Midwest ISO Transmission Considerations

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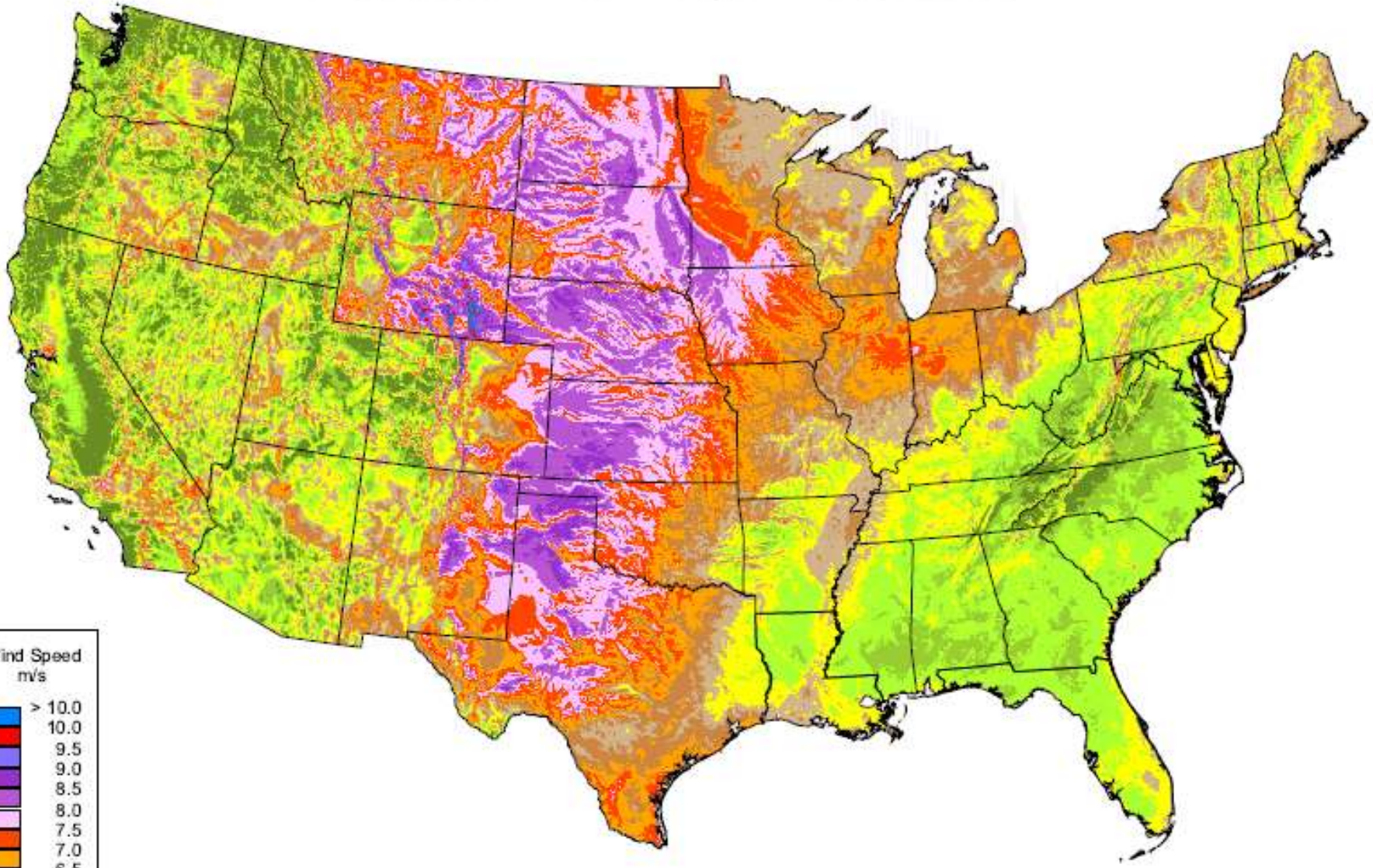
Or replace .org with .us if outside U.S.

United States - Annual Average Wind Speed at 80 m



Wind Speed
m/s

> 10.0
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
< 4.0

Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator® Web: http://navigator.awstruewind.com | www.awstruewind.com. Spatial resolution of wind resource data: 2.5 km. Projection: Albers Equal Area WGS84.

AWS Truewind

NREL
National Renewable Energy Laboratory
Innovation for Our Energy Future

30-JAN-2004.1.1

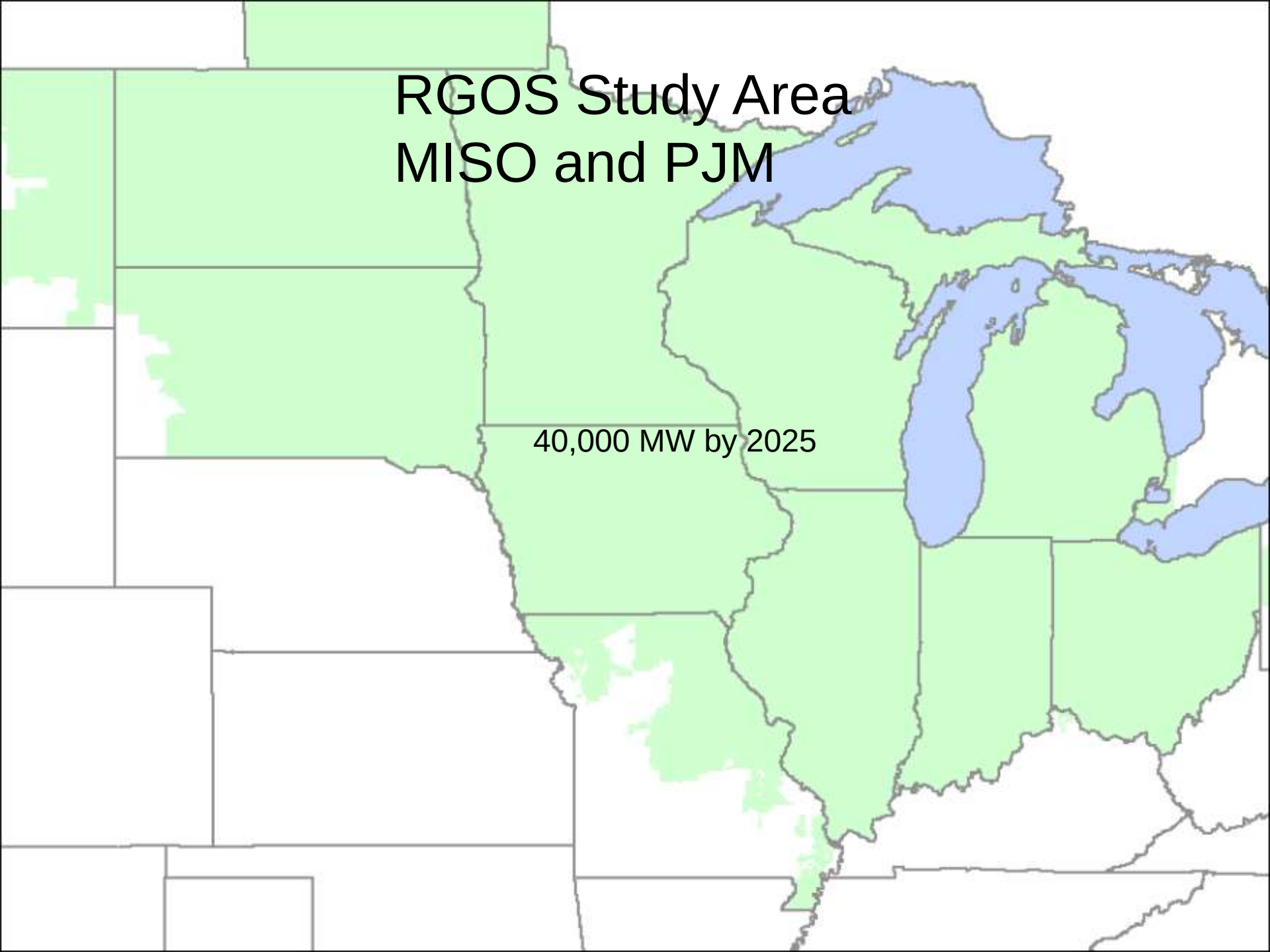
Transmission Study Processes

- Midwest ISO MTEP processes- http://www.midwestmarket.org/home+planning+expansion planning+MTEP
  - Transmission Expansion-Appendix A-Next to be constructed
  - Top Congested Flow Gates
  - Generation Interconnection Studies and Agreements
  - Transmission Service Requests
  - Regional Transmission Outlet Study-Midterm-10+years
- PJM-RTEP process
- PJM-MISO Cross Border- Joins MTEP(MISO) and RTEP(PJM)
- Eastern Interconnection Planning Collaborative- U.S. and Canada- long term 15+years
- SMART-http://www.smartstudy.biz/-input to RGOS
- Green Power Express-ITC – in study phase-input to RGOS
- Eastern Wind Integration Transmission Study

