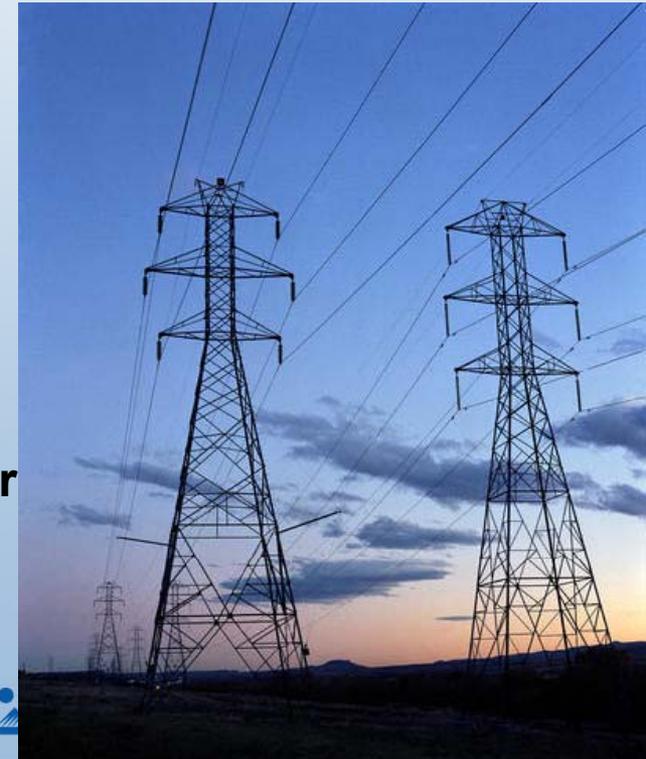




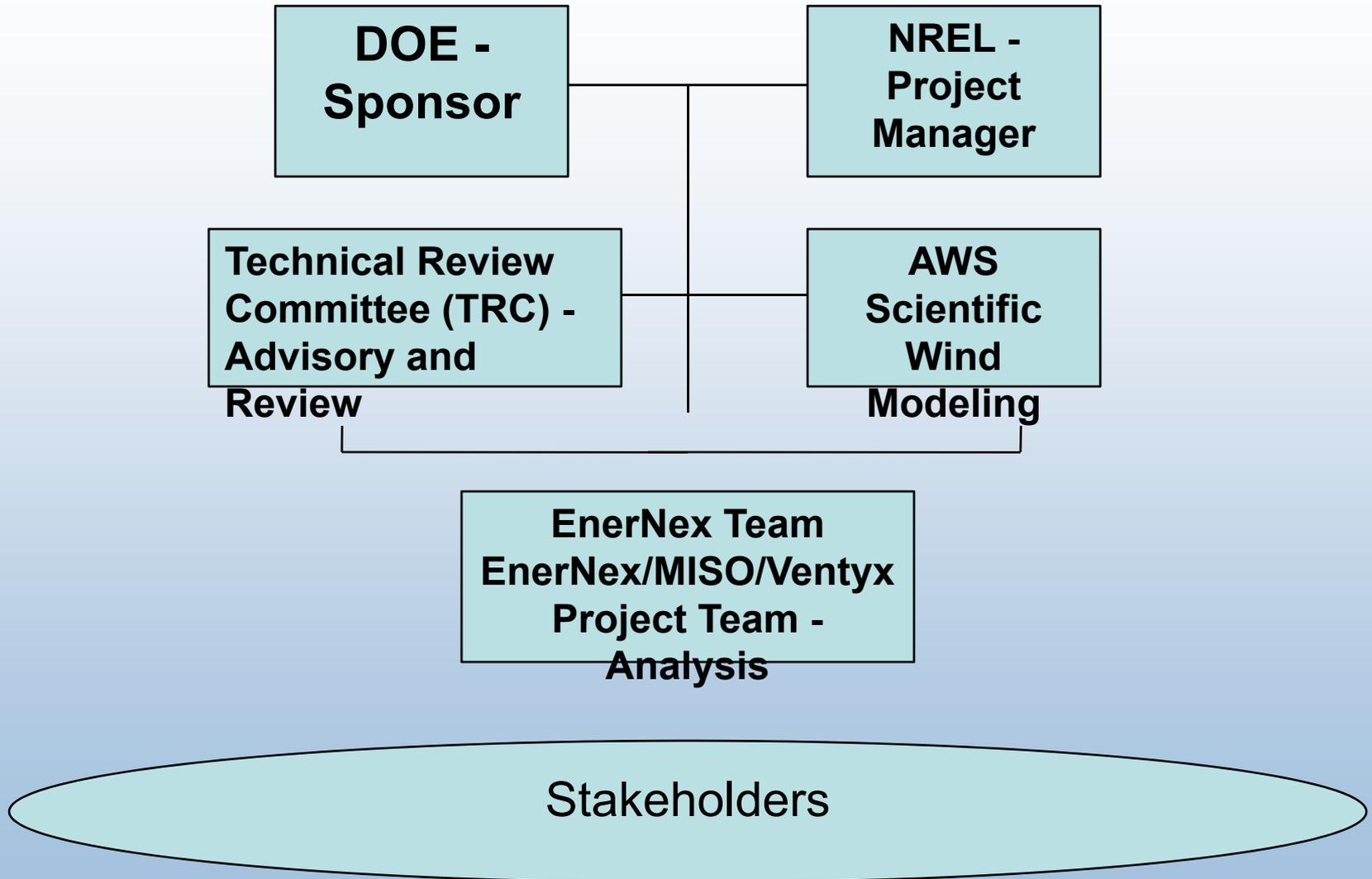
Eastern Wind Integration and Transmission Study Overview

TRC Meeting #1
St. Paul, MN
Aug. 19, 2008

Dave Corbus
National Wind Technology Center
National Renewable Energy Lab



Project Organization



Objectives of Eastern Wind Integration and Transmission Study (EWITS)

- Evaluate the power system impacts and costs and transmission associated with increasing wind capacity to 20% and 30% of retail electric energy sales in 2024 for the study area
 - Study Area includes (MISO/PJM/SPP/TVA /MAPP/NYISO/ISO-NE) and other interested parties
- Build upon prior wind integration studies and related technical work;
- Coordinate with JCSP and current regional power system study work;
- Produce meaningful, broadly supported results through a technically rigorous, inclusive study process.

Key Issues & Questions include

- What system operational impacts and costs are imposed by wind generation variability and uncertainty?
- What are the benefits from long distance transmission that accesses multiple wind resources that are geographically diverse?
- What are the benefits from long distance transmission that move large quantities of remote wind energy to urban markets?
- How do remote wind resources compare to local wind resources?

Key Issues & Questions include

- How much does geographical diversity help reduce system variability and uncertainty?
- What is the role and value of wind forecasting?
- What benefit does balancing area cooperation or consolidation bring to wind variability and uncertainty management?
- How does wind generation capacity value affect reliability?

