



Western Electricity Coordinating Council

Transmission Expansion Planning Policy Committee **2008 Study Results**

Spring 2009 Technical Workshop
U.S. DOE 2009 Congestion Study

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Today's Discussion

- TEPPC Study Scenarios
- 2008 Study Results
- 2009 Study Requests
- Related WECC Activities



2017 Renewable Energy Scenarios

- 15% Renewables Case – PC4A
- 15% Renewables plus 20% Energy Efficiency – PC4B
- 15% Renewables plus 20% Energy Efficiency plus a \$20 per ton CO2 adder – PC4C-3

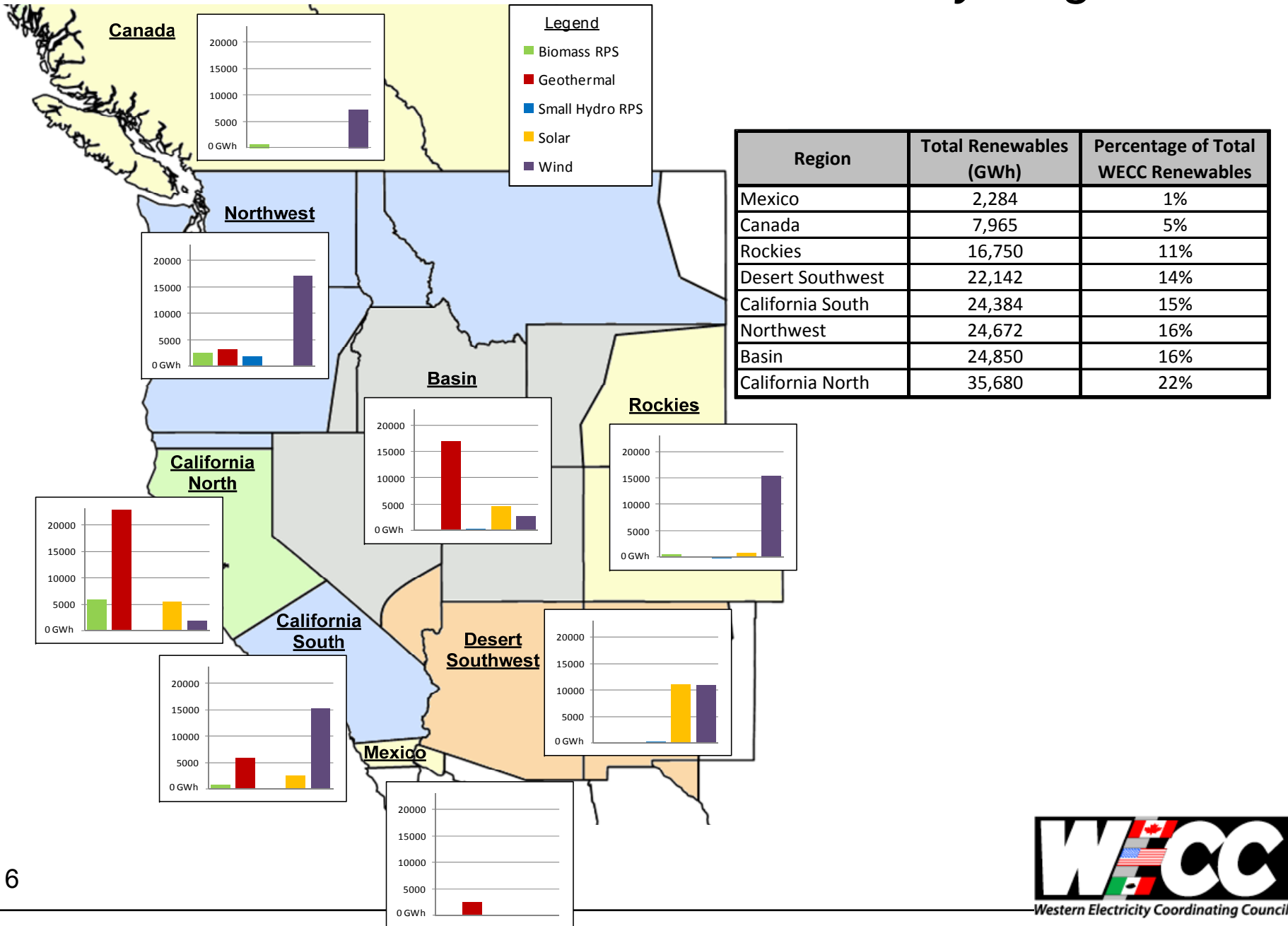
2017 - Base Case

- **Loads** – Member supplied 2017 Forecast
- **Transmission System** – WECC base case 2016-2017
- **Generation** –
 - All existing, plus LRS Category 1 and Category 2 generation.
 - Sufficient RPS resources were added to meet minimum RPS requirements for 2017, which equates to a contribution by renewables of ~8.6% of total WECC energy.
 - High cost local resources were used to fill the remaining load-generation gap.