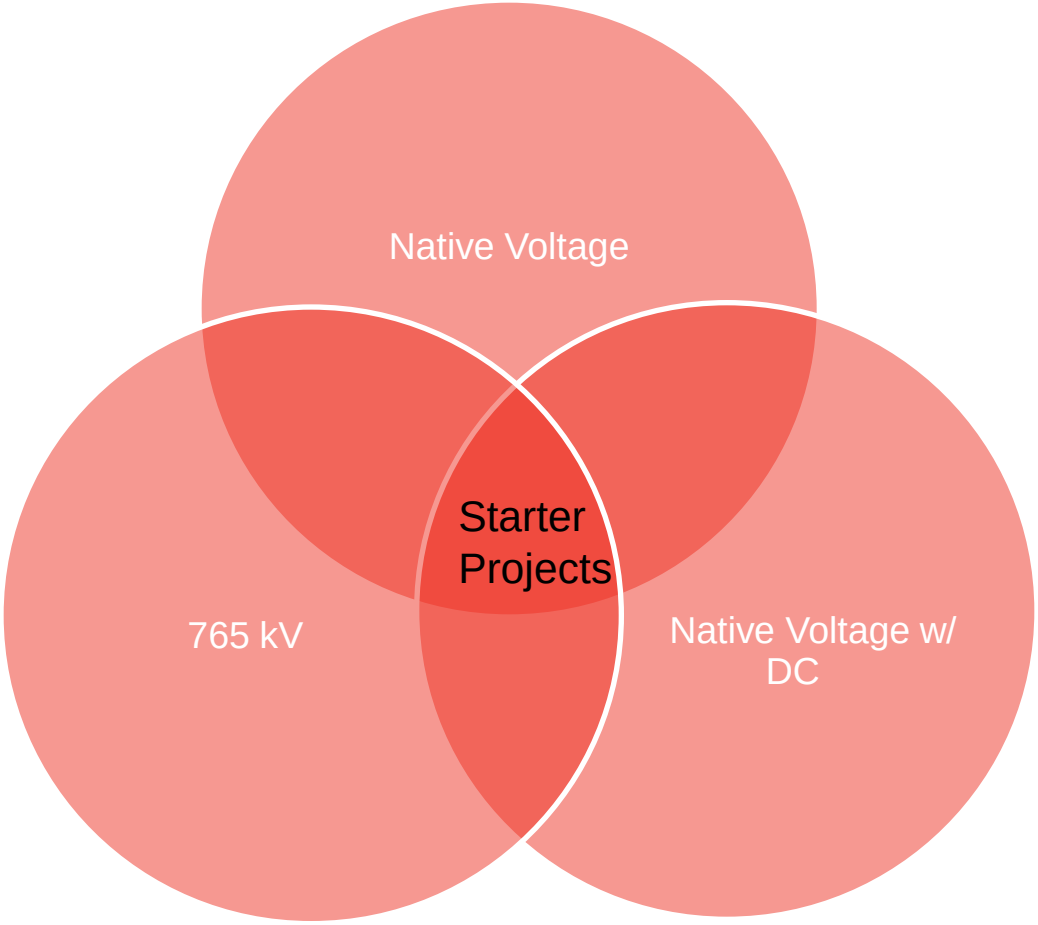
  DOE/NREL 20% and 30% national wind RPS-2010

Canadian Participation

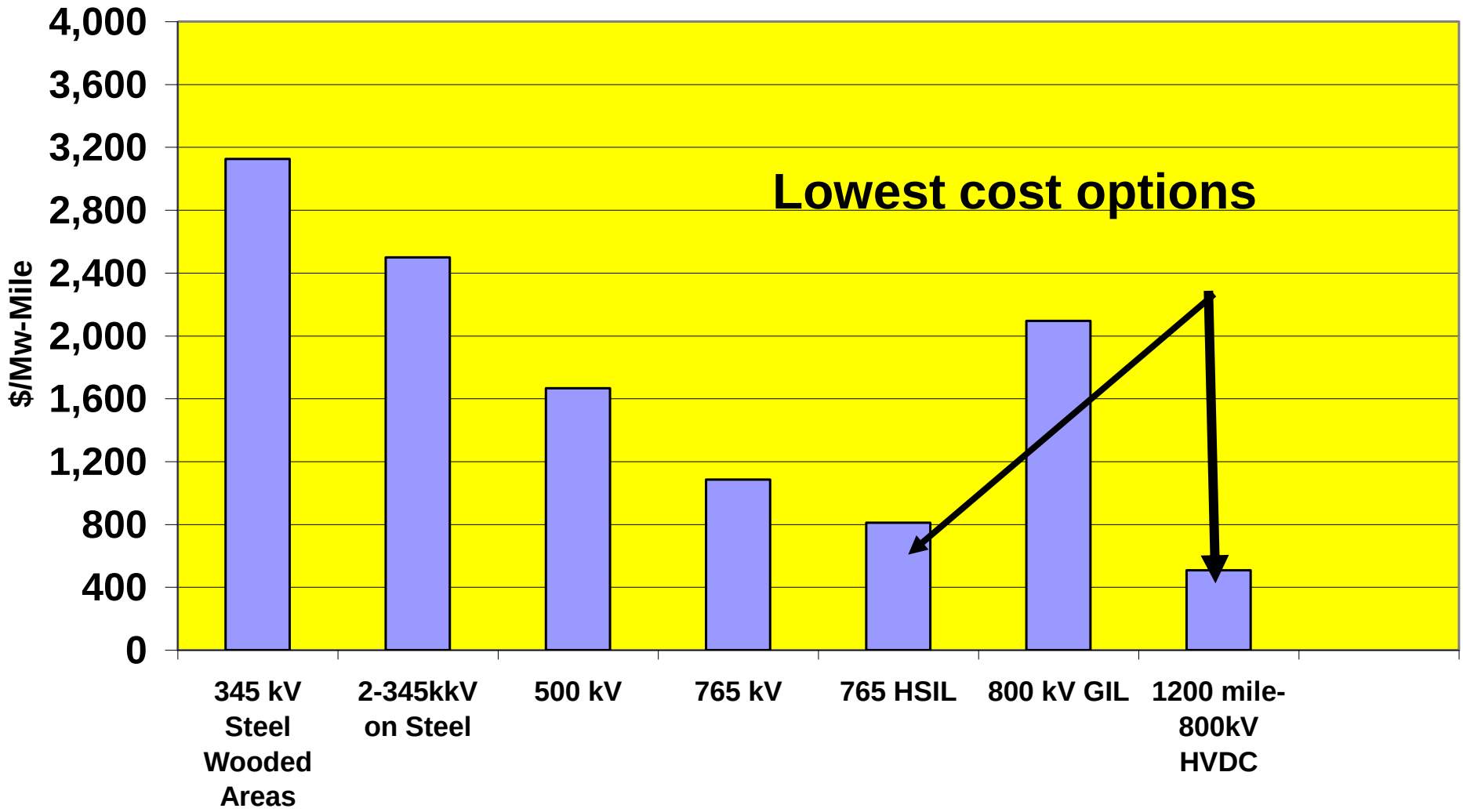
- Manitoba participates as a coordinating member in the Midwest ISO Planning processes
- EIPC is the only other planning process involving Canada
- The Midwest ISO participates in operation discussions with the IESO but not Planning.
- Canada is included in the model building processes with NERC. The Midwest ISO uses the NERC models as a base.