Joint Coordinated System Plan (JCSP)

- The 2007/2008 Joint Coordinated System plan will include MISO, PJM, SPP, TVA, MAPP, NYISO, ISO-NE plus other interested parties
- The JCSP will perform a long term planning study incorporating both economic (2024) and reliability (2018) analysis of system performance for the combined four JCSP areas
- Collaboration with the parallel DOE Eastern Wind Integration & Transmission Study will provide underlying assumptions for generation scenarios
- Scheduled to be completed December 2008

Key Tasks- Eastern Wind Integration & Transmission Study

- Mesoscale modeling and Siting
- Transmission Study
 - In conjunction with JCSP study
- Integration Study

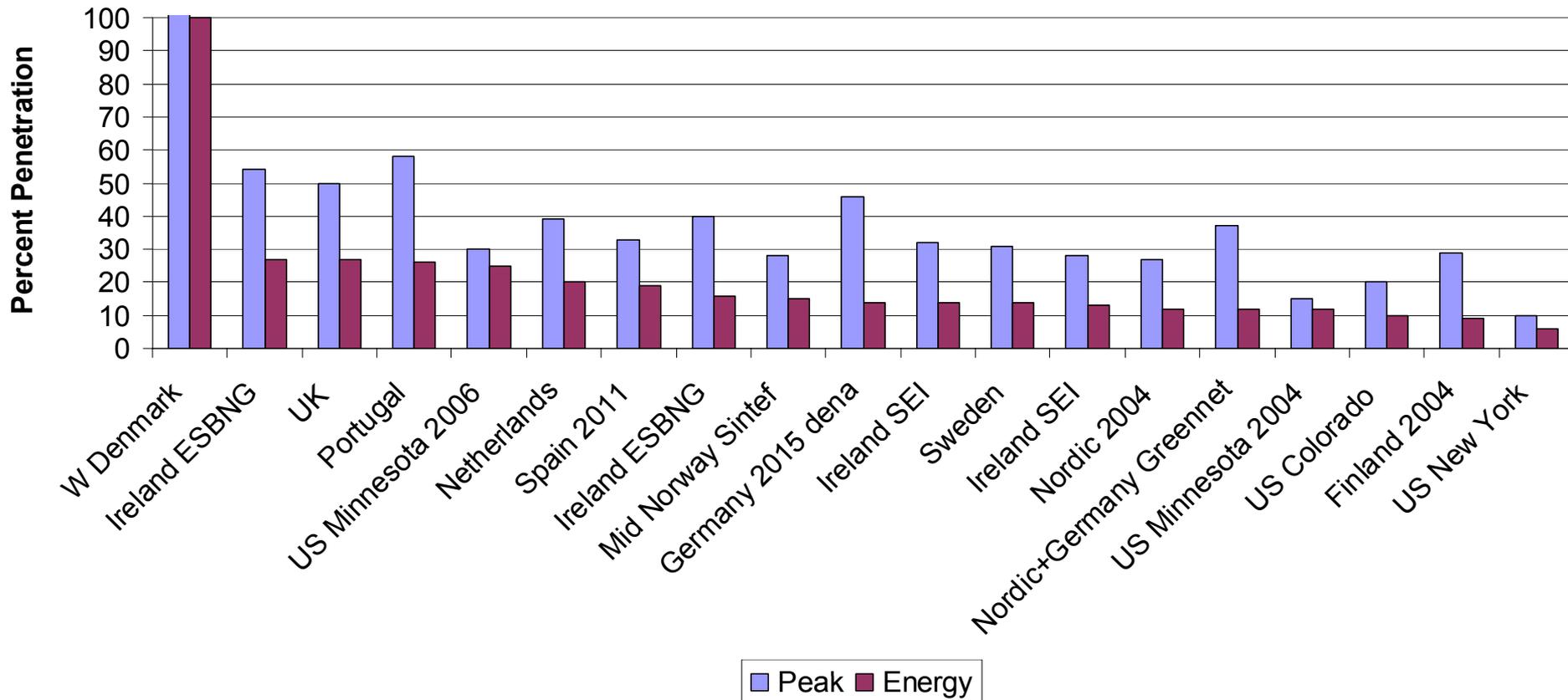
Key Tasks - Mesoscale Modeling

- Develop high quality wind resource data sets for the wind integration study area
 - Mesoscale modeling
 - 3 years of time series data
 - 10-minute data at 2 km spatial resolution
- Develop wind power plant outputs
- Identify wind sites

Key Tasks- Wind Integration Study

- Evaluate operating impacts
 - Regulation
 - Load Following
 - Unit Commitment
- Evaluate reliability impacts (ELCC/LOLP)
- EWITS is a wind integration study
 - Focus on operating impacts in all time frames and reliability impacts in the planning time horizon
 - What are the integration costs and issues for 20 and 30% wind?

International Energy Agency Report: Wind Integration Studies



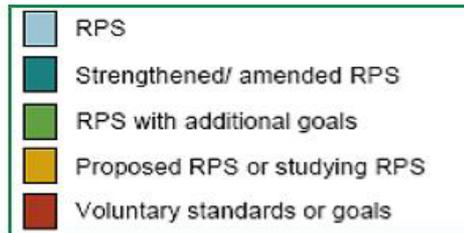
- Recent International Energy Agency Report: *Design and operation of power systems with large amounts of wind power*

http://www.uwig.org/IEA_Annex25-State_of_the_Art_Report.pdf

Scenario Development and Siting

- Four Different Scenarios
 - 20 and 30% wind scenario
 - Scenario that emphasizes high capacity factor wind development in the Midwest with larger transmission component
 - Scenario as above but also emphasizes development of regional wind resources with lower capacity factors
- All of four scenarios require a lot of wind and transmission!
 - Some offshore wind required
- NREL/AWS have identified over 700 GWs of wind plants for the study team to develop sites for the 4 scenarios with input from the TRC
 - Scenario sites will be selected from the “Superset” of 700 GWs of sites

Why 20% and 30% Wind?



