



Enabling Renewables via Transmission WCI & HPX Examples

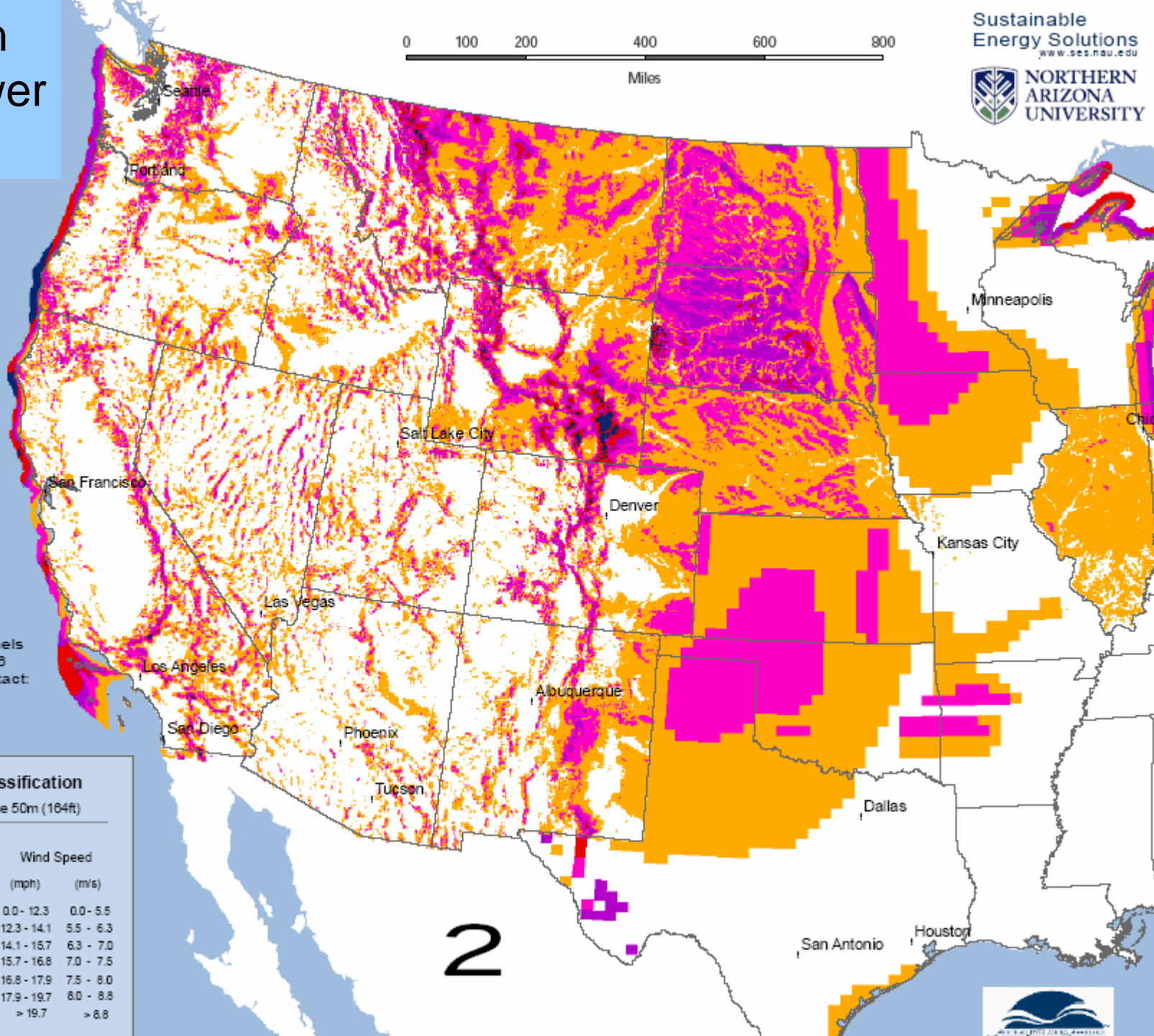
*Jerry Vaninetti, VP Western Development
Denver, Colorado
Trans-Elect Development Company, LLC*

***Increasing Renewable Energy in the Western Grid Summit
Western Governors Association & National Wind Coordinating Collaborative***

Ft. Collins, CO
September 27-28, 2007



Western Wind Power Map



Average Annual Wind Resource
50m (164 ft)

Wind Data
Provided By NREL

Spatial resolution of
high-resolution wind
resource data
200m (656 ft)

Spatial resolution of
low-resolution, 1986
wind resource data
20 mi (32.2 km)

Albers Equal Area Conic

Created by: Grant Brummels
Date of Creation: 3/5/2006
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NREL Wind Power Classification