RGOS Study Area
MISO and PJM
40,000 MW by 2025

Some Transmission is Common to All Plans

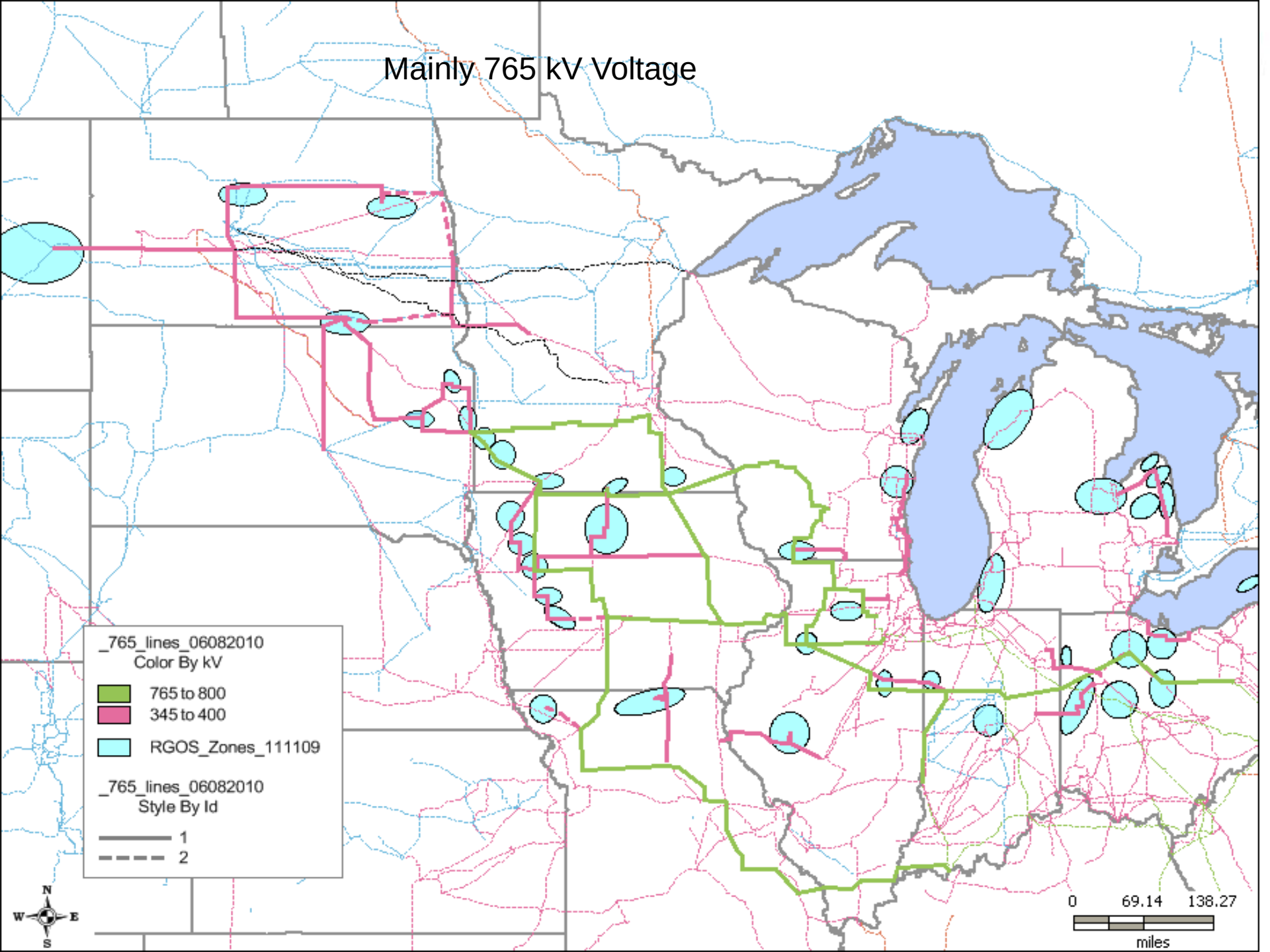


Transmission and Substation Costs per Mw-mile by Transmission Voltage And Type of Construction



Target typical planned loading Mw, use economics to choose voltage

Mainly 765 kV Voltage



Phase 1 Report
Strategic Midwest Area Renewable Transmission (SMARTransmission) Study

Date: July 1, 2010

Figure 1-1: SMARTransmission Study Area

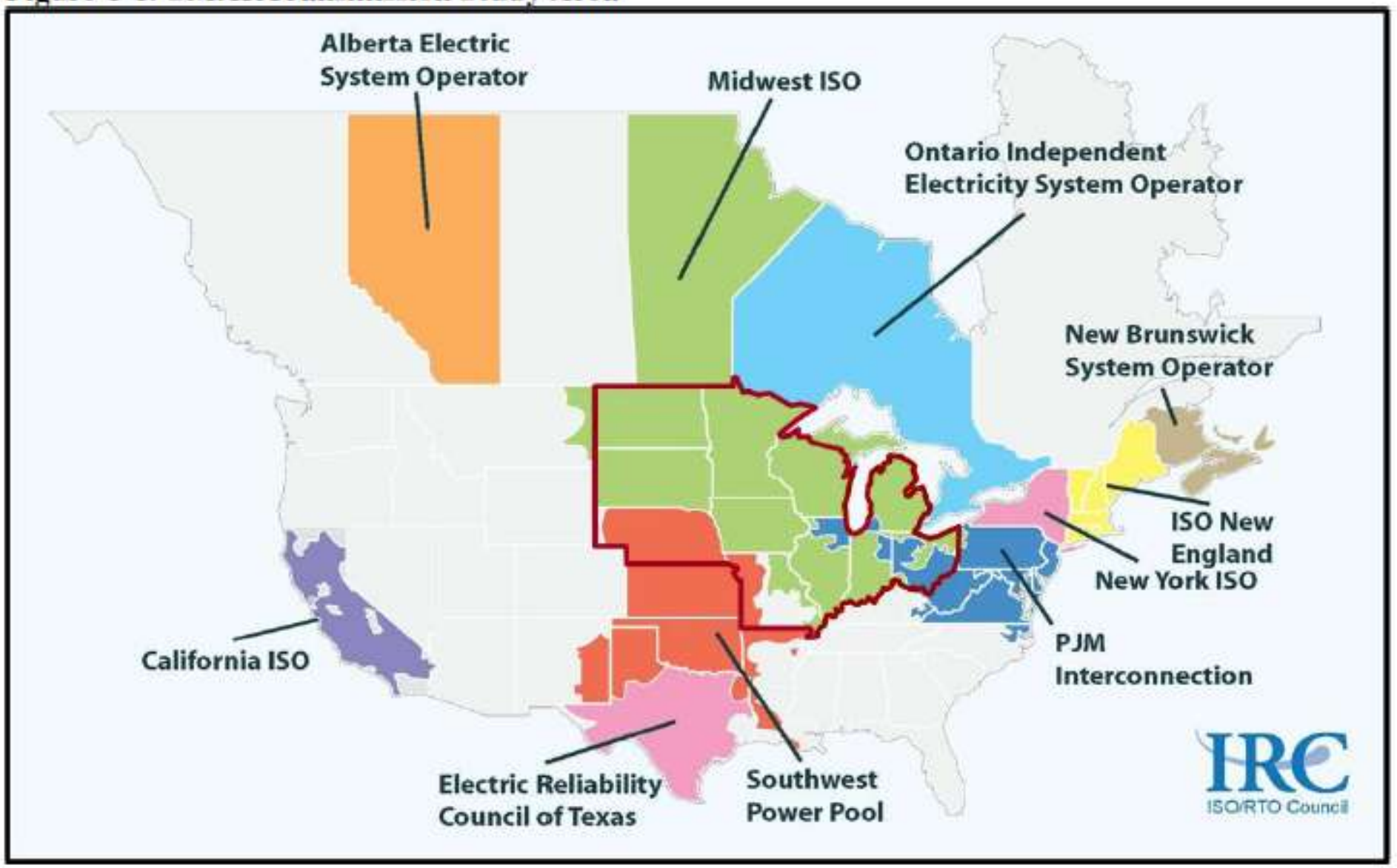
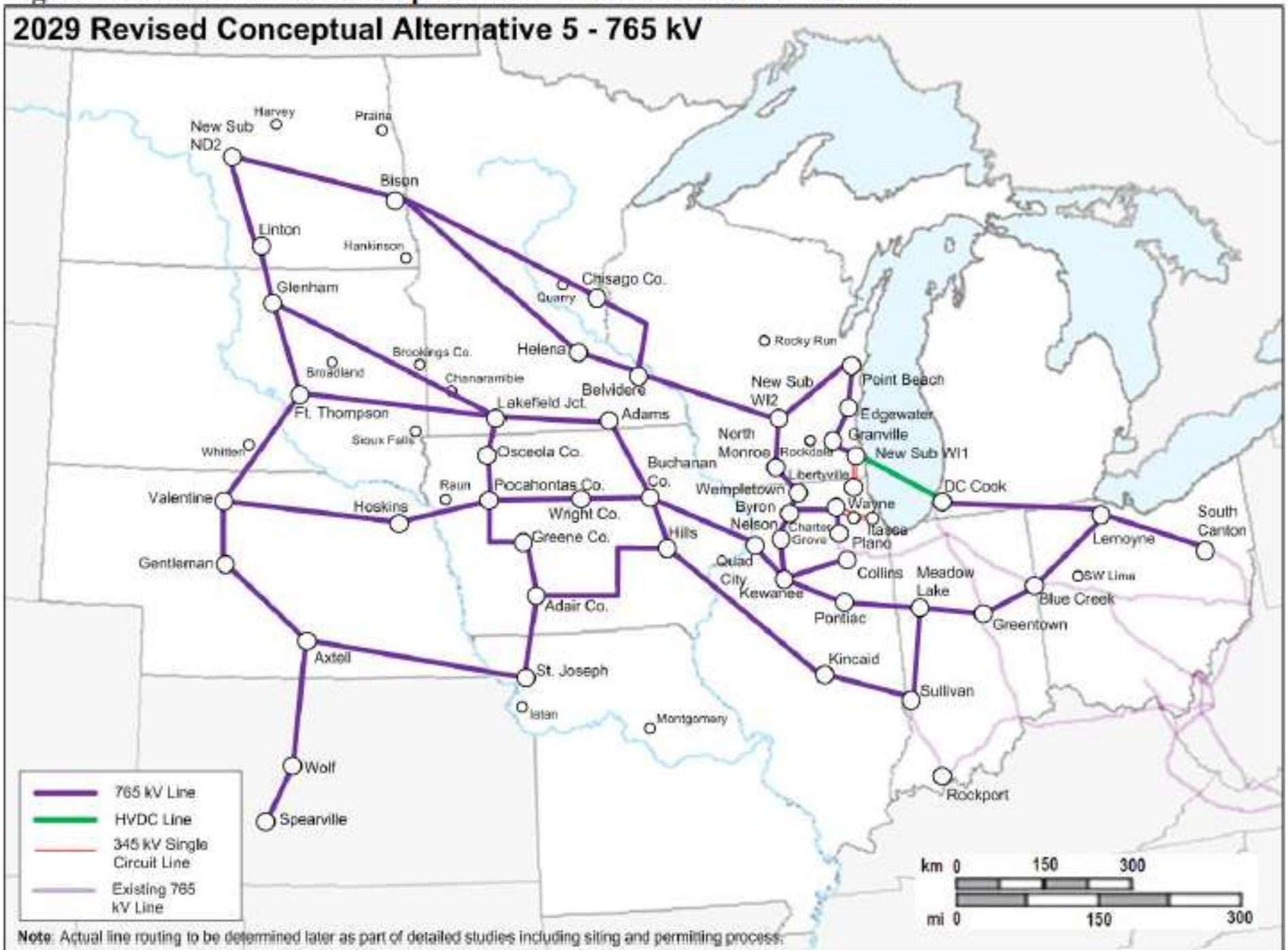


Figure 1-3: 2029 Revised Conceptual EHV Transmission Alternative 5



Note: Actual line routing to be determined later as part of detailed studies including siting and permitting process.