MT: 15% by 2015

WA: 15% by 2020

OR: 25% by 2025
(small utilities, 10%)

NV: 20% by 2015;
solar 5% per year

CA: 20% by 2010

AZ: 15% by 2025, of
which 30% is distributed

NM: 20% by 2020
(co-ops 10%)

CO: 20% by 2020;
including 4% solar

KS: 20% wind by 2020

TX: 5,880 MW by 2015

FL: 20% by 2020

HI: 20% by 2020

ND: 10% by 2015

MN: 25% by 2025;
(Xcel 30% by 2020)

IA: 2% by 2011

MO: 11% by 2020

WI: 10% by 2015

IL: 25% by 2025

IN: 10% by 2017

OH: 20% by 2023

VT: load growth to
10%, 2007-12

NH: 23.8% in 2025

ME: 30% by 2000;
10% new by 2017

MA: 4% by 2009; +
1% annual increase

RI: 16% by 2019

CT: 27% by 2020

NY: 24% by 2013

NJ: 22.5% by 2020;
including 2% solar

DE: 20% by 2019,
including 2% solar

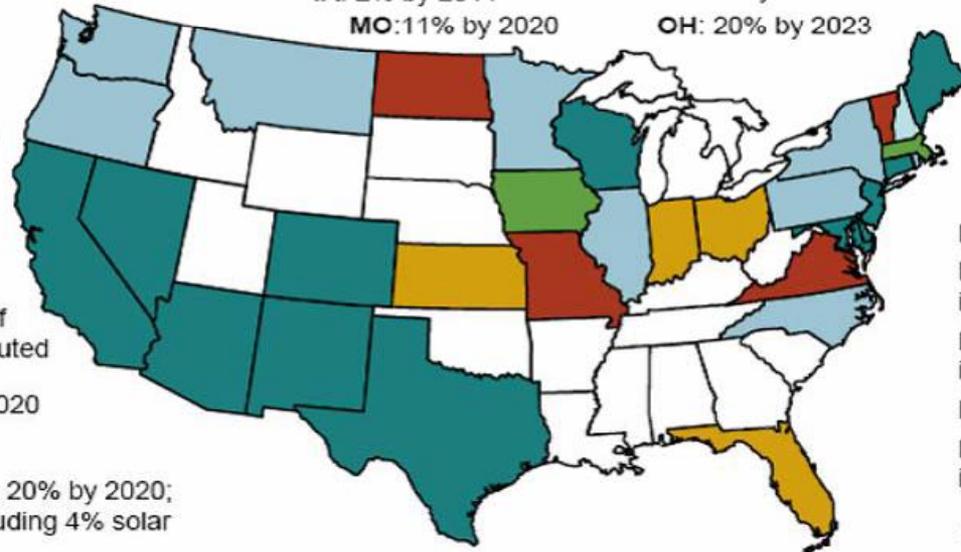
PA: 18% by 2020

MD: 9.5% in 2022,
including 2% solar

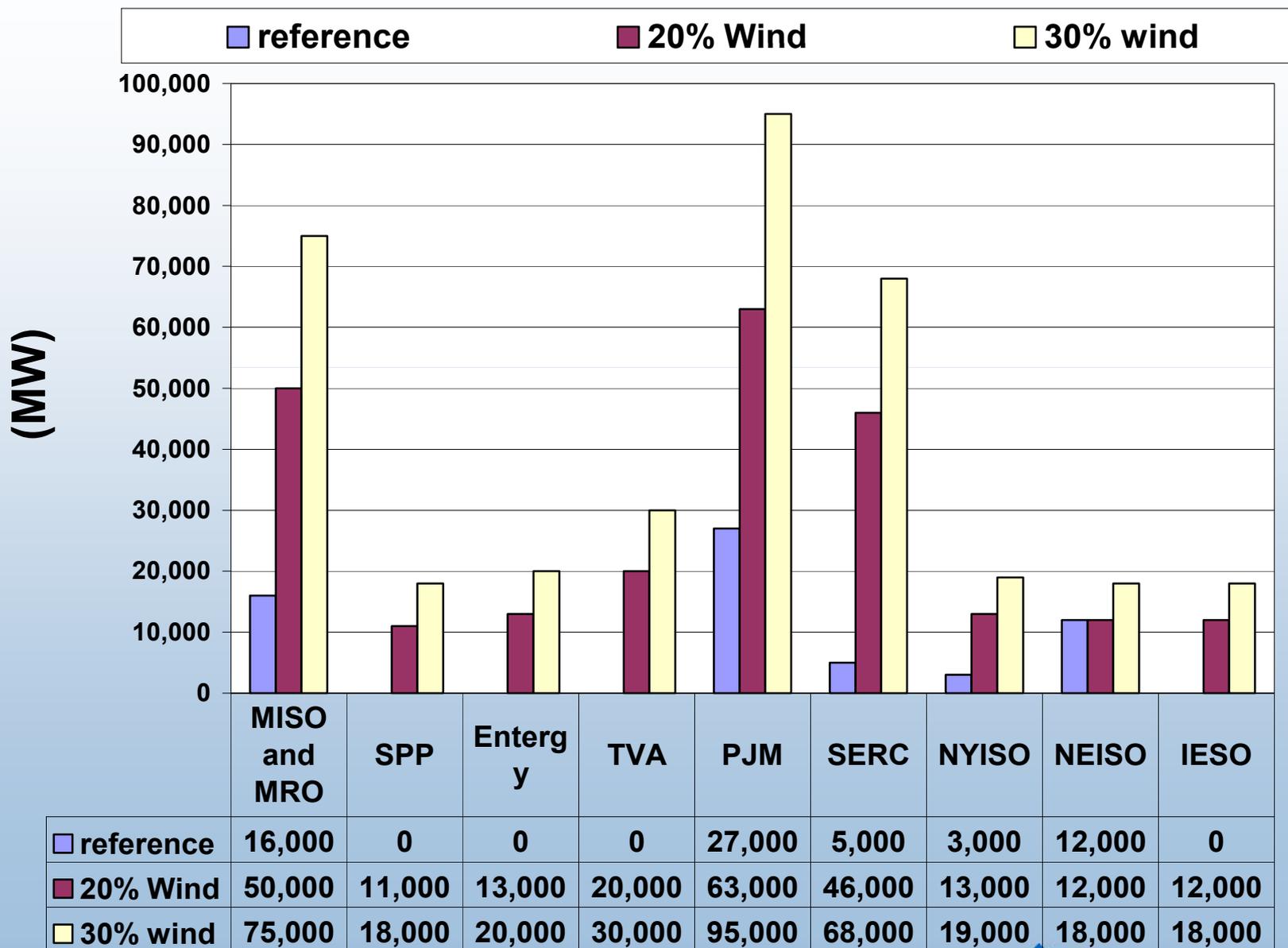
DC: 11% by 2022

VA: 12% by 2022

NC: 12.5% by 2021



Regional Wind Requirements

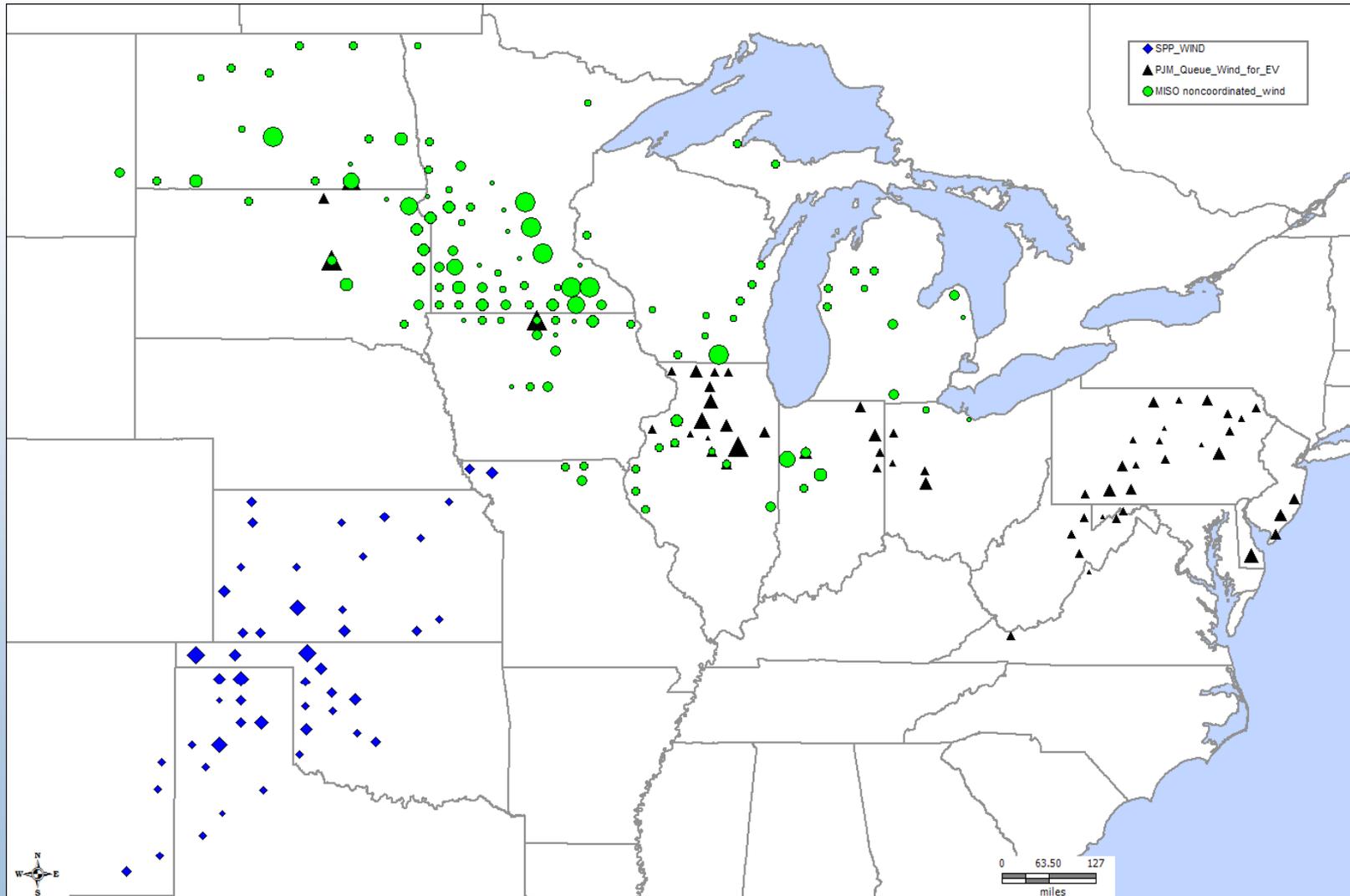


Key Tasks- Mesoscale Modeling and Siting

- Identify wind power generation sites for 20% & 30% wind energy scenarios
 - 700 GWs of total wind power plant data generated in time series for 3 years!

