

Enabling Renewables via Transmission WCI & HPX Examples

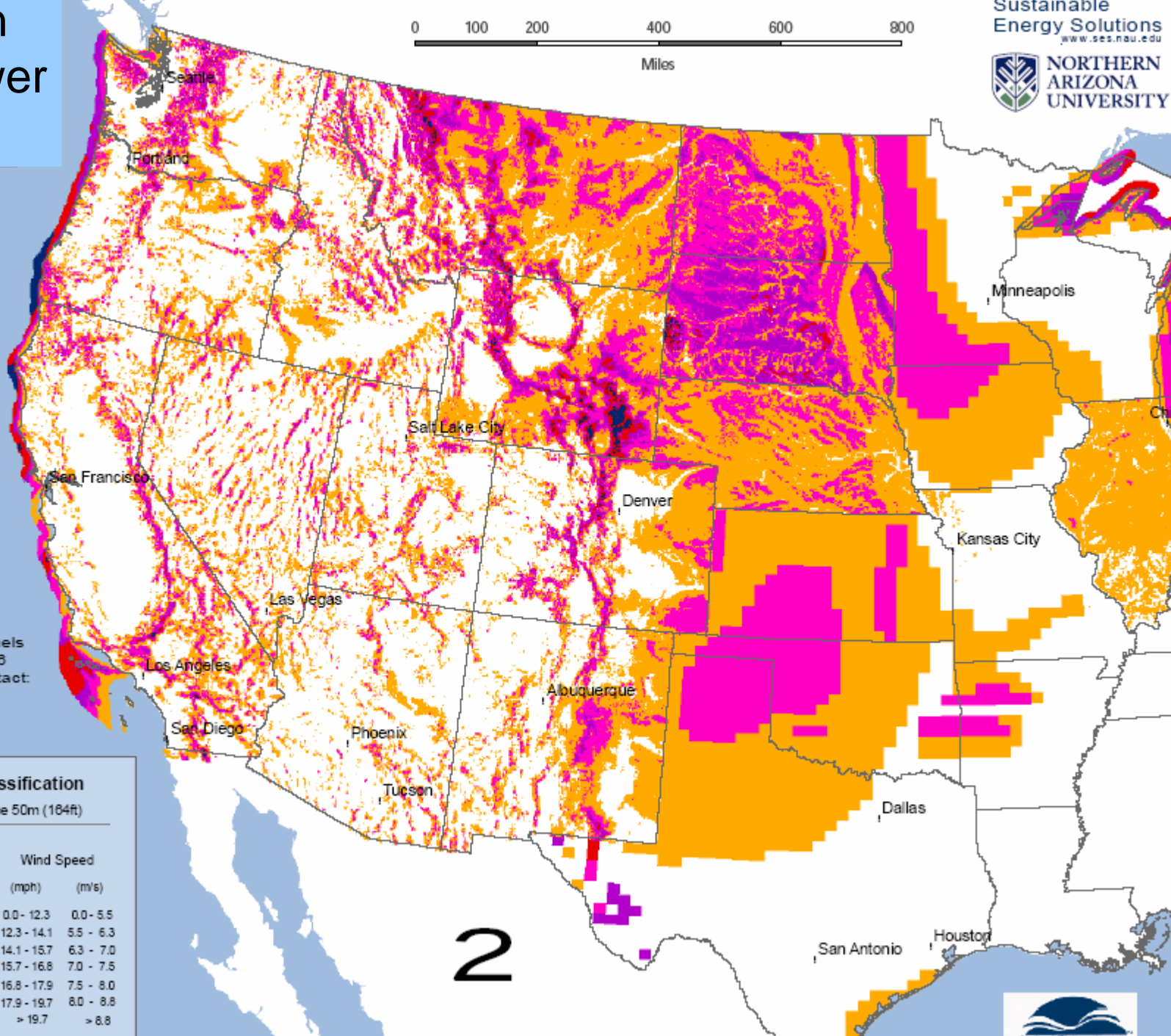
*Jerry Vaninetti, VP Western Development
Denver, Colorado
Trans-Elect Development Company, LLC*