2017 – 15% Renewables

- **Loads/Transmission** – no change
- **Generation** – A mix of renewable resources were added in order to increase the energy production from renewables from 8.6% to 15% of total WECC energy
 - WIRAB provided specifications regarding the type and amount of renewable generation required by state.
 - WECC used a variety of resources, including meso-scale wind and solar data compiled by NREL, to place renewable generation at specific bus locations.
 - The meso-scale data was also used to create the wind and solar profiles used in the study.
 - Final fuel-type split of renewables(by energy):
 - 45% wind, 16% solar, 32% geothermal, 7% biomass

Location of Renewable Resources by Region

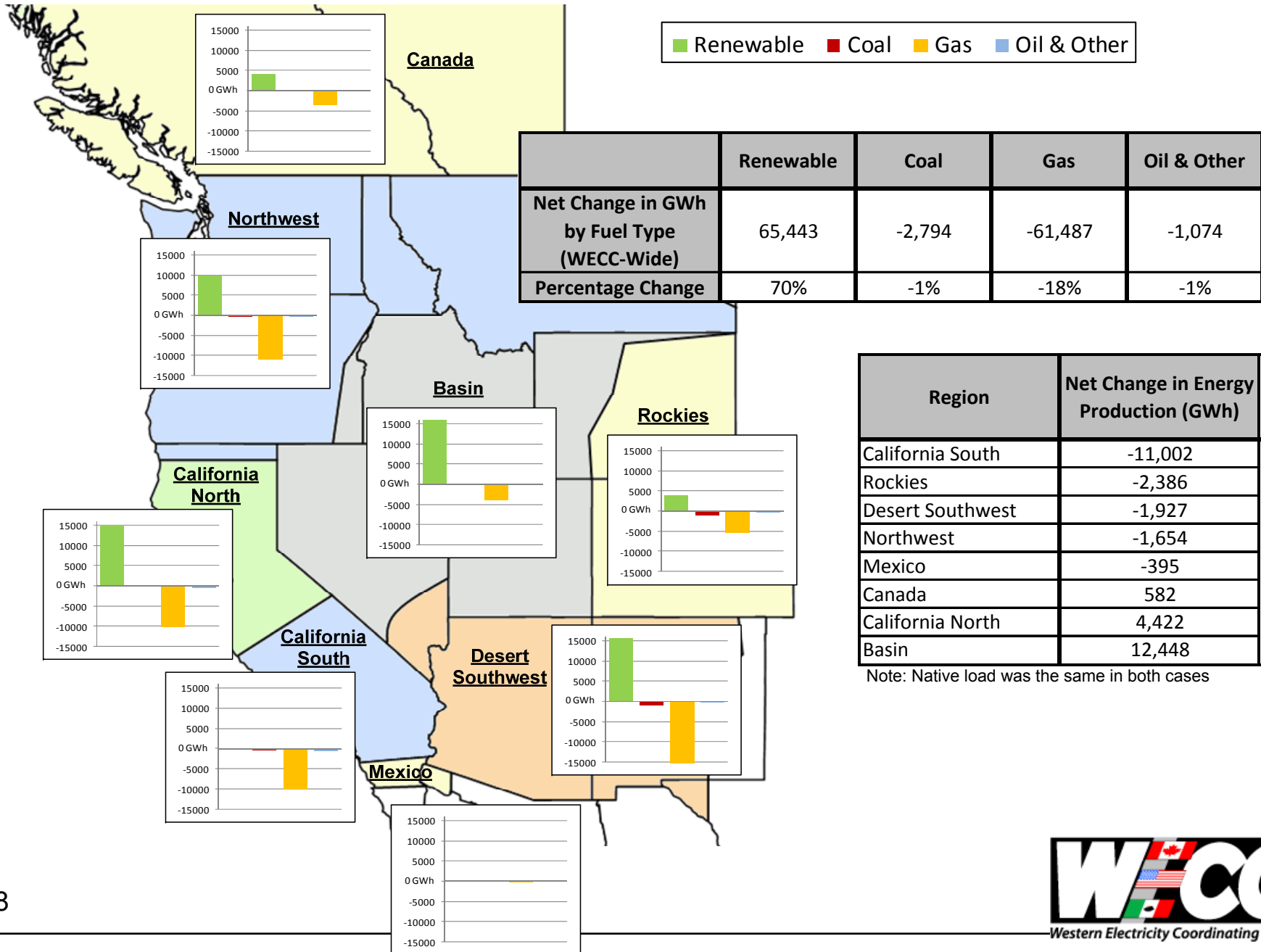


