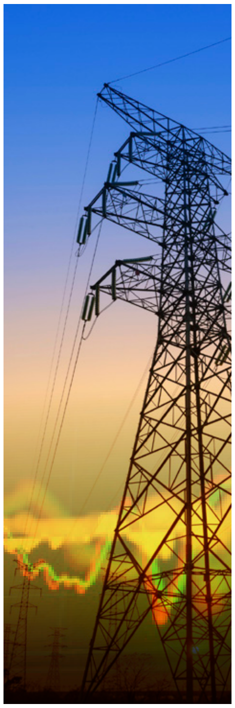
WHITE PAPER

Utilities and Storage: Will Optimizing on Resiliency Pull Storage Back from the Edge of the Grid?

By Rick Fioravanti and Matt Robison



Shareables

1. Now is time to shift the debate away from the potential of storage and focus on the longer view issues of ownership and placement. The optimal answer for customers and systems still is open.
2. Emerging resiliency and reliability benefits may pull some storage back from the edge of the grid. Activities in California, Texas, and New York are opening a pathway for utilities to demonstrate those applications.
3. The window to find the right mix of answers on location will not stay open for long. Market forces and state initiatives are pulling deployment exclusively to the customer side. That might be the right answer, or it might not be, but stakeholders should start being proactive today in finding out.

Shifting the Debate

The critical question is no longer whether storage on the distribution and customer side of the grid is going to fulfil its promise. Rather, our industry needs to begin to shift the debate away from the potential and focus on the longer view questions of ownership and placement of the systems. Today, storage is beginning to identify itself as a resiliency tool for the grid. Individual states are even starting to create opportunities for the technology to be established in that role and are setting guidelines and precedents for utilities to own it.

This development is not minor. Thus far, regulatory uncertainty and debates about asset classification have played just as great a role in the pace of storage deployment as has the technology development itself. As the precedents that are being set begin to offer the opportunity for stakeholders to resolve these uncertainties, the roles that utilities, developers, and end users will play in using storage long into the future must be defined. The immediate call to action to set these roles and definitions is not simply for the sake of an academic debate: It will have deep and lasting implications.

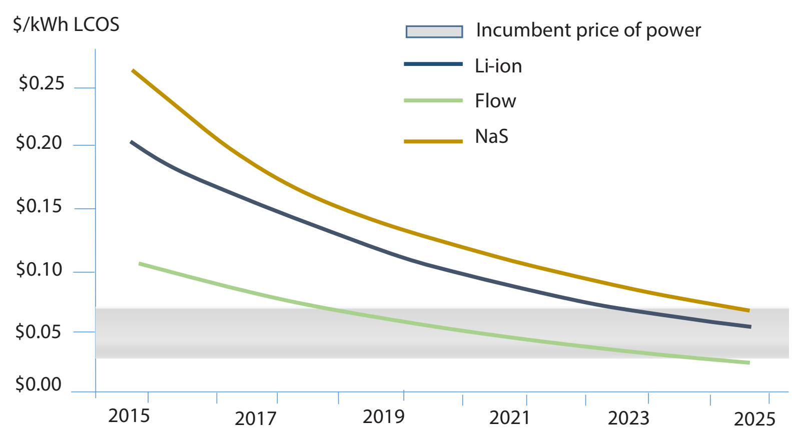
For utilities, a possible role in storage deployment is being explored. States such as California, Texas, and New York are constructing signposts to help stakeholders understand directional trends and ownership guidance. California took the first step with its 1.325 GW storage ruling to place storage across all segments of the grid while allowing utility ownership for 50 percent of the installations. In Texas, the utility Oncor became the first to establish storage technology as a resiliency tool for the grid and to show the potential value it could create. New York also determined that storage could be a resiliency tool and encouraged utilities to examine the business case for this application, allowing for utility ownership in such cases. In each of these activities, precedent is beginning to be established, but actions are required before they are set. The stakeholders involved must respond to these initiatives and further define the roles and applications for storage.

