Powering Ohio's Economy with Offshore Wind

First in the Water, First in Jobs

The Cleveland Foundation - NorTech - Cleveland - Ashtabula - Lake - Lorain -

US Electric Power Sources

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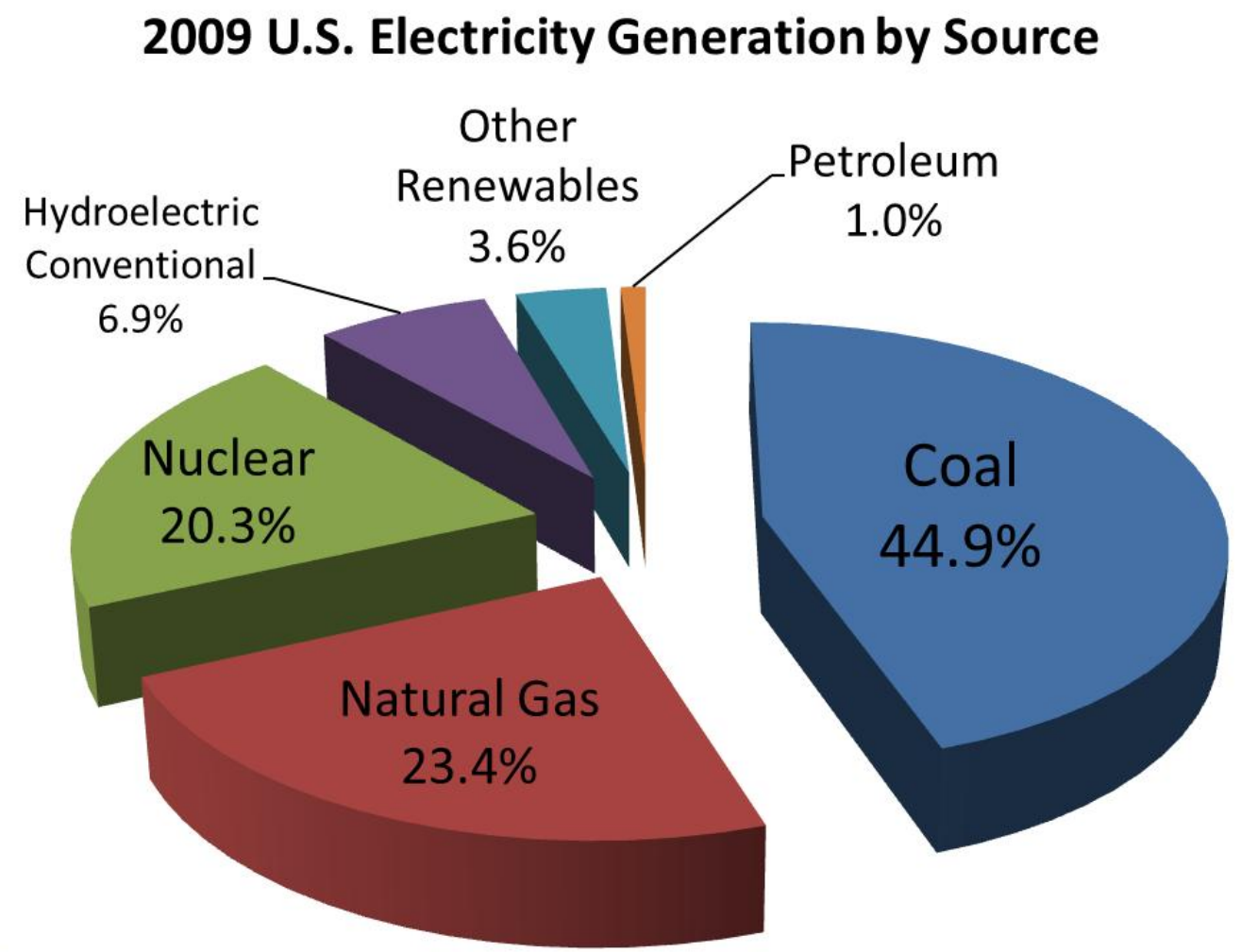

Ohio & Wind Energy History

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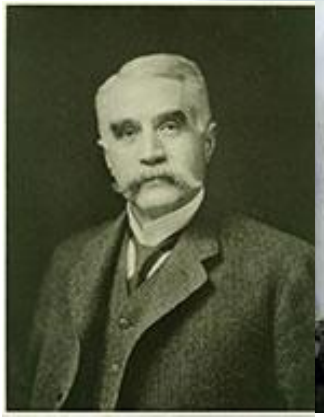
- Charles F. Brush
  - Born in Euclid, Ohio
  - In 1887, he created world's first wind-powered electric generator in Cleveland.
  - 144 blades, 50-ft. Rotor = 12 kilowatts
  - Brush's company was sold and eventually became General Electric.



- NASA Glenn Research Center
  - Located in Brook Park, Ohio
  - Led U.S. Wind Energy Program between 1974-1980
  - Turbine development paved the way today
  - 3.2 MW turbine in Hawaii
  - Program eventually divested.

Question: *"So where did Ohio's turbines go?"*

The NEXT Big Thing

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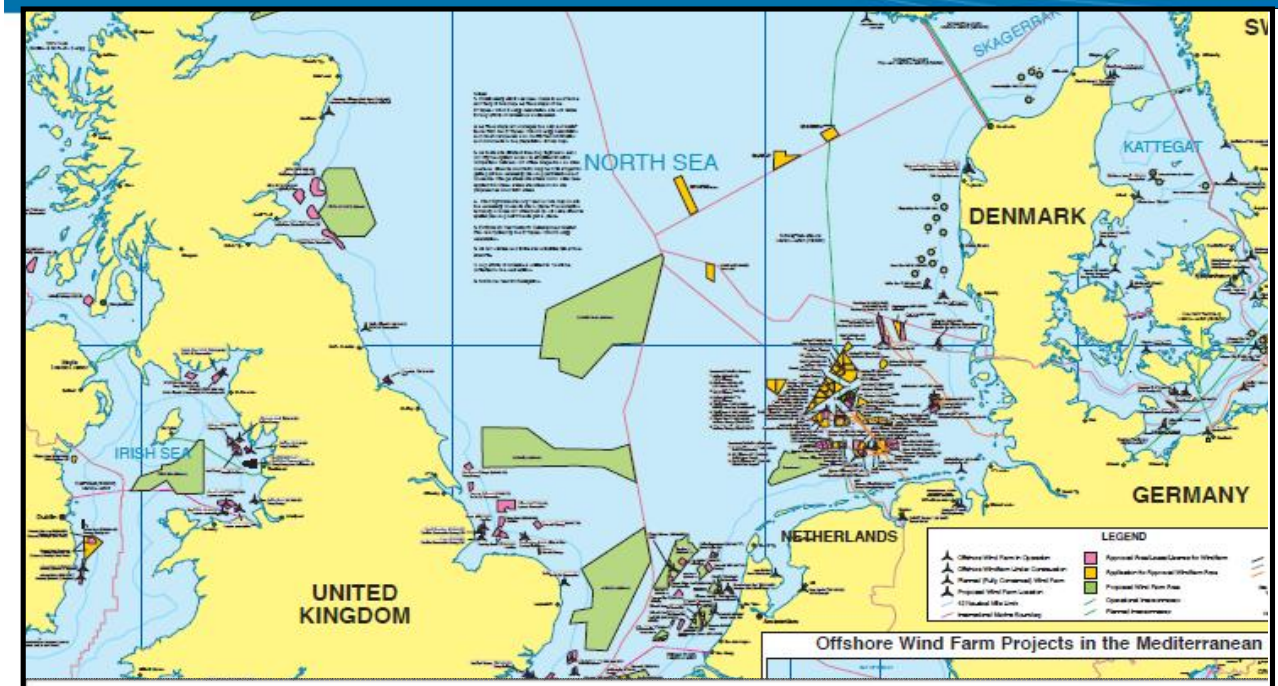

1.0 Offshore Wind-Driven Job Creation

Table 1: EWEA capacity and employment forecasts (onshore & offshore)

	Annual capacity (MW)			Cumulative capacity (MW)			Employment		
	Onshore	Offshore	Total	Onshore	Offshore	Total	Onshore	Offshore	Total
2007	8,344	210	8,554	55,500	1,100	56,535	147,736	6,370	154,106
2010	6,873	1,331	8,205	76,500	3,500	80,000	129,271	41,396	170,667
2015	8,086	2,300	10,386	112,500	12,000	124,500	151,047	61,401	212,448
2020	9,949	6,805	16,754	145,000	35,000	180,000	176,199	152,491	328,690
2025	10,519	8,504	19,023	164,800	74,500	239,300	177,194	191,744	368,938
2030	9,882	9,590	19,472	180,000	120,000	300,000	161,606	215,637	377,244

Source: EWEA

Europe:

- 2,500+ MW in operation
- $100 BB in projects planned
- Manufacturing is growing
- Ports are being converted
- Jobs are being created
- Export of IP & expertise

Asia:

- $30 BB Investment in Wind
- Using European experience & dramatically driving costs down

The Model:
Resurgence of Bremerhaven, Germany

Boomtown Bremerhaven: The Offshore Wind Industry Success Story*

Formerly a region of high-unemployment, the German port of Bremerhaven has experienced a remarkable economic upturn, transforming into a major offshore wind power know-how centre and more.

