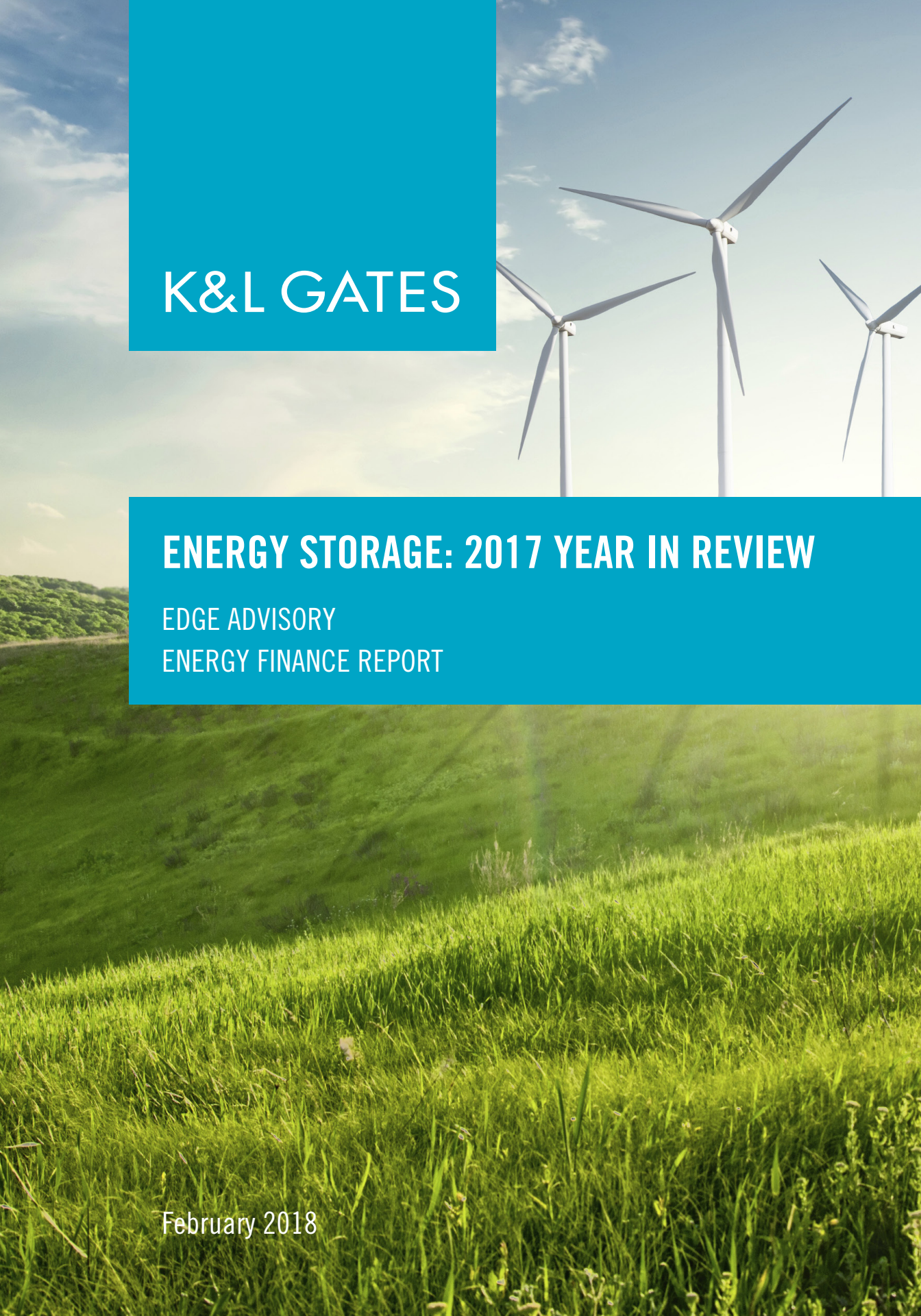

K&L GATES

ENERGY STORAGE: 2017 YEAR IN REVIEW

EDGE ADVISORY
ENERGY FINANCE REPORT

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IN THIS ISSUE

FROM THE EDITORS

James Wrathall, Elias Hinckley, and William Keyser, Editors

Many experts view 2017 as the year in which energy storage turned the corner, from nascent technology to full-fledged energy market participant. Major milestones included the construction of a large-scale energy storage facility to replace a natural gas plant in California, completed in less than six months; a large-scale solar-plus-storage PPA in Arizona priced substantially below prior market floors; and Tesla's announcement in December of the successful powering of a 100MW mega battery in South Australia, completed in less than 100 days, as promised by Elon Musk.

In November, the Energy Storage Association (ESA) and Navigant Research released "*35 x25: A Vision for Energy Storage*," with a plan for deploying 35 GW of storage by 2025. This report predicts rapidly climbing demand, based on the growing need for grid reliability and resiliency; an increase in development of low-cost renewable resources supported by storage; the need for a more flexible and adaptable power grid; ongoing improvements in storage technologies; and the continued rapid decline in costs of storage equipment.

GTM Research projects the U.S. market for energy storage reaching $3.1 billion by 2022, with an estimated cumulative revenue of $10.4 billion from 2017 to 2022. As recently noted by Kelly Speakes-Bachman, CEO of ESA, "Grid battery technology is similar to consumer electronics and EVs. There is a massive economy of scale, coupled with increasing power densities and installation efficiencies. All-in costs are dropping quickly, up to 50 percent every three or four years. We expect that to continue for some time before it begins to level off." With the progress made in the last couple of years energy storage and generation hybrids are likely to replace natural gas peaking plants in many parts of the country.

Evolving market rules are expanding revenue opportunities for energy storage, including from deferred transmission and distribution upgrades, reduced peak demand charges, integration of intermittent resources, and provision of ancillary services. With the Federal Energy Regulatory Commission (FERC) poised to rule on its pending Notice of Proposed Rulemaking (NOPR) for energy storage and distributed energy resources, energy storage projects may soon receive additional regulatory support for providing

TOPICS COVERED INCLUDE:

- A review of the top 10 developments for energy storage in 2017
- The increasing role of utilities as energy storage purchasers and developers
- Trends and challenges in project financing and monetization
- Federal and state policy evolution and resulting market opportunities
- The latest tools for evaluating and implementing storage projects
- Critical minerals supply: a potential bottleneck?

capacity, energy, and ancillary services in organized markets run by regional transmission organizations (RTOs) and independent system operators (ISOs).

This issue of EDGE reviews energy storage developments in 2017, focusing on the key factors that will impact the sector going forward.

Heading into 2018, we look forward to further accelerating growth, and to continuing to work closely with companies, investors, trade associations, and policy makers in addressing changes in market rules and maximizing the opportunities for energy storage across the electric power sector.

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VISIT OUR BLOG

TOP TEN ENERGY STORAGE DEVELOPMENTS OF 2017

2017 saw major announcements of progress for energy storage technologies, economics, and deployment. Below are ten of the top milestones of the year driving growth in this sector.

1. UTILITIES EMBRACING ENERGY STORAGE

As discussed in detail in the article later in this newsletter by Lola Infante of Edison Electric Institute, investor-owned utilities have embraced energy storage in their business models and planning processes. The trend is towards greater utility financing and ownership of storage assets, deployed around a variety of use cases.

California continues to lead. In December, Pacific Gas & Electric (PG&E) announced 165MW in energy storage contracts submitted to the California Public Utilities Commission for approval. San Diego Gas & Electric (SDG&E), Southern California Edison (SCE), and PG&E are under a mandate to put a total of 1.825GW of energy storage capacity online, with 1.325GW by 2024.

Utilities in several other states announced deployment of storage projects as an alternative to investment in transmission and distribution infrastructure, including Arizona Public Service (2 MW, 8 MWh storage in lieu of 20 miles of transmission lines), National Grid (48 MWh energy storage system on the island of Nantucket), and Duke ($30 million investment to develop two owned battery storage systems in North Carolina).

According to a GTM Research report in Q4 2017, utilities across 14 U.S. states have included nearly 2 GW' worth of storage into integrated resource planning. Public Utility Commissions are actively pursuing storage alternatives in New York, Michigan, Connecticut, Rhode Island, Minnesota, and California, among a much larger group of states focusing on storage in their IRPs.

2. GLOBAL COMMITMENT TO ELECTRIC VEHICLES

Early in 2017, Norway became the first country to announce a ban on internal combustion vehicles, moving to the sale of only electric vehicles (EVs) by 2025. Several other countries made similar announcements (although with later transition dates), including France, India, and the United Kingdom. Finally, in September, China, the world's largest car market, said that it is considering a ban on internal combustion engines, on top of several very aggressive EV policies already in place.

China will require automakers to meet a cap-and-trade auto emission rule beginning in 2019. Auto manufacturers with annual sales of more than 30,000 vehicles will be required to meet a quota of 10 percent of sales as EV or plug-in hybrids, with a target of achieving at least 20 percent of Chinese auto sales by 2025.

Carmakers have responded. Volvo announced all its cars will have electric motors starting in 2019 (although many will be hybrids). Volkswagen, the world's biggest automaker, announced a $12 billion investment in EVs. In the United States, General Motors has committed to a "zero-emissions future" and announced a number of new EV models.

What does this mean for energy storage more generally? EV batteries use lithium-ion technology that also is common in larger-scale utility projects. As demand for vehicle batteries drives production, prices for batteries across the board will come down. EVs will also become an integrated storage resource participating in distributed grid applications. Many states and market operators are already considering options for integrating EVs into the grid.

3. MAJOR CORPORATE MOVES

Several large companies announced major moves in energy storage, further evidence of the maturation of the sector and large-scale financial opportunities ahead. Moves include:

- AES and Siemens combining their respective energy storage businesses to form a new company, Fluence;
- Wartsila acquiring Greensmith Energy Management Systems, expanding on its business model of integrating storage and generation assets; and
- Scottish power generator Aggreko agreeing to pay $52 million to acquire Younicos, the German-U.S. provider of battery technology and energy storage solutions.

4. STORAGE AND SOLAR HYBRIDS REACHING GRID PARITY

In May, Tucson Electric Power announced a contract with NextEra Energy Resources for a major solar-plus-storage project. TEP entered into a 20-year power purchase agreement (PPA) at a rate below 4.5 ¢/kWh for both solar and storage, with the solar portion being quoted at under 3 ¢/kWh and the storage portion at about 1.5 ¢/kWh.

Many experts see 2017 as a tipping point when storage began to compete as an alternative to natural gas peaker plants in some areas of the country. In California, for example, efforts to build a major gas plant in Oxnard, California, were paused to examine whether storage and other distributed assets may be able to meet demand more cost-effectively. Storage

5. HURRICANES PUT A SPOTLIGHT ON STORAGE FOR GRID RESILIENCE

Hurricanes Harvey, Irma, and Maria combined for one of the most deadly and destructive hurricane seasons in decades. After Hurricane Maria hit Puerto Rico and the U.S. Virgin Islands with sustained winds of 155 mph, taking down virtually all the electric power supply on the island, a number of companies and mainland U.S. utilities rallied to support more resilient grid infrastructure replacement.

This coalition of utilities and industry groups developed a $17.6 billion proposal for rebuilding Puerto Rico's electric distribution system. The group includes Puerto Rico Electric Power Authority (PREPA), New York Power Authority, Consolidated Edison, Electric Power Research Institute (EPRI), several national labs, Edison International, and

other organizations. The plan focuses particularly on resilience based on the inclusion of energy storage and advanced grid technologies.

In response to the damage, the U.S. Department of Energy (DOE) has identified over 200 sites in Puerto Rico that could be suitable for the development of microgrids, many serving vital facilities such as water treatment plants and hospitals. In total, DOE identified more than 11 MW of energy storage capacity as viable, with several hundred additional sites under investigation.

The resilience value of energy storage has been highlighted by these disasters. For example, AES data from two of its projects in the Dominican Republic, also hit hard by the hurricanes, confirmed that its energy storage systems stayed in operation throughout both Hurricane Irma and Hurricane Maria.

6. FAST, FLEXIBLE, AND AFFORDABLE SOLUTIONS TO URGENT NEEDS

In response to the massive Aliso Canyon gas leaks threatening the energy supply for gas-fired plants in Southern California, energy storage developers designed and built projects to provide grid reliability—a total of 100 MW of storage deployed in less than six months following approval by regulators. The project demonstrated the speed and flexibility with which storage can be deployed to meet urgent needs.