The rapid need for action is further underscored by the fact that these recent developments are not occurring in a slow moving market or static environment. In parallel, storage and solar developers are actively deploying storage on the customer side of the meter and trying to determine additional applications that devices can perform as well. Hence, for utilities, inactivity presents the risk of having the opening question simply being answered for them. Given what is actually at stake, a more proactive approach begs to be taken.

Where We Are Today

One of the driving forces behind the expansion of storage has been its rapid cost decline (see Figure 1[1]), which has been similar in pace to the more celebrated drop in solar photovoltaic (PV). The chart below shows the levelized cost of storage in comparison to traditional technologies and though not yet at parity, shows a rapid decline in process. These falling costs have expanded the current applications for storage from initial uses like ancillary services and renewable integration to growing areas like resiliency, peak-shaving, and combinations of storage with other distributed energy resource (DER) assets. Though it is true that the total cost of a containerized, AC storage unit is more than simply the battery cost, it is also the case that the pace and depth of cost declines is simply too great to ignore, let alone to assume that near-term price hurdles will not be overcome in the next two to four years."

Figure 1: Projected Levelized Cost of Energy Storage Decline



Source: ICF International

These price trends are driving applications at the edge of the grid. When comparing this cost decline to similarly plummeting solar PV cost curves, it is apparent why solar and storage are also beginning to be coupled together. One application from this pairing is storage being used for peak load reduction at facilities. However, even more significantly, when combined with solar, the combined system begins to tap into reliability and resiliency benefits as well. The solution is not perfect yet: At this stage of storage development, the reliability application is limited by size of the load rather than by average storage capabilities. The combined system can only handle small, critical loads instead of supplying the entire load of a facility or home for long periods of time. On the other hand, during critical events such as

[1]Data were used from Goldman Sachs report, The Great Battery Race, October 2015 chart showing the "Utility scale LCOS (levelized cost of storage) will storage be above an average generation cost from baseloaded power such as coal or CCGT."

Superstorm Sandy, the solar-storage combination would have been the only system that could have operated and supplied critical loads for multiple days without an operating electricity and gas infrastructure. The combination is therefore on the cusp of demonstrating a real and meaningful resiliency-led business case.

Resiliency Pulls Storage Back from the Edge

"Resiliency" as an emerging application area is not limited to single family homes but has been extended to the larger grid as well. Typically, when storage has been examined from the substation level to the utility edge, the three main benefits center on distribution capital deferral, peak shaving capability, and reliability. The size of the device ranges from 1 to 3 MW and decreases as it gets pushed further to the edge of the grid. However, since Superstorm Sandy and as seen in the chart to the right, resiliency is becoming a more dominant driver for storage applications as long-term outages become more and more common across the United States.

But the growing link to resiliency will have far greater ramifications than just pushing the technology back from the edge of the grid. In this context, storage becomes a reliability tool for the grid itself, changing its classification and allowing the technology to be thought of in terms of additional societal benefits. More critically, under a focus on improving overall reliability and societal benefits, the path to potential rate-basing becomes increasingly justifiable, carving a role for a specific application for utility ownership and operation of storage.

Figure 2: Major Recent Storm-Related Outages

After the storm, the long wait for power

It took utilities in New York and New Jersey nearly weeks to restore power to 95 percent of customers who lost it after Superstorm Sandy. That's among the longest outages since 2004, but restoration was slower after several other storms.

Duration of power outages cased by major hurricanes and tropical storms

YEAR	STORM	STATE	DAYS TO RESTORE POWER TO 95% OF THOSE WHO LOST IT	PEAK OUTAGES IN MILLIONS (AND % OF CUSTOMERS
2005	Katrina	Louisiana	23+*	0.91 (42%)
2005	Rita	Texas	16	0.78 (8%)
2005	Katrina	Mississippi	15	1.00 (70%)
2005	Wilma	Florida	14	3.25 (36%)
2008	Ike	Texas	14	2.47 (23%)
2012	**Sandy**	**New York**	**13**	2.10 (23%)
2012	**Sandy**	**New Jersey**	**11**	2.62 (65%)
2004	Ivan	Florida	10	0.44 (5%)
2012	**Sandy**	**West Virginia**	**10**	0.27 (27%)
2004	Charley	Florida	9	1.60 (18%)
2004	Frances	Florida	8	3.50 (40%)
2004	Ivan	Alabama	8	1.07 (46%)
2011	Irene	New York	7**	0.94 (12%)
2012	**Sandy**	**Pennsylvania**	**6****	1.27 (20%)
2011	Irene	New Jersey	6**	0.81 (18%)
2012	**Sandy**	**Connecticut**	**6****	0.63 (31%)

