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Source: NASA

Western Transmission and Energy Imbalance Market Update

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LSI Electric Utility Rate Case Conference, Las Vegas, NV
March 5, 2015

Overview

I. Transmission

A. Transmission Investment

B. FERC Order 1000 – Transmission Planning and Cost Allocation

- *Status of implementation nationally and in the West*

- *Discussion of CAISO lines to be built in AZ and NV*

C. Transmission Rate Incentives

II. Energy Imbalance Market

A. Background

B. New CAISO, PacifiCorp, and NV Energy EIM

- *Drivers for participation, implementation, and performance*

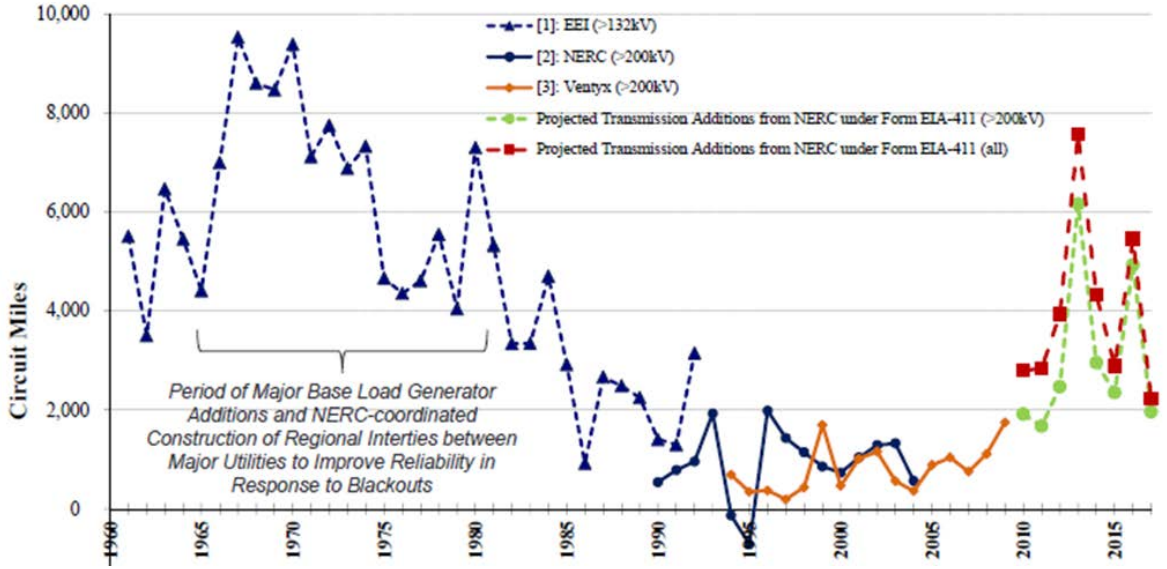
C. Possible New Northwest Intra-Hour Energy-Only Market

I. Transmission

A. Transmission Investment

A. Historical and Future Transmission Additions

- 3,000 to 7,000 circuit-miles per year reported for 2013-16 in U.S.; Equivalent to $7-16 billion (averaging $12b) per year nationwide
- Up from 1985-2005, but still below levels of 1960s to early 1980s
- Significant replacement/upgrade needs over next decade(s)



Source: Brattle Group, 2013

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EPA Clean Power Plan as Driver for Increasing Transmission Investment

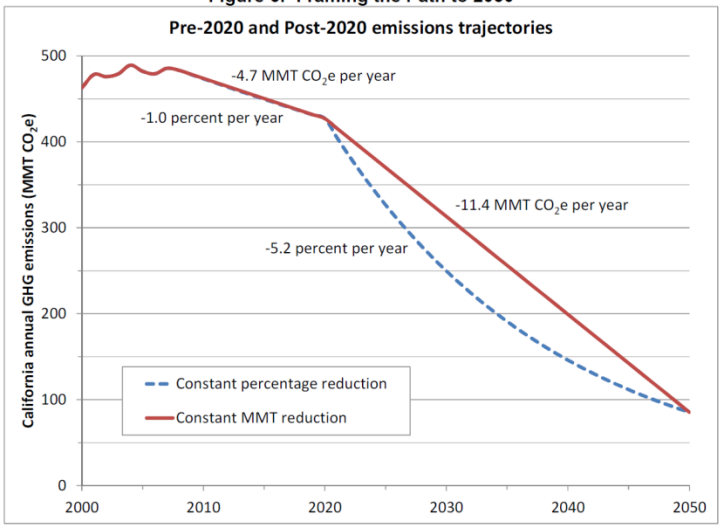
- EPA's proposed Clean Power Plan would require states to cut carbon pollution from power sector by **30% from 2005 levels by 2030**, with interim goals starting in 2020
- Each state would have flexibility to choose how to meet goal, including use of four building blocks:
  - Make fossil-fuel fired plants more efficient
  - **Use low-emitting power sources more**
  - Use more low or zero emitting power sources
  - **Use electricity more efficiently**
- States can develop a state-only plan or collaborate with each other to develop plans on a multi-state basis
- Final rule to be issued June 2015
- If adopted, likely to increase need for new transmission investment

California GHG and Clean Energy Goals

Current GHG Goals

- AB 32, the "California Global Warming Solutions Act of 2006," requires reduction in GHG emissions to **1990 levels by 2020**
- State goal is **80% below 1990 levels by 2050**

Figure 6: Framing the Path to 2050
Pre-2020 and Post-2020 emissions trajectories



Source: California Air Resources Board

Gov. Brown's New Energy Goals

- **50%** of electricity from renewable sources by **2030**
- **Reduce petroleum use** in cars and trucks by **up to 50%**
- **Double** the amount of **efficiency achieved in existing buildings** (increasing the existing goal by about 50%)

B. FERC Order 1000 – Transmission Planning and Cost Allocation

- Issued in 2011 on decisions on rehearing, Orders 1000A and 1000B, were issued in 2012
- Basics: Directed all public utility transmission providers to:
  - Develop a **regional transmission planning process** which considers transmission needs driven by federal, state, and local **public policy mandates**
  - Participate in broader **interregional transmission coordinati**on
  - Establish new **cost allocation** methods for regional and interregional transmission facilities that result from the Order 1000 processes, based on six cost allocation principles.
  - Remove from their FERC-jurisdictional tariffs any **"federal right of first refusal"** to an incumbent public utility transmission provider to construct regional transmission facilities
- Deadlines: Regional plans, 2012; interregional plans, 2013
- Upheld in all respects by the U.S. Court of Appeals for the D.C. Circuit in 2014

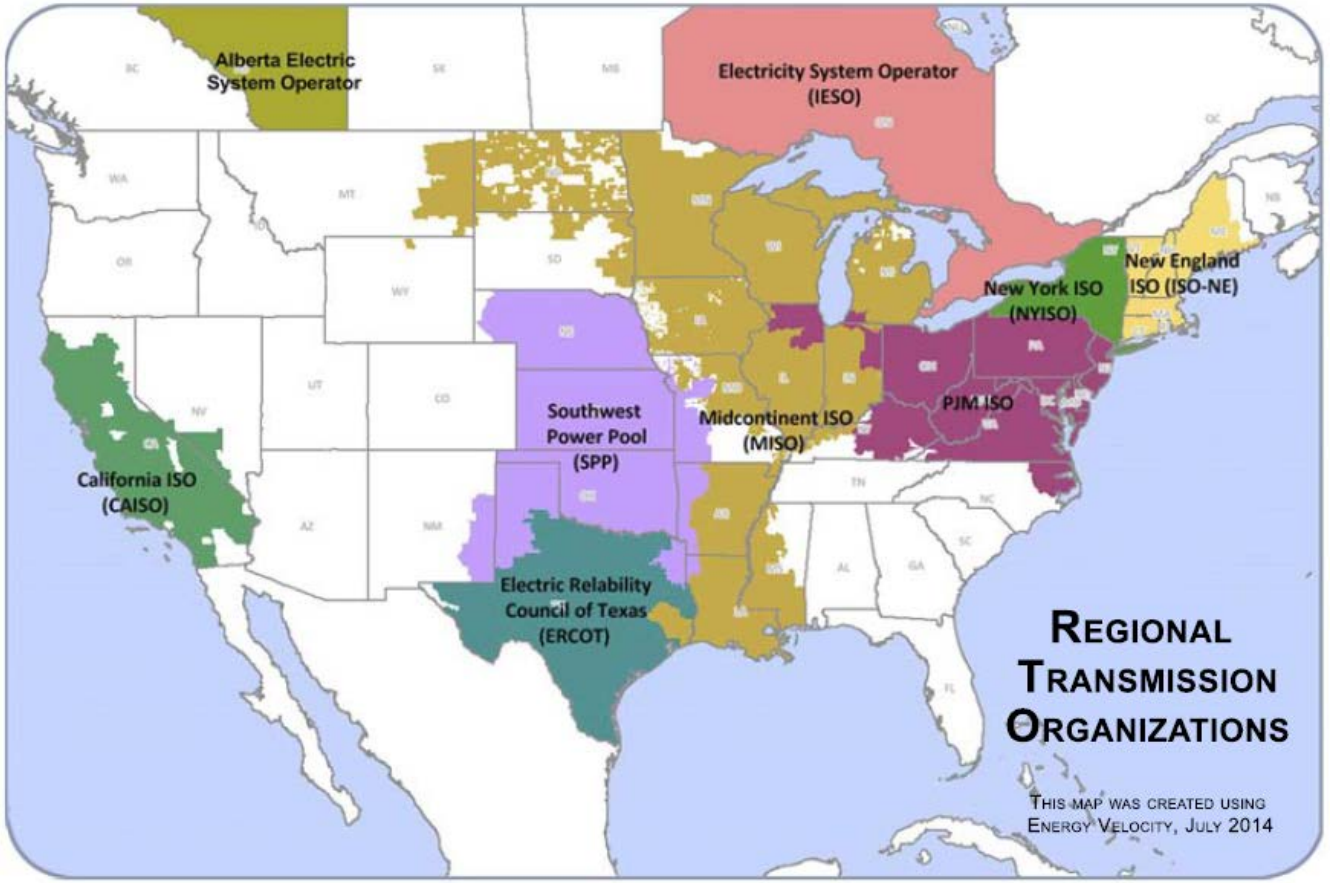
1. Status of Implementation Nationally

- Regional Plans
  - All Regional compliance filings have been made
  - FERC has accepted all, at least in part
  - Many pending cases challenging FERC orders on compliance filings
- Inter-Regional Compliance Filings
  - FERC only recently began to act on these filings
  - None fully accepted yet
  - No litigation yet

