datacenters. The Experience Centre is intended to help the OCP community increase awareness of the advantages of OCP Hardware and OCP design architectures, and provides a real-life demo environment for customers.

Edgar van Essen, managing director of Switch Datacenters, comments: "While the data centre market is exploding on a worldwide scale, we need to continuously keep looking for more efficient, smarter and greener solutions to be able to compete. OCP is one of the

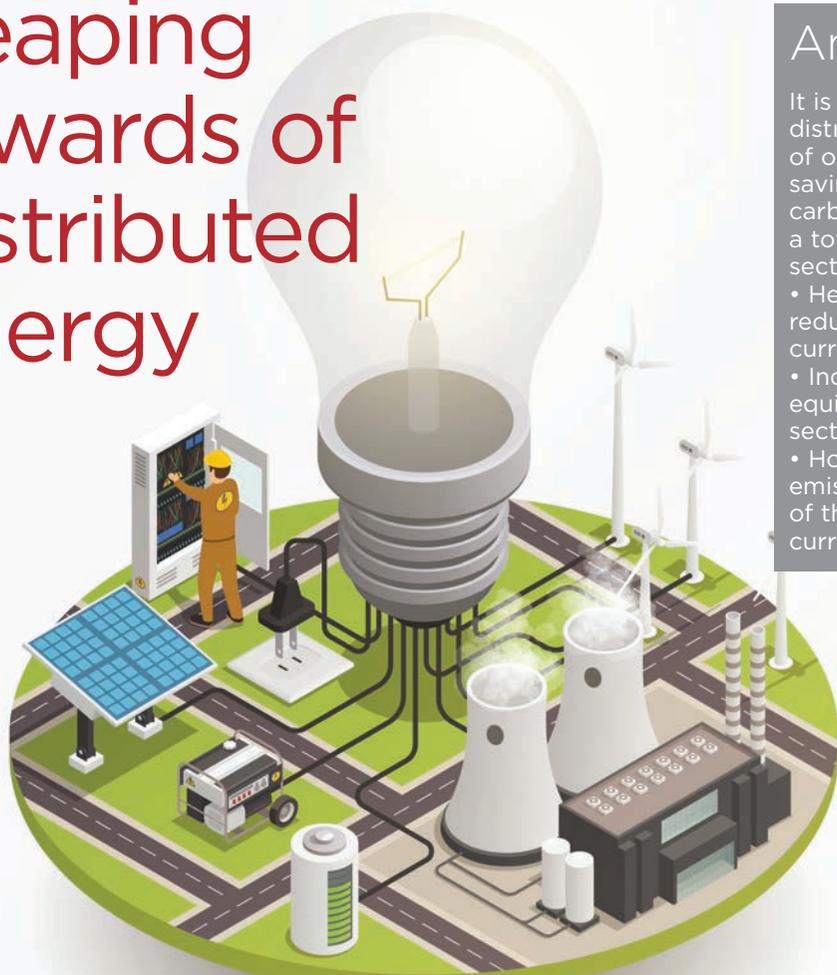
supplier and mix and match the best hardware for your application. You are not locked into a single supplier," Carter comments.

Ultimately, issues regarding the supply chain and sales support channels, which posed a potential barrier to adoption in the past, are now being resolved, Carter claims.

As OCP adoption has grown and there has been worldwide acceptance, integrators have become increasingly interested in delivering open source solutions and the market has now opened up for smaller customers.

"The supply chain is getting better every year. In 2017, we felt there was a dramatic shift in terms of the adoption and interest in OCP. It was no longer a push, but a pull for OCP product," concludes Carter. ●

Reaping rewards of distributed energy



Annual savings

It is estimated that the deployment of distributed energy solutions in just 50% of organisations could achieve annual savings of 9 MtCO_{2e} (metric tons of carbon dioxide equivalent) culminating in a total of 137 MtCO_{2e} by 2030. For each sector that would mean:

- Healthcare: an annual emissions reduction equivalent to 16% of the NHS's current carbon footprint;
- Industry: an annual emissions reduction equivalent to 11% of the industrial sector's current carbon footprint;
- Hospitality and leisure: an annual emissions reduction equivalent to 14% of the hospitality and leisure sector's current carbon footprint.

The falling cost of distributed energy technologies is opening up opportunities for hospitals and industrial sites to make a major impact on emissions reductions

A report by Centrica shows that new energy technology could meet more than half of the 20% carbon reduction target by 2030 for the healthcare, industry and hospitality sectors, as set out by the Clean Growth Strategy.

Following the Intergovernmental Panel on Climate Change (IPCC) report, on the impacts of global warming of 1.5°C, Centrica's *Powering Sustainability* report highlighted the opportunity for distributed energy technologies (such as battery storage), onsite generation and energy efficiency, to deliver an 11% saving across the sectors.

The report also recommends that a full assessment be completed across all sectors of business and the public sector

to identify the opportunities posed by distributed energy technology for the UK.

Centrica Business Solutions managing director Jorge Pikunic said: "The UK has made a big contribution to the fight against global warming. Much of this has been due to the shift away from coal-fired generation and the deployment of solar and wind energy. But things get more difficult from

here, as we strive to hit our goal of an 80% reduction in UK carbon emissions by 2050.

"The good news is that business and the public sector can play a central role over the next decade in our path to decarbonisation. This report shows how by adopting distributed energy technologies, we can significantly reduce emissions and make a positive impact to the economy at the same time."

According to Pikunic, sites are now realising that there is potential to create new revenue streams, while the trend is being driven by the falling cost of distributed energy technologies.

Battery prices are down 79% since 2010 and are expected to fall further still to about

\$70/kWh by 2030 – a further 67% drop on today's prices. Distributed energy costs will continue to come down as technology advances, supply chains become more efficient and manufacturers achieve economies of scale.

New financing options are also available to companies for the deployment of distributed energy technologies.

A growing number of banks are offering 'green loans' to businesses and energy companies, such as Centrica, are also offering finance packages, which makes distributed energy solutions more accessible than ever before.

In support of the research, Gudrun Cartwright, director of environment at Business in the Community, commented: "It is great to see such a clear analysis of the potential of distributed energy systems to build energy resilience, cut carbon and save money for business and the NHS."

Pikunic concluded "This is not just about hitting targets or obeying rules set down by the government and regulators.

"We know from talking to our customers there is a growing customer preference for climate-friendly products, services and providers, which means that there is a commercial imperative too." ●

11%

Energy saving that distributed energy technologies can deliver across the healthcare, industry and hospitality sectors

AEG provides power conversion solution for MiRIS

Photovoltaics combined with battery storage in ambitious European energy pilot

AEG Power Solutions, a global provider of power supply systems for critical applications, is supplying a power conversion system to CMI Energy for its MiRIS project.