*Louisiana had restored power to 75 percent of customers after Katrina when Hurricane Rita arrived and knocked out more customers.

**Selected recent outages of less than eight days listed for comparison.

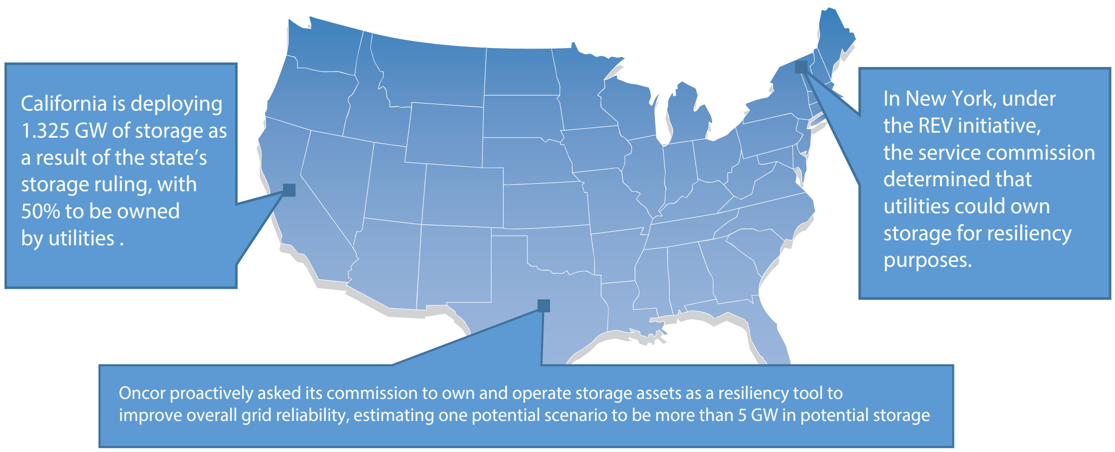
Source: U.S. Department of Energy: Ventyx: AP analysis

Today, though, the questions of optimal location and ownership roles are not being answered by rigorous analysis or the presentation of a business case—at least not in a proactive or widespread way. Rather, we may end up arriving at a de facto answer as innovative applications such as solar and storage systems start to push the technology almost exclusively to the customer side. To be clear, this development is not necessarily bad: Customer-side placement may be optimal for some services. Moreover, all stakeholders should realize that the choice of location and applications of storage it is not a single, binary one. Storage can and probably will be used across the grid for multiple purposes. What is important to recognize are the compelling potential benefits for utility-side placement of storage, including safety, economies of scale, and greater ease of maintenance and dispatch. A real possibility exists for storage to provide reliability and resiliency benefits. Locating the device near the substation or on the feeder may simply be best. These issues are worth exploring proactively and rigorously.

Trends on Resiliency and Potential Utility Ownership

Today, a number of actions in states are aimed at performing assessments to allow the optimal location to be determined for certain storage applications—especially resiliency.

Figure 3: Summary of Activities in Key States



California is allowing utilities to own storage in its attempt to deploy 1.325 GW. Although allowing 50 percent utility ownership to help answer questions on optimum locations is a significant precedent-setting step, it is not yet a policy decision. In Texas, based on the comprehensive reliability benefits offered by storage, Oncor petitioned its commission to allow ownership of those assets. The initiative was bold but also perhaps pushed the needle too far in attempting to have the device perform grid services as well. By contrast, the New York Reforming the Energy Vision (REV) initiative took the ownership question in a slightly different direction. In that case, the New York Public Service Commission (PSC) decided that utilities could own and operate storage if the device was used for resiliency.