Source: FERC

Federal Energy Regulatory Commission

Regional Transmission Organizations



Source: FERC

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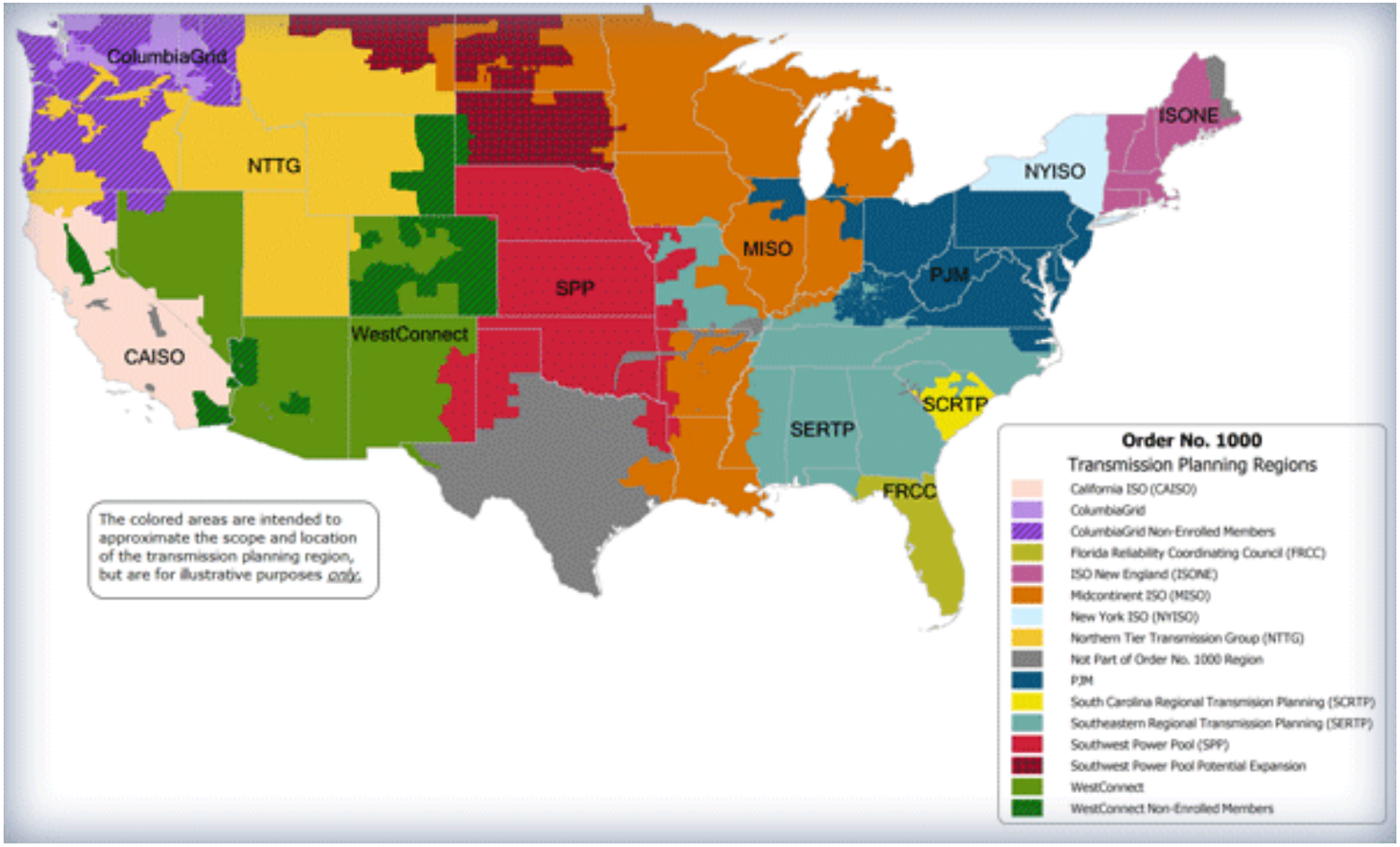
Order 1000 Transmission Planning Regions



Source: FERC

2. Status of Implementation in the West: Regional Filings

- Order 1000 in effect in all regions in the West
- Status of regional filings:
  - CAISO – Accepted; no judicial challenges
  - Columbia Grid – Accepted in part with compliance filings pending; one judicial challenge by Avista thus far
  - Northern Tier – Accepted in part with compliance filings pending; no judicial challenges thus far
  - WestConnect - Accepted in part with compliance filings pending; one judicial challenge by El Paso thus far

Source: WECC

Regional and Sub-Regional Planning Groups in the West

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Participation Issues in Regional Filings

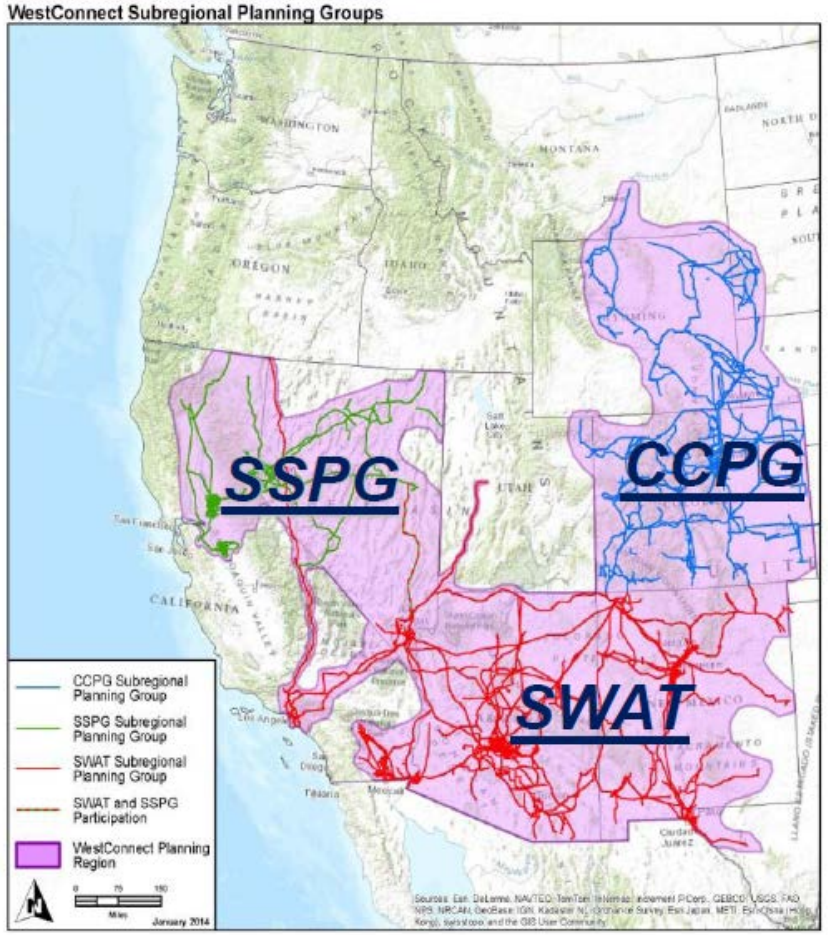
- Relationship between regions and non-FERC jurisdictional transmission providers is important in the West
  - Examples: Columbia Grid with BPA; WestConnect with WAPA and public power utilities
- FERC Review
  - FERC's initial position: To participate, must enroll in region
  - Compromise reached in FERC orders issued Sept. 18, 2014:
    - *Planning: Non-jurisdictional entities can have the Region plan for them without requiring them to enroll*
    - *Cost allocation: If non-jurisdictional entities enroll, they must participate in binding cost-allocation*

WestConnect Challenges
Boundaries and Participation

- Note challenges with footprint, especially CA municipal utilities
- Note challenges with participation
  - All entities required to sign Planning Participation Agreement ("PPA") to become a voting member
  - Entities in grey (non-FERC jurisdictional entities) participate in Order 890 transmission planning process, but have not signed PPA yet

Source: WestConnect

WestConnect Challenges
Integration and New Approaches



Source: WestConnect

- Under Order 890, WestConnect planning was done by three sub-groups
- For Order 1000 compliance, three sub-regions have been merged
- There is a need to change approaches used, including doing economic analysis using production cost modeling for the first time

2015 WestConnect Projects

State(s) Traversed	Number of Projects	Transmission Line Project Miles	Planned Investment ($ x 1,000)	Number of Projects	Transmission Line Project Miles	Conceptual Investment ($ x 1,000)
	PLANNED			CONCEPTUAL		
Arizona	66	555	$ 722,000	49	1,089	$ 1,020,000
California	21	815	$ 3,154,000	2	140	$ 54,000
Colorado	26	386	$ 532,000	10	668	$ 1,312,000
Nebraska	1	0	$ 4,000	0	0	$ -
Nevada	21	23	$ 248,000	8	293	$ 667,000
New Mexico	15	107	$ 131,000	2	255	$ 602,000
South Dakota	1	0	$ 4,000	0	0	$ -
Texas	12	14	$ 34,000	0	0	$ -
Wyoming	6	217	$ 108,000	0	0	$ -
Multi-State	14	3,217	$ 8,357,000	4	4,475	$ 8,400,000
Total	**183**	**5,334**	**$ 13,294,000**	**75**	**6,920**	**$ 12,055,000**

Source: WestConnect

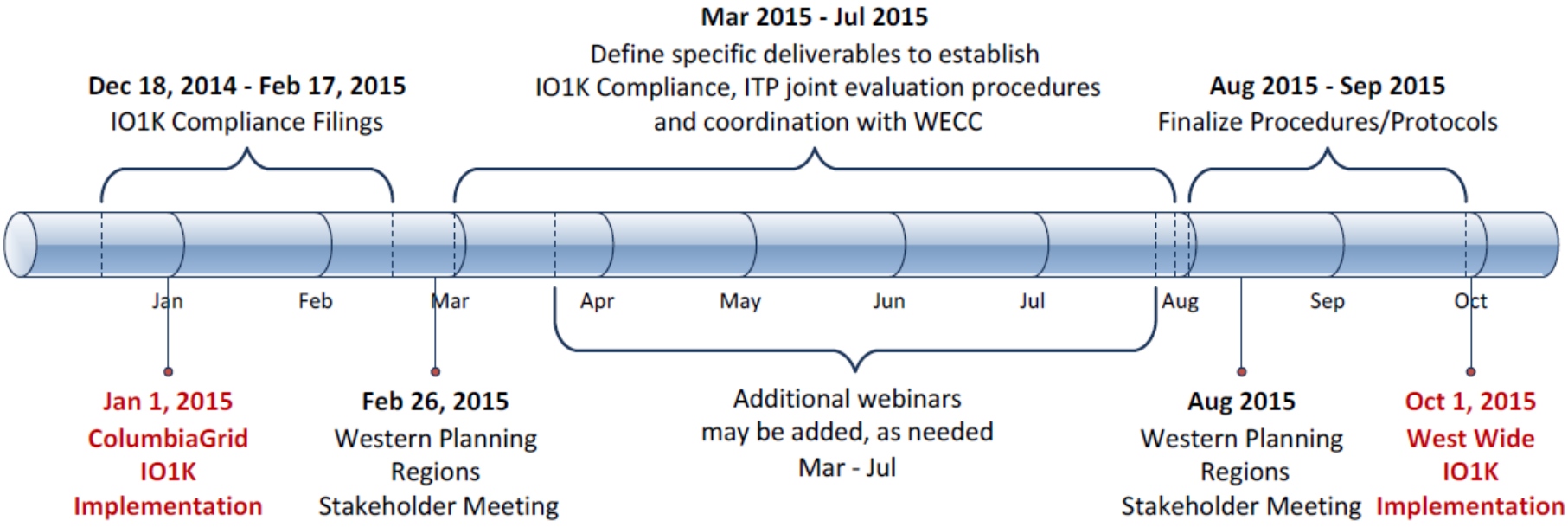
3. Status of Implementation in the West - Interregional Filing

- Western regions collaborated on common tariff language for their initial inter-regional filing in 2013
- Key concepts
  - Regional processes are foundation
  - Planning procedures include:
    - *Interregional planning coordination and data exchange*
    - *Identification and joint evaluation of Interregional Transmission Facilities ("ITFs")(i.e. lines which interconnect at least two planning regions and seek interregional cost allocation)*
      - Standard is whether ITFs would address regional transmission needs **more efficiently or cost-effectively** than separate regional transmission facilities
  - Cost allocation procedures for lines selected by regions for inclusion in plan for purposes of cost allocation, which requires a benefits determination and assignment of costs

Western Inter-Regional Filings, 2014-15

- FERC issued first order on Dec. 18, 2014, accepting almost all of filing
- Compliance filings required of CAISO and Columbia Grid which relate to clarifications of proposed tariff language, which were filed February 17, 2015
- Western planning regions already voluntarily implementing
- Columbia Grid tariff provisions took effect January 1, 2015
- New tariff provisions are to take effect October 1, 2015, for CAISO, NTTG, and WestConnect
- West-wide meeting held February 26, 2014

