

Great Lakes Wind Energy Center (GLWEC)

Pilot Project and Applied Research Center

Feasibility Study Conclusions

Building an Advanced Energy Economy through
Offshore Wind Power

Presented by

The Executive Committee of The Great Lakes Energy Development Task Force
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Great Lakes Wind Energy Center

is a public/private/philanthropic/academic collaboration between:



Cuyahoga
COUNTY OF OHIO



PORT OF CLEVELAND
Cleveland - Cuyahoga County Port Authority



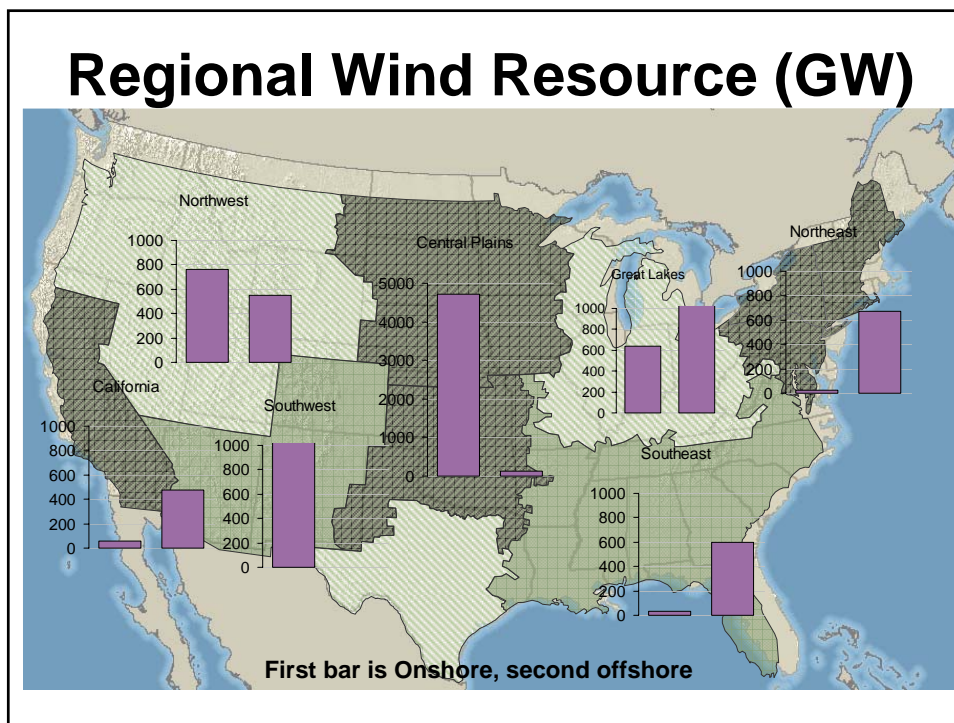
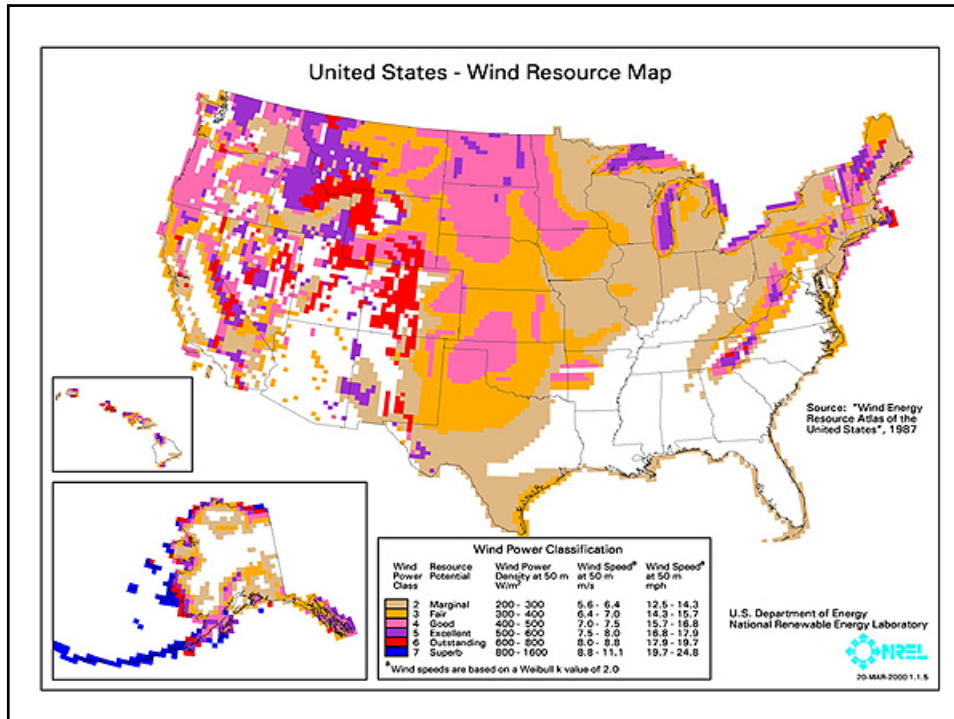
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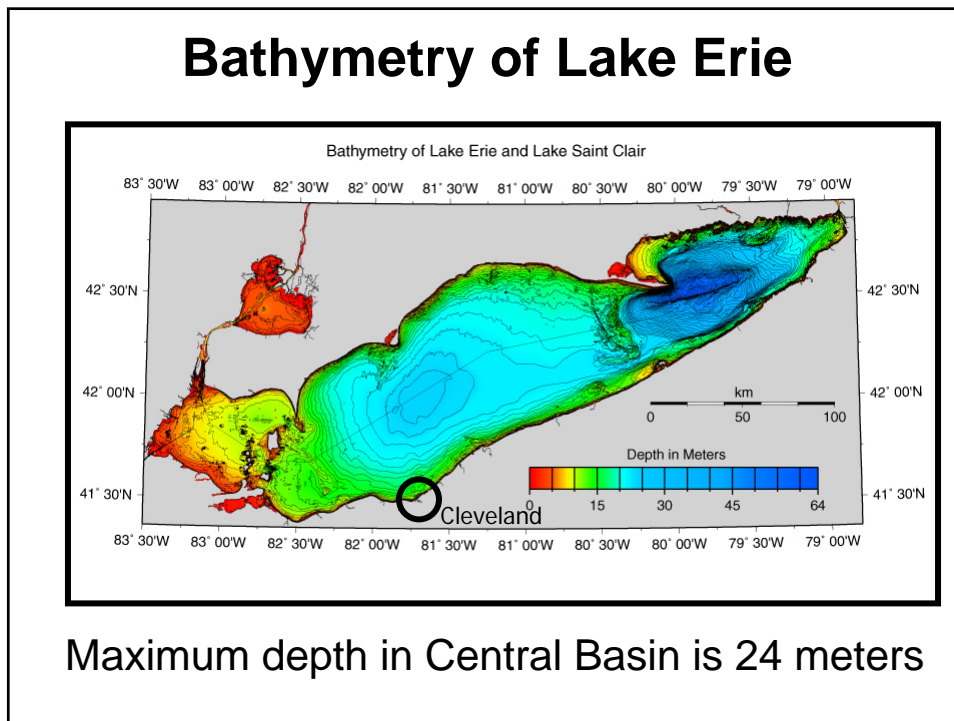
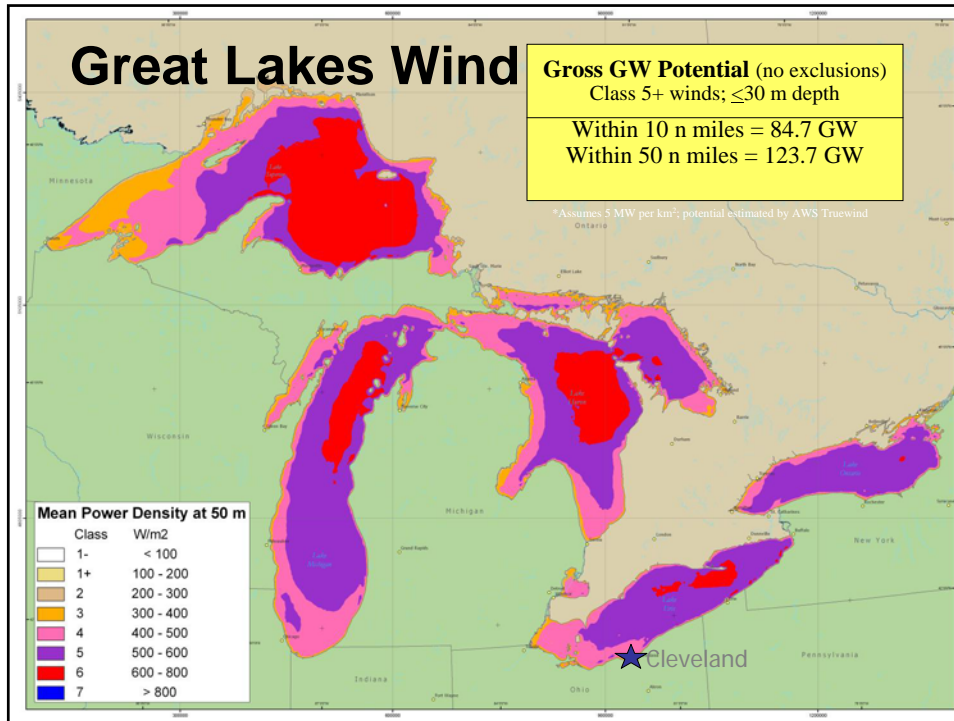


