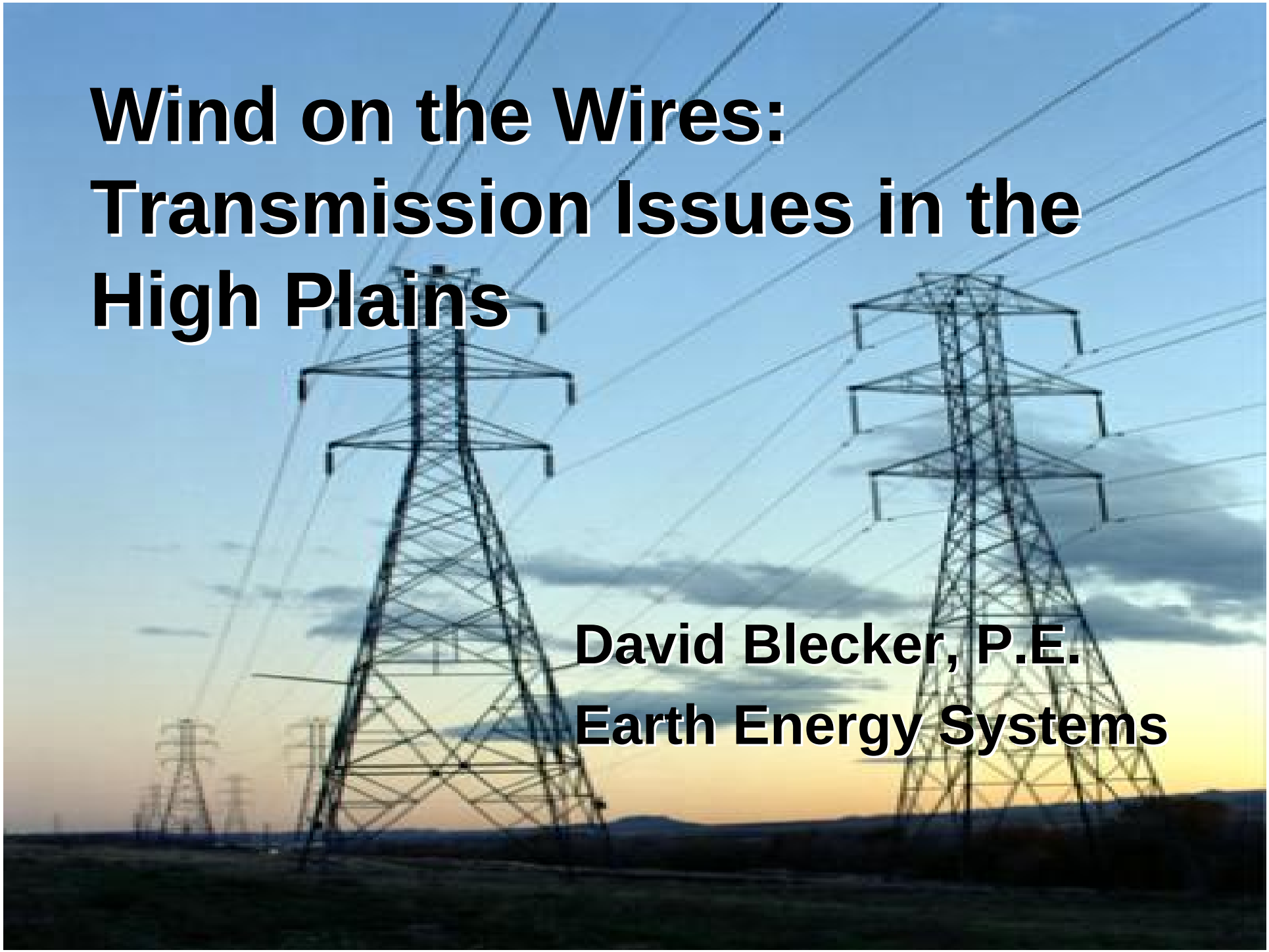
