enel x

Why energy strategy is key to data centre growth

Data centres continue to cut emissions while enabling grid innovation

Content

Introduction

The global pandemic and resulting lockdowns have changed the way people create data.

The 'new normal' of remote work and schooling saw an increased need for technology use at home including video conferencing, online learning, and entertainment. Each of these activities caused a significant rise in data creation, for example the increase in video streaming alone caused a **40% surge in data** between February and April 2020[1].

Before this, global data consumption and storage were already on a well-established long-term growth trajectory. Gartner predicts that 30% of the workforce will be working from home by 2024, and data centre electricity use is expected to increase fifteen-fold by 2030 to 8% of projected total global electricity demand[2].

The data centre and co-location sector is evolving to meet this increasing energy demand, however in doing so many operators are reviewing their **energy strategies** to ensure they keep carbon emissions to a minimum. They are doing this not only because it's the right thing to do, but because the industry's energy use is under scrutiny to ensure sustainability measures are taken to offset environmental impact.

This whitepaper looks at the business drivers for a new energy strategy including climate change, electricity grid issues and the need to build energy resilience. Energy and emissions visibility, energy efficiency, low carbon energy, procurement, and Virtual Power Plants (VPPs) and Demand Response are discussed as fundamental elements of a sound energy strategy.

[1] Data Centres and Data Transmission Networks.
[2] Nature: How to stop data centres from gobbling up the world's electricity.

Business drivers

Climate change is driving the need for a refreshed energy strategy.

Data centre energy use is currently estimated at **200 TWh each year**, creating CO2 equivalent to **0.3%** of the world's carbon emissions[2]. In addition, the Information and Communication Technology (ICT) ecosystem (including personal digital devices, mobile-phone networks and televisions) accounts for more than 2% of global emissions[2], and ICT energy consumption is increasing by 9% every year[3].

This has driven new sustainability initiatives for data centres and co-location operators worldwide. In addition to activist group attention and the increasing scrutiny on data centres' energy use from external stakeholders, customers are also demanding that data centres are powered by 100% renewable energy sources. Tenants of the like of Microsoft and Google demand it.

How the major players are leading the net-zero journey

Some of the major players in the data centre industry are leading by example. **Microsoft**, which had previously set an interim goal of switching to 70% renewable energy by 2023, now says it will meet its target of using **100% renewable energy** for all of its data centres and buildings by 2025, and will no longer use carbon offsetting to meet its goals. According to Microsoft, *"Purchasing renewable energy is consistent with our commitment to carbon neutrality. We are continually searching for ways to integrate more renewable power into our portfolio to lower our carbon footprint."*[4]

Google and **Apple** both claim to have already reached the **100% milestone**, with Google pledging to match renewable supply and demand hourly, 24/7 by 2030[5]. **Amazon** says it will run on 100% renewable energy by 2030. **Facebook** claims to have used 86% renewable energy for all its operations in 2019, and states: *"We're proud of how efficiently our data centres operate today, but we're always looking for new ways to increase that efficiency... with each new data centre we build, we add renewable energy to the local grid."*

The industry-wide efforts to reduce emissions are reflected in the overall statistics. Despite exponential growth in data and workloads, energy demand from data centres has increased only modestly over the past 10 years. Older data centres have been retired and repurposed. Improved energy efficiency measures have been widely adopted by small to mid-size data centres. Hyperscale data centres are functional and efficient, right down to the removal of video connectors and blinking lights from the machines that fill these huge data warehouses. However, as our **demand for data grows**, it will become harder to rely on further efficiency improvements to keep electricity demand down. There will come a point where electricity demand will start to climb, and **sourcing clean energy** will be the only way to **keep emissions down**.

[3] "Lean Ict: Towards Digital Sobriety": Our new Report on the Environmental Impact of Ict.
[4] Self-Regulatory Initiative.
[5] Self-Regulatory Initiative.

Energy efficiency and cost drivers

Managing grid capacity needs collaboration with major energy users

Awareness of public sentiment regarding carbon emissions has no doubt helped shape the energy reduction and **zero-carbon policies** of today's tech giants. But there are also practical considerations behind the drive to increase energy efficiency and reduce carbon emissions. The **increasing and unpredictable demand** that data centres are placing on the grid is prompting some governments to consider putting embargos on further data centre development. For example, in **Singapore** where land size is small and power use is high, the government placed a **moratorium** on new data centre development from 2019 through 2021 to cut emissions while local authorities considered a balance between sustainability and supporting business needs[6].

