

GLOBAL ENERGY STORAGE: 2017 YEAR IN REVIEW AND 2018-2022 OUTLOOK

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1. 2017 IN REVIEW

1.1. Introduction

2017 was one of the most exciting years yet for energy storage, as several markets saw formative policy developments, interesting business models materialize and a rush of corporate merger and acquisition activity. A total of 1.4 gigawatts and 2.3 gigawatt-hours of energy storage was deployed globally in 2017, with Australia taking the pole position in terms of power capacity at 246 MW, while the U.S. market led the world in terms of energy capacity at 431 MWh.

1.2. Following the Frequency in Europe

As expected, the European utility scale segment is dominated by the Frequency market, following the example set in the early days by the US markets. The U.K. and German markets went head to head with 117 MW and 135 MW deployed in power terms over the year. The U.K. rollouts are mainly the result of a highly competitive Enhanced Frequency Response (EFR, a type of sub-second response) auction run by National Grid toward the end of 2016 that resulted in shockingly low clearing prices (as little as £7/MWh or \$9.9/MWh). Interestingly, the weekly contract duration in the German market hasn't put off project development, against the more favorable four-year contact duration lengths of the U.K. EFR tender (limited to just 201 MW), or the two-year durations in the wider U.K. frequency market.

National Grid recently initiated the process of restructuring the ancillary services market in the U.K. After having planned an EFR Part 2 auction, it ultimately opted to cancel this, and instead attempted to integrate an EFR-type service into one frequency market to rule them all. The idea is to simplify the market, make it more transparent, and more accurately value variables like speed of response. The market was waiting patiently to learn the outcome, which has been pushed to the end of 2018. In the meantime, storage players have been bidding into the standard Dynamic Firm Frequency Response market and earning significantly greater revenues than the faster EFR would allow, in an attempt to get in early before this market is saturated.

We saw yet more frequency market restructuring in Europe as the European Network Codes went into effect, which includes harmonization of the balancing markets. A number of proposed changes that will impact the frequency markets of the coupled markets of Austria, Belgium, France, Germany, the Netherlands and Switzerland were announced, although nothing specifically to improve the conditions for storage.

1.3. Optimism Tempered by a Few Blows to the Storage Business Case in U.K.

The government and Ofgem have been talking up the value of flexibility and the importance of technologies such as storage to enable a low-carbon energy system, particularly in the face of imminent coal plant closures. A number of positive policy announcements have been made that should help storage, such as legislation more clearly delineating the definition of storage and the modification of the generator license to allow it to also apply to storage (though the latter appears to be something of an awkward fix for the common double-charging issue). Distribution network operators have also been given clear messaging that they should not own or operate storage, and it is up to the free market to provide these types of solutions.

However, although both government agencies and regulators hyped storage over the course of 2017, the business case suffered. Embedded benefits will be scaled back from an average forecast of £47k/MW/year to £70k/MW/year (\$66k/MW/year to \$99k/MW/year), down to £3k to £7k/MW/year (\$4.2k/MW/year to \$9.9k/MW/year) by April 2021. In addition, the capacity market saw deratings down to 18% for 30-minute-duration systems, coupled with the lowest T-4 clearing price yet of £8.40/kW/year (\$11.8/kW/year). With over 3 GW of storage capacity getting through the prequalification process but only ~400 MW securing contracts, there is a glut of uncontracted projects in the U.K. market right now.

1.4. North American Market Started With a Bang

The first quarter of 2017 set the record for most megawatt-hours deployed in any given quarter in the U.S., with a total of 234 MWh of storage deployments. The bulk of these deployments went toward the fulfillment of California Public Utilities Commission's expedited procurement to meet capacity needs stemming from the Aliso Canyon facility's shutdown. Taken as a whole, the remaining three quarters of 2017 collectively deployed less storage in the U.S. was installed in the first quarter, but 2017 was still a big year for U.S. energy storage. The biggest reason for this market momentum was the renewed diversity in storage efforts from various state markets. Massachusetts and New York enacted laws to set energy storage targets. Several other states initiated legislative and regulatory efforts to incorporate energy storage in grid-planning activities, while a few others made strides in energy storage procurement requests and contracts. The biggest of these developments took place in Arizona and California.

Arizona utilities issued plans for almost 600 MW of energy storage in their resource planning, only to be recently overshadowed by Arizona Corporate Commission's more ambitious energy modernization plan that calls for 3,000 MW of energy storage.

In addition to the Aliso Canyon deployments in California, the state retained the title of the leading market for the behind-the-meter sector in 2017, with 110 MWh of deployments that made up 73% of all BTM storage deployed during in the entire U.S. The state also saw the tension between gas-

based peaking assets and energy storage come to a head, as the CPUC interjected in CAISO's determination on reliability-must-run contracts for three Calpine gas plants. The commission advised utility Pacific Gas and Electric to procure energy storage and other distributed energy resources through competitive solicitations.