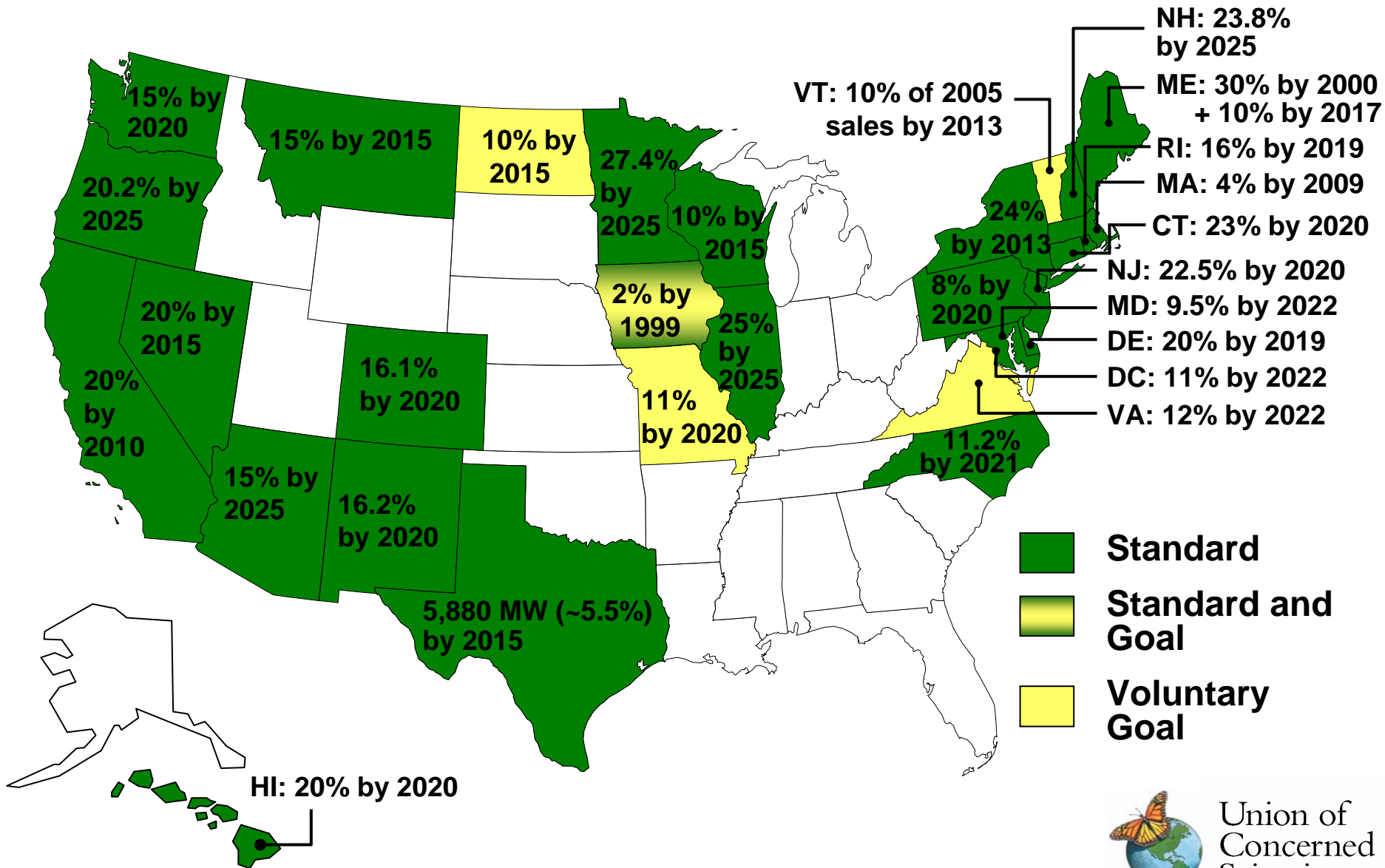
Average Annual Wind Resource 50m (164ft)

Wind Power Class	Wind Power Density (W/m ²)	Wind Speed (mph)	Wind Speed (m/s)
1 Poor	0 - 200	0.0 - 12.3	0.0 - 5.5
2 Marginal	200 - 300	12.3 - 14.1	5.5 - 6.3
3 Fair	300 - 400	14.1 - 15.7	6.3 - 7.0
4 Good	400 - 500	15.7 - 16.8	7.0 - 7.5
5 Excellent	500 - 600	16.8 - 17.9	7.5 - 8.0
6 Outstanding	600 - 800	17.9 - 19.7	8.0 - 8.8
7 Superb	> 800	> 19.7	> 8.8

2



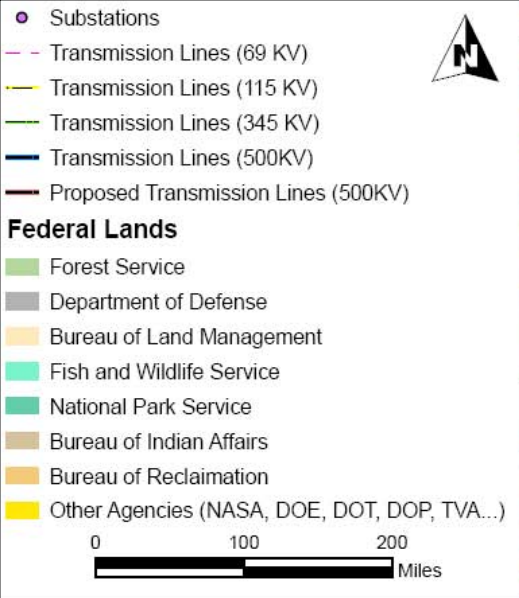
Effective Renewable Electricity Standards



