Meeting Procedures

Participation for Members of the Public:

> Members of the public are muted upon entry.

> Questions and comments may be submitted in writing through the Q&A feature at any time during the event.
  > Chat is disabled

> Today's materials along with a recording of the webinar will be posted to NYSERDA's Great Lakes Wind website.

> If technical problems arise, please contact karen.fusco@nyserda.ny.gov
Overview of Feasibility Study

Lake Resource Characterization, Port Infrastructure
National Renewable Energy Laboratory (NREL)

Technology, Cost Analysis, Economic Development
National Renewable Energy Laboratory (NREL)

Permitting, Risk/Benefit Analysis, Visualization Study
Advisian

Interconnection to Electric Grid
Pterra/Brattle Group

Stakeholder Input from Public Feedback Session

Next Steps and Study Timeline

Q&A
Today’s Objectives

> To provide a brief overview of the Study
> To provide a mid-Study update on research to date
> To provide an overview of input received during the Public Feedback Session
> To provide an overview of the remaining timeline for Study completion
> To provide an overview of next steps after Study completion
Directs NYSERDA to:

> Conduct a feasibility study for wind energy generation in the Great Lakes

> Commence work with 180 days of Order within a $1 million budget
Great Lakes Wind Feasibility Study

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Wind Lead

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Research Engineer

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Engineering Analyst

Mike Optis, Ph.D.  
Senior Atmospheric Scientist

Aubryn Cooperman, Ph.D.  
Wind Engineer

Stein Housner, M.S.  
Wind Engineer

Matt Shields, Ph.D.  
Wind Cost Engineer

Patrick Duffy, M.S.  
Wind Cost Engineer
Physical Characteristics

<table>
<thead>
<tr>
<th>Lake</th>
<th>Total Area</th>
<th>Area beyond 5 miles from shore</th>
<th>Area beyond 10 miles from shore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erie</td>
<td>590 mi²</td>
<td>270 mi² (~2 GW)</td>
<td>70 mi² (~0.5 GW)</td>
</tr>
<tr>
<td>Ontario</td>
<td>3,500 mi²</td>
<td>2,350 mi² (~18 GW)</td>
<td>1,450 mi² (~11 GW)</td>
</tr>
</tbody>
</table>

**Lake Ontario: Area > 10 miles offshore**

- Depth: >200 m: 10%, 150-200 m: 40%, 100-150 m: 30%, 60-100 m: 10%, 60-80 m: 5%
- Ice cover: >7 days: 2%, 1-7 days: 4%
- Soil type: Sand: 70%, Clay: 5%, Silt: 15%
- Sediment thickness: >180 ft: 10%, 120-180 ft: 20%, 60-120 ft: 25%
- Lakebed slope: <1 ft: 10%, 1-5 ft: 30%, 5-10 ft: 40%
- Mean wind speed: 8.5-8.75 m/s: 5%, >8.75 m/s: 1%

**Lake Erie: Area > 5 miles offshore**

- Water depth: 60-80 ft: 50%, 20-40 ft: 10%, <20 ft: 40%
- Ice cover: 7-10 days: 30%, No ice: 70%
- Soil type: Sand: 50%, Clay: 10%, Silt: 40%
- Sediment thickness: >180 ft: 2%, 120-180 ft: 20%, 60-120 ft: 40%
- Lakebed slope: >5 ft: 5%, 4-5 ft: 35%, 1-2 ft: 50%
- Mean wind speed: >9 m/s: 5%, 8.75-9 m/s: 45%, <8.75 m/s: 50%

Analysis grid:

- Lake Ontario: 15' x 15'
- Lake Erie: 1' x 1'
NREL is updating the Great Lakes resource data, replacing WIND Toolkit from 2015. New data uses recent advances in the Weather Research and Forecasting (WRF) numerical weather prediction model. Updated data cover a 21-year period instead of 7 years, and indicate higher wind speeds compared to the WIND Toolkit (lower figure). The eastern part of Lake Ontario has the highest annual average wind speeds at 8.5-9.0 m/s. Increases in wind speed over Lake Erie range from 0.8-1.6 m/s, and about 0.2-1.0 m/s in Lake Ontario. Data for the Great Lakes are publicly available (See: NREL 2021).
**Depth to Bedrock – Close to Surface**

**Lake Erie Depth to Bedrock (NY Waters)**

- Less than 250 ft (76.2 m)
- Average ~100 ft (30.5 m)


**Lake Ontario Depth to Bedrock (NY Waters)**

- Less than 295 ft (90 m)
- Average ~74.8 ft (22.8 m)


Ports and Infrastructure

Key parameters for offshore wind:
- Dock length, water depth at port, crane size and staging area.

