The Role of Energy Storage in Grid Modernization: Updates and Developments

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ABSTRACT

Significant decreases in energy storage technology price points have been a major driver for installations of hybrid energy systems that pair energy storage with renewable technologies such as wind and solar. Levelized cost of electricity dropped from \$800/megawatt-hour in 2013 to \$170/megawatt-hour in 2017. Standardization of energy storage as a commodity is a key factor to moving energy storage forward with the wide deployment similar to solar. While FERC has issued some guidance to support energy storage markets, much of the leadership in developing standardization is coming from regional grid operators. Additionally, innovations in battery technologies may catalyze wider energy storage deployments. While 99% of energy storage deployed in the US is comprised of lithium ion chemistry using cobalt, companies such as Urban Electric Power are innovating on battery chemistry to develop safer alternatives such as the Zinc-MnO2 battery that provides similar or better performance to current lead-acid battery technologies with more flexible use cases.

에너지 저장장치 기술의 가격절감으로 인하여 풍력 태양광과 같은 신재생에너지와 에너지저장장치의 하이브리 드형 설치모델이 가시권에 들어왔다. 2013년 메가와트시 당 800달러였던 가격은 2017년 170달러까지 줄어들 며 가격 절감에 대한 기대를 높이고 있다. 입법/행정적인 측면에서, 태양광 시장이 그러했듯이 에너지 저장장치 의 표준 규격화는 대량 보급에 있어서 가장 핵심적인 요소중 하나이다. FERC가 에너지 저장장치 시장을 지원하 겠다는 몇몇 지원방안을 마련하는 동안, 규격화에 공헌한 대부분의 리더십들은 지역사회의 그리드 산업계에서 나왔다. 이와 같은 사실에 더하여 배터리 기술의 발전 또한 저장장치 보급의 촉매제가 될 것이라 기대되고있다. 미국에 보급되는 99%이상의 에너지 저장장치가 cobalt를 사용하는 lithium ion 형식으로 나아갈 동안, Urban Electric Power와 같은 회사들은 Zinc-Mn02 배터리 형식을 채용해 좀 더 안전한 대안을 개발하고자 하고 있다. 이와 같은 형식의 배터리는 현재 사용되는 lead-acid 스타일의 배터리 기술과 비슷한 성능을 내는 동시에 좀 더 유연하게 사용처를 정할 수 있다는 장점이있다.

SUMMARY

The US power sector, at the wholesale level, is mostly served by RTOs and ISOs, which comprise two thirds of the US electricity market. Order 841 only applies to equal access to storage in regulated markets under FERC. It does not address issues such as utility vs distribution at a private level or state mandated procurements. FERC's Order 841 requires RTOs to grant equal access to their wholesale markets to storage resources. 841 standardized the open access to the market for storage. It was focused on the distributed types of storage like Tesla PowerWalls or standalone storage batteries that can be grid connected. Order 841 did not change day-to-day operations for most RTOs on average, as groundwork had already been laid with progress being seen.

• One of the major drivers of hybrid renewable systems have been requests from utilities or municipalities, using RFPs, and these RFPs are outside the jurisdiction of FERC and FERC's Order 841, which orders RTOs to grant equal access to storage resources.

- Many of the RTOs are undertaking their own stakeholder discussions to standardize roles within the RTOs. California has their own RTO, and is very far along in hybrid energy systems using storage. There is much discussion in PJM right now on how to model values to forecast revenue.
- FERC announced that they will hold a technical conference on hybrid technologies to learn more about hybrid resources. It remains to be seen whether there will be a rulemaking regarding this in the future, but there will be a technical conference.
- If the analogy is made to sports, then currently, the US is in the second quarter approaching halftime, suggesting that there is still much more legislation and development in the field of energy storage, hybrid energies, and electricity markets.

Urban Electric Power initially started to tackle the issues around urban energy use, specifically grid congestion. Within that context, there are limitations on what kinds of energy storage can be sited inside buildings within the city. The zinc anode battery was the technology that Urban Electric Power used as their technology for wide deployment in varying siting situations. This battery is safe, less toxic, and provides stable power for long periods of time in urban environments.