RPS Requirements (MW) – West

(from Union of Concerned Scientists)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2020%
CALIFORNIA	9,344	9,471	9,582	9,695	9,821	9,948	10,077	10,207	10,340	10,474	10,610	46%
WASHINGTON	1,683	1,872	2,060	2,205	2,349	2,492	2,635	2,777	2,918	3,059	3,199	14%
COLORADO	638	807	957	1,113	1,291	1,474	1,644	1,820	2,006	2,197	2,396	10%
ARIZONA	328	424	532	630	733	843	1,047	1,265	1,496	1,742	2,004	9%
NEVADA	634	841	884	1,117	1,173	1,368	1,437	1,509	1,585	1,664	1,747	8%
OREGON	-	399	401	404	406	1,222	1,229	1,236	1,243	1,250	1,676	7%
NEW MEXICO	426	487	564	629	696	841	921	1,005	1,093	1,186	1,282	6%
MONTANA	206	207	209	210	211	319	321	323	325	327	329	1%
TOTAL	13,258	14,508	15,189	16,001	16,680	18,506	19,311	20,143	21,006	21,899	23,243	100%
HPX States	1,391	1,717	2,053	2,371	2,720	3,158	3,613	4,090	4,595	5,125	5,682	24%



Disclaimer: this map is for study purposes only and is not meant to imply any specific project routing



High Plains Express (HPX) Project

Note: Conceptual Routing

- Initial Feasibility Studies
 - Synergies with other projects
- Integrated AC System
 - Improved connections between states/systems
 - Improved Reliability
- Two 345 or 500 kV lines
- 1,200 Miles
- 2,000 MW – 3,000 MW
- Significant renewable component
- Power Imports/Exports
- Stakeholder Process
- Project Participants
 - Xcel, Tri-State, WAPA, PRPA, CSU, PNM, SRP & Trans-Elect
 - WIA, NM-RETA & CEDA?
- http://www.rmao.com/wtpp/HPX_Studies.html

Wind Resources & Installations

(from NREL & Interwest Energy Alliance)

Generation Capacity (MW)

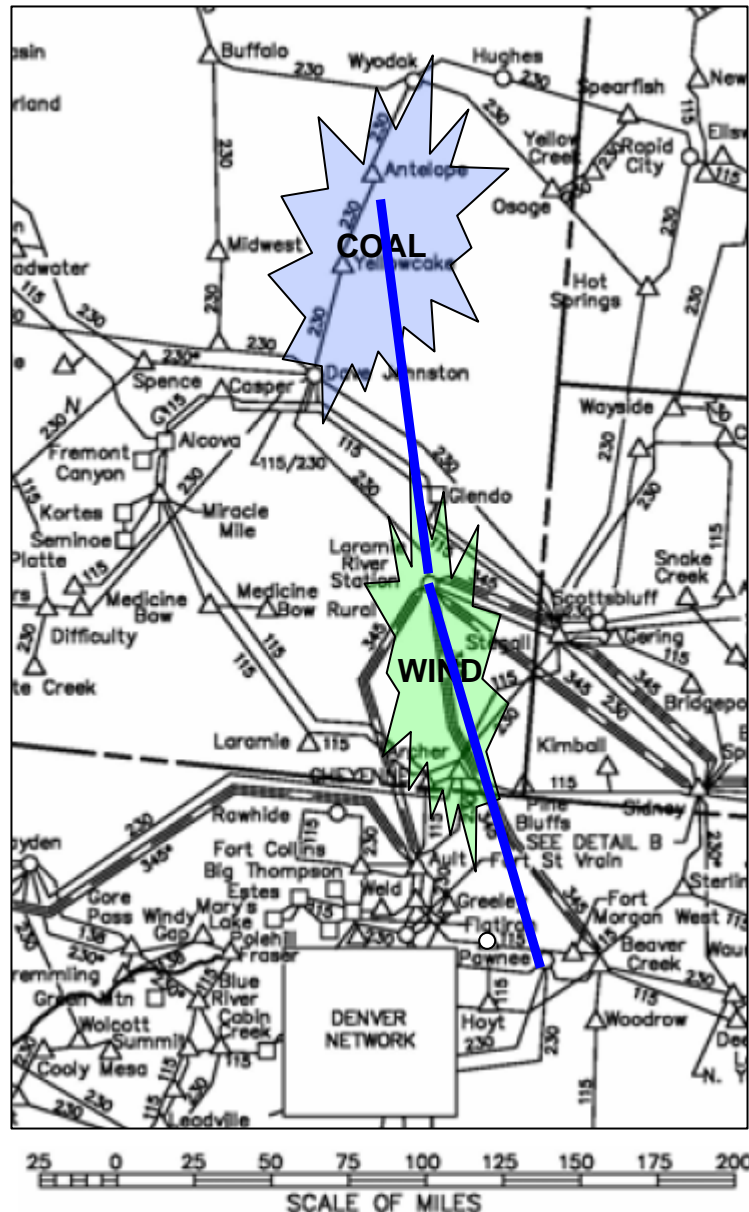
Developable* Installed ('07)