Another risk is that governments may put legislation in place to demand throttling mechanisms that place an upper limit on instantaneous energy use. This approach would require energy use capping mechanisms that turn off equipment or run servers more slowly – actions that are highly problematic for data centres. Either option would put unwanted constraints on tech corporations and limit their ability to meet the requirements and **Service Level Agreements (SLAs)** of their customers.

If data centre operators are to continue to expand their operations, they will need to work with networks and grid operators to increase grid stability. As large energy consumers, data centres are well placed to help improve grid stability in a variety of ways including through **Virtual Power Plant (VPP) participation** and **Demand Response** programs. These programs provide critical grid balancing services that are needed to support the uptake of variable renewable energy generation on the grid and **improve overall grid stability**. By participating in a VPP and Demand Response programs, data centres help create a more **secure energy future** for everyone, while mitigating the risk of restrictions to their growth.

[6] State of the APAC data centre market.

Building energy resilience is a two-way street

Grid stability is critical to data centres. Large tech corporations are expected to **deliver 100% uptime**, and customers expect 100% availability from their data centre providers. What's more, data centre outages are expensive. According to a recent study, the average cost of data centre downtime in 2020, across all industries, was approximately **$7,900 per minute**. The financial penalties for even a few seconds loss of service can be severe. In addition, security of electricity supply is paramount to customer acquisition and retention.

Extreme weather events and natural disasters can also cause disruption to electricity supply. In **Australia** the electricity grid is feeling this pressure with the closures of coal-fired power plants, ageing infrastructure, and **large amounts of renewable generation** coming online. These factors coupled with network and transmission issues, which are heightened by heatwaves during summer and the bushfire season, have seen the grid face increasing strain and system security issues. However building **energy resilience is a two-way street**, and data centres can offer their energy load to **support grid stability**.

Leading data centre operators already use their back-up energy supplies to support the grid with **VPP and Demand Response services**. This technology can be seen as a risk but, in fact, such mechanisms can benefit both sides. We will go into more detail on this in the next section on Energy Strategies when we look at VPPs, Demand Response and resilience.

Energy strategies

Lowering emissions, managing grid stability, maintaining resilience and coping with volatile electricity prices cannot be left to chance. To effectively tackle all of these issues, data centres need an energy strategy that encompasses every aspect of the organisation's energy use. This includes energy and emissions visibility, energy efficiency, low carbon energy, procurement options, VPPs and Demand Response.

Energy and emissions visibility

The first step in an energy strategy is to get full **visibility** of current **energy use and emissions levels**. A clear picture of a data centre's energy landscape helps to identify the specific needs, helps to optimise energy use, highlights inefficiencies, and enables benchmarking against similar organisations to assess performance.

Energy efficiency

Once an organisation has a clear picture of its energy landscape, the next step is to identify opportunities for **efficiency gains**. Many data centres have already moved towards using more efficient servers, and the big players have invested in highly efficient hyperscale data centres. As well as housing efficient, purpose-built servers, these data warehouses are also designed to **reduce the cost of cooling**. Google, for example, uses machine learning to automatically optimise cooling in its hyperscale data centres. Other organisations deliberately locate their data facilities in regions with colder climates, where outside air can simply be piped in to cool the servers. Microsoft is testing underwater data centres to improve cooling efficiency.

Analysing hardware efficiency

For a long time, the data centre sector has focused on Power Usage Effectiveness (PUE) as an energy efficiency metric. There has been significant work done on the cooling side to address this, however commentators suggest that gains have flattened over recent years[7]. A large proportion of a facility's energy draw comes from the IT hardware and servers in particular. With the slowdown in Moore's Law, the doubling of efficiency between successive generations is no longer as true as it was. This means that there are opportunities to reduce operational energy and embodied energy simultaneously with the use of refurbished hardware and remanufactured machines[8]. Tools that calculate this and suggest optimum hardware solutions have been developed and deployed in mid-tier and smaller data centres as a means of reducing use phase emissions and furthering circular economy[9].

However, with hyperscale operators developing proprietary technology to cut costs and power, the divergence in data centre design and increase in bespoke solutions may render energy efficiency benchmarking standards less meaningful as like-for-like comparisons become harder to identify.