Vessel Limits Define Turbine Size
- The locks on the St. Lawrence Seaway limit the size of vessel that can be brought into the Great Lakes.
- Traditional Wind Turbine Installation vessels are not feasible due to width limitations.
- Barges are being considered to install the turbines.

Sources:
(Assessment of Vessel Requirements for the U.S. Off., 2013)
(Learn About the Seaway / Great Lakes St. Lawrence Seaway Development Corporation, n.d.)
Turbine Selection

- Representative turbine: **GE Cypress 6.0-164**
  - Specific Power 284 W/m²
  - Rotor Diameter 164 m
  - Turbine rating 6.0 MW
  - Hub heights available up to 112 m

- Selection of a land-based model due to transportation constraints in the Great Lakes and commercial availability aligned with timeframe of Great Lakes projects

- Supply chain for 6.0 MW scale land-based turbines may be more sustainable

- Class I or II machines are considered viable due to high mean wind speeds in the Great Lakes – many other options exist.
Comparison of Turbine Sizes

> Great Lakes wind turbines will be smaller than the 12 to 15-MW Class ocean-based wind turbines

> Comparable to Block Island Wind Turbines

> FAA limitations may restrict maximum height to 610 ft

> One GE Cypress 6.0-164 wind turbine can produce over 20 GWh per year – enough to power about 2,800 NY homes.
Fixed-Bottom Substructure Types: Lake Erie

> **Considerations for support structure feasibility**
  - Installation method
  - Seabed compatibility
  - Ice structure interaction
  - Local manufacturability
  - Cost
  - Technology readiness

> **Key Drivers for Lake Erie**
  - Low profile at waterline
  - Shallow lakebed penetration due to bedrock
  - Port adaptability

*e.g. LEED Co is using Mono-Buckets in Lake Erie*
Floating substructures have not yet been deployed in ice-covered waters

Considerations for support structure feasibility
- Installation method
- Seabed compatibility
- Ice structure interaction
- Local manufacturability
- Cost
- Technology readiness

Key Drivers for Lake Ontario
- Low profiles at waterline
- Port adaptability
### Cost Modeling and Cost Reduction Pathways

<table>
<thead>
<tr>
<th>Scenario development</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fixed and floating scenarios</td>
</tr>
<tr>
<td>• Capacities and technologies based on commercial operation date</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model customization</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Updating generic assumptions in ORCA and ORBIT for the Great Lakes</td>
</tr>
<tr>
<td>• Ports, vessels, grid, turbine rating, capacity factors, ice protection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost and sensitivity study</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ORBIT: Installation timelines and costs</td>
</tr>
<tr>
<td>• ORCA: LCOE heat maps, cost projections, detailed cost breakdowns</td>
</tr>
</tbody>
</table>

Near-term COD

Long-term COD
Estimating the **job and economic impacts** using NREL’s Jobs and Economic Development Impact (JEDI) model

- Results will include the impacts of development, manufacturing, installation, and operations for the state of New York

Assessing the **workforce and economic development potential** from port utilization to support wind development in Lake Erie and Ontario

Identifying **existing workforce programs** at vocational schools, community colleges, and universities which could train and educate a Great Lakes wind workforce
Thank you

For more information, please contact:

Walt Musial
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Rebecca Green
rebecca.green@nrel.gov
Great Lakes Wind Feasibility Study

American Clean Power Association
The Advisian Team is working on three aspects of the NYSERDA Great Lakes Wind Feasibility Study

I. State and Federal Permitting Study
II. Geophysical and Geohazards Study
III. Relative Risk, Minimization/Mitigation, and Benefits Study
Great Lakes Wind Feasibility Study: Risks/Benefits

> Unique Aspects of GL Wind
  • Submerged Lands Act
  • Near international boundary w/Canada
  • Very few prior freshwater wind farms

> 14 Major Federal and State Permits, Consultations, or Authorizations
  • Wide range of issues addressed
  • Permits required for construction, turbines, cable installation
  • Required permits/approvals vary based on wind farm size (e.g., SEQRA vs. 94-C) and lead NEPA agency (i.e., there are multiple paths)

