White Paper

Energy Storage:
A Delicious, Non-Decadent Tool

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Is Your Energy Storage Project the Bacon or the Caviar of Your Grid?

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Energy storage is a powerful tool that can be used by electric utilities to increase grid flexibility and reliability. Given the increased use and implementation of energy storage, it is also difficult for utilities to ignore.

It seems that nearly every news cycle includes a story on the potential or application of energy storage. What's driving the interest? Cost decreases in the technology, an increasing number of deployments, interest from regulators and compelling thought leadership are all drivers. These stories range in tone from overly optimistic to unrealistically pessimistic. From nearly every fact-based analysis, however, one point is clear: Storage is a versatile asset class poised to change the way energy is generated and consumed. For utilities, the key is knowing whether their application of storage will be the "bacon," one that makes everything better, or the "caviar" — an unnecessary luxury.

Energy storage: The uniquely versatile asset

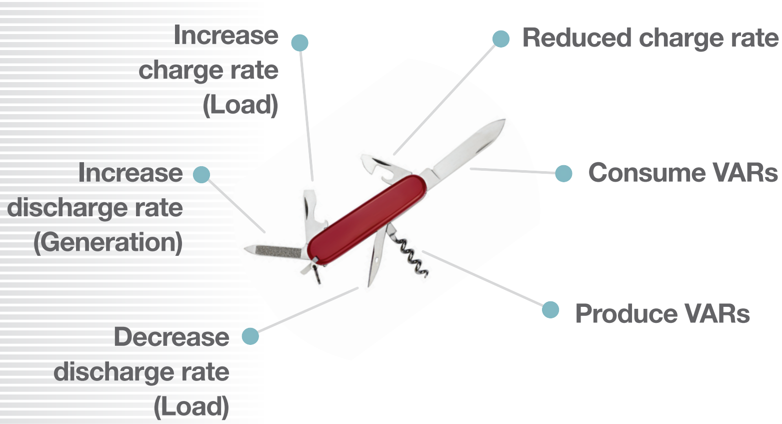
Energy storage is one of the most flexible assets a utility can deploy and one of the few that can look like both load and generation via multiple operating modes. For instance, storage can look like generation by either increasing its discharge or decreasing its charge. When coupled with power electronics, energy storage can also act to source or sink volt-ampere reactive units (VARs). While these attributes are unique, what truly sets energy storage apart as an asset class is the ability to react quickly and precisely to changes in grid conditions from a dead stop.

Energy storage can also be sited flexibly — and nearly anywhere — because of its power density and modularity and because it has no emissions during operation. These features allow storage to fulfill multiple use cases for the distribution utility; it's a timely benefit for capital-strapped utilities that seek to address multiple needs with a single multi-purpose asset.

The challenge for the utility is to cut through the hype about energy storage and the myriad technology to get projects that are prudent. Utilities must have a framework to support evaluation of storage, one that helps them decide if the project is worthwhile and truly adds value to their operations.

Figure 1

Versatility of energy storage technologies — a multi-purpose tool



- Fast-reacting, precise, fully controllable generation or load
- No minimum output
- Rapid deployment
- Limited geographical constraints
- Modular, scalable and portable
- Proven field reliability

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Four Factors for Assessing Storage Projects

In assessing and screening potential storage projects, utilities must consider use case, ownership structure, siting location and control scheme — each are vital and will have a significant impact on a project's ultimate success.

1	Solid Use Case	A good use case has multiple value streams, but 1-2 core applications
2	Right Ownership	Monetizing the value of storage requires the right ownership structure for the asset
3	Great Location	Like investing in real estate, it's about location, location, location
4	Intelligent Control	Controlling small assets on a MW-scale requires controller informed by conditions

Figure 2: Key factors to consider when screening potential energy storage projects

SOLID USE CASE

Energy storage projects require a use case, or a set of objectives against which the storage is dispatched. Typically there are multiple applications that can create value for the project stakeholders. The literature on energy storage is rife with application descriptions; the recent framework developed by the Rocky Mountain Institute (RMI) offers a helpful structuring of the applications with regard to their value (Figure 3, next page).