***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

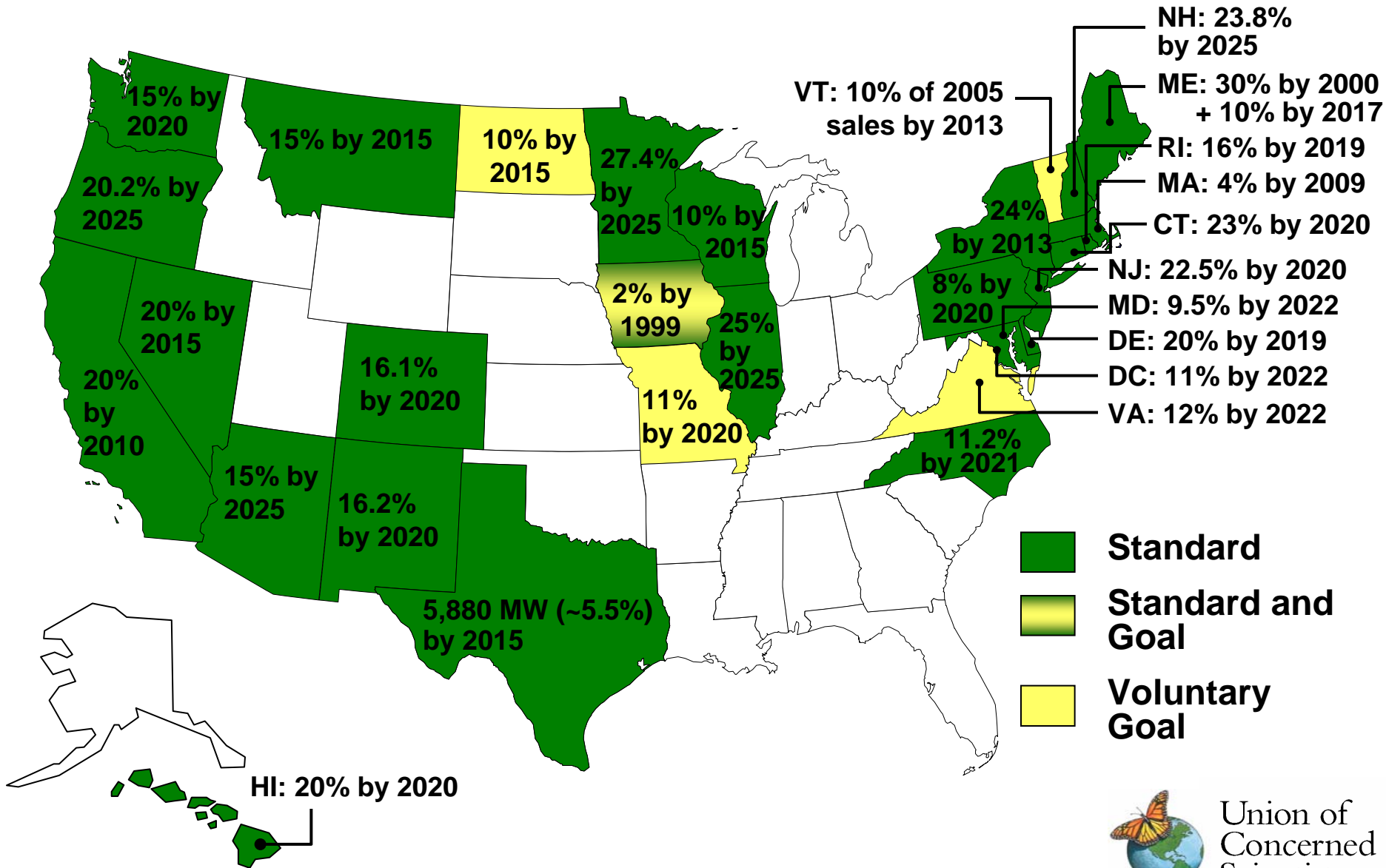
Average Annual Wind Resource 50m (164ft)

