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**Rocky Mountain Area
Transmission Study (RMATS)
Discussion**

November 9, 2004

Agenda

- » RMATS Overview – [Mike DeWolf](#)
 - Background Information
 - Modeling Approach
 - Overall Economic Results
- » Comparison of RMATS and PacifiCorp IRP – [Pete Warnken/ Mike DeWolf](#)
 - Study Scope Differences
 - Key Input Assumption Differences
- » New Wyoming Coal/Transmission Expansion Portfolio – [Pete Warnken](#)
 - Rationale, Assumptions, Resource Table
 - Summary Results and Conclusions
- » General Observations – [Pete Warnken](#)
- » Group Discussion
- » Wrap Up



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RMATS Overview

Mike DeWolf





RMATS Study

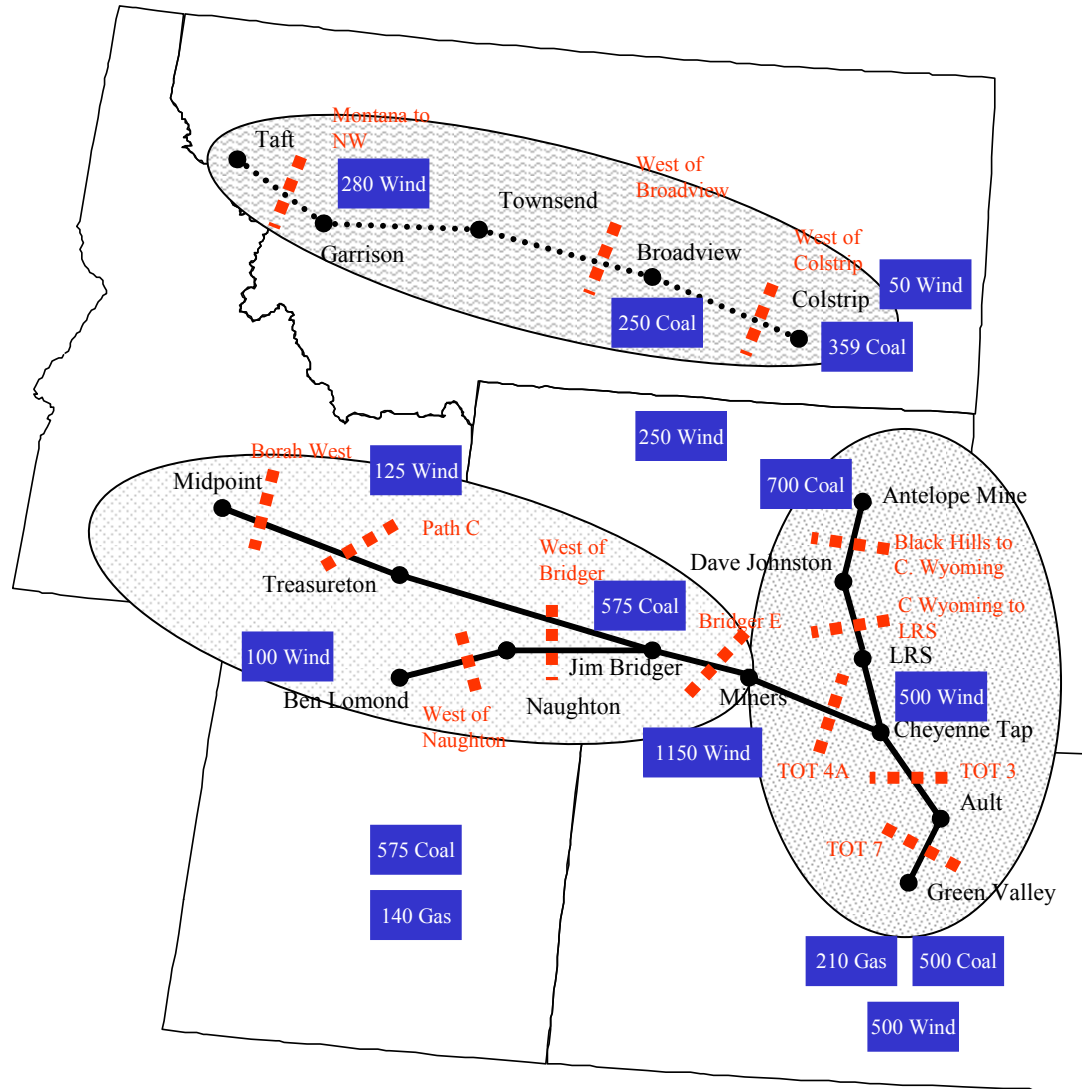
- » RMATS study
 - West-wide in scope
 - Not company specific
- » Phase I: Economic screening study
 - Completed in September 2004
 - Identifies projects to be analyzed further in Phase II
- » Phase II
 - Conducts technical studies
 - Addresses siting, cost assignment and recovery issues
 - Identifies project sponsors and arranges financing
- » Phase III
 - Construct projects