At least four of Germany's North Sea and Baltic Sea major ports have been transformed into the country's main wind industry logistical centres and/or equipment manufacturing/supply bases during the past few years.

'Of the €500 million invested for offshore wind power development along the German North Sea coastal region during the past years, about half came to Bremerhaven.'

European Success = Asian Dominance

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- Asia Plans domination by 2015
  - Sinovel Plans to be #1 by 2015
  - 9X Total American Wind Energy
  - Investment is Staggering
    - $20.5 Billion
    - **$10 Billion (49%)**

- Econ 101
  - ✓ The Technology is Proven
  - ✓ Sales to North & South America = Profits at Home
  - ✓ Drives Manufacturing and Jobs at Home

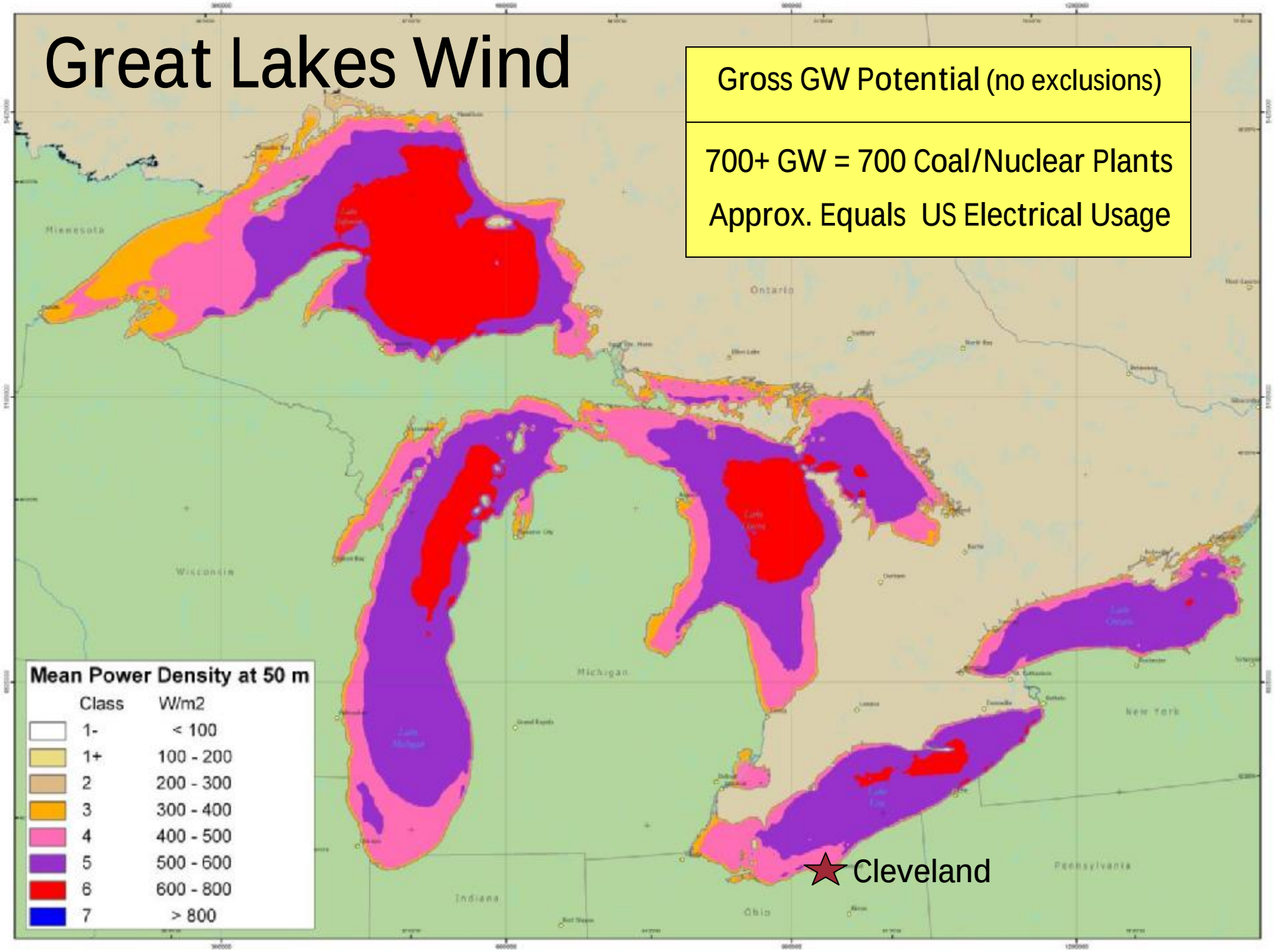
South Korea plans offshore wind project
South Korea plans to build an $8.2 billion offshore wind farm in the Yellow

Great Lakes Wind

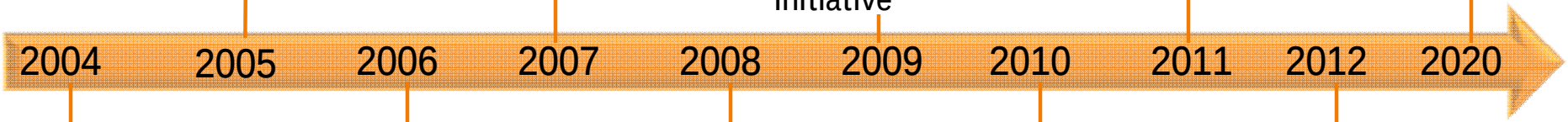
Gross GW Potential (no exclusions)

700+ GW = 700 Coal/Nuclear Plants

Approx. Equals US Electrical Usage



Timeline



2004

Cleveland Foundation Vision for an Ohio driven Lake Erie offshore wind industry.

2005

Cleveland Foundation funds anemometer on the City of Cleveland water intake crib 3.5 miles offshore.

2006

Cuyahoga County forms Great Lakes Energy Task Force to promote advanced energy in Ohio.

Cleveland Foundation funds the Great Lakes Science Center Wind Turbine on the Cleveland waterfront

2007

Task Force proposes offshore wind as a regional economic development engine, calling for a Feasibility Analysis.

2008

Feasibility Analysis is completed, confirming environmental and technical viability of offshore wind in Lake Erie.

2009

LEEDCo is formed as the vehicle to advance Ohio's offshore wind energy initiative.

SC2019 Advanced Energy Generation Initiative

2010

GE selected as turbine partner

Bechtel/GLWE/Cavallo selected as developer

Economic Impact Study by Kleinhenz Associates

Avian Radar/Bat Survey

Geophysical Survey

Basic Fisheries Survey

Shipwreck Survey

2011

Geotechnical, fisheries, historic preservation, & permitting analysis, power purchase agreement.

2012

Commence construction on initial five-turbine, 20 MW wind project.

2020

1000 MW in Lake Erie

Ohio becomes hub for a Great Lakes offshore wind industry.

Regional

Public/Private

Private Investment

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It's the Jobs

Offshore Epicenter

20 MW Pilot Project

Turbine Partner

"Freshwater Wind"

