

Evolution of Grid Planning in the West



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CREPC/WIRAB
Meeting
April 27, 2016
Salt Lake City, UT



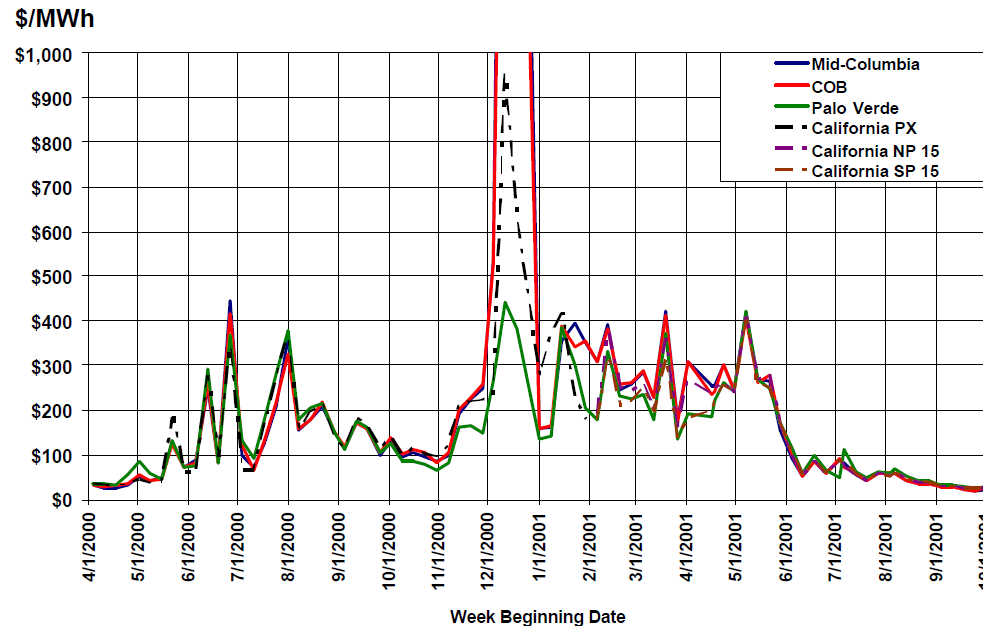
Historic Timeline

- **2000-2001:** Western energy crisis and the Western Governors' call for a plan
- **Early 2003-05:** SSG-WI and RMATs studies
- **2006:** WECC creates home for transmission expansion planning with TEPPC
- **2009-14:** DOE's ARRA grant boosts analytical tools, stakeholder engagement, and state/provincial input
- **2014-16:** Post-ARRA era features shift to address reliability issues and changes under Order 1000



Western Energy Crisis 2000-2001

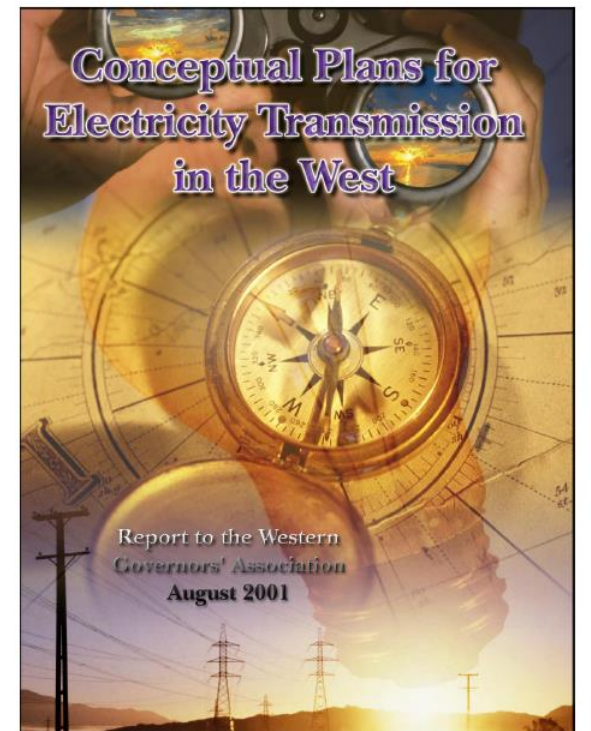
- Electricity market turmoil in 2000
 - Wholesale electricity prices increase 800% in 2000
 - Shortages and multiple blackouts in California
 - Causes: low hydro period, market restructuring, manipulation