West-Wide Coordination 2015



From Presentation for West-Wide Inter-Regional Meeting, Feb. 26, 2015

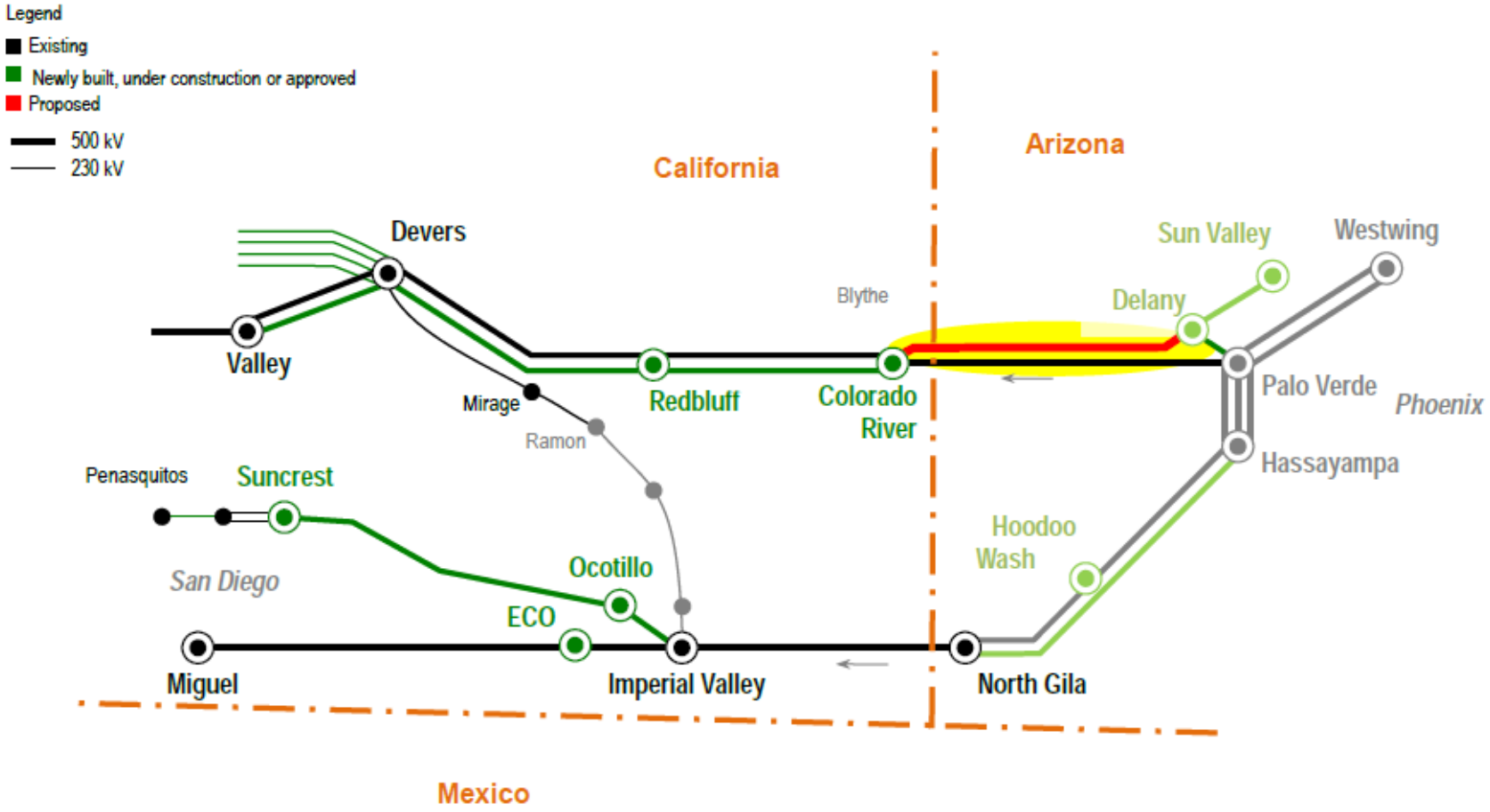
4. CAISO Transmission Plans and Impact on Its Neighbors

- In 2012, CAISO began implementation of a new transmission planning process
  - Identifies reliability, policy-driven, and economic projects
  - All costs of >200 kV lines are paid by all users of grid through transmission access charge
- In 2012-13, CAISO identified a large number of new transmission projects in CA and started to use its competitive solicitation process, e.g.
  - Gates – Gregg
    - *Reliability project, with policy and economic benefits in PG&E service territory*
    - *Approximately 59 miles of 230 kV line; cost $115-$145 million*
    - *Five applicants and project sponsor selected was PG&E and MidAmerican Transmission LLC, in conjunction with Citizens Energy Corporation*
  - Sycamore-Pennasquitos
    - *Policy-driven project in SDG&E service territory*
    - *Approximately 11 miles of 230 kV line; cost $111- $221 million*
    - *Four applicants and project sponsor selected was SDG&E , in conjunction with Citizens Energy Corporation*

CAISO Lines into Arizona and Nevada

- In 2013-14, CAISO identified many projects expected to cost almost $2 billion, including two economic projects to neighboring states, currently in competitive solicitation process –
  - Delaney-Colorado River – CA and AZ
    - *115-140 miles, 500 kV line, cost approximately $300 million*
  - Harry Allen-Eldorado – NV
    - *60 miles, 500 kV line, cost approximately $144 million*
- 100% of the cost of both of these lines will be paid for by CAISO ratepayers which will be rolled into the Transmission Access Charge
- Need to comply with all applicable federal, state, and local permitting laws

Delaney-Colorado River



Source: CAISO

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Delaney-Colorado River Benefits

Table 5.7-25: Cost-benefit analysis of the proposed Delaney – Colorado River 500 kV

7% discount rate	Capacity Benefit	
	200 MW	300 MW
Total benefit ($M)	406	477
Total cost ($M)	442-469	442-469
Benefit-cost ratio	.87-.93	1.02-1.09

Table 5.7-26: Cost-benefit analysis of the proposed Delaney – Colorado River 500 kV

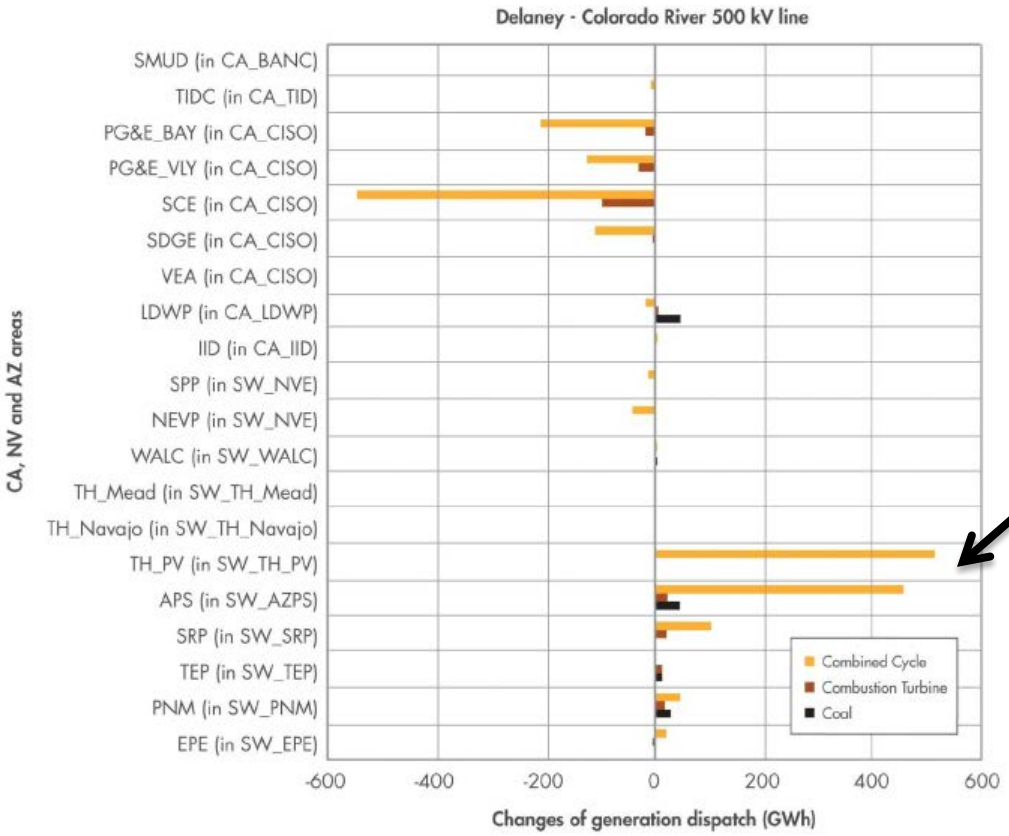
5% discount rate (sensitivity)	Capacity Benefit	
	200 MW	300 MW
Total benefit ($M)	528	617
Total cost ($M)	530-560	530-560
Benefit-cost ratio	.95-1.0	1.11-1.17

Source: CAISO

- Production cost model shows sufficient economic benefits
- Improves deliverability of renewable resources
- Improves reliability in the event of outage of major import line

Impact of Delaney-Colorado River on Generation

Figure 5.7-15: Generation changes with addition of the Delaney – Colorado River 500 kV line



Note the expected increase in usage of combined-cycle generators in Arizona

Source: CAISO

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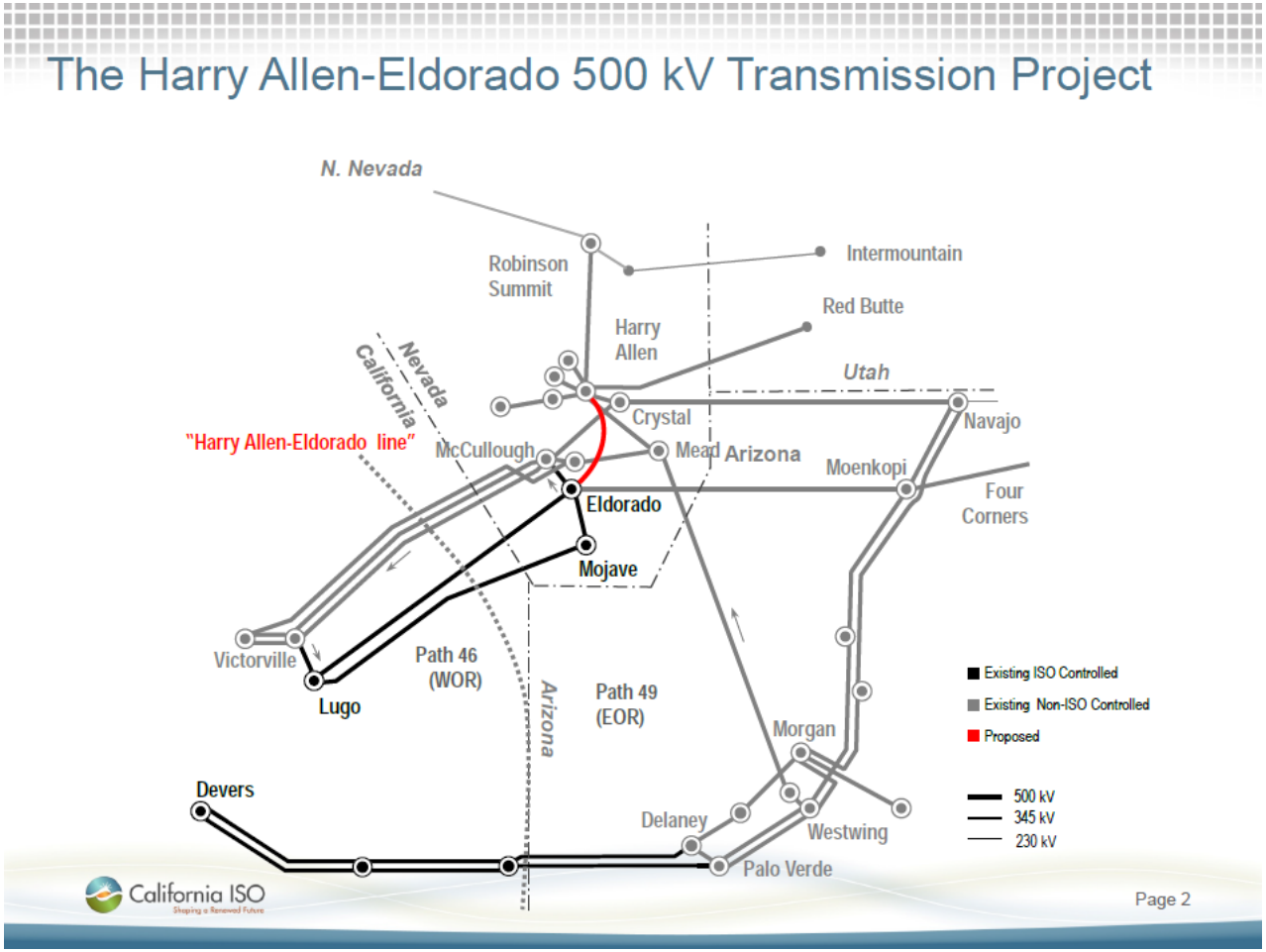
Applicants for Project Sponsor

