C O M M E N T

Weighting the Risks and Benefits of Energy Storage on Fleet Emissions: Academics vs. Fundamentals

by John Fernandes

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I. Introduction

In their paper, *Managing the Future of the Electricity Grid: Energy Storage and Greenhouse Gas Emissions*, Richard L. Revesz and Burcin Unel of New York University School of Law (NYU team or authors) highlight a critical (and often times contentious) issue that the energy industry is attempting to address: how to quantify and incorporate a societal value of decreased greenhouse gas (GHG) emissions into the dollar value of incremental energy that is provided to the electric system. The NYU team has appropriately noted that this discussion becomes more complex when one considers the ability of energy storage to withdraw energy in real time to be injected when it can be better utilized later. This capability has the potential to change the way "marginal" energy is defined.

II. Concurrence

Beginning with issues currently at the core of effective energy storage enablement, the NYU team adequately summarized existing market barriers and the lack of full valuation of all of the technical capabilities of energy storage. Fortunately, as also noted by the authors, the industry is actively overcoming these roadblocks. The Federal Energy Regulatory Commission's (FERC's) recent Policy Statement and Orders 841 and 845 offer clarity on critical components such as cost recovery for project execution and effectively create a unique asset class for energy storage. And with so many states now pursuing storage policy development or active project deployment, jurisdictional lines may become less of a hurdle for more complex systems offering any combination of retail, distributed, and bulk system benefits. Central to the authors' message, I fully agree with the recommendation that externalities related to GHG emissions should be internalized and that markets should value all of the benefits that energy storage can provide.

I must also commend the NYU team on their attention to resources that are "on the margin" during real time operating hours. Up until recently, many discussions on energy and associated environmental issues focused bluntly on "clean" and the "peak," with neither term objectively defined. Stakeholders are now appropriately recognizing the relevance of marginal resources across an operating day and how capturing electrons from these resources during specific hours can dramatically change the cumulative emissions from the fleet.

I note the inclusion of losses or round-trip efficiency of storage as a limiting factor in the contribution that storage can make to the grid, be it in terms of price savings, capacity factor, or environmental benefits. The efficiencies of specific storage technologies weigh heavily in any investment decision. It would be sound practice to take losses into consideration when establishing the parameters for policies that leverage storage to accomplish a societal objective.

Finally, I applaud the authors pointing out the shortcomings of New Source Review standards and how the standards could be updated to reflect the probable impact of any advanced technology coming to the market. It appears the authors have identified a standing potential flaw of the standards, and if this flaw may be exacerbated by the capabilities of storage, it is worthy of greater scrutiny.

III. Questions

Most of my questions are targeted towards theories that, while philosophically reasonable, may not precisely reflect what I believe are the operational realities occurring in most U.S. energy markets.

A. *Storage + Renewables*

First, the NYU team opens their position by stating that standard policy assumes that storage is "necessary" for the integration of renewable resources. I believe that policy supported by much of the storage industry never strongly reflected this sentiment, or at least has moved past it.

The authors cite a storage mandate adopted in 2013 in Puerto Rico as an indiscriminate policy to incentivize storage that did not consider potential risks, but I offer that this mandate was technically sound, reflecting technical needs. Energy storage is an ideal resource to mitigate the grid impacts of high penetrations of intermittent resources in an isolated area while also providing parallel benefits such as the ability to shift output. I also enforce that island grids are highly unique, and while policies like those adopted in Puerto Rico should lead to productive discourse, these policies should not form the basis of any other storage directive without parallel system dynamics.

I will not necessarily argue that there may exist storage policies that bluntly encourage storage + renewables, and I do agree that policy should be precise, with clear objectives and metrics for success. When storage is being supported for the socially-conscious goal of sustainability, "why and how" should be the solution-focused questions.

B. Arbitrage

Under several scenarios, the NYU team focuses on energy arbitrage. First, the team has set the assumption that, without storage, the lone factor limiting the output of legacy fossil generators is demand. To the best of my understanding, emissions and air quality standards would cap the production from these facilities even in a condition of unlimited load. To simply assume that technical/physical mitigation measures render these restrictions moot without impacting the operating costs of the plant would be incorrect. I would be interested to see how environmental constraints could alter the authors' assumption.

The team then cautions that legacy fossil generators (coal, specifically) will be incentivized via the use of storage to increase their output during off-peak hours and store the power, to be injected later. While theoretically reasonable, this assertion grossly misrepresents the value of energy arbitrage in the market. Arbitrage as a standalone application, especially for the size storage system that would be required for such an application, is not a viable business model, even for zero-variable-cost wind, in any energy market in the United States (save for perhaps isolated pricing nodes with extreme price volatility). The economic realities of market prices probably make this scenario theoretical only and should not preclude the integration of storage into any market.