1.5. South Korea Made Impressive Progress on Its 500 MW Target

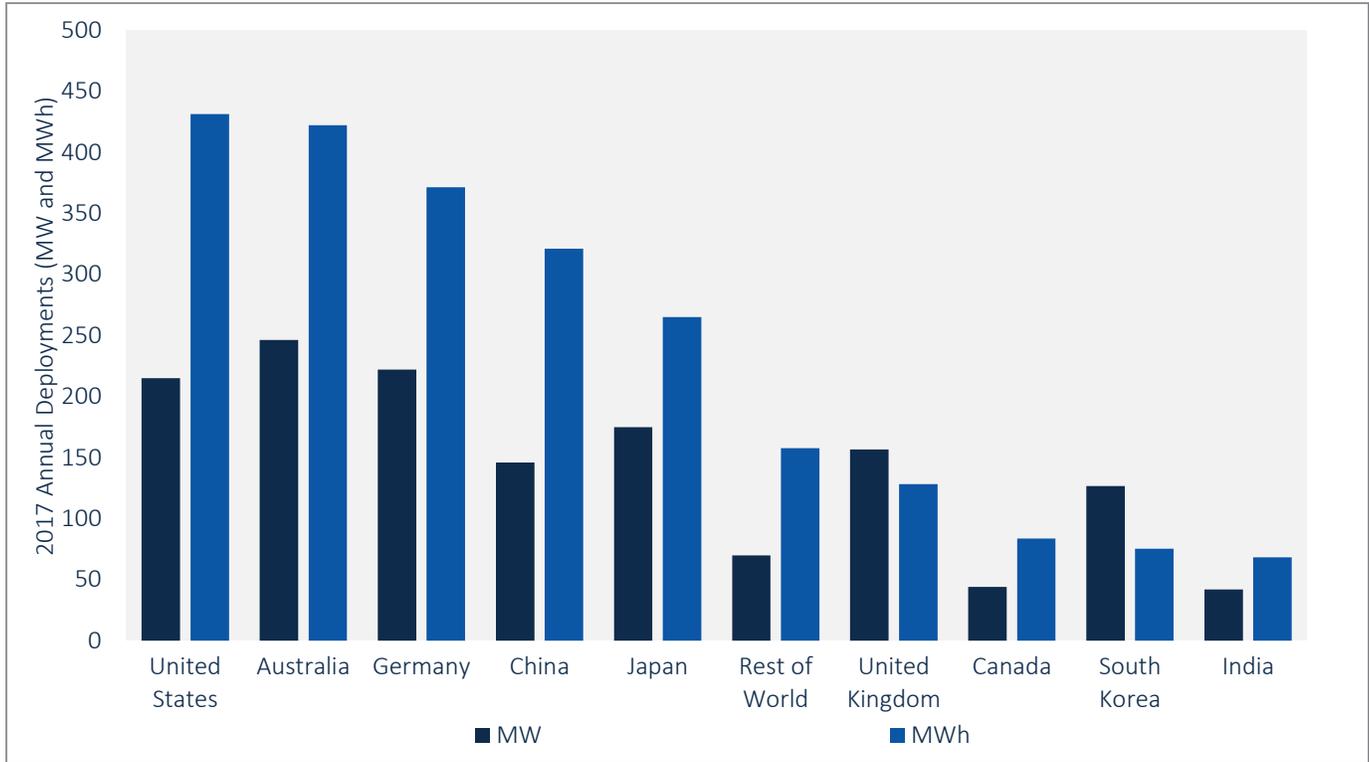
In 2014, South Korea's monopolistic transmission and distribution company Kepeco commenced on an initiative to deploy 500 MW of energy storage to provide frequency regulation services in the form of several projects of 16 to 48 MW each. By the end of 2017, Kepeco had deployed a cumulative total of more than 370 MW of energy storage across 13 projects; four of these projects totaling 112 MW were deployed in 2017, completing three of four planned deployment phases. These deployments have provided Kepeco savings on energy payments to constrained traditional generators, while also supporting South Korean technology vendors. All projects to date have employed Korean batteries and power conditioning systems.

1.6. Residential Markets Pick Up Pace in H2 2017 With Australia Leading the Way

In the German market, the KfW 275 program, which incentivizes new solar-plus-storage, is plowing ahead with consistent year-on-year growth. By the end of 2017, Germany had nearly 80,000 behind-the-meter installations, mainly residential but with a growing number in the commercial space. However, pickup has thus far been scant among industrial companies because the incentives are just not there. Still, Germany is clearly one of the strongest global markets for residential PV. The rest of Europe also saw continued ramp-up of residential deployments, with most major players now including storage in their offerings in an attempt to lock in customers and capitalize on the decentralized energy market, a serious threat to utilities' traditional business model.

However, the biggest residential storage market in the world in 2017 was Australia, which saw a tripling of residential storage deployments over the previous year. High retail electricity rates and diminishing or expiring feed-in tariffs have encouraged residential solar customers to choose storage for self-consumption benefits. As a result, for the past few years, Australia has been the preferred testbed for new residential energy storage products, as several technology vendors have first introduced their residential product portfolios in Australia.