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



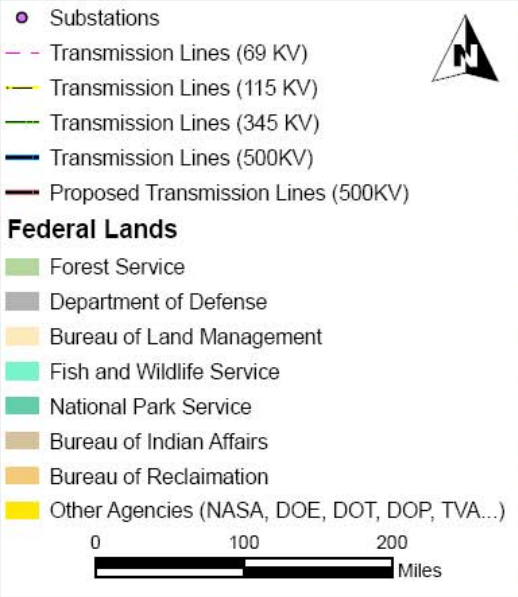
Effective Renewable Electricity Standards



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)

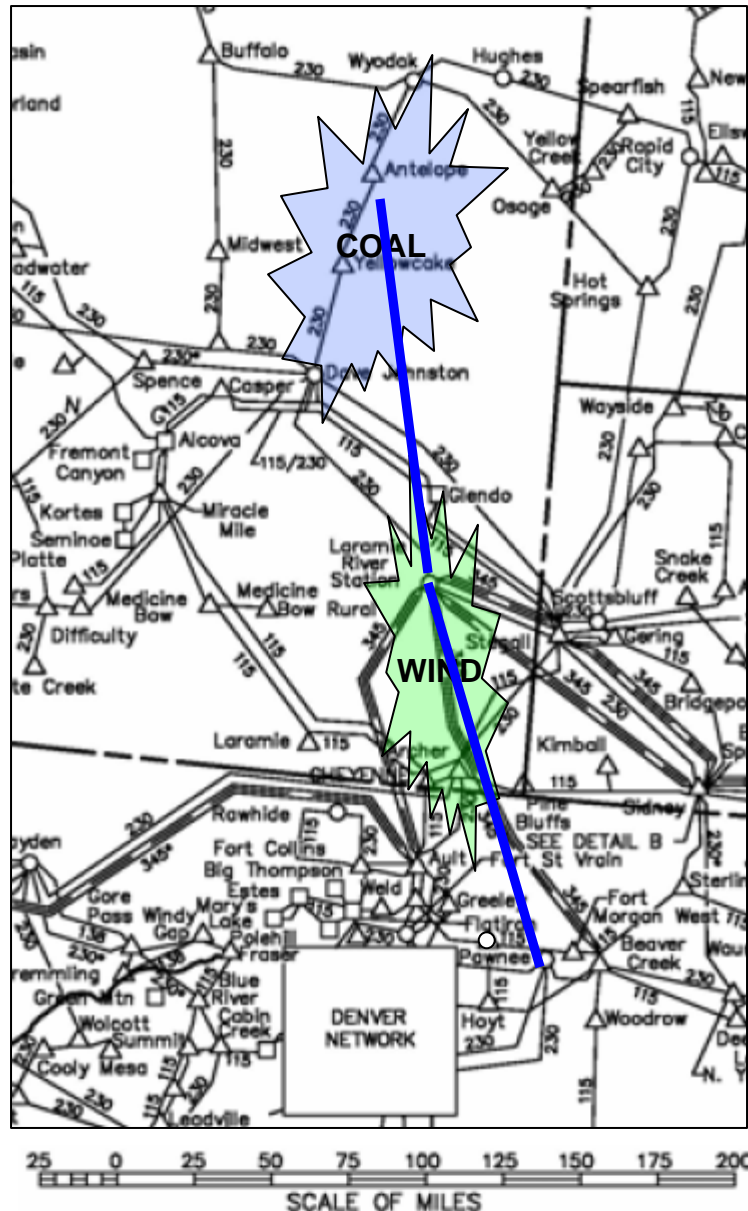
Developable* Installed ('07)