Western Energy Crisis 2000-2001

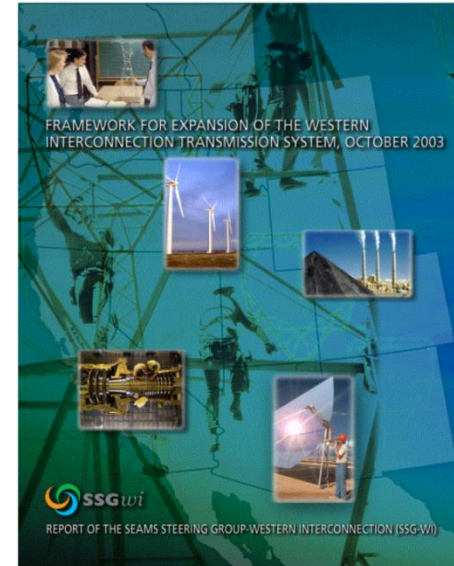
- Western Governors held roundtable to discuss actions to respond to the crisis:
 - What transmission enhancements are needed?
 - No answer
 - Convened stakeholders to develop conceptual transmission plan in August 2001
 - Precedent as the first interconnection-wide transmission analysis/plan



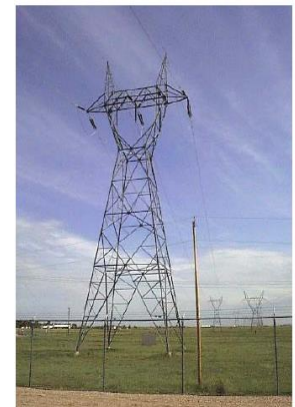


Early Planning Efforts: 2003-2005

- Seams Steering Group – Western Interconnection (SSG-WI)
 - 3 proposed RTOs in the West sponsored stakeholder forum to perform interconnection-wide studies 2003-2005
- Rocky Mountain Area Transmission Study (RMATS)
 - 2004 study of resources additions in Rockies (WY, UT, MT) and transmission to deliver to load areas in coastal states
- Lessons
 - Inclusive, stakeholder-vetted processes
 - Need for long-term funding & institutional home



Rocky Mountain Area Transmission Study RMATS



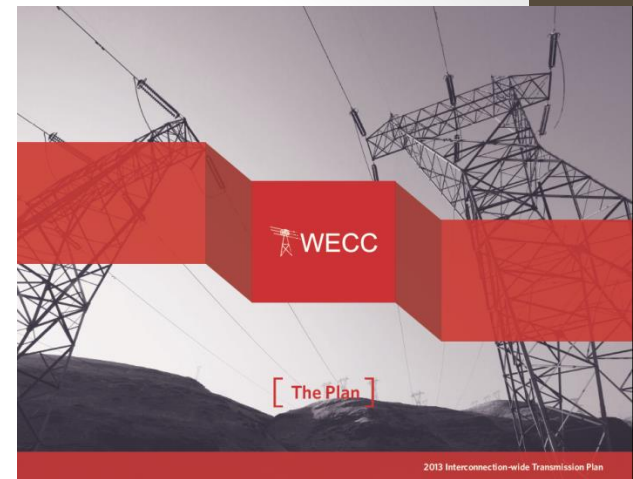


TEPPC Created: 2006

- Call for interconnection-wide transmission planning
 - Western Interconnection operates as a single system
 - Ad hoc planning efforts not sustained; need for a permanent home
- WECC steps forward
 - WECC Board created the Transmission Expansion Planning Policy Committee (TEPPC) as formal Board committee in April 2006
 - SSG-WI database transferred to WECC for use in TEPPC
- Charter identified 3 original functions:
 - Oversee and maintain public database
 - Provide policy direction and management of economic transmission planning process
 - Guide the analyses and modeling of Western Interconnection economic transmission expansion planning



ARRA Grant: 2009-2014



- U.S. DOE grant stimulus grant in 2009 enabled TEPPC to enhance and expand transmission planning efforts
 - Analytical tools –
 - Developed 20-year capital expansion tool
 - Environmental data to inform planning
 - Stakeholder input –
 - Scenario Planning Steering Group created for diverse stakeholder input
 - State-Provinces provide input under grant to Western Governors
 - Consultant expertise –
 - Improved data on capital costs and performance of resource options and transmission, scenario development, model improvements
 - Transmission plans
 - TEPPC produced comprehensive transmission plans for DOE in 2011 and 2013