Research Partners

Strategic Advisors

LEEDCo Mission

First Offshore Project

- In Lake Erie/Great Lakes

Develop Infrastructure

- Ohio Captures Majority of Jobs

Maximize Opportunity

- Ohio Becomes Epicenter

Economic Development Study

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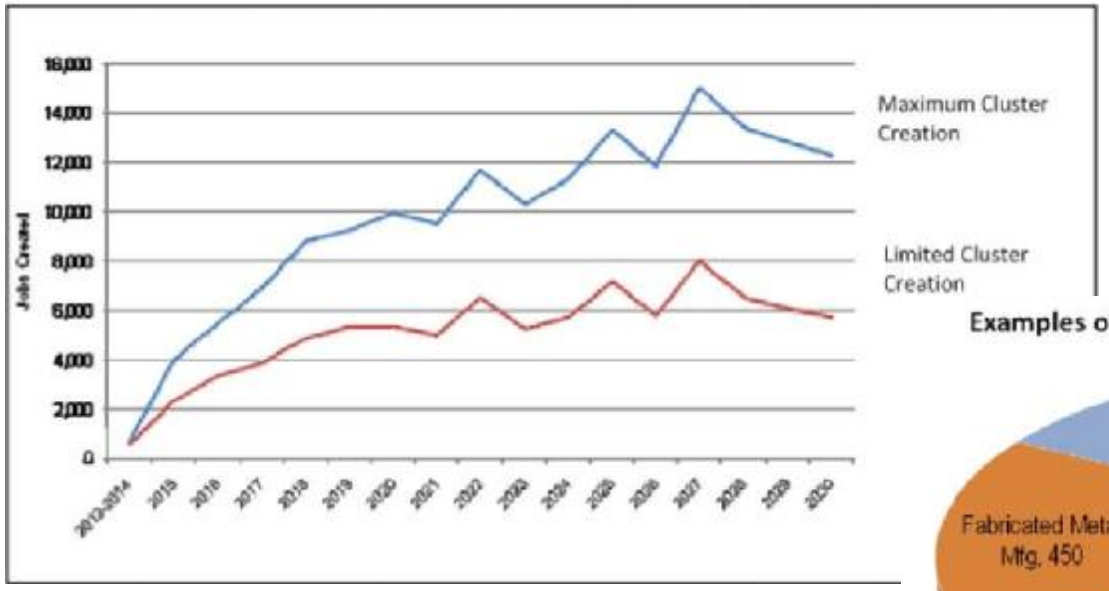
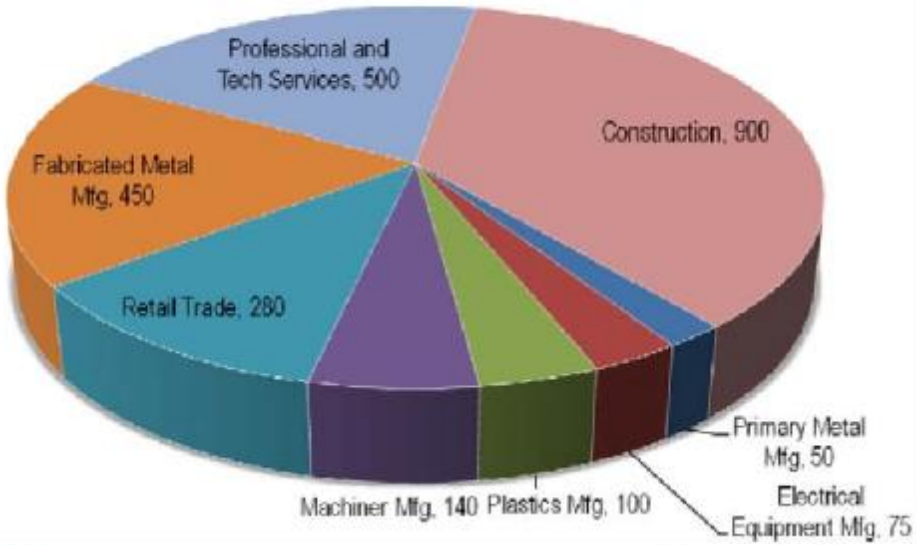
- Kleinhenz impact study sponsored by NorTech shows thousands of jobs just from Ohio projects.

Figure 6. Lake Erie Offshore Wind Industry: Potential Cluster Creation 5000 MW Scenario

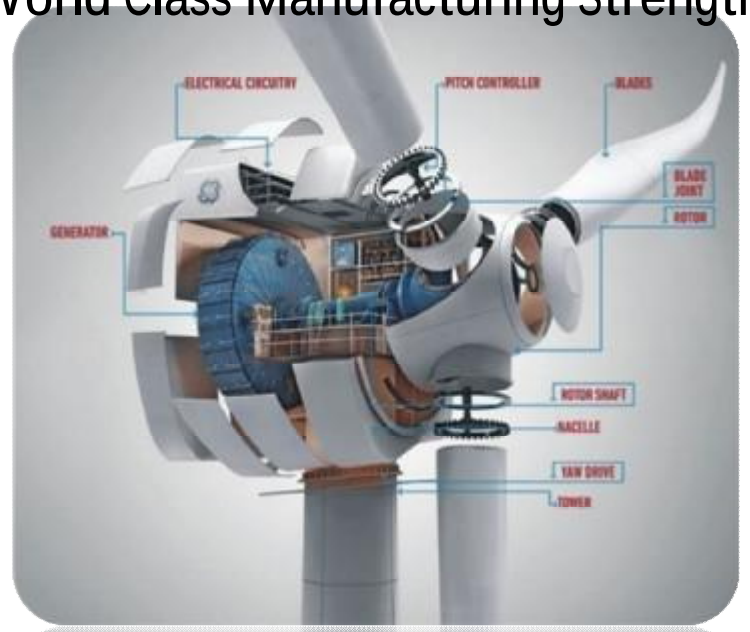


Examples of Short Term Job Creation by Major Sector (2018)



Ohio Currently…

- Ohio Already a Leader in Onshore Wind
- 7,500 Wind Manufacturing Jobs
- World Class Manufacturing Strengths



TIMKEN Lubrizol EATON Powering Business Worldwide LINCOLN ELECTRIC

AVTRON KELLY AEROSPACE Parker Great Lakes Construction, Inc. Rockwell Automation EBNER FAB kokosing CONSTRUCTION COMPANY INC.

Ohio Ports Can Dominate

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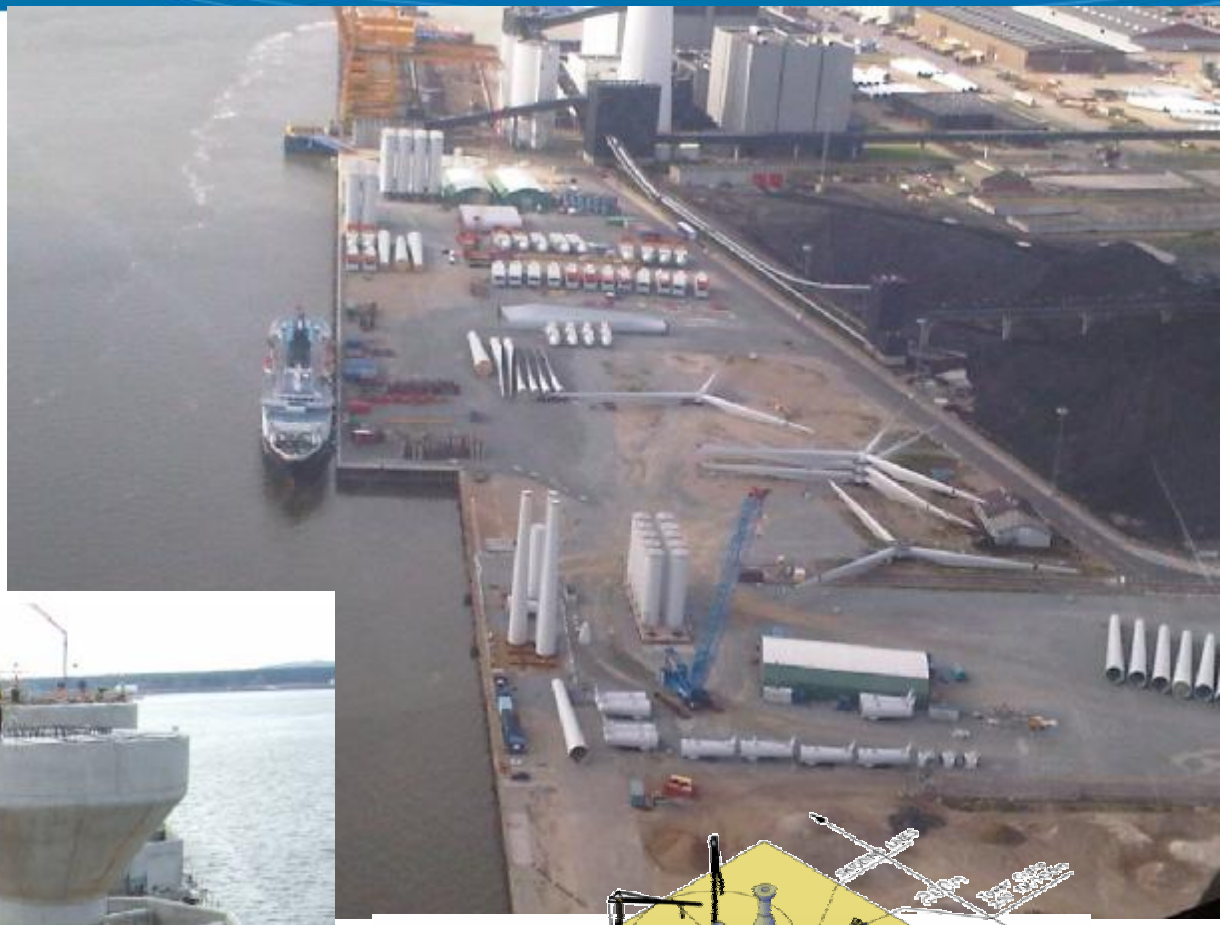
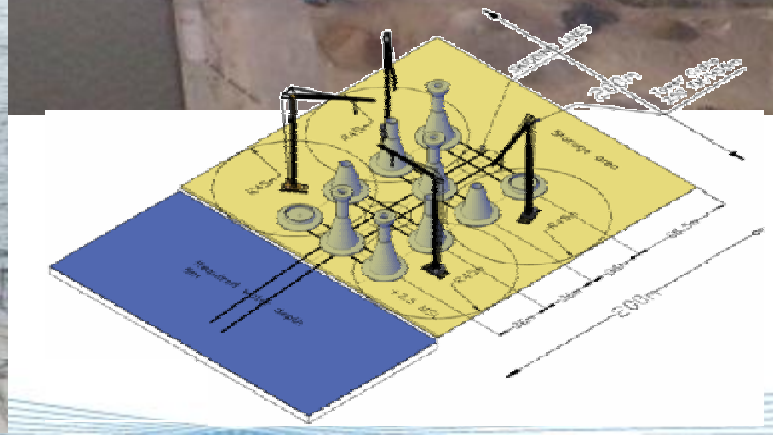
Large scale construction

- Initial Project fabrication & staging can be in Cleveland
- Jobs for 100's of Clevelanders
- Later Projects will Employ 1000's of Ohioans





...But There's More in Offshore

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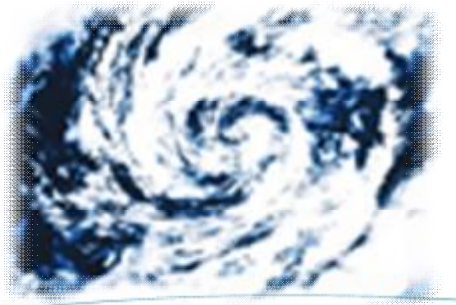

Lake Erie's Current Project

Collaborative Process

Consensus Building

Lease Option – 9 nm^2

Project Size – 3 nm^2

Lease Process in Place

Defined Path Forward

Steel Piles

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Offshore Nacelle

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Offshore Turbine Blade

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Offshore Wind Construction

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An Offshore Wind Community

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QUESTIONS?