Figure 1.1 Annual Energy Storage Deployments by Market, 2017 (MW and MWh)



Source: GTM Research

1.7. Legacy Energy Companies Snapped Up Storage Companies

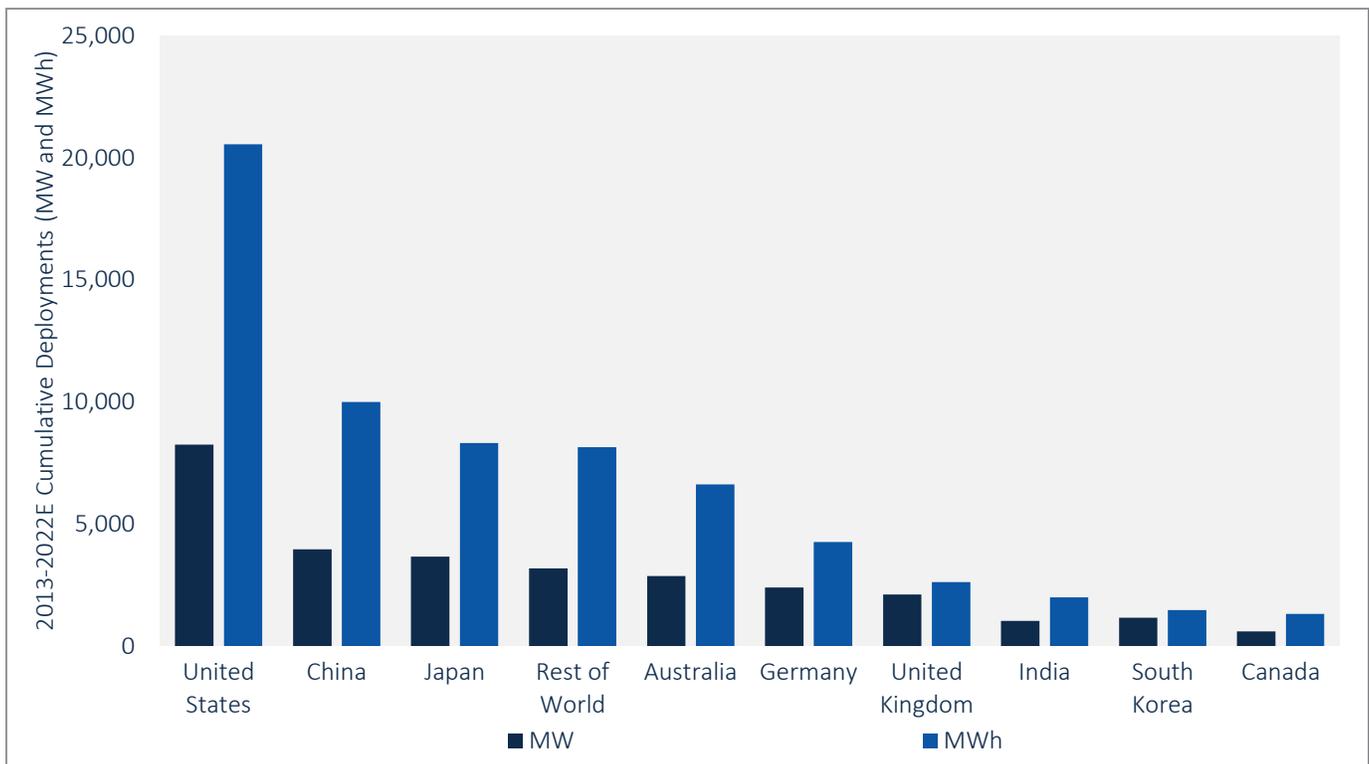
Italian giant Enel bought Demand Energy; French energy behemoth Total acquired Saft; and Engie took a majority share in Green Charge. Two conventional fossil fuel plant companies, Aggreko and Wartsila, clearly recognized the complementary value storage could bring to their businesses and bought up Yunicos and Greensmith, respectively. We will watch to see how these energy titans will fare in developing innovative offerings in the coming year, bringing their strong background in the conventional energy business into the brave new world of storage. Siemens and AES also announced a joint enterprise to enter the storage market, dubbed Fluence.

2. LOOKING AHEAD TO 2018 AND BEYOND

2.1. 2018 and Beyond

While the U.S. is expected to remain the leading market from 2018 through 2022, China will surpass all markets beside the U.S. to become the second-largest market in 2019; it will maintain this spot through 2022. Several markets will see continuous refinement of policy and market mechanisms to encourage energy storage on several fronts – renewable integration, time-of-day-based PPA structures, competitive market redesigns, retail rate reforms, urban and remote microgrids, and distributed resources for grid services and as virtual power plants. As a result of these initiatives and energy storage system improvements, the annual global energy storage market will be 8.6 GW and 21.6 GWh by 2022.

Figure 2.1 Cumulative Energy Storage Outlook by Market, 2013-2022E (MW and MWh)



Source: GTM Research

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GLOBAL ENERGY STORAGE NOTE

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