



2024 CU Boulder Collegiate Wind Competition Team

Project Development

dc DESIGN CENTER
COLORADO

COLLEGIATE
WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

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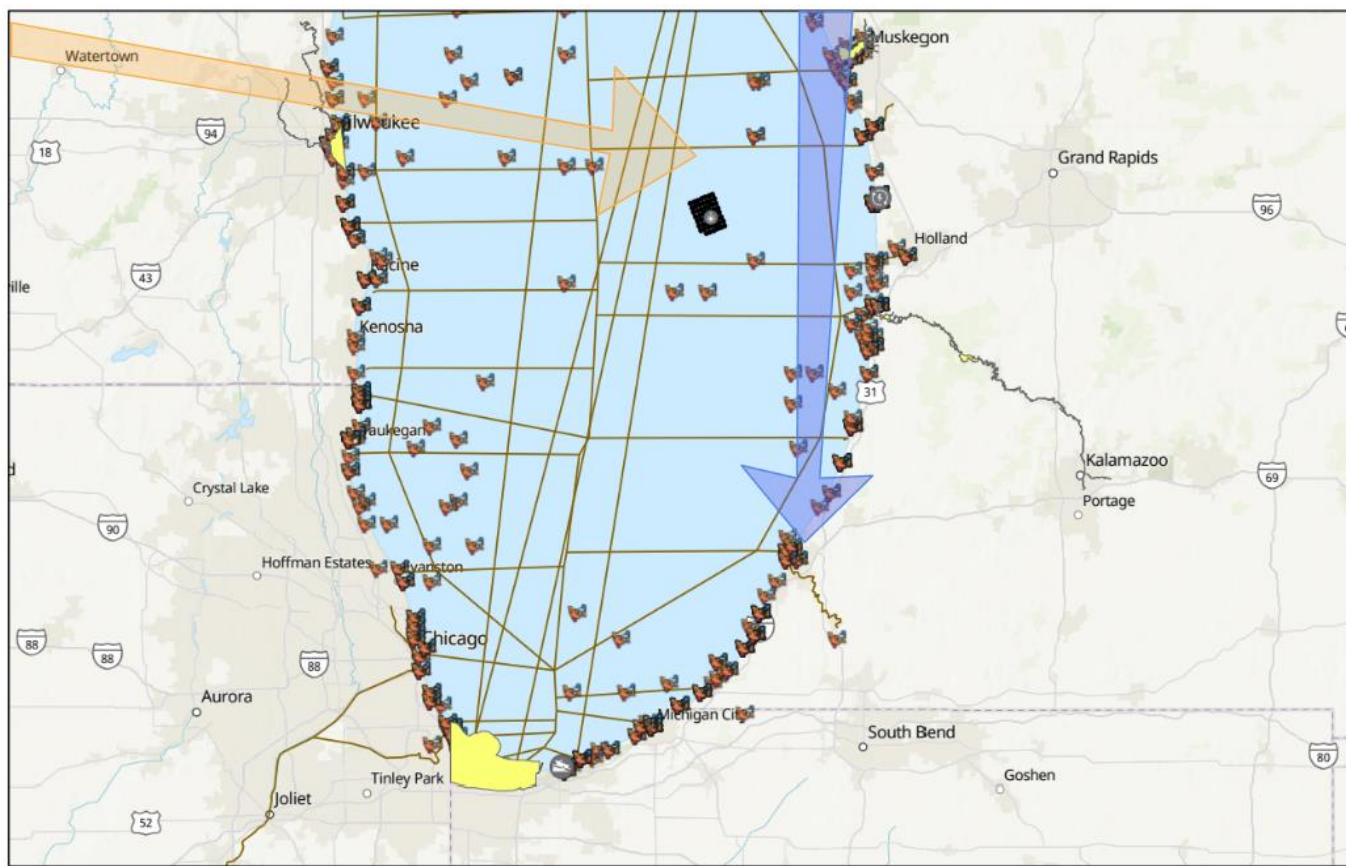
Competition Overview

The 2024 Collegiate Wind Competition, Project Development Challenge, is to design an offshore wind farm with a hybrid storage or generation component in either Lake Michigan or Superior. The natural resources, stakeholders, and ancillary benefits must be accounted for alongside a 20-year financial model.