RMATS Phase I


- » Regional collaborative process
 - Broadly represented RMATS Steering Committee called the shots
 - Focused on economically viable transmission
 - Resource strategy ranked PRB coal and open range wind as highest priority
 - Used 2008 as base year and 2013 as a test year
 - Less importance was placed on short term needs (e.g., lead time required to build coal may require filling the gap with gas.)

RMATS Recommendation 1 Transmission Projects

- 
 Modified Interface
- 
 Added Resource
- 
 Added 345 kV Line
- 
 Added Series Compensation Only




 Montana Upgrades


 Bridger Expansion


 New WY- CO lines

RMATS Phase I

» Modeling

- West-wide in scope, not company specific
- Detailed transmission representation
- Simplified dispatch
- Generic assumptions
- Optimized production costs for West as a whole
- Modeled physical use of transmission without contractual, tariff, or other operating constraints

RMATS Phase II

» Modeling

- To update assumptions based on powerflow and stability studies, IRPs, and new fuel price information
- To improve simulations of system, with Rocky Mountain and company focus
- SSG-WI next round of West-wide studies getting underway
 - ⇒ Realistic scenarios that iterates with RMATS
 - ⇒ Estimate completion date: Summer 2005

RMATS Overall Economics

2013 Test Year \$ million	IRP-Based Case	Recommendation I	Delta
Annual Production Cost	20,046	19,780	266
Incremental Annualized Fixed Cost	756	961	(205)
Annual Savings			61

- » Annual production costs does not include CO₂ allowance costs.



Comparison of RMATS and PacifiCorp IRP

Pete Warnken

Scope Differences Between RMATS Study and IRP

Scope Item	RMATS	IRP
Study Type/Objective	<p><i>Economic Screening Study</i></p> <p>Objective: Determine West-wide potential savings if new Powder River Basin coal and Open Range wind were developed with the associated transmission to reach load.</p>	<p><i>Resource Planning Study</i></p> <p>Objective: Determine the optimal PacifiCorp resource mix and build pattern -- from a least-cost/least-risk perspective -- that meets system load requirements and reliability criteria.</p>
Geography	WECC-wide	PacifiCorp footprint
Timeframe	Snapshot for two years: 2008 baseline and 2013.	Simulations from FY2006-FY2025; Resource additions from FY2006-FY2015
Modeling Approach	Market model (ABB Market Simulator) that yields a WECC-wide optimal dispatch and DC power flow solution; includes calculation of location-specific node prices (LMP's).	Market model (MarketSym) that yields an optimal PacifiCorp cost-based commitment, dispatch, and power transport solution, with access to WECC markets for system balancing.
Topology Representation	33 sub-areas (bubbles), with +13,000 buses.	18 PacifiCorp sub-areas: 6 for West control area, 12 for East control area.