7. EASTERN STATES MOVING ON ENERGY STORAGE POLICIES

As detailed in our report from the States section below, 2017 saw many eastern and mid-western states joining leaders such as Hawaii and California with aggressive policies supporting storage deployment. Massachusetts announced $20 million in grants for 26 new energy storage projects, supporting the commonwealth's announced target of 200 MWh of energy storage deployment. And on November 29, New York Governor Andrew Cuomo signed legislation for the NY Public Service Commission to create a statewide energy storage target for 2030.

8. COAL PLANTS CONTINUING TO SHUT DOWN

Notwithstanding the Trump administration's commitment to coal in its "energy dominance" agenda and the DOE's Notice of Proposed Rulemaking to support traditional baseload generation, utility coal plant power closures continued in 2017, driven in large part by market forces. At least 27 coal-fired plants, with a total capacity of 22 GW, were newly slated for closure last year.

These continued closures highlight the opportunity for new renewable energy projects and storage to fill the void created by retiring coal plants.

9. TESLA MEETS ITS 100 MW AUSTRALIA PROJECT DECLARATION

In March, Tesla CEO Elon Musk wagered he could solve blackouts that have been plaguing South Australia by installing a major battery storage system within 100 days or he would hand over the system for free. In December, Tesla pronounced the system operational: a 100 MW, 129 MWh storage system collocated with a 315 MW wind farm.

10. U.S. ENERGY STORAGE SECTOR GROWTH ACCELERATING

The above developments were indicative of continued sustained growth for the sector. According to the Q4 2017 U.S. Energy Storage Monitor from GTM Research and the Energy Storage Association (ESA), 41.8 MW of energy storage were installed in the third quarter, a 46 percent year-over-year increase against the Q3 2016 growth and a 10 percent growth over the Q2 2016.

GTM Research projects total energy storage for 2017 to be 295 MW, an increase of 28 percent from the 231 MW deployed in 2016. It sees the U.S. energy storage market hitting more than $3 billion by 2022, a 900 percent increase over 2016.

ROUNDTABLE DISCUSSION – EXCERPTS FROM K&L GATES'S ENERGY STORAGE EVENT

Energy Storage, Distributed Generation, and the Evolving Grid: Policy Developments and Market Opportunities

On October 11, K&L Gates hosted a full-day event at our offices in Washington, D.C. A series of four expert panels discussed the full range of recent developments and trends for policy, regulation, and market development underpinning energy storage and distributed energy resources. The event was cosponsored by the Edison Electric Institute and the Energy Storage Association.

Highlights from the event are excerpted below:

PANEL 1: FEDERAL, STATE, AND WHOLESALE MARKETS – REGULATORY DEVELOPMENTS AND TRENDS

William Keyser, Partner, K&L Gates, Moderator: What are you seeing on the regulatory and market fronts? Where are the opportunities, and what more do you feel is needed?

Michael Kormos, Senior Vice President of Wholesale Markets and Energy Policy, Exelon: For energy storage, the biggest need is to be looking at multi-value streams. We are starting to cross lines between distribution, transmission, and energy markets. At Exelon and working with a lot of our utilities, we are starting to find a lot of really good opportunities to put batteries in place, mostly as distribution assets right now.

Michael Berlinski, Director of Emerging Technologies, Customized Energy Solutions: If I had to just pick one word it would be "change." I would describe it as exponential change really. The number of new opportunities is increasing every year. I have been in this industry since 2010, when there was one company with one battery doing one service, and only in one ISO, as Mike pointed out. Now there are over 500 MW of advanced energy storage batteries and flywheels providing services in the organized wholesale markets in the United States and Canada. That's six ISO markets, so the industry has come a long

way. At the same time the use cases have changed dramatically and have grown. There are opportunities to get long-term contracts, not just merchant plays. Participation options, the number of services, variety of applications, and the ability to participate for both behind and in front of the meter has taken off.

Jason Burwen, Policy, and Advocacy Director of the Energy Storage Association: Flexibility, particularly of batteries, means you can have electricity exactly when need it, and distributed to where you need it. This decouples supply and demand, which allows much greater operational capabilities for the grid.

Costs of storage are declining so rapidly that it has gone from being abstract to being included more and more regularly in utility planning and interconnection queues, not just in PJM but in other RTOs as well.

FERC is looking at a proposed rule on the role of energy storage in the wholesale markets, which would direct the RTOs to develop participation models for storage. The goal is to remove barriers to participating in all market products that energy storage resources are technically capable of providing, in part by changing the optimization and modeling in the scheduling and bidding of these assets to enable them to provide their services more flexibly. For example, in New York ISO staff members are now in the process of developing their energy storage resource construct.

One key step is removing barriers to physical access through interconnection. Again there is a pending rule before FERC on interconnection. It has provisions that would expedite the interconnection of energy storage, particularly when co-located at existing generation sites. If finalized, that rule is going to speed up the rate at which energy storage is entering the market at transmission connected voltages.

On another front, recently supplemental comments were filed by stakeholders in FERC's primary frequency response docket. FERC is proposing performance requirements for resources as a condition of interconnection that are uncompensated. For energy storage,

being capable of a particularly fast response and able to arrest frequency deviations more effectively than conventional generators has significant value. We see that with National Grid in the UK having procured energy storage enhanced frequency response as a market product.

William Holmes, Partner, K&L Gates: We are seeing very interesting developments with solar-plus-storage. In high-priced markets like Hawaii it's being put out both behind the meter and in utility scale configurations. Not too surprising in Hawaii because the price of electricity is very high there.

What's more remarkable is the Tuscan Electric Power Company recently executed a PPA for solar-plus-storage. Here you are stateside, with a major project that apparently pencils out. There was a report filed recently with the Minnesota Public Utilities Commission that supports using solar-plus-storage as an alternative to natural gas as peaking resources and made the argument that a solar and storage system will pencil out now or in the near future.

William Keyser, K&L Gates: Where are you telling people to look for the best opportunities for energy storage? What regions and what particular RTOs?

Mike Berlinski, CES: New York and California are really interesting because they are each single state ISO systems. You have states that are very forward thinking in terms of technology and consumer involvement, having utilities try out new technologies and solutions. With wholesale markets on top of that, there are major additional opportunities.

Michael Kormos, Exelon: From a regional perspective, Exelon is all PJM. We have a very active, competitive generation, retail supplier side as well as the utilities. Right now, we are seeing more opportunities on the utility side. With energy storage, we are able to look at fairly large capital deferments, such as for distribution substations. Especially in urban locations, rather than expand the substations, you can bring in batteries because a lot of these things are just peak problems, they're needed only a couple hours a day. We are seeing a lot of opportunities there. I think FERC is very comfortable with utility ownership of energy storage assets. We are having those discussions in our states and I think most of the states are getting comfortable, but it is still an issue we are working through. Using storage as a transmission or distribution asset, where any revenues you receive just go back to offset the revenue requirements, is a really good model to get this jumpstarted.

William Keyser, K&L Gates: Are there opportunities for developers of battery storage, setting aside the utilities, in some of these RTOs? I am thinking of PJM as the first example to get in on some of the competitive transmission opportunities and using offsets to provide a lower cost product.

Jason Burwen, ESA: It is really important to utilize these assets as well as possible. In the way that transmission moves electrons across space, storage moves electrons across time. Storage is not a generator in the traditional sense and I think recognizing that is critical to understanding why storage is a part of the infrastructure and not just a generator. Storage should be viewed as part of the transmission expansion planning process—studied as a transmission asset and modeled as storage should be—not as some sort of weird looking generator. For example, whether you have a potential network upgrade or power flow issue, if you can modify the storage operations to avoid that, then you have a possibility of doing something that could really assist in transmission expansion planning by deferring the need for a wire for mitigating congestion.

Michael Kormos, Exelon: Dominion is in the PJM market. It participates with a rate based generation. This is not a problem for the market. The question is how do you handle it on the back end at the state level as to the revenues received? How do they get flowed back to the customers who are in fact paying those rate-based assets? And I think the model we proposed and then FERC said they were interested in, was just simply crediting back those revenues to the revenue requirement. We are not looking to profit from this. We're looking to keep the system reliable. We want to use the

best technology available to do that. We think that's what utilities should be doing. For us, it would be turning the asset over to the RTO. Let the RTO optimize that asset, use it in the market when that is economic, don't when it's not.

Audience question from **George Dallas, Southern Company:** As a utility, we also have been looking heavily at battery storage. And I was curious, for some of the installations where you are looking at deferring, what is the typical deferment period? Are we talking five years, or do you think it is more of a 10-year cycle or longer?

Michael Kormos, Exelon: In some cases, we are seeing fairly long deferment because of the load growth. But for the most part, unless you are seeing that kind of load growth, it may be five years, at least on some of these. The beauty of it is, if the period is longer, great, and if it is shorter you can always use the battery someplace else. I mean they are fairly mobile.

Jason Burwen, ESA: The fact that storage is modular so you can build it to whatever scale, that it can be deployed very quickly, means you are not on the three-year or five-year capacity development timeline. You can make that decision and six months later the installation is there providing the service. This allows you to really manage the uncertainties in a manner that is both reliable and cost effective. The ability to move storage assets around is an extra benefit. ConEd in New York is piloting batteries on movable trailers, sort of plug and play batteries that they can move around to different substations seasonally to meet different demands in their system. Now you have a reconfigurable grid.

William Holmes, K&L Gates: I was at an energy storage conference recently and a gentleman from GE confidently predicted that energy storage prices will settle at 10 percent of what they are now. Now we do not know what the timeline for that is. Is that five years? Is it 10 years? But the general trend is that energy storage is getting a lot less expensive. At some point, you start seeing what Mike was just talking about. It actually becomes an attractive alternative when you combine it with solar or some other generating source as an alternative to a gas fired peaking plant. That is going to have major impact.

Mike Berlinski, CES: I would just add that from Massachusetts, with the Massachusetts *State of Charge* report that we were part of, we identified

We are not looking to profit from this. We're looking to keep the system reliable. We want to use the best technology available to do that. We think that's what utilities should be doing.

some significant benefits, including rate payer savings, from battery storage collocated with conventional generation. But a barrier is that many ISOs do not allow this, do not recognize that type of combined or hybrid resource. They make you register them separately and participate separately, which can preclude fully realizing the benefits, including increasing resource capacity values. If you have to register both assets separately, you are left with the minimum capacity value of either resource.

Michael Kormos, Exelon: I had the pleasure and honor to run one of the largest power grids in the world. And intermittent and unreliable, those are two things we don't like. Storage is sort of a nirvana. It is very predictable. It is very reliable. You know how much you have and how you can use it. I think that is why you are seeing a different attitude from those responsible for running the grid or running the utilities, running the distribution system. Our biggest challenge is the just in time delivery nature of our product. That creates a lot of challenges. That creates a lot of cost. So the more we are able to use storage—and I agree, it's just time movement instead of location movement—there is a lot of value. I also agree the rules are going to change slowly. That is just the nature of the beast.

Audience Question, Elias Hinckley, K&L Gates: One of the things we are seeing is how corporate sourcing is really influencing the drive to renewables generation. Companies like Facebook and Apple and Google are pushing for these products. Is that something that could create development and opportunities for energy storage, particularly keyed off resilience?

William Holmes, K&L Gates: We represent a lot of corporations that are procuring renewable energy under contracts. Often you can make the case to them that because an energy storage device will be deployed in conjunction with this wind farm or this solar facility, they will get more renewable energy or the energy will be less expensive. At least on the grid scale projects, the corporate customer is very interested. They are also interested in onsite energy storage deployments, because in some areas where the market rules allow reducing demand charges by dispatching an energy storage device during a time when you would otherwise have a peak. Now they are looking at it from a pure cost savings perspective.

Jason Burwen, ESA: Each case is going to be very individual. In the abstract, resilience sounds great but each customer has to make the cost-benefit analysis for themselves. Retail suppliers will say a flat load is something they want to serve. That's very predictable to them, so they can price very impressively. A very peaky load has a lot of volatility and they have to price it in accordingly. So being able to flatten out your load is a real plus on the energy buyer's side. You may be able to get a much better energy deal.

PANEL 2: DISTRIBUTED ENERGY RESOURCES– MARKET OPPORTUNITIES AND CHALLENGES

Buck Endemann, Partner, K&L Gates–Moderator: To start, can each of you address how you are seeing emerging DER market opportunities?