TEPPC Post-ARRA Grant: 2014-2016

- Emerging issues and new focus on reliability
 - Increasing level of renewable energy
 - Coal plant retirements and loss of baseload generation
 - Increasing penetration of distributed energy resources
 - Integration of variable generation on the power system
 - Clean Power Plan impacts
- Desire to link production cost model with power flow model to perform reliability analysis
 - NTTG developed this “round trip” capability
 - WECC has struggled to reconcile database used in production cost model and power flow model



TEPPC's Common Case Foundation for Important Western Studies

- NREL's Western Wind and Solar Integration Studies 1, 2 and 3
- NREL and E3's Energy Imbalance Market (EIM) Studies
- SPSC/WIEB/E3's Natural Gas-Electric Adequacy Study
- WECC/WIEB/NREL/E3 Flexibility Assessment Study
- Clean Power Plan analysis

WESTERN WIND AND SOLAR INTEGRATION STUDY

PREPARED FOR:
The National Renewable Energy Laboratory
A national laboratory of the U.S. Department of Energy

PREPARED BY:
GE Energy

MAY 2010

The Western Wind and Solar Integration Study Phase 2

D. Lew, G. Brinkman, E. Ibanez, A. Florita, M. Heaney, B.-M. Hodge, M. Hummon, and G. Stark
NREL

J. King
RePPAE

S.A. Lefton, N. Kumar, and D. Agan
Intertek-APTECH

G. Jordan and S. Venkataraman
GE Energy

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Technical Report
NREL/TP-5500-55568
September 2013
Contract No. DE-AC36-08G028308

NREL

Western Wind and Solar Integration Study Phase 3A: Low Levels of Synchronous Generation

Nicholas W. Miller, Bruno Leonardi, and Robert D'Aquila
GE Energy Management

Kara Clark
National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC. This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Technical Report
NREL/TP-5500-63277

Western Interconnection Flexibility Assessment

Final Report

December 2015

Natural Gas Infrastructure Adequacy in the Western Interconnection: An Electric System Perspective

Phase 1 Interim Report

March 2014

Western Interconnection Flexibility Assessment

Interim Project Report

April 2015

NREL

Examination of Potential Benefits of an Energy Imbalance Market in the Western Interconnect

M. Milligan and K. Clark
National Renewable Energy Laboratory

J. King and B. Kirby
Consultants

T. Guo and G. Liu
Energy Exemplar

PUGET SOUND ENERGY

California ISO
Shaping a Renewable Future

Benefits Analysis of Puget Sound Energy's Participation in the ISO Energy Imbalance Market

September 2014



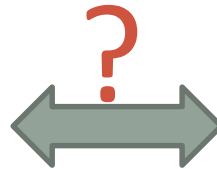


WECC Board



TEPPC

Performs studies on the 10- and 20-year cases examining alternative futures and implications for the transmission grid
Uses production cost model for 10-year studies and a capital expansion tool for 20-year studies



PCC

Develops recommendations on reliability matters based on load-resource balance and the adequacy of the physical infrastructure of the bulk electric grid
Uses power flow model and creates Base Cases that are used to evaluate established reliability standards

- TEPPC and PCC do not use a common data set for their respective planning studies



TEPPC and Regional Planning Groups

- FERC Order 890
 - Established 9 planning principles for U.S Transmission Providers (TPs)
 - TEPPC and RPGs could perform regional studies that meet TP obligation to perform studies
- FERC Order 1000
 - Required “Regions” to form and perform new planning and cost allocation tasks
 - CAISO, NTTG, ColumbiaGrid, WestConnect coordinate as the Western Planning Regions
 - No formal role for TEPPC





History Lessons

1. Planning processes must be open and inclusive, and encourage broad stakeholder participation
2. Database needs to be public to enable stakeholder review and vetting; critical for validation, credibility and support
3. Value of planning across the entire Western Interconnection; an interdependent system
4. Planning in the electric sector needs to be flexible to respond to important emerging issues
5. TEPPC's Common Case produces an expected 10-year future that is an important benchmark for policy analysis and contributes to other important research in the West

Questions?

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