Saft White Paper

Taking energy storage ‘behind the meter’ in commercial and industrial applications

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Taking energy storage 'behind the meter' – the case for battery ESS in commercial and industrial applications

Commercial and industrial (C&I) enterprises are waking up to the potential of 'behind-the-meter' battery Energy Storage Systems (ESS) as a way of enhancing self-consumption and reducing exposure to rising energy costs. Battery ESS offers a way to improve the manageability, quality and cost-efficiency of supply, especially as C&I enterprises install renewable sources such as solar photovoltaic (PV) systems.

Battery-based ESS has grown in popularity over the past few years – both in front of and behind the meter – and is fast approaching a combined capacity of 10 GW globally with significant room for growth.

This growth is being driven in part by falling costs of technology, but also by more favorable regulatory and market conditions and, significantly, by improvements in the manageability and customization of ESS systems, which make them more suitable for a broader range of applications beyond grid-scale projects.

Grid-scale battery ESS is becoming increasingly important as variable renewable power sources grow in significance. Storage makes wind and solar power dispatchable and compatible with grid requirements. It also supports the electricity system in managing demand peaks, grid bottlenecks and stability issues. Now, ESS is increasingly being seen as a way of enhancing energy management in C&I environments too.

One industry analyst, Navigant Research, predicts there will be a total of 10 GW of accumulated C&I storage worldwide by 2026[1] . Advanced energy markets in Europe and North America are leading the way. According to energy research firm Delta Energy & Environment, Europe will see a combined 260 MWh of C&I storage installed annually by 2020[2] – approximately 20 times the figure installed in 2016. The business case for energy storage is strongest in retail, agriculture, water and waste treatment and industrial processes requiring 24-hour power, according to Delta.

1 - Navigant Research Energy Storage Tracker Q418, available at: https://www.navigantresearch.com/reports/energy-storage-tracker-4q18

2 - Delta Energy & Environment and European Energy Storage Association EMMES 3.0 report

Furthermore, there is a significant market opportunity opening up for third-party providers to deliver demand-side response (DSR) aggregation between energy suppliers and C&I customers.

Such C&I applications require customizable and cost-effective solutions to be financially viable, as they are typically more complex than grid-connected battery ESS solutions.

Illustration 1: solar installation in an airport area

// Market drivers for C&I energy storage

To date, the main markets for battery ESS have been grid-scale and residential applications; only a small fraction of the total operational ESS applications can be considered commercial and industrial.

However, recent years have seen significant advances in battery technology, as well as policies that have incentivized self-consumption among C&I enterprises. These include tougher energy-efficiency standards, new carbon reduction initiatives, higher peak demand charges and reductions in feed-in-tariffs for renewables.

C&I enterprises can use ESS to cut their electricity bills through increased self-consumption of locally produced electricity and reduced peak loads. Many enterprises also envisage generating additional revenue through participation in electricity flexibility markets.

In fact, demand-side management of energy enables enterprises to optimize their energy spending both through peak power reduction (that is, reducing the power drawn from the grid) and PV time-shifting. Self-generated PV energy can either be consumed during peak evening hours, or be remunerated at a higher tariff when sold during peak periods.

As well as enhancing cost savings from self-consumption, behind-the-meter energy storage also offers C&I enterprises a way to improve the robustness of their overall energy system, through better-optimized management of renewable energy production and consumption, and enabling cleaner, greener back-up power than diesel generators.

Illustration 2: solar PV plant in agriculture area / farm

In some advanced energy markets, C&I enterprises can earn revenue from participating in grid ancillary services or balancing markets. Technically, the ESS may be used to directly inject or absorb active power to and from the grid. For example, the UK National Grid's 'Firm Frequency Response' program rewards participants for using energy storage to help keep the grid frequency within mandated tolerances by feeding or drawing energy as needed. Another option is to participate in programs that reward demand flexibility: the enterprise can reduce the power drawn from the grid, while the in-house ESS provides reliable energy for critical loads and processes.

The Energy Storage World Forum has identified four key value propositions of energy storage for C&I enterprises:

• Bill management – cutting peak demand charges by shaving peak load and flattening the load profile through the day. ESS combined with on-site renewable energy sources can also provide a hedge against volatile electricity prices

• Increased grid independence – higher self-consumption of on-site renewables, leading to energy bill savings and lower carbon footprint

• Ancillary services – additional revenue from the provision of ancillary services such as frequency response and voltage control

• Arbitrage and energy market bidding – with optimized control and software systems, C&I enterprises could unlock revenue from participation in sophisticated energy, ancillary and capacity markets.

// Behind-the-meter energy storage in practice

One enterprise that has profited from behind-the-meter energy storage is EXKAL, Spain's leading manufacturer of refrigeration systems, which has deployed a lithium-ion (Li-ion) based ESS to optimize the utilization of its existing solar PV plant. Thanks to a 20 percent reduction in peak power demand and increased self-consumption, the site's energy bills are now up to eight percent lower than before.