• 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

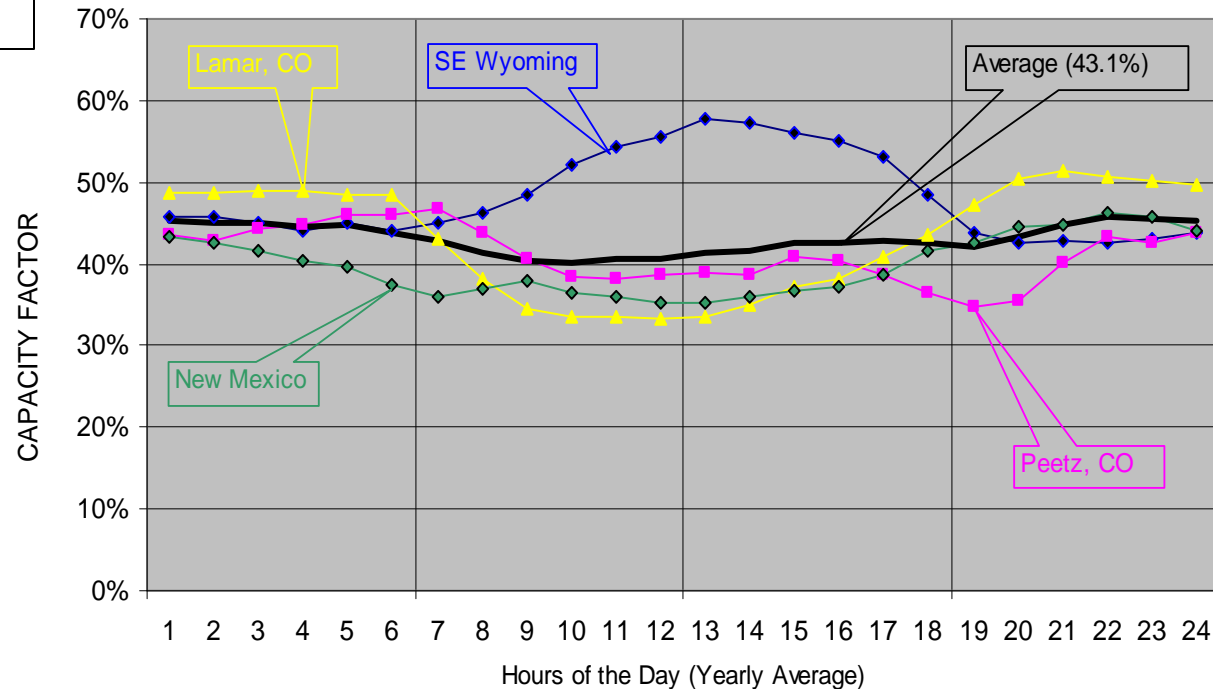
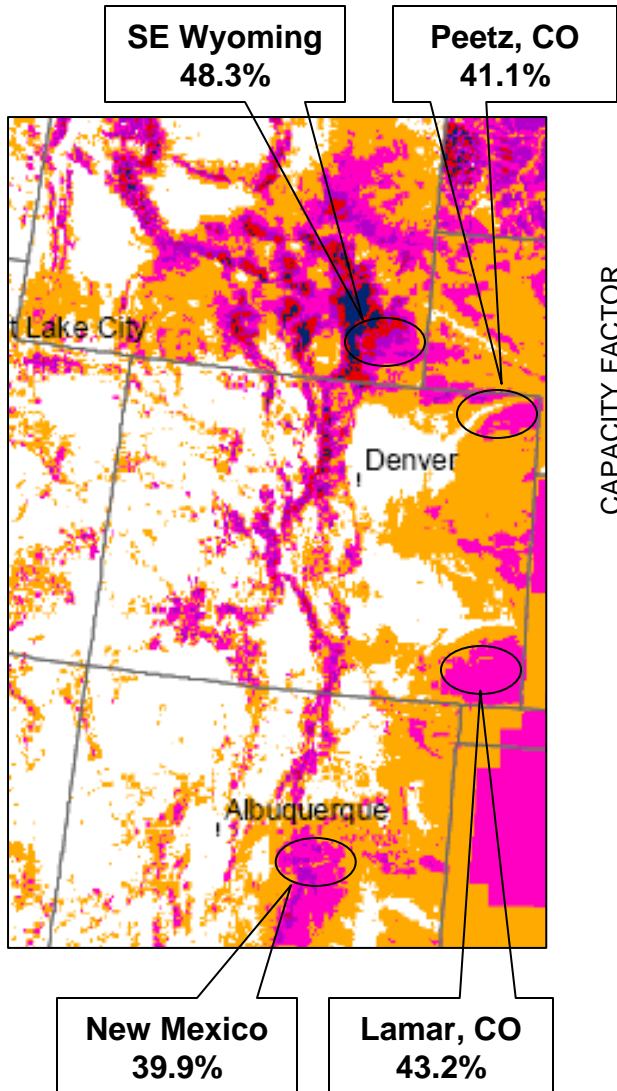