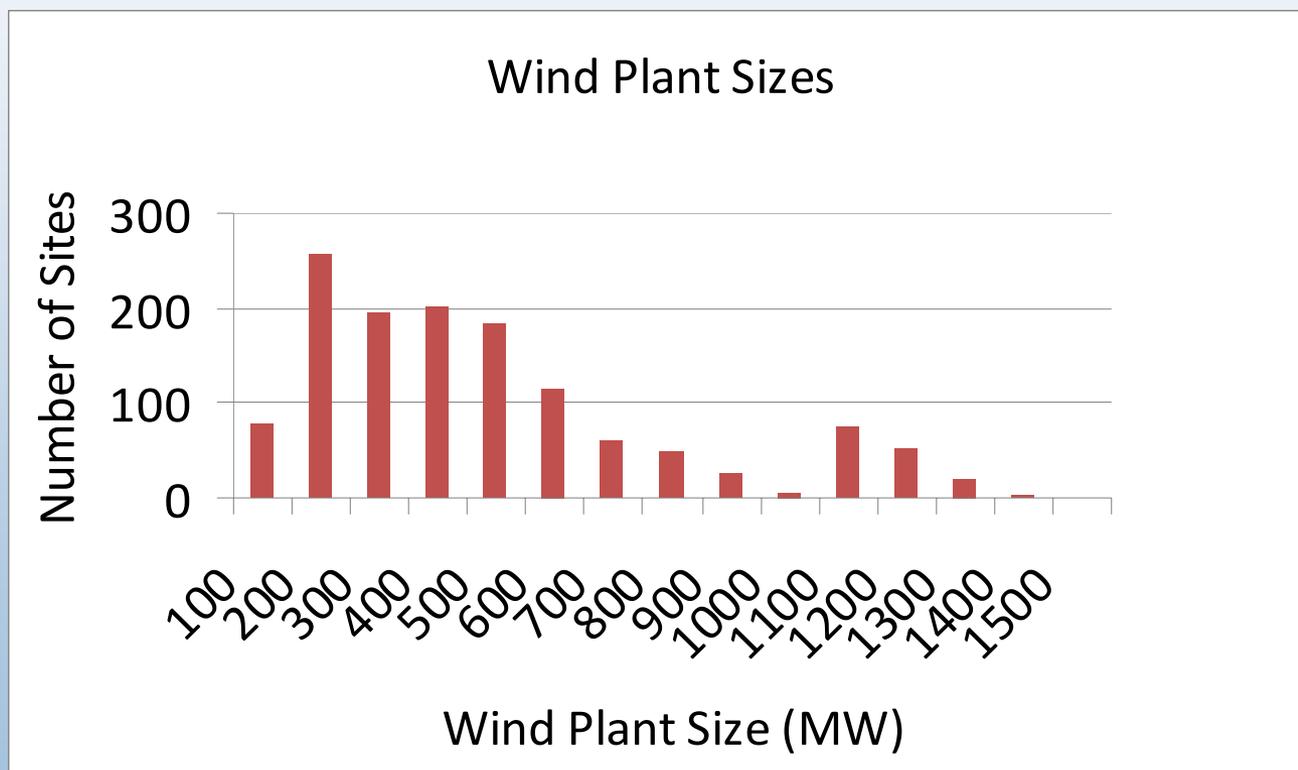


Existing Queue Data



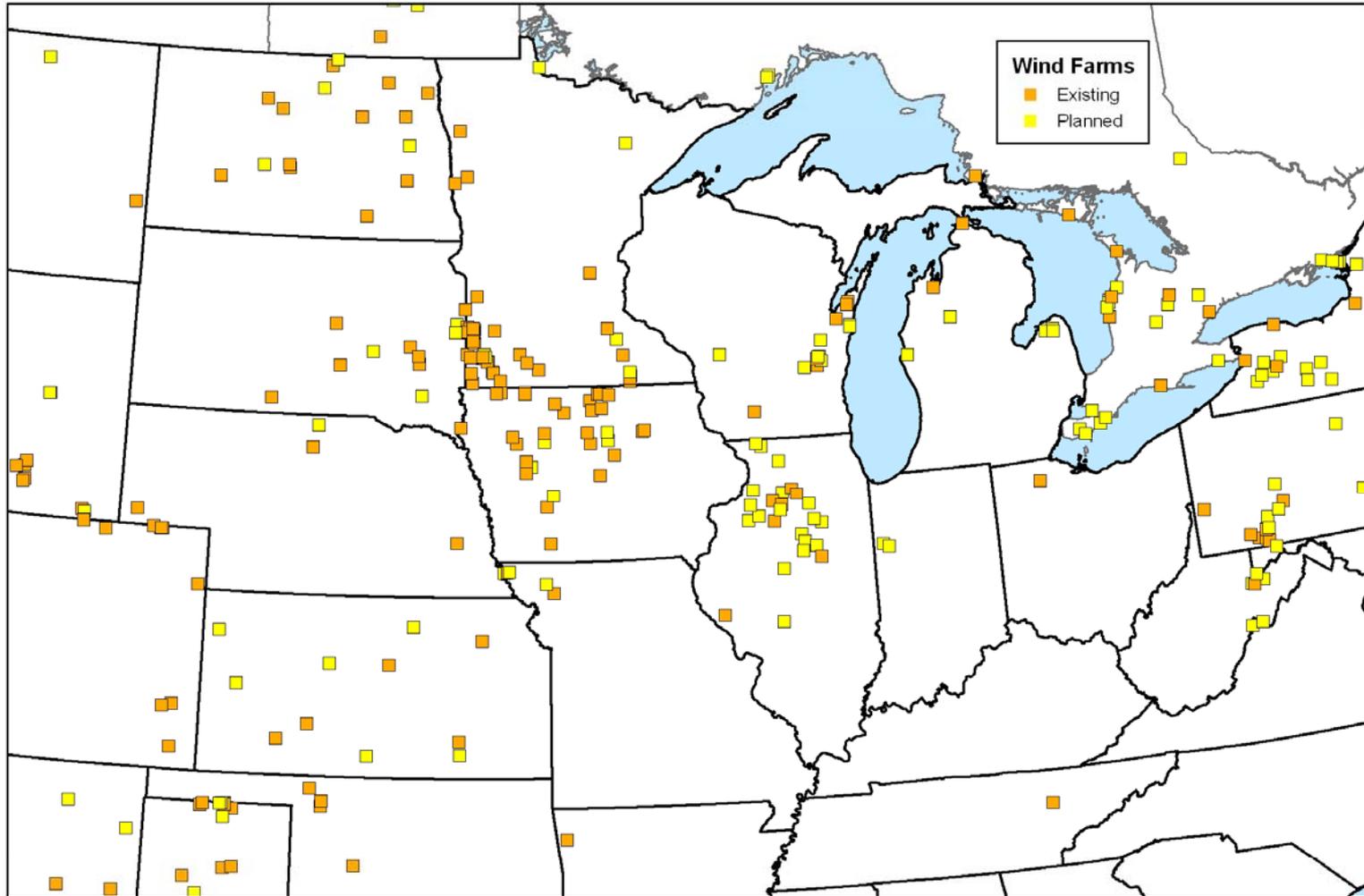
Superset of Wind Sites

- Total sites – 1325 (PROMOD limitations)
- Average size – 430 MW (100 – 1500 MW)