Scope Differences Between RMATS Study and IRP

Scope Item	RMATS	IRP
Market Representation	<ul style="list-style-type: none"> » Models physical use of transmission without contractual, tariff, or associated operating constraints » Market prices are generated as part of model solution (hourly LMP's) 	<ul style="list-style-type: none"> » Assumes four WECC markets (Mid-C, COB, Palo Verde, 4-Corners) available for system balancing only; transactions allowed up to transmission line firm capacity rights. » Existing contractual obligations modeled. » Prices modeled externally using PacifiCorp's forward price curve and MIDAS model.
Resource Representation	<ul style="list-style-type: none"> » Created four resource scenarios: two to serve RMATS loads, and two expanded to allow export to coastal states. » Used generic resource cost and operational parameters determined by RMATS working groups. » Hydro and wind dispatched with fixed hourly inputs. 	<ul style="list-style-type: none"> » Resource types and locations varied to determine mix that minimizes PVRR over 20 years; 22 portfolios examined. » Used PacifiCorp's own cost and operational parameters (Resource Development and Management Dept.) » Hydro is dispatched subject to monthly peak/energy limits; wind dispatched with fixed hourly inputs.

RMATS/IRP Assumption Comparison

- » Targeting the year 2013, which is the RMATS test year, and Utah/Wyoming location

Input Category	RMATS	IRP
Load Growth	<ul style="list-style-type: none"> » Utah area energy grows approximately 3% year between 2008 and 2013. Peak load growth is approximately 3.7%. » Wyoming loads grow approximately 1% over the same time period. Peak load growth is approximately 1%. » Based on PacifiCorp 2003 load forecast; covers the entire state. 	<ul style="list-style-type: none"> » Utah energy and coincident peak growth rates are 3.5% and 4.58%, respectively, for FY2006 through FY2015. » Wyoming energy and summer coincident peak growth rates are 1.0% and 0.56%, respectively, for 2005 through 2015. » Based on more recent PacifiCorp forecast (March 2004). Covers PacifiCorp service territory only.
Gas Price Forecasts	<ul style="list-style-type: none"> » Annual flat price of \$6.5/MMBtu (Henry Hub) in CY2013 (nominal). » Transportation cost to Utah is \$0.46/MMBtu. » Sensitivities run with \$4.50 and \$8.50 prices. » Source: Northwest Power Planning and Conservation Council, CEC 	<ul style="list-style-type: none"> » Average price of \$4.7/MMBtu (Rockies) in CY2013 (nominal). » Transportation cost included. » Sensitivity run with base gas and electricity prices escalated by 20% » Source: PIRA Energy Group

RMATS/IRP Assumption Comparison

Input Category	RMATS	IRP
Coal Price Forecasts	<ul style="list-style-type: none"> » Assumed the use of Southwest Wyoming mine mouth coal for a single Bridger unit: \$1.11/MMBtu. » Source: Northwest Power Planning and Conservation Council, and composite of plant developer estimates. 	<ul style="list-style-type: none"> » PRB coal delivered to Bridger: \$1.39/MMBtu
Fixed Costs	<ul style="list-style-type: none"> » Gas: Capital = \$579/kW, Fixed O&M = \$7.25/kWh » Coal: Capital = \$1,244/kW – \$1,769/kW, Fixed O&M = \$25.00/kWh » Wind: Capital = \$804/kW, Fixed O&M = \$17.50/kWh (plus \$5.5/MWh for wear & tear) 	<ul style="list-style-type: none"> Gas: Utah-S Dry Cool CCCT, Capital = \$587/kW, Fixed O&M = \$11.44/kW-yr » Gas: Utah-N Wet Cool CCCT, Capital = \$623/kW, Fixed O&M = \$7.66/kW-yr » Coal: UT Brownfield Coal, Capital = \$1,687/kW, Fixed O&M = \$32.23/kW-yr » Coal: WY Greenfield Coal, Capital = \$1,722/kW, Fixed O&M = \$38.78/kW-yr » Wind: No fixed costs included in PVRR.
CO₂ Costs	<p>Calculated for sensitivity analyses only; CO₂ costs not included in economic cost/benefit calculations for base scenarios. Sensitivity simulations modeled \$5/ton & \$15/ton allowance costs applied to incremental tons of CO₂ produced for cases with and without new resources.</p>	<p>Assumed \$8/ton allowance cost as base assumption for all portfolios; conducted stress tests for alternative cost levels (\$0, \$10, \$25, \$40).</p>