Environmental Considerations

Site Environmental Obstructions



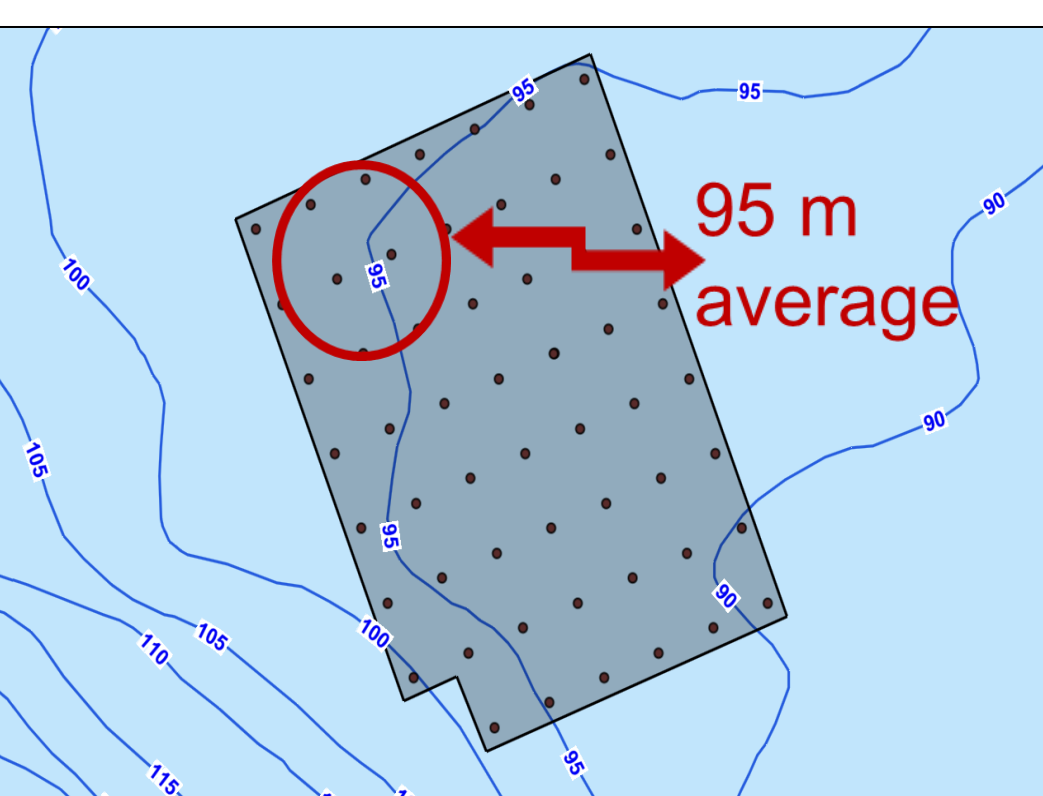
- Fishing zones
- Shipping lanes
- Military zones
- Environmentally protected areas

Permitting

- Federal
 - EPA, NEPA, FAA, DOT, FEMA, etc.
- State
 - Michigan Dept of EGLE, etc.
- Local

