ELECTRICITY STORAGE : A TECHNOLOGY WHOSE TIME HAS COME?

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Overview

Grid-scale electricity storage capacity has begun to expand in recent years as its costs decline and as various state policies have supported storage expansion in conjunction with renewable energy. Further storage cost reductions and continued expansion of variable renewable generation will likely lead to expanded storage deployment. In this study, we make projections of future storage capacity under different storage technology advancements and gas market conditions. We also analyze how storage interacts with other capacity and generation, such as coal, gas, nuclear and renewable sources.

We use an enhanced version of the National Energy Modeling System (NEMS) called NEMS-REStorePlus to project the future capacity and generation mix. Through an hourly dispatch, REStorePlus provides the temporal resolution required to assess the arbitrage value of storage and variable renewable generation that has considerable differences in availability throughout a day and season. At the same time, NEMS-REStorePlus is a integrated U.S. energy model where energy prices and electricity demands are consistently projected. Thus the feedbacks of changing generation patterns and energy prices can be assessed.

Methods

NEMS-ReStore combines an houry dispatch model, REStorePlus, with the version of NEMS used in EIA's Annual Energy Outlook (AEO) 2018[1]. REStorePlus regionally computes the optimal operation of storage and the revenues it receives, variable renewable generation and curtailments, and hydroelectric generation. In NEMS-REStorePlus, the capacity available of all technology types and their marginal prices are provided by the Electricity Market Model (EMM) of NEMS. The EMM projects new utility-scale storage capacity additions using the arbitrage value provided by REStorePlus and the rest of the electricity system conditions (demands and prices) in the EMM.

For this study, we investigate the interaction between storage cost and natural gas prices through a set of cases with alternative costs and performance characterizations for storage and alternative natural gas supply assumptions. The potential for continued low natural gas prices driven by expanding supplies will influence the competition between storage and natural gas generation. In addition, the relative advantage of investing in storage can be examined across the substantial regional variation in mix of existing generating capacity (coal, nuclear, renewable, etc.). The gas supply cases provide an indication of how sensitive storage deployment and changes in natural gas generation and consumption are to natural gas prices. The full suite of cases illustrate where storage is most likely to be deployed and how its deployment will impact the mix of generation under the alternative gas market conditions.

Results

Expansion of utility-scale electric storage depends on storage technology advancement as well as future natural gas prices. The value of storage stems from both arbitrage and contributions to meeting capacity reserve requirements. Higher natural gas prices increase arbitrage revenue and thus lead to greater storage capacity investment. The adoption of storage varies regionally due to differences in historical generation assets as well as additions of variable renewable generation.

Conclusions

Electricity storage has the potential to become a significant player in the electric power grid. The NEMS-REStorePlus model provides a unique platform for assessing its interactions with other elements of the U.S. electricity and energy markets under a wide range of conditions.

[1] See http://www.eia.gov/forecasts/aeo/.