



GOING GREEN

Decarbonizing the data center industry

A green and economically viable back-up power system technology makes way for a fully decarbonized data center.

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Sustainability has long been a major topic for data centers, which are among the world's largest consumers of electricity. Optimizing power consumption and reducing carbon emissions are always top of mind for data center operators. So far, renewable energy procurement has been essential in allowing large cloud providers to run an almost entirely decarbonized infrastructure. The need for backup power systems, however, has made running a fully green operation elusive for many.

The diesel genset – the most popular and robust back-up power supply solution – is a double-edged sword. Though critical for ensuring operational continuity in data centers, their use means that carbon emissions are unavoidable. At the beginning of 2020, initiatives around emission-free data centers were announced, pushing the industry to rethink the role of these stalwart systems.

Speed is of the essence: A new model for the future-proof data center

A new technology – the Battery Energy Storage System (BESS) – has emerged that can put an end to the quest for data center carbon neutrality. Centered around lithium-ion (Li-Ion) batteries, BESSs are emission free. Moreover, "they have a better cost-effectiveness than a corresponding diesel genset configuration. Most essential, however, is their potential for supporting and stabilizing the grid while generating additional revenues, essentially reducing investment to zero over a period of five to seven years. It's a win-win for the energy ecosystem.

BES systems can switch from grid to battery operations a hundred times faster than a diesel genset. The speedy switchover between grid to battery operations is the key enabler to further cost reduction. In a typical data center design, the uninterruptible power supply (UPS) is designed to provide power continuity to the critical load until the diesel genset is up to speed, which takes as long as 15 seconds. Such a UPS system would then run anywhere from five to ten minutes.

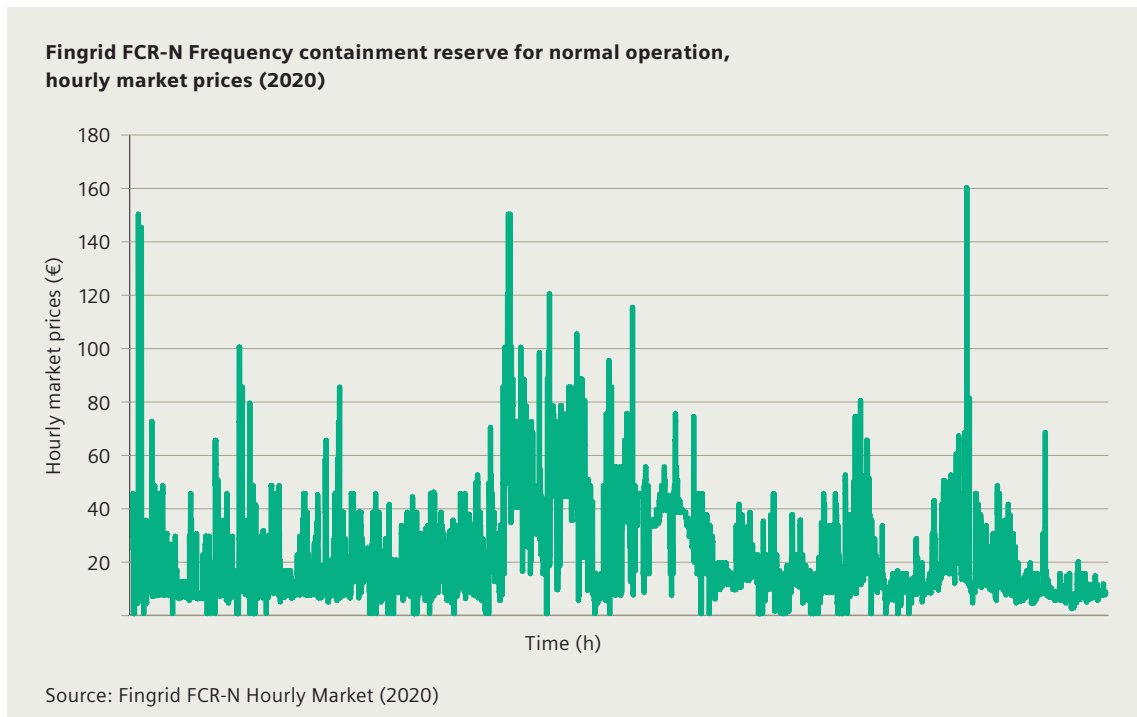
Because switching from grid to storage can be as fast as 150 milliseconds, the UPS battery pack can be a lot smaller, up to 90%. Data center operators can then either allocate extra space to the critical load, which in turn leaves capacity for other IT equipment, or simply reduce the space, which in such a high-density building environment translates into reduced construction cost.