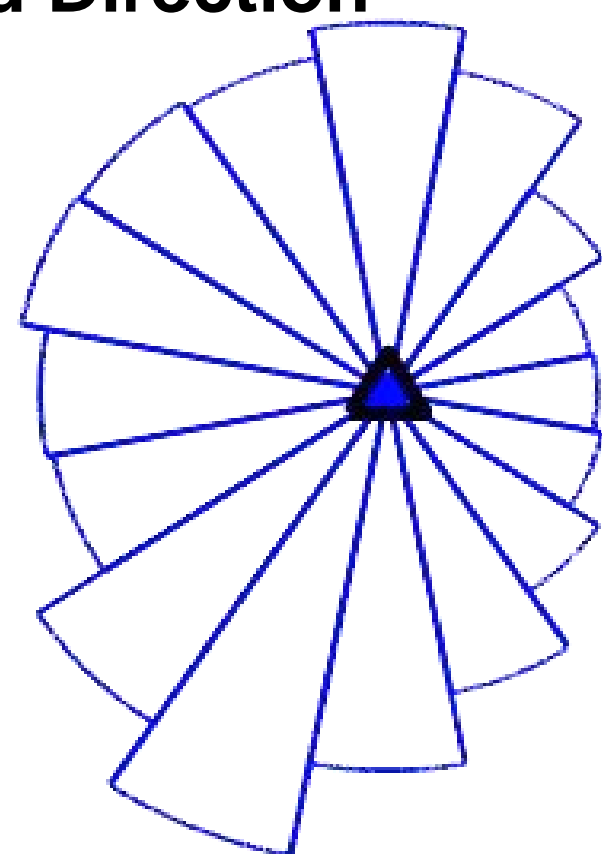
Environmental Traits

Depth and Lakebed

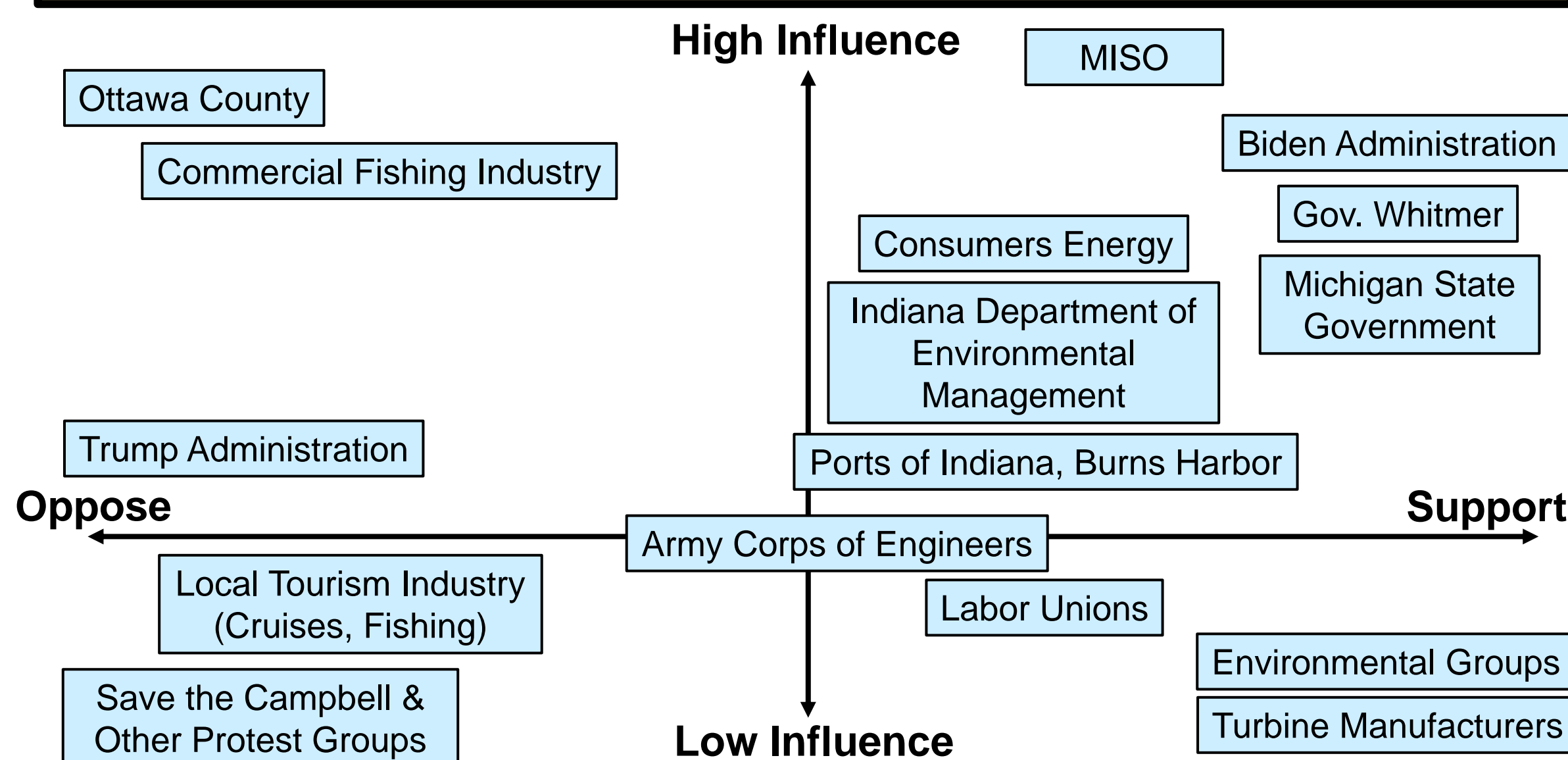


Wind Speed and Direction

- SW winds
- Average speed: 7.7 m/s at a 150 m hub height
- IEC II site



Key Stakeholders

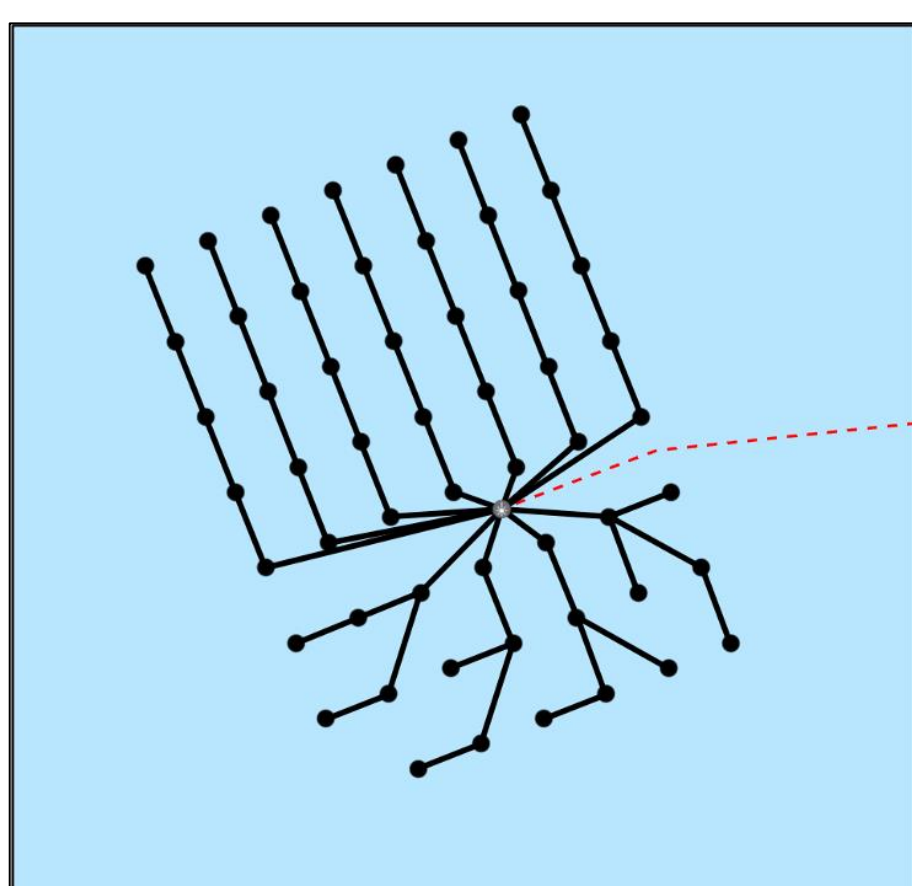


Site Design

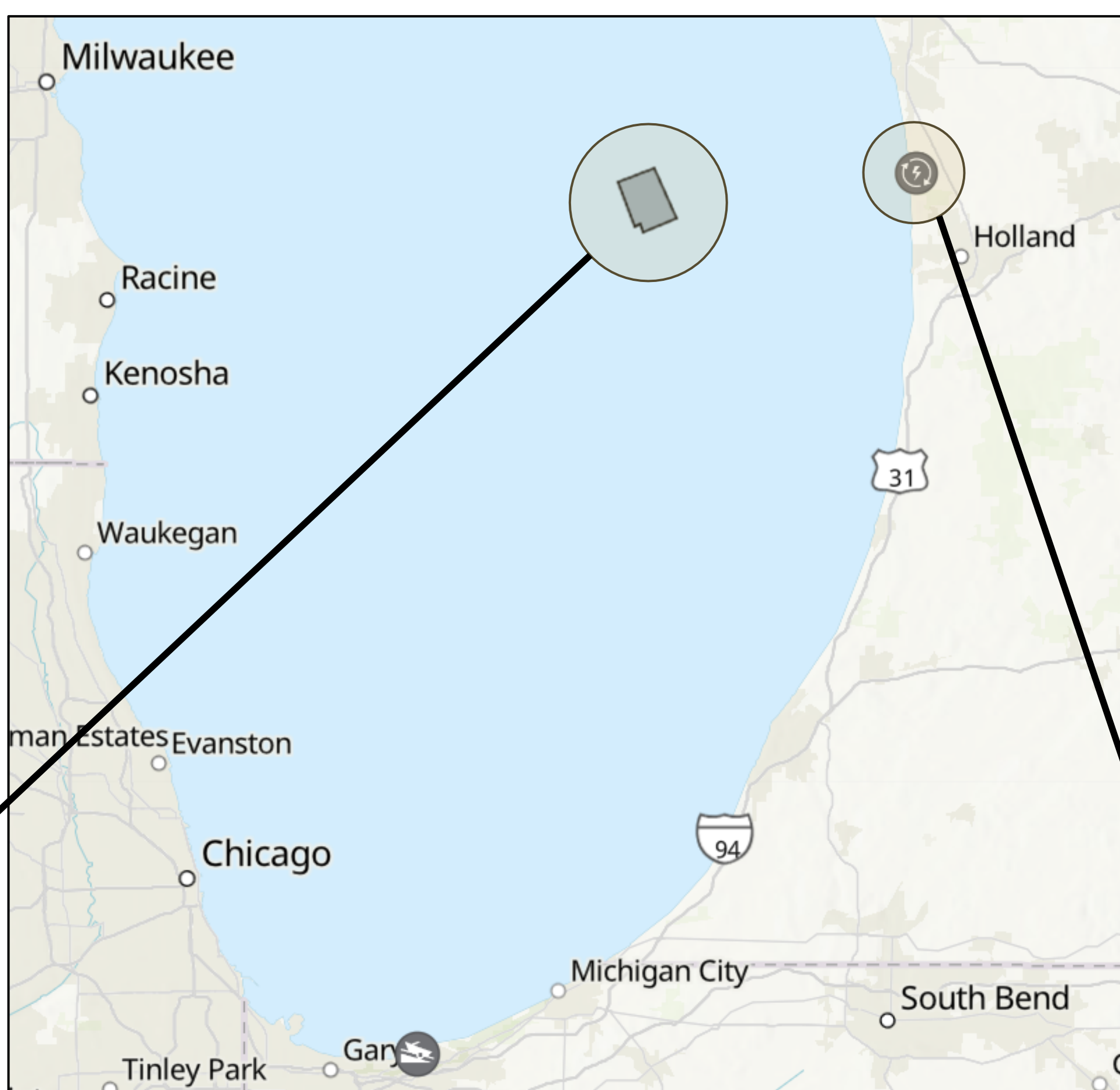
Wind Farm Site

Nameplate Capacity:	330 MW
Total acres:	14,145