Existing Transmission Lines



New Lines Under Development

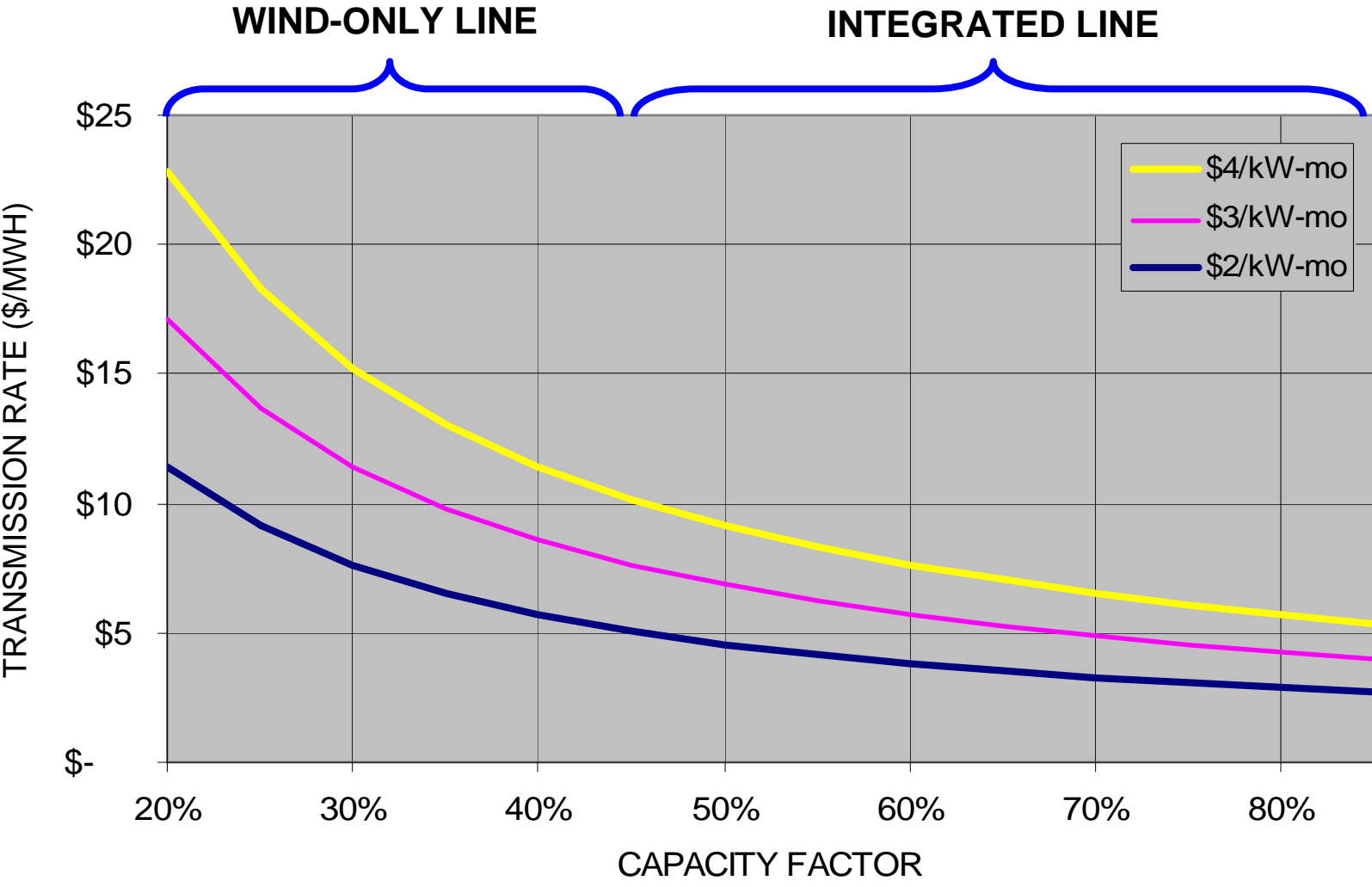
Geographic Diversity of Wind



- **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?