Revenue generation

More important, however, is the ability of BESSs to generate revenue and to stabilize the grid. As assets, diesel gensets are largely underutilized. Aside from their use as backup power supply, and aside from periods of maintenance, which accounts for less than 1% of operations per year, they remain idle.

A battery energy storage system, however, can be utilized anytime to support and stabilize the grid and generate revenues with different approaches, including, but not limited to, virtual power plants, demand response or fast frequency regulation.

The energy market in Finland is an example. By participating in the hourly frequency containment reserve market for normal operations (FCR-N, pictured in the slide), data center operators can generate up to €150,000 per year per MW, according to prices negotiated in 2020 and published by Fingrid, the Finland's transmission system operator.



Alternatively, participation in the yearly market – in which the price is constant during the entire calendar year – could yield data center operators more than €150,000 per year per MW. It's commonly accepted by the industry that by participating in the frequency regulation market, a reasonable payback time can be expected within five to seven years.

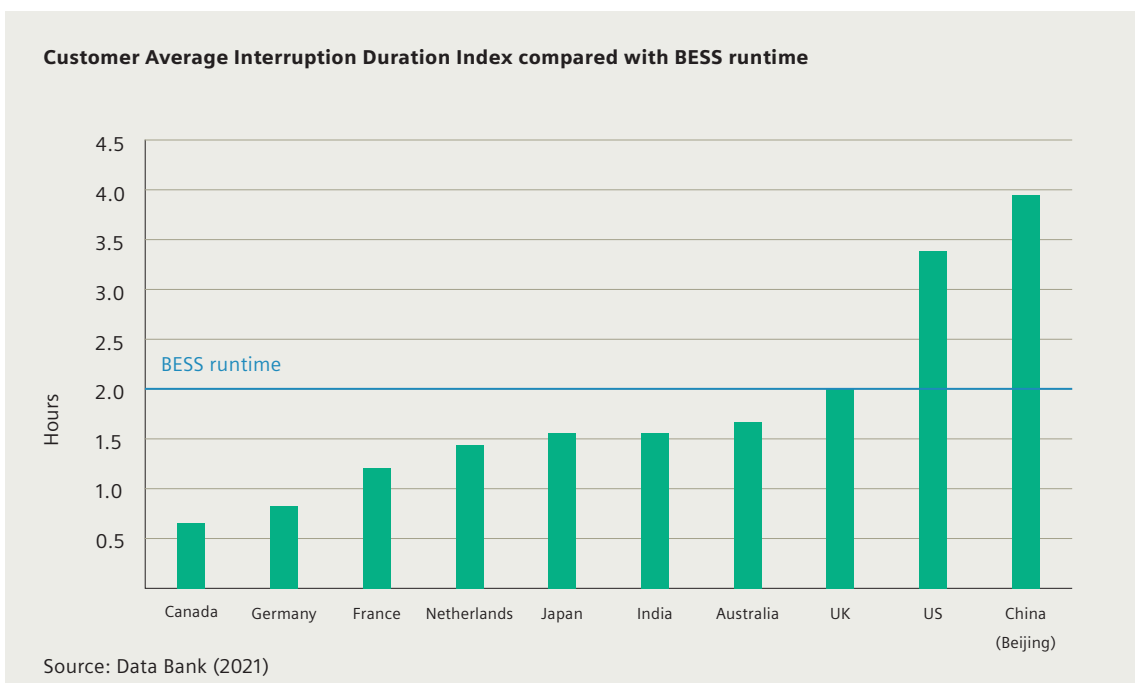
While appreciating the financial advantages a BESS provides, some industry experts express concerns about its limited runtime. Compared with diesel gensets, BESS cannot guarantee an unlimited number of hours of autonomy at site conditions*. The yet unconventional solution lies in re-examining conventional thinking. Back-up power systems were traditionally designed to cover many hours to several days of power outage.