Tim Fox, Vice President, and Research Analyst, ClearView Energy Partners: At ClearView, we frame the wholesale markets with three "Fs." The first one is fragmentation. We've seen power moving to the states at the expense of the federal government as well as regional institutions such as the ISOs and RTOs. We are also looking at the fundamentals: that is the second F. It is probably not a surprise to anyone here that we are long capacity, and long energy, but we have to wait. We are seeing flat and declining demand in most markets. It is no longer about attracting new energy demand right now. The dynamic is in trying to take someone else's share. That leads us to our third F, which is fuel fights. In this environment, how will each participant seek to protect their market position and attain new market share. At the same time, we are seeing an increasingly prescriptive policy environment, in which states and the federal government, most recently with DOE's resiliency NOPR, are looking to support certain resources, in some instances down to actual specific generation units.

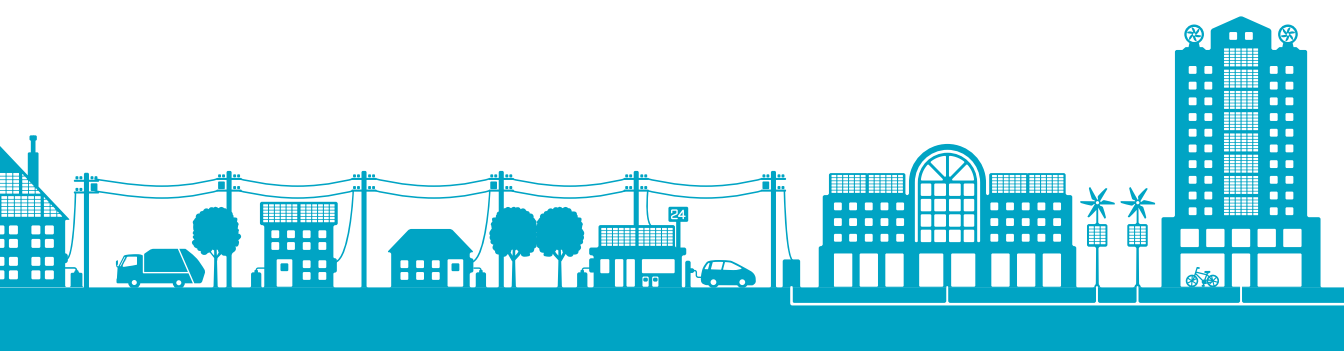
Dan Nordloh, Executive Vice President of Global Business Development, EnSync Energy Systems: We are seeing an almost outside-in approach. We have been deploying these assets on the customer's side of the meter for some time now, and the utilities are now recognizing these assets are out there. We are actually subrogating load from the grid and providing electricity at a price that is competitive with the utility. We are able to provide resiliency, and the conversations with the utilities are evolving pretty rapidly. Utilities are understanding the potential value of DERs and asking how they can leverage those as appropriate. There is not a technological hurdle any longer. This really is a pricing and policy scenario—and that's exciting for us. I think it is the front end of what the 21st century is going to look like, highly transactive, utilizing DER.

Tanuj Deora, Executive Vice President, Smart Electric Power Association (SEPA): One of the very exciting things about the FERC NOPR was it went from being just about energy storage and expanded to more distributed energy resources, broadly. At SEPA we focus on technologies like solar, energy storage, demand response, EVs, microgrids and the like. But it really is bringing all these things together to create a portfolio on the distribution system in a sophisticated way. We think about it more like a transmission system. I would push back though on the comment that the technology is there. In general the technology is there to make that vision happen, or it will be soon. But there remain a lot of integration challenges that are still not resolved. Many of the comments in response to the FERC NOPR are addressing those.

Lola Infante, PhD, Director, Generation Fuels, and Market Analysis, Edison Electric Institute: The FERC NOPR combined energy storage and DER aggregation, when they seemed to be on completely different tracks. Different issues, different stakeholder practices, I think, at the end of the day. We need to solve a whole lot of technical issues before we can even begin to think about policy options and regulations for DER aggregation.

Buck Endemann, K&L Gates: In your perspective, which states are doing it right? Are some states doing things better than others or taking different approaches than others?

Tanuj Deora, SEPA: California has done a lot of great things to promote individual technologies, but they have yet to provide an overall vision of how all these different initiatives and all these different dockets and pieces of legislation are going to ultimately fit together. I think that is a bit frustrating for some of the utilities there. But they are leading in a lot of ways, thinking about how we can actually do the nuts and bolts evaluation of DER, both temporally and by location. Illinois is another example. They are connecting energy marketplaces with a data platform, providing data analytics both for operational effectiveness and for consumers. Illinois passed their Future Energy Jobs Act. It is not 100 percent there yet but they are doing a nice job working to bring it together. In Vermont, a lot of folks are excited about Green



Mountain Power offering consumers batteries and solar panels through the utility itself. A lot is happening with individual utilities and third parties providing innovative solutions.

Dan Nordloh, EnSync Energy Systems: I wanted to just address the resiliency side a little bit. This is obviously an evolutionary market right now. We are in the early stages. You cannot necessarily monetize and put a value on resiliency at the macro level, on the customer side of the meter, but more at the micro level, customers absolutely are putting a value on resiliency. Because when we execute PPAs with them, those are at a set price, and if they want a resiliency factor, that is an upcharge. So in terms of determining what the monetary value of resiliency is, we are able to do that today.

Scott Hennessey, Senior Manager and Regulatory Counsel, Tesla: I'll even put a finer point on that. On the homeowner level, we sell the Powerwall, a backup storage for homes, in Florida. If you don't have batteries when the power goes down on the distribution grid, you don't get to use your solar. At my house, just up the road, when Exelon and PEPCO go down, then I can't get the benefit of the system on my roof. But if you have batteries, then you can have the solar power even where the utilities are down. In the last hurricane in Florida, Tesla's systems that have solar-plus-storage stayed up and running. Hurricane winds can damage everything. But we did check on those, they stayed operational, while other systems obviously went down when the power went out. So individual consumers, as much as companies and utilities, care about resiliency benefits of storage as well.

Lola Infante, Edison Electric Institute: Our members see the value of flexibility and the value of resilience. There is a trend in both wholesale and retail markets to value these distributed resources in terms of the benefits and services that they provide. Of course there are integration issues, technical issues, but rate design is a critical

element in all that, in doing that right. I think each state will focus on rate design and the compensation issues differently and they will find a variety of unique solutions.

Buck Endemann, K&L Gates: Let's talk about the traditional tensions between DER and utilities. Do they remain? Are they changing?

Lola Infante, Edison Electric Institute: Frankly, I don't think "tension," understood as opposition, is what characterizes reality any more. DERs are not contrary to utilities or fundamentally in tension with them. That would be like saying a power plant versus poles or wires versus utilities. It does not really make much sense. We are at the point where DERs are part of the system and all the pieces must work together. Someone mentioned at the break that the last panel really had not emphasized that the states where energy storage is really taking off are states where utilities are allowed to own energy storage assets. This is an important point. Storage resources can really help utilities better manage the grid. Utilities want to deploy these resources, they can be a very powerful tool to enhance the grid and make it more resilient, and they can also be a tool to better address customer needs. Utilities are the managers of that grid and responsible for its reliability. Storage and other DERs can and should be deployed in a way that supports them in this mission.

Tim Fox, ClearView Energy Partners: When utilities want to start deploying DER on their own, there has been some pushback from third party providers. Because utilities do have an incumbent advantage, and the ability to attract capital at low cost. Utilities are positioned to move quickly, which can impede the ability of new companies trying to compete in the DER market. I will not offer an opinion about that, but this is an issues we are seeing echo through several different states.

Tanuj Deora, SEPA: So does there have to be tension between utilities and non-utility players in the electric power sector? The answer is no. There doesn't have to be. But there can be, and sometimes that can be good, sometimes it's not. Three particular tensions come to mind. One, there's a tension of capital deployment. Who gets to deploy capital and who gets to make money? The solar industry has done a lot of innovative and great things, and they have been driven in part by a profit motive to take capital and deploy it at the expense of the utilities. The IOUs have pushed back, but other utilities do not have that as a primary driver. The municipal utilities and cooperatives don't necessarily have a desire to deploy more capital. Tension also exists around two other factors, which are control and accountability. On control, utilities want to control deployment so they can optimize for their needs and for their customers and their brand. We should try to understand what should be controlled by the utility and what should be controlled by third

parties. That's not a simple question, it will require a lot of conversation. There is also focus on accountability. This one is a little different because sometimes you want accountability and sometimes not. More often we probably do not. Often there has been an issue on the deployment of DER around impacts for less sophisticated consumers, low and middle income or the elderly. Some people don't want to think that much about their energy choices or want to pay any premium. Utilities are feeling a lot of accountability to serve everybody under the regulatory compact. Some innovative thinkers in the electric power space are suggesting that the traditional view of the regulatory compact is outdated. If that is the case, in addition to making profits, do third-party providers need to have an obligation to serve communities for our collective benefit?

Lola Infante, Edison Electric Institute: Think about the economics. In 2016, the EEI member companies alone, so not the whole electric power sector, invested $120 billion. About half of that, maybe as much as 60 percent, was for transmission and distribution. That is a lot of dollars. One of our members recently noted that if we only invested 1 percent of the collective T&D budget in energy storage, it would create a $500 million market per year for many years going forward. That is a lot of potential waiting to happen.

Scott Hennessey, Tesla: Customers want the least expensive, highest value, most reliable electricity. And customers are beginning to take more control to make sure that is happening for them. Utilities are beginning to understand that as well. At the end of the day, this can be good for the utility, it can be good for the customers, it can be good for the environment, it can be good for the investors, it can be good for everybody. But I think the consumers have really been in the lead. The way that we have grown distributed solar is that consumers made market decisions to start trying some things. Adoption is driving the costs down. Today we are seeing energy buyers asking for things that should be commercially available and in some cases they're getting frustrated with their utilities. We saw that in Nevada with MGM leaving NV Energy. We saw a little more collegial parting but still a parting of ways in Washington State where Microsoft is leaving the energy supply from Puget Sound Energy to the tune of a $26 million dollar exit fee. Often it is not because the utility doesn't want to provide alternatives but because the utility are not able, under the regulatory structure, within the timeframe in which the consumer is asking for it. Utilities cannot provide a sweetheart deal to a particular consumer, unless they have a lot of political capital or a lot of political support for doing so. So they have to wait until the PUC can establish a product

or approve a product that they want to offer and sometimes consumers are not willing to wait. That is when the third-party developers come in and say we can provide something different. It is being initiated by consumer interest and consumer demand. They are asking for it, and someone, either a utility or third party, is going to deliver.

Lola Infante, Edison Electric Institute: I have a slightly different angle on that. I think what technology has done is enable choice. This is not just technology driving costs down. Costs have been determined by policy as well. The interplay between customer expectations, needs and wants, technology development and availability, and cost-effectiveness are dependent on policy, particularly financial incentives seeking to accelerate deployment of technologies that cost-wise, are not quite there yet. All those issues are interrelated and I don't think there is one that drives the rest.

Tanuj Deora, SEPA: DER will continue to represent more of the energy portfolio going forward. DER has the opportunity to make or save money behind the meter. There is a menu of applications to do that, some of which have been discussed today. Frequency regulation, demand charge reduction, time of use shaping, there are about a dozen things you can do. The technologies are evolving to deliver what will be of value and prioritize those on a real time basis, towards sourcing the least expensive, most reliable, highest value from any available energy source. I think that is where we are heading.

PANEL 3: WILL THE PRESIDENT'S AGENDA ON ENERGY AND INFRASTRUCTURE IMPACT THE DEVELOPMENT OF MARKETS FOR STORAGE AND DISTRIBUTED ENERGY RESOURCES, AND WHAT CAN WE EXPECT FROM CONGRESS?

James Wrathall, Counsel, K&L Gates, Moderator: As an opening question, what are you seeing at the federal level with Congress and the Trump administration, and how is that impacting energy storage and DER?

The solar industry has done a lot of innovative and great things, and they have been driven in part by a profit motive to take capital and deploy it at the expense of the utilities

Lisa Jacobson, President, Business Council for Sustainable Energy: There are concerns about the direction here in Washington, given the work we are doing with the federal government. But I think there is a diversity of views, even within the Trump administration, on what to do and who really is in charge. We are still seeing interest in the opportunities on energy storage and DERs, there actually is a lot of interest.

Christopher Hickling, Director of Government Relations, Edison Electric Institute: Part of the problem from our perspective are regulations on the books that actually preclude our members from owning and operating assets, including storage, microgrids, and electric vehicle infrastructure. We are looking to change the policies on those sorts of things. Our companies should be able to play in those markets. And the whole issue of value is really challenging. Everybody understands price but value is a hard thing to calculate. So, there are big challenges, but also really big opportunities for this technology.