Number of turbines:	55
Annual generation:	1,236 GWh
Distance between turbines:	1,000-1,200 m
Closest turbine to shore:	36 km

Turbine and Cable Placement



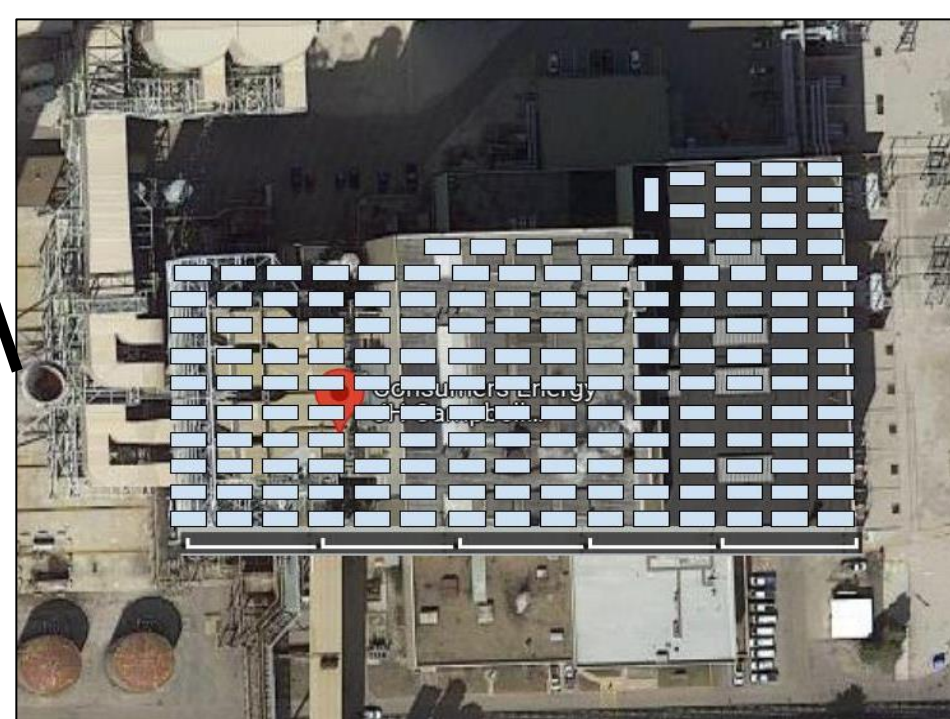
Site Map



Hybrid Site

Storage Capacity:	660 MWh
Total area:	2,364 m ²
171 Tesla Megapack units	
Includes:	PCS, inverter, thermal management system, AC breaker
Weight:	25,400 kg
Percentage of Ottawa County load:	7%