• Wyoming	257,650	319
• Colorado	73,130	1,066
• New Mexico	73,040	496
• <u>Arizona</u>	<u>2,310</u>	<u>0</u>
TOTALS	406,130	1,881

Note: Current WECC peak demand ~ 175,000 MW

* Class 4 +; excludes unsuitable land; 5 MW per km²

Wyoming-Colorado Intertie Project (TOT3)



200 miles
230 kV
450 MW

180 miles
345 kV
900 MW

- Recommended by RMATS
 - TOT3 Constraint
 - 6 Lines w/ 1,600 MW Capacity
- Public/Private Partnership
 - Wyoming Infrastructure Authority, Trans-Elect & WAPA
- Potential HPX building block
- Wind & Coal Resources
- Customers: LSEs & Generators
- Provides mechanism to tap non-firm capacity across TOT3
 - 100 MW @ 99% of the Time
 - 500 MW @ 75% of the Time
- Open Season Auction Jan-08
- ~2013 on-line date
- Project Website:
 - www.wyia.org/wci

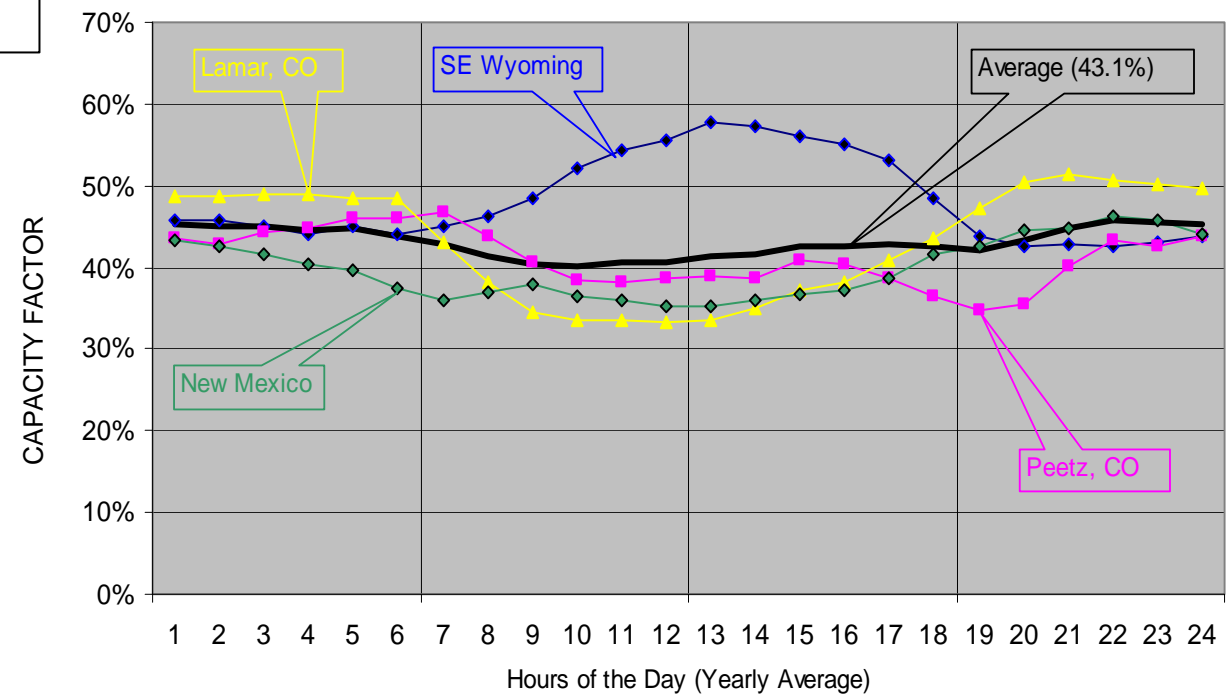
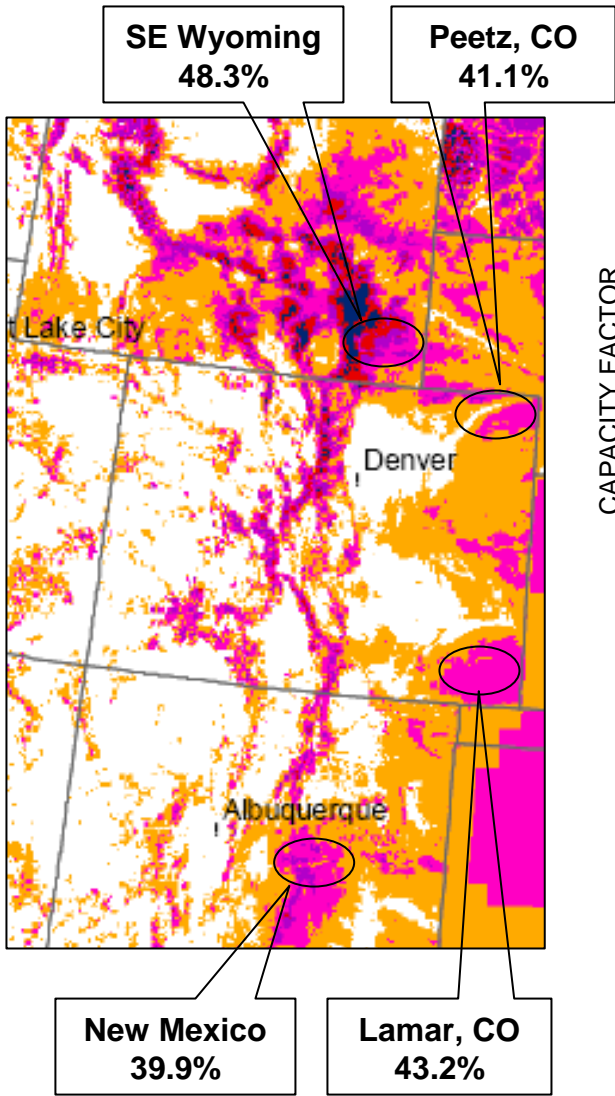