MiRIS is an ambitious photovoltaic pilot plant combined with energy storage. The installation consists of 6,500 solar panels (with a peak production capacity of 2MWp) at Serain in Belgium, combined with battery energy storage systems using different technologies – namely two types of flow batteries, one type of lithium-ion battery and NaS battery – to give, when all the equipment will be in operation, a total of 5.4MW hours.

The energy management system that monitors the facility was developed by ULiège (the University of Liege) in collaboration with CMI Energy.

CMI will use the system as a test bench of typical use cases (electricity self-consumption, solar photovoltaic time shift and resale of the exceeding electricity, as well as primary reserve, voltage stability, etc) in different configurations (off

and on-grid) and comparing the storage technologies.

Intelligence collected through the tests will give an in-depth understanding of how the different types of battery perform depending on production and usage profiles and ultimately will support the improvement of integrated electricity production/storage/management systems.

The power conversion system consists of a Convert SC Flex converter and a transformer embedded in an outdoor enclosure. The bi-directional power converter provides a high conversion efficiency factor for both the charging and discharging phases and offers a wide range of DC input voltage, which spans from 330V to 1,000V. This allows the converter to be used with any type of battery technology.

For the MiRIS project, Convert SC flex is combined with a flow battery storage, proving its capability to provide the initial charging phase required by the batteries. Convert SC Flex will also demonstrate that it allows seamless transition between on and off-grid mode. ●



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Data centre projects around the world are being delayed by issues around power availability because conventional wisdom states they need to be grid connected. In some countries, systems are already operating near to full capacity, so new data centres put significant additional strain on the local and national electricity grid.

“Speed of growth is essential for the data centre sector but power is the biggest constraint,” explains Aggreko’s head of global accounts, Matthew Parker.

Upgrading a local distribution network to cope with a new data centre build or expansion will often add time and considerable cost to a project. However, temporary gas generation can offer a solution to offset potential delays.

In recent years, power generation companies have invested heavily in research and development programmes to advance gas generation technology. As a result, temporary gas generators now offer a viable alternative to their diesel counterparts. They can help bridge the gap when electricity networks cannot deliver on a data centre’s demands, while also providing a sustainable long-term substitute for mains power.



Power: the biggest constraint for data centre growth?

The longest lead item on the critical path to project success need not be power procurement, argues Aggreko’s Matthew Parker. He says onsite gas generation can overcome power constraints and speed up data centre deployment. Louise Frampton reports

In countries such as Ireland, where the gas network is extensive, gas powered generators are already helping to keep data servers online.

“We need to unlock more sites for data centres,” comments

Parker. “There is concern over big balance sheet investments; global standardisation is a major driver; and there is a future in tradable power.”

He believes onsite gas generation holds the key to all

three of these trends. One of the most important benefits of onsite gas generation, however, is the speed of deployment – power can be established on site in as little as 12 weeks: “In places where there are grid constraints around the world – whether it is Japan, Dublin, Amsterdam or Slough – we can usually be on site and get the data centre up and running before the grid can.

“Onsite gas generation is also cost competitive with the grid, depending on the duration of the project, while emissions requirements can also be met.”

The energy ‘trilemma’

When considering data centre power strategies, Parker points out that sites need to prioritise and decide what is their main issue? Is it cost, sustainability or security?

“At present, the main issue facing customers is security – it is about securing power and ensuring power quality,” he comments.

“But, with gas generation, the power provided is also modular and scalable. We can design and build, over a period of time, so that the solution exactly fits the evolving needs of the data centre as they ramp up. Other potential issues concern commissioning – customers may want to commission at a higher

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load than they initially operate. This can be dealt with by bringing in elements of our fleet. We can also offer an interim power solution, until the grid or other more permanent source of power arrives,” Parker explains.

He adds that onsite gas generation can be cost competitive with the grid, as well as competitive in terms of sustainability.

However, the amount of space required to install this type of plant is approximately double the usual plant size, so there are land issues that must be considered. If piped gas is not available, a virtual pipeline can be created with trucked gas, using LNG.

“What you get is a very safe and very resilient plant,” comments Parker. “People worry about onsite gas, but LNG [once gasified] is incredibly safe. It is lighter than air so, if it leaks, it simply evaporates,” comments Parker.

He says that a mindset change around LNG is required to encourage adoption at large scale: “Although it is more expensive than piped gas, the difference is not huge, and it is certainly cheaper than diesel over time.

“If you are in parts of the world that are more remote, and access to piped gas and



In places where there are grid constraints we can usually be on site and get the data centre up and running before the grid can

electricity connection is a challenge, LNG could be a good option, despite adding complications in terms of logistics.”

There are other benefits to onsite generation, beyond tackling the issue of power availability, however. Like diesel variants, gas generators can be effectively synchronised with the electricity grid, so they operate in parallel with the incoming electricity supply. Aggreko argues that this offers flexibility for data centre operators, as follows:

- **Base loading to reduce costs:**

Electricity consumption from the grid is reduced and replaced with gas generation. Gas generation produces a constant power output, providing base load power at a potentially cheaper price than electricity from the grid. The data centre uses the grid supply to meet varying loads above the base load.

- **Base loading to increase the total electrical supply for the site (commonly to support additional data**

- **capacity and expansion):**

Gas generation is used in addition to the existing grid supply, therefore providing additional capacity. Typically, the gas generators would still take the constant base load of the site and the grid would support any varying load.

These options provide a wide scope for meeting local power circumstances – for example, being able to meet increased peak loads can be beneficial for existing sites that urgently require additional power for expansion but are limited to a maximum supply under a pre-existing electricity contract. The connection and design of parallel mode generation does, however, require the local network operator’s approval, so this needs to be planned in advance.

- **Resilience**

Gas generation allows a site to be commissioned, become operational and expand, as well as improve resilience and security of supply. This resilience is a significant

advantage for mission critical sites. “When the big storms hit Dublin in 2017, the grid was not out five times. Our plant were not out once,” Parker points out.

In the future, a rental gas generation solution could allow users to keep pace with advances in efficiency while avoiding potential technology risks associated with uncertainty over regulation. Data centres could also use the technology as an additional source of revenue to offset energy costs. Aggreko partners with energy aggregator Origami Energy and is currently discussing how to unlock spare capacity in the data centre sector.

“Our plants never run at full capacity. That spare energy could be traded on the market for considerable profit; our plant not only save costs, but also have the potential to generate revenue,” Parker continues.