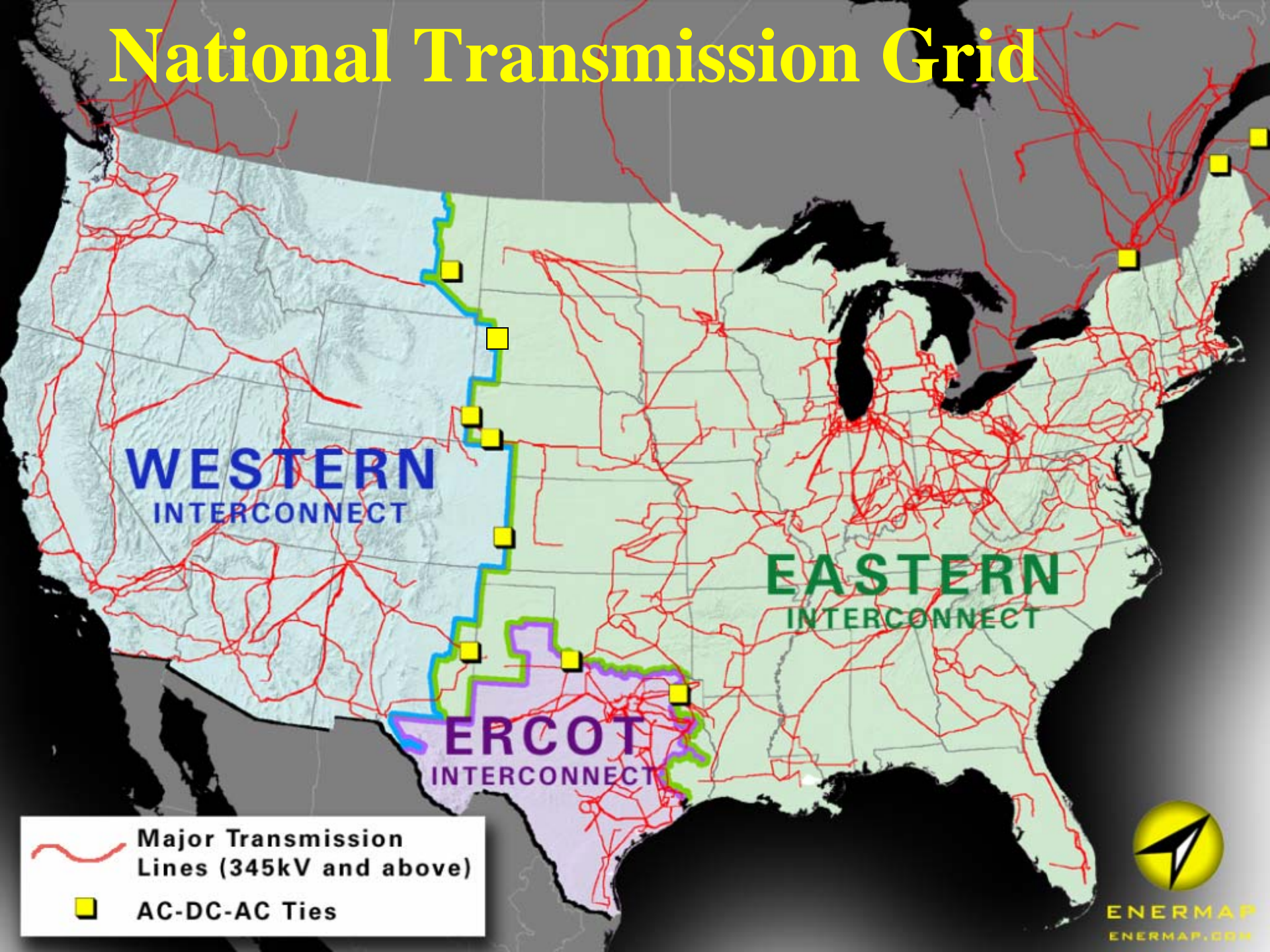
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Supplemental Slides for CEDDA