Existing Transmission Lines



New Lines Under Development

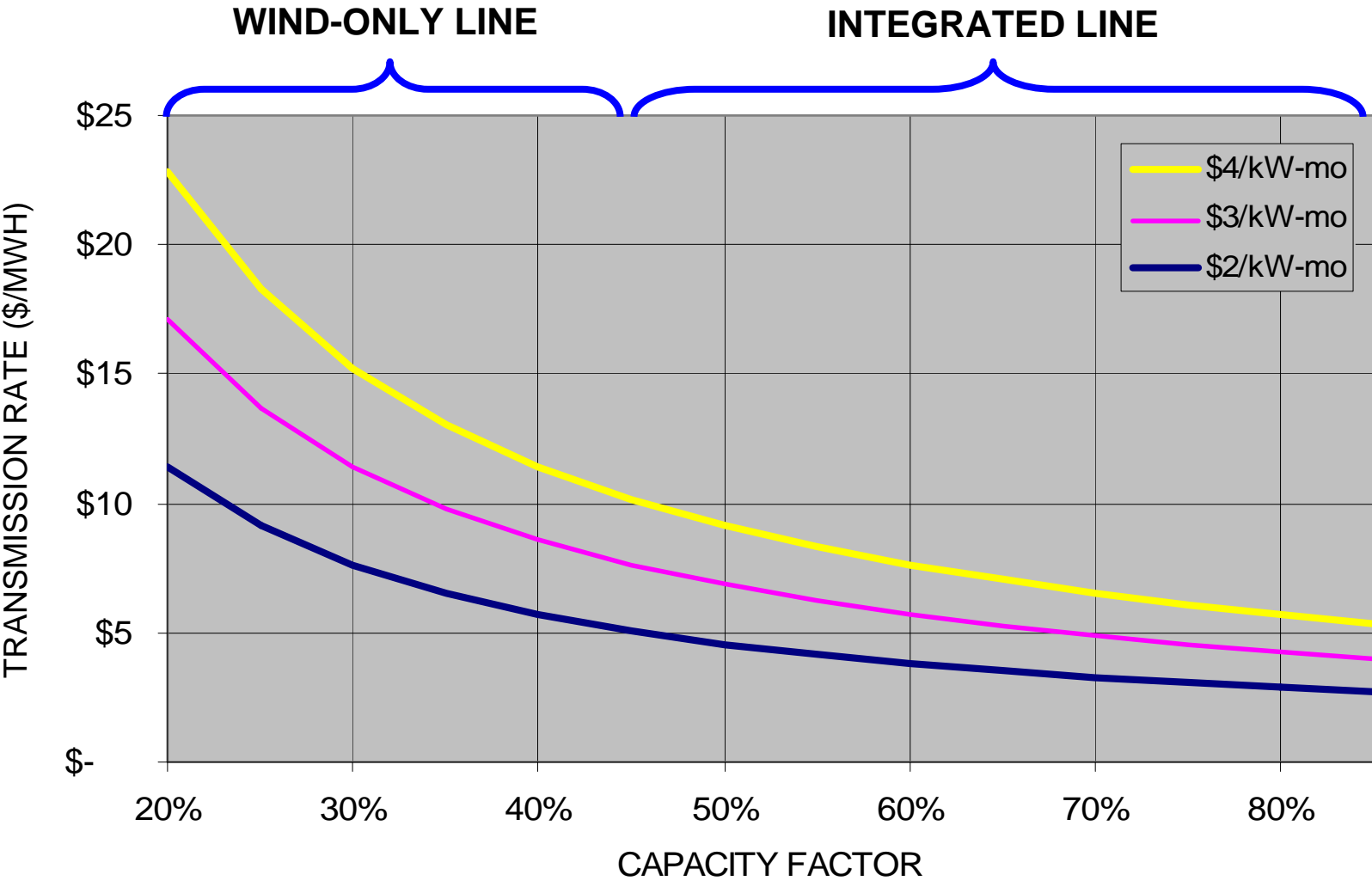
Geographic Diversity of Wind



- **Geographic Diversity Improves Overall Availability of the Wind**
- **Standard Deviation Reduced**
- **Reduced Integration Costs**
- **Advantages for all states**