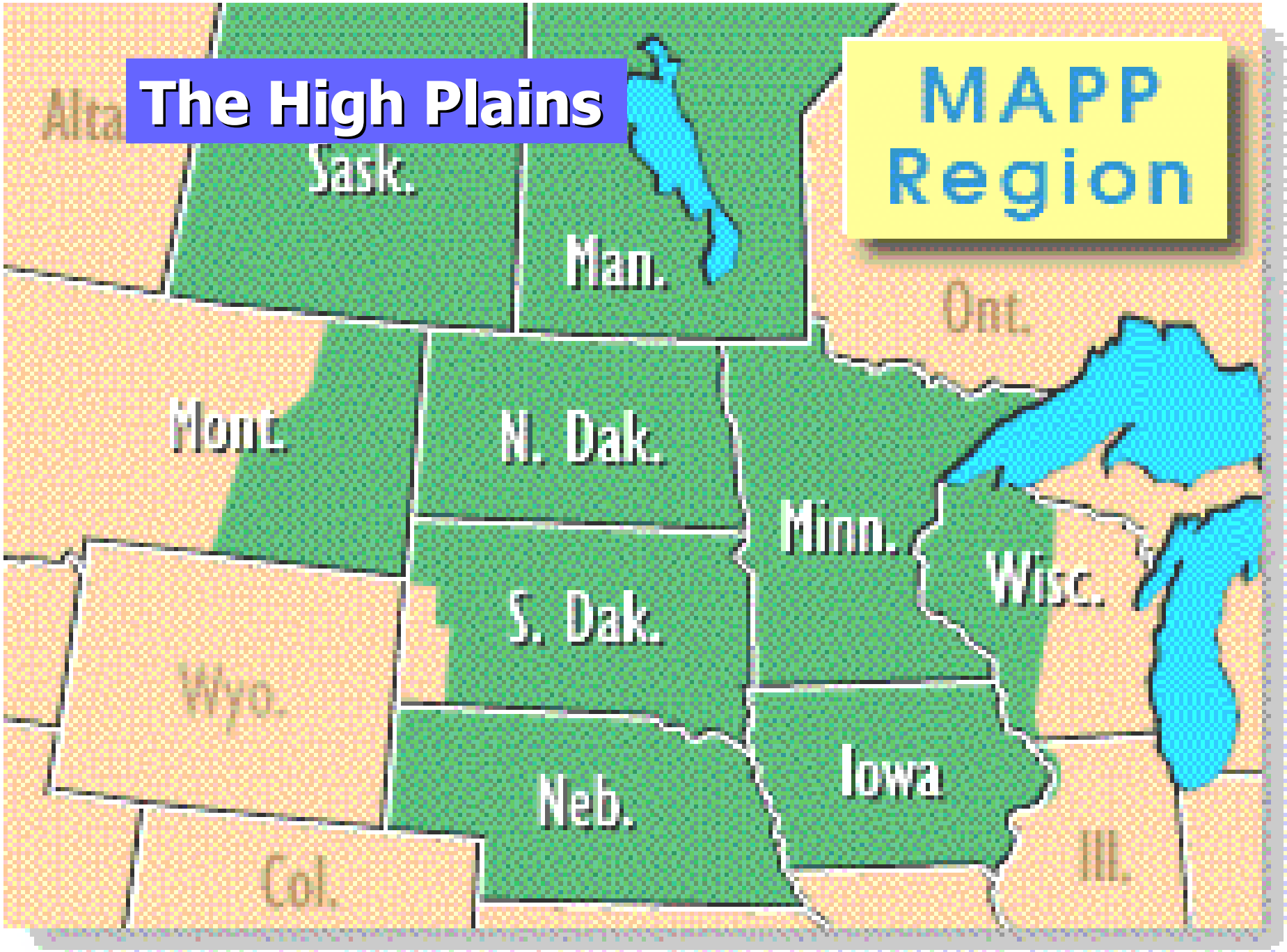