He concludes: “Through education and the passage of time, people will come to recognise the resilience and power quality of gas plants, especially when teamed with batteries. It is about delivering at the pace customers want; rental of on site gas generation is faster and more cost-effective than the grid, while still performing well in terms of the environment.” ●

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Environmental focus fuels interest in gas genset market

Cummins' Prime Power Segment director Craig Wilkins speaks to *Mission Critical Power* about the latest trends in onsite generation. He believes natural gas has "come of age" and predicts that it will increasingly be relied upon as a source of power for mission critical sites in the future

There is an increasing interest in using gas generator sets for mission critical sites. End users want to know the key differences between using diesel standby generator sets compared with gas generator sets as a base source of onsite generation, with the grid being used only as a backup. The key drivers leading this shift are environmental considerations, the need for increased reliability and

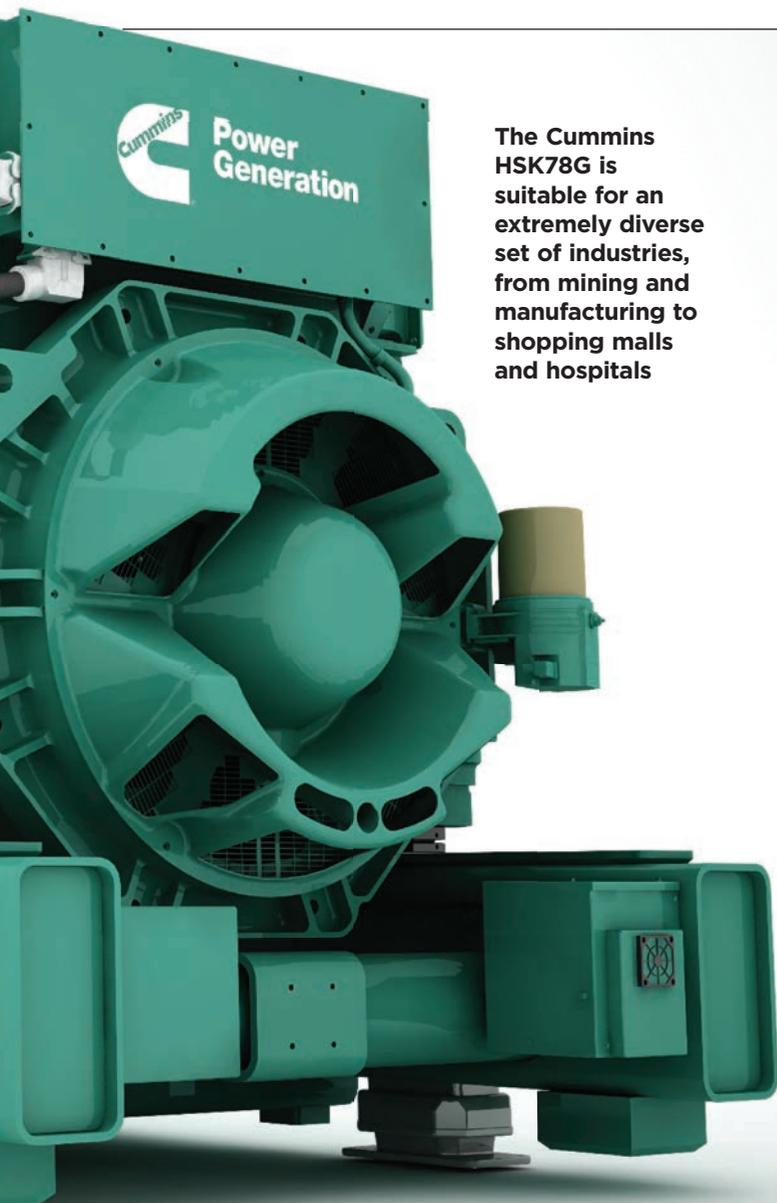
potential savings in energy costs.

Most of these benefits can be achieved with gas generators, but it is still early days, due to regulatory barriers in some EU countries (although not in the UK) and the high rates offered by grid owners to keep the required availability when needed. It is an increasing trend, however, which we will be focusing on more in the future as we look into our wider gas product portfolio expansion.

The Cummins HSK78G models, for example, are suitable for an extremely diverse set of industries, from mining and manufacturing to shopping malls and hospitals. The series offers a total package of gas generator capabilities for prime, cogeneration, trigeneration and peaking power applications. The new series is able to burn pipeline natural gas, flare gas, biogas and even the lowest British Thermal Unit (BTU)

fuels with high efficiency and low emissions.

These models work equally well in the most extreme and remote environments, from dense urban settings to open rural spaces. Utilising low-cost, low-BTU and free fuel sources that would otherwise be considered waste products leads to the HSK78G models delivering robust power even with very aggressive fuels with minimal derating. This



The Cummins HSK78G is suitable for an extremely diverse set of industries, from mining and manufacturing to shopping malls and hospitals

fuel flexibility helps overcome potential barriers and also keeps maintenance and ownership costs low.

Whether operating in scorching heat or the wettest humidity, the gas gensets deliver full electrical efficiency powering a plant, enabling a landfill to sell electricity to the grid, or powering an offshore rig using its raw flare gas.

Coming of age

Natural gas has without doubt come of age. An uninterrupted supply of fuel, cleaner technology and a better total cost of ownership all combine to present a viable option for future power needs. By using a lean burn generator set, air pollutant outputs will be lowered, including NO_x, hydrocarbons (HC) carbon monoxide (CO) and particulate matter (PM), which will ensure compliance with

6:1

The typical fuel cost ratio for diesel and natural gas respectively

emission regulations. Emission levels can be reduced with a lean burn gas engine because it uses twice as much air in the fuel/air mix than is required for total burn, which lowers burn temperature and NO_x output.

Diesel generators are not usually allowed to run for long periods of time because of emissions limits. The main difference is that the NO_x emitted from lean burn engines is far less than that of diesel engines. Lean burn levels are as low as 250-500 mg/Nm³ compared with 2500-3000 mg/Nm³ for diesel. Furthermore, lean

burn particulate levels are almost zero, so meeting location-specific emissions regulations can be far easier across a global perspective.

Lean burn generators are more effective, in part because a resupply of diesel may be compromised in a major disruptive event. Also, if customers have access to a gas pipeline, they do not have to worry about running out of diesel. Combined heat and power (CHP) options can also provide benefits to lean burn generators.

A lean burn gas is most efficient for applications such as hospitals because they can recover the waste heat from the generators to heat the buildings and to form hot water and steam. Customers can also offset boilers with heat from the engines.

Due to the ability to produce power and to recover heat to be reused elsewhere, there is an added financial benefit for

at high altitudes and in high ambient temperatures.

The quality of natural gas:

The HSK78G delivers high electrical efficiency at lower methane numbers without derating. Customers can expect more stability, more reliability, greater uptime, proven power density and lower fuel costs.

Cogeneration, or combined heat and power (CHP)

options: Cogeneration, or combined heat and power (CHP), increases fuel efficiency by harnessing the thermal energy created as a by-product of the generator's operation. CHP generates savings for the customer in multiple ways, notably because the price of electricity can be as much as five times the cost of thermal energy.