MidwestISO
Energizing the Heartland

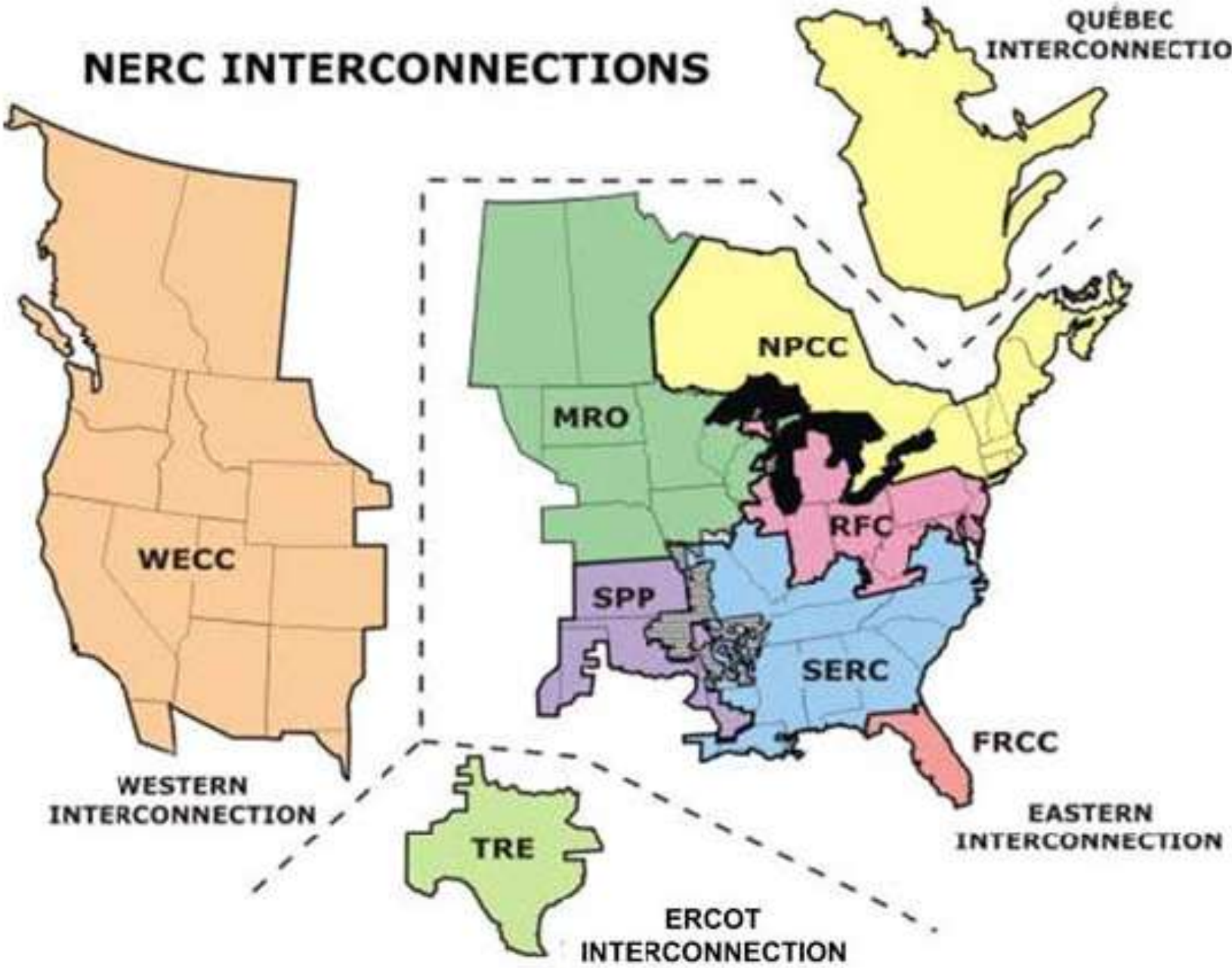
EASTERN WIND INTEGRATION AND TRANSMISSION STUDY:

Executive Summary and Project Overview

Prepared for:
The National Renewable Energy Laboratory

Prepared by:
EnerNex Corporation

January 2010


NERC INTERCONNECTIONS
QUÉBEC INTERCONNECTION
NPCC
MRO
RFC
WECC
SPP
SERC
FRCC
WESTERN INTERCONNECTION
EASTERN INTERCONNECTION
TRE
ERCOT INTERCONNECTION

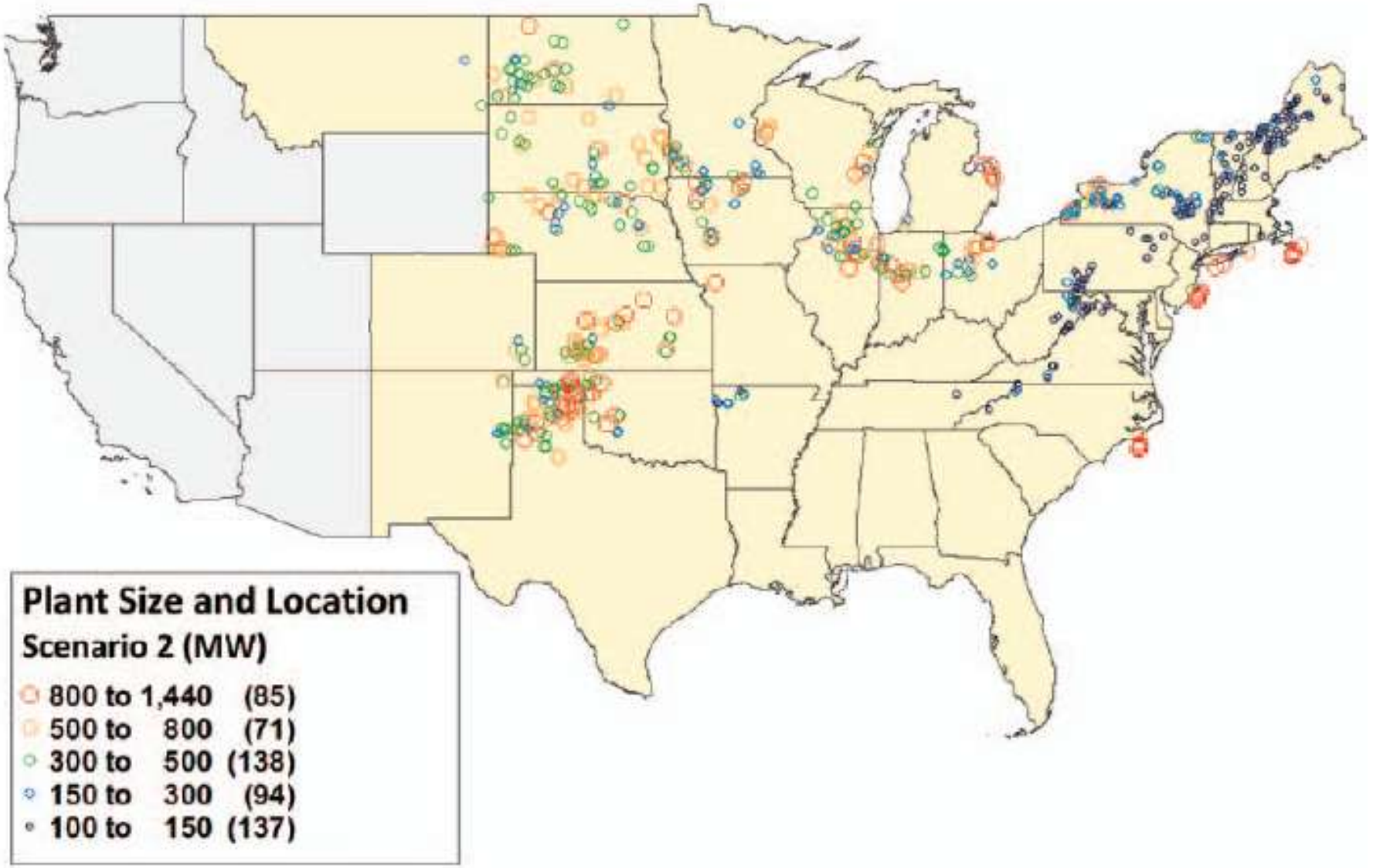
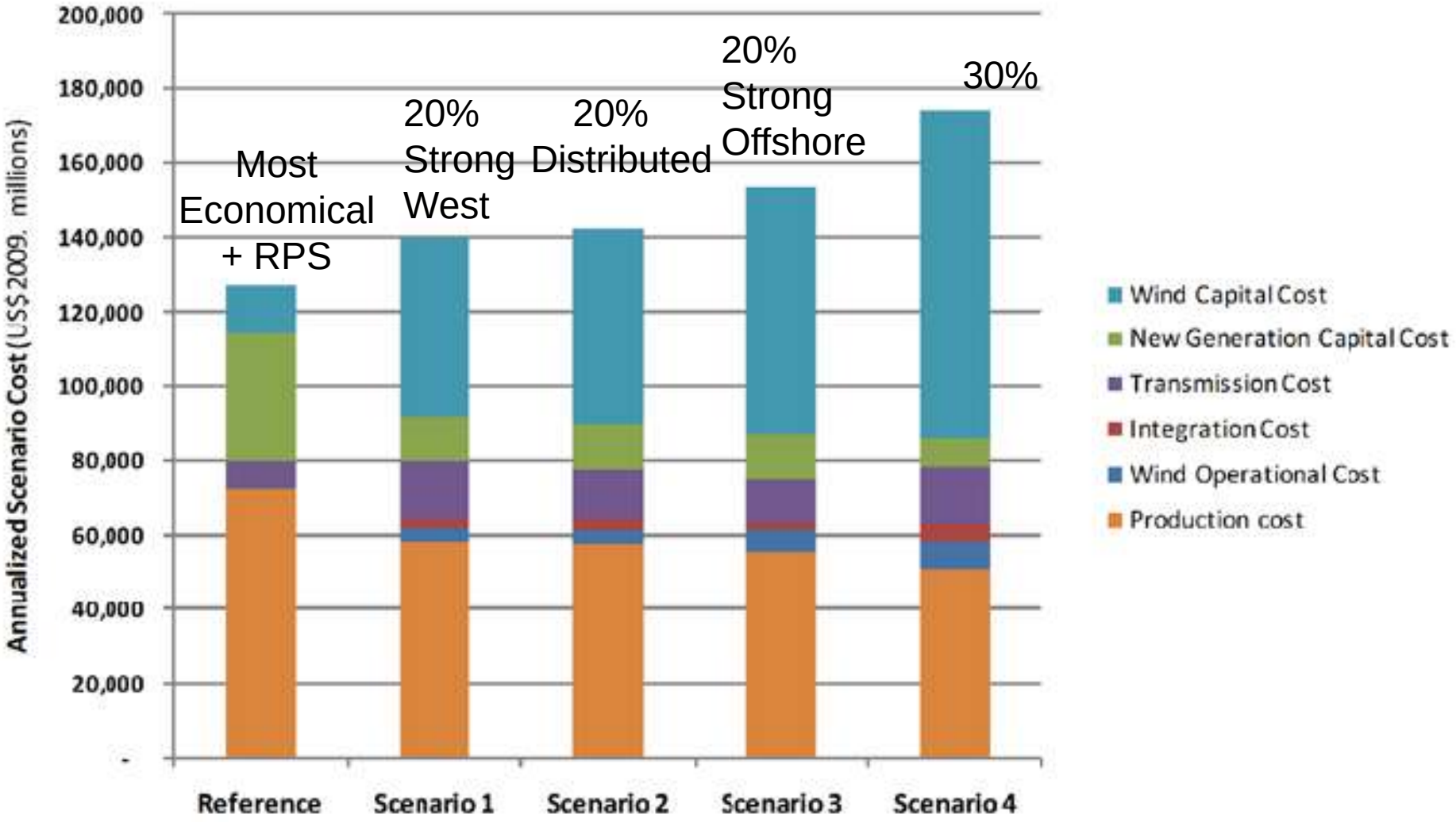