[7] Uptime Institute: Beyond PUE: Tackling IT's Wasted Terawatts
[8] Optimizing server refresh cycles: The case for circular economy with an aging Moore's Law (computer.org)
[9] Interact: How to execute a 5-year strategy on server efficiency

Low-carbon energy

Efficiency measures can only go so far. Once efficiency has been maximised, the next step is to look at **sourcing green electricity for power**. In the past, the best way to do this was to make a long-term agreement with an energy company that can guarantee to deliver a supply of clean electricity sufficient to meet an organisation's growing needs. However, these long-term arrangements come with risk – we have seen Australian market prices drop significantly in the last two years, and some who entered long term arrangements are already 'out of the money'. In addition, onsite renewables are not a viable solution because the amount of renewable energy that can be produced, such as from rooftop Solar PV, is only a fraction of a data centre's overall energy consumption in most cases.

Data centre operators can choose to become off-takers using **Power Purchase Agreements (PPAs)**. As well as guaranteeing supply, this approach allows them to reliably predict future costs. However, negotiating PPAs can be technically complex. Some key parameters include the term of the agreement; whether the PPA includes a private wire and/or storage; and how risk is allocated between procurer and generator. Optimising these parameters to deliver a bespoke agreement that suits both generator and off-taker requires depth of knowledge and experience.

Sourcing 'green energy' through the purchase of **Renewable Energy Certificates (RECs)** can also provide the required 'greening' of supply, but without the long-term contract risk. The other benefit of this method is that the company can ramp purchasing in line with its wider strategy, for instance working up to 100% renewable over a designated time and purchasing additional RECs as its electricity use grows.

Case Study

Leading tech giant accelerates renewable energy purchase through auctions

In 2018, a leading multinational technology company that specialises in internet-related products and services matched **100% of its global electricity consumption with renewable energy** for the second consecutive year. Looking to the future, they recognised that sustaining a 100% match would require thinking beyond historical procurement methods. To continue meeting users' needs in a sustainable way, the company decided to streamline its renewables procurement process by running reverse auctions (where energy sellers bid for a buyer's business) for wind and solar projects. Their goal was to find a way to source, negotiate, and sign a large wave of renewable energy deals in a single, global push.

Using Enel X's **proprietary reverse auction technology, 10 agreements** comprising more than **1.2 GW of renewable energy** were successfully transacted. In addition to securing the renewable energy needed to maintain their industry-leading commitment to sustainability, running digital reverse auctions provided complete transparency, accelerated the procurement process and was instrumental in the achievement of cost optimisation goals.

Procurement

For electricity consumers with a large geographical footprint, procuring clean electricity is not as simple as it is for a customer switching to a renewable energy supplier. Data centre operators can simplify their energy purchases through a holistic, **three-step process:**

1. Strategy

Understanding how different renewable energy resources and product options accomplish different objectives is the cornerstone of an **effective renewable energy strategy**. Data centre operators should prioritise their goals among reducing costs and emissions, budget stability, contractual complexity, speed to market and tenure.

The next step is to select the best resources e.g. wind, solar, biomass; the best products e.g. PPAs, Virtual PPAs and RECs; the appropriate geographies, and the types of production (new vs. existing projects) for tender.

2. Execution

Given the complexity of renewable energy contracts, **request for proposal (RFP)** definition is a critical step for apples-to-apples comparisons. RFPs should be structured to manage market, basis, counterparty, and contractual risks effectively. For example, commercial operation date (COD) guarantees, production guarantees, and REC deliveries should all be consistent across bidders so that organisations can evaluate deals on equal terms.

After qualifying renewable energy developers or suppliers, either sealed-bid or live renewable PPA auctions can be conducted to ensure bid transparency, exert maximum competitive pressure, and render the best possible price for renewable buyers.

The production of physical and virtual PPAs may then be integrated into your **broader supply mix** by optimising net meter aggregations, managing monthly market settlements, incorporating hedging and risk management strategies, arranging REC delivery, retirement, and arbitrage opportunities, and by providing scheduling and bid support for physical PPAs.

3. Support

To further maximise the economic benefits of renewable PPAs, revenue streams exist for renewable off-takers through managing and bidding renewable capacity into annual and seasonal capacity markets.