National Transmission Grid



WESTERN
INTERCONNECT

EASTERN
INTERCONNECT

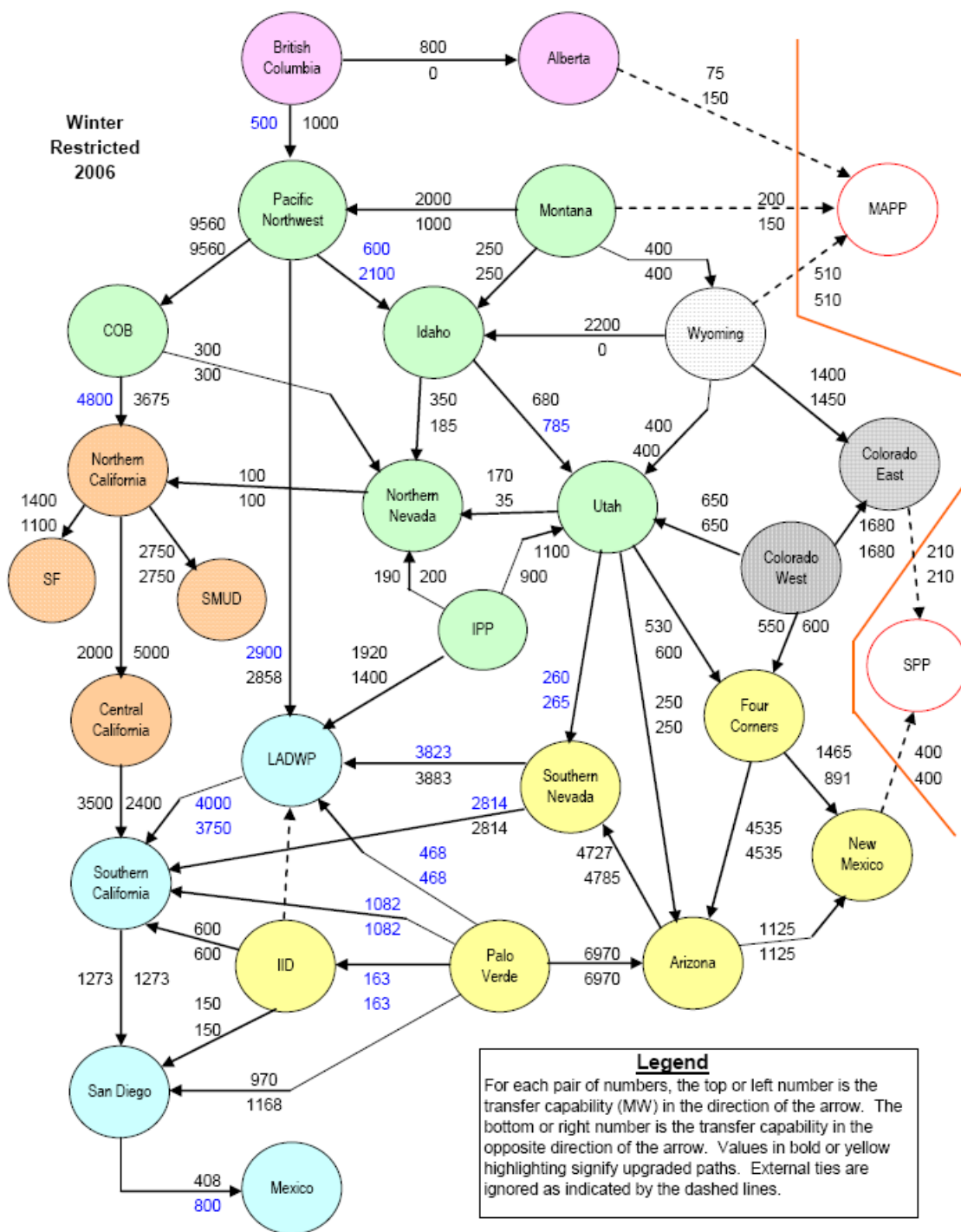
ERCOT
INTERCONNECT

Major Transmission
Lines (345kV and above)