Figure 2-10. Installed capacity—Scenario 2


Most Economical + RPS
20% Strong West
20% Distributed
20% Strong Offshore
30%
Annualized Scenario Cost (US$ 2009, millions)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
Reference
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Wind Capital Cost
New Generation Capital Cost
Transmission Cost
Integration Cost
Wind Operational Cost
Production cost

4.4.1. Regional Generation Weighted LMP Changes

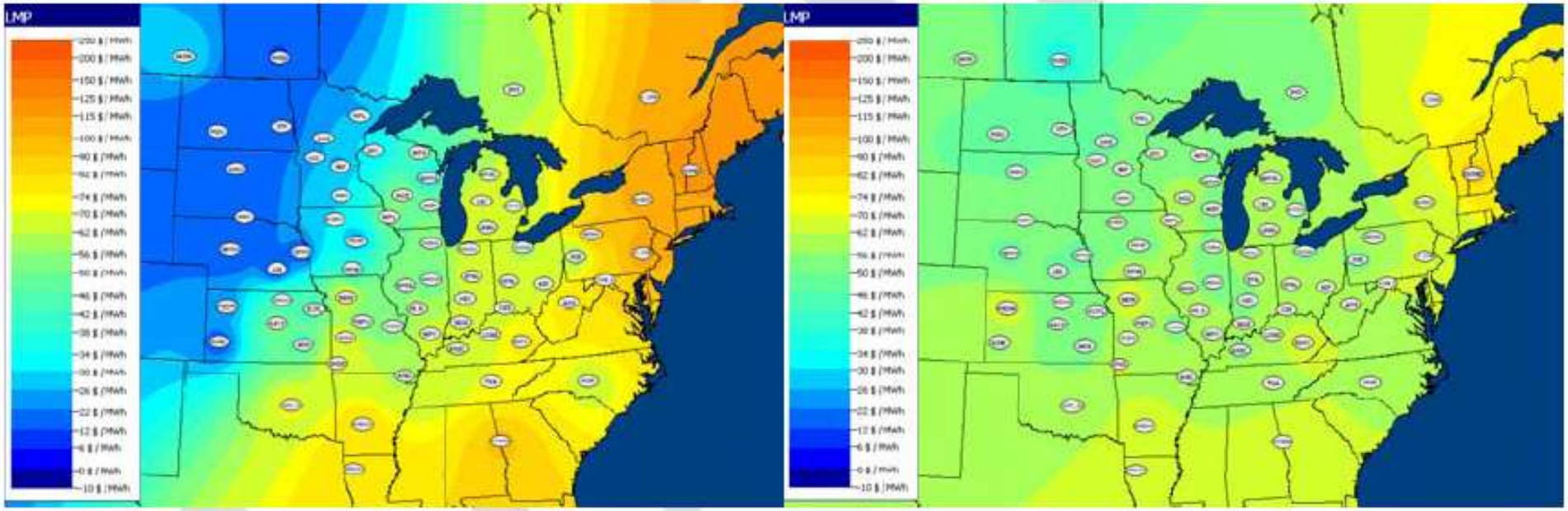
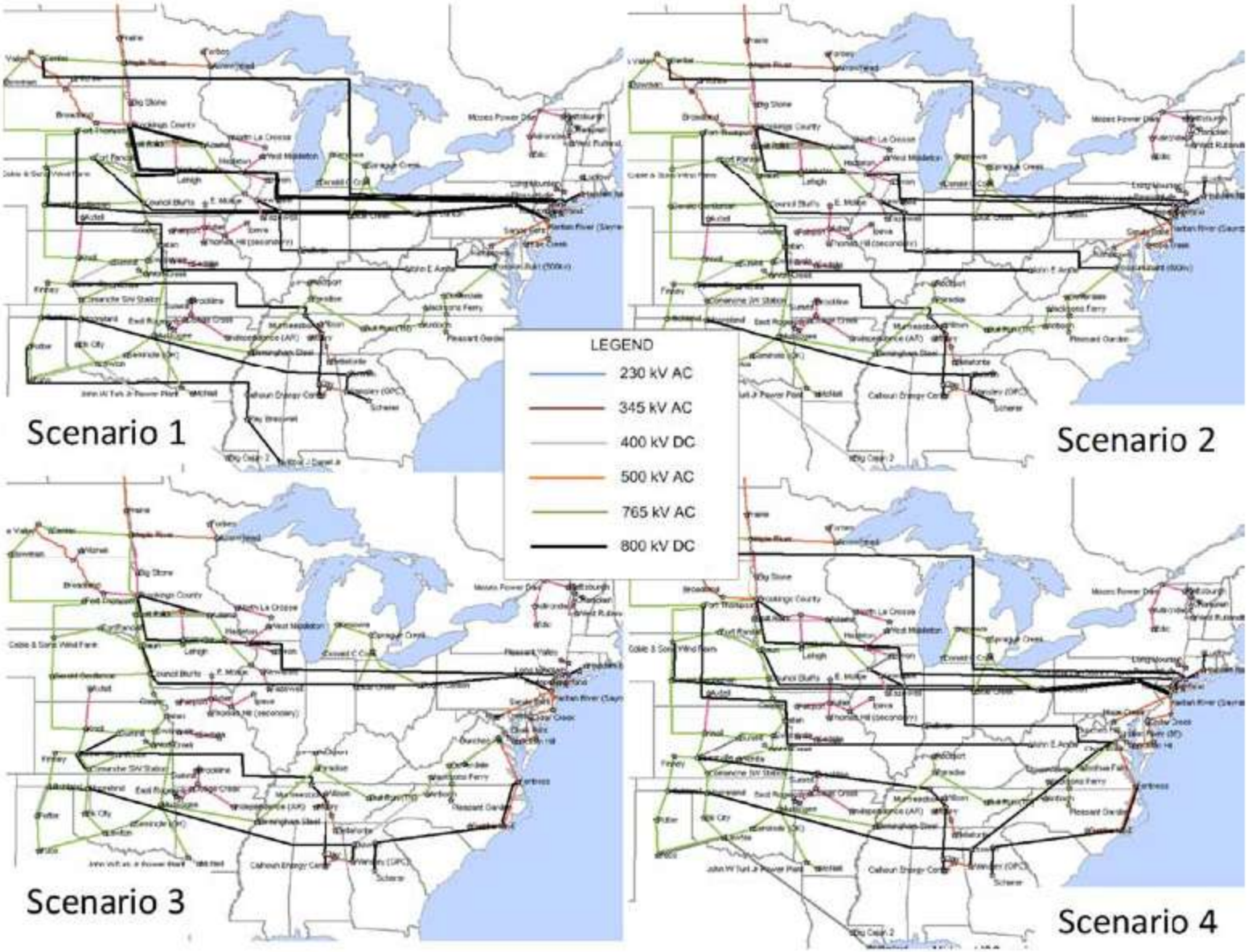
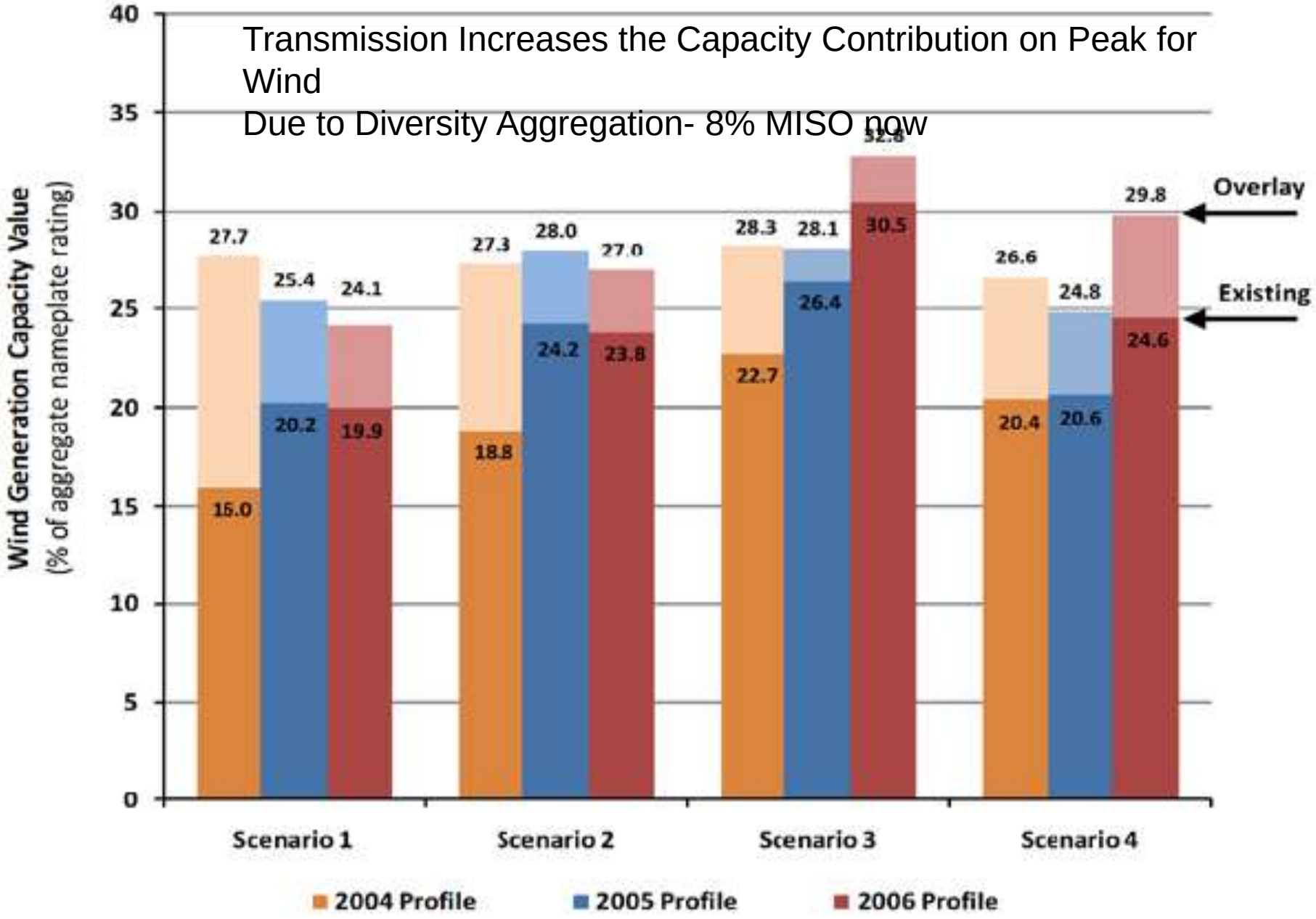


Figure 33: Scenario 1 Annual Generation Weighted LMP Comparison


LEGEND
230 kV AC
345 kV AC
400 kV DC
500 kV AC
765 kV AC
800 kV DC
Scenario 1
Scenario 2
Scenario 3
Scenario 4

Transmission Increases the Capacity Contribution on Peak for Wind

Due to Diversity Aggregation- 8% MISO now



What Can Be Done with the Surplus

- Reduce the generation
  - Paying for the generation but not fuel
  - Must have transmission to deliver renewable energy to the load. The system was designed to deliver from the fuel generation that most likely in another location.
- Sell the surplus for a profit