Need More Information?

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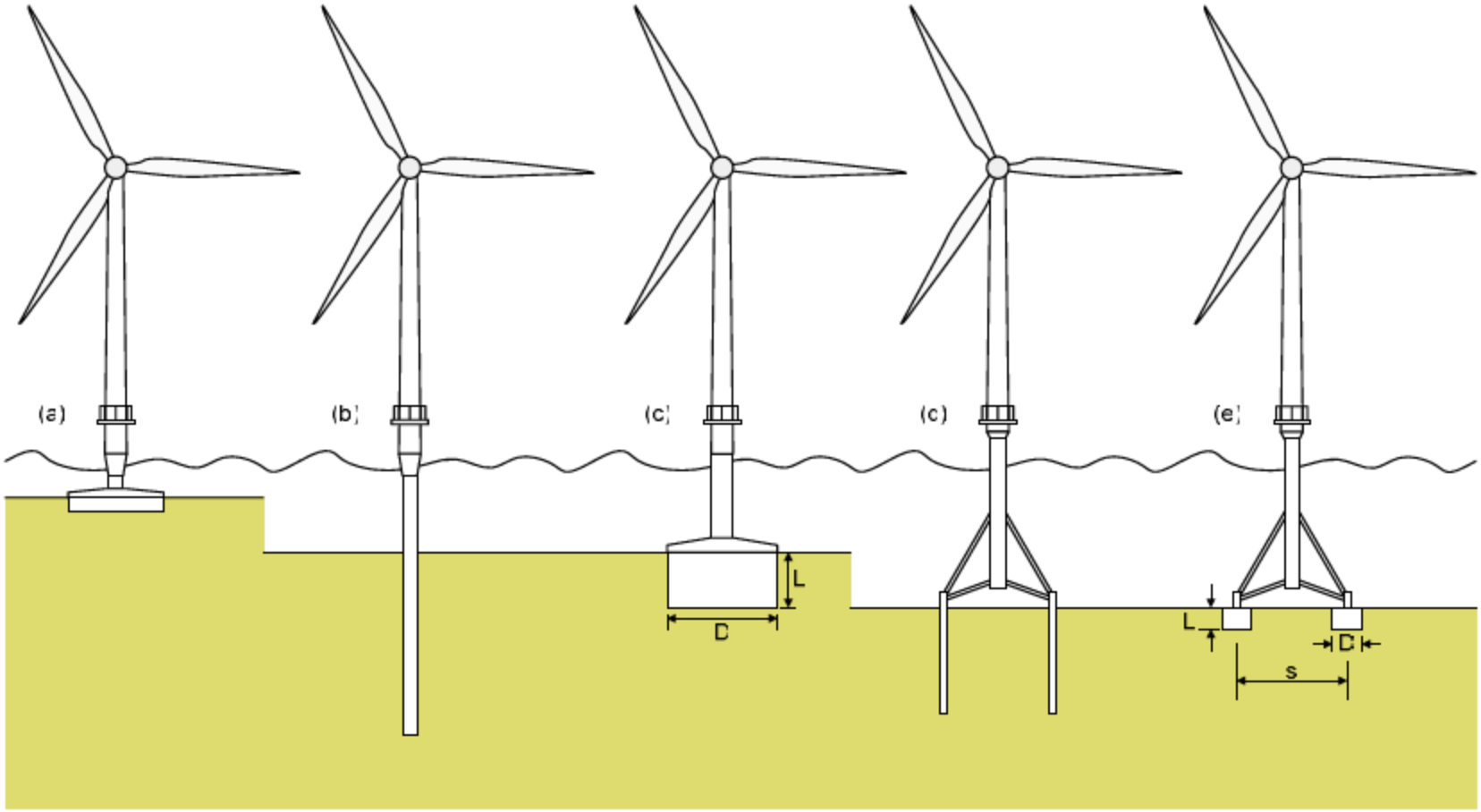
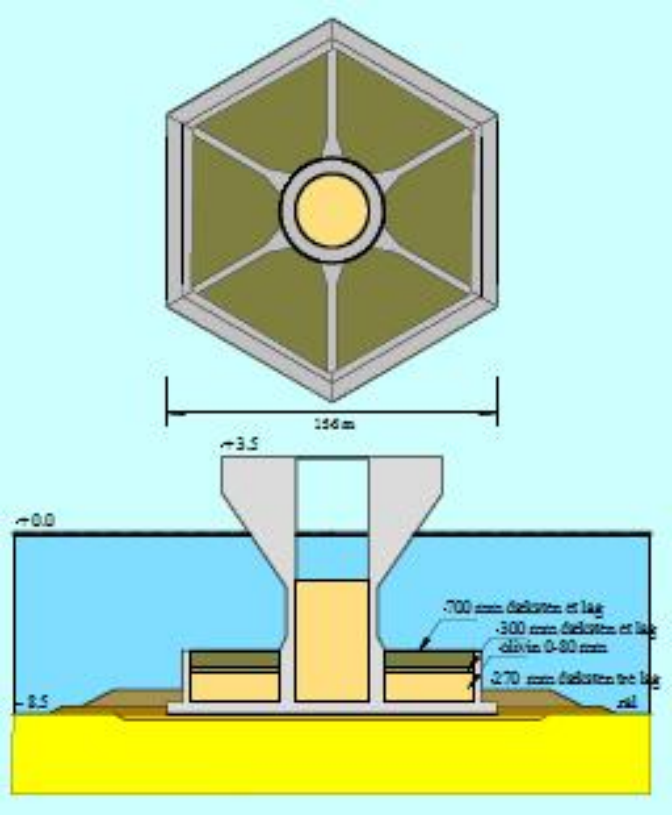
Foundations



Gravity Foundation



Offshore Turbine Tower

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Offshore Nacelle

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Offshore Substation

Where Europe is Headed

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Offshore Wind Construction

Offshore Wind Crew Transport

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Offshore Wind Subsea Cabling

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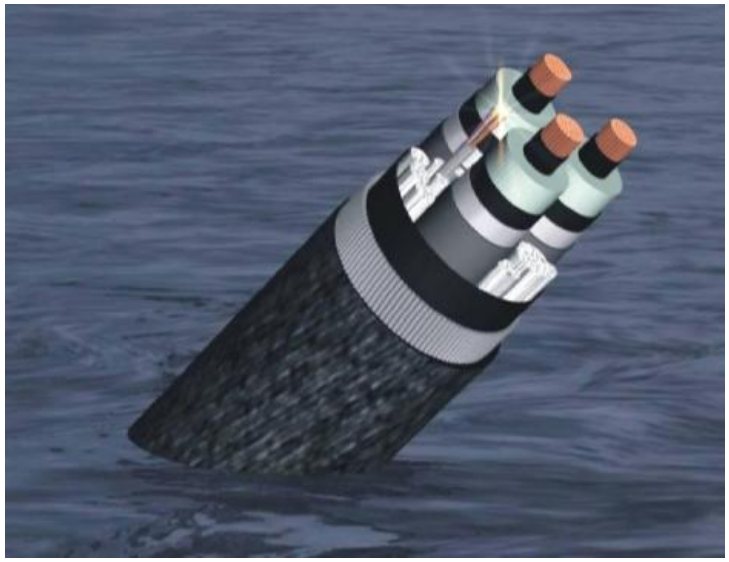