Source: NREL wind performance projections

Line Utilization Dictates Transmission Rates



Getting Transmission Built

- Project Support
 - Interstate or Intrastate
 - Provincial vs. Regional Agendas
 - Incremental or Master Plan
 - Generator Leads vs. Integrated Lines
 - Project Sponsorship
 - Utility vs. External
- Commitments for Capacity/Cost Recovery
 - Load Serving Entities
 - Generators/Traders
 - Regulatory Support

Conclusions

- Transmission is a renewable enabler, but is most cost-effective when fully utilized & integrated
 - Solutions: overbuilding, firming & shaping
 - Geographic Diversity: supplementing wind with wind/solar
- New transmission: a mechanism for tapping non-firm
- RPS is a finite market, so additional demand will have to come from the marketplace
 - Potential supply exceeds RPS demand & transmission capacity
 - Costs for all incremental resource additions are rising dramatically
 - Carbon tax and PTC are likely to tip the balance
- The High Plains Express & Wyoming-Colorado Intertie projects provide benefits:
 - Improved connections with adjoining states: reliability
 - Geographic diversity to reduce wind integration costs
 - Provides infrastructure & mechanisms for enabling renewables
 - Access to competitively-priced remote resources
 - Creation of import/export opportunities

Questions?



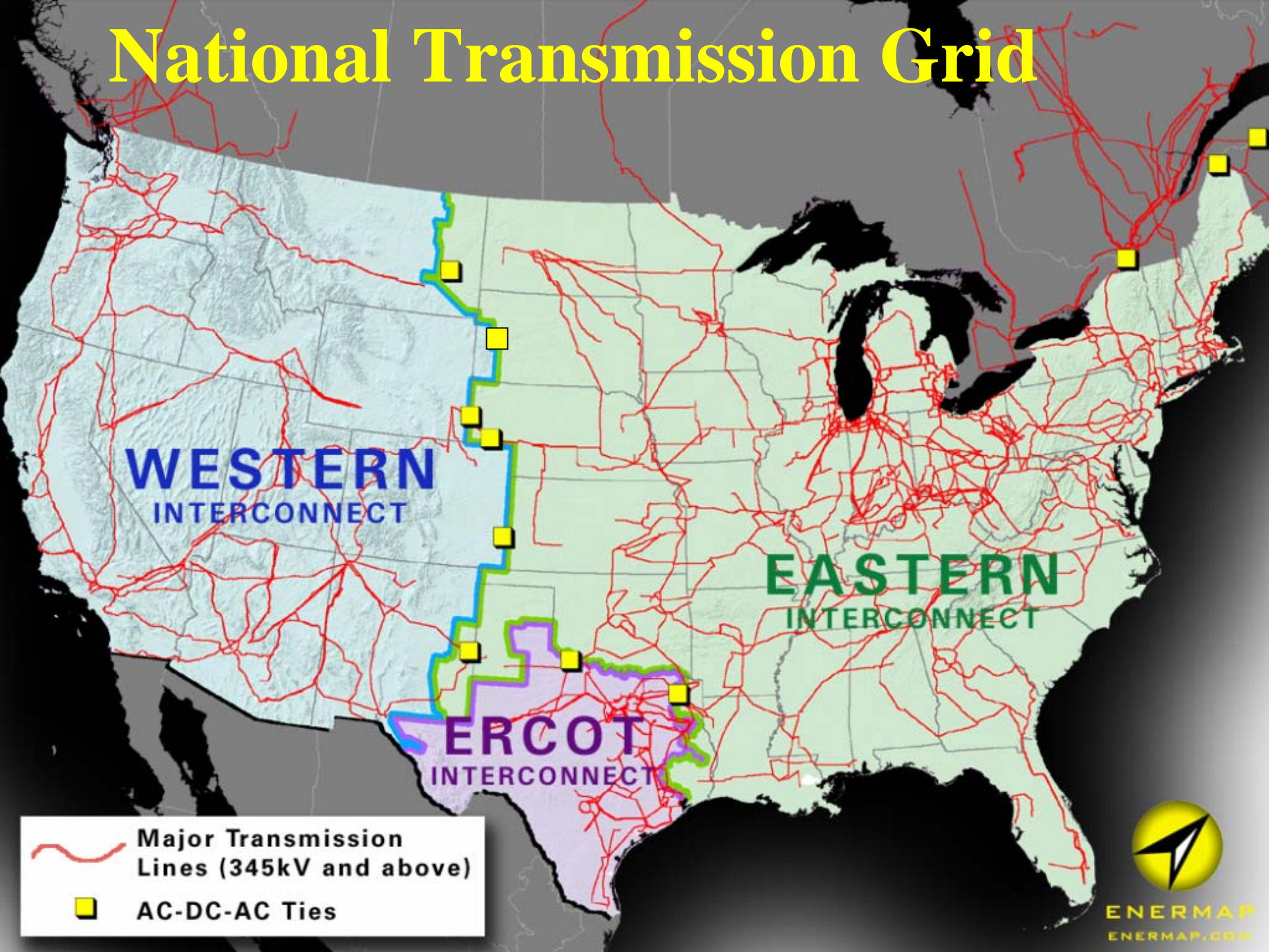
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Supplemental Slides for CEDA