> Case studies including freshwater wind farms in Europe

<table>
<thead>
<tr>
<th>Permit or Regulatory Requirement</th>
<th>Covered Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Environmental Policy Act Review</td>
<td>Major federal action such as granting a federal permit</td>
</tr>
<tr>
<td>Clean Water Act Section 404/Rivers and Harbors Act</td>
<td>Excavation or placement of dredged or fill in waters of the U.S.</td>
</tr>
<tr>
<td>Clean Water Act Section 401 Certification Permits</td>
<td>Federal action that discharges to navigable waters of the U.S.</td>
</tr>
<tr>
<td>National Historic Preservation Act Section 106 Certification</td>
<td>Impacts to historical or cultural resources</td>
</tr>
<tr>
<td>U.S. Coast Guard Private Aid to Navigation Permit</td>
<td>Obstructions or hazards to navigation</td>
</tr>
<tr>
<td>Federal Aviation Administration Obstruction Evaluation</td>
<td>Hazards to air navigation</td>
</tr>
<tr>
<td>National Oceanic and Atmospheric Administration</td>
<td>To be determined upon sanctuary designation</td>
</tr>
</tbody>
</table>
  National Marine Sanctuaries Section 304(d) Consultation |
| New York State 94-C Regulations | Major renewable energy project siting and permitting |
| New York State Environmental Quality Review Act Review | Discretionary state agency activities not covered by 94-C |
| Coastal Zone Management Act Consistency Review | Federal activities within New York State’s coastal zone |
| New York State Dredge and Fill Permit | Excavation or placement of dredged or fill in New York State waters |
| New York State Grants of Lands Underwater | Structures located on state submerged lands |
| New York State Coastal Erosion Hazard Areas (CEHA) Permit | Activities in designated CEHA areas |
| New York State Incidental Take Permit | Take of New York State listed species |
Developed cross-functional process flow charts for the overall permitting process

- Two scenarios developed
- Shows activities of the developer and all federal and state regulators
- Handoffs between agencies and actors (i.e., integration points)
- Opportunities for public comment and public announcements
- Visualizes triggers, decisions points, and information flows between processes

Example draft
## Great Lakes Wind Feasibility Study: Risks/Benefits

### In progress - Relative Risks, Minimization/Mitigation, Benefits Study

<table>
<thead>
<tr>
<th>Construction Stressors</th>
<th>Post-Construction Stressors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise/Particle Motion without Pile-Driving</td>
<td>Noise/Particle Motion</td>
</tr>
<tr>
<td>Noise/Particle Motion with Pile-Driving</td>
<td>Scour</td>
</tr>
<tr>
<td>Increased Vessel Traffic</td>
<td>EMF, Vibration, Heat</td>
</tr>
<tr>
<td>Bottom Disturbance</td>
<td>Permanent Structure</td>
</tr>
<tr>
<td>Habitat Alteration</td>
<td>Collision/Attraction/Displacement</td>
</tr>
<tr>
<td>Collision/Attraction/Displacement</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contacted Agencies, Academics, Officials</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Fish and Wildlife Service</td>
</tr>
<tr>
<td>NY Department of Environmental Conservation</td>
</tr>
<tr>
<td>Ontario Ministries of Environment, Conservation, and Parks</td>
</tr>
<tr>
<td>US Geological Survey</td>
</tr>
<tr>
<td>Audubon</td>
</tr>
<tr>
<td>Black Swamp Bird Observatory</td>
</tr>
<tr>
<td>BirdCast</td>
</tr>
<tr>
<td>The Nature Conservancy</td>
</tr>
<tr>
<td>American Bird Conservancy</td>
</tr>
<tr>
<td>University of Maryland</td>
</tr>
<tr>
<td>University of Delaware</td>
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<tr>
<td>University of Michigan</td>
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<tr>
<td>Point Blue Conservation</td>
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<tr>
<td>Black Swamp Bird Observatory</td>
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</tbody>
</table>
In progress - Relative Risks, Minimization/Mitigation, Benefits Study

Example Map:
- Known Wrecks
- Potential Wreck
- Protected Areas
- Submarine Cables

Receptor Groups
- Shorebirds
- Waterfowl
- Migrating birds
- Bats
- Wetlands
- Dunes
- Fishing Areas
- Areas of Concern
- Important Environmental Areas
- Wrecks
- Shipping
Visibility and Related Impacts

Ongoing and Future Analysis

- Based on the composite data and parameters provided by NYSERDA and NREL
- Visual impact along the coastline will be determined by using a baseline wind turbine/substation design and common, GIS-based line-of-sight and over-the-horizon geometric analyses
- Establish zones of visibility for the nominal size/height of the structures selected
Thank you

American Clean Power Association

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Interconnection Feasibility
Each pin represents a potential POI showing the substation name.