Your energy management partner should suggest **adjustment measures** and provide administrative support for renewable energy reporting. They should also assist with the management of RECs by ensuring received RECs are correct; by certifying, tracking, and retiring them with local registries, as well as validating invoices, incorporating renewable production into GHG emission reports and providing guidance in the development of **Carbon Disclosure Project (CDP)** reports and disclosures.

Virtual Power Plants (VPP), Demand Response and resilience

Being available to respond in times of grid stress through a **VPP with Demand Response programs** has proven to be a successful strategy for both **data centres and grid operators** for many years. VPP participation makes the network more resilient by helping to avoid outages, using **dispatchable capacity** from existing assets (backup generators, UPS and flexible loads), rather than building new supply side and network capacity, which is not sustainable.

For data centres, VPP participation is a unique solution that supports operations, management, and sustainability initiatives. Benefits include **enhanced emergency preparedness**; a **significant new revenue stream** that can offset electricity costs or be reinvested in more sustainability initiatives; all while providing critical support to the electricity grid.

Data centres can easily participate in Demand Response programs by utilising their back-up systems, but there are still questions around how participation works with some business models. For example, co-location data centres operate within strict customer SLAs, and operators are understandably cautious about adopting measures that are perceived as a threat to uptime. However, participating in these programs enhances resilience, and does not reduce site redundancy levels or result in loss of power to the data centre.

Case Study

Digital Realty, Australia

Digital Realty has innovated the way it consumes energy to support the Australian electricity grid. Its two Australian data centres are available to **switch over to UPS and backup generation** to provide capacity as part of **Enel X's VPP** to support the grid with **Demand Response** programs, bringing several benefits.

Digital Realty recognised that large energy demand is placing stress on the grid in Australia, which is at a tipping point when it comes to the renewable energy transition. The VPP project helps to iron out some of the instability in the market created by variable renewable generation sources.

Before participating, Digital Realty had detailed discussions with customers, working extensively to explain the program and the benefits. Once they understood the benefits, the **customers quickly became supportive** of the concept, in part because they receive the benefit of **sharing the revenue earned** from participation. From a sustainability perspective, the VPP supports the energy transformation, and Digital Realty expects VPPs to play a key part in APAC energy markets for the next five to 10 years as we transition to renewable energy.

Other leading co-location data centre operators (and their customers) have also actively embraced VPP and Demand Response participation. The key reasons why data centres participate include:

A better way to test backup systems

Most data centres still perform on-load testing of backup systems at pre-planned times, but grid outages don't occur at pre-planned times. Proving that you can respond correctly to Demand Response events without advanced notice/planning is the most realistic way to test. And any problems that are revealed while doing this occur in a safer environment while the grid is still there, which is much less risky than finding a problem during a real grid event.

Avoid downtime

Responding to Demand Response events can prevent an actual outage that would result in more grid downtime and longer time running on generators. This is an example of how the data centre can be a "good grid citizen" that helps everyone. Being a good grid citizen is also sometimes demanded by data centre customers who require ESG commitments from their partners.

Earn revenue

VPP participation provides data centres with additional energy, capacity and ancillary payments simply for being on standby; this is a valuable income stream to help offset energy costs, or to be reinvested in other sustainability initiatives.

Enable more renewables

Renewables like solar and wind are intermittent, and result in more disruptions to the supply/demand balance needed to maintain the grid frequency. Without large users like data centres participating on the demand side, more expensive frequency balancing capacity would have to be deployed from traditional generators. VPP participants are improving grid sustainability by enabling more renewable generation, without increasing costs.

Prepare for potential future grid restrictions on maximum energy use

The same mechanisms put in place to respond to Demand Response event triggers can be used to transfer some data centre load over to backup systems when a maximum demand threshold is reached.

[10] Australian Energy Market Operator: 2020 Electricity Statement of Opportunities
[11] Bloomberg New Energy Finance, 2019

Demand Response in action – how Enel X created Australia's largest Virtual Power Plant

In **Australia**, the grid is not as reliable as it once was. The transition to renewable power has increased grid frequency fluctuation and increased the cost of power. The Australian Energy Market Operator (AEMO) stated that **to ensure system reliability and affordability**, targeted actions must be taken to provide additional **dispatchable capacity from the demand side** (energy users)[10]. Enel X has responded to this need by creating Australia's largest VPP[11].