Lisa Jacobson, President, Business Council for Sustainable Energy: It seems like the Trump administration has decided to make a move on something relating to pricing and resilience. This is the DOE proposal for a FERC rulemaking. I don't think storage is what they had in mind when they refer to 90 days of onsite fuel. We do see a lot of concern about what that rule would do in terms of blowing up the market. That should not be an option. I think it is important to recognize that there are resilience attributes of storage that may be unpriced and the question is, are markets able to provide that value through contracts, direct compensation, penalties, or service obligations? And if not then what kind of value do we need to put on those things and how do we do that?

James Wrathall, K&L Gates: Let's talk about the recent hurricane disasters in Puerto Rico and the U.S. Virgin Islands. There is going to be assistance for these islands. No doubt about it. Would you advocate that storage or related technologies ought to be brought into that, and do you see anything happening along those lines?

Lisa Jacobson, Business Council for Sustainable Energy: We are looking at ways and mechanisms, bonding programs and community block grants, those kinds of things, to promote funding for storage in the hurricane response. In many of those programs the definitions are broad and so we don't really have definitional problems with including storage. But for FEMA, it is my understanding that they do have some of those definitional barriers. That is something that we do need to think about and that is happening in real time.

Christopher Hickling, Director of Government Relations, Edison Electric Institute: One concern coming out of Puerto Rico was some companies saying "well, let's rebuild it as a distributed system with only batteries and solar." And I would no more advocate for that than for a grid that's built only on coal and nuclear. Our experience is that resilience has a lot of factors, and a balanced energy mix and some redundancy and some spare equipment are very important. If you have single points of failure, if you only rely on one kind of energy source or one kind of method of delivering energy, you are setting up for more failure.

James Wrathall, K&L Gates: What about tax reform and infrastructure financing?

Lisa Jacobson, Business Council for Sustainable Energy: On infrastructure, our country is going to spend billions of dollars over the next few years. I think the recent disasters have been a wakeup call to any vulnerable county, city, or state that could be impacted by these kinds of storms. Looking at the images of Houston is devastating for any mayor. Whether it is natural disaster or a cyber incident, this is just a wakeup call. Whether Congress acts or not, we are going to be spending a lot of money on infrastructure and I think there is a leadership role for the Department of Energy. At a federal level, you can provide a lot of value to states and localities as they are trying to sort through what the options might be. Obviously, it needs to be done in partnership and in conversation with the providers and the private sector.

Christopher Hickling, Edison Electric Institute: I think infrastructure is coming, and tax reform as well. I think these are part of the five or six big things that could happen over the rest of this session of Congress. Our companies are ready for this debate. One nice thing, where we think about smart cities and other sorts of infrastructure bills, is that we do not need access to that funding. Our companies have access to capital. That is why tax reform is important to make sure that we can keep that sort of balanced investment mix. Where we need help is streamlining federal siting and permitting. Not doing away with environmental review, but working to do all the review at once instead of it taking 10 years and $10 million to get a project through. The Energy Committee has been very helpful on this. We think the permit streamlining provisions should be noncontroversial and could really play a good role in moving infrastructure forward.

Lisa Jacobson, Business Council for Sustainable Energy: Regarding specific legislation that our members are following at the federal level, that would include the Advancing Grid Storage Act, sponsored by Senator Franken and Senator Heinrich. It really deals with trying to get over the hurdle for small utilities, communities and states to do their first storage project and to support capacity building. And then there is an effort in the tax discussion to have an energy storage investment tax credit.

PANEL 4: MONETIZATION AND FINANCING FOR ENERGY STORAGE PROJECTS

Bill Holmes, Partner, K&L Gates, Moderator: What are the key use cases you are focusing on, where you are seeing market opportunities for revenue, and what are the key attributes for bankability?

Jennifer Burke, Energy Storage Marketing and Strategy Manager, Lockheed Martin Energy: We see the energy storage market segmenting, so there will be different technologies that will be better positioned for different applications. Regarding your question on bankability, Lockheed Martin Energy is focused on developing and commercializing products that deliver optimum overall value to our customers. One way we do this is through product design, for example by designing durable, reliable products that are easy and quick to install. Our focus is on providing products that customers can count on, developed and backed by Lockheed Martin, a company with a reputation for honoring our customer commitments.

D. R. Richardson, Partner, Vision Ridge Energy Partners: As investors looking at battery storage, our focus is on the future of batteries as a much more integrated part of the grid. The question is how do you get there? While some technology risk exists, assessing risk depends on your level of expertise. The core issue is

of economic value—how does the asset make money under what conditions? That means different things to different people, but the most important part of things is for terms and risks to transparent. If revenue is contracted, you can take a longer view. If it is a merchant revenue asset, we want to get paid back faster and recover our capital faster. Energy storage as an asset class is investable; it is the revenue model that is complicated.

Judy McElroy, Chief Executive Officer, Fractal Energy Storage Consultants: We mainly serve two categories of clients: utilities and developers. Utilities, from our experience, are most interested in business models that include peak shaving for mitigating costs and exposure to power-supply related expenses (transmission fees, capacity obligations and share of ancillary services). These costs will continue to rapidly escalate since they are based on peak load. Even if you can demonstrate a highly economic business model, for instance frequency regulation, most utilities would rather focus on business models that service their core business principles, e.g. delivering reliable low-cost power, rather than running a purely merchant plant.

Developers come to us because they want to know, "What is the economic potential of adding storage to my solar or wind farm?" Some are early stage and some have interconnection agreements. There are many economic business models, value streams depend on many things, such as: market revenue, configuration (AC or DC coupled), duty cycle, and battery technology. There is also tremendous room for financial optimization and de-risking by understanding tax incentives, sizing, and augmentation strategy. We're seeing solicitations shift from solar-only, to solar+storage. Adaption of storage has been fueled by three motivators: 1) mandates 2) grants 3) operational pain points. Lower component prices will continue to incent developers to enter the space.

Bill Holmes, K&L Gates: So we've talked about lithium ion technology. We talked about flow batteries and we've also referred to pump storage. Is there a technology preference or is it very much dependent on the uses? Is there some other technology of which you are aware that there might be a bit of a game changer going forward?

Jennifer Burke, Energy Storage Marketing and Strategy Manager for Lockheed Martin Energy: For each storage project, you have to do the analysis specific to the project. Where is it based, how will it be operated, what are the use cases, what sort of revenue streams are expected? You can slice and dice a market into many different segments and many different use cases. Lockheed Martin Energy develops both lithium-ion energy storage systems and long duration flow battery systems, with our own proprietary flow technology, and we believe there is a demand for both technologies. We see long duration, flow batteries really making sense for duration

requirements of 6, 10, or 12 hours. If you have a really long duration battery and then you pair it with the ability to do daily cycles, you have very different endurance characteristics compared with other storage technologies. There's real demand for technology that can do that.

Judy McElroy, Fractal Energy Storage Consultants: When it comes to comparing different technologies there's a huge knowledge gap. I think it goes back to the credibility of sales people and websites. We spend a considerable amount of time improving people's understanding of how technologies work and what they really cost. Brochures and spec sheets don't tell the whole story. Articles and white papers are readily available, but so many are biased or written by academics who have either: 1) never touched a battery 2) don't understand real-world performance or 3) don't have a grasp of market dynamics. There is no best chemistry, each has its advantages and disadvantages, but lithium-ion has become dominant with at least 94% market share (last three years), and the trend is expected to continue. In your financial analysis, you need to understand how a technology performs based on the dispatch model and performance parameters. For instance, with lithium-ion chemistries you need to account for roundtrip efficiency and HVAC load. Also, each chemistry has a preferred SOC range, otherwise it will experience accelerated degradation. These are just a few items that are important to include in your modelling.

With flow batteries, aside from financial stability, the technology is a completely different animal. The roundtrip efficiency is lower because of the membrane exchangers and electrolyte pumps. Flow batteries are good at charging and discharging slowly (over 3-5 hours), but this limits the types of services the system can perform. If I want to peak shave 10 MW for two hours, I could install a 20 MWh lithium or I would need to install a 40 MWh flow (C/2 vs C/4). In the end, if the flow companies can keep getting orders, they will have the ability to scale down costs.

There is a lot that goes into analyzing these projects. I encourage people to get educated, do your homework and avoid having a vendor do your sizing or financial analysis.

Jennifer Burke, Lockheed Martin Energy: I fully agree that you have to look at the total cost of ownership across the total project life. Lockheed Martin Energy has a whole team that does that analysis. Looking at the total cost of ownership, Lockheed Martin's proprietary flow battery systems make economic sense for customers for long-duration applications.

D. R. Richardson, Vision Ridge Energy Partners: It does not really matter in my view what the technology is. We're open to trying different technologies. What matters more is will it work for that application and what is the opportunity for generating revenues?


Li-ion
Energy storage
CAUTION

INVESTOR-OWNED ELECTRIC COMPANIES AIMING TO HARNESS THE POTENTIAL OF ENERGY STORAGE

By Lola Infante, PhD, Sr. Director Generation Fuels and Market Analysis, Edison Electric Institute

Energy storage is a promising technology that, along with other resources, will benefit customers by allowing greater penetration of renewable energy; adding resilience and reliability; creating more dynamic energy infrastructure systems; and enabling transportation electrification, microgrids, smart grids, smarter cities, and smarter communities. Energy storage has been called a "game changer," a "panacea," and a "disruptor."

The investor-owned electric companies (electric companies) in particular have seen rapidly accelerating momentum towards the adoption of energy storage to promote service offerings and meet core interests.

For electric companies, energy storage technologies are not a thing of the future. Electric companies have been operating energy storage for decades. Today, batteries, flywheels, compressed air, thermal storage, and pumped hydropower are operational across the United States. Energy storage is well on its way to becoming an integral part of our electricity system. Electric companies are the largest users and operators of operational storage in the United States, representing more than 98 percent of the more than 24 GW of active energy storage projects, including pumped hydropower. Electric companies are using storage for a wide range of purposes that result in improved operation of the energy grid; increased reliability, resiliency, and operational flexibility; and the integration of more solar and wind energy.

Driven mostly by electric companies, the use of energy storage, particularly batteries, is growing at a rapid rate, with an estimated 231 MW installed in 2016 alone, up 300 percent from 2014. The majority of those projects are being deployed in the utility segment, which is expected to continue to dominate the market in the future as well, although the residential and nonresidential customer segments are expected to grow considerably in the next few years.

While total numbers are not yet in, new installations in 2017 are expected to

exceed those of 2016 and to include construction of many new projects in many parts of the country. For example, San Diego Gas and Electric Company built, in partnership with AES Energy Storage, the largest lithium-ion battery storage project in the world. The Escondido Substation storage facility is a 30-MW storage facility, comprised of approximately 400,000 batteries installed in 20,000 modules within 24 containers. This facility will be able to provide flexible peaking capacity; will help to balance the large amount of solar generation entering the Southern California energy grid; and also will be able to deliver ancillary services, like voltage and frequency control.

Other notable recent electric company energy storage projects include the following:

- Arizona Public Service is developing a 2-MW, 8-MWh battery storage project as an alternative to the installation of approximately 20 miles of new transmission lines north of Phoenix, deferring capital expenses.
- National Grid is planning a 48-MWh energy storage system on the island of Nantucket, Massachusetts, as a backup reliability asset and to defer capital expenditures on underwater transmission cables from the mainland.
- Duke Energy, in North Carolina, has announced $30 million in planned investment in battery storage systems in North Carolina, in addition to smaller scale solar-plus-storage installations in the Great Smokey Mountains National Park.
- Southern California Edison installed what it believes to be the world's first battery-gas turbine hybrid system in Norwalk, California, integrating a 10-MW, 4.3-MWh battery system with a 50-MW gas turbine.

The momentum in this sector is poised to carry into 2018. Many other electric companies have built or announced plans to build new energy storage facilities that will, in many different ways, help improve the operation, reliability, and resilience of the energy grid.

Energy storage also has been taking on a much greater role in utility planning, particularly in integrated resource plans (IRPs). For example, the 2017 IRP issued by Portland General Electric (PGE) includes proposals for at least five different energy storage projects across a mix of applications. These include a standalone transmission-connected

[1] U.S. Department of Energy, Global Energy Storage Database: http://www.energystorageexchange.org/.

[2] GTM/Energy Storage Association, *U.S. Energy Storage Monitor, Q3 2017*, September 2017.

storage device of 4–6 MW; a microgrid battery storage project collocated with a combined solar and biomass facility; a battery unit connected with a substation providing capacity and other ancillary services; another combined storage and solar facility of 1.75 MW; and as many as 500 behind-the-meter batteries at residential properties, centrally controlled by PGE. Electric companies in several other states are similarly including storage in IRP processes, including Arizona, California, Indiana, New Mexico, and North Carolina.