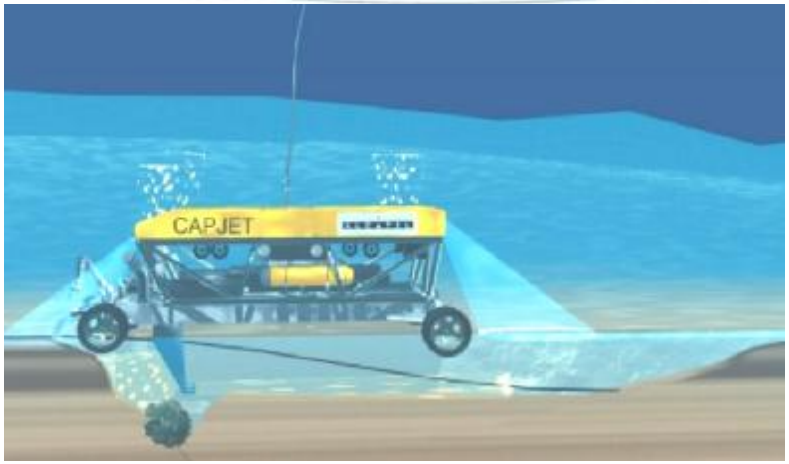

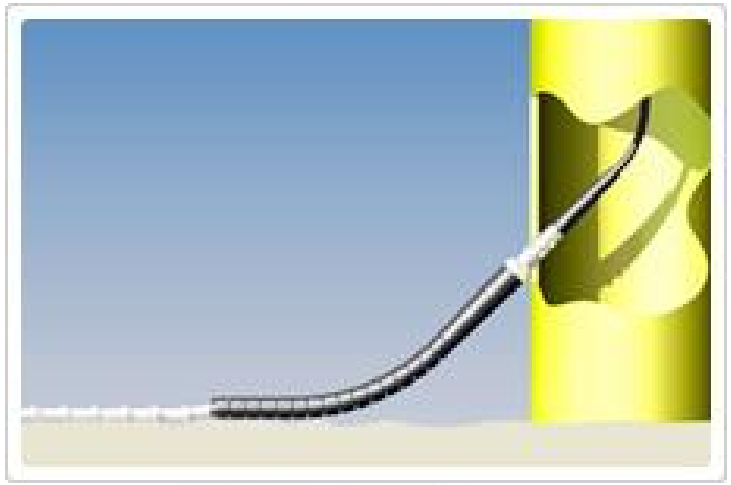

Current Cost of Offshore Wind

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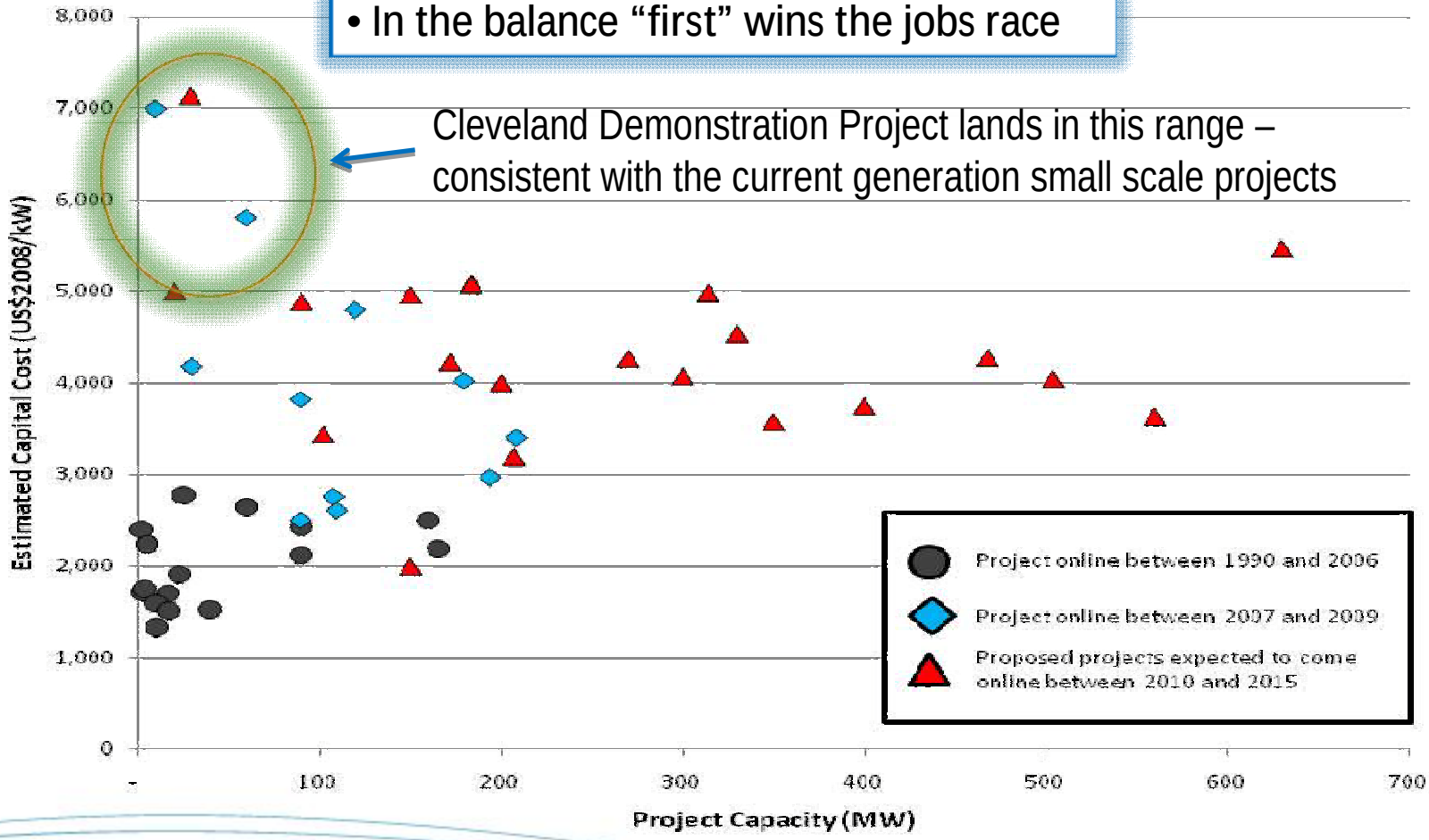
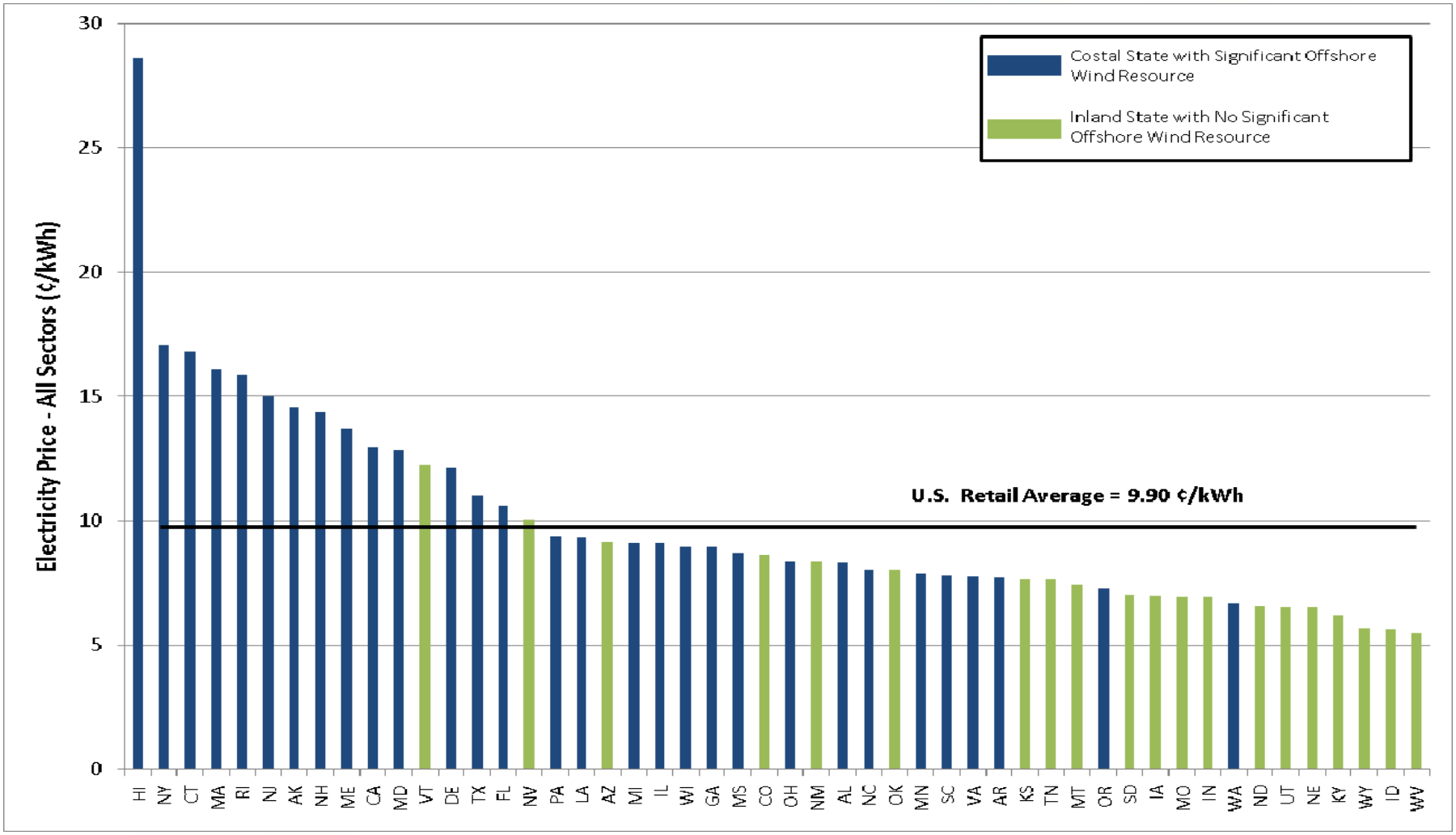
Trade-off:
- Small scale positions Ohio as first
- Small scale means higher price power
- In the balance "first" wins the jobs race