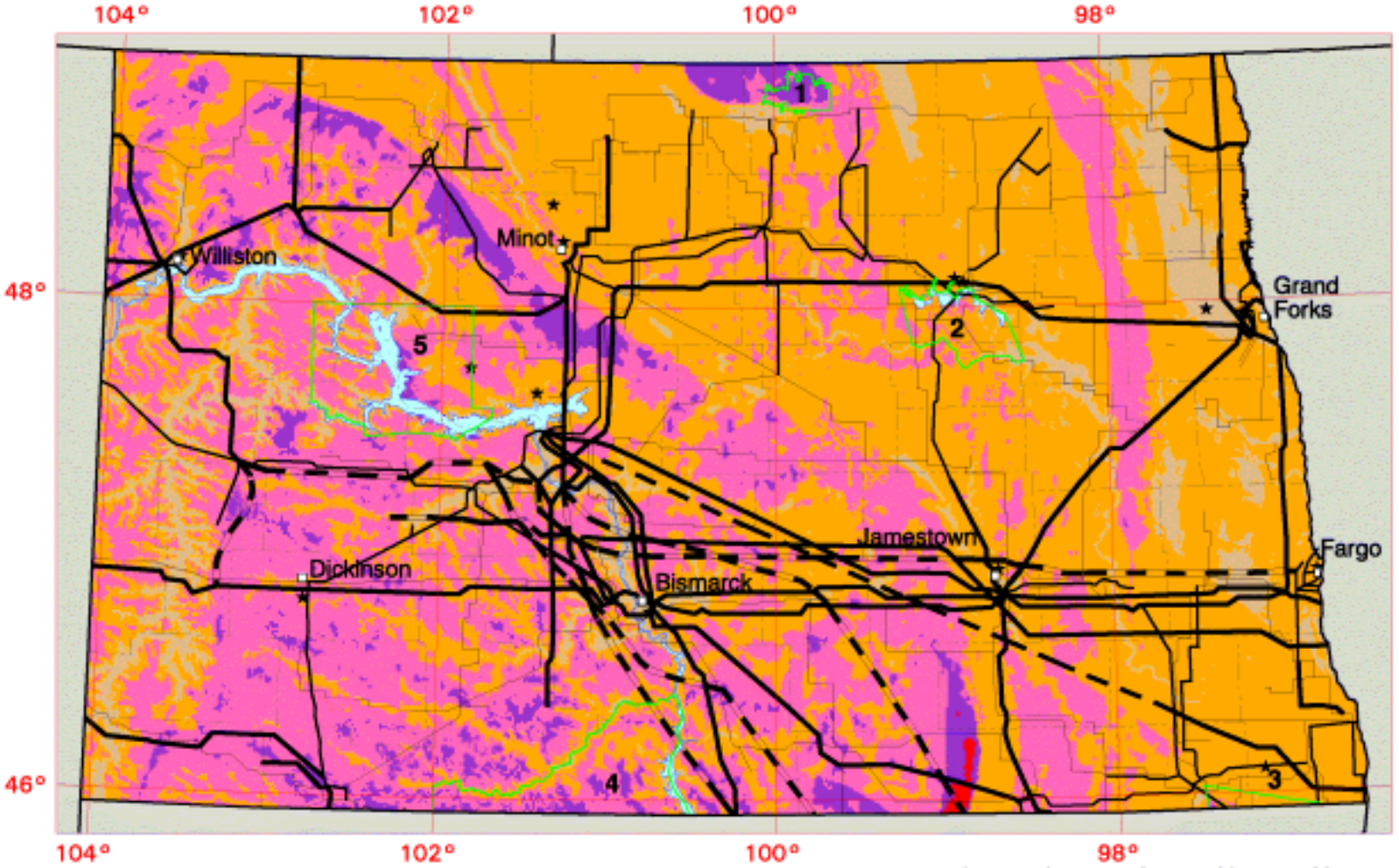