National Transmission Grid



WESTERN
INTERCONNECT

EASTERN
INTERCONNECT

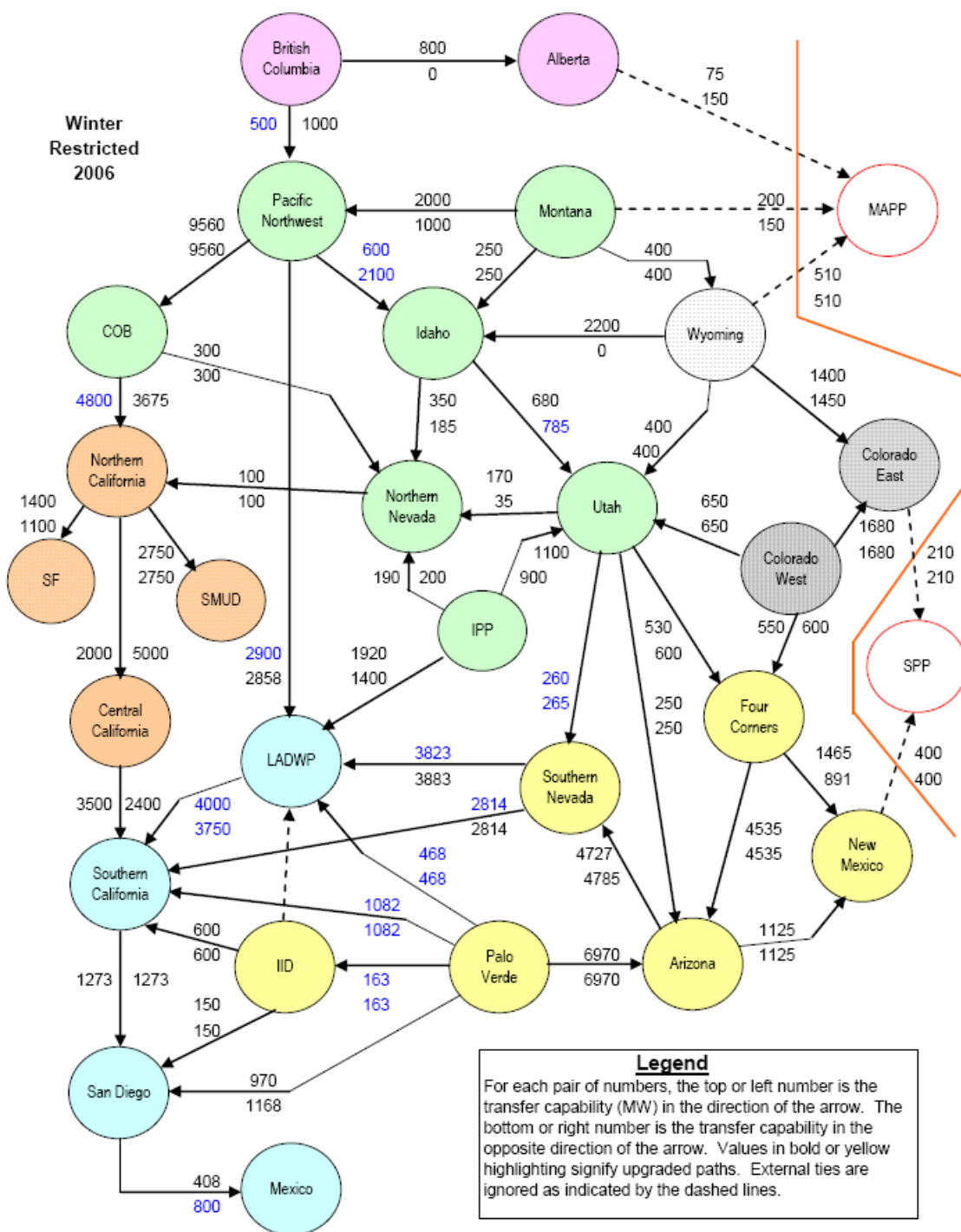
ERCOT
INTERCONNECT

Major Transmission
Lines (345kV and above)

