The new frontier for Middle East energy

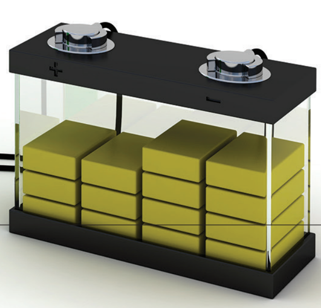
Chadi Salloum and Julian Nichol of Akin Gump offer insight into the latest developments in energy storage deployment to cope with the rise of renewable energy projects in the region.

With renewable energy targets being publicised by various countries in the Middle East, utilities are seeking to address the intermittency of renewable energy supply with viable energy storage solutions – such as batteries. This increasing interest in batteries as the preferred energy storage solution has been driven by battery technology advancement and a reduction in battery prices over recent years. These factors are enabling energy storage deployment to support renewables grid integration especially at times of peak demand, such as during the summer season in the Middle East.

The Abu Dhabi Department of Energy (DoE and formerly the Abu Dhabi Water & Electricity Authority) was a Middle East pioneer in exploring large scale uses and deployment of battery storage systems. By 2016, it deployed 108 MW of molten salt (NAS) battery energy storage systems (BESS) across the Abu Dhabi distribution network in one of the largest energy storage projects in the world. The BESS work to primarily level the electricity load curve and defer generation investments through peak shaving.

The BESS deployment occurred before the DoE's award of the 1,177 MW Sweihan Solar PV Project, currently the largest solar project in the world, expected to commence operations in mid-2019. Akin Gump advised the DoE on various aspects concerning the supply, installation, and deployment of the BESS and on all aspects of the Sweihan solar project.

In January 2018, the DoE indicated that it is also planning to add more solar capacity to the generation



mix. With the increase of renewables deployment there is potential for Abu Dhabi to add more energy storage capacity either on a stand-alone basis or as an integral part of a solar project. This is similar to what is currently being implemented and contemplated in Jordan on a smaller scale. As Jordan adds more solar and wind capacity it is also moving ahead with energy storage projects to strengthen network availability and reliability. In August 2017, a PPA was signed for what has been dubbed the Middle East's largest solar-plus-storage project to date, a 12MW solar PV facility with a 12MWh lithium-ion battery. Financial close for the project was achieved in May 2018.

In addition, Jordan issued an RFI in July 2017 for the development of stand-alone energy storage projects in two phases, with the first to be a 30MW / 60MWh electricity storage plant. The second phase's scope and size is to be determined. The phase one plant would be used for ramp-rate control of PV and wind power generators in the local area and to shift renewable energy generated off-peak to times of peak demand. Phase one is planned to be completed by April 2019 and has generated a lot of interest. Such interest partly stems from Saudi Arabia's USD200 billion plan to establish the world's biggest solar projects including the construction of the largest utility-scale battery that will supply evening hour power to consumers.

Further, in June 2018 NGK announced that it had received an order from the Dubai Water & Electricity Authority (DEWA) for a NAS battery to be used as a pilot linked to a 13MW solar PV plant in the Mohammed bin Rashid Al Maktoum Solar Park. The battery has a combined capacity of 1.2 MW with a storage capacity of 7.2 MWh.

Overall, there is a lot of exciting development and potential for energy storage deployment in the Middle East and this is expected to intensify alongside the ramp up of renewable energy deployment in the region.

ENERGY STORAGE "USE CASES"

Energy storage can provide immense value in terms of "Grid Services" and "Customer Services". We characterize **Grid Services** as implementations of storage that are beneficial for the task of running the electric grid reliably, efficiently and safely. Such services include:

» "frequency regulation" which allows transmission operators to control frequency on the grid by storing electricity when supply exceeds demand and discharging it onto the grid when demand exceeds supply;

» "contingency reserves" where transmission operators must maintain sources of electric power that can be drawn on extremely quickly in order to mitigate stresses to the reliability of the grid. Energy storage has the technical capability to perform that function well;

» "voltage support" is key to maintaining reliability on the grid and is regulated through reactive power dispatch. Batteries can be connected to the grid with inverters that are programmed to monitor and supply voltage to the system when voltage lags.