It is noteworthy that in Texas, it was the utility that asked the Commission to determine whether they should own and operate storage. In New York, it was the PSC that ruled that utilities, when using the devices for resiliency, could own and operate storage. In New York, utilities that had used traditional metrics such as deferral, peak shaving, and reducing reliability penalties to measure the benefits versus cost of storage can now potentially include the societal benefit of reliability and resiliency as well.

These activities are showing that for resiliency, the issues of the optimum location and ownership now are actively being explored, at least in a preliminary fashion. Though this question may still be unanswered, precedents are beginning to be established. Once established, they typically are difficult to reverse.

Events at the Edge of the Grid

Markets tend not to idle, particularly in an industry where modernization and rapid adoption of emerging technologies are becoming the rule. When Tesla announced its PowerWall product offering, it became apparent that though the industry had not started examining optimum locations, developers were moving forward on deploying systems on the customer side of the meter. Solar + storage combinations were beginning to be developed as well. In fact, in 2014, the Chief Executive Officer for Solar City said, "Every Solar City customer will get a battery backup for their solar systems

within 5 to 10 years."[2] In parallel, middleware offerings started allowing customer-sited storage assets to be aggregated and offered to support the grid. These market forces are being matched by regulators in a numbers of states. These regulators are leading initiatives to enable broad DER interconnection—including customer-side distributed storage. Eventually the systems will interact with the grid in markets across a distribution system platform. These initiatives are gathering their own momentum. Although they do not preclude utility-side storage ownership, they are certainly strengthening the pathway to customer-side placement.

Significant Financial Impacts

Predicting market sizes for storage or any emerging technology always has a level of uncertainty. However, the activities that are being seen in the states listed above provide some insight into the potential size of the resiliency market. Oncor's initial evaluation on the amount of storage necessary to meet its resiliency goals was more than 5 GW valued at $5.2 billion. This level of adoption—and the value of this storage application—is very likely representative, certainly within the same order of magnitude. It could reasonably be extrapolated proportionally to other states (for example, with just a "no regrets" ruling, California is allowing approximately 670 MW of storage to be owned by investor-owned utilities). The bottom line is simply that the market for resiliency is not small. The interest by all stakeholders to respond is understandable. However, once again, though the market size provides motivation for deployment, it is only when all market forces are participating are they able to determine optimal locations or the best ownership structure. Especially in energy markets where regulation plays such a significant role, these questions should ideally be answered by pairing market dynamics with rigorous analysis and demonstration.

The Right Perspective for Action

From a utility perspective, what should an executive do? The broad tendency has typically focused on waiting for a technology to hit a point of acceptable economic viability before moving on initiatives to deploy. In addition, the industry is seeing not only rapid price declines but also new storage technologies being introduced to further enhance the performance characteristics and capabilities of the devices. In the context of such rapid innovation, pausing and waiting for the next iteration of cheaper technology with greater capability is tempting. However, in this case, cost and performance are not the only milestones needed to clear a pathway for deployment. In most states, particularly those with deregulated utilities, parallel activities also must occur. In New York, for example, creating a business case to show the benefits is just one such required step. Examining potential regulatory issues and asset classifications are others. These parallel activities must begin today in order to clear the potential deployment hurdles of tomorrow. If utilities approach these additional necessary actions sequentially by waiting for further price declines in the technology, they will most likely incur too great a delay. The result will be an opportunity lost to fast-moving market forces and those that can operate more nimbly.

Barriers to Utility Ownership

When utilities look to the concept of storage ownership, it is not simply a matter of understanding the value offered. Utilities face regulatory or "stroke of the pen" risk that has, in the past, acted as a barrier to deployment. Hence, conducting the analysis to show a potential optimum location for resiliency is no guarantee of deployment. Moreover, the process of policy formation has an embedded timeline that adds uncertainty and should incentivize all stakeholders to begin actions today.