Data centres are a key sector of focus for Enel X's **VPP** in Australia. They can participate **without any capital expenditure** or investment in additional equipment, and can simply **use existing assets** without introducing any risk to their business. VPP participants alter their grid electricity consumption when needed simply by switching to onsite backup systems. Rather than exporting to the grid, data centres are paid to reduce consumption when the grid needs more supply. Enel X currently works with several data centres in Australia.

The grid support is only required under emergency conditions, typically for no more than 30 hours (~0.34%) per year. As these hours can count towards backup systems on-load testing, the net amount of additional hours can be low. As data centres are important facilities where information security and facility stability are the top priority, they can be cautious about VPP participation. However, Enel X has proven to customers through actual applications that VPP participation is viable, safe, and can occur without interrupting regular operations.

Other examples of Enel X helping data centres to participate in Demand Response DR programs through VPPs include **South Korea**, where the data centre industry is growing at an extremely fast pace. Many global corporations – including **AWS** (operating at four locations including metropolitan areas and Busan), **Microsoft** (Seoul, Busan), **Google, Oracle, SAP**, have data centres there. Similarly, in **Japan**, where there are around **600 data centres** run by commercial operators, Enel X is using its VPP technology to support Japan's DR programs, by enabling data centre operators to automatically switch to backup generation.

Fast frequency response

Another way that data centres can work with grid operators for their mutual benefit is through **ancillary programs** such as providing **fast frequency response (FFR)**. When grid operators have a large amount of renewable energy in the mix, there is less inertia and the system is more sensitive to sudden changes in frequency – threatening the balance of supply and demand and compromising the stability of the grid. FFR solves the problem by creating a sudden reduction in demand with response times of **less than one second** in some markets.

Enel X has **pioneered its own FFR technology** and works with data centres and other businesses to support the evolution of the energy system. As with other Demand Response mechanisms, **businesses are rewarded** financially for their contribution, and, thanks to Enel X's technology can participate without any capital investment.

Most data centres' UPS systems already have frequency protection built in to protect from volatility of frequency as part of their power quality protection. This means that participating in FFR is similar and **replicates the UPS' normal process**. The latest generation of UPS systems are capable of maintaining a "floating" capacity in the battery, over and above that needed for critical load response. Therefore UPS systems are ideally placed to fulfil the need for fast responding assets to help **stabilise grid frequency.**

The technology can be seen in action in **Ireland**, which, according to Dr David Connolly, CEO of the **Irish Wind Energy Association**, *"is number one in the world for the share of electricity demand met by onshore wind."* As of 2020, Enel X manages over **400 MW of FFR capacity globally.** To participate in the FFR program, clients must be able to respond very quickly when frequency drops, a process which can be automated using Enel X technology.

Holistic energy planning

Energy management initiatives extend beyond the matter of supplying power to the data centre itself. Increasingly, businesses are seeking **holistic approaches** to manage their energy needs. Today, battery backup and diesel or gas-powered generators are used extensively to support short and longer-term business continuity in the event of power outages, but Microsoft has successfully tested **hydrogen fuel cells** to provide continuous standby power and help the company move away from fossil fuels[12]. In a similar move, Google has installed a large-scale battery plant at a Belgium data centre as backup power for 3 MW of computing load while also providing grid balancing services[13].

As the use of electric vehicles grows, workplaces are integrating charging infrastructure for employee and visitor use. **Smart EV charging** can play a role in grid balancing by integrating these more flexible, non-critical loads into an overall energy efficiency plan.