What's clear from RMI's analysis is that the values, both estimated and observed, for energy storage applications vary widely. The time needed for a simple return on investment of a storage asset performing a single application is exceedingly long, assuming storage is priced in the $1,200–$1,500/kW range. Therefore, it is critical that multiple applications and related value streams be combined, or "stacked," on a single deployment to support the economic case for storage.

SOLID USE CASE
(continued)

Choosing and sizing the battery storage technology is highly dependent on the mix of applications — a critical point not explicitly referenced in the RMI report. A mix of applications that requires both high-power operation (short burst charges or discharges from the battery) and long discharges may increase the cost of a battery system and negatively impact a project's economics. Similarly, storage asset cost can be minimized for use cases in which the battery dispatch profiles are well matched to the set of application requirements in terms of duration and intensity. Therefore, it is crucial to consider the application "stack" when screening a storage project concept to ensure a battery system can be economically designed to meet the demands of the use case.

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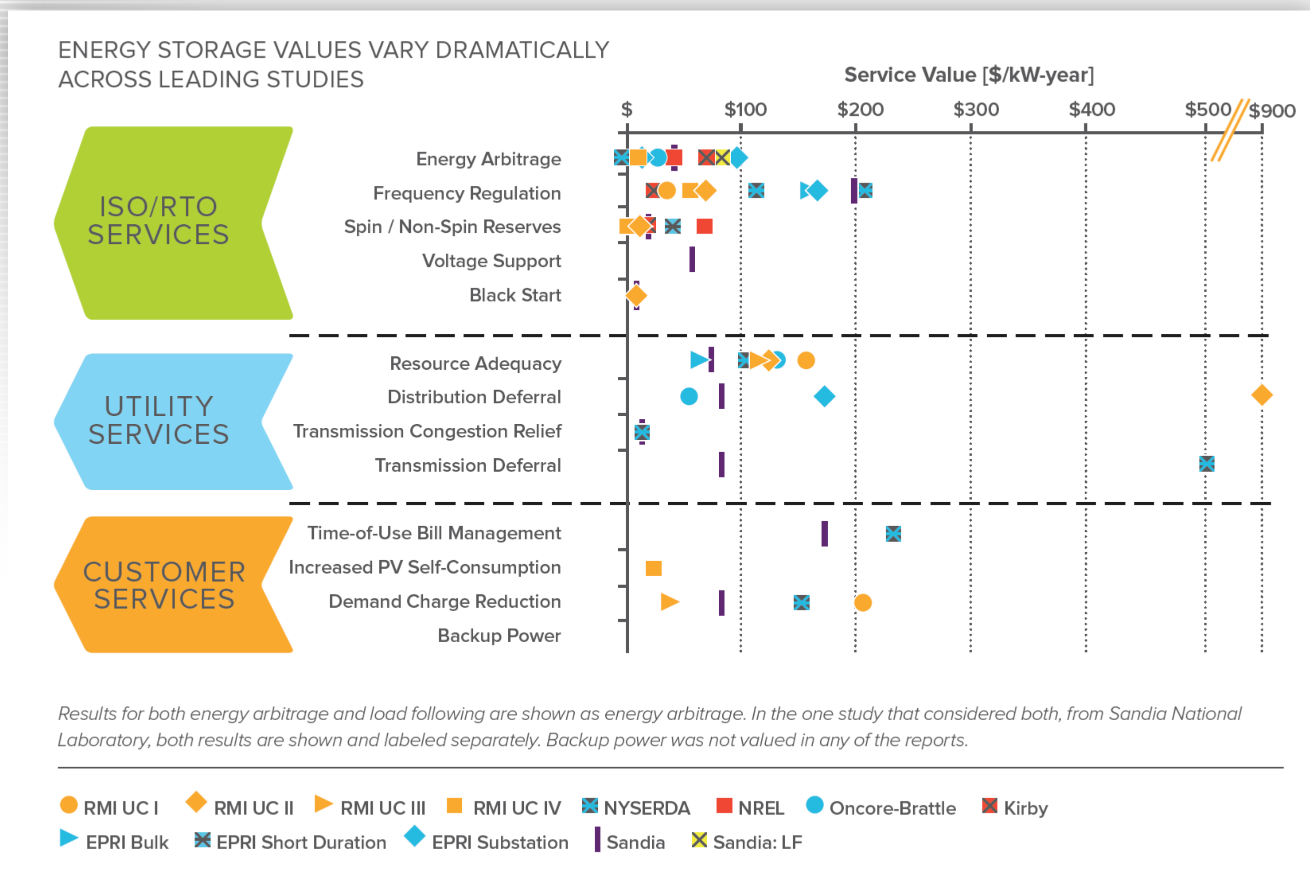

Figure 3: Energy storage applications and associated value ranges. Source: *Ÿ{ bÁR@c•c¦ }@¢Á\ÁÕ~ˆb¸dÁR•b¸| dÁˆc¸~| b,* Rocky Mountain Institute, October 2015.