- Validated applications received from:
  - **DCR Transmission, LLC** (A joint venture between Abengoa Transmission & Infrastructure and an affiliate of Starwood Energy Group Global, Inc.)
  - **California Transmission Development LLC** (a wholly owned subsidiary of LS Power & Associates)
  - **Duke-American Transmission Company LLC**, in collaboration with Western Area Power Administration Desert Southwest Region, and Citizens Energy Corporation.
  - **NextEra Energy Transmission West LLC** (a wholly owned subsidiary of NextEra Energy Transmission)
  - **Southern California Edison Company**
  - **TransCanyon DCR LLC** (wholly owned by TransCanyon LLC)
- Currently in collaboration phase, so some applicants may decide to work together
- CAISO target for selection of Project Sponsor is June 12, 2015

Harry Allen-Eldorado



Source: CAISO

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Harry Allen-Eldorado Benefits

Assumptions	5% Real Discount Rate, 10% ROE	5% Real Discount Rate, 11% ROE	7% Real Discount Rate, 10% ROE	7% Real Discount Rate, 11% ROE
Dispatch Benefits	$157	$157	$119	$119
Capacity Benefits	$189	$189	$148	$148
Total Gross Benefits	**$346**	**$346**	**$267**	**$267**
Revenue Requirement for line	**$288**	**$301**	**$240**	**$252**
BCR	**1.20**	**1.15**	**1.11**	**1.06**

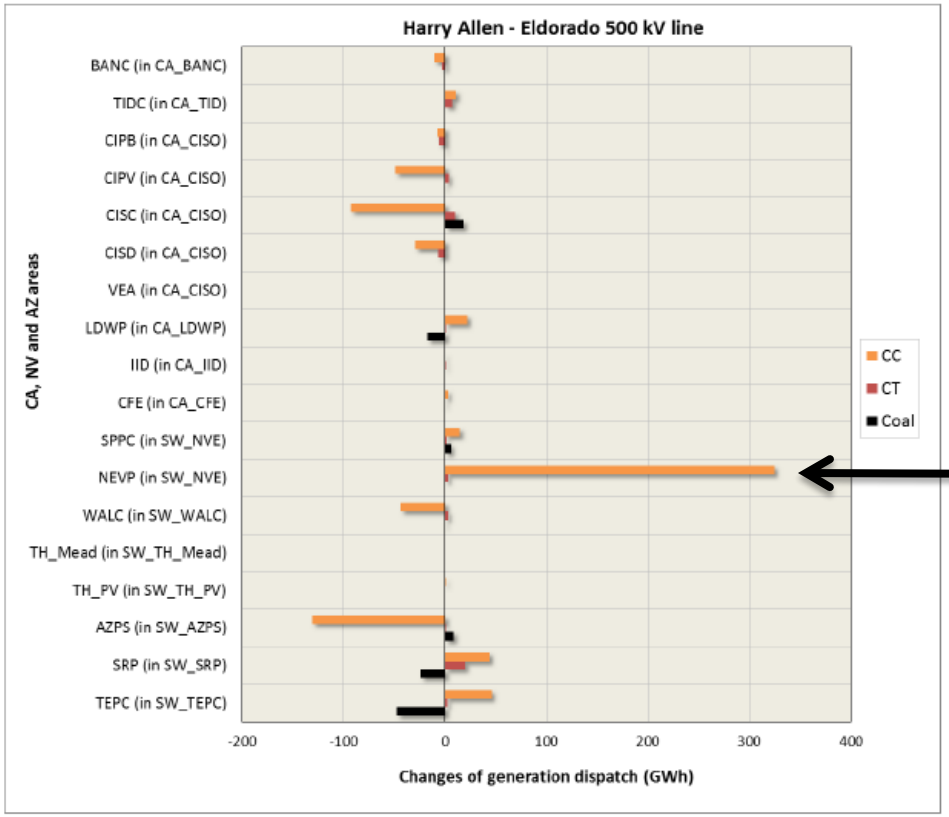
Other benefits not quantified:

- Renewable integration
- Reliability

Source: CAISO

Impact of Harry Allen-Eldorado on Generation

Figure 4: Generation changes with addition of the Harry Allen – Eldorado 500 kV line for Year 2024



Note the expected increase in usage of combined-cycle generators in Nevada

Source: CAISO

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Current Schedule for Harry Allen-Eldorado

- April 30 – Applications due
- May 5 – Validated list of applicants due
- Collaboration period, if applicable
- November 17 (or fifty days later if collaboration) – Selection announced

C. Transmission Rate Incentives

- FERC has exclusive authority to set transmission rates
- In 2005 Congress gave FERC authority to adopt rate incentives under FPA Section 219
- Sample incentives
  - FERC can reduce risks by, for example, pre-authorizing: (1) recovery of Construction Work in Progress ("CWIP"); (2) recovery of pre-commercial costs as an expense or as a regulatory asset; and (3) recovery abandoned plant
  - FERC will increase the ROE for turning over control to RTO, ISO
  - FERC can also authorize an increased rate of return on equity for taking on significant risks
- FERC Implementation
  - Orders 679: Nexus test - connection between the incentive(s) requested and the proposed investment
  - FERC Order 679-A: Facilities for which incentives are sought must enhance reliability or reduce congestion
  - In 2012, after receiving 85 applications for $60 billion of investment, FERC Issued Policy Statement which tightened standards, especially for granting higher return on equity

Recent Applications for Incentive Rates

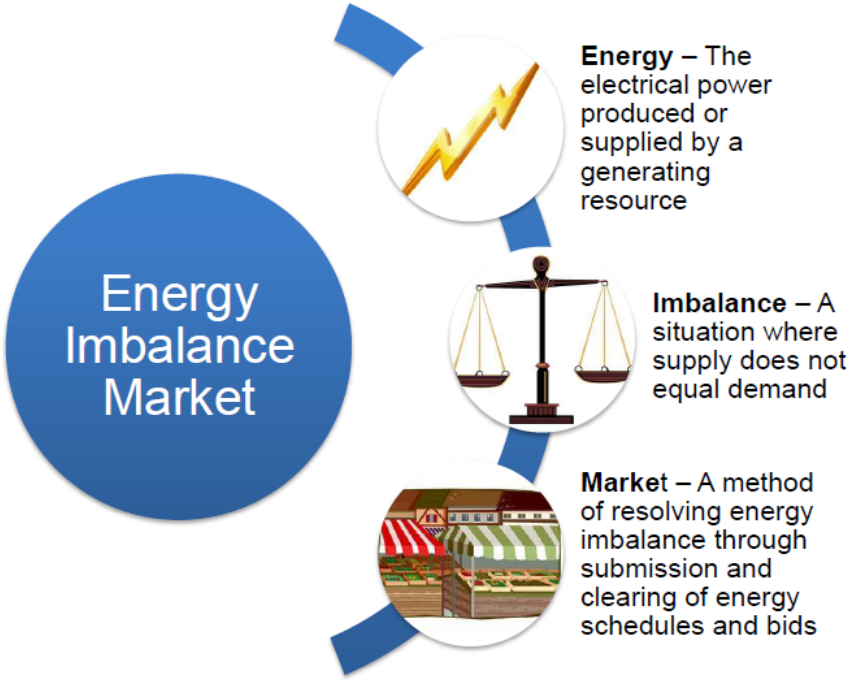
- Recent applications for incentive rates for projects that result from competitive solicitation
  - Gates-Gregg (Project Sponsor is partnership of PG&E and Mid-American)
    - *PG&E – FERC authorized recovery of abandoned plant and 50 basis point ROE adder for RTO participation*
    - *Mid-American – FERC authorized same incentives as for PG&E and (1) recovery of pre-commercial costs as regulatory asset; and (2) hypothetical capital structure of 52% equity/48% debt*
  - Suncrest-Pennasquitos (SDG&E is sole Project Sponsor)
    - *SDG&E requested recovery of abandoned plant and 100 basis point ROE adder*
- Note that ratepayer costs may be higher than if these projects were solely projects of the State's utilities only

II. Energy Imbalance Market

A. Background

Basics

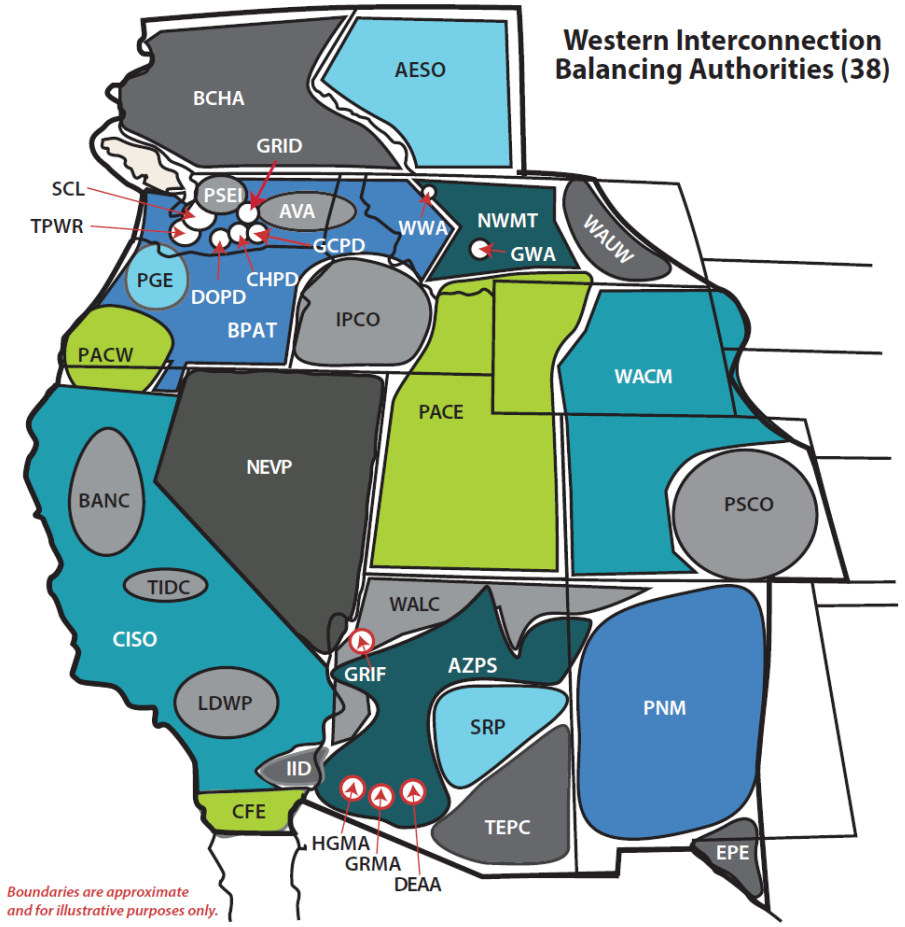
- What is it?
- How does it work?
- What are the benefits?
- Who is currently participating?