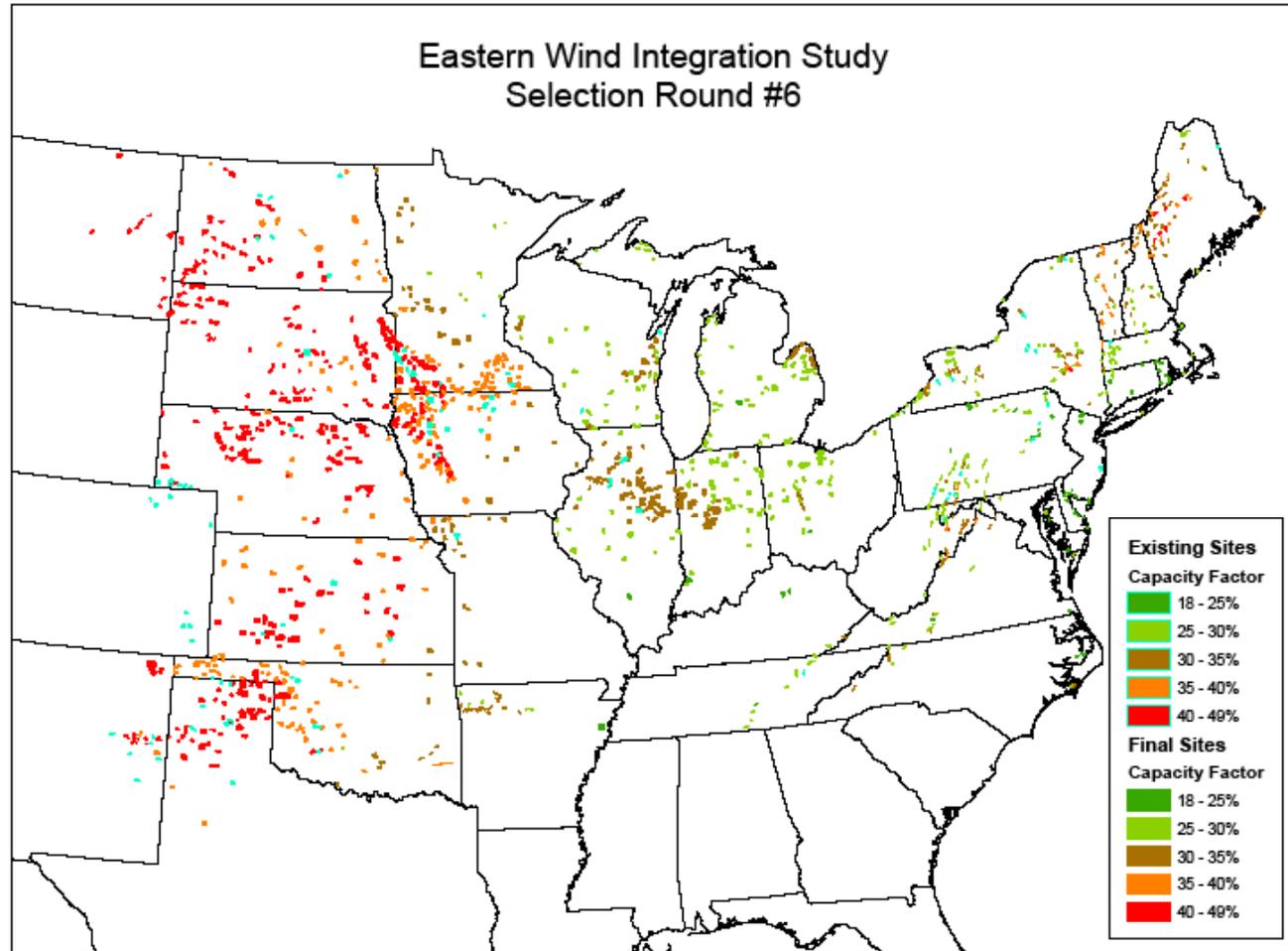


Existing and Planned Sites

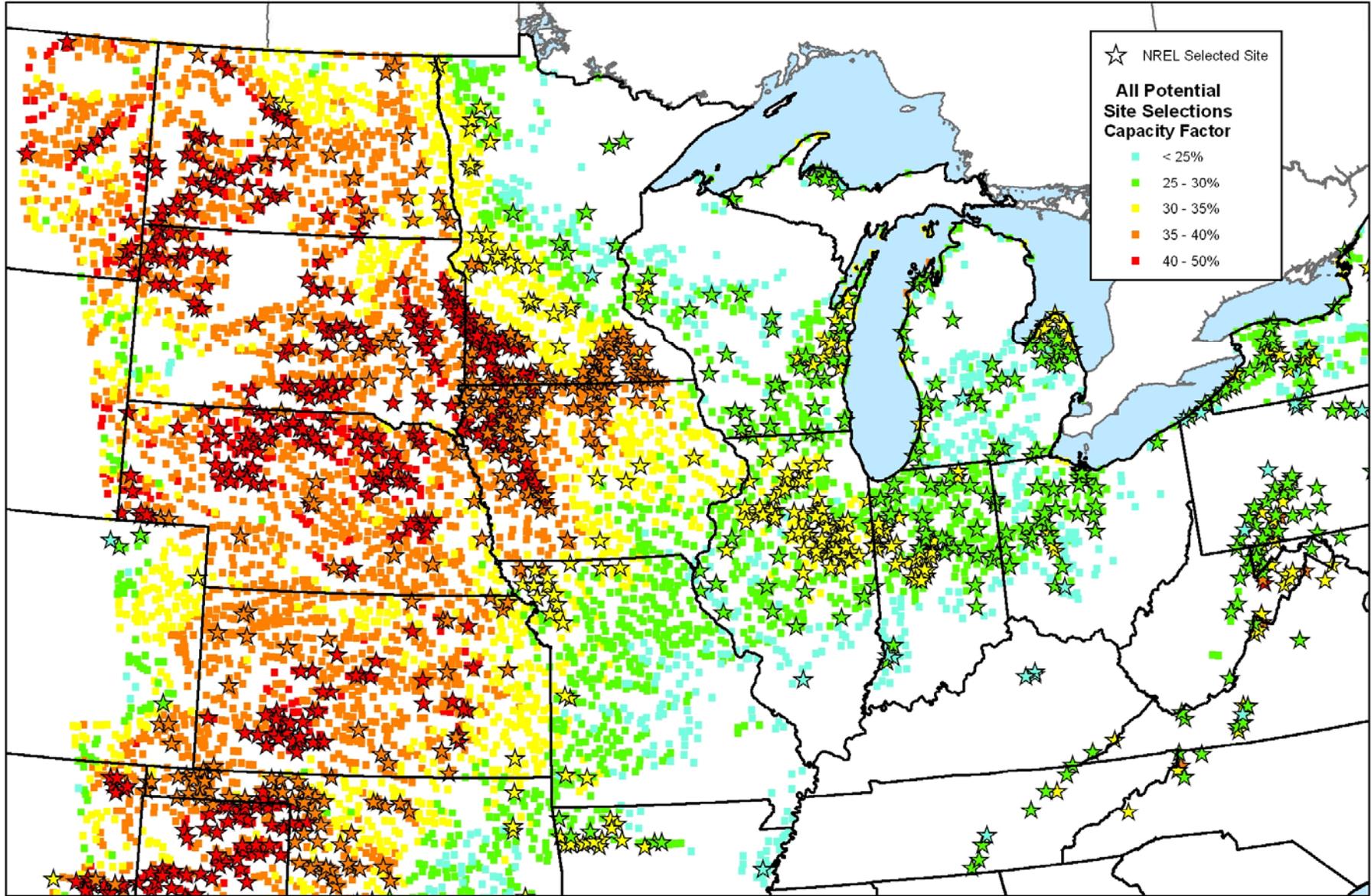
EWITS Site Selection



