Evaluating Energy Storage to Enhance the Value of Offshore Wind:
Modeling Approaches

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As Massachusetts prepares for up to 1600 MW of offshore wind by the mid-2020s and as energy storage technology advances and costs decline, the opportunity to enhance the value of the offshore wind energy with storage becomes interesting for wind project developers, ISO New England grid operators and utility ratepayers, and state renewable and climate policymakers. UMass has efforts underway to assess large-scale energy storage technologies and model the integration of storage with offshore wind generation and the ISO-NE grid.

One effort, presented fully in an OSES Conference paper, provides an Excel based, Visual Basic (VBA) model that examines the integration of offshore wind and storage within an electric grid system comprised of fleets of multiple conventional generators and intermittent solar PV. The hourly simulation model has been used to analyze the opportunity for increasing amounts of offshore wind, with and without storage, to displace conventional generation and fuels. The model includes a solar PV module to consider scenarios of high renewable energy penetration and the interaction on grid fuel displacement with solar, offshore wind, and storage.

A second modeling effort uses system dynamic modeling to analyze the value proposition for energy storage integrated with the day ahead and real time energy pricing, capacity markets, and impacts on marginal prices and carbon emissions of the wholesale grid market. The hourly simulation will enable energy market bid strategies and storage control strategies to analyze the economic value of storage to project owners and ratepayers. Analyses will consider a range of projections for ISO-NE system supply curves and emission factors, and bulk storage technologies applicable for the 2025-2030 timeframe.

A schematic sketch of the system dynamic model is here. The research is currently focused on building the model with a characteristic set of parameters, variables, and equations that describe the relationships between system components. The research will then develop a database of model inputs representative of alternative future conditions for the offshore wind, storage, and energy markets. Following, analytical methods will be applied to chart out and evaluate a set of results under reasonable scenarios and sensitivities. The research findings will be used to offer observations and recommendations to the market and policymakers, and identify areas for further work.