Source: CAISO

Balancing Authority Areas

- A balancing authority ("BA") matches generation with load and maintains electric frequency of the grid in a balancing authority area ("BAA")
- There are 37 BAs in the western interconnection
- Today, each BA balances load and generation separately



Source: CAISO

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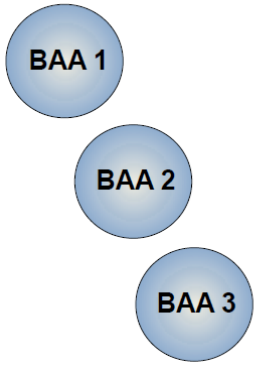
Balancing Authority Interaction

BEFORE

- Each BA balances load and generation manually and maintains reserves



Each BA examines their load/resource imbalance

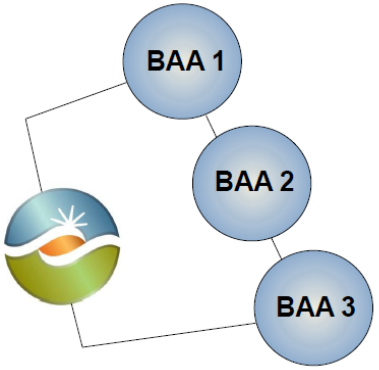
They manually dispatch resources from within their BAA to resolve the imbalance

They do not have the benefit of other BA's resources to help with the imbalance

Source: CAISO

AFTER

- EIM resolves imbalances in real time through an automated multi-BAA energy dispatch service



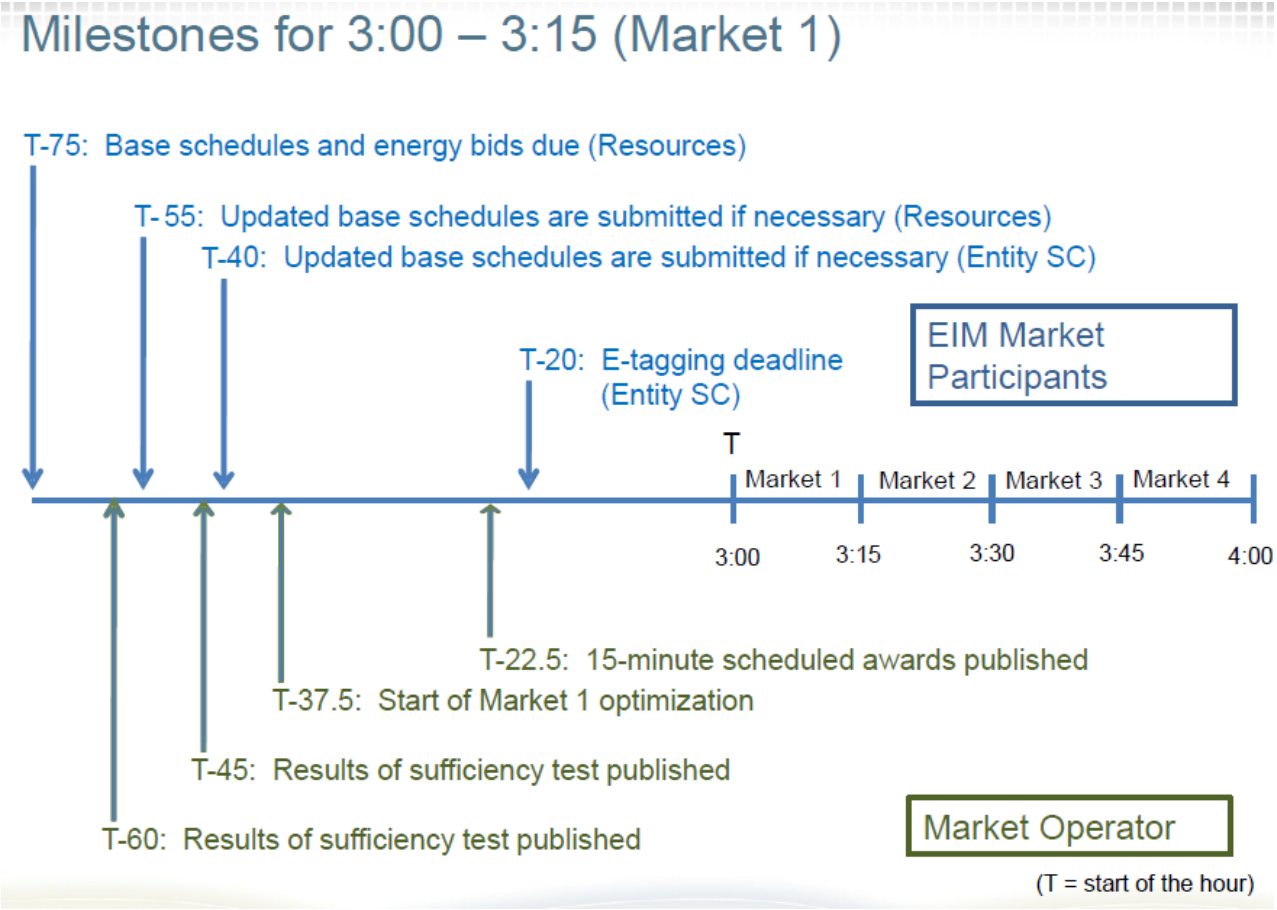
All resources in the EIM footprint are visible, even if not available for EIM dispatch

The real-time EIM optimization will efficiently dispatch participating resources to maintain balance

The real-time market looks ahead at the situation in upcoming intervals

Source: CAISO

EIM Market Operations



Source: CAISO

NREL Study of West-wide EIM

- In 2013 NREL studied the potential benefits of a West-wide EIM
- Conclusions:
  - Increasing the temporal and geographic footprint to the entire West would moderate the variability of renewable generation and electricity demand
  - By introducing 5-minute economic dispatch to meet imbalances, there could be
    - *More efficient dispatch of generators*
    - *More efficient clearing of imbalances*
    - *Reduced need for flexibility reserves, often provided by quick-response reserves*

NREL West-wide EIM Study Results

- With full participation in the West, there would be an annual West-wide operating benefit between $146 and $294 million per year
- There is an additional benefit of approximately $1.3 billion per year associated with moving from hourly to 10-minute dispatch
- Benefits would be somewhat less with reduced participation or lower natural gas prices

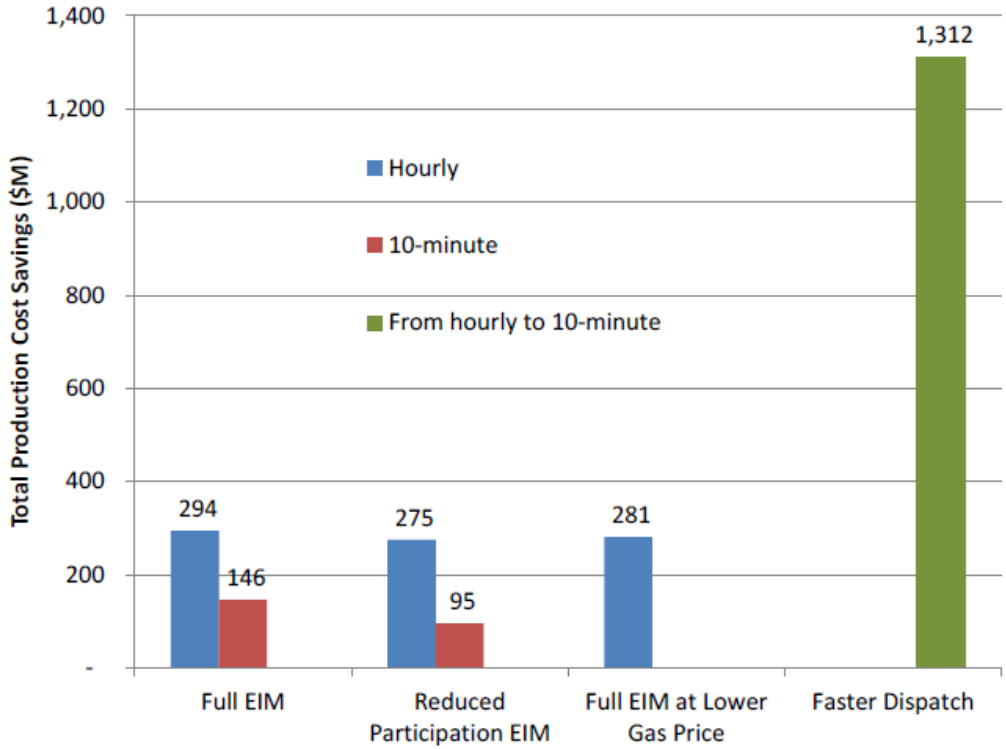


Figure ix. Comparison of West-wide EIM benefits

Source: NREL

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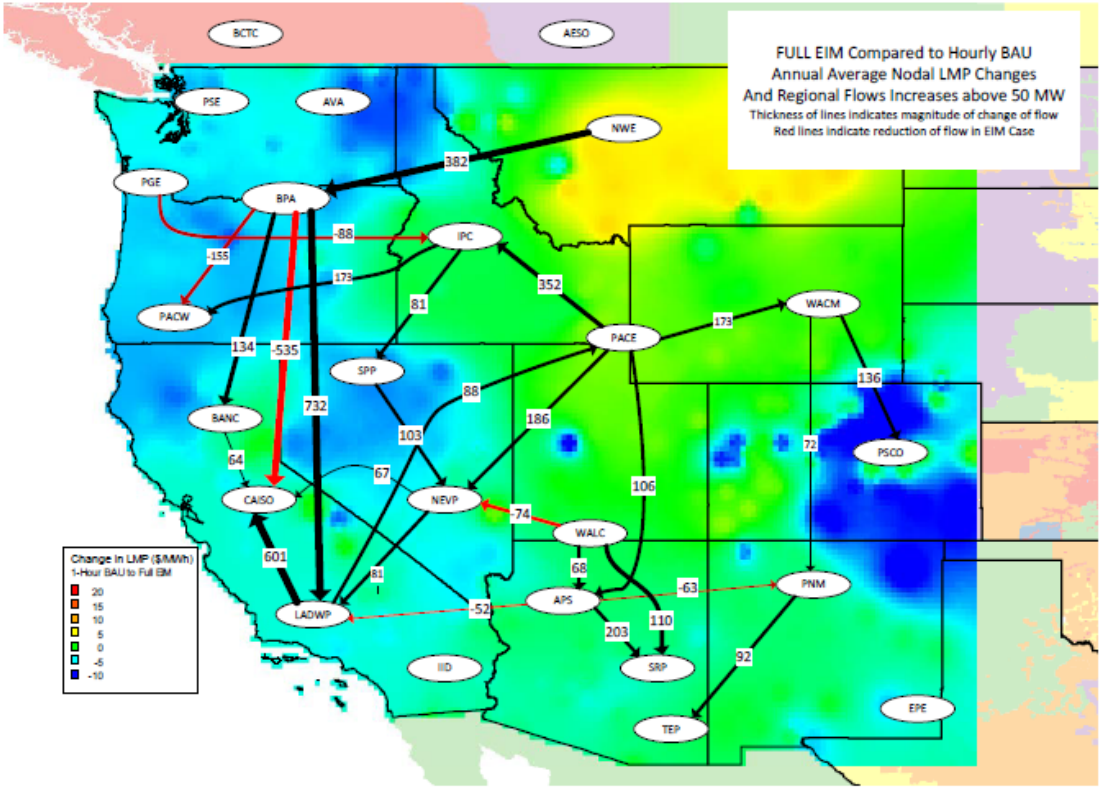
Distribution of Benefits for West-Wide EIM