579 GWs of Wind Sites from Wind Site Selection process for EWITS

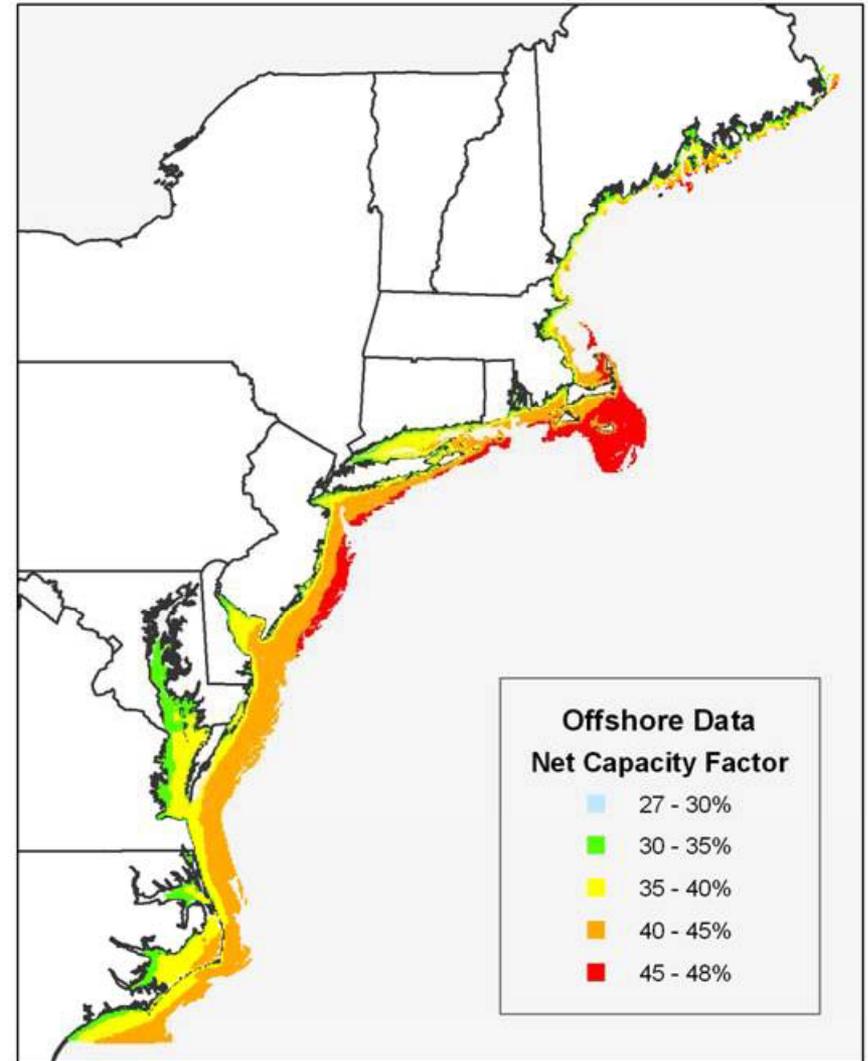


EWITS Site Selection

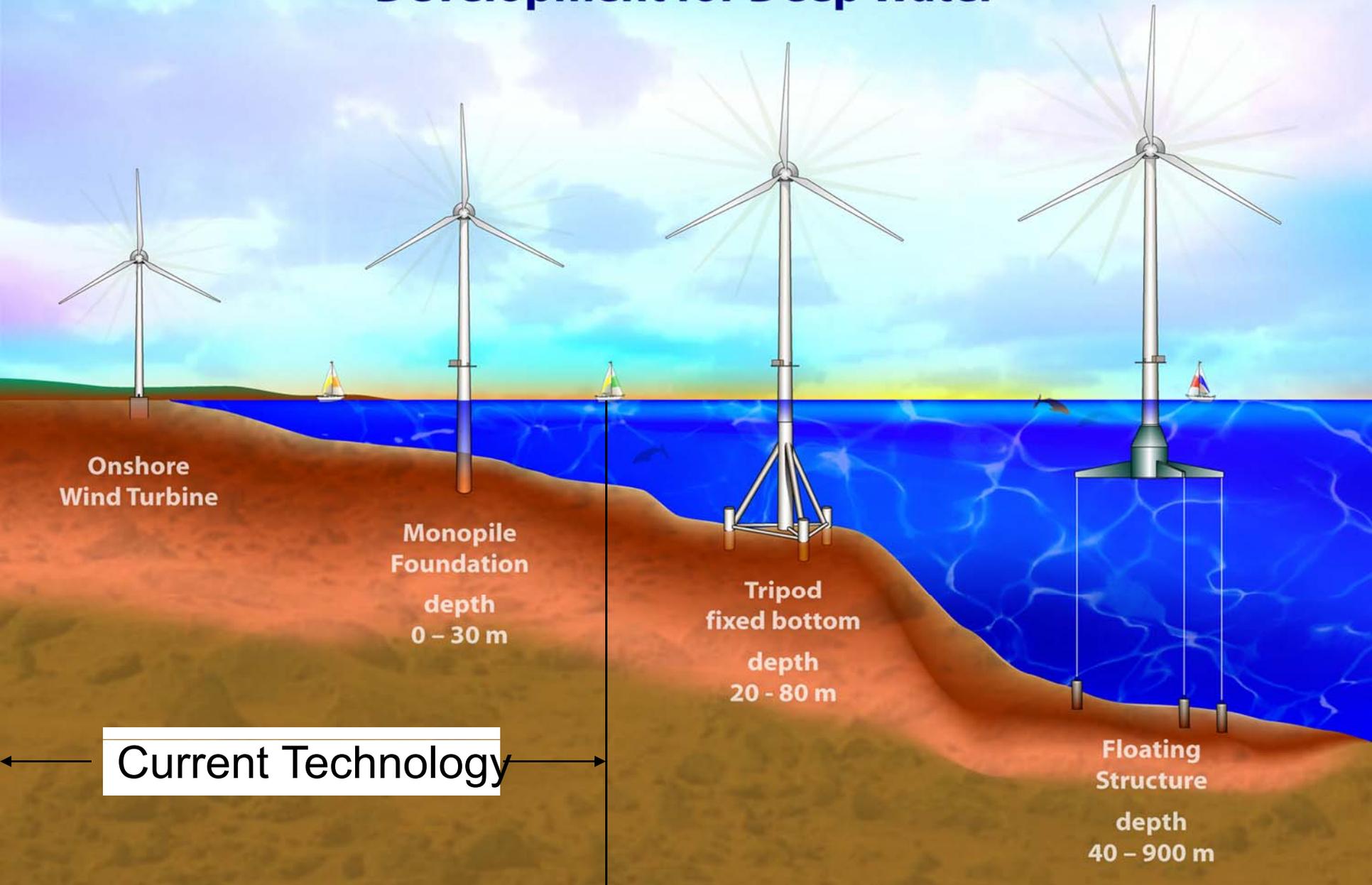