Cleveland Demonstration Project lands in this range – consistent with the current generation small scale projects



US Power Prices



The Vision

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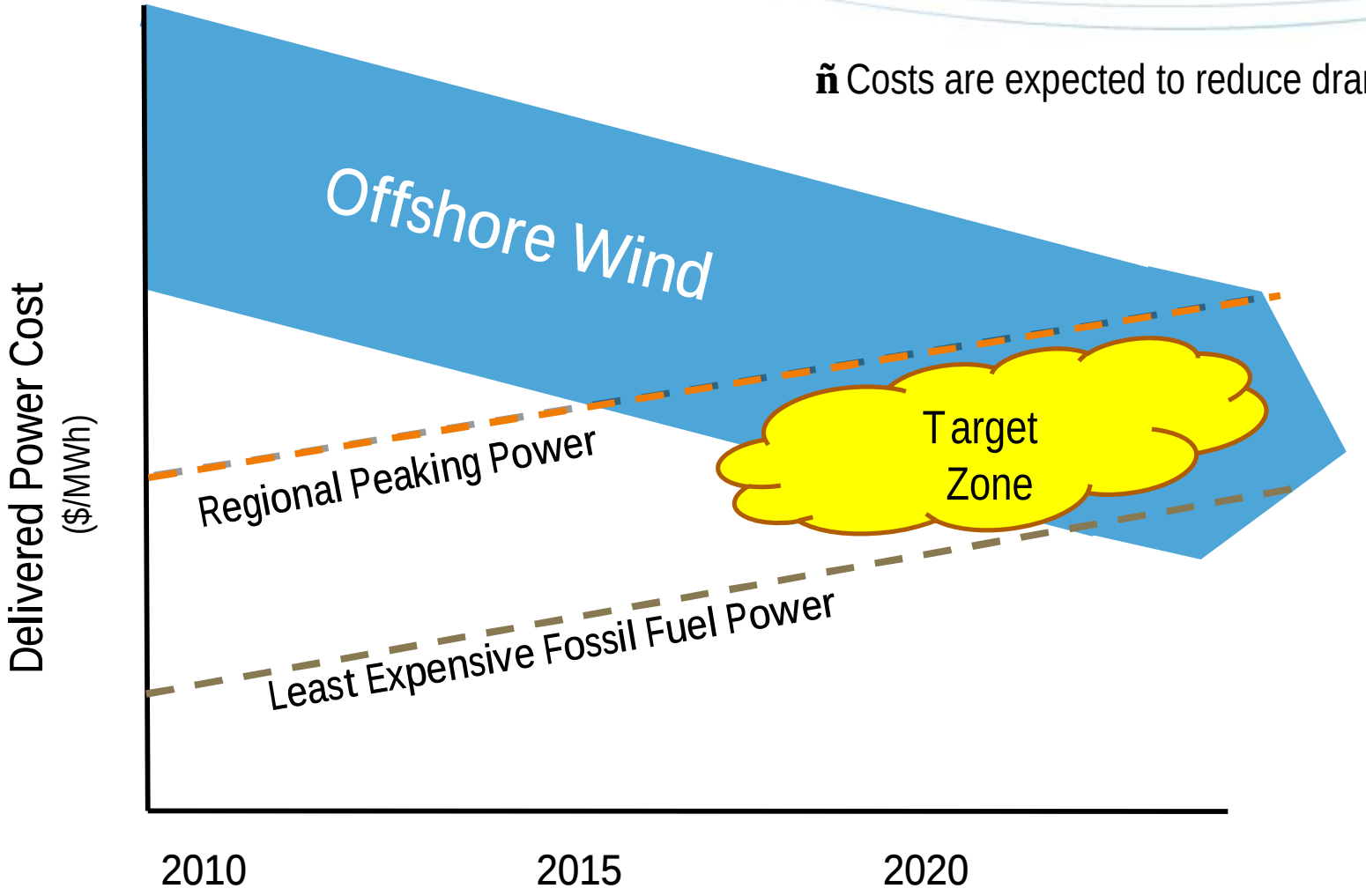
ñ Costs are expected to reduce dramatically



ñ Cost Curve driven by technology, manufacturing, & installation efficiency

Offshore Wind Another Look

Environmental Risks (physical/biological)

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- Seabed sediments
- Scour pits
- Riparian and coastal processes
- Seabed contamination
- Water and air quality
- Protected sites and species
- Benthic ecology
- Fish and shellfish/ Fisheries
- Birds
- Marine mammals and bats
- Cables and pipelines
- Military activities
- Disposal areas
- Electronic and magnetic fields
- Onshore grid connection
- Noise and vibrations
- Cumulative risks
- Climate change
- Decommissioning

Human Risks

- Worker health and safety
- Integrity of shoreline communities
- Tourism and recreation
- Aesthetics
- Cultural/historic views
- Property values
- Conflicting uses/accidents
- Shipping and navigation
- Noise
- Radar/radio disturbances (military/commercial uses)
- Transmission lines
- Electromagnetic fields
- Marine archaeology
- Cumulative risks (e.g., air quality)

Risk = Context

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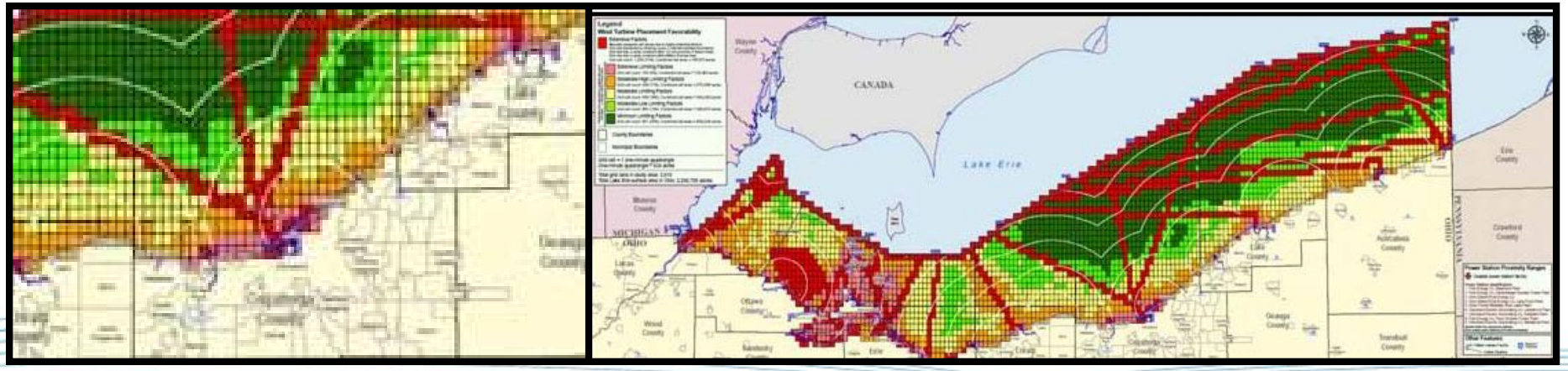
Subject To: regulations, expert opinions, and politics

- MMS Guidelines and NEPA compliance (data/procedures)
- Thresholds of adverse impact
- Public hearings
- Regulatory triggers, e.g., threatened and endangered species
- Joint permitting process
- Utility corridors
- Exclusion zones/GIS mapping (ODNR a leader in Great Lakes)