Key Results -15% Renewables

Compared to the base case

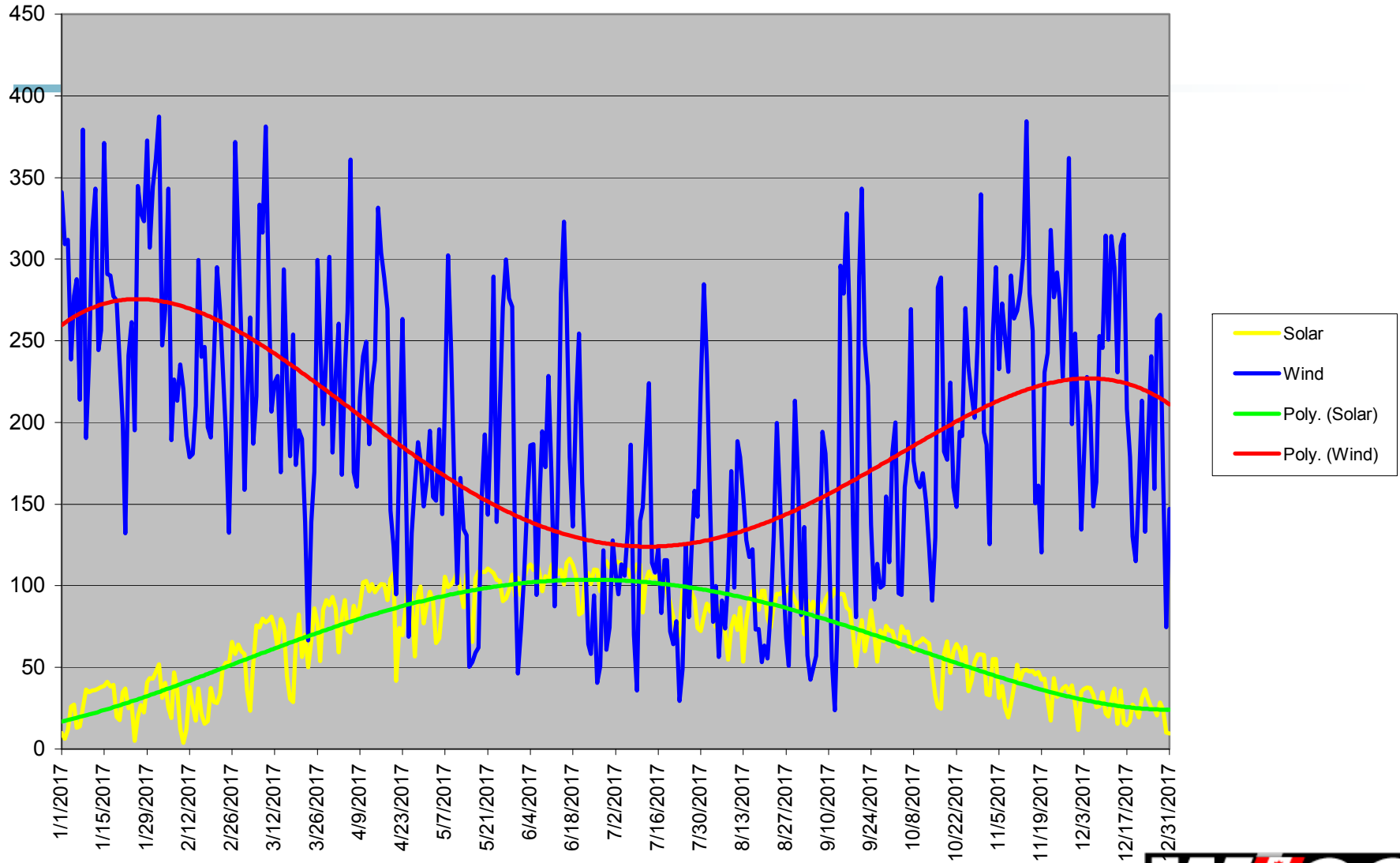
- CO2 emissions decreased 4.7%
- Natural gas generation decreased 18% relative to the base case
 - States with the largest percentage drop in gas production: CO(41%), MT(78%), NM(35%) and UT(22%)
- Other generation relatively unchanged

Change in Energy Production from PC-4 Base Case to PC-4A



WECC Daily Wind & Solar Energy w/Trendlines PC4A WIRAB (15% Renewables)

GWh



2017 – 15% Renewables plus 20% Energy Efficiency

- 2017 loads (both the energy and peak demands) were reduced consistent with the WGA/CDEAC Goal of 20% Energy Efficiency in 2020
- Generation and transmission remained the same as the 15% renewables case