Despite its growing popularity and rapid market growth, energy storage continues to face challenges that are preventing these technology options from achieving their market potential and maximizing the benefits they can provide to customers and society as a whole. Some of the main challenges for storage include the relatively high costs for some technologies, as well as regulatory requirements and ownership restrictions that can make it difficult for these technologies to participate in markets on a comparable basis with other resources. Federal and state policymakers across the country are studying these challenges and increasingly are introducing new or updated policies and regulations that eliminate or reduce these barriers to ensure that energy storage continues to have a bright future and role in our energy grid.

Electric companies have been operating energy storage for decades. Today, batteries, flywheels, compressed air, thermal storage, and pumped hydropower are operational across the United States.

INDUSTRY Q&A WITH DAN NORDLOH, EXECUTIVE VICE PRESIDENT, ENSYNC ENERGY SYSTEMS

EDGE: Can you describe EnSync Energy's business model and tell us a bit about what you do?

Mr. Nordloh: EnSync Energy is an energy management systems company. Our objective is to deliver the highest value, most reliable electricity. We do that through technologies that, utilize various energy sources, including distributed generation assets, such as solar and several types of energy storage. By developing and engineering our own power control hardware and energy management software, supported by a deep understanding of the relevant power and storage technologies, we design systems that deliver on a real time basis, the highest value, often times least expensive, and most reliable electricity. We offer hardware and software solutions behind the meter to provide for grid services such as frequency regulation, demand response mitigation, and time of use shifting. We work with prospective clients in terms of really understanding load characteristics and their utility bills which allows EnSync to do a deep dive on system engineering modeling and financial modeling to achieve optimal design and effectively prioritize applications that deliver the highest value on a real time basis. One of the advantages is that EnSync seeks to essentially "future proof" these projects. The fact of the matter is that things are going to change. Most generation assets today are 20 plus year assets. Over the lifetime of those assets, load characteristics are going to change, price is going to change, policy is going to change, and the world around that building or the site is going to evolve. Our technology is easily adaptable to new circumstances, to ensure it continues to deliver the highest value, most reliable electricity.

EDGE: EnSync Energy has developed innovative approaches to financing for customer-sited energy systems. Can you give us an overview of the options for C&I customers and talk about the particular problems your financing solutions overcome?

Mr. Nordloh: EnSync has done a lot in the realm of solar-plus-storage PPAs. We are using a methodology that removes a number of hurdles for project implementation. PPAs allow us to deploy systems at the C&I level and give those off-takers a defined price for electricity and resilience, with reliable budget numbers so they know what their spend for electricity is going to be for the next 20 years on a contractual basis. We actually did the first solar-plus-storage PPA in Hawaii, and have a lot of lessons learned and rigor now worked into our modeling. One of those lessons is the

importance of financing. The model should be able to consider over the course of the next 20 years not only the applications available today, but also the potential upside of the technology over time. For example, if grid services are later going to be assigned value, is there the ability to monetize down the road; and how do you prioritize and value those services? Effectively we are creating the ability to provide spot market sale of electricity from these distributed energy resources to a utility or ISO ready to receive it. Robust financing methodologies allow us to deliver the right scenario today, meeting the needs of investors in those PPAs, and also provide stepping stones to the future, when additional opportunities to save money behind the meter or create revenue opportunities behind the meter emerge.

EDGE: EnSync Energy has been a leading supplier of solar-plus-storage solutions in leading edge markets like Hawaii. Where do you see opportunities in markets that are in earlier stages, such as in the Northeast? What are the top two or three emerging state markets now?

Mr. Nordloh: We have definitely had success in Hawaii due to some more obvious factors: price, policy, and the need for customers to have resiliency in the event of grid outages. I believe Hawaii is a bellwether for the United States nationally. In the Northeast corridor, EnSync sees a tremendous amount of opportunity, as well as in California. Each region is going to have its own drivers for the uptake of solar-plus-storage technologies. But in the Northeast states and California there is a lot of work underway to create revenue streams and markets for various applications that provide grid services and monetize distributed energy resources. There are also other parts of the country where demand charge expenses comprise a large portion of utility bills and customers may not yet necessarily be paying a lot of attention, but opportunities will arise. DER (distributed energy resource) systems can really help mitigate demand charges. We are starting to take a look at some of the less discussed regions of the United States that could benefit from microgrids and/or distributed energy resources in general, including the Midwest and Southeast.

EDGE: For distributed storage and solar-plus-storage projects, how does EnSync Energy approach the utility interface? How does your Internet of Energy Control Platform communicate with grid operators?

Mr. Nordloh: There are two distinct aspects to how EnSync enables the 21st century grid. One is the Matrix™ Energy Management platform; hardware which is sited within the utility grid infrastructure. Often this is on the customer's side of the meter, or acting as a microgrid. The platform Matrix technology physically manages the electrons of the DERs to leverage the highest value, most reliable electricity on a going basis. From the internet of energy perspective, DER Flex™ is a cloud-based utility grade capability technology that allows the utility to have visibility into these distributed energy resources in terms of kilowatts (kW) and units of reactive power, called KVAR. It allows the utility to make a simple call through a control signal to leverage kW or KVAR to provide for grid services. DER Flex offers an aggregation and monetization capability that can interface with our Matrix Energy Management platform. It can also interface with other types of hardware control technology that provides utilities or ISOs the visibility, and the aggregation capability for realizing grid services, and allowing the technologies to deliver value on both sides of the meter. The technology is not the hurdle any longer. Achieving appropriate payment for both electricity and for grid services is going to really drive how DER assets are valued and leveraged going forward.

EDGE: DER solutions offer grid operators major benefits in deferring expenditures for new assets and modernization. How should those benefits be monetized to appropriately compensate distributed solar and storage project owners?

Mr. Nordloh: Distributed energy resources are definitely becoming part of the utility grid infrastructure. The opportunity for utilities is to determine what the value of those DER assets are to them. Access to stored electrons may be particularly valuable at times of the day when the grid is experiencing pressure. With DERs, certainly with solar-plus-storage, there will be opportunities to build systems a little bit larger than what customers might need and store excess solar generation, so when there is high demand—in the evening for example—those excess electrons can be deployed to provide grid services and de-stress the grid. This can definitely defer the need to invest in additional generation capacity. It takes burden off the transmission and distribution side of the grid infrastructure. It can be thought of as providing for almost a self-healing grid, when there are DERs throughout a landscape with DER Flex, which can be easily aggregated to provide for grid services. This capability can solve a lot of problems.

This is exactly what EnSync Energy aims to determine with internet of energy software that we've deployed. Everyone knows DERs are increasingly becoming part of the utility grid infrastructure, so utilities and ISOs need a way to determine the exact value those DERs play on their system. Full expectations are for DER Flex to provide a great deal of visibility (both sides of the meter) on how utilities will monetize electrons and kVARs for grid services and de-stress the grid. It gives the customer clear and specific market signals of what DER electrons should be prioritized and when. Many energy experts are stating that utilities can defer investment in some new generation capacity, while taking the burden off transmission and distribution side of the grid infrastructure. This technology can be thought of as supporting a self-healing grid, when multiple DERs, along with DER Flex, are placed throughout a landscape to easily aggregate and provide for grid services. We believe this capability can solve a lot of problems.

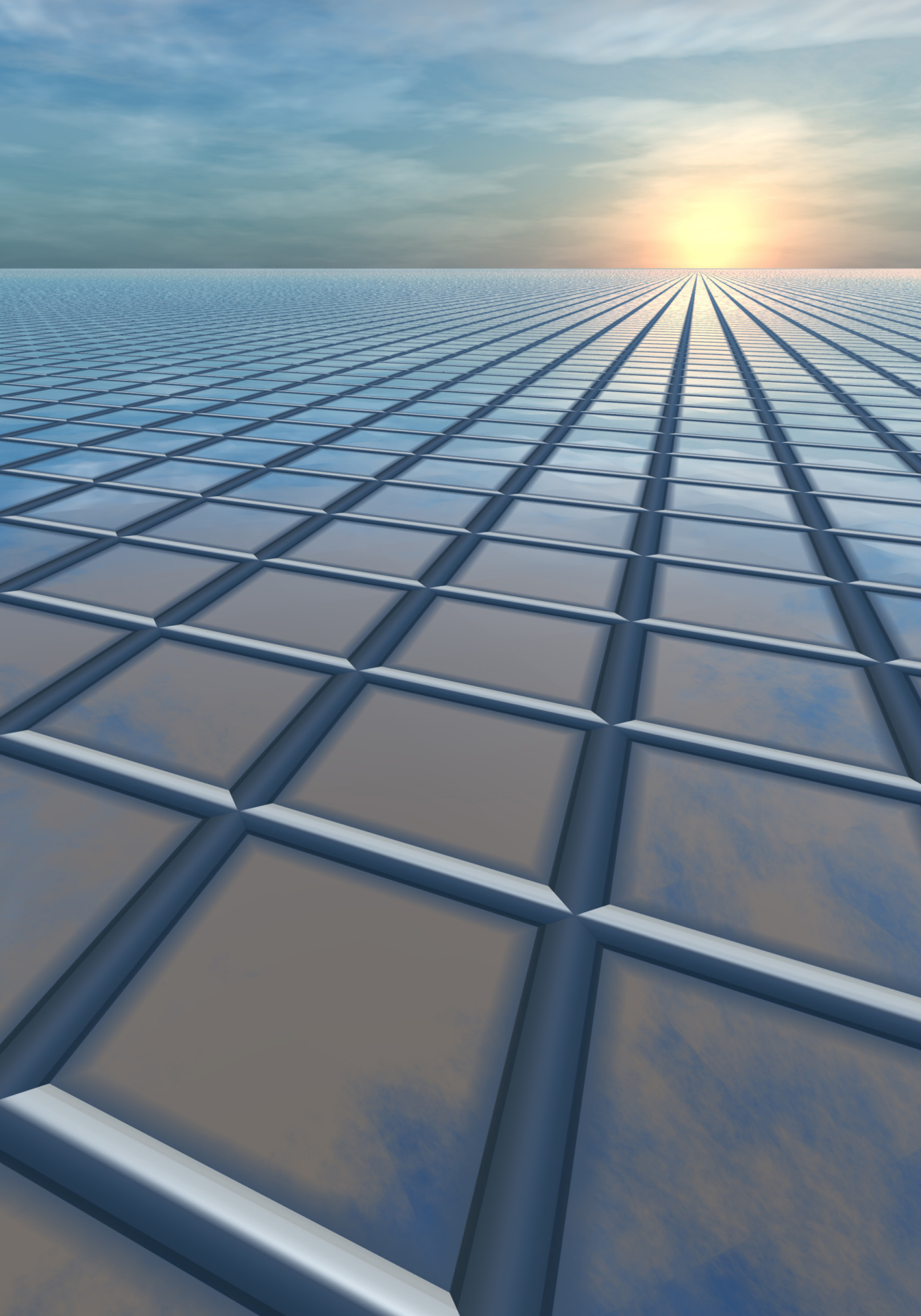
EDGE: The 2017 hurricanes in Texas, Florida, and the Caribbean caused massive and extended power outages. Fast forward to a decade from now, assuming widespread adoption of systems such as EnSync Energy's, how would the grid be more resilient in such scenarios?

Mr. Nordloh: A lot of people don't realize that with conventional solar installations, if the grid goes out, the solar panels can no longer be utilized. Our systems are designed to allow for grid connection, yet still "island," meaning they can disconnect from the grid in the event of an outage. The technology recognizes when the grid is down, disconnect, and continue to provide solar to power the building. Today, when there is an event

like a hurricane and you lose all power, most people default to diesel generators. EnSync designs to allow integratione of diesel within our energy ecosystem, and alongside solar, storage, and nearly any other generating asset. If the grid goes down, generators are going to serve a purpose, but ideally the EnSync's system minimizes the run time of generators and leverages those other assets as much as possible. In long term outages like we've seen in the Caribbean, there is no guarantee fuel will be available to power the generators. With the Matrix the customer now can rely to some extent on solar, along with conventional generation, and can really orchestrate those assets on a going forward basis to better ensure as much power as needed. In many cases the EnSync system design establishes prioritization of loads based on criticality. This provides not only diesel but also renewable generation and energy storage more options and more runways in the event of a long-term outage.

EDGE: Do you see blockchain or other new transaction or communication technologies on the horizon as fundamentally changing the approach to DER integration with the grid?