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CASE WESTERN RESERVE
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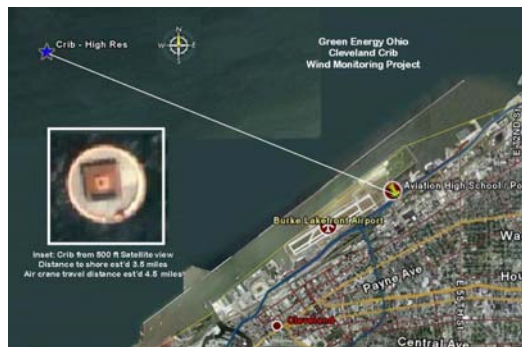
Water Intake Crib

Permanent platform, 3 miles offshore downtown Cleveland

Independent power system (wind, PV, batteries) and communications link



Verification of Predicted Wind Energy Resources



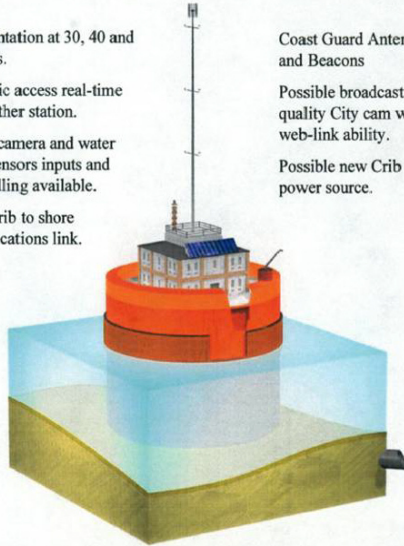
Schematics of Water Intake Crib

Instrumentation at 30, 40 and 50 meters.

Full public access real-time base weather station.

Security camera and water quality sensors inputs and data handling available.

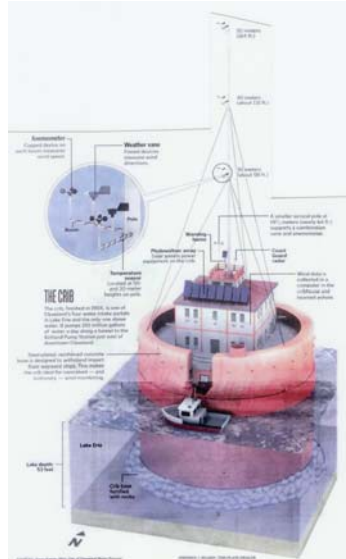
Secure Crib to shore communications link.



Coast Guard Antennas and Beacons

Possible broadcast quality City cam with web-link ability.

Possible new Crib power source.