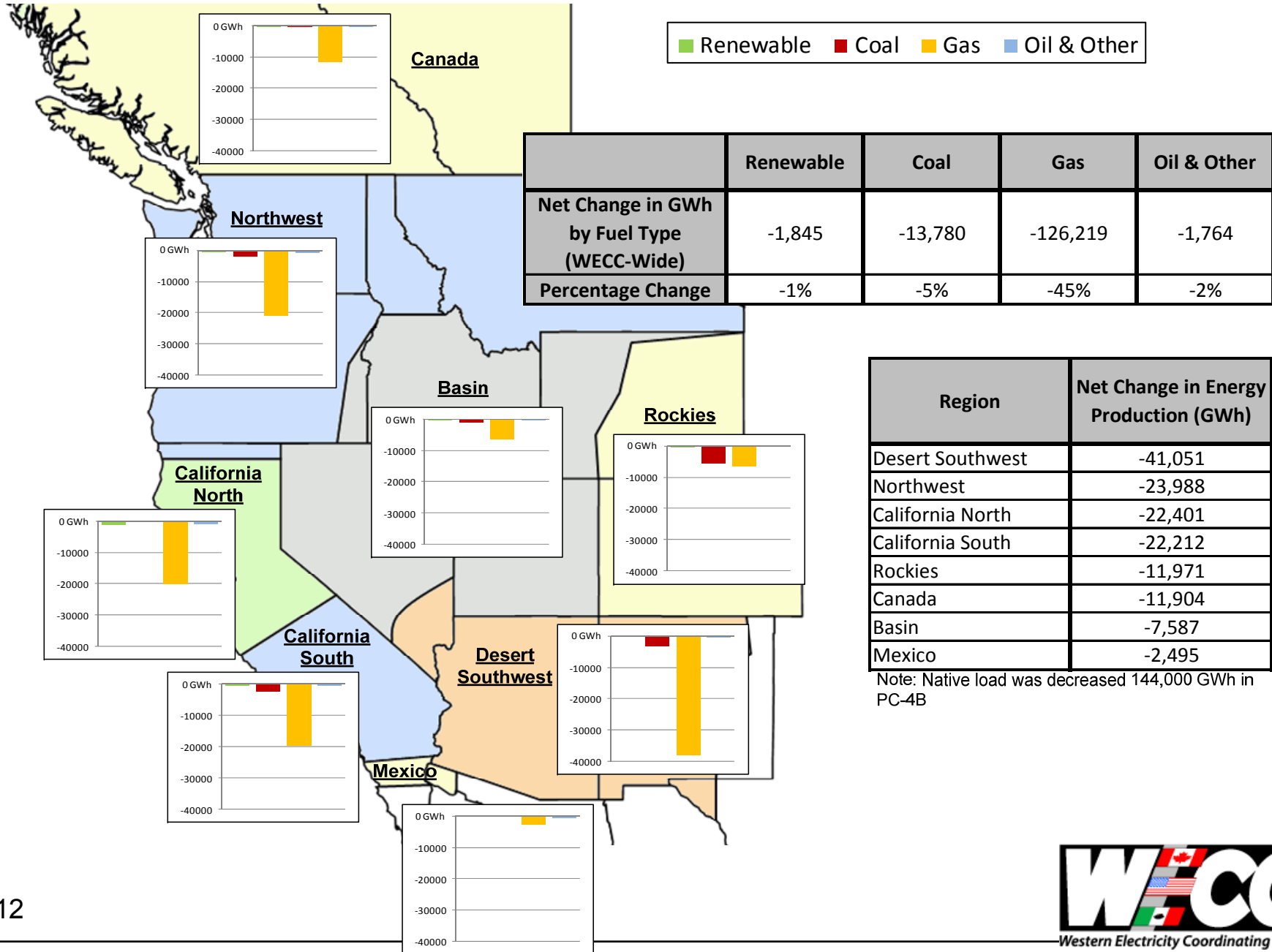
Adjustment Factors to Loads for Energy Efficiency			
	CDEAC Transmission Task Force	Proposed for TEPPC Loads	Category
AZ	18.50%	19.00%	High
CA	7.00%	12.00%	Low
CO	16.40%	17.00%	Medium
ID	5.80%	12.00%	Low
MT	5.00%	12.00%	Low
NV	19.10%	19.00%	High
NM	14.90%	17.00%	Medium
OR	5.00%	12.00%	Low
UT	16.60%	17.00%	Medium
WA	5.00%	12.00%	Low
WY	13.70%	17.00%	Medium
AB	0.00%	12.00%	Non-WGA
BC	0.00%	12.00%	Non-WGA
MEX	0.00%	12.00%	Non-WGA

Key Results – 15% Renewables plus 20% Energy Efficiency

Compared to the 15% Renewables Case

- CO₂ emissions decreased 16.5%
- Coal generation decreased 5%
- Natural gas generation decreased 44%
- Transmission congestion ***increased***
 - particularly on paths that move energy from the interior toward the more heavily populated coastal areas