Battery Placement



GE Haliade 6 MW Offshore Turbine

- Hub height: 150 m
- Rotor diameter: 150 m
- Rated wind speed: 12 m/s
- Current use: Block Island Wind, Rhode Island

Hybrid Options Considered

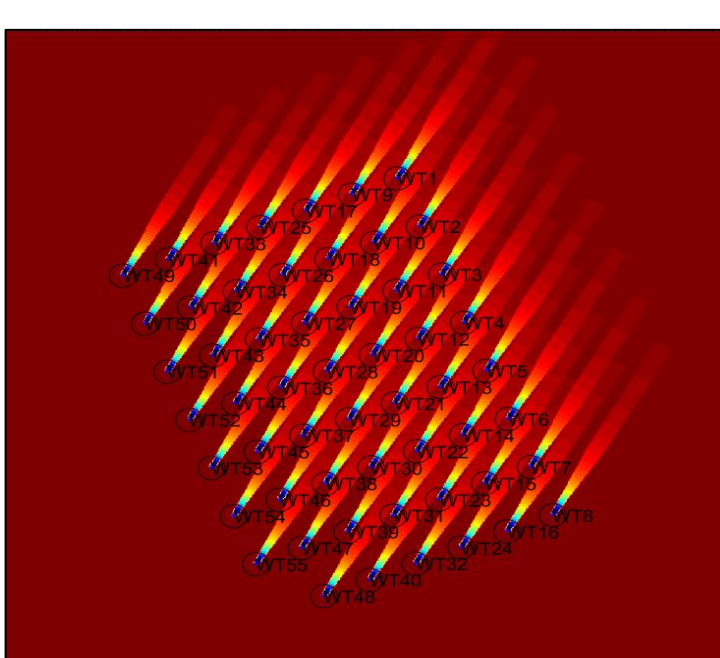


- Battery
- Hydrogen
- Solar Energy

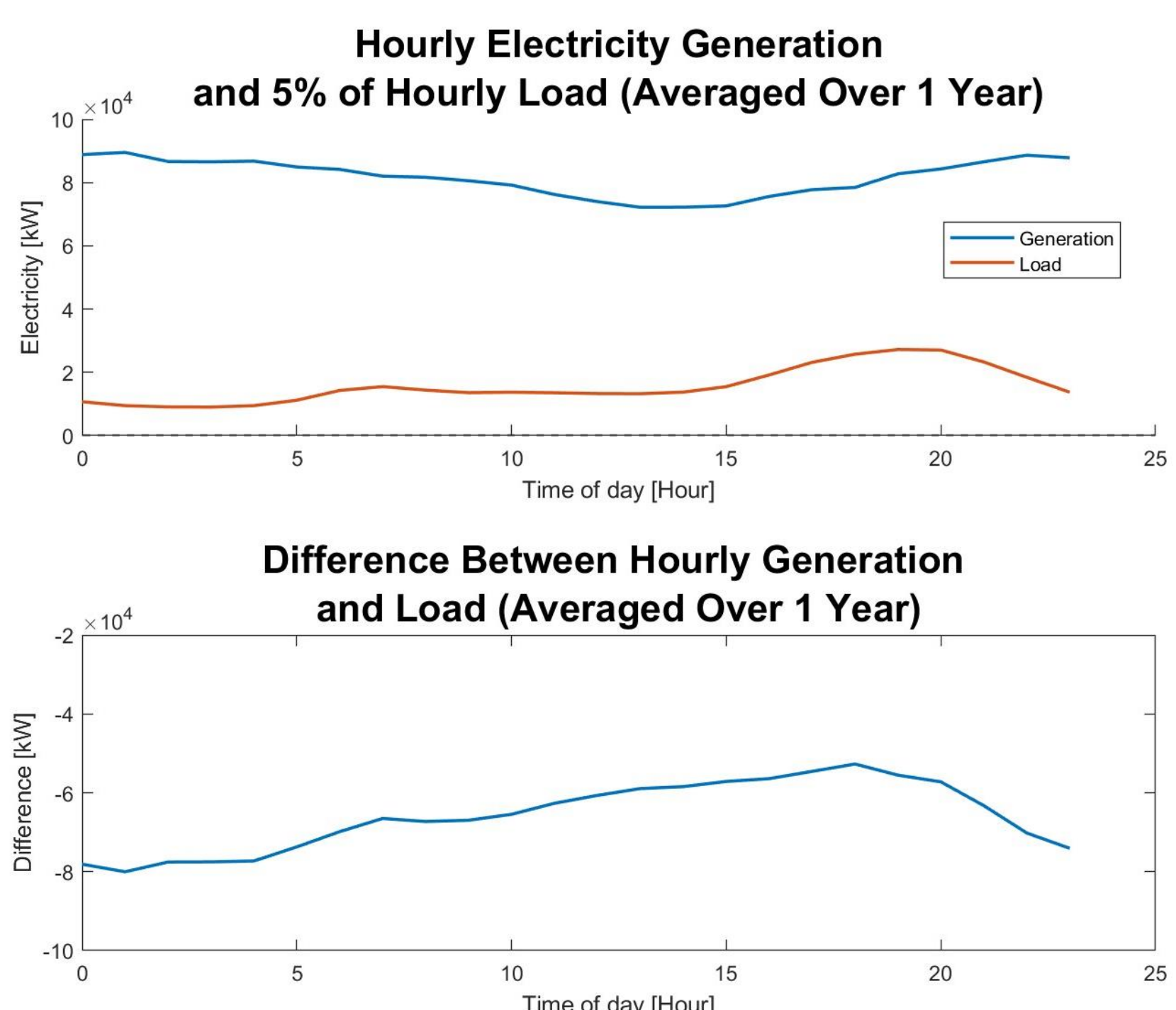