- Distribution of benefits would not be uniform
- This is a map of change in locational marginal prices between a full EIM and hourly BAU scenarios
- Locational marginal prices go down the most in areas in dark blue benefit, followed by areas in turquoise



Source: NREL

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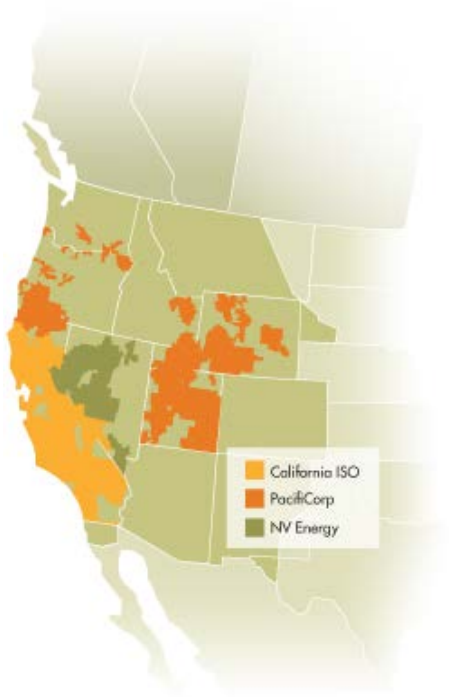
B. New CA ISO, PacifiCorp, NV Energy EIM

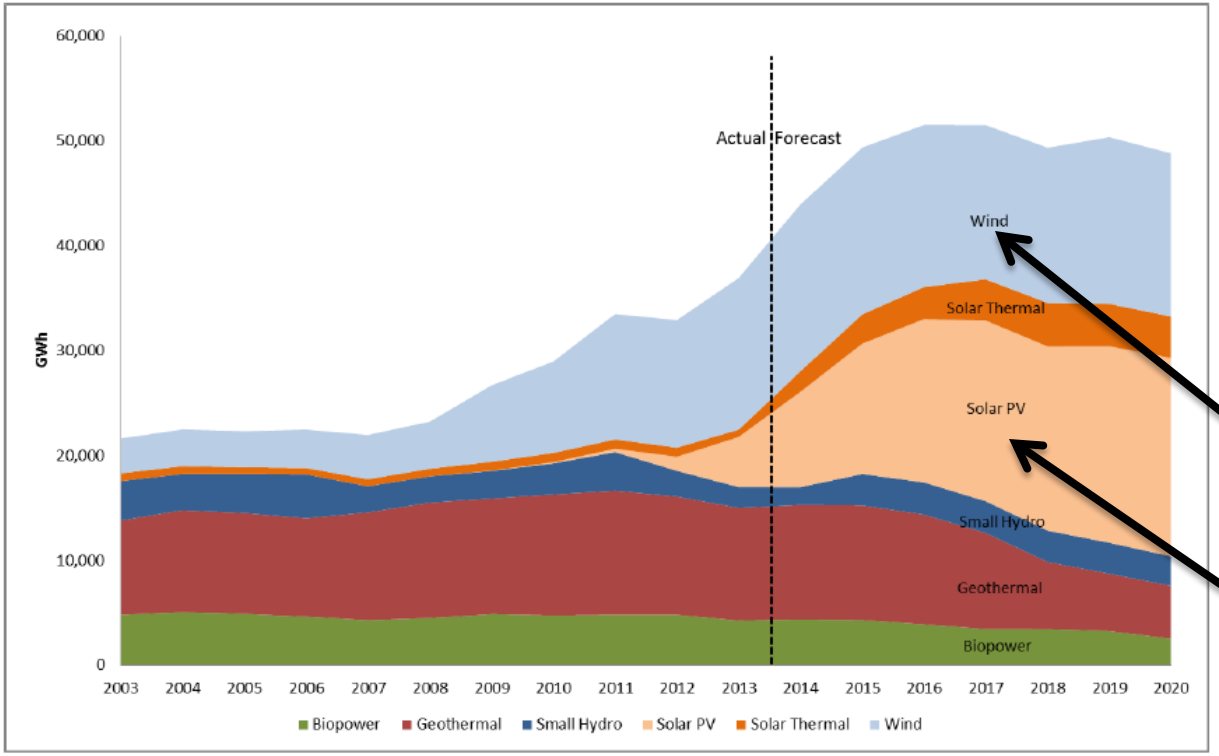
- CAISO and PacifiCorp
  - In 2013 signed MOU regarding development of EIM
  - In 2014 received FERC approval and EIM went live
- Addition of NV Energy
  - In 2013 signed MOU regarding participation in EIM
  - In 2014 NV Energy received approval from PUCN
  - In 2015, expect to receive FERC approval to join EIM
- Note: PacifiCorp in 2005 and NV Energy in 2013 were purchased by subsidiaries of Berkshire-Hathaway



Source: CAISO

1. Drivers for Participation in EIM

Figure 3: Renewable resource mix, actual and forecasted by year [10]



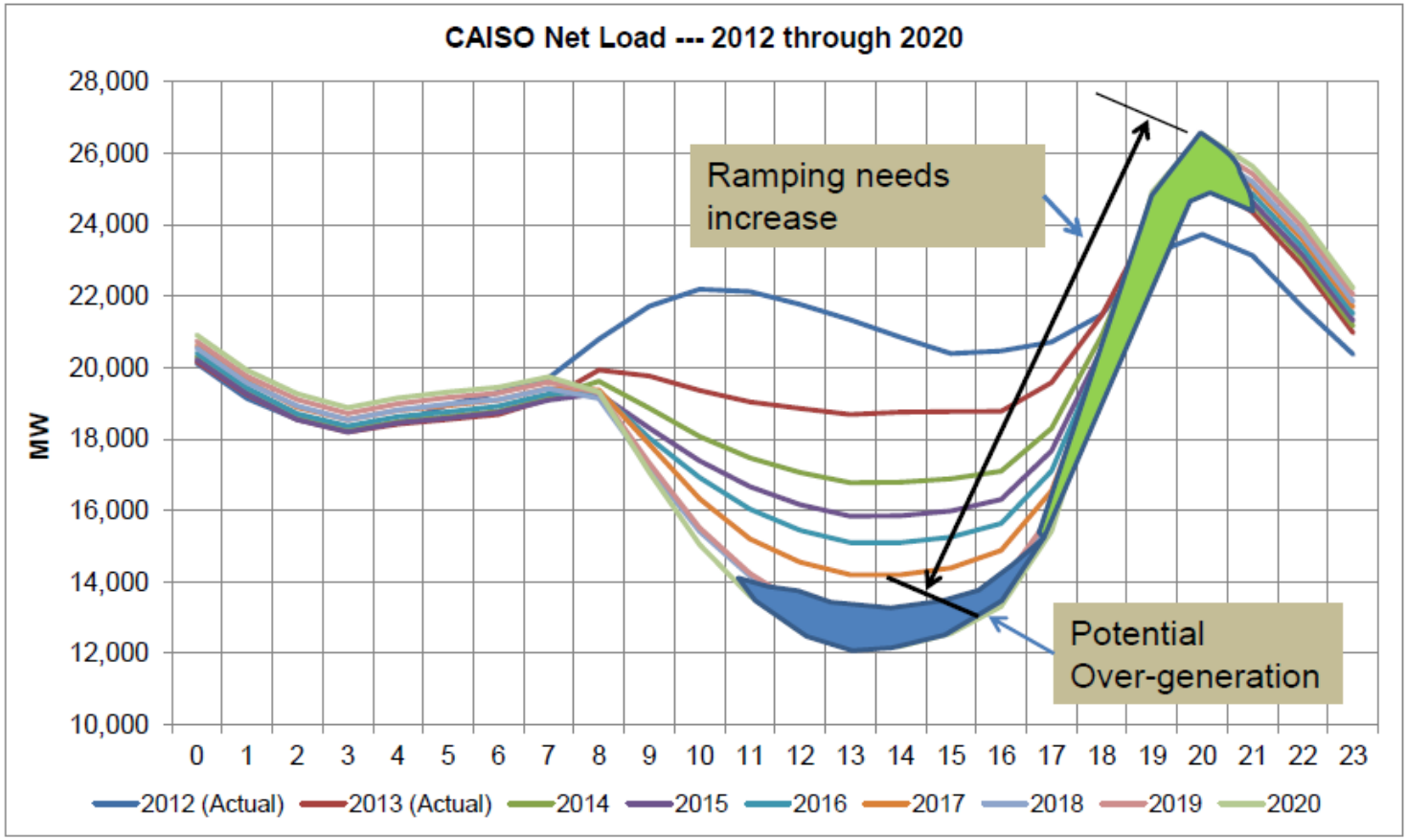
- In CA, high RPS requirement – 33% by 2020
- Most of renewables are intermittent (solar PV and wind)
- Expected to lead to over generation and curtailment

Wind

Solar PV

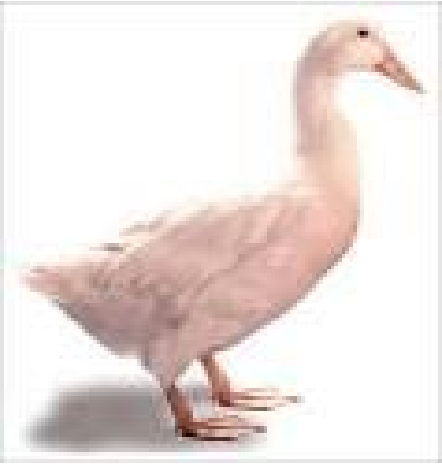
Source: CPUC, RPS Quarterly Report, 3d Quarter 2014