  - Profit helps reduce the generation payments
  - Need to be able to deliver energy to the market- pay for transmission- need above $6/MBTU to pay for transmission in the energy market, other products may allow justification of transmission with lower gas prices.
  - Need access to the markets- need a seller and a buyer pair
- Store the energy
  - Use surplus off peak capacity to drive a CAES plant with a 50% capacity factor- would work in the west today if gas were at $6/MBTU, but gas is at $4.50/MBTU

Estimated 20 year present value potential of diversity products for the U.S.

- Load diversity $76.3B
- Wind economic development-130,000 MW $85.0B
- Wind variability reduction 20% $15.9B
- Wind forecast error reduction 25% $6.8B
- Wind capacity credit $49.3B
- Electric price diversity $8/MBTU gas $30.6B
- Contingency response reduced reserve $54.9B
- Total potential benefit $288.0B

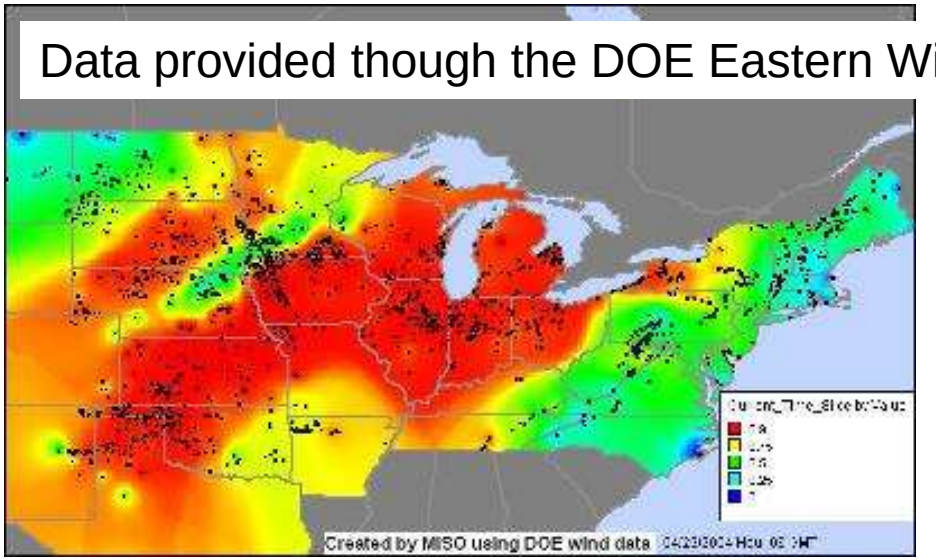
Potential Transmission

- The benefit to cost ratio 2.13:1
- The cost of the transmission is $135B
- Entry systems of 9000 MW $9B

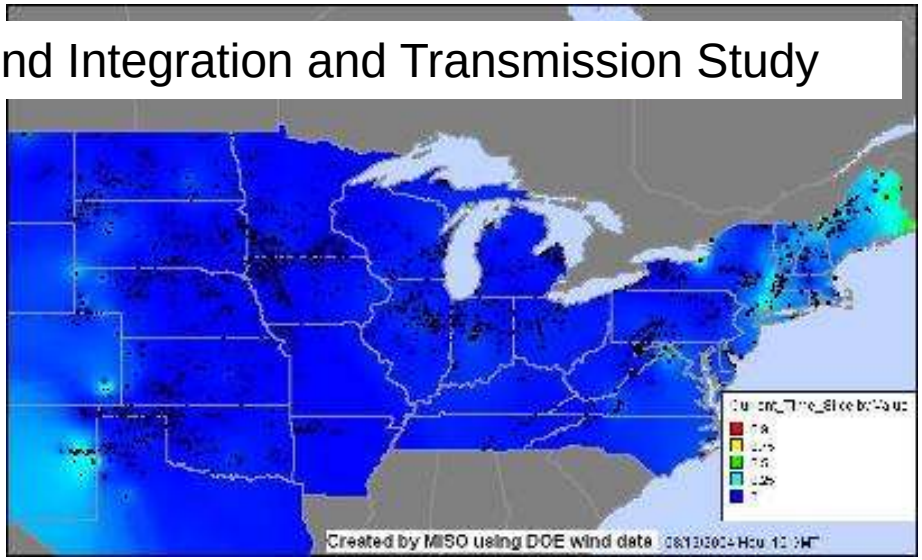
- What projects could be possible?