Risk Assessment

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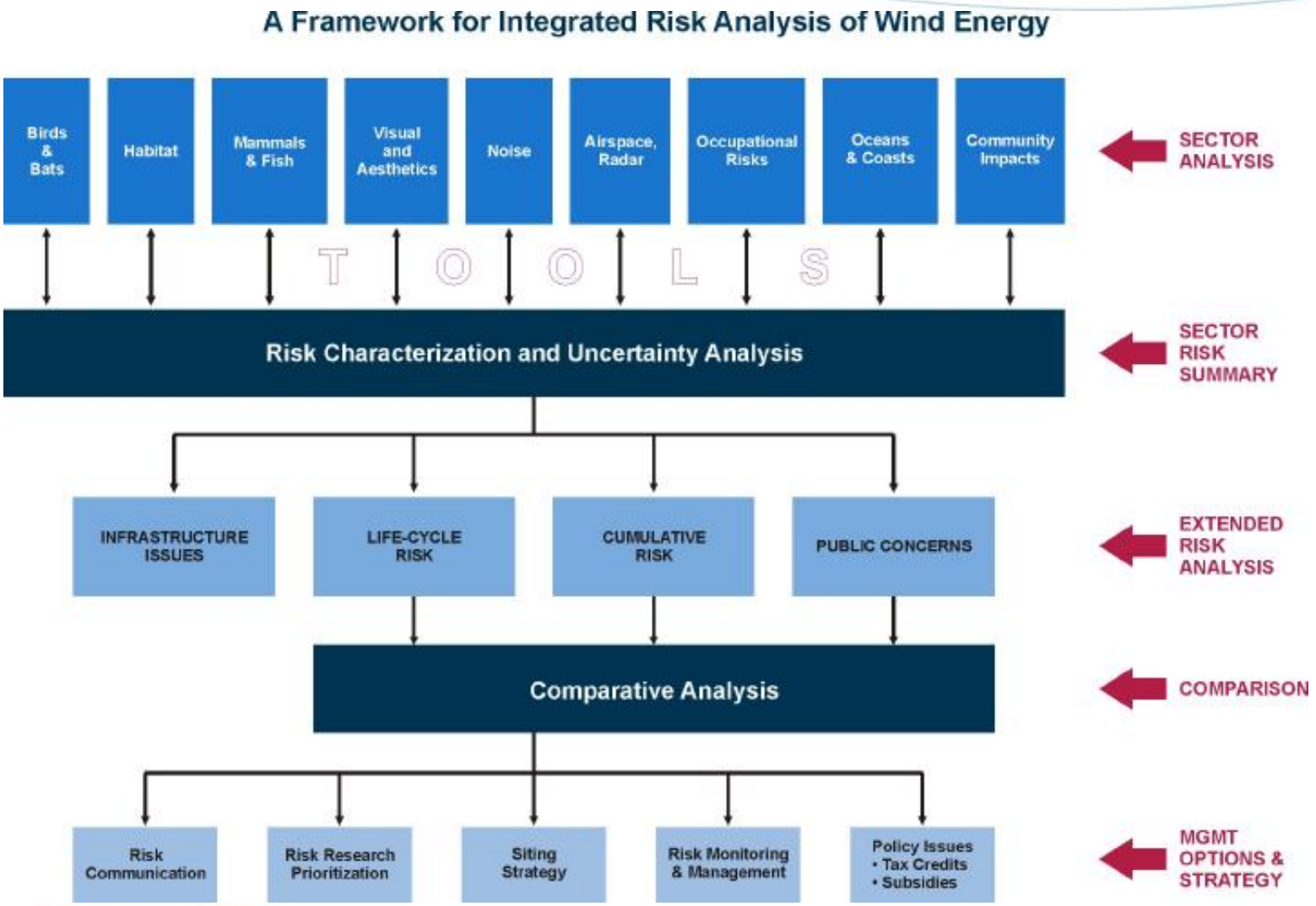

Fill in Knowledge Gaps

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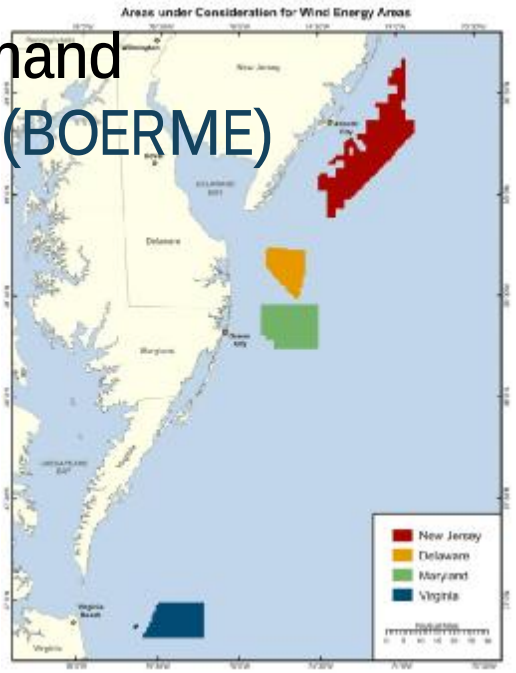
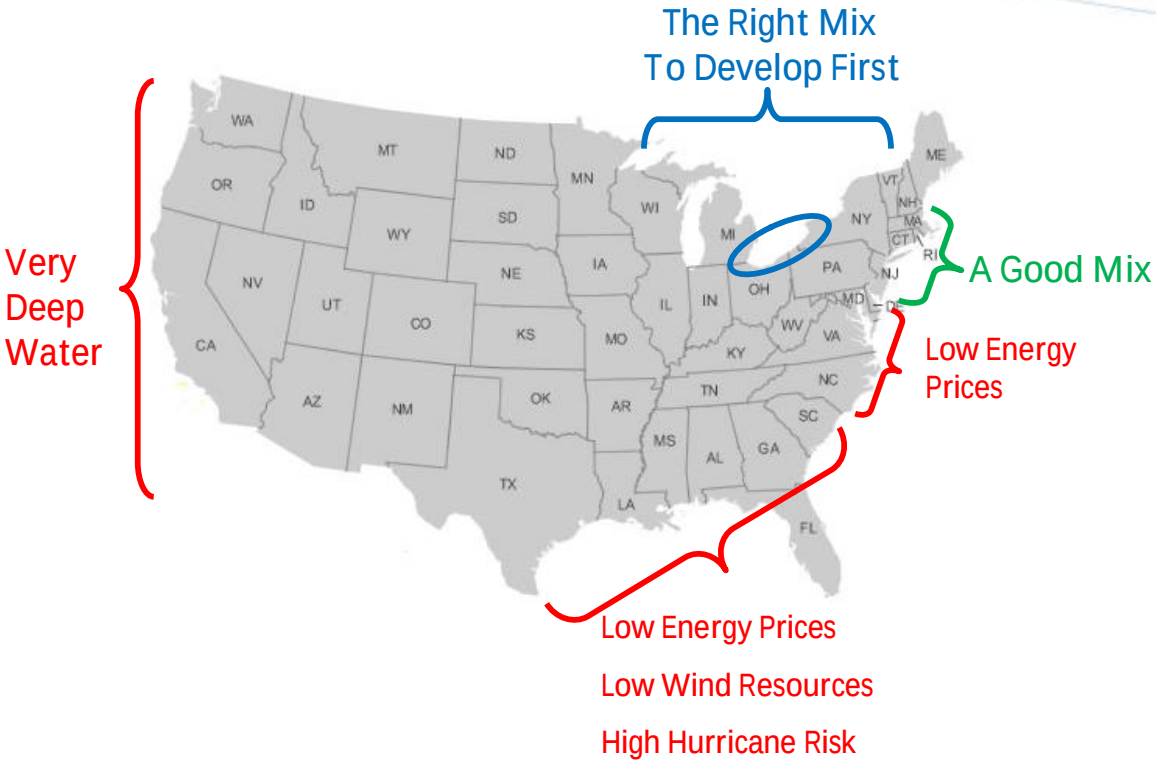
- Validate wind resource assessments (Cleveland Crib/NREL)
- Initiate integrated risk analysis

- Establish knowledge base for comparative risks/benefits
- Designate renewable energy zones where demand
  - Wind Energy Areas – Smart from the Start (BOERME)



- One-stop shop for permitting/lease fees
- Finance baseline studies/research priorities
- Sustained public dialogue

Domestic Offshore Wind



Select Great Lakes Projects*

MI – Scandia Wind – 150 MW
NY – NYPA – 100-500 MW
WI – Aquilo Wind – 50 MW
IL – Evanston – 200 MW
OH – LEEDCo/Freshwater Wind – 20 MW
OH – LEEDCo/Freshwater Wind – 1,000 MW