AC-DC-AC Ties



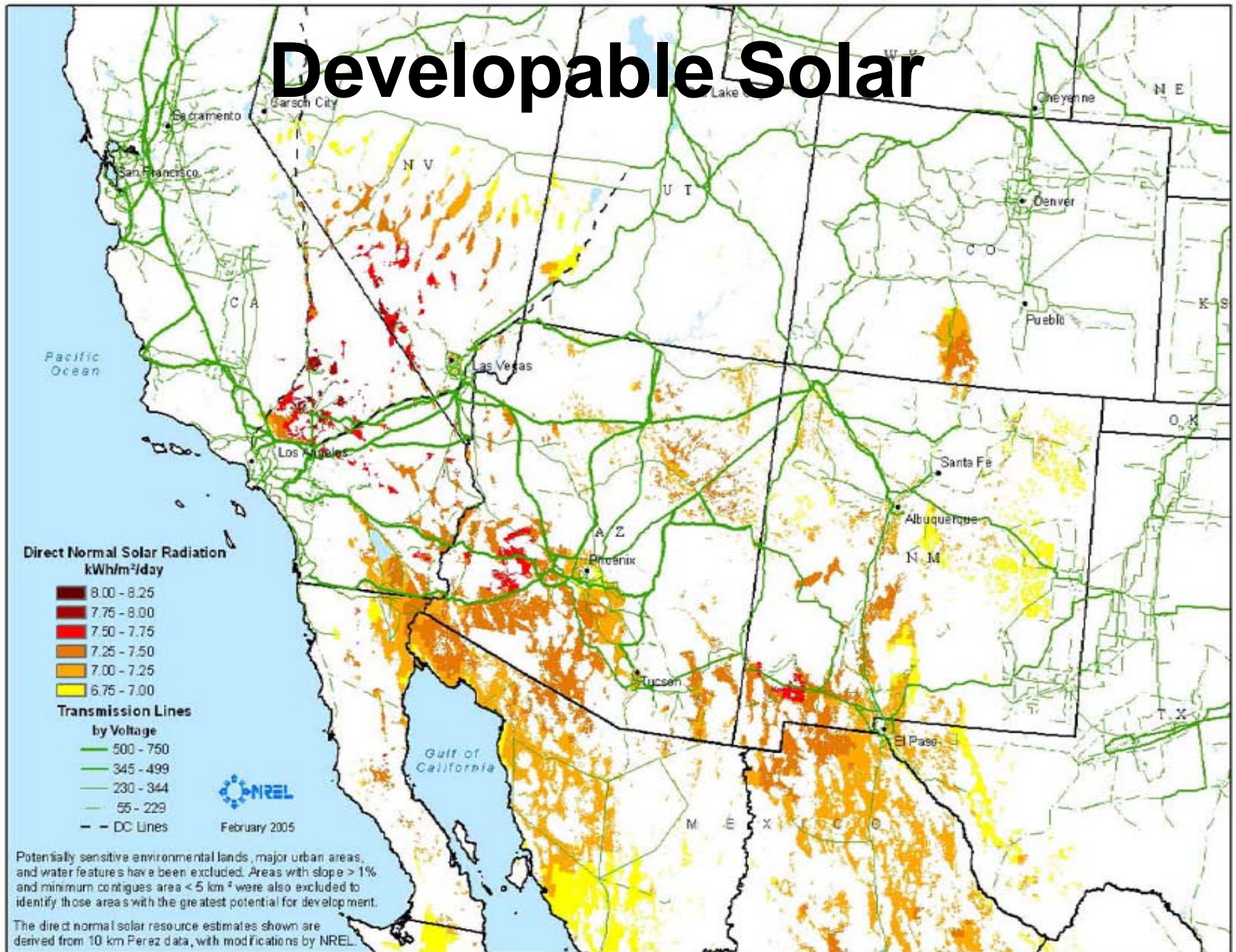
ENERMAP
ENERMAP.COM



Power Flow Capacities between WECC Control Areas

Most paths are fully subscribed

Developable Solar



Potentially sensitive environmental lands, major urban areas, and water features have been excluded. Areas with slope > 1% and minimum contiguous area < 5 km² were also excluded to identify those areas with the greatest potential for development.

The direct normal solar resource estimates shown are derived from 10 km Peraz data, with modifications by NREL.

Transmission Development

- Transmission Line Costs (excluding substations)
 - \$1.5 MM/mi for 500 kV for 1,500 MW = \$1,000/kW
 - \$1.0 MM/mi for 345 kV for ~750 MW = \$1,333/kW
 - \$0.75 MM/mi for 230 kV for ~400 MW = \$1,870/kW
- Transmission Development
 - Design, economics, permitting, routing & customers
 - 5-7 Year Timetable
 - Typical development costs: ~\$10 million/project
 - Risky proposition not suited to traditional utilities
 - Role for Independent Transmission developers
- Role of State Transmission Authorities
 - Seeding transmission development for economic and power generation development, focused on renewables
 - Public/private partnerships to leverage limited budgets
 - Providing public policy support to transmission expansion

CEDA Scope

- Transmission Agenda
 - Renewables-only or minimums agenda?
 - Renewables need to be “firmed” – transmission implications
- Local or Regional Focus
 - Local: generator leads (extension cords)
 - Which projects/zones merit assistance?
 - Questionable benefit to reliability
 - Regional: expanding renewable markets beyond RPS
 - Realizing the benefits of geographic diversity (wind firming wind)
- CEDA’s Role in Transmission Development
 - Assistance to generators and/or local utilities?
 - Public/Private Partnerships?
 - Serving Native Load vs. Import/Export Markets
 - Cost Recovery: PUC rate based vs. merchant markets

Role for Trans-Elect?

- Public/private partnerships to leverage development expenditures & share risk
 - Path 15 and Wyoming Infrastructure Models
- Trans-Elect Development Company LLC
 - Professional transmission development
 - Transmission-only agenda
 - Appetite for risk
 - Marshaling stakeholder support/public policy
 - Established WECC reputation
 - Local/Regional Presence
 - Denver, Colorado offices
 - Partner in HPX and WCI projects