Conclusions Regarding RMATS/IRP Differences

- » Scope differences between RMATS Phase I and IRP studies lead to different results:
 - Studies distinguished by dissimilar futures – RMATS study assumes a flow-based, regionally-operated system, whereas the IRP reflects PacifiCorp's current market constraints and mandate to serve its own customers.
 - Unlike the IRP, RMATS study is not designed to focus on near-term resource decisions and their impacts on future resource requirements.
- » Structural differences in modeling approach and technology means that there is a limit to which results can converge by changing inputs.
- » Conclusion of RMATS Phase II represents the point at which comparisons with the IRP become meaningful.
 - At that time, PacifiCorp can incorporate specific RMATS project evaluations into the IRP process.
 - In the meantime, PacifiCorp will continue to participate in RMATS and other transmission planning initiatives (a 2004 IRP Action Plan Item).



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New Wyoming Coal/Transmission Expansion Portfolio

Pete Warnken

New Wyoming Coal/Transmission Expansion Portfolio

- » Portfolio developed to more closely match RMATS thermal and transmission resource assumptions.
- » Wyoming Coal Resources: Two 575 MW pulverized coal units at Jim Bridger site (958MW).
- » Build two 345 kV lines from Jim Bridger to serve Utah load:
 - 100% PacifiCorp owned
 - Capital Cost - \$554 million (Cost is rough estimate)
- » Resulting Resource Build Table:

Portfolio	Unit Type	Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Q: Transmission Expansion with Additional Wyoming Pulverized Coal													
East	Brownfield Coal	Utah-S						575					575
	Greenfield Coal	WY									958		958
	Dry Cool CCCT w/ DF	Utah-S				525							525
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586
	IC Aero SCCT	WMAIN (ISO)								194			194

RMATS and IRP Resource Additions

State	Gen Type	Name Plate Generation Value Yr 2013 (FY 2014)	
		RMATS Recommendation I	IRP Portfolio Q
Colorado	Coal	500	500
	Gas	210	210
	Wind	500	500
Idaho	Coal		
	Gas		
	Wind	125	125
Montana	Coal	609	609
	Gas		
	Wind	330	330
Utah	Coal	575	575
	Gas	140*	525*
	Wind	100	100
Wyoming	Coal	1275	958
	Gas		
	Wind	1900	1900 / 700
Total	Coal	2959	2642
Total	Gas	350	735
Total	Wind	2955	2955
Total Firm		3900	3968

Notes:

* Portfolio Q includes the 534 MW Lake Side gas plant in FY2006, whereas RMATS does not.

For Portfolio Q, Wyoming coal resources come on line in FY2014.

Values in gray font represent regional resource assumptions.

Portfolio Q Performance Summary

- » PacifiCorp performed deterministic, stochastic, and scenario risk analysis on this portfolio. *Detailed modeling results for Portfolio Q will be provided tomorrow.*
- » Deterministic Analysis: PVRR is highest among all portfolios – higher capital costs more than offset its relative production cost advantage over other portfolios.
- » Stochastic Analysis: Performs well with respect to stochastic cost measures; ranks among the top portfolios.
- » Scenario Risk Analysis:
 - CO₂ Allowance Costs – Out-performed all other portfolios at the \$0/ton case; PVRR exceeded all other portfolios for \$8, \$10, \$24, and \$40 cases.
 - High Gas Costs – Had lowest PVRR of all portfolios, assuming 20% escalation of gas/electricity prices over base values.

Conclusions

- » Portfolio Q's variable cost performance results are consistent with what is seen in the RMATS study: coal resources have a beneficial impact on a portfolio's overall net variable costs.
- » Scenario Risk Analysis confirms that the main drivers for economic performance are gas price and CO₂ cost futures.