Change in Energy Production from PC-4A to PC-4B



2017 – 15% Renewables + 20% EE + plus a \$20/ton-CO₂

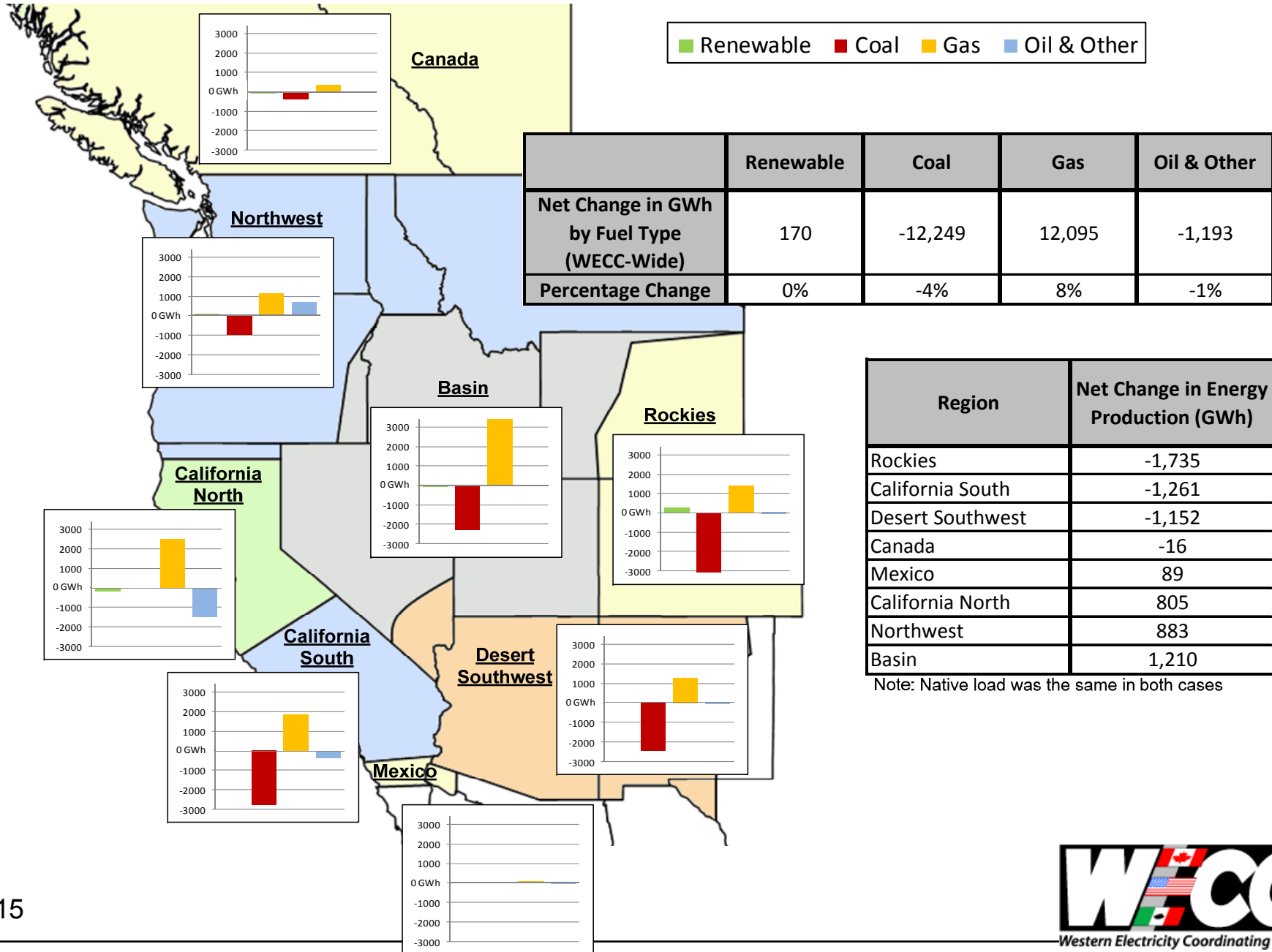
- No change to loads, generation, or transmission
- The CO₂ adder is a simulation surrogate for either a carbon tax or a emission cap-and-trade scheme
- A \$60 and \$40/ton-CO₂ adder were tested in addition to the \$20/ton adder
 - Observed extreme shifts in the resource dispatch order
 - Results not realistic

Key Results - 15% Renewables + 20% EE + plus a \$20/ton-CO₂

Compared to the 15% Renewables Case + 20% Energy Efficiency

- CO₂ emissions dropped 3.1%
- Gas Generation increased by 7.7%
- Coal Generation dropped by 4.5%
- Resulted in a 50% increase in production costs

Change in Energy Production from PC-4B to PC-4C-3



Key Results - 15% Renewables + 20% EE + plus a \$20/ton-CO₂

Compared to the 2017 Base Case (Cumulative Effects)

- CO₂ emissions dropped 22.9%
- Coal generation dropped 10%
- Natural gas generation dropped 51%

Transmission Congestion

- Transmission congestion was identified in all PC-4 cases
- The following paths were in the top 10 most congested paths in all PC-4 cases
 - IPP DC Line, Table Mountain to Vaca Dixon, Four Corners Transformer, TOT2C, Montana-Northwest