Additional savings are provided by thermal offset,

“Natural gas has without doubt come of age. An uninterrupted supply of fuel, cleaner technology and a better total cost of ownership all combine to present a viable option for future power needs

mission critical sites. There is also a benefit to the environment, delivering cogeneration for electricity, heating, hot water and steam.

So, what do sites need to consider before adoption? Cummins has developed a checklist:

Electrical efficiency: The quality of pipeline natural gas fluctuates around the world depending upon the source. The quality of gas affects the amount of electricity a generator set delivers, which in turn, affects the production capability of a customer's operation. Customers require a consistent level of electrical efficiency, regardless of natural gas quality.

Cummins' HSK78G generator series maintains electrical efficiency performance on a wide range of pipeline natural gas conditions – as well as

or the cost of fuel that is not needed as a result of the thermal recovery provided by a CHP system.

Environment in which the generator set operates, or 'ambient capability': As engines operate, they tend to overheat. In aggressive environments – such as hot and humid climates, or when running for extended periods of time – the generator's engines can be overheated causing a loss in efficiency or even a shut down.

A generator's ambient capability is the maximum temperature at which it can operate without experiencing a loss of efficiency.

For customers operating in such these extreme environments, ambient capability is an essential factor when selecting a generator set. Without a high ambient »

capability, customers risk having to stop the generator set to let it cool or derate the engine, which can lead to reduced power efficiency and shorter operational life.

Fuel flexibility (low BTU fuels/low methane): Fuel sources and associated costs (eg, transportation and storage) vary greatly around the world. Whether operating in a remote area or an urban locale, operators look for the most readily available, least

generator sets are known for. The HSK78G continues that tradition. The long major overhaul service cycle of 80,000 hours and extended life to overhaul are among the best in the industry, providing a high return on capex investment for end users.

Serviceability: When a generator set goes down or is underperforming and needs service, production slows or stops; this is unacceptable to customers. They need

of ownership. The typical fuel cost ratio is 6:1 for diesel and natural gas respectively, which is a fairly big difference. When making a purchase decision, a customer must weigh both the initial capex costs as well as the longer-term operating expenses or total cost of ownership.

Diesel applications need to consider the amount of fuel required for desired run time to dictate the size of the fuel storage tank. Therefore, fuel supply is limited and also requires delivery considerations.

across countries, which eliminates the need for fuel transportation, handling and storage issues. No fuel tank cleaning is required and the fuel processing requirement is close to zero, considering the on-skid fuel filter requires servicing only every 3,000 hours approximately.

The future

Ultimately, the use of coal-fired generation is reducing as a trend and natural gas is now being seen as a reliable, efficient and clean fossil fuel source to supplement renewable energy.

In the long-term, renewables and non-conventional power will continue to become a major part of the global energy mix, as an environmental focus drives stringent emissions regulations.

Facing a future that will bring energy management through diverse technologies, digital acceleration and zero emissions, large companies are starting to invest in microgrid technology, and looking to combine renewable energy sources with traditional power generation. Battery storage, fuel cells, solar, wind and hydro power solutions are also playing their part as different applications and drivers require a varying mix of technologies. Hence increasing investment and moving towards a range of new technology choices is becoming crucial. ●

“In the long term, renewables and non-conventional power will continue to become a major part of the global energy mix, as an environmental focus drives stringent emissions regulations

Craig Wilkins, Cummins



expensive, adequate fuel source for their application. In cases where the fuel source is low-BTU, they need the generator set to deliver reliable power using aggressive fuels.

The HSK78G delivers robust and reliable power on very aggressive fuels with less derating in comparison to competition. Fluctuations in fuel quality are managed automatically, without the need for operator intervention or recalibration.

Maintenance intervals:

When a generator set is not running, operators are losing money at best. At worst, critical applications that rely on power can't function. Minimising the number of shutdowns needed for routine maintenance and extending the lifecycle of major overhauls are therefore primary considerations in the buying decision.

Generator sets are significant capex commitments. Customers need confidence that their investments will have long lifecycle service intervals for key components, providing high returns.

Long service intervals are a result of high durability and reliability, two traits Cummins

fast, dependable, competent service to get fully operational immediately. Facility, production and maintenance managers need to be confident that when they need service, they can trust their generator manufacturer to respond with a sense of urgency.

Comparing total cost of ownership:

Fuel is the generator's largest operating expense component. Fuel savings can make a significant impact on a generator's total cost

Certain provisions need to be made on the installation location of the fuel tank as it would need to comply with local environmental codes. Another important element to consider is that the fuel and tank require maintenance when stored for long periods of time, which is usually the case especially for diesel generator standby applications.

In comparison, natural gas is available through an extensive pipeline network

UK market has 'potential to triple in size'

A boom in onsite generation is in now sight and the UK market has the potential to triple in size, according to Jonathan Maxwell, CEO of investment company Sustainable Development Capital. "There is a very substantial opportunity," he suggests. "The intensity of focus from large corporates on minimising their carbon footprint is completely different compared with five years ago."

Some argue that Brexit threatens to undermine decentralised and flexible technologies, but Maxwell thinks Brexit may ultimately create greater demand for onsite generation.

"There are always two sides to these coins, and differences of opinion make a market," he says. "Brexit does create uncertainty. It will slow decision making at a corporate level. On the other hand, it may increase issues with energy security: we have a degree of reliance on international gas and interconnectors. Those problems do not go away, they are no easier to solve."

Maxwell says resilience – or security of supply – is a major aspect of the business case to invest in energy efficiency and onsite generation. The UK new nuclear programme is diminished and behind schedule, while coal plants are closing and grid operators are working harder to reliably accommodate increasing volumes of renewables.

"If energy security is a driver to people being more efficient with energy and generating more on site, I would say Brexit is at least as much a tailwind as a headwind," Maxwell suggests.



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What's in STOR for energy users in 2019?

GridBeyond UK managing director Wayne Muncaster believes that flexibility is just as important as energy efficiency. So what trends can large energy users see in 2019 and how can they stay ahead of a rapidly changing market? Louise Frampton reports

The energy landscape in the UK has been changing in the past 10 years, with a proliferation of large-scale solar, increasing penetration of wind power and, more recently, large-scale battery storage. These changes are bringing challenges, increasing complexity, as well as opportunities for businesses that are seeking to monetise their power assets.

"These energy sources have a very different profile to the large thermal generators of the past, which are coming off line at a rapid rate in the wake of the large combustion plant directive," comments GridBeyond UK managing director Wayne Muncaster.

"This has created a very different energy mix. Energy users are also increasingly investing in self-generation, with roof-top solar in the residential market place and we are seeing the start of battery energy storage.