CAISO Net Load



Net Load is load less wind and solar generation

Source: CAISO



Source: Maple Leaf Farms

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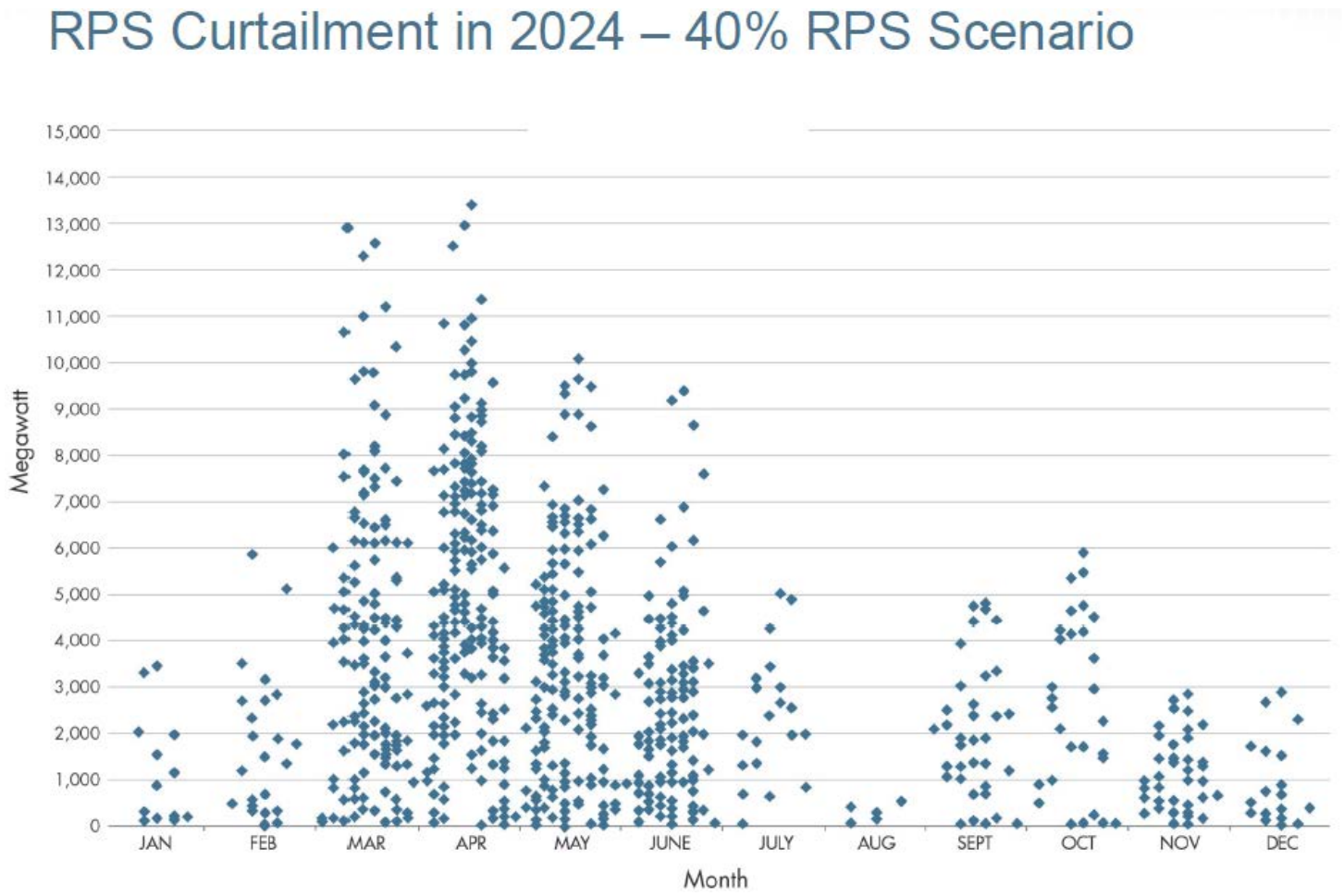
RPS Curtailment in CAISO



Source: CAISO

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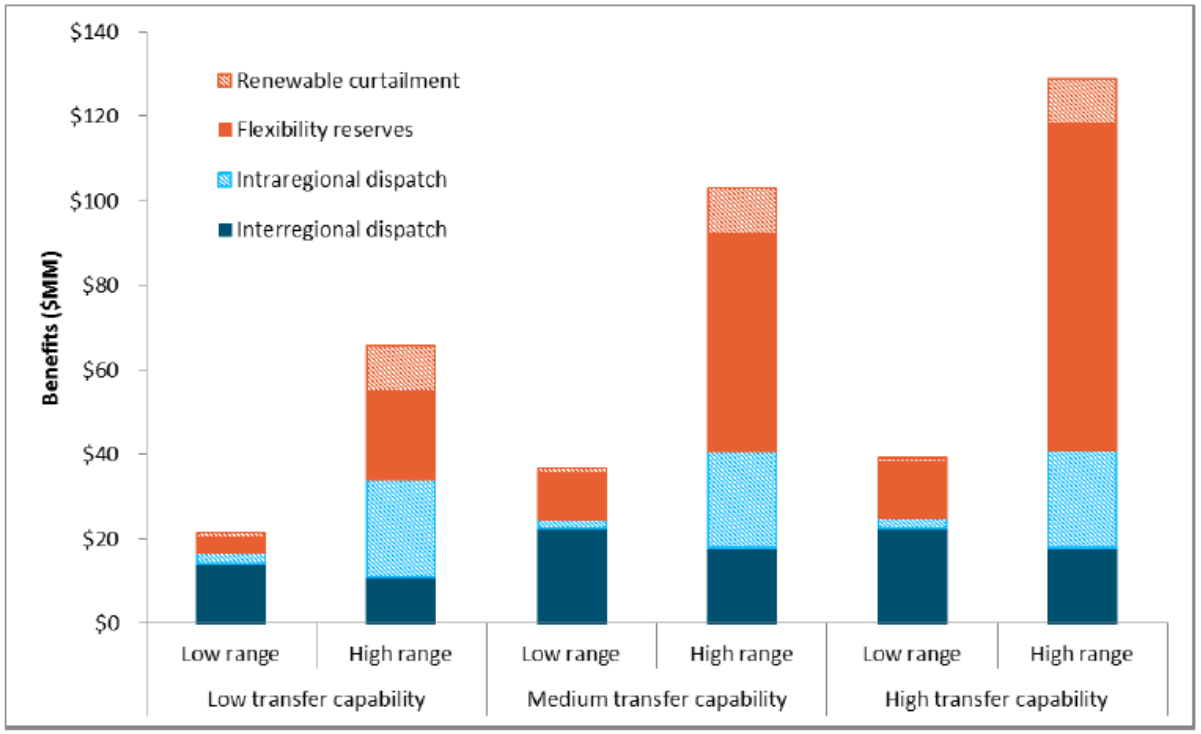
Benefits to PacifiCorp

- PacifiCorp had study done of the benefits to PacifiCorp
- Found significant benefits, which increased with transfer capability

Figure 1. Low and high range benefits under low (100 MW), medium (400 MW), and high (800 MW) PacifiCorp-ISO transfer capability scenarios (2012$)



Source: Study by E-Three for PacifiCorp

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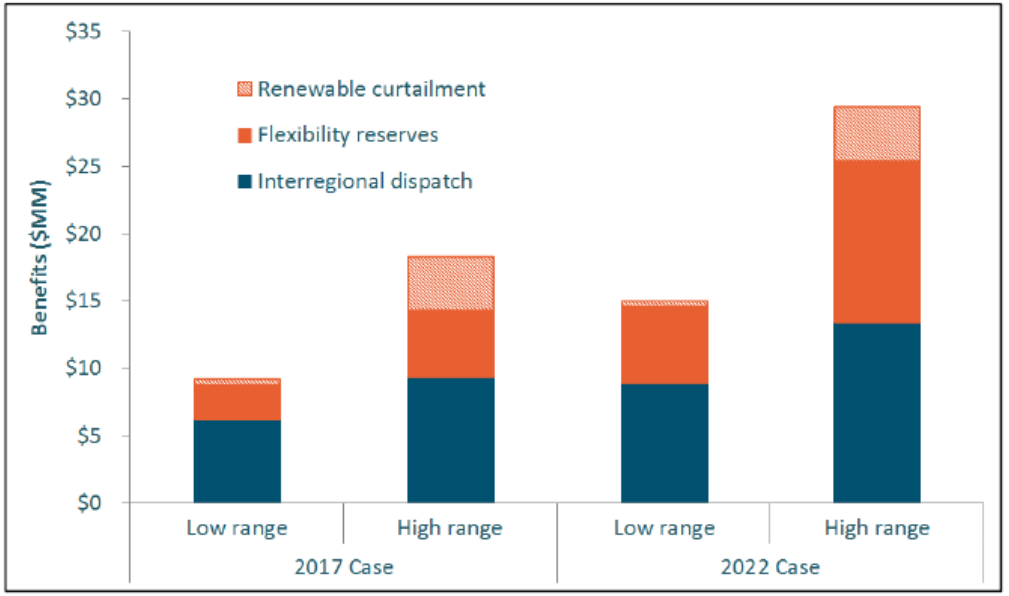
Benefits of NV Energy Participation

- CAISO and NV Energy had study done of benefits to EIM participants to having NV Energy join EIM
  - Study concluded that there would be significant benefits that would increase over time
- NV Energy also made a case for the benefits of joining an EIM to the PUCN to get its consent to join the EIM
  - Noted benefits to Nevada of facilitating development of renewable resources

Figure 1. Low and high range incremental gross annual benefits to all participants from NV Energy Participation in EIM (2013$)



Note: Figure represents total incremental benefits to all EIM participants as a result of NV Energy's participation in the EIM.

Source: Study by ABB and E-Three for CAISO and NV Energy

2. Implementation

- **Entity implementation agreements**
  - PacifiCorp FERC approval: June 28, 2013
  - NV Energy FERC approval: June 13, 2014
- **Design**
  - Tariff amendment filings by CAISO and PacifiCorp: February 2014
  - Initial FERC approval: June 19, 2014
  - Several amendments
- **Implementation -** Fully binding on November 1, 2014

Design Basics

- Any balancing authority can join and become an “EIM Entity”
- In BAAs outside the CAISO, participation by generators is voluntary
- Generators that want to participate sign an agreement to become an “EIM Participating Resource” in the CAISO
- Participants only sell energy in the 5-minute real time market
- CAISO uses its market software to economically dispatch generators in all of the EIM Entities
- Prices are settled by the CAISO
- Pancaked rates are avoided by imposing no wheeling charges, but this is being revisited
- There is currently a small administrative fee

Market Power Concerns

- Only part of tariff filing which required significant additional work before implementation
- Intervenors noted that PacifiCorp affiliates own much of generation in PACE and PACW
- FERC agreed with intervenors that proposed tariff provisions relating to market power monitoring for transfers between BAAs were inadequate
- Resolved by having CAISO Department of Market Monitoring agree to monitor real-time transfers in and among all BAAs

Table 1. Maximum Capacity of Coal and Gas Resources in PacifiCorp East BAA Potentially Participating in EIM

	Maximum MW		
Type	**PacifiCorp**	**Other**	**Total**
Coal	2,287	0	2,287
Natural gas	1,725	160	1,885
Total	4,012	160	4,172

Table 2. Maximum Capacity of Gas and Hydro Resources in PacifiCorp West BAA Potentially Participating in EIM

	Maximum MW		
Type	**PacifiCorp**	**Other**	**Total**
Natural gas	977	0	977
Hydro	431	0	431
Total	1,408	0	1,408

Table 3. Maximum Capacity of Wind Resources Potentially Participating in EIM

	Maximum MW		
Type	**East**	**West**	**Total**
PacifiCorp	594	195	789
Other	n/a	n/a	224
Total	---	---	1,013

Source: CAISO Dept. of Market Monitoring

Governance

Stakeholder Transition Committee

- Roles: advise on EIM matters, propose independent EIM structure
- Sectors: investor owned utilities, publicly owned utilities, generators and marketers, alternative energy providers, EIM participants, government agencies, public interest entities
- Open meetings, CAISO staff support, no compensation
- To be replaced when permanent governance structure is adopted in late 2015