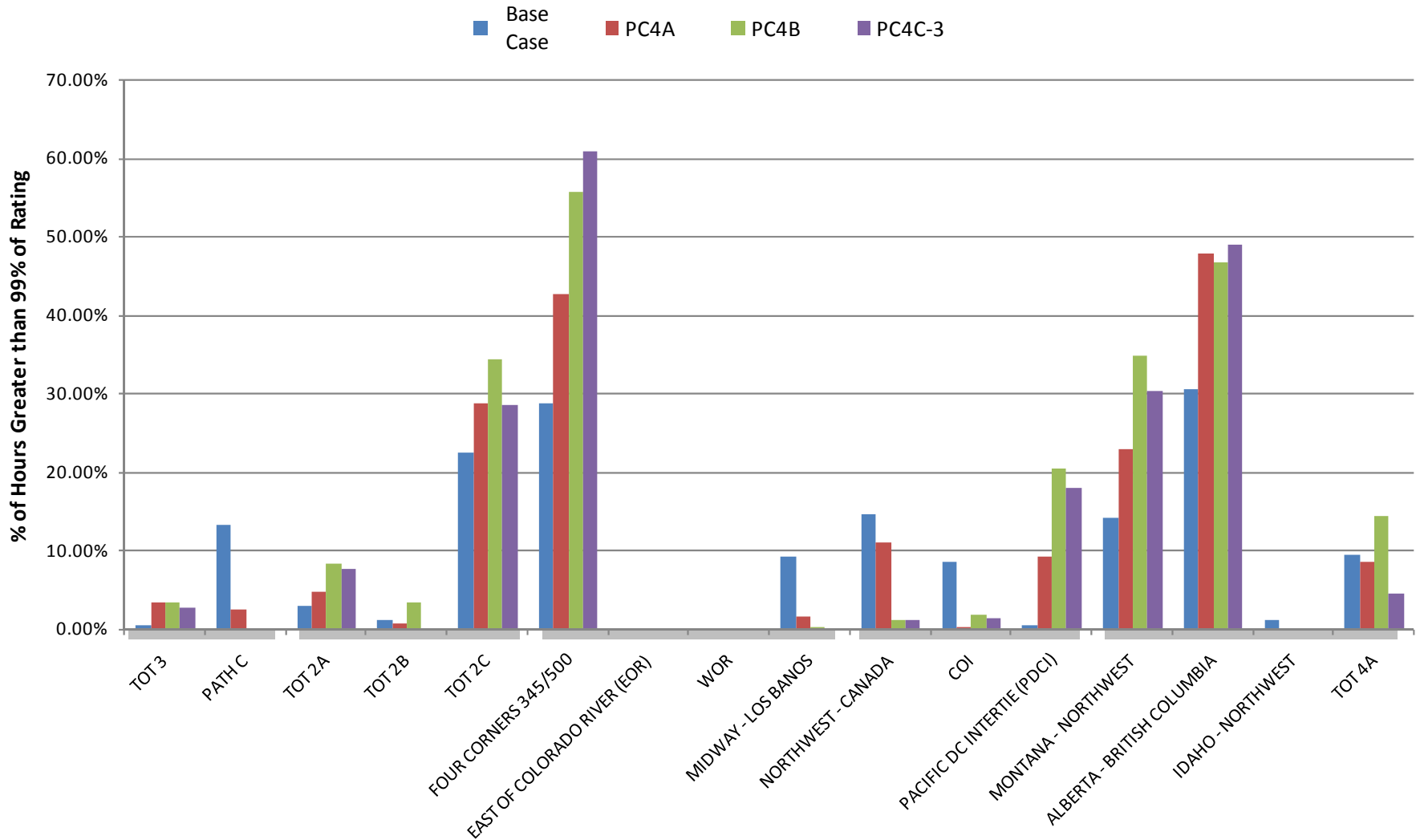
Transmission Paths

Flow on selected transmission paths, particularly those that connect regions, were compared between cases