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In fact, third-party ownership models, where energy storage devices sited at the customer premise serve both end customer and the utility, are already creating new opportunities.

RIGHT OWNERSHIP

The proposed ownership structure is the second critical factor for utilities to consider. As previously stated, multiple applications can be "stacked" to improve the economics of an energy storage project; however, the values that accrue directly to the distribution utility are limited. According to RMI, the classic "poles and wires" distribution utility can only justify an investment in energy storage by taking advantage of the avoided cost streams related to maintaining resource adequacy, deferring transmission and/or distribution upgrades and avoiding transmission congestions charges (Figure 3, previous page). Therefore, standard utility asset ownership models limit application stacking.

We need structures that bridge multiple stakeholders (e.g., utility and end customer or market participant) and monetize the value from end user and/or market facing applications. "Multi-tenant" models, where two stakeholders share a third-party asset, are particularly useful in bridging the gap. In fact, third-party ownership models, where energy storage devices sited at the customer premise serve both end customer and the utility, are already creating new opportunities. For example, Southern California Edison procured over 150 MW of capacity contracts for Commercial and Industrial-sited energy storage as part of its 2014 Local Capacity Requirement, and the municipal utility in Minister, Ohio, deployed a PV-plus-storage project via creative third-party ownership schemes.

GREAT LOCATION

Asset siting, while intimately tied to the storage use case and ownership model, is its own critically important factor in evaluating and preparing for an energy storage project. The analysis by RMI and others suggests that applications which utilize storage spatially closer to load have, on average, greater value than those located nearer to generation (Figure 3). This makes sense, because there is considerable value add in the transmission and distribution of power and energy from centralized power stations and the grid edge. Additionally, assets at the grid edge have the potential to participate in more applications across the utility value stream (Figure 4).

Furthermore, because of load pockets, congestion, aging infrastructure and areas of high penetration PV at the grid edge, the location of storage has a large effect on its value. It is important for the utility to consider the locational value of storage, even down to the location on a feeder, to create a comprehensive assessment of its total value. Fortunately, engaged industry and related stakeholders are driving rapid advancement of analytical tools utility planners and developers can use to determine locational value. The continued growth in grid edge sensors and telemetry solutions are also supporting this improvement.