Offshore Wind

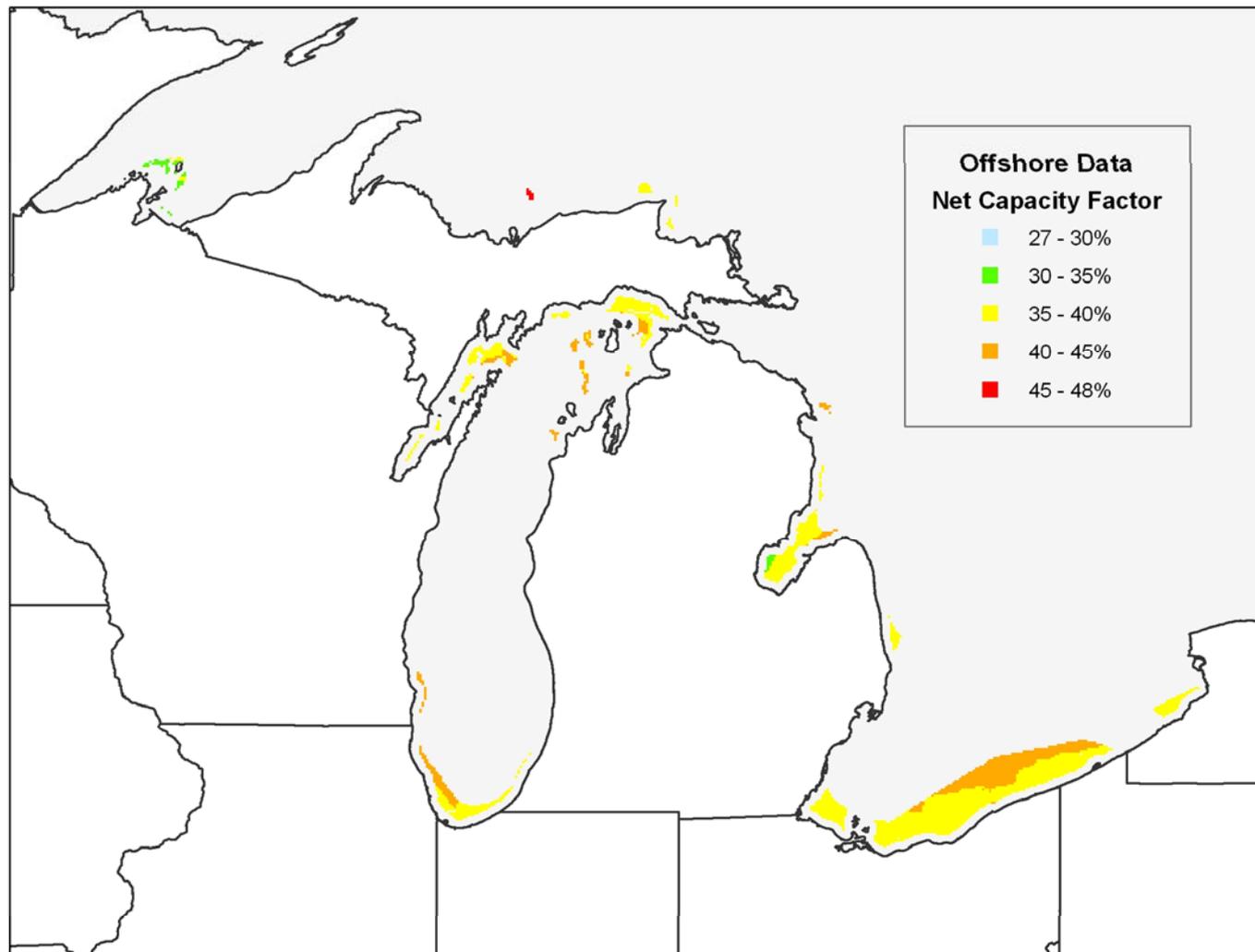
- Great resource
- Well correlated with load and close to load centers
- More expensive!