Maximum and Minimum Wind

Data provided though the DOE Eastern Wind Integration and Transmission Study



Simulated Maximum Power Output on April 29, 0600 GMT for calendar year 2004



Simulated Minimum Power Output on August 13, 1500 GMT for calendar year 2004

	2005		2006		2007		2008	
	MW	% of NP	MW	% of NP	MW	% of NP	MW	% of NP
Nameplate Capacity (NP)	871		1,032		1,462		3,008	
Actual Metered at Peak	103 [1]	11.8% [1]	686 [2]	66.5% [2]	24 [3]	1.6% [3]	351 [4]	11.7% [4]

[1] Midwest ISO Peak Hour - August 3, 2005 16:00

[2] Midwest ISO Peak Hour - July 31, 2006 16:00

[3] Midwest ISO Peak Hour - August 8, 2007 16:00

[4] Midwest ISO Peak Hour - July 29, 2008 16:00

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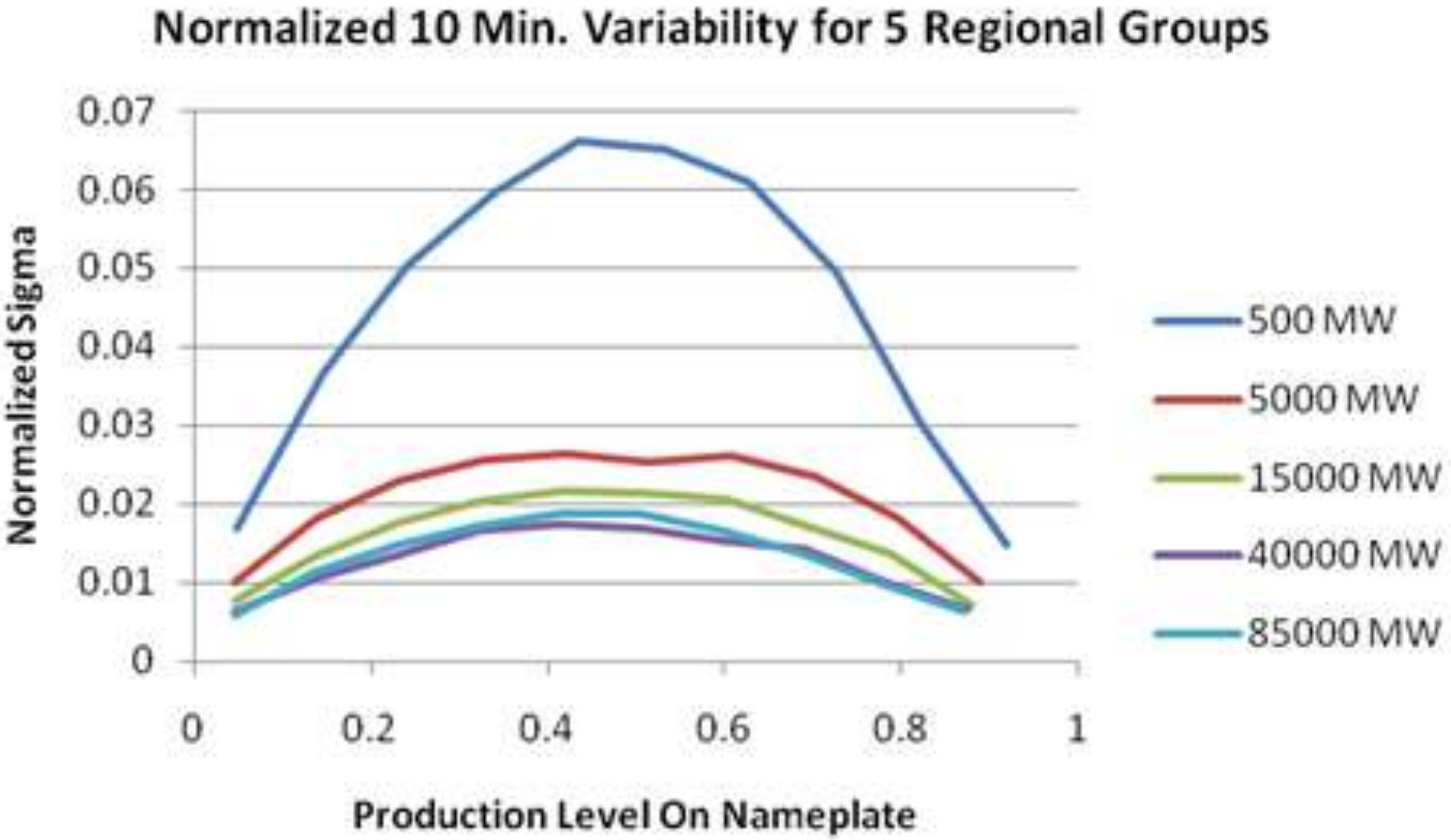
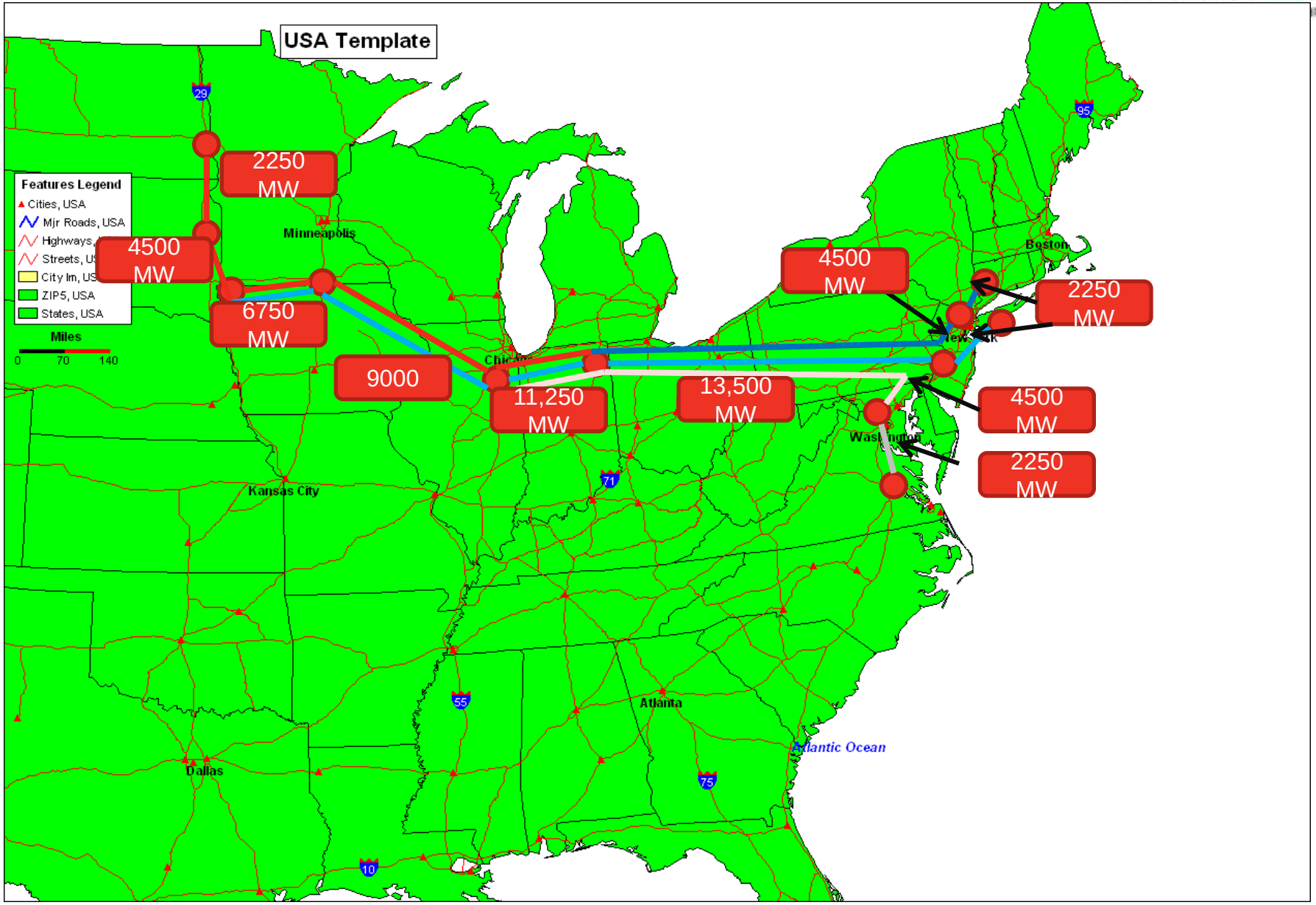
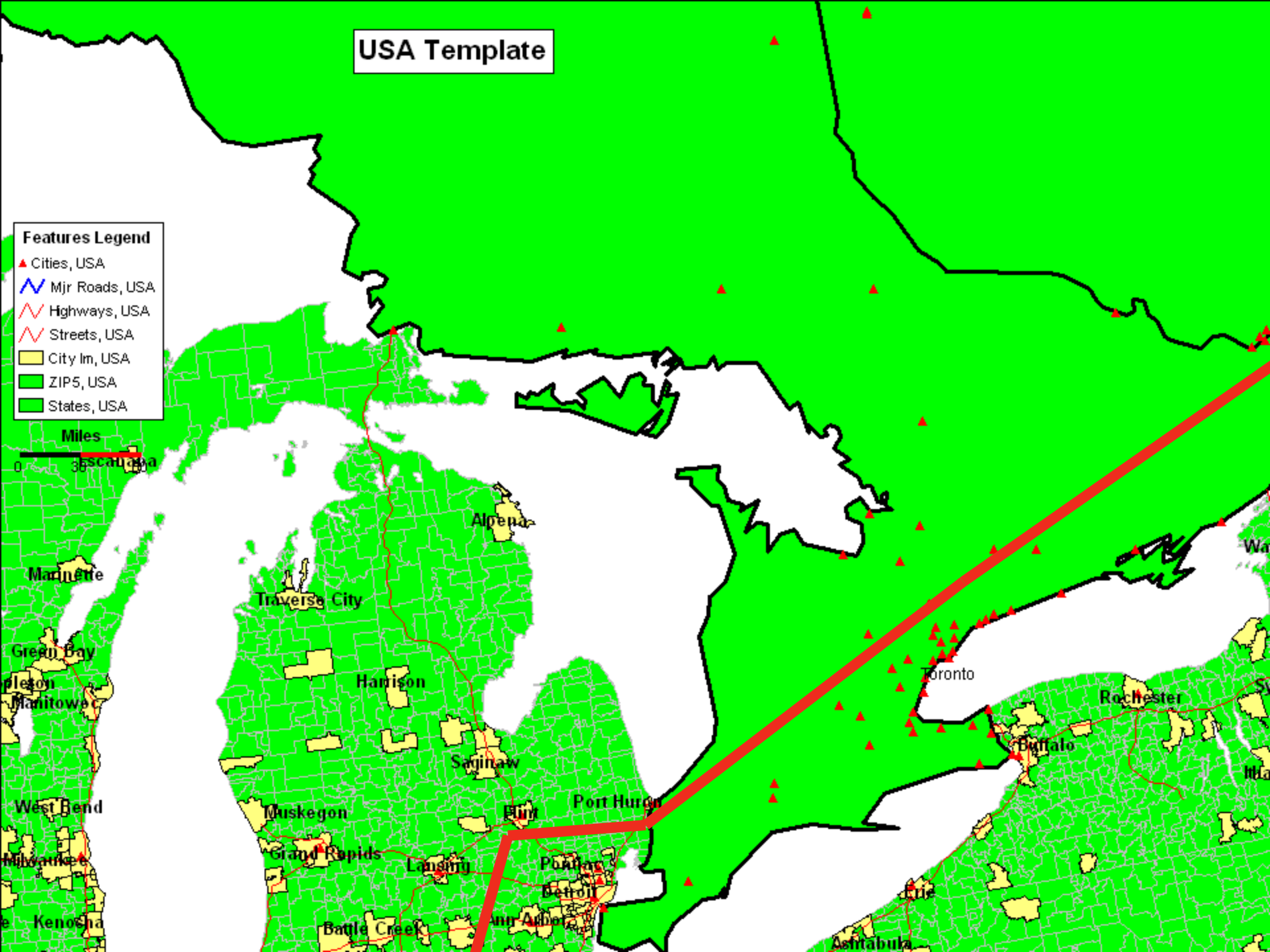
Wind Diversity