* According to the Uptime Institute's definition.
** Customer Average Interruption Duration Index

But with grids becoming more and more stable, what is the average outage duration that a user actually experiences? CAIDI**, a metric tracked by many grid operators, measures exactly that. Plotting CAIDI against the average BESS runtime of two hours reveals that a BESS can cover most, if not yet all, outages.

One large installation provided by Fluence, a BESS manufacturer owned by Siemens and AES, provides 100MW of power with four hours of runtime, for example. Called Gridstack™, this Li-ion BESS includes medium-voltage transformer, a power conversion module, multiple prefabricated cubes, a telco cabinet – for data transmission and comprehensive control and asset management – and a management software, with machine learning algorithms to improve system performances of the whole lifecycle management.

Such an industrial-strength design is built for data center short-term backup power supply, flexible peaking capacity, frequency regulation, renewable integration, transmission, and distribution enhancement. To cope with potential change in power demand, the Li-ion BESS is scalable. Modular, prefabricated cubes guarantee safety and cost-effectiveness, regardless of storage technology.



BESS + Cloud = autonomy / Autonomy through combined technologies

For those seeking unlimited hours of autonomy at site conditions above and beyond, however, a hybrid solution of BES and cloud technologies is the answer. Utilizing cloud infrastructure mitigates the risk associated with longer outages by allowing operators to shift computing workloads to another data center.

Hyperscale cloud providers are pioneering this approach, and they have huge expectations in terms of cost savings and revenue generation. Google itself announced their installation of a battery-based power back up system in the center in Belgium.

Enterprise and corporate data center operators, for which cloud technology is largely available, can find themselves in a similar situation. According to a 2018 report by market analyst 451 Research, “more than 90% of organizations” are projected to adopt that technology. Such approach will lead organizations to turn towards decarbonization and consolidate investments into a more reliable, distributed digital infrastructure.



Colocation providers may be prevented from being the first adopters of the BESS technology because of their existing SLAs. Many tenants still expect unlimited hours of autonomy in case of grid outage. There is an opportunity to rethink the terms and conditions of the site reliability by offering a distributed architecture wherein tenants that would achieve the highest levels of service availability are obliged to spread workloads in two (or more) data center facilities.

Towards a sustainable data center ecosystem

Google won't be the only hyperscale provider banking on BESS technology. With the costs of lithium-ion batteries (in \$ per kWh) falling, driven by increased demand and large-scale manufacturing, BESSs are becoming a more economic and viable solution for replacing diesel gensets.

Better cost-effectiveness is measurable in terms of both capital and operational expenditure, calculated over a period of 20 years of asset lifecycle management.

Financial and operational advantages notwithstanding, the environmental benefits of moving to a BESS and cloud solution can be substantial. According to Google estimates, over 20 gigawatts of backup diesel generators are currently in service across the data center industry. This represents a massive opportunity for deploying cleaner solutions.

By embracing full decarbonization, not only can data centers ensure an economically viable business model, but they can also future-proof their operations, provide stabilization to the wider grid, and move to the positive side of the energy equation.



About the author

Giuseppe Leto is responsible for the data centre vertical market and manages the portfolio strategy including evolution, positioning and promotion of solutions and services.

He has a long experience within the data center market and has deep insight into the needs and trends of industry. He has two master's degrees and currently lives with his family in Switzerland.

The information and conclusions provided in this document are based on review and analysis of 3rd party industry data. It is subject to change and errors.