Integration of Marine Renewable Energy into Electric Power Grids and Value Proposition Development of Economics and Resilience

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Introduction

Ocean covers 68.5 % of earths surface. With increase in worldwide energy demand, the energy industry cannot continue sourcing energy from fossil fuels over a long term. Climate change, and possible future exhaustion of fossil fuel supplies have resulted in energy production from renewable sources. The Marine Renewable Energy (MRE) has been considered as one of the alternative for clean energy source. This include offshore wind, tides, ocean currents, waves, thermal differences, salinity gradients, and biomass. The technical Hydrokinetic resource potential in the US has been observed to be 898-1229 TWh/year for wave energy, 45-163 TWh/year for Ocean currents, 576 TWh/year or Ocean thermal energy and 222-334 TWh/year for Tidal streams [1]. Assuming the fact that 50% of the US population lives within 50 miles of coastline in the US, harnessing the Ocean energy using Marine and Hydrokinetic (MHK) technologies to produce electricity can provide clean , renewable electricity to communities and cities [1].

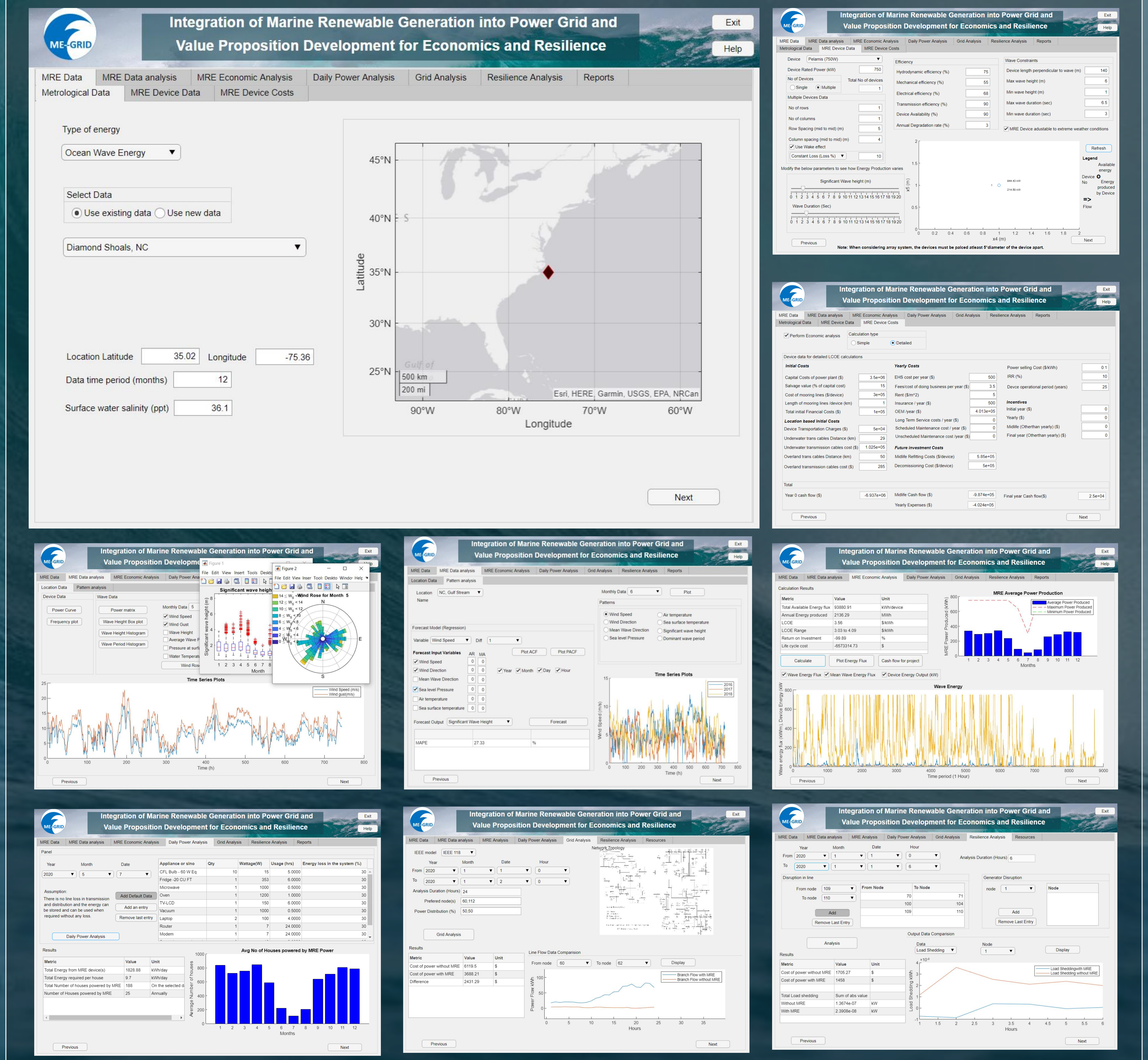
Purpose

The objective of this project is to develop the value proposition of MRE in power grid integration in terms of energy economics and resilience. Systematic models and approaches using data analytics and optimization are developed to investigate the value of MRE to grid economics and resilience. An open-source tool (ME-Grid) is designed and will be made publicly available to the community for research and teaching.

Methodology

- Data analytical model to quantify the uncertainty and variability of MRE.
- Stochastic optimization model for optimal scheduling and economic dispatch of the power grid with MRE to minimize total operation cost and enhance the power grid resilience.
- Optimal planning model for MRE interconnection and cost-benefit analysis.
- Open-source toolbox for conducting studies on evaluation of MRE’s contribution to the economics and resilience of the power grid.
- Outreach to K-12 schools and community colleges.

ME-Grid software tool



GitHub link Tool available after Jul 2021

Analysis and Conclusions

The software tool will be an open-source and public accessible through GitHub. For the analysis, the metrological data from NOAA Buoy[2] will been used. Time series analysis and data analytics of metrological data, available energy flux for MRE power generation, levelized cost of energy (LCOE) analysis, life-cycle cost-benefit analysis, average number of houses than can be powered by MRE devices, effect of MRE on the economics of power grid operation, and analysis on the impact of MRE generation to reduce load shedding and enhance resilience during extreme events, can be performed using the ME-Grid tool. The results calculated by ME-Grid will be shown and visualized in the form of plots.

References

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2. US DOC/NOAA/NWS/NDBC > National Data Buoy Center (1971). Meteorological and oceanographic data collected from the National Data Buoy Center Coastal-Marine Automated Network (C-MAN) and moored (weather) buoys. NOAA National Centers for Environmental Information. Dataset. https://www.ndbc.noaa.gov/station_history.php?station=41025 Accessed [09/25/2020].

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