"In the commercial space, there is now rapid change with CHP and increasing

penetration of behind the meter battery storage. All of this, added to the grid-scale energy mix, makes forecasting and balancing much more complicated and this creates problems for National Grid," Muncaster continues.

Demand-side response (DSR) and the flexibility it provides is therefore crucial in supporting the UK's transition to lower-carbon generation. Large energy users can benefit financially and this is going to become an increasingly attractive proposition in the wake of rising energy costs. According to Muncaster, a 40% increase in electricity costs is predicted over the next four years, making it essential for consumers to participate in the energy markets in different ways, using a holistic approach (see Figure 1.)

In a recent webinar (*GridBeyond's Definitive Guide to Energy in 2019*), Muncaster identified a number of key trends for 2019 and highlighted the different costs associated with various types

of generation. Nuclear power is expensive – for example, power generated at Hinkley Point C costs £92.50 per MWh, while offshore wind is as low as £57.50.

According to Muncaster, solar could be as cheap as £40 per MWh by 2030 and is likely to sit between £50-£60 per MWh in 2019.

He adds that batteries are expected to continue to reduce in cost, while behind the meter projects are likely to increase in number throughout 2019. High electricity costs and sustainability goals will drive deployments, especially collocated with embedded generation.

"We expect the change in energy mix to accelerate over the next 10 years," Muncaster explains. "Sites that were allocated for solar have been shifting to battery energy storage.

"However, with potential problems in the DFFR [Dynamic Firm Frequency Response] market in terms of paying for batteries, they have been moving to gas peaking

plants and are now looking to shift back to solar sites... There will be increasing renewable projects throughout 2019."

Improving efficiency

Against a backdrop of rising costs and increasing complexity, a holistic approach is required to optimise energy strategies, according to Muncaster.

He advises that reducing demand is usually the first port of call, while asset and process efficiencies need to be looked at in tandem.

Consumers should start by looking at their demand assets and which of their assets have flexibility – ie what can be turned up or turned down? Users also need to be able to visualise how effective their consumption is within their processes – are their processes scheduled to take place to take advantage of cheaper power – through Triad avoidance, for example? Is production pushed either side of the Triad? What is the control strategy around this?

One question that is currently



“One hundred per cent of the bids included some form of wholesale market access, with the ability to trade on the day ahead or even intra-day... this is going to become the norm rather than the exception

efficient assets and reducing your overall energy demand should always be the first thing you look at,” he says, adding: “Often, GridBeyond sits behind a SCADA investment or compressor upgrade project. Energy efficiency is a very broad church, as is demand management.

“Energy efficiency will continue to be important, while demand management, or flexibility, will become just as important. In essence, energy efficiency is reducing the overall levels of energy you use, while flexibility is being more prescriptive about when you use it.

“It’s important to understand that more efficient assets don’t affect the level of flexibility. If you’re putting in things like VSDs to drive efficiency, then by their very nature they have the potential to give you more variability and more flexibility. So variable assets are able to play in the energy markets in different ways than interruptible assets.

“I see them as common

bedfellows, I don’t see one as a detriment to the other, I see them as just as important, and the difference to me is that energy efficiency has been important for a long time, while flexibility or demand management has been a side show. I see flexibility as being just as important as energy efficiency and, ultimately, it may even start to become more important.”

Technology

The blurring of the lines between consumer and prosumer, and the increasing complexity of the markets, can only be managed through sophisticated technology, Muncaster argues.

By gathering data, GridBeyond’s technology platform can identify and understand energy patterns to see where efficiencies can be made. The same platform uses operating parameters and schedules to further optimise resilience. Site and asset data can facilitate predictive maintenance, as energy

consumption patterns can reveal a great deal about the status of equipment.

Predictive maintenance is important for ensuring that efficiency remains optimised and the system is designed so that any early signs of failure will generate alarms for review and action.

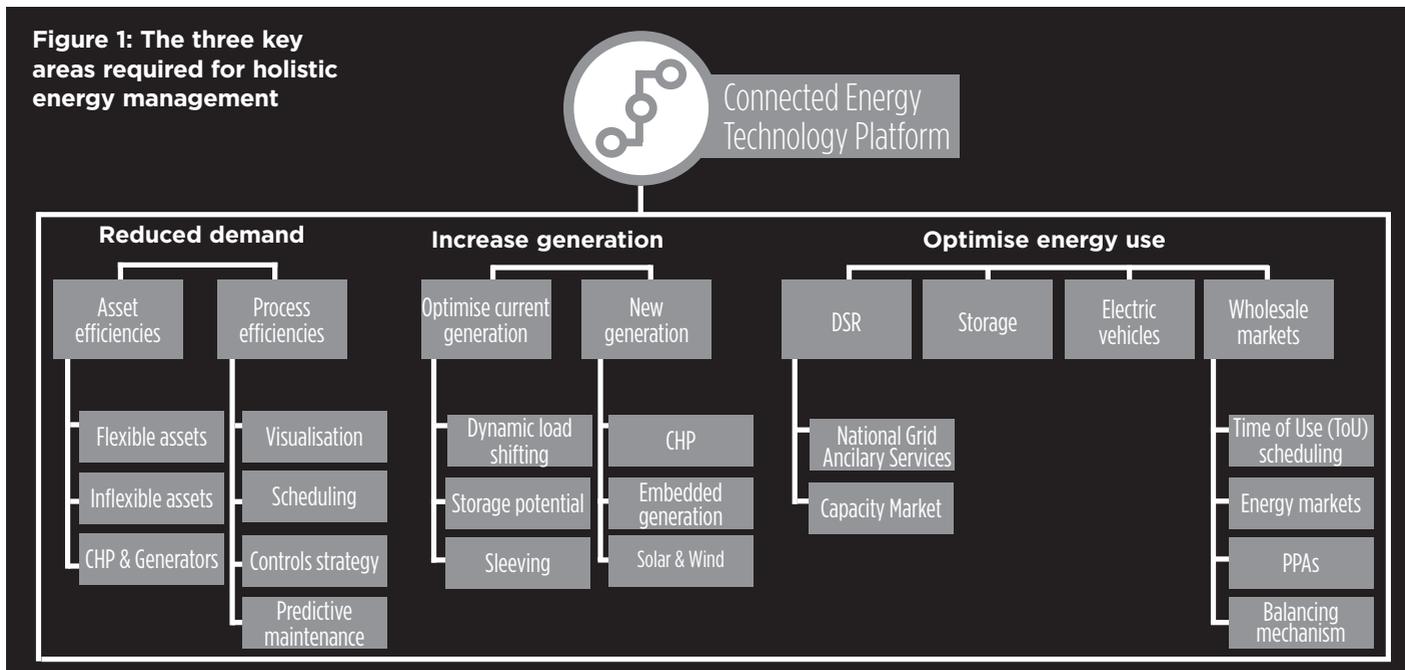
Increasing generation

More and more businesses are choosing to add embedded generation to their site. Consumers need to optimise their current generation, as well as ascertain the potential for new generation opportunities. As such, it is imperative sites have the technology to optimise this.