Transmission line routes with voltage ratings ranging from 115 to 345 kV are shown as red lines.
Potential Points of Interconnection (POI) for Lake Erie

Each POI is characterized by size of GLW it can support on a solo capacity headroom basis, consistent with the DPS straw proposal for headroom calculations.

For the initial selection process, POIs are identified based on a maximum straight-line distance of 30 miles from the lakeshore. Further filtering is applied to exclude POIs that are electrically close and potentially have the same or similar headroom.
Erie 1: 900 MW
Erie 2: 300 MW
Ontario 1: 1,000 MW
Ontario 2: 100 MW
Ontario 3: 2,000 MW
Ontario 4: 80 MW

Interconnection Regions
For purposes of bracketing locations for GLW interconnections, potential points of interconnection (POI) are grouped geographically by region.
Selected power flow models: NYISO FERC 715 cases for 2025 and 2030, new model developed to represent 2030 with 70% renewable energy

Identified initial set of Points of Interconnection (POIs) using defined criteria

Calculated capacity headroom for each POI

Grouped POIs by geographic region. Identified capacity headroom on a regional basis

PENDING: Capacity headroom for total combined interconnections from both Lake Ontario and Lake Erie
Thank you

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Hannes Pfeifenberger hannes.pfeifenberger@brattle.com
Public Input From Public Feedback Session
Great Lakes Wind Feasibility Study

Topic Types from June 9, 2021

> Role of Wind in Energy Transition
> Policy and Planning
> Potential Future Siting Considerations
> Environmental Impacts
> Socioeconomic Impacts

| Registration Numbers | 151 registrants  
| Attendees           | 110 attendees |
| Commenters          | 25 verbal     
|                    | 62 written    |
| Role of Wind in Energy Transition | • Include context on the necessity of renewable energy transition in mitigating future climate impacts, including to the Great Lakes  
• Provide context on the role of Great Lakes Wind in achieving overall CLCPA commitments, including assessment of need for upstate wind capacity  
• Compare wind energy with other potential renewable energy sources |
| Policy and Planning | • Be transparent on data sources and methodologies in the Study to ensure the public understands the science and facts that will be utilized in any future decision-making  
• Provide information on professionals internal and external to state government working on the Study  
• Conduct additional public outreach  
• Consider support for and opposition to Great Lakes Wind in the region  
• Consider lessons learned from Block Island Wind Farm |
| Potential Future Siting Considerations | • Establish a standard for “responsible” siting of wind in the Great Lakes  
• Articulate rationale for any differences in approach between ocean wind and Great Lakes wind  
• Respond to concerns about Public Trust Doctrine and Rivers and Harbors Act of 1899  
• Consider the utilization of different wind technologies (e.g. suction, floating) |
## Environmental Impacts
- Assess wind impacts on wildlife, soil sediment, local ecosystems, sensitive habitat, drinking water, and public health
- Assess the likelihood of contamination from wind turbines or manufacturing
- Include plan for decommissioning turbines in an environmentally sensitive way
- Assess cultural resources

## Socioeconomic Impacts
- Analyze impacts on lakeshore tourism (e.g., businesses running sportfishing and boating recreational activities) and fisheries
- Analyze jobs impacts, including assessment of impacted industries, wages and career growth potential, increased regional investment, domestic supply chains, and export opportunities
- Analyze ratepayer impacts from transition to wind energy
- Analyze the potential for Community Benefits Agreement
- Evaluate programs necessary for training and expanding the domestic workforce with an emphasis on ensuring opportunities for dislocated workers, as well as access and career pathways for both disproportionately impacted communities and BIPOC communities
Next Steps
Great Lakes Wind Feasibility Study Remaining Timeline

**Draft Study**
Fall 2021
- Continued research and Study production
- Internal NYSERDA review
- Public Webinar #4 (October)

**Final Study**
Early 2022
- Filling with PSC to satisfy order
- Public release
- Additional public webinars (as needed)

**Public Service Commission**
2022
- Decision on feasibility of GLW
- Related public comment periods per regulation (if needed)
Multiple opportunities to stay engaged!

Webinar #4: October 2021– Presentation of the draft Study by NYSERDA and the Study researchers

Sign-up for email updates and get the latest on study progress at the NYSERDA Great Lakes Wind website nyserda.ny.gov/Great-Lakes-Wind-Feasibility-Study

Email the Great Lakes Wind Team at greatlakeswind@nyserda.ny.gov
Thank you

For more information, please contact:
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greatlakeswind@nyserda.ny.gov

Visit the project website at:
nyserda.ny.gov/Great-Lakes-Wind-Feasibility-Study

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