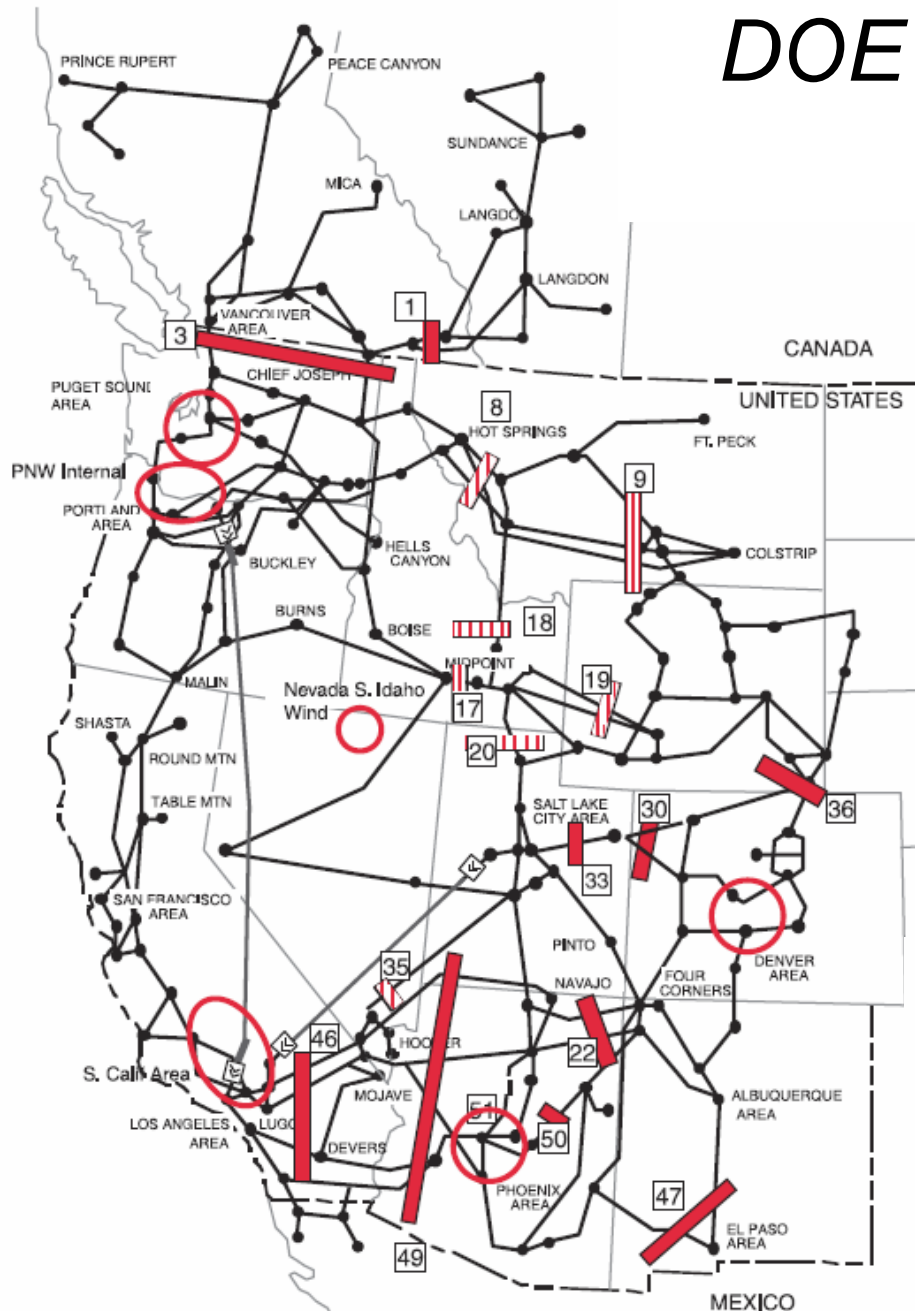


#	Path Name
36	TOT 3
20	PATH C
31	TOT 2A
78&79	TOT 2B
35	TOT 2C
23	FOUR CORNERS 345/500 kV
49	EAST OF COLORADO RIVER (EOR)
46	WEST OF COLORADO RIVER (WOR)
15	MIDWAY - LOS BANOS
3	NORTHWEST - CANADA
66	COI
65	PACIFIC DC INTERTIE (PDCI)
8	MONTANA - NORTHWEST
1	ALBERTA - BRITISH COLUMBIA
14	IDAHO - NORTHWEST
37	TOT 4A

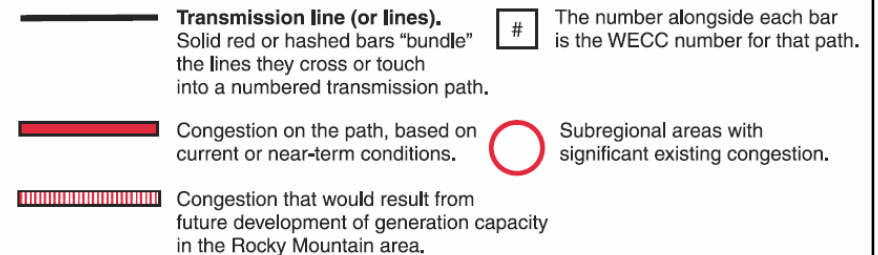
Path Loadings as a Percentage of 99% of Rating



DOE Reported Congestion 2006 Study



- Projects underway that will address identified congestion
- Local congestion being addressed by affected entities