Storage capacity, production schedules, market prices and export opportunities all feed into GridBeyond’s technology platform to ensure generation assets reduce costs, increase revenues and deliver environmental benefits. The technology monitors multiple market opportunities, operational parameters and »

concerning consumers is how will the realities of the new energy market affect the value of energy efficiency investments? Muncaster believes that energy efficiency will remain critically important. “Continuing to replace old assets with ever more

Figure 1: The three key areas required for holistic energy management



asset status (such as fuel levels and battery state-of-charge), while also optimising decision-making.

Optimise energy use

On a basic level, reduced demand and increased generation can be delivered without particularly smart technology. However, to ensure the most intelligent and timely decisions around energy are made, while leveraging the opportunities available through demand-side response, storage, EVs and the wholesale market, a site requires a highly sophisticated platform.

With access to the wholesale market via Time of Use (ToU) optimisation and Power Purchase Agreements (PPAs), businesses can integrate ToU scheduling with process scheduling. Machine learning technology can be used to take into consideration all the various facets of electricity supply and demand to make intelligent choices around purchase, consumption, storage, generation and export to access the balancing mechanism (BM).

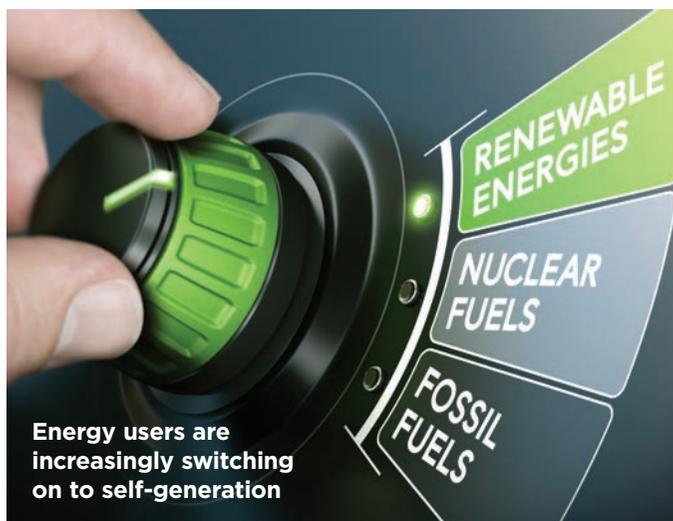
Unlike balancing services, the BM is an ad-hoc market with highly changeable prices.

Flexibility

Muncaster points out that the markets are rapidly evolving, but there will continue to be significant opportunities around the trading of flexibility in 2019.

He says: “Recently, I was speaking to a water company that was out to tender on their supply contract. One hundred per cent of the bids included some form of wholesale market access, with the ability to trade on the day ahead or even intra-day...This is going to become the norm rather than the exception. The ability to trade flexibility will increase in 2019.”

Some of the schemes available include fast balancing services such as static FFR and dynamic FFR. Enhanced FR and FCDM are no longer procured or about to disappear, while changes in the market will mean that fast reserve will



become more accessible, having previously been the preserve of large power stations, until now.

Dynamic regulation, dynamic balancing, dynamic containment and static containment are all new services being discussed by National Grid. While these were originally tipped to be launched this year, they are now unlikely to be available until next year, according to Muncaster.

There are also slower balancing schemes available, which include STOR, demand turn up, capacity market and Project TERRE (Trans European Replacement Reserve Exchange). Project TERRE is an implementation project developed by a group of Electricity Transmission System Operators (TSOs), including National Grid, to

fulfil an EU legal requirement imposed by the European Electricity Balancing Guideline. It is due to come on line in quarter four of 2019.

In addition, there are other opportunities around smart tariffing – such as Triad avoidance and DUoS avoidance, for example.

Brexit

There has been a great deal of uncertainty around the potential impact of Brexit on market opportunities and this was evident in the questions raised during the GridBeyond webinar. Muncaster is optimistic and points out that National Grid believes that most of the markets will be unaffected: “Project TERRE is the European view, but there is already work underway to see what that looks like post-

Brexit. Our problems are due to the fact that we have an island network. Yes, we have interconnectors, including the 2GW interconnector to France, which creates other issues all on its own, and the interconnector to Ireland, but that’s effectively an exporter.

“Our problems are dictated by the nature of our network, and the nature of our network won’t change post-Brexit. Most of the services that we’ve talked about will still be required.”

Triad charges

Muncaster is less positive when quizzed about the impact of the potential removal of triad charges, however: “The ultimate impact is that it’s going to put £100-125 million worth of cost back onto the bottom line of UK businesses; that’s not something we expect businesses to sit back and take lightly. So, if we assume the Ofgem ‘minded-to’ decision is what happens, it will drive business to look at recovering their increased costs in other ways,” he comments.

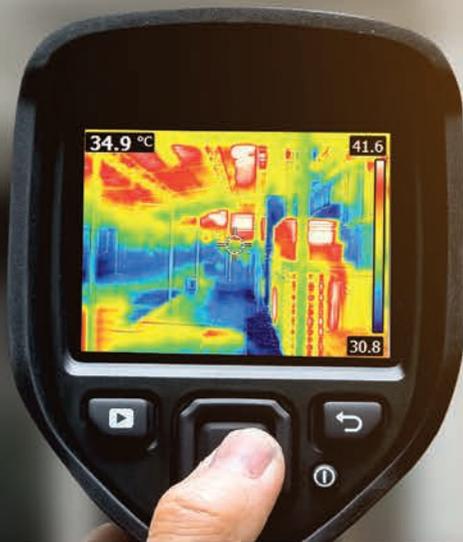
The removal of triad charge will accelerate the wholesale market, in his view: “If I can’t do a simple thing to avoid peak charges at triads, I’ll have to have a contract that enables me to look at the day ahead market and avoid peak charges within that market – ie businesses will look to optimise production within the wholesale market on an ongoing basis, not just passively through triads.” ●

Proving your metal: savings at UCB

GridBeyond has helped a variety of industries to engage with demand-side response and optimise their energy strategies. This has included United Cast Bar (UK) – a leading metals manufacturer. Using the company’s energy intelligence and control platform, UCB was able to generate revenue from National Grid programmes, avoid peak charges, monitor and analyse energy consumption patterns while reducing its carbon footprint and optimising equipment performance. It later approached GridBeyond to take its energy resilience to the next level with an on-site commercial battery.

GridBeyond’s partner, ESB Smart Energy Services, invested in and managed the installation of a 500kW battery storage solution, enabling UCB to participate in National Grid’s Dynamic Frequency Response programme and enhance its peak avoidance.