Mr. Nordloh: Yes, we do. Our DER Flex Internet of Energy platform offers what we consider an enabling capability for the 21st century grid. That capability is to aggregate, integrate, and provide grid services from distributed energy resources. Ultimately, this can provide for a spot market sale of electricity from DERs. On a real time basis, we are looking at the price of electricity in various markets, with the opportunity to sell into those markets where a contract is in place. Today transactions are handled with conventional settlement tools and databases. But blockchain is on the horizon. The ability to use a distributed ledger for real time settlement of transactions is going to promote much greater emphasis on DERs.



EVOLVING APPROACHES TO FINANCING FOR ENERGY STORAGE PROJECTS

By Stan Lewandowski, James Wrathall, and William Holmes, K&L Gates LLP

Installed capacity of energy storage is expected to reach 2.5 GW by 2022 in the United States alone, more than triple today's capacity. Accelerating demand will drive an increasing need for sophisticated and cost-effective project financing. Unlocking sources of financing across the sector will be vitally important in realizing the monetary and societal benefits of energy storage.

FUNDAMENTALS AND CHALLENGES OF ENERGY STORAGE FINANCING

Financing for energy storage projects shares some of the same fundamentals as solar and wind energy generation projects. Investors and lenders seek projects that can demonstrate (1) contracted long-term revenue streams; (2) technology that is well proven and reliable; and (3) contractual performance assured by creditworthy counterparties or financial instruments such as performance insurance.

Beyond these fundamental similarities, however, energy storage projects are inherently more complex than solar and wind projects and typically face several additional types of challenges in seeking financing.

First, in contrast to the relatively simple metrics of renewable generation projects (e.g., energy generated (in kWh) multiplied by PPA prices over time), energy storage projects may generate economic benefits through one or more different value streams. In preparing an economic model to support financing, the sponsor must clearly define the use cases for the project and link them to concrete and reliable future net revenue streams. Where a project benefit is in the form of cost savings, such as demand charge reduction, quantifying and monetizing that benefit will be a key step. Energy storage may also entail multiple concurrent benefits, such as providing grid-support services while at the same time serving as onsite energy supply. Deriving solid financial returns for these value streams—and ensuring that any potential conflicts and management issues among them are addressed—will be a necessary prerequisite to financing.

Second, compared to generation projects, energy storage technology requires significantly more active and sophisticated management over the life of the project, and has greater potential for change of use, than solar or wind. Operations and asset management for solar projects with a PPA are straightforward, well understood, and contractually defined. The framework generally needs to deliver energy on a steady stream over time, addressing only sporadic and mostly immaterial operations and maintenance issues.

Achievement of bottom-line results with a storage project, however, typically requires dynamic ongoing management and software controls to address changing circumstances and objectives. Where grid services are provided, those controls must mesh with the utility framework and meet applicable communications, technology, and contractual requirements. Realizing the revenue streams on which financing will be based thus faces significant additional ongoing uncertainties compared to traditional renewable energy generation projects.

Finally, the market and regulatory contexts for energy storage are rapidly evolving and may be unpredictable. Value streams may quickly change or dry up, as seen in the recent decision of PJM Interconnection LLC (PJM), to substantially decrease its "Regulation D" payment rates for frequency regulation services from energy storage. Utilities and state public utilities commissions in several major jurisdictions are in the process of reforming energy distribution and customer platforms. Interconnection rules, siting requirements, and market participation procedures are changing. New storage technologies are emerging, and software systems and transaction regimes such as blockchain are creating major new capabilities. All of these areas of change create potential risks and opportunities that must be assessed in considering financing terms.

Given these inherent complexities, the cost of capital for storage project finance has yet to see substantial reductions. On the risk-return continuum, equity has, understandably, been the dominant source of financing for the nascent energy storage industry to date. Debt and tax equity are beginning to take on more active roles, however, as revenue streams, risk factors, and contract structures are becoming more clearly defined.

CURRENT PROJECT FINANCING INSTRUMENTS

While many energy storage projects have been developed as merchant facilities, particularly in PJM and other RTOs such as the Electric Reliability Council of Texas and Midcontinent Independent System Operator, Inc. (MISO), several energy storage projects have successfully

[3] This article was previously published in the November 2017 issue of *Project Finance International* and is reprinted with permission.

entered into long-term contracts for offtake of the storage resource or to assist in financing. Although these long-term agreements are sometimes referred to casually as energy storage "PPAs," this omnibus term is bit of a misnomer because several forms of agreement have been developed to take advantage of energy storage systems as both a generator and a load (i.e., discharging and charging). While each form of energy storage agreement has its own peculiar features, several forms of agreement generally in use are summarized below.

Energy Storage Tolling Agreement

California utilities have used energy storage tolling agreements in connection with their procurement of utility-scale storage projects that are interconnected to the transmission or distribution system. Under a tolling agreement, the energy storage system developer is responsible for obtaining site control, permits, interconnection rights, equipment, and construction contracts and achieving agreed-upon milestones, usually including a target commercial operation date and a guaranteed commercial operation date. The buyer (here, the utility) pays for the electricity used to charge the battery storage system and receives the right to charge or discharge the system for energy and ancillary services, all within specified operating parameters. The storage provider receives a capacity payment, which is adjusted for the storage system's availability and round-trip efficiency, and a variable operations and maintenance (O&M) payment for energy dispatched

from the system. The buyer will usually insist on the right to dispatch the system to provide ancillary services like frequency regulation, usually without any additional compensation to the seller beyond the capacity and variable O&M payments. Because the buyer owns the energy stored in the battery, tolling agreements often prohibit or restrict the developer's use of the storage system for station service—a condition that requires the developer to enter into a retail service contract for the system's non-storage load. Energy storage tolling agreements are similar in many respects to gas tolling agreements, with "round-trip efficiency" being analogous to a heat rate and "availability" generally performing the same function under both types of agreement.

Capacity Services Agreement (CSA)

Under a CSA, the developer is responsible for most of the development activities associated with a tolling agreement but must charge the energy storage system at the developer's own expense. The offtaker (usually a utility) pays a capacity charge for the system, subject to adjustment for availability, and uses the storage system's capacity attributes to satisfy the offtaker's resource adequacy (RA) requirements. CSAs are used for utility-scale energy storage projects that will be interconnected with the transmission or distribution systems, and at least one California utility, Pacific Gas & Electric (PG&E) has used a CSA format for its most recent round of energy storage solicitations.

Demand Response Energy Storage Agreement (DRESA)

If a developer provides onsite, behind-the-meter storage to a number of customers, it may be able to aggregate the storage capabilities of those customers and enter into a DRESA. A DRESA between a local utility and an energy storage system developer allows utilities to compensate an energy storage system developer for providing the utility with energy storage system capacity and demand response energy storage ancillary services.

Each customer contractually allows the developer to make the storage systems available to reduce demand at the direction of the utility offtaker. The developer then enters into a long-term DRESA with a utility buyer under which the developer agrees to cause its customers to switch to energy storage as and for the duration requested by the utility, again subject to the operating parameters of the aggregate system. During this period, the developer's customers will rely on energy discharged from the storage system instead of electricity from the utility, thus reducing load on the grid. A DRESA may allow demand response assets to be deployed without capital expenditures by either the storage system host or the local utility, which provides advantages to several stakeholders at once.

BEHIND-THE-METER PROJECTS

In states like Hawaii, California, and New York, energy storage systems have been installed on the customer's side of the meter, allowing the customer to charge the system in off-peak hours and then discharge it during peak hours. These systems can be dispatched in response to demand response price signals, to reduce the customer's usage of peak power, or to shave peaks and thus reduce peak demand charges. The agreement between the developer and its customer may take the form of a third-party PPA, particularly if the storage system is combined with a solar installation, with payments to the developer based on electricity delivered to the customer. Another type of agreement shares the savings that the customer achieves because it is able to shave its peak demand (and thus its peak demand charges). To date, such agreements exist primarily in states that offer one or more unique market conditions, such as high retail electricity prices, time-of-use rates that allow charging at off-peak prices and discharging at on-peak prices, market design such as peak demand charges in California or demand response markets in New York, and incentive programs such as California's Self-Generation Incentive Program (SGIP). Developers and utilities are continuing to create new forms of financeable agreements applicable to their fast-growing sectors, similar to where solar photovoltaic market players were ten years ago. A brief review of the most common behind-the-meter storage financing agreements available follows.

Operating Leases

An operating lease is an arrangement whereby the owner of an energy storage system grants the host the right to use the system in exchange for a monthly fee that covers the rental of the energy storage system and (in most instances) its operation and maintenance fees, software access fees, installation costs, permitting costs, and sales and property taxes. The energy storage company, acting as the lessor, uses third-party financing to purchase the energy storage asset; therefore, it is essential that the lease provides for the owner's ability to assign the lease to its financing party.

During the lease period, which is usually 10 years from its commercial operation date (although terms as short as three years have been used), often with the option to extend the term for an additional 10 years subject to the particular lease terms, the energy storage system remains the property of the owner/lessor who will operate, manage, repair, and maintain it. The owner/lessor provides a long-term (again, often for 10 years) limited equipment warranty. The value proposition for the storage system typically will focus on reducing high time of use electricity rates or demand charges and providing backup power

to the host/lessee in the event of grid outages. In most cases, the host/lessee will be granted an option to purchase the energy storage system before the lease terminates for its fair market value.

Concurrently, the energy storage system owner/lessor may operate the energy storage system to provide supporting services to the electrical grid, offering potential additional revenues from such activities. This operating lease model is used widely today by leaders in the energy storage market.

Demand Charge Shared Savings Agreements

Similar to the energy savings performance contract structure used for energy efficiency projects, a demand charge shared savings agreement (DCSSA) between a host (for instance, a hotel owner) and a third-party energy storage system owner or operator allows the host to enjoy lower energy consumption costs due to reduced demand charges achieved by discharging the energy storage system during peak hours and by performing energy arbitrage by drawing power during off-peak periods. With the DCSSA, the third-party financiers rely on an allocated portion of the energy cost savings from the reduced tariff-specific demand charges that will be distributed by the host to the project financing providers. The most significant advantage to the host is access to the energy cost-reducing third-party asset with zero upfront capital expenditure on the host's part. Under the DCSSA, the host is provided energy storage-related services on a storage-as-a-service basis.

Several companies, including Stem, Advanced Microgrid Solutions, and Green Charge Networks utilize this model in their contractual arrangements with third-party commercial and industrial hosts.

PROJECT FINANCING RISK IDENTIFICATION AND MANAGEMENT

Energy storage agreements share many of the issues typical of any long-term PPA, such as force majeure, defaults, collateral assignment, and dispute resolution. Given the complexities of energy storage, however, project financing must effectively address a number of categories of risks associated with new technology, business management, market and regulatory evolution, and credit profiles.

Change in Law and Regulatory Risk

One of the most difficult issues in an energy storage agreement is allocating change in law risk. In California especially, utilities will often procure energy storage so that they can meet AB 2514 targets, or other procurement mandates, as well as satisfy RA requirements. If, after the agreement is signed, there is a change in the laws

or tariffs governing the targets, RA qualifications, or other key operational features or attributes of the energy storage facility, which party bears the risk of that change?

Developers prefer to shift the risk to the offtaker, arguing that the procuring utility is in the best position to manage changes in the laws, rules, and tariffs governing energy storage systems and how they count in meeting procurement targets or satisfying RA requirements. A utility will often resist a full assumption of this risk, arguing that the small risk of an adverse change in law is better borne by the developer than the ratepayers. Developers, for their part, prefer to avoid provisions that merely excuse its performance and give it a right to terminate in the event the law changes; such language would increase the risk that the energy storage system will end up as a merchant plant, thus making it difficult to finance the system. Force majeure clauses are not adequate to the task of addressing this issue, and agreements need to address change-of-law risk allocation head on.

Not surprisingly, compromises are developing along the same lines as the change-of-law provisions affecting renewable portfolio standard compliance provisions in renewable energy PPAs. In some instances, utilities will agree to accept the risk of a change in law. In others, the parties will agree to allocate the risk such that the developer bears compliance costs up to a certain point, after which the utility may decide whether it wants to incur additional costs to cause the system to comply with the new law. From the developer's standpoint, the important outcome is that the utility cannot treat as a default the failure to comply with the new law after the cost threshold, if any, is reached, nor can it refuse to continue to receive and pay for the contracted energy storage services specified in the agreement.

Technology Risk

Energy storage agreements usually include a fairly detailed exhibit setting out the system's operating parameters. These provisions are especially important in a tolling agreement or any other contract in which a third party has the right to dispatch the facility. If the storage system is operated within the agreed-upon operating parameters, the storage provider is required to meet the availability and round-trip efficiency standards set forth in the agreement. On the other hand, if the system is operated outside its agreed-upon parameters, the developer will have a contractual defense to any penalties imposed due to nonperformance. Experience in the PJM and MISO teach that tariff or rule changes that change the way a storage system operates can adversely affect the system's performance and may also limit warranty claims under the storage system's procurement contracts.