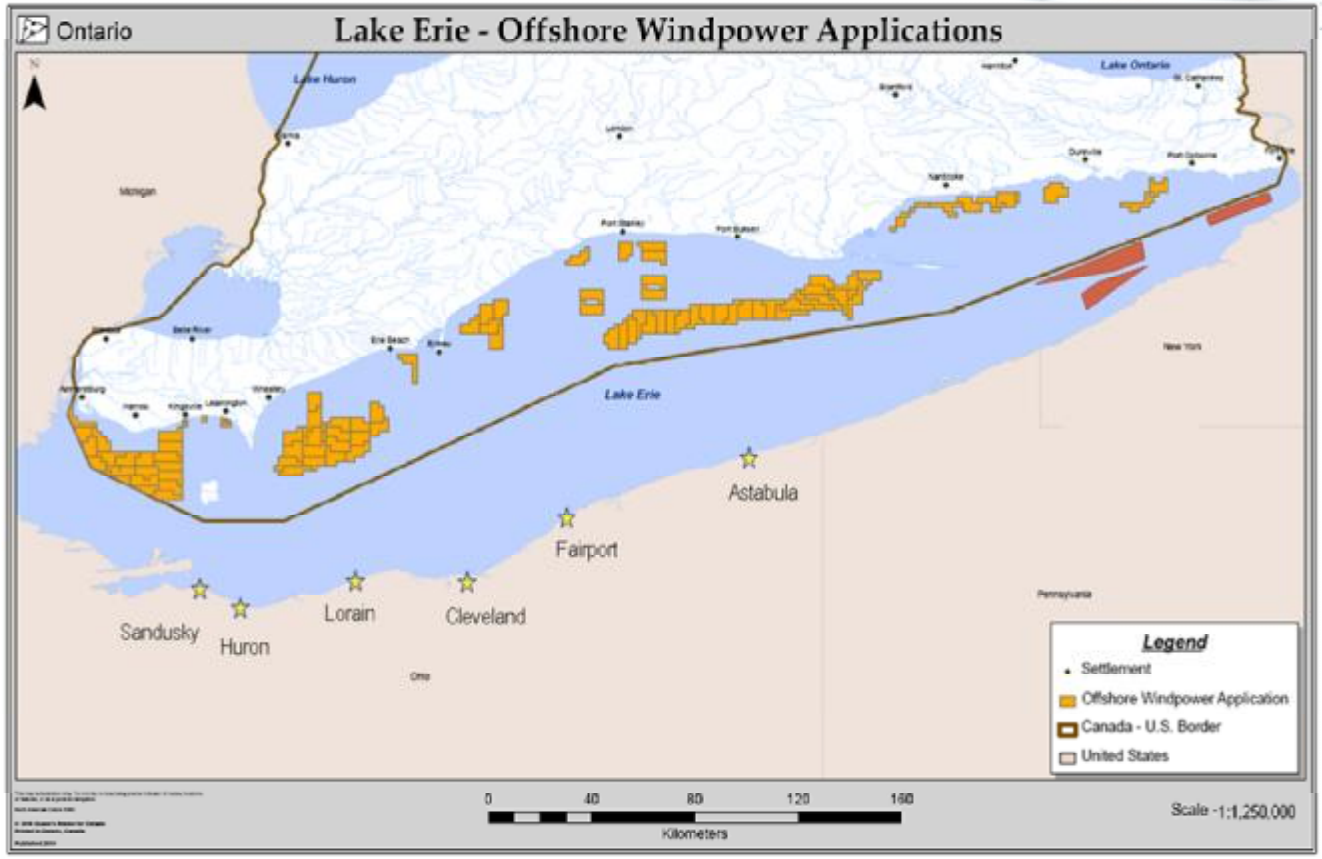
Select East Coast Projects*

MA – Hull - 15 MW
MA – Cape Wind – 468 MW
RI – Deepwater Wind/Block Island – 30 MW
RI – Deepwater Wind/RI Sound – 385 MW
NY – Con Ed/LIPA – 350/700 MW
NJ – Fishermens Energy Atlantic City – 20 MW
NJ – Fishermens Energy Federal Waters – 350 MW
NJ – Garden State Offshore Energy – 350 MW
NJ – NRG Bluewater Wind – 350 MW
DE – NRG Bluewater Wind – 300-450 MW
VA – APEX Wind – 1,200 MW
VA – Seawind Renewable Energy – 1,000 MW

What does this mean for Ohio?

- *Sputnik moment…*
- *Ready or not: Offshore wind industry is coming*
- *Urgency: Race is on to capture economic benefits*
- *Utilize momentum to be first in the water*

Current Lake Erie Activity



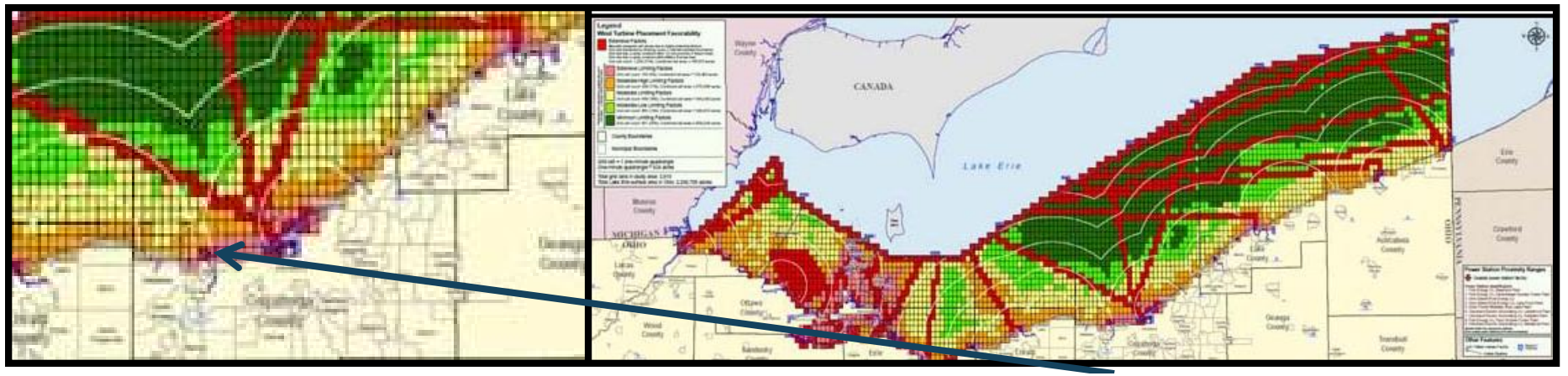
- Canada - 4,500 MW
  ~1500 Turbines
- New York – 500 MW
  ~150 Turbines
- Penn. – 1000 MW
  ~ 300 Turbines

ü Ohio's ports are ideally suited for serving the industry – <u>maritime & logistics jobs</u>

ü 50% of Canadian projects content can be outsourced – <u>manufacturing & engineering jobs</u>

Ohio Positioned to Win

- ü Regulatory Leadership
  - ØODNR
  - ØUSACE
- ü Manufacturing Strengths
- ü Collaborative Process
- ü Consensus Building
- ü Active R&D Institutions
- ü Private Investment



Bird Habitat - Bird Migration - Distance from Shore - Fish Habitat
Industry & Restricted Areas - Lakebed Sediments – Shipping - Shipwrecks,

Development Plan Outcome

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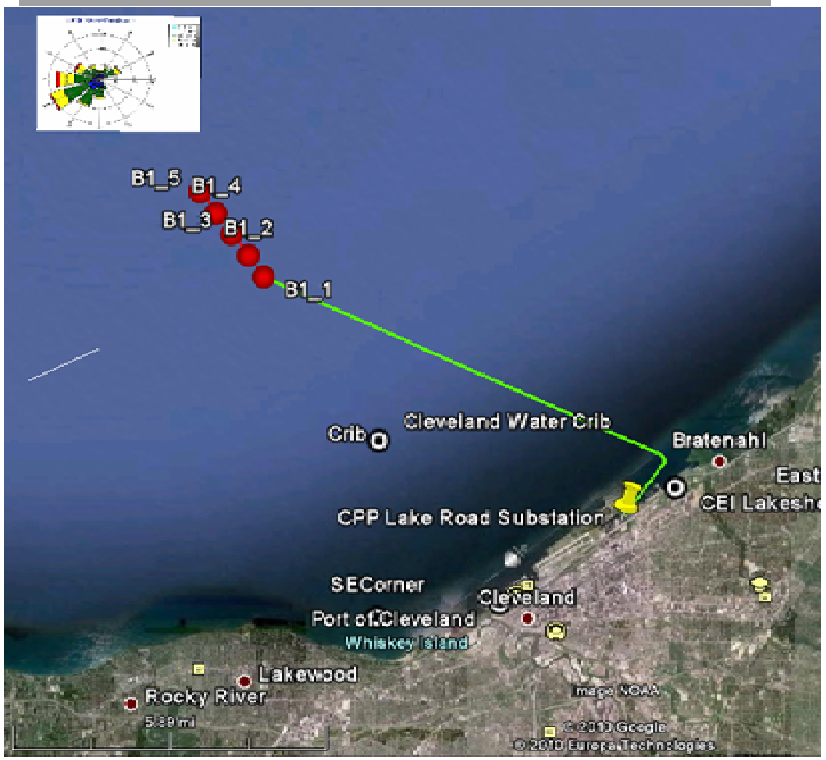
Initial Project – Start Small



- Implementation is More Predictable
- Guidance for Next Projects

Commercial Scale – Think Big

- 1 nm Spacing is Typical
- Turbines 10 – 15 nm Offshore

Located in favorable areas per ODNR suitability

Why Offshore Wind?

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- Energy production potential is immense
  - –Great Lakes region has wind production capacity to satisfy U.S. demand
- Proximity to major population centers
- Stronger and steadier than land-based winds
- Large-scale, virtually "out of sight" projects
  - –Voids noise & aesthetics issues surrounding land turbines

Depth	Lake Erie	All Great Lakes
< 20 m	44 GW	151 GW
20-30 m	21 GW	58 GW
30-40 m	3 GW	40 GW
Total < 40 m	68 GW	249 GW

Leave behinds

Executing on the Opportunity

LEEDCo has:

1.Created political momentum behind job creation

2.Completed many development activities.

Development inroads that have greatly accelerated the ability to build the project include:

- 4 years of Meteorological data
- Avian Studies
- Benthic Studies
- NEPA consultations
- Agency Consultations
- Vessel negotiations
- Political momentum to secure rate-based PPAs with power offtakers
- Agreement to socialize cable costs
- MOUs with Counties on agency to offer submerged leases
- MOU with GE regarding turbine supply and manufacturing

Bottom Line: LEEDCo's activities have accelerated development by 2 years