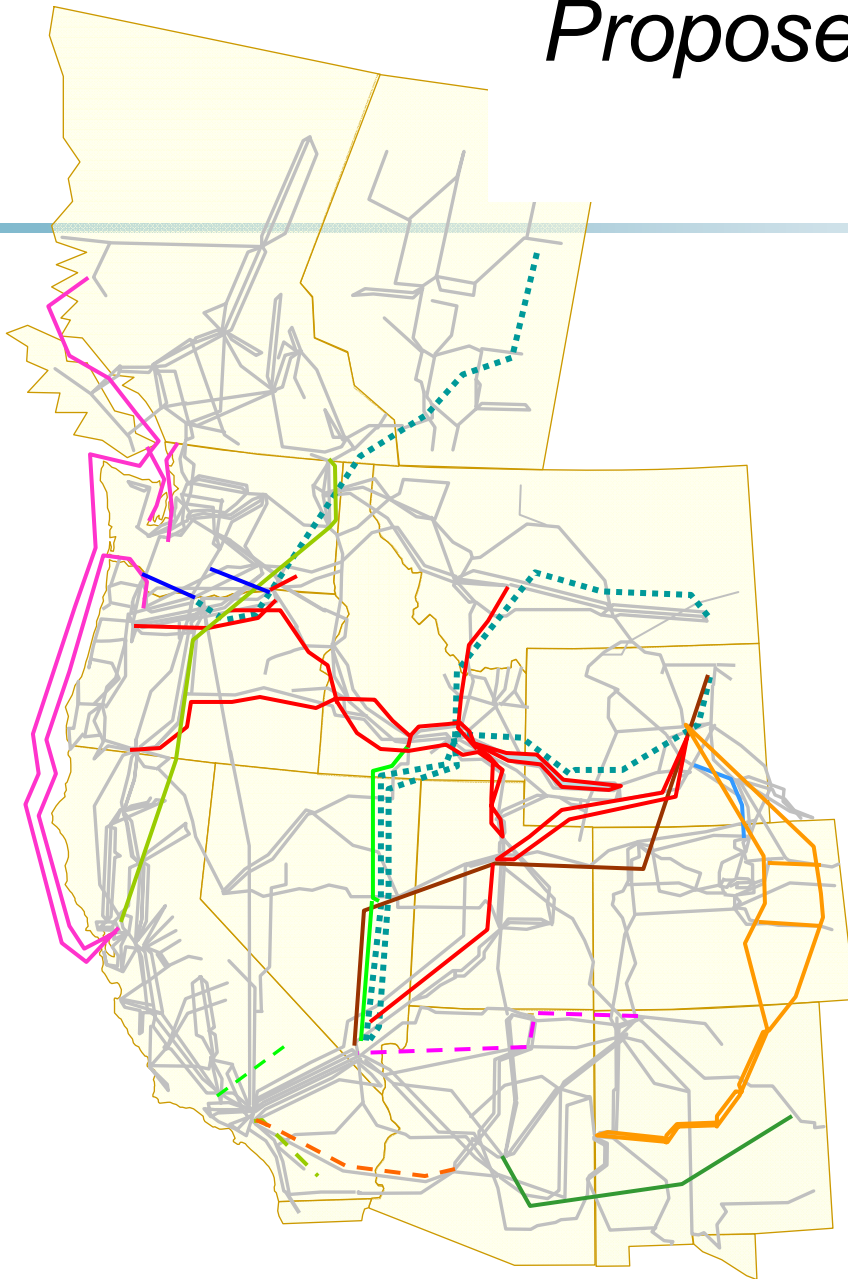
Proposed Major Transmission Projects in WECC

Proposed Transmission Projects in the Western Interconnection

Note: This plot includes selected projects from Table 3.2 of 2008 TEPPC Study Plan(v7)

Projects have been grouped to simplify coding.

-  Sea Breeze Projects
-  TransCanada Projects
-  Gateway & Other NTTG Projects
-  Columbia Grid Projects
-  TransWest Express
-  LS Power & Great Basin Projects
-  WY-CO Intertie Project
-  High Plains Express
-  Sun-ZIA
-  Canada/PacNW-NoCalif
-  Central CA Clean Energy (C3ET)
-  Green Path North
-  Devers-Palo Verde 2
-  Navajo Transmission Project



Cautions on Result Interpretations

- Natural gas and coal prices were held constant throughout all PC-4 cases
- CO2 reductions are heavily dependent on the order renewables, energy efficiency, and a CO2 adder were applied
- Transmission congestion is dependent on site selection of renewable and gap generation
- In our model, the renewable resources have a marginal cost of zero, so no conclusions can be made regarding the capital costs associated with the various scenarios

TEPPC 2009 Study Plan

- TEPPC has received 23 study requests from 9 organizations
 - Common themes:
 - Impacts of existing and aggressive RPS and GHG emission reduction policies
 - Impacts of large wind resource additions in various parts of the west
 - Impacts of specific transmission projects
- TEPPC workgroups and subcommittee will work to combine the requests into a synchronized study plan for 2009

Link to Additional Information

- TEPPC 2008 Annual Report
 - Final draft will be up for approval by the WECC Board of Directors on April 28
 - Until then, you can find the draft report on the TEPPC webpage of the WECC website
- White papers noted in this presentation can also be found on the TEPPC webpage
 - www.wecc.biz

Related WECC Activities

- Planning Coordination Committee (PCC)
 - Tracks proposed transmission projects
 - Manages path rating process
- Load & Resources Subcommittee (LRS)
 - Gathers and reports information on future load and resource expectations of members
- Variable Generation Subcommittee (VGS)
 - Holistically addressing variable generation integration issues in the West

Questions

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