<http://www.livedata.clevelandcrib.org>

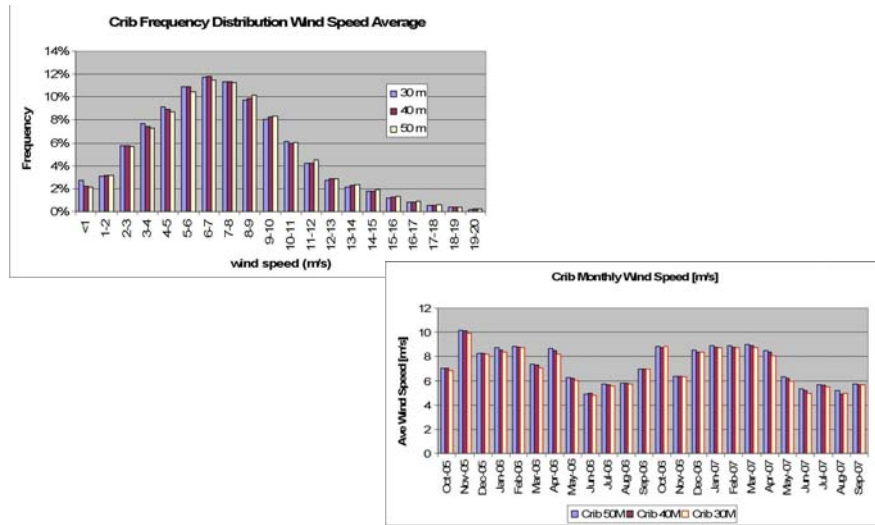
<http://www.webcam.clevelandcrib.org>

Wind Data from Crib: 10/05-9/07

	<u>30 m</u>	<u>40 m</u>	<u>50 m</u>
Avg. wind speed (m/s)	7.14	7.25	7.34
Cubic avg. wind speed (m/s)	8.51	8.61	8.69
Prevailing incident wind direction	SW	SW	SW
Turbulence intensity (std. dev./ m/s)	0.163	0.143	0.137
Wind power density (w/m ²)	446.1	453.9	466.5
Calculated Weibull (k)			2.15
Calculated Weibull (c)			8.3

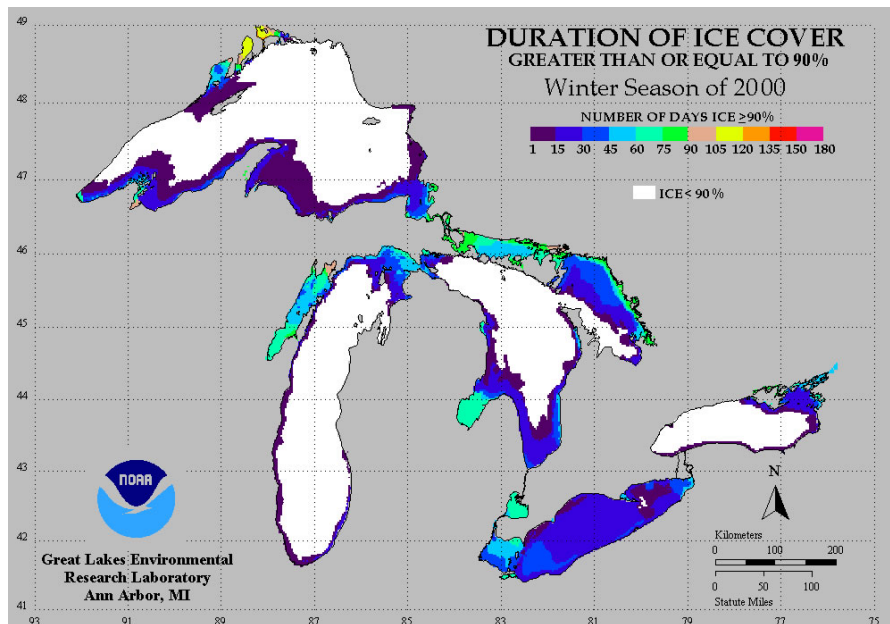
Source: "Wind Resource Assessment for Near-Shore Lake Erie", Green Energy Ohio, January 10, 2008

Results from 2-Year Wind Study

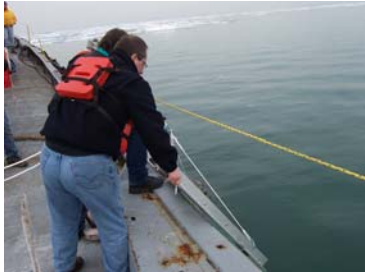


Source: "Wind Resource Assessment for Near-Shore Lake Erie", Green Energy Ohio, January 10, 2008