The platform combines the energy flexibility in the battery with the flexibility in UCB’s onsite equipment and machinery to provide an increased amount of energy demand availability. By combining control of large demand assets with the control of the highly flexible battery assets, GridBeyond’s hybrid platform allows UCB to maximise the value for its participation, essentially increasing its revenues.



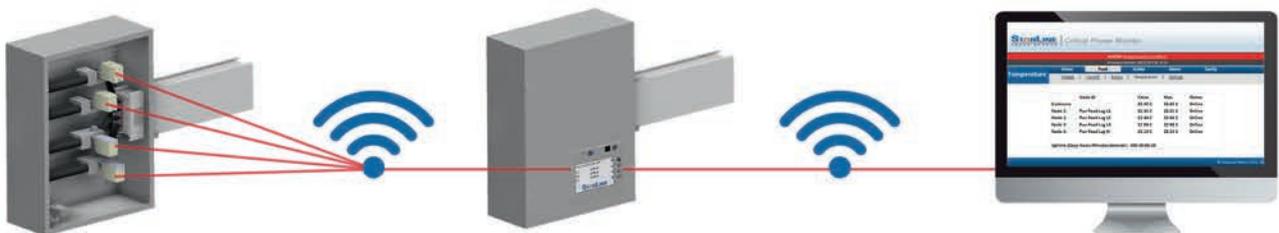
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An effective way of participating in demand-side response is through investment in leading-edge battery energy storage technology.

An energy storage asset, when connected to the grid, can manage demand through an intelligent energy management system. It enables the smart and flexible use of energy and rapid response to grid events. This can include access to DSR contracts such as Firm Frequency Response (FFR), Enhanced Frequency Response (EFR) and, until it was recently suspended, the Capacity Market, to provide revenue for the site.

As well as providing DSR, energy storage can also help provide backup to the site in the case of any energy-related failures that occur throughout the energy network. Energy storage solutions, such as Powerstar Virtue, have the ability to provide integrated full uninterruptible power supply (UPS) capabilities that can support the load in the event of an energy-related failure. In some cases, this response can be seamless – in less than a millisecond.

This next generation of UPS is able to provide site-wide protection rather than system specific protection, which means the entirety of the site can be protected from energy-related failures rather than the protection being limited to specific systems, such as IT, which is the norm in traditional UPS systems.

Energy resilience

As the energy transition progresses and the need for the National Grid to use DSR increases as the energy network becomes more decentralised and distributed across many smaller sources rather than concentrated in a few large power plants, the potential for energy-related failures is set to increase.

The ability of some energy storage solutions to provide enhanced energy resilience through full UPS capabilities alongside DSR is especially important due to the



increasing demand for energy and heightened expectations for businesses to be operational at all times – any disruption to the energy supply could be significantly costly for both a company's finances and its reputation.

When considering investment in DSR assets, the wider business case should be considered as there are additional benefits that certain energy storage solutions can provide.

One of these, in the case of Powerstar Virtue, is the ability to integrate patented voltage regulation technology. This ensures that all of a site's electrical equipment is operating at an optimal level close to its design characteristics. The presence

of voltage regulation results in reduced energy consumption and costs, as well as prolonging the life of electrical equipment.

The wider business case can add robustness to the decision to invest in assets that can provide DSR as it is an evolving market.

Potential Capacity Market amendments

An example of an evolution within DSR can be found in the suspension of the Capacity Market mechanism, which was introduced by the British government in 2014 to provide an insurance policy against the possibility of future energy-related failures, such as brownouts and blackouts, to ensure that customers continue to benefit from reliable electricity supplies.

The Capacity Market was brought to a surprising halt in November 2018, when the European Court of Justice annulled the European Commission's decision not to object to the Capacity Market. This immediately suspended the Capacity Market.

The suspension came after a challenge from Tempus Energy, which claimed that the Capacity Market privileges generation over DSR providers in a discriminatory and disproportionate manner.

The challenge essentially argued that less sustainable types of generation receive greater rewards than low-carbon alternatives, such as DSR providers that use energy storage, and that the Capacity Market failed to sufficiently incentivise

“Energy storage is a vital component in balancing the network as it provides users with the flexibility required to partake in DSR while securing their own operations through site-wide UPS

Dr Alex Mardapittas, Powerstar





businesses to reduce their consumption during demand peaks, which is again a less favourable outcome for smarter and cleaner technologies such as energy storage.

It is likely that the Capacity Market will need to be amended to remove this seemingly structural bias against DSR and cleaner energy before the suspension can be lifted.

This is good news for assets such as energy storage, which support the transition to cleaner sources through storing energy from renewables at times of excess generation for later use.

Potential amendments that have been implemented in other markets, such as in France and Poland, gave preference to low-carbon generators and greater access to DSR asset owners.

Enhanced business case

This potential greater access to the Capacity Market for DSR asset owners will further increase the revenues that can be achieved from owning an energy storage solution. In addition to the savings that the solution can provide through reducing energy costs and

increasing energy resilience, alongside the expected increase in value of DSR processes such as energy arbitrage, the business case for energy storage is set to be enhanced further.

The importance to the UK electricity system of balancing the network through DSR is almost impossible to overstate. The balancing of the network enables the reliable supply of electricity, and for the economy of the UK and the everyday lives of its citizens to continue as normal. Through the energy transition, it is crucial that the balancing of the network also transitions in a way that best suits the changing energy landscape in order to best support the new ways in which energy will be transmitted, distributed and consumed.

Energy storage is a vital component in balancing the network as it provides users with the flexibility required to partake in DSR while securing their own operations through site-wide UPS. The value of such technologies is enhanced when bespoke solutions can be made, which enable customers to select the features that are most relevant to their operations. ●

Powering the data centre of the future

What will the data centres of the future mean in terms of power?

Riello's Leo Craig recently addressed some of the industry's key questions at Data Centre World. Speaking to *MCP* in an exclusive interview, he points out that 5G is going to change the way we process data and the way data is going to be used, while industry is going to be increasingly reliant on artificial intelligence, digitisation and big data.

"The question is, will industrial sites use a cloud data centre, located many kilometres down the road, which will encounter latency issues; or are they going to use an edge data centre at the point of where the critical process is? I believe we are going to see a reversal of what has happened in the past – businesses previously moved away from on-premises data centres to the cloud, but parts of the cloud will now migrate down to the edge of the premises. We need to understand how we are going to power this," says Craig.

He believes the move to the edge will have a significant influence on future UPS design: "Modular solutions will be compatible with this trend but the power densities of modular systems will need to start increasing. The size of the UPS will also have to decrease. Space at the edge is going to be at a premium."

As the cloud moves to the

“

The size of the UPS will have to decrease. Space at the edge is going to be at a premium

edge, UPS systems will also need increasing intelligence. The next challenge will be around how to store the energy, Craig predicts.