We think of **Customer Services** as implementations of storage that directly decrease a customer's costs or provide some additional resiliency specifically for that customer's application. Such services include:

» "managing electricity time-of-use" for consumers which becomes possible when utilities harnessing energy storage use grid power during low cost periods of time to charge energy storage systems, thereby allowing customers to time shift their energy usage and minimise the amount of electricity purchased during higher cost times;

» "energy storage for self-consumption", which is promoted through consumers being able to store rather than export excess generation produced from their solar PV panels or wind turbine;

» "demand charge reduction" which can be achieved by a consumer gaining, through the use of an intelligent energy storage system, the ability to implement peak shaving or to simply independently manage demand to avoid periods of high power prices;

» "backup power" capability which is achieved by pairing energy storage with local power generation such as solar PV panels, enabling the maintenance of power quality for residential or industrial applications.

INTEGRATING SOLAR PV AND ENERGY STORAGE – "S2" PROJECTS

Despite its many benefits, integrating solar PV and energy storage – the so called S2 solution - is not perfect: storage technology is largely viewed as nascent and, at very

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large and very small scales, relatively expensive. Inevitably, battery platforms will improve and become more cost effective over time. As S2 commercialisation ramps-up across the Middle East region, the core engine for storage deployment is likely to be the power purchase agreement or "PPA" as it typically referred to.

Three value streams can be monetized through PPAs – energy, capacity and renewable credits and S2 PPAs can monetise all three effectively. The PPA allows the electricity buyer to control the contracted power generation resource through dispatch instructions. The buyer tells the power producer when to ramp generation up and down to meet requirements associated with current grid conditions. To compensate the generator, the customer will make an energy payment and a capacity payment. The energy payment typically reflects the cost of operating the plant through the measurement of electrical energy delivered whereas the capacity payment will provide compensation for the fixed costs of installing the plant with a return on equity.

The PPA architecture fits the S2 platform well. The energy charge would include a component of operational cost, however given solar energy is produced on an "as available" basis to either charge the battery or make deliveries to the customer, some innovation in the structure of the PPA is required. This could include permitting the buyer to curtail power export from the plant when energy is not required, on either a compensated (where the recovery of energy charges is essential to the economic viability of the project), uncompensated (where all the power plant economics can be recovered through capacity payments) or partially compensated (where some form of energy charge payment is required to maintain project economics) basis.

Other possible structures for dealing with "excess power" generation from the S2 renewable resource include discounting the price of excess energy; creating a floor for the energy payment; defining windows of time when the buyer "must" purchase excess energy, or permitting the seller to sell excess power to third parties. Solutions that impose energy consumption requirements on the buyer may correspondingly be expected to contemplate a minimum energy production guarantee from the generator.

Capacity charges are typically dependent on plant availability to respond to dispatch directives from the buyer. To ensure power is produced on demand, availability in a conventional plant requires adequate fuel supply. In an S2 plant, the amount of fuel available to charge the battery is entirely weather dependent. This weather constraint could be addressed by setting availability windows that align with the anticipated charging of the battery; limiting the overall number of hours in a day that the battery must be available; limiting energy consumption by the buyer, or adjusting the availability commitment for weather conditions.

The demand shifting capabilities of S2 technology gives it a distinct edge in domestic, commercial and industrial applications. In the utility market, with the exception of island economies, S2 has not yet proven its value relative to conventional power or vanilla renewables solutions. That said, as battery absorption accelerates across the Middle East and costs decline, it is not difficult to envision S2 PPAs as the new solar standard.

The authors thank their partners Dan Sinaiko and John Marciano, co-heads of the firm's global project finance practice. For a "deeper dive" on energy storage, see Akin Gump's "Storage School" website at www.storage.school.

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