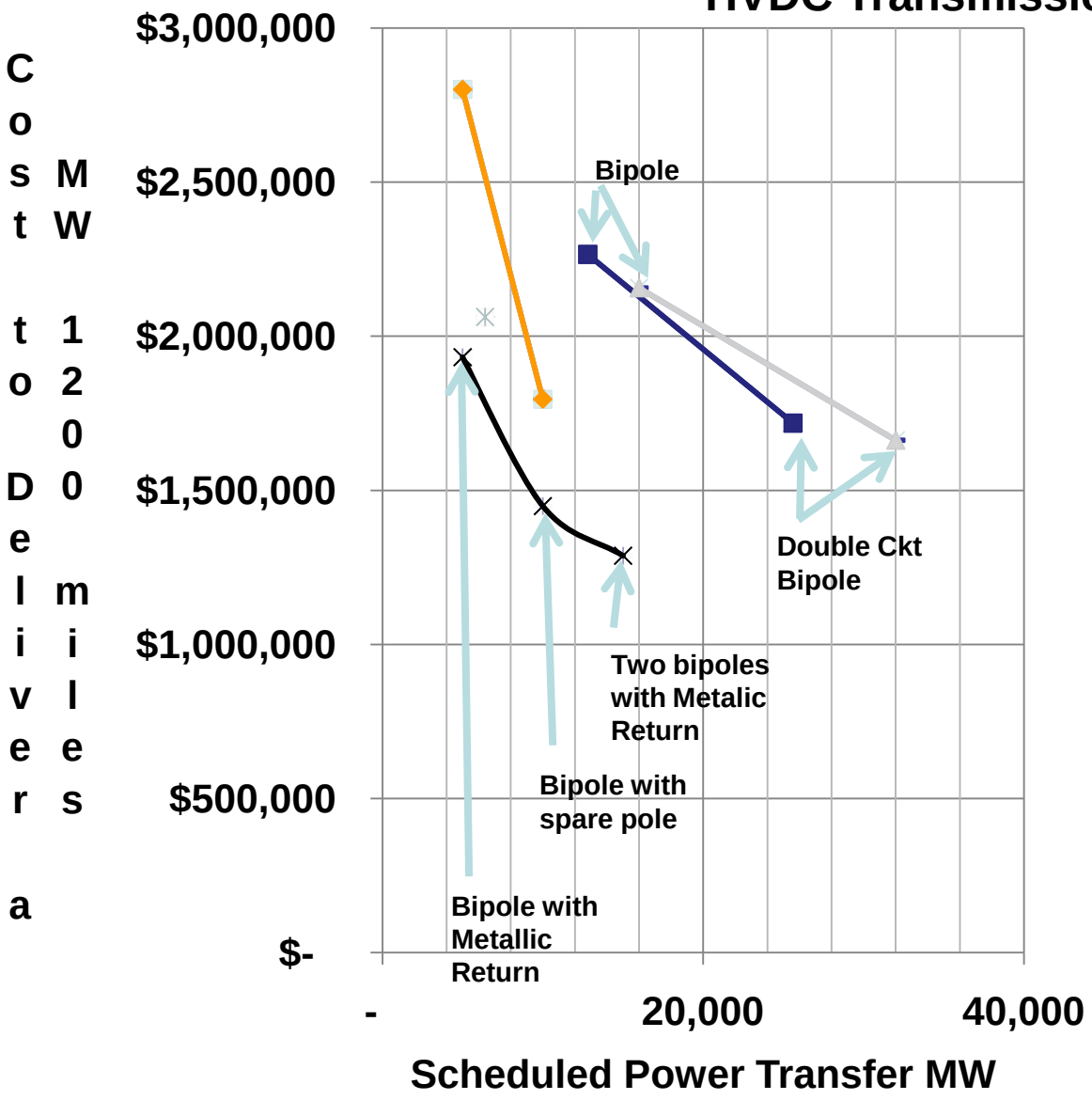


Electric Pipe Ratings




USA Template
Features Legend
Cities, USA
Mjr Roads, USA
Highways, USA
Streets, USA
City lm, USA
ZIP5, USA
States, USA
Miles
0
30
Alpena
Marinette
Traverse City
Green Bay
Manitowoc
Harrison
Saginaw
West Bend
Muskegon
Flint
Port Huron
Grand Rapids
Lansing
Pontiac
Detroit
Kenosha
Battle Creek
Ann Arbor
Toronto
Rochester
Buffalo
Erie
Ashtabula

HVDC Transmission Format Delivery Costs



Conclusion

- The Midwest ISO and PJM intersection has about 40,000 MW of RPS wind generation development-RGOS
- The Midwest ISO has a 20,000 MW Summer-Winter diversity
- Gas prices affect the transmission justification for energy market diversity
- Most of the potential benefits are not gas price dependent
- EIPC is to develop a set of conceptual transmission plans for the Eastern Interconnection for several scenarios.
- The price of natural gas and political considerations are the main problems to building transmission.
- Underground HVDC may be the best option to obtain transmission that may be able to be economically justified
- Traditional business models probably will not be used