Wind on the Wires: Transmission Issues in the High Plains

David Blecker, P.E.
Earth Energy Systems


The High Plains
MAPP Region
Alta
Sask.
Man.
Ont.
Mont.
N. Dak.
Minn.
Wisc.
S. Dak.
Wyo.
Iowa
Neb.
Col.
Ill.

North Dakota - Wind Resource Map



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m²	Wind Speed[a] at 50 m m/s	Wind Speed[a] at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7

[a]Wind speeds are based on a Weibull k value of 2.0

★ Meteorological Station with Wind Data
□ City or Town

40 0 40 80 120 160 Kilometers
25 0 25 50 75 100 Miles

Transmission Line Voltage

- 69 Kilovolts
- 115 Kilovolts
- 230 Kilovolts
- 345 Kilovolts
- Under Construction

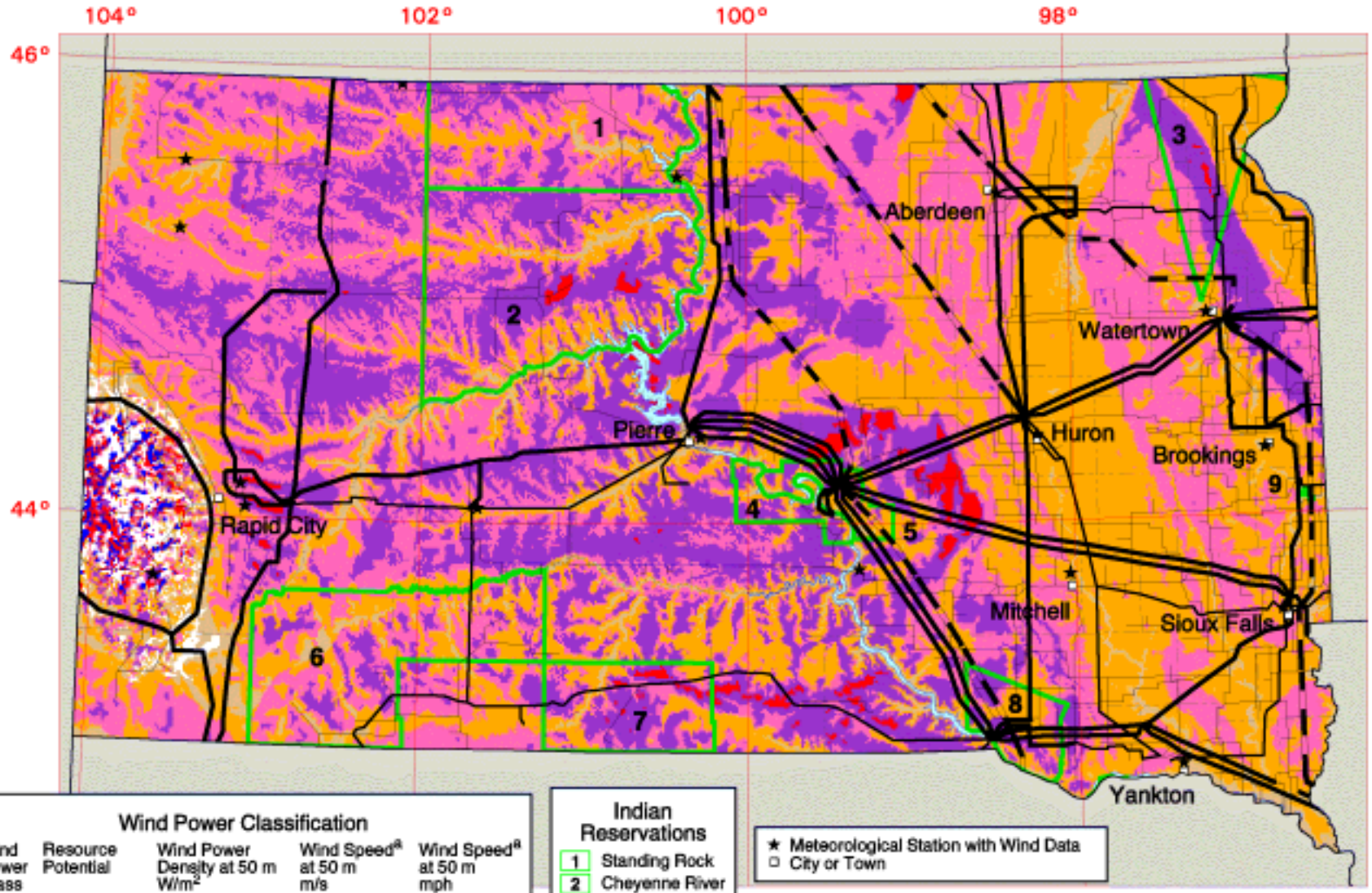
Indian Reservations

