

# A mathematical model for the optimal design and network integration of an offshore wind farm in New Jersey

Ryan Weightman, Dr. Benedetto Piccoli

## Intro

There exists a growing excitement at the prospect of offshore wind providing the state of New Jersey as much as 11 gigawatts of energy by 2040. However, renewable resources provide inherent and novel hurdles when being tied to an existing power grid. With our model, we hope to highlight and study these hurdles to provide insight to decision makers in the energy sector.

## Methods

1. Conduct a literature review and parameter search to describe the existing energy landscape.
2. **Model New Jersey's Power grid:** This will allow us to tune data and ensure our parameter estimations are accurate by comparing results to real data from 2023 and previous years.
3. **Incorporate offshore wind energy:** Traditional long term electrical power system models are designed to model the dispatch of energy from a dispatchable plant. Future models must incorporate large portions of varying and inflexible generation.

## Results

Currently New Jersey has two key characteristics that will be strongly affected by the influx of wind energy.

- First, we consume about 15% more energy than we produce, meaning the interstate flow of electricity will be significantly changed when we have a surplus rather than a deficit.
- Second, the estimated offshore wind energy will be as much as 30% of the energy produced sometimes and as little as none during extreme weather conditions. This suggests mitigation like increased battery storage or more complex interstate flow of electricity is necessary.

## Discussion

After extensive literature review and data search, an energy forecast model on the timescale of days is unique and will hopefully provide valuable insight to how NJ will look when offshore wind is engaged in the power system.



New Jersey current energy producers	MW Capacity	Estimated Production Yearly	Real Production Yearly	Observed Capacity Factor
Nuclear	3458	28.77m	26.7m	.88
Natural Gas	10708	53.46m	30.6m	.33
Petroleum	226	1.58m	66.6k	.03
Renewables	517.45	1.50m	1.3m	.29

By parameterizing our model using data ranging from PJM provided load data to power production data provided by the Energy Information Administration, we hope to be able to model the future power grid of the state of New Jersey