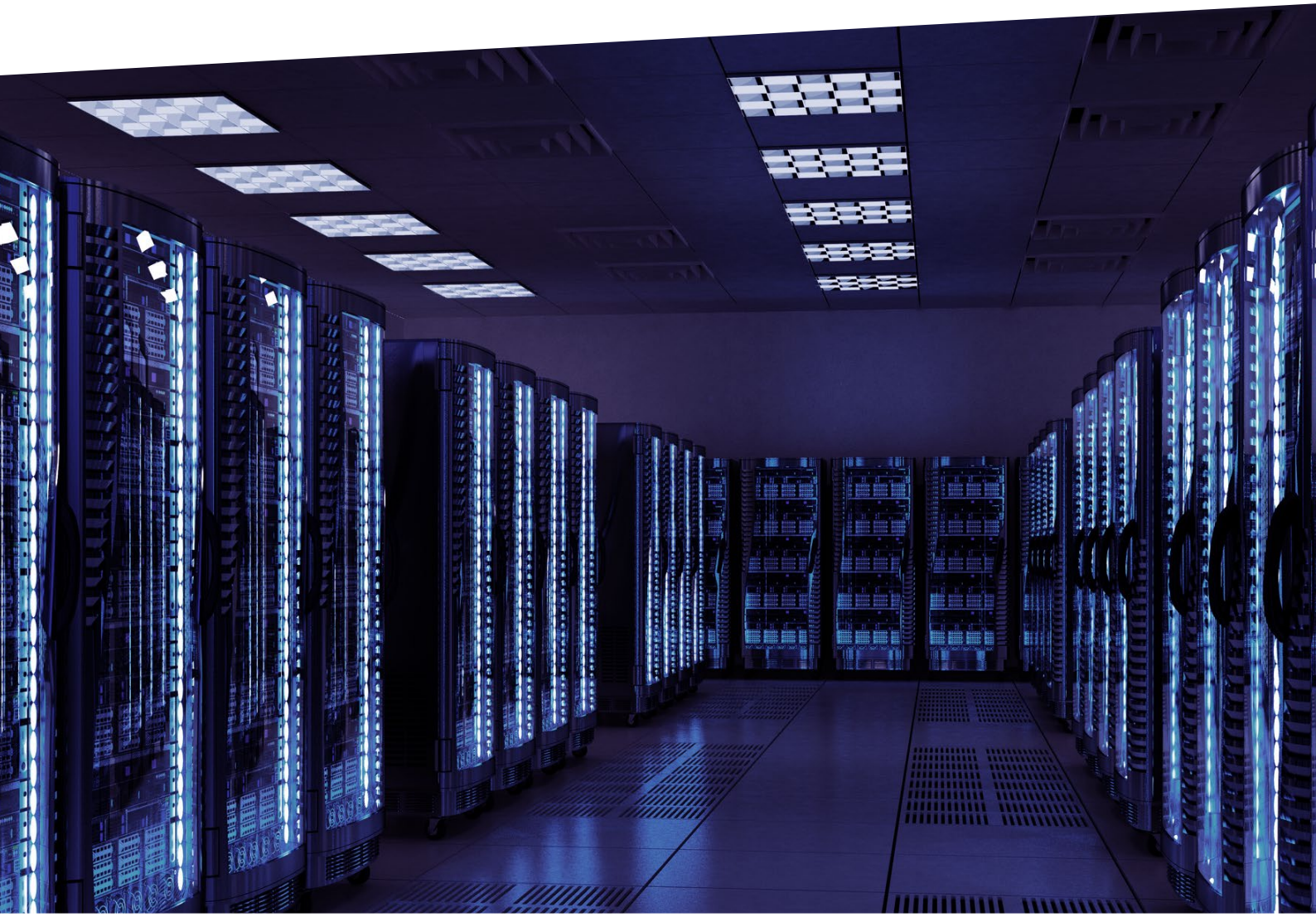
Microsoft News: Microsoft tests hydrogen fuel cells for backup power at datacenters
DataCenter Knowledge: Google thinks data centers armed batteries should anchor carbon free grid

Conclusion

The way we create data is changing and growing rapidly across the globe. For data centre and co-location services to continue their **current trajectory of expansion**, they need to review their **energy strategies** and have **best practices** in place. In many ways, a sound energy strategy gives data centres a license to operate. Operators need to meet the challenges of reducing carbon emissions, managing the effect of their growth on grid capacity and maintaining resilience.

An effective strategy includes optimising energy efficiency, planning and implementing a procurement strategy, and exploring ways to co-operate with grid operators. By committing to renewables and participating in **Demand Response programs**, data centres can help maintain the **stability of the grid, improve testing realism** and find **valuable new sources of income.**

The data centre industry has the resources and opportunity to play a partnership role as a **platform for innovation** in energy production, management and distribution at a scale that is unmatched by almost any other industry. Such a partnership approach could be the key to both grid stability and data centre growth over the next decade and beyond.



About Enel X

Enel X is leading the energy transformation all over the world. We help businesses to decarbonise, digitalise and electrify energy use to drive sustainability outcomes and reduce costs.

For more information, visit: www.enelx.com.au, or get in touch with one of our energy advisory experts at info@enelxanz.com.au.