Behind the representations on operational performance is a concern that the energy storage technology will not perform as expected in the future and/

or that operation and maintenance costs will be greater than anticipated. Today, lithium-ion batteries are perceived as safe and bankable. Because successful project financings depend on long-term manufacturer warranties backed by creditworthy entities, it is normal today for equipment manufacturers to stand behind their products with warranties that range from several to ten years. Performance ratings and performance guarantees are increasingly being used to mitigate the technology risk posed by the lack of long term performance energy storage system-related data.

Safety risks have also been a major area of focus. The U.S. Department of Energy (DOE) and Underwriters Laboratories are continuing to work on establishing codes and standards for avoiding project technology failures and resulting health and property impacts and financial liabilities. As in the solar industry, the practice of conducting bankability studies to support financing is taking root for storage. Performed by technical consultants with access to extensive databases of prior projects, such bankability studies can provide detailed due diligence on the project technology, reliability, and durability; the manufacturer and supply chain; and operations, asset management, software controls, and maintenance going forward.

Asset Management Risk

As discussed above, energy storage must be effectively managed and controlled to interface with generation sources and the grid. Software technology uncertainties and the need to rely on sophisticated asset management services over time create additional risks that must be assessed.

Credit Risk

There is always a risk of default by the borrower, who may be unable to service the debt as contracted. Prospective lenders are cautious about entering the market, as it is still considered immature despite the fact that several lenders have been actively supporting

certain developers deploying energy storage systems in the past few years. Credit risk assessment for energy storage also extends beyond the project counterparties to third parties, such as equipment manufacturers, software suppliers, and asset managers that the project may be relying on for warranties, guarantees, and operational effectiveness going forward. Insurance covering project assets and operations, as well as performance insurance supporting performance guarantees, often will be required.

TRENDS TOWARD STANDARDIZATION

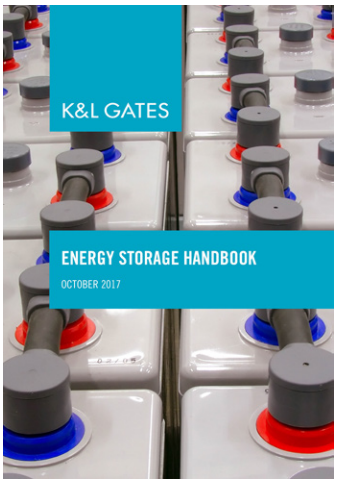
A number of participants in the energy storage sector are actively working towards standardized approaches to risk management and contractual allocation. End-to-end contractual solutions are being developed by companies whose business models require ease of obtaining finance. Such efforts are being augmented by a number of nongovernmental organizations, such as the Energy Storage Association and Rocky Mountain Institute's Business Renewables Center, that provide forums for finance experts to work with developers in overcoming common obstacles and streamlining financing processes. Sandia National Labs, the National Renewable Energy Laboratories, and others are working under DOE programs seeking ways to reduce barriers for new lenders and to create trusted analytical benchmarks to assess and price risk in more systematic ways. Further rapid advances in these areas should be expected in the next few years, helping to open the spigot of financing for the energy storage sector.

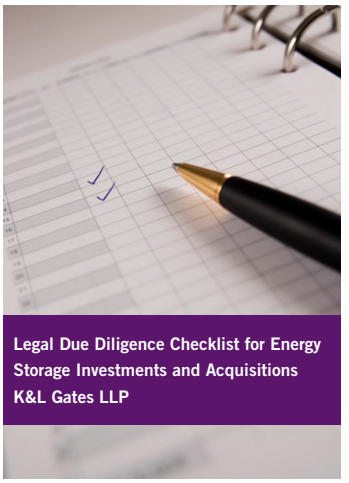
In recent years, the energy storage industry has seen several significant and positive changes including equipment cost reductions, regulatory incentives, viable market structures, and proliferation of long-term agreements. Each of these makes deploying energy storage systems more bankable than ever before. As access to project financing is still an issue for many developers, however, it is encouraging to see project finance lenders taking a greater interest in financing large-scale energy storage projects in the United States and abroad.

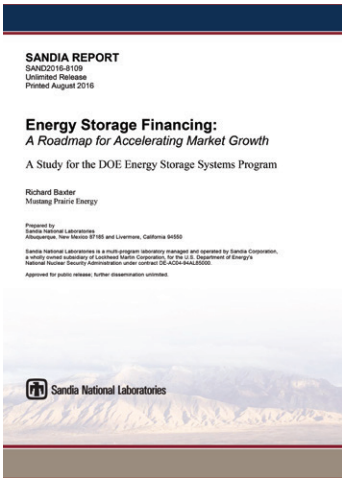
In addition to more lenders entering the market, one of the main potential catalysts for the expedited deployment of additional energy storage systems would be Congress passing an investment tax credit for stand-alone storage facilities. With or without a storage investment tax credit, the fundamental economics and optimism in the energy storage industry indicate that energy storage can flourish in the coming years and the project financiers will have ample opportunities to make a significant contribution to this process. Each of the groups of participants in the storage ecosystem—sponsors, developers, financiers, and utilities—must work to streamline and standardize structures and contracts. The overarching commonality with solar and wind technologies is that energy storage offers massive potential economic benefits that could be unlocked as these parties work on more effective approaches to financing. The question is not whether, but when and how rapidly the sector can realize the kind of progress seen to date in renewable generation.

TOOLS OF THE TRADE: RESOURCES FOR ENERGY STORAGE PROJECT EVALUATION AND FINANCING

Energy storage projects can be complex and may present novel technical and economic issues for evaluation. A number of specialized resources have been developed in the past few years, which may assist in the evaluation process, with highlights noted below. For access to these materials or if you have any other questions, please contact **Bill Holmes** at **bill.holmes@klgates.com**, or **Buck Endemann** at **buck.endemann@klgates.com**.







2017 YEAR IN REVIEW: REPORT FROM THE STATES – SUPPORTING ENERGY STORAGE THROUGH INCENTIVES AND POLICIES

By Michael L. O'Neill, K&L Gates LLP

States have played a leading role in developing energy storage. Starting with California's AB 2514 in 2010, numerous states have set energy storage procurement targets, provided funding for energy storage pilot projects, and otherwise incentivized energy storage market development. The outline below catalogues many of the efforts states have undertaken to spur energy storage development, such as procurement mandates, state tax credits and other customer-side incentives, state level grant-making programs, and other incentives for private actors to deploy energy storage systems. These state-level programs are critical considerations for developers of or investors in US energy storage projects.

As policy laboratories, states provide regulators and industry with the opportunity test aspects of market design, replicating and building upon positive results in other jurisdictions and discarding initiatives that did not produce the desired effect. In evaluating any decision to invest in the U.S. energy storage sector, a decision maker should consider the policies and market design choices that the relevant regulators have made that will affect the investment opportunity.

Just as state policies can encourage development of energy storage markets within their jurisdictions, different policy decisions can slow or stall development of a state's storage market. For example, a state that incentivized energy storage in the past could reduce or cancel those incentives if new political leadership changes the state's energy policy direction. Developers of or investors in energy storage therefore should monitor policy developments closely for how policy changes can affect their investment portfolio or targets.

Sophisticated market participants might also consider advocating for certain policies that advance their goals for the energy storage sector. The U.S. energy storage industry is still at its early stages, so there are numerous opportunities to

[5] For a more complete outline of state programs, see K&L Gates' "Energy Storage Handbook" (October 2017), http://klgates.com/energy-storage-handbook-10-17-2017/

shape energy storage policy outcomes at the state level through advocacy to state legislators and executive officials, regulators, and economic development programs with energy storage mandates.

STATE INCENTIVES FOR ENERGY STORAGE

The following briefly outlines prominent state programs incentivizing energy storage programs. Note that some states are pursuing a suite of different energy storage incentives, so a single state's programs may fit under more than one category.

Procurement Mandates

- Arizona's Utility Mandates: In August 2016, the Arizona Corporation Commission (ACC) directed the state's largest public utility, Arizona Public Service Co. (APS), to develop a $4 million residential demand and load management program to facilitate residential energy technology. The ACC directed the Tucson Electric Power Co. (TEPCO) to develop a similar $1.3 million incentive program in February 2017.
- California's AB 2514: This 2010 statute directed the California Public Utilities Commission (CPUC) to set appropriate energy storage procurement targets for the large investor-owned utilities in the state. The CPUC sets a goal of 1,325 MW of energy storage by 2024, with biennial interim deadlines and energy storage procurement plans leading to the 2024 target year. Likewise, the statute also directed the governing boards of each local municipal utility to develop appropriate storage targets.
- California's AB 2868: In 2016, California adopted AB 2868, which requires the state's investor-owned utilities to propose programs and investments for an additional 500 MW of distribution-connected or behind-the-meter energy storage resources with useful lives of at least 10 years.
- Massachusetts Energy Storage Initiative: On June 30, 2017, Gov. Charlie Baker announced that January 1, 2020.
- New York Legislation: Gov. Andrew Cuomo signed legislation on November 29, 2017, that directs the New York Public Utilities Commission (NYPSC) to set a target for energy storage procurement to be met by 2030. In a statement released with the bill signing, Gov. Cuomo indicated that he expects to work with the state legislature in the next legislative session to address his concerns with the legislation's interplay with New York's Reforming the Energy Vision strategy and fiscal commitments by the state.

- Nevada's Procurement Investigation: As directed by the state legislature, the Public Utilities Commission of Nevada is investigating whether it should establish a program mandating that the state's electric utilities procure energy storage systems.
- Oregon's HB 2193: Under this June 2015 statute, electric companies with at least 25,000 retail customers must procure at least one energy storage system with at least 5 MWh of energy. According to the implementing regulations, the electric companies must propose the projects by January 2018 and the projects must be operational by January 1, 2020.

Customer-Side Incentives

- Nevada's "Right to Interconnect": In its recently passed AB 405, Nevada established a right for every resident "natural person" to interconnect his or her renewable energy system, including energy storage systems, to the utility's electricity grid. Incorporated into the state's Renewable Energy Bill of Rights, this "right to interconnect" is part of a larger legislative package restoring the state's net metering program.
- Maryland Tax Credit: In May 2017, Maryland instituted a tax credit for costs associated with installing an energy storage system. The program permits a tax credit of up to $5,000 for residential systems and the lesser of $75,000 or 30 percent of the cost of commercial systems. The tax credit will be available for systems installed between 2018 and the end of 2022. The program is limited to $750,000 across all tax payers for any given taxable year, issued on a first-come, first-served basis.

Regulatory Programs

- Arizona's REST Project: The ACC has proposed to incorporate the development and adoption of energy storage into the state's Renewable Energy Standard and Tariff. This proceeding is ongoing.
- California's SGIP: California overhauled its SGIP in the spring of 2017 to prioritize the development of distributed energy storage resources. This adjustment doubled the available funds for

This adjustment doubled the available funds for the program to $166 million per year and directs that 85 percent of the funds be available to storage technologies.

the program to $166 million per year and directs that 85 percent of the funds be available to storage technologies. The program carves out some funding for small scale projects, but 90 percent of the funding will be available to projects larger than 10 kW.

- Massachusetts SMART Program: The final rules for the Solar Massachusetts Renewable Target (SMART) program, issued in August 2017, creates a financial "adder" above a solar project's base compensation rate for solar projects that co-locate with eligible energy storage projects.
- New Mexico's IRP Approach: In August 2017, the New Mexico Public Regulation Commission voted unanimously to change its rules to require utilities to consider energy storage in their integrated resource planning processes.
- New York's Two-Project Mandate: In March 2017, the NYPSC directed the state's utilities to increase the "scope and speed" of their energy storage programs. To this end, the NYPSC is requiring all of the state's utilities to install at least two separate energy storage projects by the end of 2018.
- Texas' Rule Adjustments: The Public Utility Commission of Texas (PUCT) has adjusted its rules to allow energy storage to participate more easily in the state's wholesale electricity market. PUCT has exempted wholesale energy storage from transmission service rates and wholesale storage load is excluded from ERCOT's four coincident peak demand calculations. Furthermore, PUCT's rules provide that wholesale storage is not subject to retail tariffs, rates, and charges or fees assessed in conjunction with the retail purchase of electricity.
- Washington's Final IRP Policy: During the Spring of 2017, Washington's Utilities and Transportation Commission (UTC) proposed to direct the state's investor-owned utilities to use the state's IRP process to analyze energy storage options, including behind-the-meter storage options, before committing to other resources, like gas-fired peaking power plants. Finalized in October 2017, the UTC's final policy directs utilities to demonstrate that its determination for a new resource acquisition includes a storage option by identifying and analyzing a reasonable representative range of storage technologies and chemistries. Furthermore, the UTC encourages each utility to develop tariff proposals that would disaggregate the value stream associated with storage, including traditional ancillary services.