NEW PORTFOLIO Q, AND OTHER RISK ANALYSIS PORTFOLIOS

Portfolio	Unit Type	Region												Total MWs	Portfolio Total PM MW's
			2006	2007	2008	2009	2010	2011	2012	2013	2014	2015			
E: Replace IGCC w/ PC Coal													2823		
East	Brownfield Coal	Utah-S						575					575	575	
	Brownfield Coal	WY										383	383	383	
	Dry Cool CCCT w/ DF	Utah-S			525								525	525	
West	Wet Cool CCCT w/ DF	Utah-N									560		560	560	
	Dry Cool CCCT w/ DF	WMAIN								586			586	586	
	IC Aero SCCT	WMAIN								194			194	194	
	J: Portfolio B, with Wyoming PC Replacing IGCC													2773	
East	Greenfield Coal	WY										383	383	383	
	Dry Cool CCCT w/ DF	Utah-S			525		525						1050	1050	
	Wet Cool CCCT w/ DF	Utah-N								560			560	560	
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	
	K: Portfolio C, with Wyoming PC Replacing IGCC													2820	
East	Brownfield Coal	Utah-S						575					575	575	
	Greenfield Coal	WY										383	383	383	
	Wet Cool CCCT w/ DF	Utah-N									560		560	560	
West	IC Aero SCCT	Utah-N			522								522	522	
	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	
	L: Portfolio D, with Wyoming PC Replacing IGCC													2823	
East	Brownfield Coal	Utah-S										575	575	575	
	Greenfield Coal	WY										383	383	383	
	Dry Cool CCCT w/ DF	Utah-S			525								525	525	
West	Wet Cool CCCT w/ DF	Utah-N						560					560	560	
	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	
	M: All Gas with CCCTs													2950	
East	Dry Cool CCCT w/ DF	Utah-S			525		525						1050	1050	
	Wet Cool CCCT w/ DF	Utah-N								560	560		1120	1120	
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	
N: All Gas with IC Aeros													2947		
East	Dry Cool CCCT w/ DF	Utah-S						525					525	525	
	Wet Cool CCCT w/ DF	Utah-N									560	560	1120	1120	
	IC Aero SCCT	Utah-N			522								522	522	
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	
P: CEM-Selected Portfolio													2763		
East	Brownfield Coal	Utah-S							575				575	575	
	Dry Cool CCCT w/ DF	Utah-S			525							525	1050	1050	
	IC Aero SCCT	Utah-N									261		261	261	
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)							97		97	97	291	291	
Q: Transmission Expansion with Additional Wyoming Pulverized Coal													2838		
East	Brownfield Coal	Utah-S						575					575	575	
	Greenfield Coal	WY									958		958	958	
	Dry Cool CCCT w/ DF	Utah-S			525								525	525	
West	Dry Cool CCCT w/ DF	WMAIN (ISO)								586			586	586	
	IC Aero SCCT	WMAIN (ISO)								194			194	194	

STRESS CASE PORTFOLIOS

18% PM													3156	
East	Brownfield Coal	Utah-S						575					575	575
	Greenfield IGCC	Utah-N										368	368	368
	Dry Cool CCCT w/ DF	Utah-S			525								525	525
West	Wet Cool CCCT w/ DF	Utah-N									560		560	560
	IC Aero SCCT	Utah-N					174			174			348	348
	Dry Cool CCCT w/ DF	WMAIN								586			586	586
	IC Aero SCCT	WMAIN								194			194	194
12% PM													2447	
East	Brownfield Coal	Utah-S						575					575	575
	Greenfield IGCC	WY										368	368	368
	Wet Cool CCCT w/ DF	Utah-N									560		560	560
West	IC Aero SCCT	Utah-N					87		87	87			261	261
	Dry Cool CCCT w/ DF	WMAIN								586			586	586
	IC Aero SCCT	WMAIN									97	97	97	97