PelaStar Tension Leg Platform

- Mooring lines: 5
- Optimal depth: ≥ 90 m
- No water line
- Currently in R&D

Wake Loss



Load and Generation Data

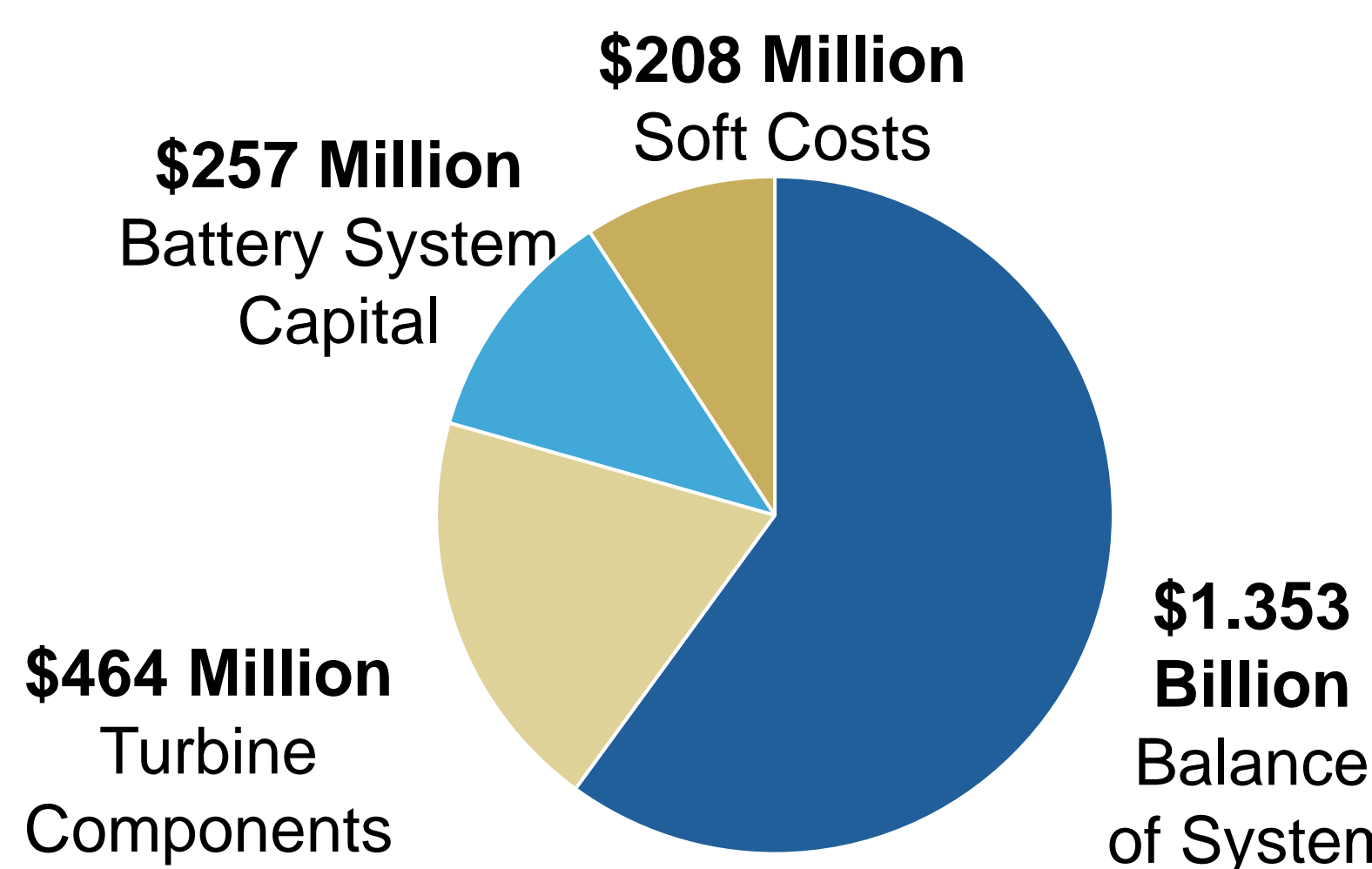


Financial Overview

Levelized Cost of Energy

- \$182/MWh – Nominal (Averaged with inflation over project lifetime)
- \$151/MWh – Present value