[2] The Buffalo News, "SolarCity, Tesla, roll out batteries that allow nighttime use of sun's energy," August 9, 2015.

In some states where distribution utilities are not allowed to own generation, steps must be taken to ensure that the device is acting as a resiliency tool and as a core component to increasing reliability. Asset classification of storage traditionally has created grey areas and additional risks. An active debate still exists on whether storage should be its own asset class. The roles to perform for a specific application such as resiliency must be clearly defined to avoid confusion. The price decline of storage should ease this issue. "Bundled" storage applications often have been the root cause of asset ambiguity. However, this bundling was just as much a function of finding a means to combat the initial cost barrier as it was taking advantage of its multiple capabilities. As the price declines, storage will be better able to specialize more in its functionality and alleviate the need to cross over into services that are provided by different asset classes in order to justify investments.

Finally, the trends pushing technologies to the edge of the grid are real and no doubt there is a desire among all policy makers to leverage this trend to modernize and enable a better grid. Anything that may generate a perception of opposite momentum will not lead to favorable decision making. Though storage is being targeted for resiliency, it also must be able to facilitate the use of technologies at the edge of the grid. It must not be seen as competitive with their capabilities or deterring their deployment. Showing that the device and its deployment continue and complement the path to grid modernization is important. In that regard, it is important to note that moving storage away from the very edge of the grid does not actually decouple the relationship between combinations of assets such as solar and storage. The devices do not have to be side by side in order for them to effectively interact. In fact, separating the devices may lead to more elaborate and beneficial coupling of technologies, such as in the concept of "shared resources."[3]

Next Steps

As storage continues along its rapid trajectory toward commercialization, we will see more specialization in applications of the technology, and those applications will find optimum points along the grid. In the case of resiliency and reliability, the jury is out on optimal locations. Several states are taking actions acknowledging that utilities may have a role in using storage to create a more robust grid. However, actions must be taken now to not only examine the opportunity but to also initiate additional changes in policies, tariffs, or classifications that would allow deployment if this approach is deemed the optimal pathway. For utilities that are considering following such a path, the following recommendations on potential next steps are offered:

1. Create the business case for resiliency. This will involve not only conducting the analysis on the optimum location of storage, but also clearly define the application and role of the device.

2. Review the potential to identify storage as a grid asset, a resiliency tool that eliminates the regulatory risk of the device falling into a classification that prevents deployment or suboptimally drives the device to another segment of the grid.

3. Use the capabilities of storage to help meet the goals of grid modernization, increase renewable penetration, and leverage the advances that are occurring on the customer side of the meter.

4. Demonstrate and test the storage system in its defined role. The business case analysis must be backed up with verifiable testing and demonstration to prove the capabilities.

[3] An approach where combined assets can be located on both sides of the meter. For example, with solar + storage, the solar device can be placed on the customer side of the meter while the storage device can be placed on the utility side of the meter The same concept would apply to microgrids where assets can be spread across the utility and customer side of the meter.

icfi.com

About ICF International

ICF International (NASDAQ:ICFI) provides professional services and technology solutions that deliver beneficial impact in areas critical to the world's future. ICF is fluent in the language of change, whether driven by markets, technology, or policy. Since 1969, we have combined a passion for our work with deep industry expertise to tackle our clients' most important challenges. We partner with clients around the globe—advising, executing, innovating—to help them define and achieve success. Our more than 5,000 employees serve government and commercial clients from more than 70 offices worldwide. ICF's website is www.icfi.com.

5. Examine unique models such as shared resources to further define the resiliency application as a component of the grid.

Like regulatory changes, these steps have embedded timelines. For storage, state activities and technology advancements are rapidly converging to make customer-side storage an essential component to modernizing our grids. Utility-side storage through applications such as resiliency could likely have a valuable role in this future as well. However, if delays occur in initiating the set of necessary actions to open this pathway, the point of convergence and the opportunity will likely be missed.

For questions, please contact:

Rick Fioravanti | rick.fioravanti@icfi.com | +1.703.934.3043