Illustration 3: solar PV plant at EXKAL's Marcilla manufacturing facility in Navarra, Northern Spain

EXKAL's manufacturing plant already had an extensive solar PV system when, in 2016, the company decided to participate in the five-year European STORY project that aims to demonstrate new energy storage technologies and their benefits in distribution systems. The project involves 18 partner institutions in eight different European countries, with the aim of analyzing and enhancing the use of distributed power generation, to reduce dependence on the distribution network.

The EXKAL factory consumes 428,000 kWh a year, with a peak load of 270 kW, and the 113 kWp roof-top PV array contributes around 158,000 kWh a year, as well as saving CO_2 emissions of over 100 tonnes a year.

Two Saft Intensium® Mini E systems have been installed to provide the EXKAL site with flexible energy storage to meet local grid code requirements, with a capacity of 50 kW power and 200 kWh energy.

The combination of the Li-ion battery and PV systems, together with an energy management system, have created an advanced energy storage facility that contributes to the profitability of the EXKAL plant. It does this by reducing the peak power element of EXKAL's utility bill and by reducing the electricity supply factor of the bill through self-consumption of energy drawn from the batteries at the most expensive time of the day.

In the EXKAL application the maximum depth of discharge (DOD) is around 80 percent and the Intensium® Mini is designed to support a minimum of 5,000 charge/discharge cycles at this level, which means that it will easily outlast the five-year life of the project.

Currently, the ESS batteries are charged by the energy generated by the PV facility. However, the power electronic equipment – an MM60 Microgrid Manager rated at 60 kVA / 54 kW – offers the future flexibility for the batteries to be charged from the site's electrical grid as well.

The decision to either charge or consume (discharge) energy from the batteries is made by an external control system designed to regulate operation according to a range of parameters such as DOD, current cost of energy

Illustration 4: Saft Intensium® Mini lithium-ion (Li-ion) energy storage systems (ESS) 'behind-the-meter' at EXKAL manufacturing site in Navarra, Spain.

(peak or non-peak) and level of consumption. The Microgrid Manager controls the flow of energy to ensure the monitored parameters are maintained within operation limits required for safety and efficiency.

By controlling the active and reactive power, the Microgrid Manager enables EXKAL's ESS to offer the following functions:

- Storage of surplus solar energy
- Reduction in peak power loads (peak shaving)
- Reducing energy consumption from the grid at peak hours
- Compensation of reactive power (power factor correction)
- Balanced consumption

Originally, the ESS was targeted at a peak shaving approach according to a pre-calculated threshold in order to reduce the demand charge levied by EXKAL's energy supplier. Subsequently, the consumption of the factory was decreased due to restructuring. Therefore, the threshold was lowered, and the strategy refocused on reducing the energy charge.

The EXKAL ESS is contributing to a 20 percent reduction in peak power during the most expensive (P1) period of the day. It is also helping to reduce overall energy consumption by 20 percent during the same peak period by self-consumption of excess PV energy. Considering that there is a ratio of approximately 2:1 between energy costs and demand charge costs, the overall saving in the site energy bill is around eight percent.

Increasing demand-side flexibility and participation

As the popularity of energy storage grows among C&I enterprises, so does the opportunity for broader market participation. As more behind-the-meter renewable generation and energy storage come on stream, it becomes more attractive for a broader range of demand-side providers – including electricity suppliers, aggregators and third-party intermediaries – to get involved in delivering a broader range of services across a wider range of enterprises.

In response to this trend, a growing number of aggregators are emerging in deregulated markets – where they act as intermediaries between C&I enterprises and grid operators, using their technology platforms to create a virtual power plant. These players can offer market access and energy trading capabilities to any enterprise with flexible load and storage.

By managing a pool of aggregated behind-the-meter loads and storage systems, aggregators can trade energy on balancing and ancillary service markets alongside generation assets. When a market for local electricity flexibility exists (which is not yet the case in many electricity systems), the energy can be sold for grid-congestion management purposes. The enterprise customers are paid in return for managing their consumption within certain response times.

As the market matures, smaller enterprises, with even relatively modest PV and ESS systems, are able to participate in more sophisticated demand-side schemes by working with such aggregators. The advantages of doing so include economies of scale, access to innovative technology, risk spreading, and participation in a wider variety of schemes (thanks to their combined volume) and access to expert knowledge and support.

Battery ESS solutions, with sophisticated management systems, are crucial in supporting such demand-side schemes. Unlike normal demand-side management, which reduces or increases loads, battery-based systems respond very quickly with a programmable and predictable power profile. Digital solutions are needed for transparent sharing of data and fast, efficient transactions in response to changing demands.

Illustration 5: solar PV plant in a commercial area

About the author

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