Great Lakes Ice Cover



Great Lakes Ice Cover



Shallow Water Ice Profiler (SWIP) by ASL Environmental

Great Lakes Ice Cover



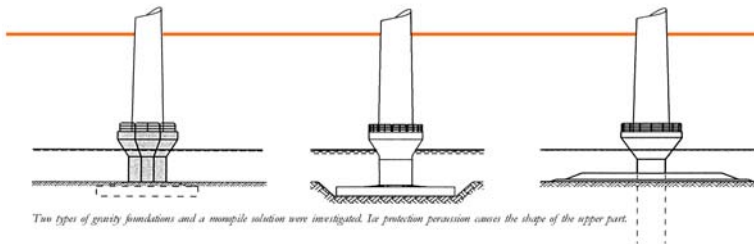
Great Lakes Ice Cover



Key Findings: Ice



- † Capital and operating costs are much higher than comparable wind projects onshore, primarily due to higher costs associated with offshore installation, access, and maintenance
- † Inverted Ice Cone is suggested to break up ice, reduce loading (by a factor of 3), and avoid ice-induced vibrations
- † Ice not identified as a prohibiting factor, further measurements planned



GLWEC Permitting Template

- Federal
 - Army Corps of Engineers Construction Permit needed (Section 10 and/or 404 of Clean Water Act) – construction activities in lakes, rivers, streams, wetlands (33 CFR 320 to 330).
 - Construction Permit triggers National Environmental Policy Act (NEPA) and Environmental Assessment/Environmental Impact Statement Process.
 - Construction Permit also triggers need for Water Quality Certificate (Section 401 of CWA). Issued by Ohio EPA under delegated CWA authority.
 - Federal Endangered Species Consultation with US Fish and Wildlife service is tied into Construction Permit.
 - Consultation with Federal Aviation Administration depending upon proximity to airports to determine whether hazard to air traffic.
 - Coast Guard consultation re navigation issues.

Permitting Template (cont.)

- State of Ohio
 - Department of Natural Resources (ODNR) consultations
 - Divisions of Wildlife review of habitat issues.
 - Division of Watercraft review of navigation issues.
 - Division of Geological Survey re foundations and structures.
 - Division of Coastal Management re submerged land leases and coastal impacts.
 - Department of Transportation
 - Office of Aviation re potential aviation hazards. Cross reference to FAA review
 - Ohio Power Siting Board
 - Approval required if electric generating facilities of at least 50 megawatts and electric transmission lines of 125kV or greater.

Key Findings: Avian Risk Assessment



- † Conclusions
 - † Literature review and local/regional data:
 - † No significant impact likely
 - † No significant barrier effect
 - † Few collision mortalities
 - † No significant displacement
 - † Very few birds expected most of the year
 - † NEXRAD study:
 - † Broad-front migration pattern
 - † No significant migratory corridor
 - † Majority will fly above turbine height
- † Recommendations
 - † Small scale of Pilot Project (~50 times smaller than commercial) does not set precedent, should only require reasonable additional studies
 - † Post-construction studies important
 - † Should consider life cycle impacts from other types of power generation
 - † Turbines located outside Audubon Important Bird Area

Key Findings: Marine Ecology & Geology



Marine Ecology:

- † **Small scale of Pilot Project**
 - † Minimal impact to water quality, benthic community, fishery
- † **No significant ecological concerns identified**
 - † Potential impacts temporary, during construction
 - † Physical disturbance of lake bottom
 - † Excavation of soil
 - † Electromagnetic disruption can be mitigated by using three-phase cables and burying them underground
 - † Operation:
 - † Limited noise and vibrations
 - † Artificial habitat creation

Geology:

- Lakebed consists of sand, muddy sand, glacial deposits
- Monopile foundations most likely: geological and economical reasons
- Geotechnical borings required prior to design

Offshore Wind Development Plan

Phase One: Great Lakes Wind Energy Center

- Through 2012 5-20 MW demonstration project to establish regulatory precedents and confirm ability to cope with icing
- Affiliated research and technology center to establish R&D pre-eminence

Phase Two: Utility-scale wind project(s) and local mfg. build-out

Mid-2010s

- Leasing and siting for commercial-scale offshore wind projects
- Commitment from turbine OEM(s) to establish local manufacturing presence (in exchange for preferential site development rights)
- Assembly of dedicated vessels

Phase Three: Main mfg. & logistics cluster for Great Lakes offshore wind

2020 and beyond

- 1+ GW of offshore wind projects in Lake Erie across Northern Ohio
- Multiple turbine/blade/tower manufacturing facilities and sizable infrastructure of vessels and installation/service crews
- New turbine designs

Possible Pilot Project Layout



For Further Information,
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