1. Turtle Mountain
2. Devil's Lake Sioux
3. Lake Traverse
4. Standing Rock
5. Fort Berthold

U.S. Department of Energy
National Renewable Energy Laboratory

NREL

South Dakota - Wind Resouce Map



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5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a]Wind speeds are based on a Weibull k value of 2.0

Indian Reservations

1	Standing Rock
2	Cheyenne River
3	Lake Traverse
4	Lower Brule
5	Crow Creek
6	Pine Ridge
7	Rosebud
8	Yankton
9	Flandreau

★ Meteorological Station with Wind Data
□ City or Town

Transmission Line Voltage

69 Kilovolts
115 Kilovolts
230 Kilovolts
345 Kilovolts

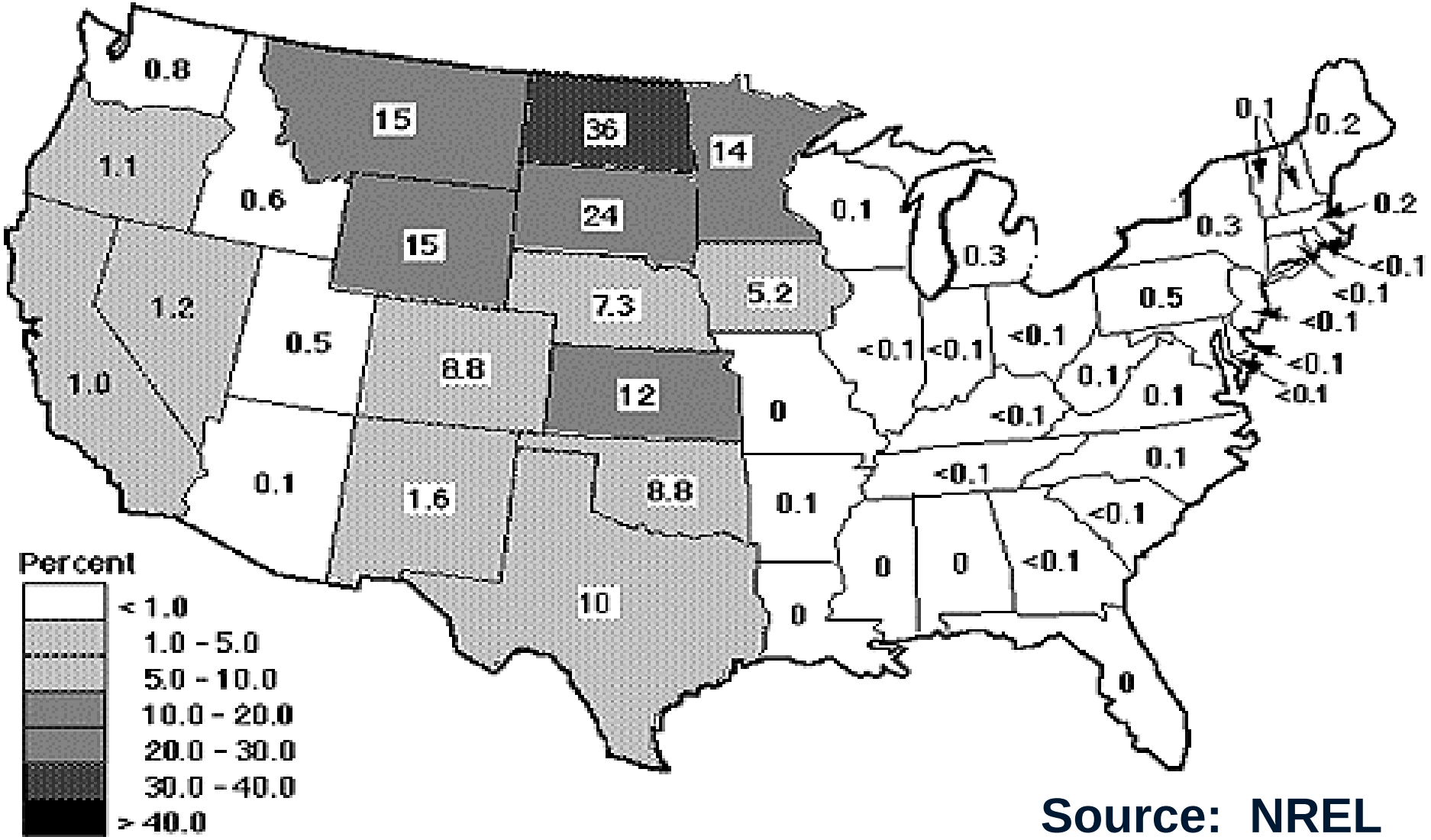
50 0 50 100 Kilometers
25 0 25 50 75 Miles