State Grant-Making Programs

- Massachusetts ACES Program: The Massachusetts Clean Energy Center has awarded 26 grants of between $243,000 and $1,250,000 each to advance "clear and innovative business models" for energy storage projects in the commonwealth. The program encourages applicants to collaborate with local utilities in developing their projects and to consider "nonmonetizable benefits" of the storage resources.
- New York Clean Energy Fund: The New York State Energy Research and Development Authority (NYSERDA) established a $15.5 million funding program for energy storage projects in April 2017. NYSERDA is focusing on early stage proposals to address core problems pertinent to New York.
- Texas's New Technology Implementation Grant (NTIG): Texas created the NTIG program as part of the Texas Emissions Reduction Plan. NTIG funds may be used to fund energy storage project collocated with renewable energy generating facilities in certain counties. NTIG has provided grants to five electricity storage projects in Texas to date.
- Washington's Clean Energy Fund: In its first round of funding between 2013 and 2015, the Clean Energy Fund awarded $14.5 million in matching "smart gird" grants for energy storage projects. In its second round, from 2015 to 2017, the Clean Energy Fund has approved several million dollars worth of additional grid modernization funding proposals.

Other Energy Storage Development Programs

- Arizona's Utility Programs: In late 2016, APS developed plans to deploy a 4 MW energy storage project to study the impacts of batteries on its system. Since then, TEPCO and another utility, Salt River Project, have each entered into PPAs to buy power from two battery storage systems to be paired with corresponding solar facilities. TEPCO and its partner, E.On, have completed development of a 10 MW battery project connected with a 2 MW solar array, that will provide frequency response and voltage control on the TEPCO system.
- Meeting Hawaii's HCEI Requirements: Hawaii's Clean Energy Initiative (HCEI) proposes a 100 percent renewable energy target by 2045 and energy storage is an important component of the state's plan to meet this goal. Hawaiian Electric's, Maui Electric's, and Hawaii Electric Light Co.'s annual joint reports describing their HCEI compliance activities describe 12 utility-scale battery projects planned for the Hawaiian Islands.

- Hawaii Natural Energy Institute (HNEI): Public-private partnerships between utilities and the HNEI have launched battery storage systems across the state. A total of four storage projects are planned under this program.
- Massachusetts Rate Cases: Massachusetts approved two energy storage pilot projects as part of Eversource's latest rate case.
- Oregon's Pilot Project: Partnering with the Sandia National Laboratories, the Oregon Department of Energy directed $295,000 state and federal funds to the Eugene Water and Electric Board in order to demonstrate energy storage and microgrid technology.

WILL AVAILABILITY OF CRITICAL MINERALS BE A CONSTRAINT FOR GROWTH OF ENERGY STORAGE?

Kristin Hoeberlein & James Wrathall, K&L Gates LLP.

Battery storage technologies are fabricated using minerals such as lithium, cobalt, and vanadium. With the recent accelerating growth in the sector, concerns have been raised about reliance on critical minerals, particularly where supply is largely from foreign sources.

Though pumped hydro still accounts for over 99 percent of grid-scale energy storage in the United States, lithium-ion batteries are quickly growing in popularity. This is due both to declining costs and their recognized value across multiple applications, including electric vehicles, behind-the-meter, and grid-scale installations. Goldman Sachs has referred to lithium as the "new gasoline." At a hearing on energy storage technologies before the U.S. Senate Energy Committee in October 2017, Committee Chairman Sen. Lisa Murkowski (R-AL) called the supply of critical minerals such as lithium the "true base load," without which energy storage technologies cannot flourish.

Given the projections for growth of battery storage, it is reasonable to ask: just how exposed will an energy storage-empowered grid be to the threat of minerals supply constraints in the future?

According to the U.S. Geological Service (USGS), global production of lithium in 2016 was 35,000 metric tons. The biggest suppliers were Australia (14,300 metric tons), Chile (12,000 metric tons), and Argentina (5,700 metric tons). Smaller producers include the United States, Brazil, China, Portugal, and Zimbabwe.

The United States currently has only one domestic lithium mining operation, located in Nevada's Clayton Valley. In 2016 the United States imported over 50 percent of its lithium, 97 percent of which came from Chile and Argentina.

Worldwide production of lithium rose 12 percent in 2016 over the previous year, a trend that is predicted to continue. Bloomberg New Energy Finance predicts that lithium-ion batteries for energy storage will become a $20 billion per year market by 2040, a tenfold increase from today. In another study, Benchmark

Mineral Intelligence found that global lithium-ion battery production capacity was at 28 GWh at the end of 2016 and is expected to rise to 174 GWh by 2020, a 521 percent increase. This could translate to a demand of 100,000 to 200,000 metric tons of lithium in the same year.

The USGS estimates there are over 40 million metric tons of worldwide lithium "resources," defined as supplies that could feasibly be extracted economically at some point in the future. It estimates global "reserves"—defined as supplies that reflect current economic viability—at around 14 million metric tons. Within the United States, lithium resources are estimated to be 6.9 million metric tons, with 38,000 metric tons of reserves. Nevada is the only known source of lithium in the United States.

China produces about two thirds of the global supply of batteries for electric vehicles. As the demand for electric vehicles is surging, Chinese companies are aggressively pursuing contracts around the world to secure lithium supplies. "Whoever controls the lithium supply chain will control the future of the electric vehicle space," said Simon Moores, managing director at research and data provider Benchmark Mineral Intelligence. "There's a global battery arms race." The growing demand has driven prices up by more than 40 percent in 2017 according to Benchmark.

Cobalt, which is also used in lithium-ion batteries, is also scarce. More than 60 percent of global cobalt supply originates in the Democratic Republic of Congo. China recently funded the purchase of a majority stake in Congo's biggest cobalt mine for more than $2.5 billion.

It should be noted that mining is not the only means to meet rising demand. As an alternative, some existing batteries may be given a second life. In 2015, one company began operating a lithium-ion battery recycling program in Ohio, bolstered by a $9.5 million grant from the DOE.

With anticipated growth in battery production in near future, the Critical Minerals Institute, an unit of DOE, forecasts lithium supplies to be "near critical" within the next 15 years. They give this designation to minerals that provide "essential capabilities" and have fragile supply chains. In this case, the projection is solely based on lithium's indispensable role in rechargeable battery technology.

Benchmark Mineral Intelligence suggests that the industry will be challenged to meet the projected demands of 550-650 GWh of lithium-ion battery cells by 2025, which would require an estimated 400,000 to 500,000 tons of lithium to be produced in that year. Absent new lithium operations or considerable increases in output by current projects, it is reasonable to expect that lithium

supply may come up short in the near future. However, the shortage is more likely to be a temporary bottleneck, rather than a permanent barrier for the industry. A more nuanced and open question is whether relative shortages could generate price spikes, which would make otherwise cost-effective projects uneconomic.

Critical minerals availability is unquestionably a vital issue for the future of energy storage. Battery manufacturers and developers should be proactively addressing long-term supply issues, as well as weighing in on federal policies that can help ensure diverse and cost-effective sources of key minerals such as lithium and cobalt. Given the impacts of market forces and increasing demand, however, and that potential supply is spread across a number of countries that are not unfriendly to the United States, it does not appear likely that minerals supply constraints will constitute a threat to U.S. reliance on energy storage for grid resilience and electric power supply.

ABOUT US

Across the United States, Europe, Asia, and Australia, K&L Gates' global storage team members have provided legal and policy advice and representation to industry and thought leaders in energy storage for a decade or more. We have helped early developers of pumped storage hydropower and compressed air storage facilities through the regulatory and transactional aspects of deploying those technologies, and we have helped our clients develop and protect their intellectual property in some of the leading new mechanical, thermal, and electromechanical storage technologies. We have advised on the cross-border acquisition of an energy storage company, including addressing the intellectual property issues inherent in such a transaction. K&L Gates combines this historical perspective with a deep involvement in the traditional and renewable energy sectors, as well as extensive knowledge of the unique energy requirements of the natural resources sector, to assist technology and product suppliers, project developers, contractors, end-users, and policy-makers in navigating the new demands and challenges in energy storage.

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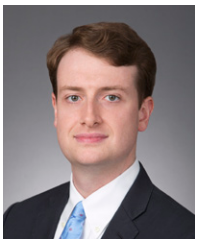

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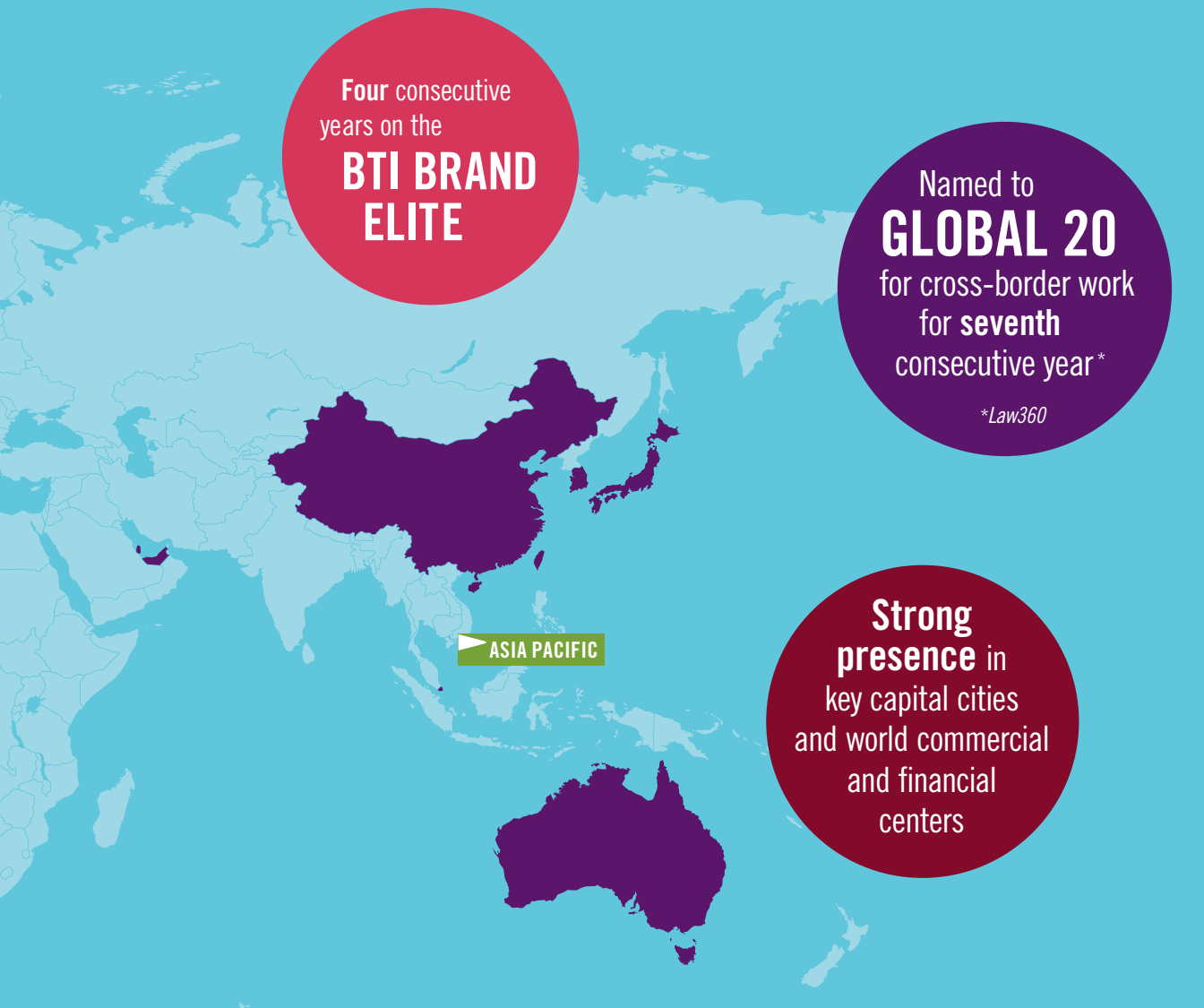

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