Capital Cost Breakdown

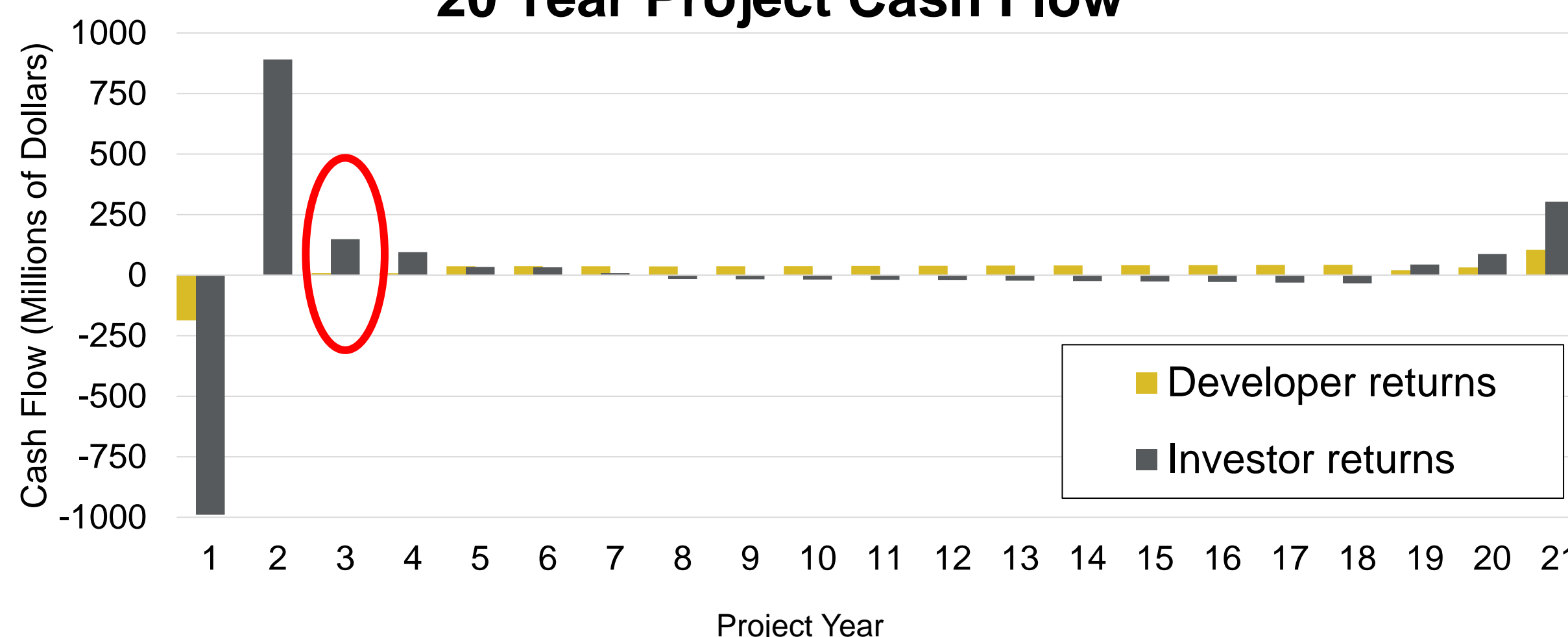


20-Yr Cash Flow Break Down/Bankability

- Partnership Flip Model
- Investors own 80% of project until they earn back their investment
- Developer owns 20% of project until investor breaks even, then ownership "flips"
- Investor: bigger tax appetite, so they receive 99% of the tax benefits to earn back their investment fast.

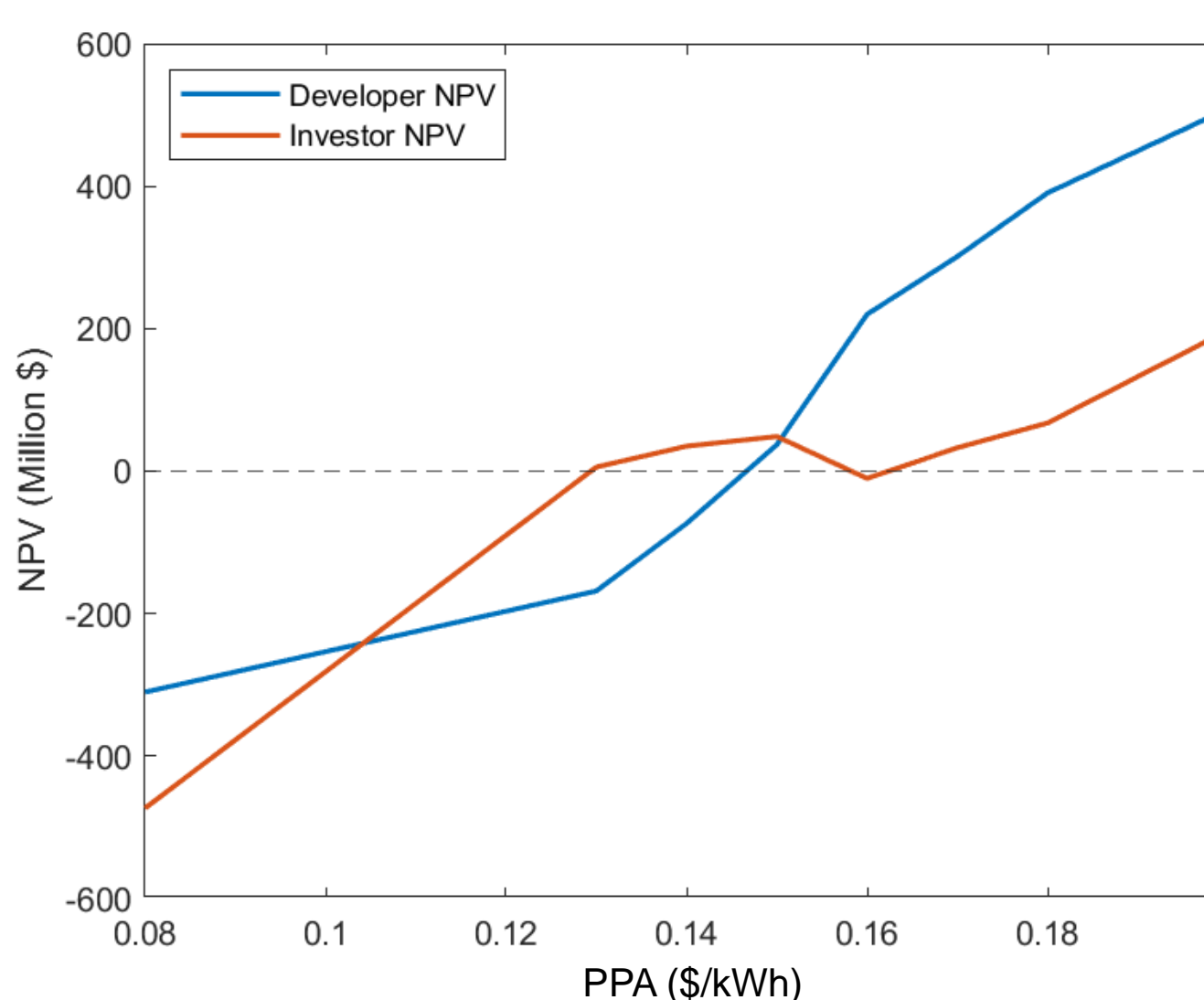
Total NPV: \$85,000,000	
Ownership Flip Year: 3	
Developer NPV:	Investor NPV:
\$84,000,000	\$66,000,000
Developer IRR: 13.36%	Investor IRR: 13.41%
Equity Payout: \$1,236,574,968	