- The Zinc anode battery was initially developed with support from ARPA-E, and this support was crucial to bringing this technology from R&D. The technology developed over time and the company used a Zinc-Magnesium Oxide battery that can be used for large scale storage resources at a low-cost using earth abundant materials and materials well established supply chains.
- Urban Electric Power partnered with an Indian company that identified zinc batteries being a good solution for home backup solutions. While Urban Electric Power was looking to the utility scale market, this experience opened up the company's horizons to residential battery technologies.
- The company has had interactions and collaborations with resources of National Labs such as Sandia to help them develop and demonstrate the technology. Urban Electric Power has had project deployments in New Mexico and New York with the intention of finding a market where the zinc battery is the best fit.
- Lithium and lead acid are matured technologies, so there are companies that exclusively make separators for lithium technologies. Urban Electric Power does not have this luxury. Lead battery technologies can be utilized with heavy modification, and lithium technologies are not compatible because of the voltage difference. This makes it difficult for novel chemistry storage technologies to enter the market.
- Customers with solar are less interested in energy storage capabilities with the new zinc batteries, but they are interested in the backup power. Urban Electric Power has used this to market this technology as a long-term backup power option when the power system goes down.

QUESTION & ANSWER

Q: Batteries were the entire discussion. What about other storage technologies, such as pumped storage hydro or compressed air energy storage models? How is the market addressing these? **A:** What 841 addresses specifically storage types that can be electrically connected to the grid. Thermal storage is the only type of storage technology not addressed under FERC's new Order 841. If it can be electrically connected to the grid, it's covered under this order. Compressed air would be covered under this order. Pumped storage is the largest storage resource in certain areas. Rules have existed prior to Order 841 that affect pumped storage. Order 841 focuses on grid connected storage resources.

A: There is a first approval for permitting pumped hydro in Montana using the same overall market drivers we have been talking about. We have seen innovations in single turbine technology that allows response times to meet current needs. Previous versions of this technology didn't have this capability.

Q: Safety issues in Korea were very serious due to several accidents that occurred last year. It is still an issue with no concrete solutions. How is the safety issue of ESS in the US in terms of public acceptance?

A: It's still a major concern in the US. It's another vulcanized situation with the fire protection standards across the country. The general guidelines are around National Fire Protection rules, but it doesn't address the inherent risks of lithium. It just addresses how to address the problem once the situation has risen. Zinc batteries are an improvement because it provides the same power as a lead-acid battery without the dangers. The industry has not caught up from an industry perspective. LFP is another safer battery type, but it doesn't have the power capabilities of lithium ion. This issue seems to be a largely under addressed issue in the industry. **A:** The fire suppression technologies around lithium ion are accepted as a unit price, but they add a lot of cost and risk. They also affect deployment opportunities. These safety regulations can also be specific to municipalities and smaller jurisdictions so there's no effort to create national standards. A lot of the growth in this space has been grid connected, so we've pushed some issues off because deployments are happening in fields rather than urban dense environments. As we move to a more distributed chemical energy storage, those issues will become more critical as a barrier.

Q: You mentioned the FERC technical conference on hybrid technologies. You also mentioned most of these technologies are deployed in a hybrid arrangement, using storage plus wind or storage plus solar. Are there any other discussions going on at the federal level regarding hybrid technologies?

A: I think at the federal level, there have been discussions that haven't specifically addressed hybrid technologies, but there are some discussions that may benefit hybrid technologies. I haven't seen too much of that, however, as that's been a bit outside of my area. I believe at the end of 2019, there were discussions about tax credits for energy storage. I don't believe that materialized given how COVID shut down a lot of discussions. In terms of exactly where these tax credits and legislation stands on energy storage, I'm not sure.

Q: How does the Zn-MnO2 battery capacity compare with lead acid batteries and cost of production?

A: It compares favorably. As far as a capacity perspective, we're roughly in the 50 watt hours per kilogram mark. The battery capacity is dependent on the use case. We have done UPS demonstrations where we showed 3 times the capacity to do the same job. Anywhere lead-acid batteries are being used, we're a better choice from a capacity perspective. From a cost perspective, it's similar. Our cost of production is at or below \$100/kilowatt-hour. We see the battery today as a great substitute for lead-acid both cost and performance wise.

Q: How do you see the broader picture of energy storage being affected by the new energy demand in a COVID-19 quarantined world?

A: From our perspective, flexibility and agility is key. We were able to transform our manufacturing line to produce hand sanitizer to keep the business running and help local communities and first responders. There is a need to think and react quickly to new needs that may arise. People will be working from home more, so having a home backup power is probably going to be something people think about more. Data center support and telecom support would also be a significant opportunity.

A: I think it will be very interesting in terms of its impact, looking at the storage market in the US. If people are working from home for elongated periods of time, even after COVID vaccines are created its unclear as to whether people will return quickly to pre-COVID. There are a lot of uncertainties.

A: The uncertainty does play a key role in chemical energy storage. The ability to quickly deploy energy storage rather than needing to reconfigure grids could add benefit during uncertainty.