I believe this market fundamental can also be applied to the notion that the owners of coal facilities would be able to "buy and burn" as much coal as they are obliged. Some coal facilities are already "dumping" electrons into the market, acting as a price-taker and exacerbating negative pricing. So far, it has not proven economic or a sound long-term strategy to pair a coal plant with storage and attempt to capture an arbitrage value.

Not necessarily arbitrage in its purest form, but still considering pricing during certain periods of an operating day, the NYU team goes on to describe how an increase in off-peak prices will increase wind investment, but a decrease in peak prices will decrease solar investment, thereby increasing fossil investment. To start, this is in part a reasonable academic premise. I could also envision an actual scenario where an investment in solar + storage shifts a peak to later intervals in the day, perhaps increasing prices during those "new peak" periods.

However, I am unable to conceive a scenario where peak prices come down to a point where solar investment is no longer economic but fossil investment is. If a localized pricing signal is not strong enough to get one more increment of solar in the ground, I cannot imagine the economics justifying, as an alternative, the construction of a fossil fuel plant. Perhaps such a scenario needs to move away from the consideration of "the peak" and more towards baseload capacity needs . , . hence, again, highlighting the importance of clearly defining such system conditions.

C. Market Manipulation

Finally, recognizing a potential personal bias as ex-FERC staff, I find the scenario where a generator can leverage market power to maximize profits of nominal relevance to this paper. People and processes are in place to ensure that energy markets function in a fair and transparent manner. I would not be naïve enough to say that there are no bad actors in the industry that would manipulate markets for personal gain; such considerations always have to be made when creating policy. However, to imply that energy storage puts the market at greater risk for such activities may be unreasonable and distract from more unique but tangible risks to consider with the integration of advanced technologies.

IV. Other Considerations

A. The Broader Issue

I strongly support the perpetuation of the discourse over the valuation of carbon. Carbon and its impacts on public health is a matter that touches so many facets of human existence across the globe. As the NYU team has pointed out, though, this breadth of complexity makes carbon a substantial issue to tackle across regulatory lines. I struggle to decide the pathway to impactful policy: top-down or bottom-up.

I was at first skeptical to targeting bottom-up discussions starting with energy storage and carbon policy, fearing this intersection would be too niche to establish practices that could be built upon to reflect more broad energy objectives. However, this direction could streamline and focus the discussions, and starting with a technology as complex as storage may facilitate the review of more general applications later. Starting with state policy offers another benefit: the role of FERC is not market design; it is to ensure that rules are just and reasonable. States may have more leeway in creating unique platforms.

B. Storage + Fossil (yes . . . fossil)

While I'm sure it is anomalous to bring up the benefits of advanced fossil technology in a discussion of decreased emission and environmental sustainability, I do not find the two to be mutually exclusive. Natural gas is a substantial and still-growing part of the generation resource mix in the United States. If the real objective is cleaner air, environmental interests would be better served by improving the efficient utilization of fossil assets instead of attempting to find ways to marginalize them on an expedited timeline.

To explain by way of example: a major challenge in regions with high penetration of wind generation is lack of ramp: in this instance, the ability to meet unexpected deviations from forecasts of wind output and load. Depending on the "services" utilized by an organized market or incumbent Balancing Authority (BA), there appears to be a ten to thirty-minute window where actions to mitigate this market condition can result in uplift costs to ratepayers, or the BA could build redundancies into the operation of the fleet. While also costly, such redundancies may include operating fossil resources at sub-optimal heat rates or, in order to have the needed response time, when not even necessary at all.

Amongst the multiple flaws of such measures is increased emissions. While standalone, grid-connected storage could provide ramping service, it so far has not been an economic driver strictly in terms of price, and standalone storage provides no on-site benefit to the fossil plant. Storage paired with new, efficient fossil generation, though, will allow the modern fleet to run at the ideal heat rate while taking unnecessary "spin" off the system, perhaps even allowing legacy units to finally retire. So, perhaps energy storage supplementing fossil generation is not such a bad thing in all instances.

V. Conclusion

This was a highly successful academic exercise. While I caution relying too heavily on certain theories and instead point to actual system and market fundamentals, the considerations, questions, and cautions raised by the NYU team will help policymakers avoid practices that invoke untended consequences that would be counter to the desired outcomes of sustainable energy policy. There is a risk that, by overstating the risk, one may create unnecessary barriers to economic and environmentally sound storage deployment. While the authors have aptly recognized the potential burden of robust studies for project deployment, I still support the notion. Careful, system-level modeling is a sound means by which to ensure project deployments are compatible with clearly defined policy objectives.