"There will be a number of pressures facing data centres in the coming years. This will include the fact that diesel generators are increasingly becoming an issue in terms of emissions – they are seen as polluting, even if only fired-up under standby conditions. Diesel generators will come under increasing scrutiny and regulation, while future methods of energy storage may favour lithium-ion batteries.

"This could be a good solution as you get high density. However, the cost is relatively low at present, as there is good availability of the raw materials required for their manufacture. This may not still be the case in five years' time, however. If we start running out of lithium-ion, the price will start shooting up."

Craig believes innovation in battery technology will need to advance further. There will also be an increasing focus on corporate and social responsibility, with more organisations working with utilities to help level out power demands or manage the frequency. He says: "This may include frequency response, but the challenge will be to get data centres to understand that they can do this and that they can benefit financially..."

"While there is a lot of talk and interest around demand-side response, getting data centres to actually make the final decision to go ahead is still a challenge. Data centres have had the ability to do this for the past 10 years, yet few data centres are actively involved. The government will need to get involved to make it happen." ●

The Energyst Event 2019

This year's event, on 1-2 May in Birmingham, looks at effective solutions for businesses in a changing energy landscape where efficiency, procurement and flexibility are converging

The Energyst Event equips attendees with the insight to better navigate a rapidly changing energy landscape.

Within the conference streams, speakers and panellists will share their expertise, experiences and insights, arming delegates with knowledge that can be transferred directly to their organisations' bottom line.

Experts in policy and regulation will break down complex changes into simple, actionable insights.

Senior energy managers from large industrials, retailers, telcos, pub chains, hotels and local authorities outline how their organisations are adapting to change, decarbonising their businesses and unlocking the value that now presents itself to businesses that grasp the opportunities emerging from the convergence of energy, transport and communications.

Learning opportunities

The two-day conference with exhibition covers all aspects of energy procurement, efficiency and flexibility, joining the dots between disciplines and highlighting key impacts for energy strategies.

Within the conference streams, speakers and panellists will share their



expertise, experiences and insights, arming delegates with knowledge that can be transferred directly to their organisations' bottom line.

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Meet the experts

Alongside the conference, the

exhibition brings together the energy industry's most forward-thinking companies. These solutions providers want to meet delegates, discuss their challenges and work out how to solve them for mutual benefit. Sponsors and exhibitors include:

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The conference and exhibition is free to attend. Energyst Media aims for it to become the industry's most focused, and most valuable, event for energy professionals.

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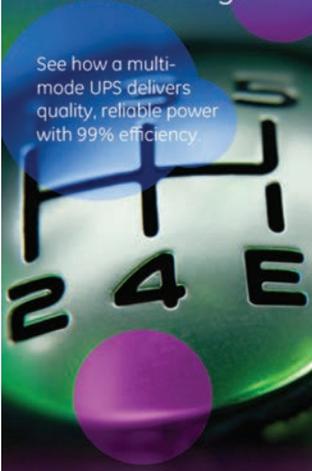
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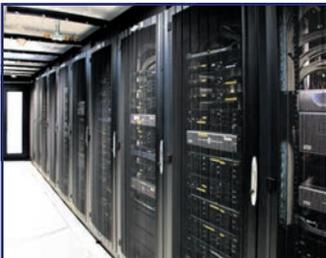
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Modular UPS offers high efficiency

Schneider Electric has introduced the Galaxy VS, a highly efficient, modular, easy-to-deploy, 10-100kW, three-phase uninterruptible power supply (UPS) designed to meet the critical power requirements of IT, commercial and industrial facilities.

With its compact and flexible design, the Galaxy VS addresses the unique requirements of edge computing and small data centres where space and access are at a premium. The UPS is up to 99% efficient and is available with optional lithium-ion batteries, doubling battery life.



Christopher Thompson, vice-president, 3 Phase Line of Business at Schneider Electric, comments: "Our newest UPS strikes the right balance for edge and cloud customers who need innovative solutions that are easy to deploy in this hybrid ecosystem. With its compact, modular design, the Galaxy VS can deploy faster and in a smaller space than traditional UPS's, saving users

time and money."

The Galaxy VS is also EcoStruxure Ready. Site managers or technical personnel can remotely monitor their Galaxy VS system status any time, any where with the smartphone app.

Li-ion ready UPS battery solution

Centiel UK recently demonstrated its new Li-ion battery solution for the first time at Data Centre World, along with its fourth generation, modular UPS system: CumulusPower.

Mike Elms, managing director of Centiel UK, comments: "Li-ion has been a 'hot topic' for some time now and has been adopted as the norm in other sectors such as electronics and automotive. The UPS industry is now taking notice and starting to see how datacentres can take advantage of its many benefits."

"Over time, we believe, there will be an inevitable shift towards Li-ion batteries as further cost reductions, driven by developments in the automotive industry, flow through to the standby power sectors.

"Incorporating Li-ion will inevitably reduce the size and weight of UPS systems overall and the longer useful working life of Li-ion will mean fewer costly replacements," Elms adds.

CumulusPower – known for its '9 nines' (99.9999999%) system availability and low total cost of ownership – works with both VRLA and Li-ion. The scalable and flexible modular three-phase UPS system combines high availability and efficiency, making it ideal for use in small, medium and large data centres.

Other products on show at DCW included the PremiumTower range, which comes in a lower cost, stand-alone cabinet, ranging from 10-120kW.

New cooling unit reduces energy usage

Rittal has developed a roof-mounted version of its award-winning and highly energy efficient Blue e+ cooling units; these are designed for enclosures of 800 x 600mm (W x D) upwards and deliver a cooling output of 1.3kW.

The new roof-mounted units also feature within the new VX25 large enclosure system as an integrated solution.

Roof-mounted climate control units are the top choice in control and switchgear applications where there is a lack of space on the front and side panels. This could be due to physical location of the enclosures and minimal gangway clearance but could also be due to an abundance of interlocks, switches or other controls preventing adequate space for a wall-mounted cooling unit.

Air routing within the enclosure is also optimised; the cold air is blown down the front of the enclosure and drawn back up the mounting plate, thereby effectively



dissipating the heat from top-mounted components such as frequency inverters.

The new roof-mounted cooling units of the Blue e+ series, like the existing wall-mounted units, work with a combination of heat pipe and conventional compressor technology.

Energy consumption is very

low because neither a compressor nor a pump is required when the cooling units are operating on the heat pipe; only the fans that circulate the air by the heat exchangers need an electricity supply. This cooling method works particularly well if there is a large temperature difference between the inside of the enclosure and the surroundings.

The additional compressor within the cooling units only kicks in when a larger cooling output is required. All the active components operate with speed-controlled drives so the cooling output always matches what is required, ensuring less energy is consumed.





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