Offshore Wind Turbine Development for Deep Water



Great Lakes Offshore Wind

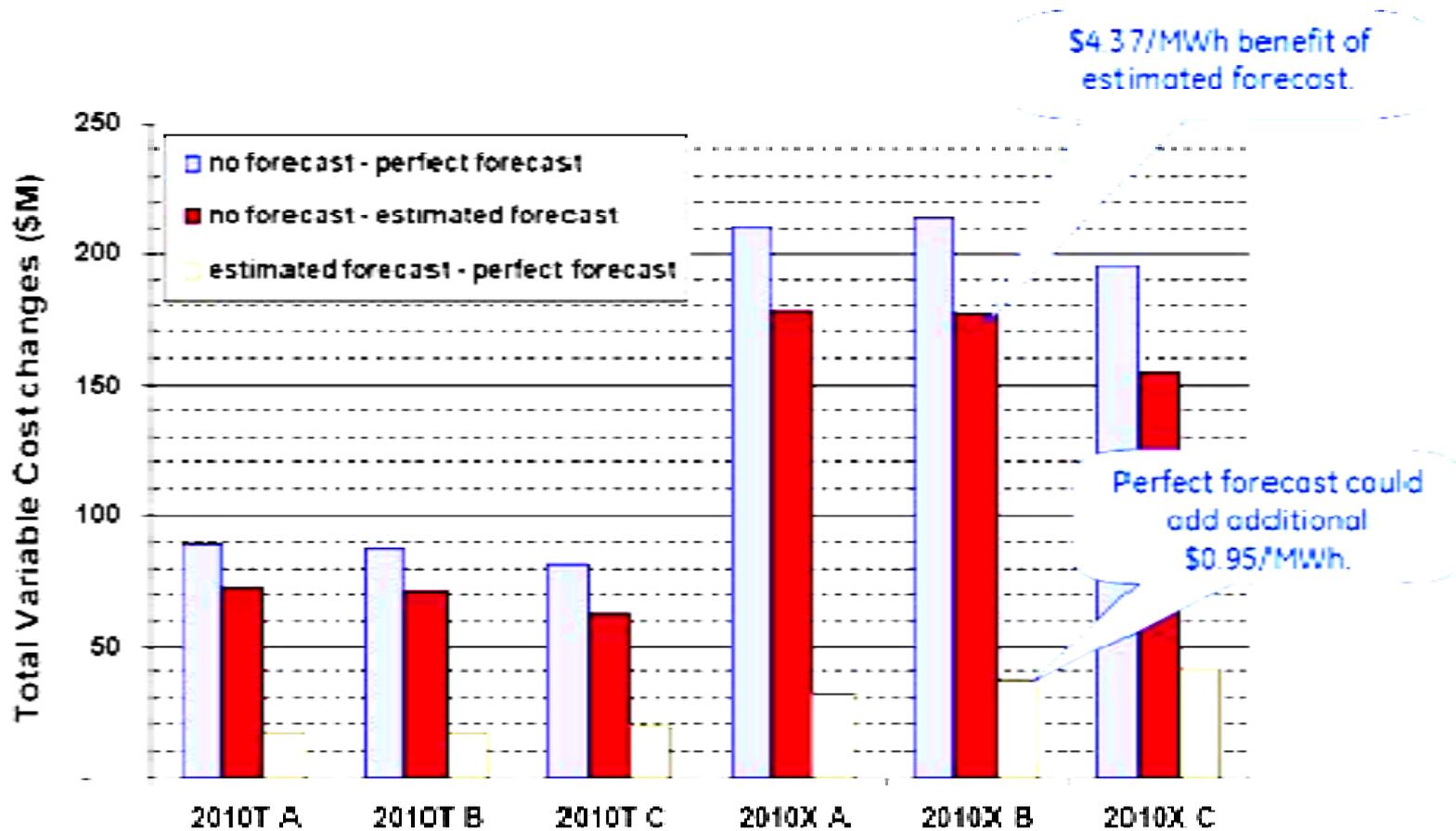


Scenarios and Siting

Things to keep in mind during the study

- How much capacity can be reasonably exported (imported) at each area?
- Assume constant energy between scenarios rather than constant number of plants:
 - Typical Great Plains capacity factor/Ohio C.F.=
 $45/30 = 1.5$
 - ~Roughly 2 MW of wind in Great Plains produces the same energy as 3 MW of wind in Ohio.

Assumptions on Forecasting will be Important Forecasting benefits for CAISO



Source: GE/CEC Presentation, 2007

Schedule

- Feb 08-March 08 Study Development (Includes preliminary wind siting for JCSP)
- March 2008 Award Wind Mesoscale Modeling Contract
- July 2008 Award Wind Integration Contract
- April – Oct 2008 Develop Wind Data Sets (2004 and 2005 data available)
- Sept 08 – June 2009 Develop Transmission Plan and Evaluate Operating & Reliability Impacts
 - 2nd TRC meeting – Oct. 8th, location TBD
 - 3rd TRC meeting – Proposed 1/22/09, Location TBD
 - 4th/5th TRC exact dates TBD – Spring, 2009
- August 2009 Complete Study

Welcome to the TRC

Your Input is Important!

- EWITS Website -
<http://wind.nrel.gov/public/EWITS/>
- Questions or other comments/input
 - Contact Dave Corbus at David_Corbus@nrel.gov (303-384-6966) or
 - Matt Schuerger at MattSchuerger@earthlink.net (651-699-4971)