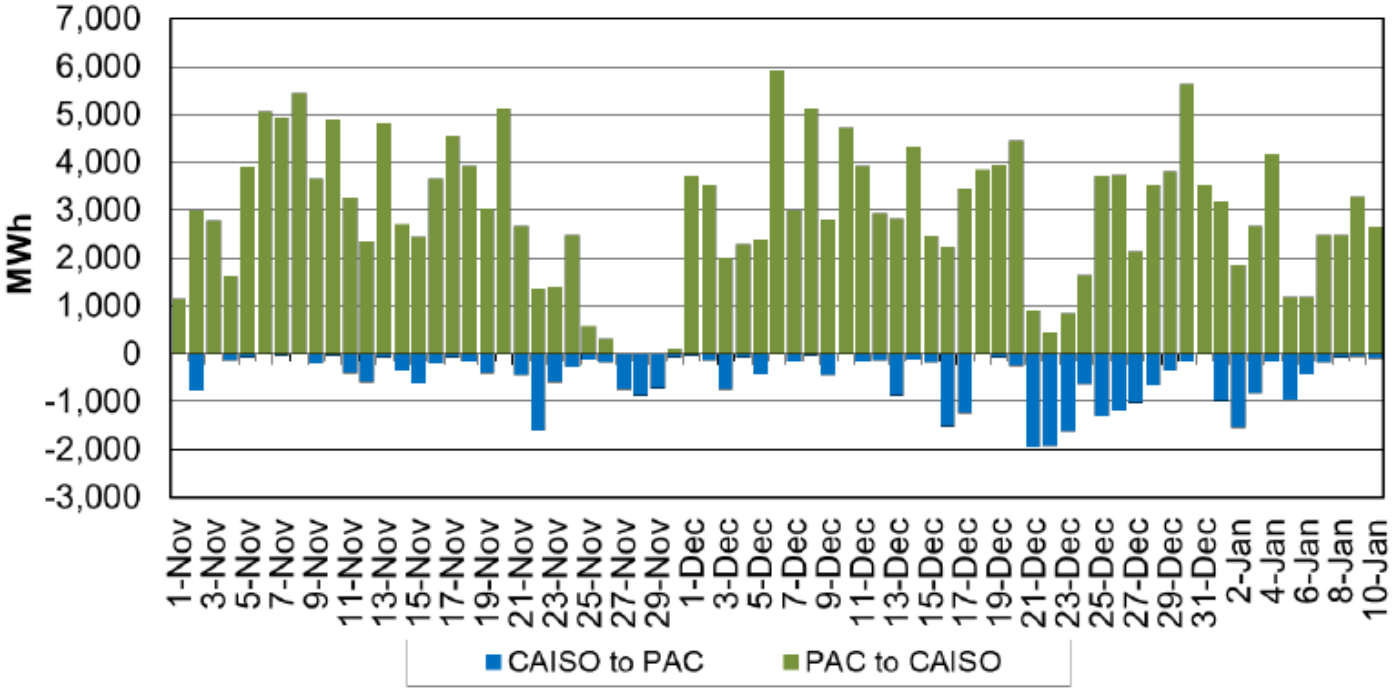
Composition

- Chairperson: Rebecca Wagner, Public Utilities Commission of Nevada
- Members:

Stephen Beuning	Xcel Energy, Inc.
Tony Braun	Braun Blaising McLaughlin & Smith, PC
Dede Hapner	Pacific Gas and Electric Company
Natalie Hocken	Representative from EIM Entity PacifiCorp
Travis Kavulla	Montana Public Service Commission
Kevin Lynch	Iberdrola Renewables
Mark Smith	Calpine Corporation
Walter Spansel	Representative from EIM Entity NV Energy
Rebecca Wagner	Public Utilities Commission of Nevada
Robert Weisenmiller	California Energy Commission
Carl Zichella	Natural Resources Defense Council

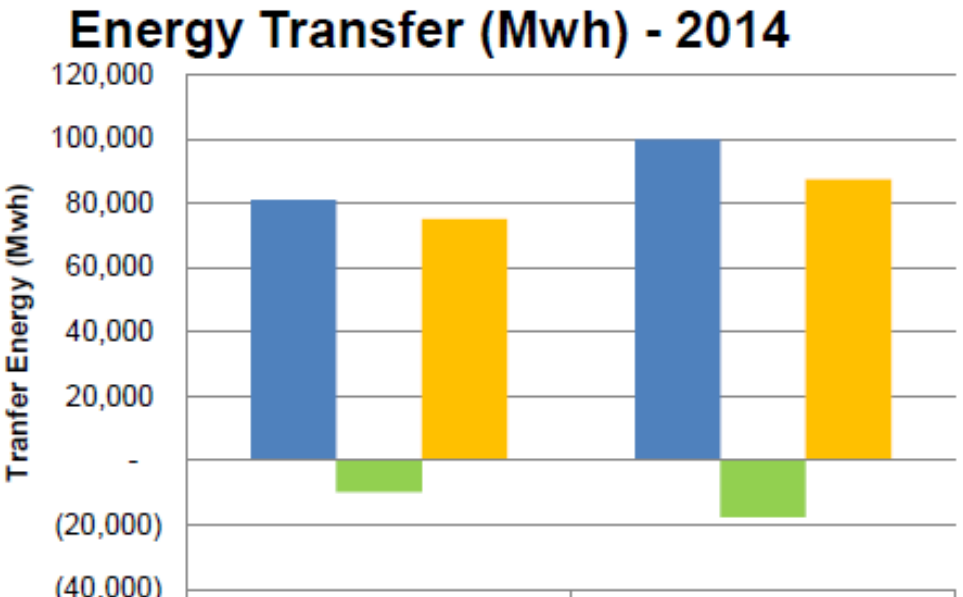
3. Performance

EIM transfer in fifteen-minute market between PAC and California



Source: CAISO

Recent EIM Energy Transfers



	November	December
PacifiCorp to ISO	80,973	99,813
ISO to PacifiCorp	(9,830)	(17,531)
PACE to PACW	75,169	87,420

- EIM dispatched energy transfers up to:
  - 421 MW in a 15 min interval from PACW to ISO
  - 220 MW from ISO to PACW
  - 200 MW from PACE to PACW

Source: CAISO

Recent Cost-Benefit Analysis

Estimated Benefits – In Millions of Dollars

BAA	November	December	Total
ISO	$0.65	$0.59	$1.24
PACE	$1.05	$1.26	$2.31
PACW	$1.39	$1.03	$2.42
Total	**$3.09**	**$2.88**	**$5.97**

Source: CAISO

- Benefits were calculated as difference between operating with EIM and without EIM
- Thus far, overall benefits observed are estimated to be $5.97 million, which is in line with forecasts
- Benefits reflect more efficient dispatch in the 15-minute market and reduced renewable energy curtailment, but does not yet include benefit of reduced flexibility reserves

EIM Modifications and Enhancements

- Modifications Needed Immediately
  - Price volatility at start-up
  - FERC approval of waiver
  - Now proposing 12-month transition pricing
- One Year Enhancements
  - Many enhancements under consideration

Figure 3: Daily Average of Fifteen Minute Market Prices in PacifiCorp West

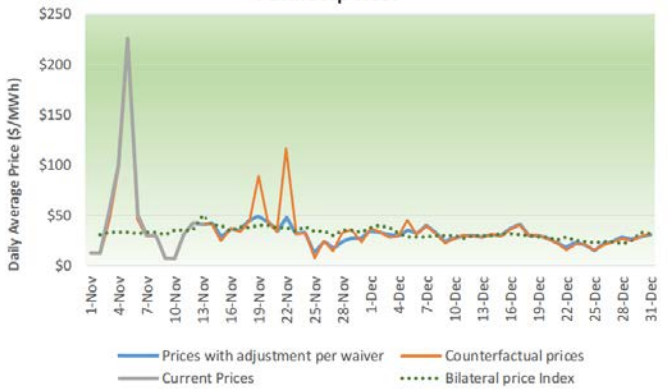
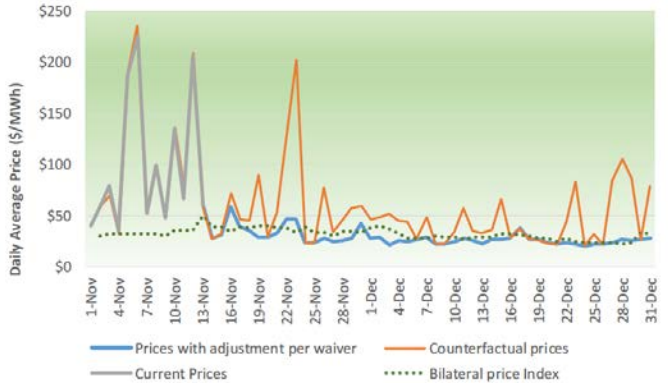


Figure 4: Daily Average of Fifteen Minute Market Prices in PacifiCorp East



Source: CAISO

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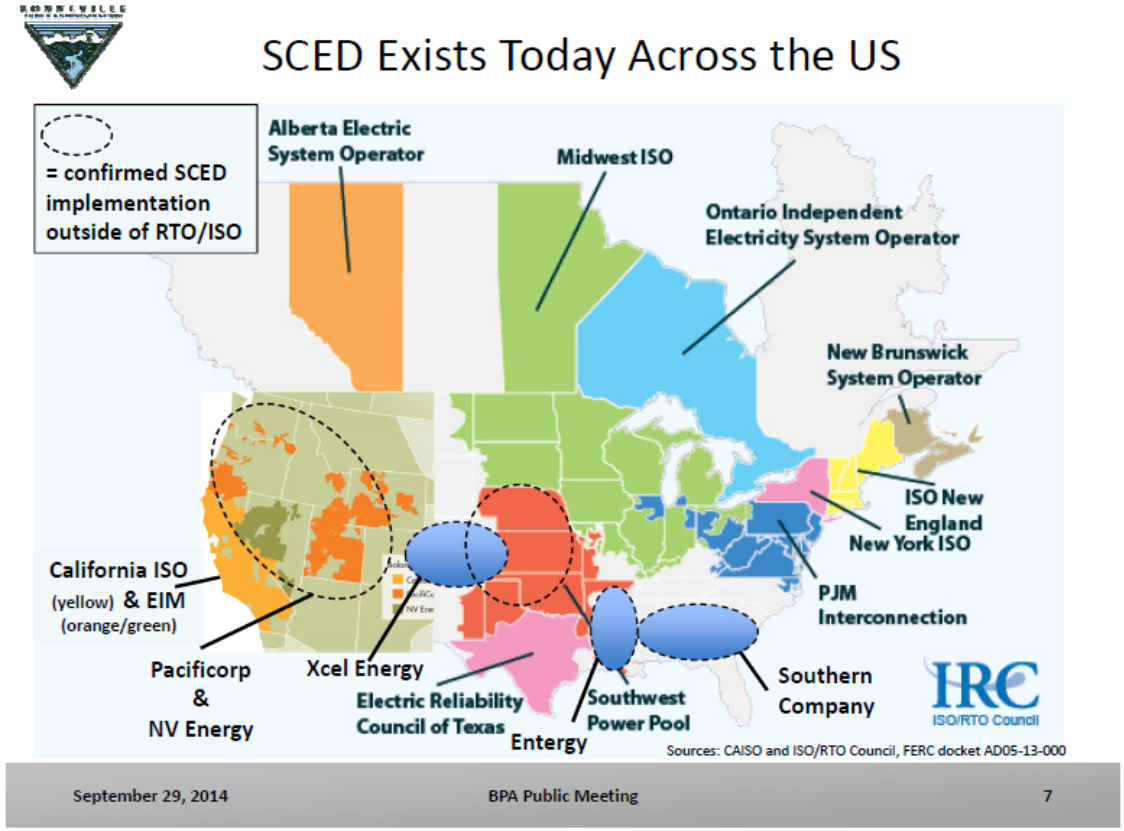
C. Possible New Northwest Intra-Hour Energy-Only Market

- BPA and the Northwest Power Pool ("NWPP") are working on developing a Security Constrained Economic Dispatch ("SCED") system, which is a within hour energy-only market
- SCED systems already exist elsewhere in the US, and BPA and NWPP intend to base their system on that used by the Southwest Power Pool
- NWPP issued an RFP for market design Oct. 31, 2014
- A FERC filing for a declaratory order is expected soon



SCED Overview

What the SCED is:

- An intra-hour market for non-firm energy
- A tool for centralized real time re-dispatch of units' *voluntarily* offered range operations
- A market in which participation
  - is voluntary for generators offering economic redispatch flexibility (ie. offered dispatchable range)
  - is mandatory for any imbalance (loads or generation) in the footprint composed of participating BAs

What the SCED is NOT:

- An RTO (with planning, day-ahead markets, BA consolidation)
- A centralized unit commitment tool
- A capacity market
- A replacement for the current contractual business structure

Conclusions

- Transmission
  - In the last ten years, pursuit of environmental goals relating to renewable energy and climate change have led to the death of transmission planning as we knew it
  - Tremendous challenges lie ahead, particularly with respect to inter-regional planning and cost allocation in the West
- Real-time markets
  - In the last three years, the addition of intermittent renewable resources and improvements in automation have begun to permit integration of real-time energy markets
  - More Western participation in real-time energy imbalance markets is likely

Questions?

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