20 Year Project Cash Flow

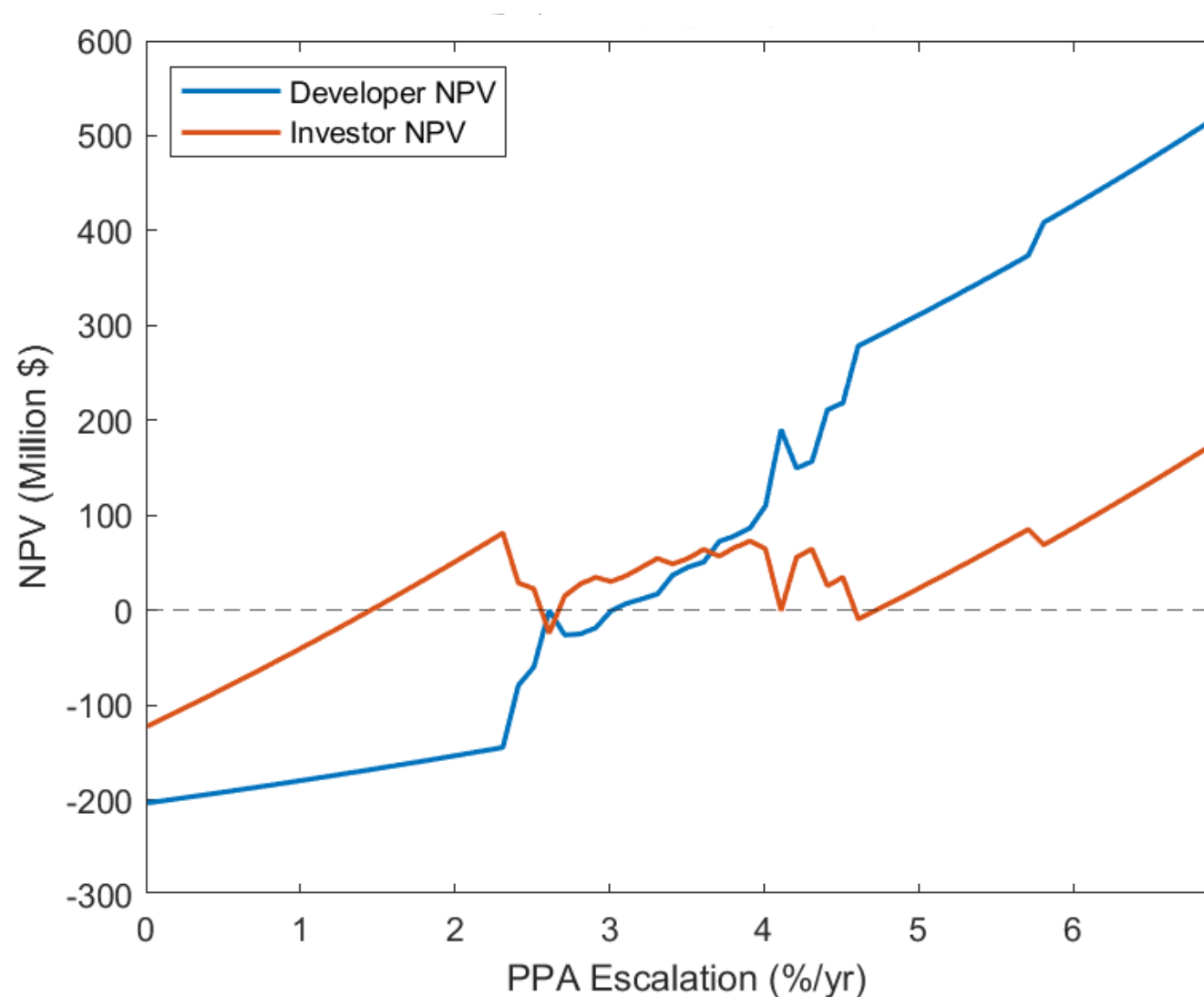


Financial Sensitivity Analysis

PPA vs. NPV



PPA Escalation vs. NPV



2024

Hypothetical Project Timeline

2056

2024-2029	2030	2031	2032-2035	2036	2036-2056
All Quarters: Community Outreach, Development	Mobilization at Burns Harbor		Shipments of Parts	Batteries Installed	Project Life Time
Beginning in 2026: Presite surveys, Environmental Evaluations, Legal Review, Auction	Mobilization at J.H. Campbell		Turbine, Foundation, Array Cables and J.H Campbell Retrofitting	Commsioning	
Same Evaluations at J.H. Campbell	Any Retrofitting Done at Port.			O&M garages built	

Acknowledgments: Roark Lanning, Dr. Julie Steinbrenner, Dr. Daria Kotys-Schwartz, Dr. Michael Walker