NREL

U.S. Department of Energy
National Renewable Energy Laboratory

Wind Electric Potential as a Percent of Contiguous U.S. 1990 Total Electric Consumption

Specifications: Wind Resource> Class 4 at 30m (>320W/m2), 30m hub height, 10D x 5D Spacing, 25% Efficiency, 25% Losses



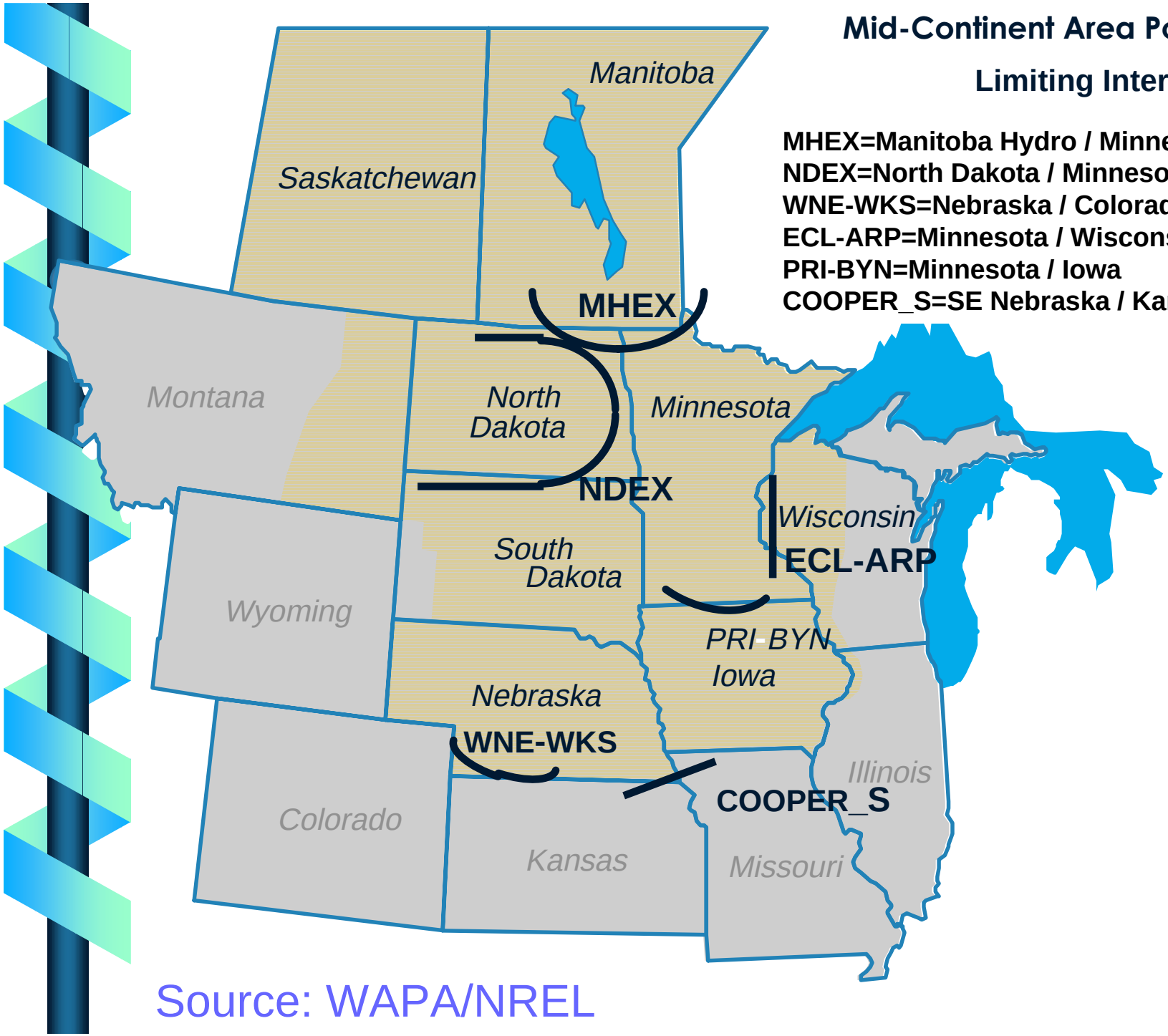
Source: NREL

Excluded Land Area: 100% Environmental, 100% Urban, 50% Forest, 30% Agricultural, 10% Range

Mid-Continent Area Power Pool

Limiting Interfaces

MHEX=Manitoba Hydro / Minnesota
NDEX=North Dakota / Minnesota & S Dakota
WNE-WKS=Nebraska / Colorado & Kansas
ECL-ARP=Minnesota / Wisconsin
PRI-BYN=Minnesota / Iowa
COOPER_S=SE Nebraska / Kansas & MO



Source: WAPA/NREL

South Dakota Wind

- HUGE resource (really big)
- Existing transmission system constrained
- Requires new wires to access distant markets for large scale development

