Evaluating Energy Storage to Enhance the Value of Offshore Wind to the ISO-NE Grid – A System Dynamic Modeling Approach

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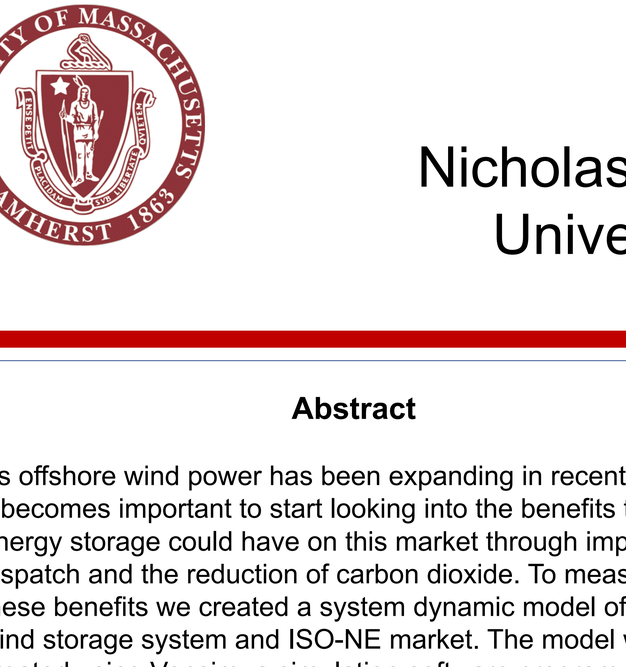
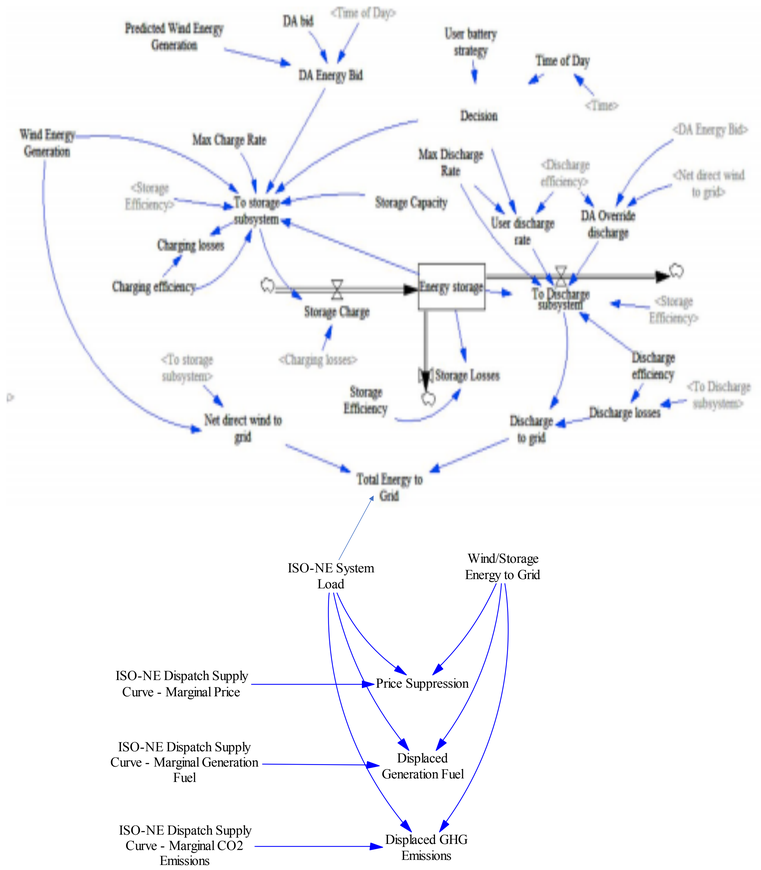
Abstract

As offshore wind power has been expanding in recent years, it becomes important to start looking into the benefits that energy storage could have on this market through improved dispatch and the reduction of carbon dioxide. To measure these benefits we created a system dynamic model of the wind storage system and ISO-NE market. The model was created using Vensim, a simulation software program, and outlines all the factors that would go into a wind storage power generation system and owner strategies to sell into the ISO-NE energy market. Our model is made to be easily altered so users can plug in their own parameters. Our base model is based off of the potential 1600 MW's of wind power that could be put in off the Cape. The model is made to evaluate under what conditions adding storage makes financial sense. We looked at the ISO New England system, and in specific the SEMASS (South Eastern Mass) region, for the incorporation of our wind power model. This is important because in 2016 the state passed a bill committing to long term offshore wind contracts of 1600 Megawatts that would most likely be interconnected to the grid along Southeastern Mass.





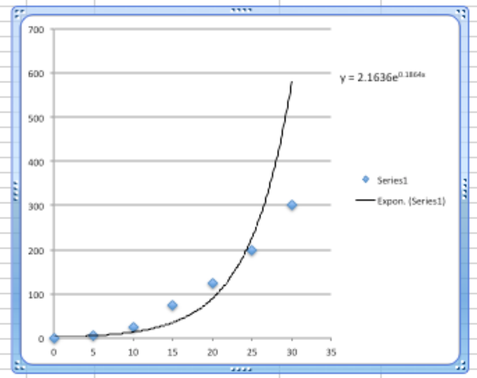
Future Research

During a few days in July we were invited to the Offshore Energy and Storage Conference at Woods Hole Cape Cod. At the conference we met others who were working on offshore storage and made some connections that could be useful in the future. What the OSES conference really showed was that we weren't working in isolation and had other groups to contact if we ever needed help. As for the model, Prasanna is planning to continue to develop the and execute an analytical study of the system as his masters thesis in Mechanical and Industrial Engineering.

Background/Description

My portion of this project was to create Excel data sheets that were called as inputs to the Vensim model. This ranged from organizing data we found on wind speed and prices, , to researching electric generation dispatch in New England and using Excel to derive equations of dispatch supply curves based on user input. The model, currently being tested, simulates test runs, will provide useful analyses to decide whether storing energy is cost effective and also when users should charge or discharge their battery. Along with this I also did a bit of the Vensim coding and helped research and find data to implement into the model.

System Capacity	Price	Emissions	Dispatch Order	Vensim Input	
Capacity (GW)	$ Per MWh	CO2 Emmisions (Lbs per GWh)	Fuel Type	Column2	Column1
0	1	0	Renewables	Coeficient	2.163566847
5	5	3	Nuclear	Exponenant	0.186418173
10	25	8	Hydro		
15	75	11	Natural gas		
20	125	15	Coal		
25	200	19	Combustion Cycle		
30	300	25	Oil		



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