AC-DC-AC Ties



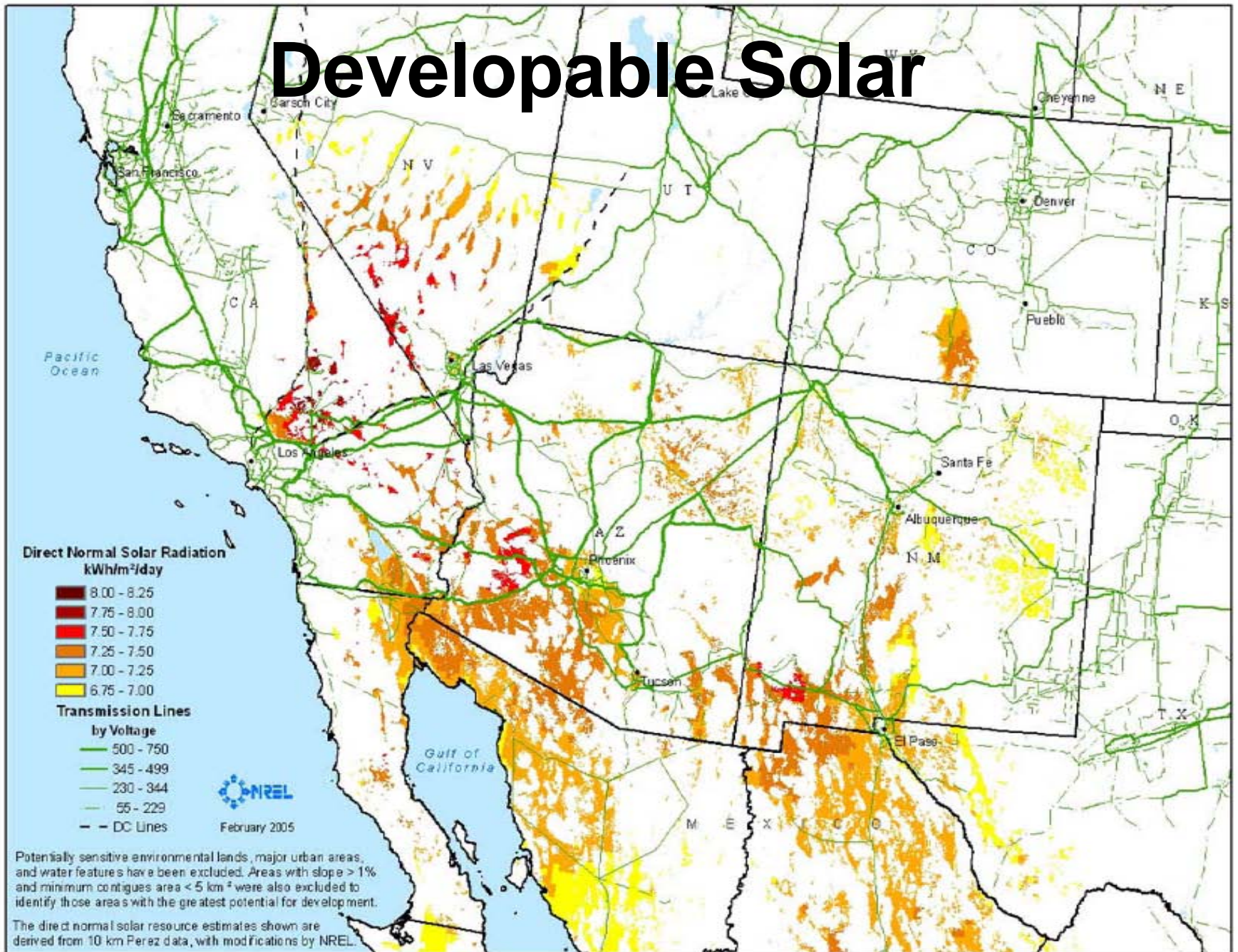
ENERMAP
ENERMAP.COM



Power Flow Capacities between WECC Control Areas

Most paths are fully subscribed

Developable Solar



Transmission Development

- Transmission Line Costs (excluding substations)
 - \$1.5 MM/mi for 500 kV for 1,500 MW = \$1,000/MW-mi
 - \$1.0 MM/mi for 345 kV for ~750 MW = \$1,333/MW-mi
 - \$0.75 MM/mi for 230 kV for ~400 MW = \$1,870/MW-mi
- 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