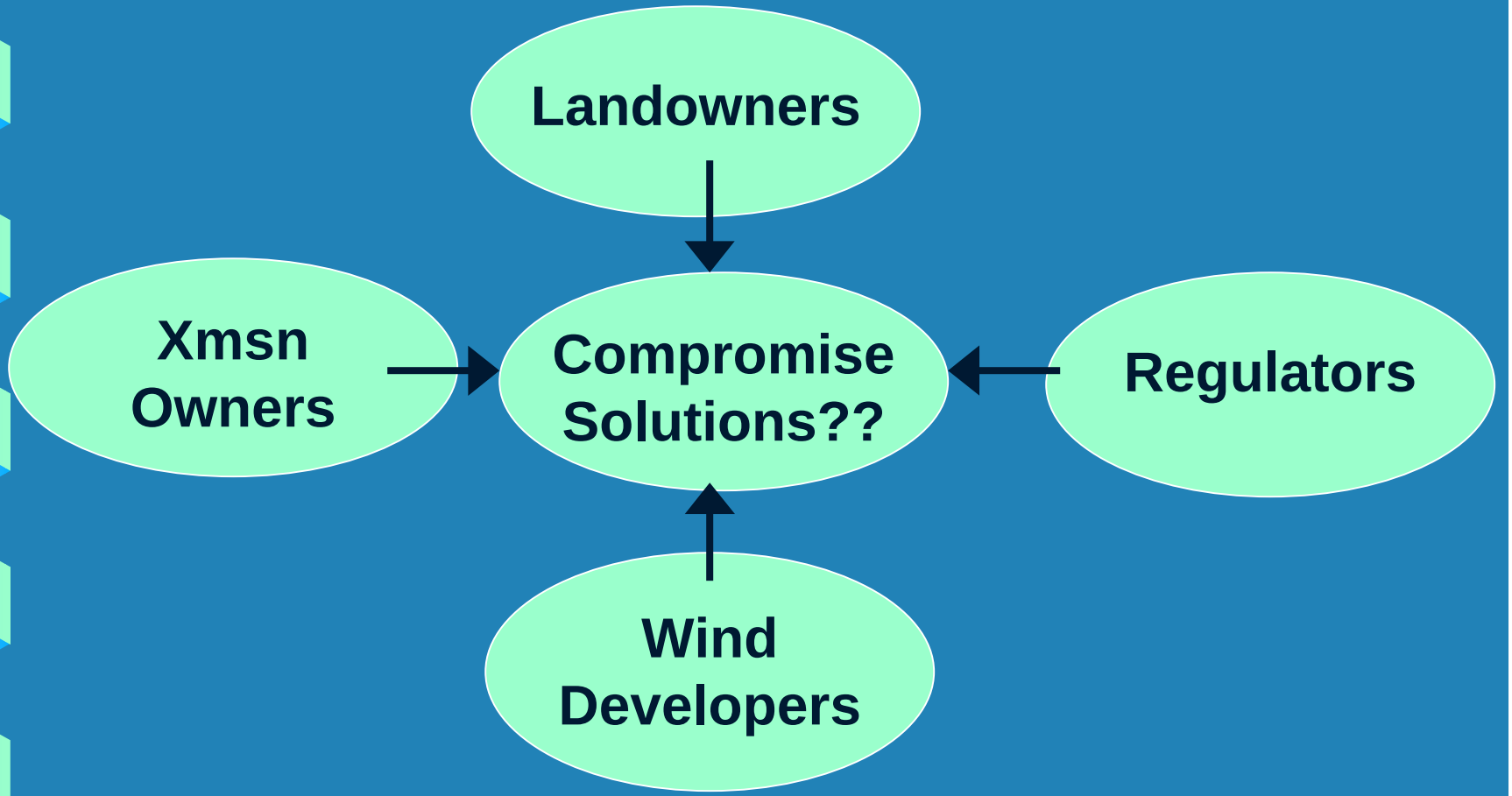
Transmission Drivers

- The “reliability” problem
- Congestion - trapped generation
- New generation additions
- Profits/market power
- Wind development (wind is where the people ain’t!)

Transmission Barriers

- Environmental Impact
- Cost recovery
- New generation
- Effective barrier to wind, DG, and DSM
- Profits/Market Protection
- Landowner Opposition

Wind Transmission Stakeholders



Wind Developers/Advocates

- Want to see wind developed
- Size does matter!
  - Small clusters can benefit state w/o need for new wires
- Transmission access capacity & rates
  - ancillary services cost
- Public Involvement
- Conflict with “environmentalists”?

Landowners/Public

- Wind Turbine Siting/Development
  - Financial benefit from wind turbine leases
  - Little impact on farming/grazing
  - Environmental impact/siting

Landowners/Public

- Power Line Routing
  - Condemnation
  - Fair market value
  - EMF
  - Property Values
  - Wires are color blind

Regulators

- Pricing & tariffs (FERC)
- Dispute resolution (FERC)
- Construction approval (PUC)
- Public interest
- Public participation

Transmission Owners

- Comply with service requirements
- System reliability
- Congestion management
- Wheeling revenue
- Eminent domain
- System planning & construction
- Public involvement ???

Policy Concerns

- Uncertainty
  - MAPP - MAIN Merger
  - Regional Transmission Organization
  - Federal and State Restructuring
  - Investment Cost Recovery
  - Private Power Lines

Policy Concerns

- Key objectives:
  - Fair, uniform & non-discriminatory federal & state policies
  - Innovative approaches to mitigate constraints
    - virtual wheeling & green tagging
  - Stakeholder participation at every level - especially public - balance needs
  - Uncloak the wizard