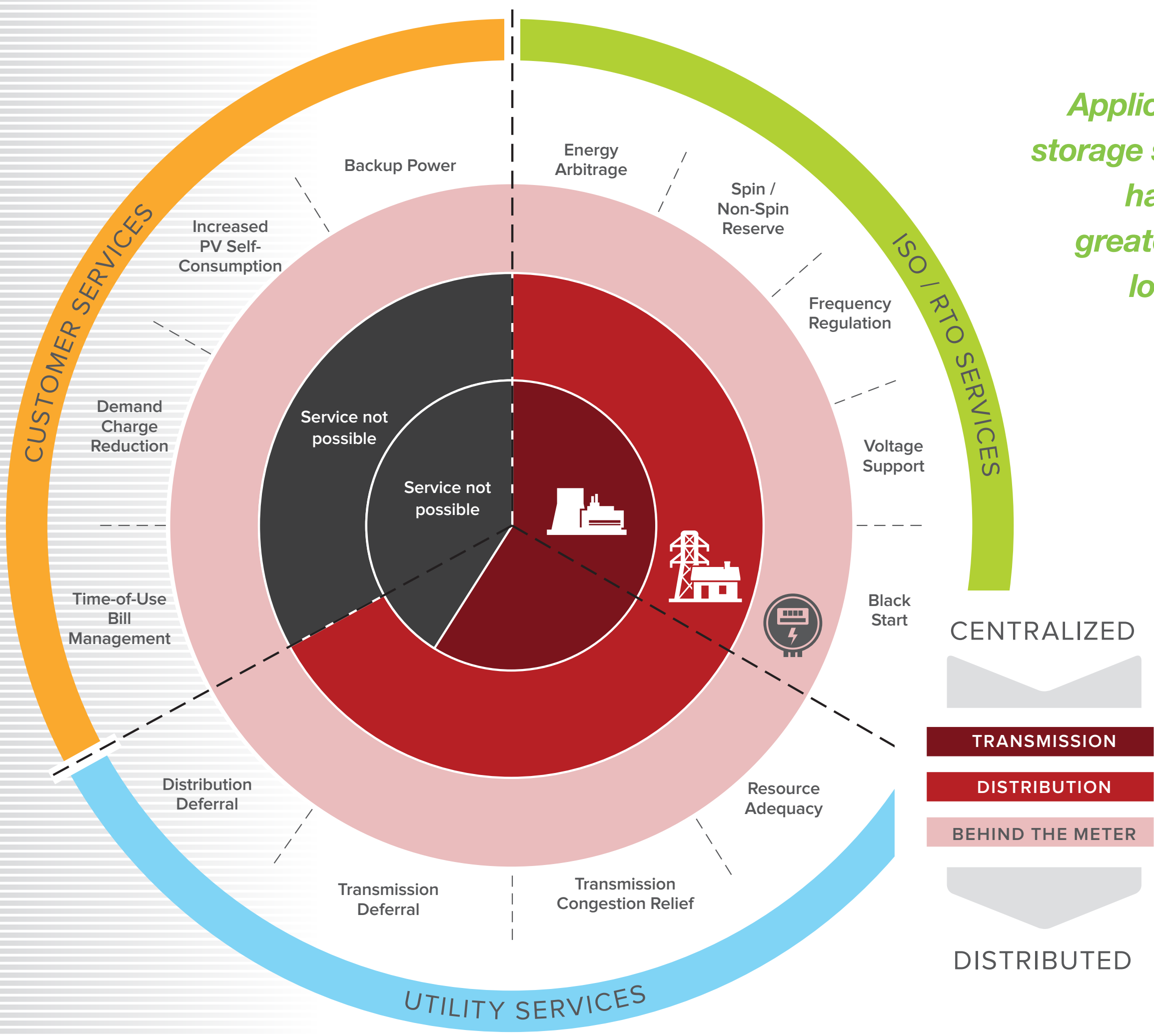

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Figure 4: Locational dependence of participation in the various energy storage applications. Source: Ÿ{ bÁR@c•c¦ }@¢Á c\ÁÕ~ˆˆb¸ dÁR•b¸l dÁ Ý˜c¸~l b, Rocky Mountain Institute, October 2015.

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INTELLIGENT CONTROL

Finally, the means by which storage is controlled during operations determines whether the value assessed during planning and pre-project analysis is achieved in the field. Typically, there are two macro drivers of storage asset underperformance. First, the premature aging of the battery system components, most critically the battery modules, rising from overuse. Second, grid operational schemes, such as distribution system switching states, may limit the ability of the battery to discharge. Both of these can be addressed by asset control schemes.

Today, storage controller vendors attempt to differentiate their solutions based on their built-in algorithms or on simulation capabilities that support the project design phase. While the value assessment occurs during pre-project planning, and is based on these capabilities, the value that is actually realized in implementation may differ because of unexpected changes to grid conditions. An energy storage controller that can react autonomously, and in near real-time, to changes based on knowledge of grid conditions, commonly referred to as situational awareness, can help address this challenge. This entails gathering the appropriate data from a utility's secure, hardened communications networks and the intelligence to use this information to dispatch the battery most efficiently. Grid-aware storage controllers make it possible to capture more value from storage and minimize the system's total cost of ownership. Utilities need to assess storage controllers carefully to ensure the capabilities of this system component can deliver maximum value.

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CONCLUSION

Energy storage is already having a marked impact on the grid and adding to the conversation about the continued modernization of the grid. By cutting through the hype and focusing on use-case development, the right ownership model, siting for value and intelligent storage control systems, utilities can assess storage projects effectively and determine whether a particular idea will be the bacon or the caviar for their grid.