State-Led Market Study

Exploring Western Organized Market Configurations: A Western States' Study of Coordinated Market Options to Advance State Energy Policies (or the "State-Led Market Study")

Fall 2021 Joint CREPC-WIRAB Meeting
October 19, 2021

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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

M. Milligan and K. Clark
National Renewable Energy Laboratory

J. King and B. Kirby
Consultants

Senate Bill 350 Study

Volume VIII: Economic Impact Analysis

PREPARED FOR

California ISO

PREPARED BY

David Roland-Holst
Drew Behnke
Samuel Evans
Cecilia Han Springer
Sam Heft-Neal

July 8, 2016

BEAR

PACIFICORP
California ISO

Regional Coordination in the West: Benefits of PacifiCorp and California IS Integration

October 2015

Energy+Environmental Economics

U.S. DEPARTMENT OF ENERGY

Analysis of Benefits of Imbalance Market in the

NA Samaan, R Bayless, M Symonds, TB Nguyen, C Jin, D Wu, R Diao, YV Makarov, L Kannberg, T Guo, S Dennison-Leonard, M Goodenough
R Schellberg, S Conger, K Harris, M Rarity, S Wallace, J Austin, R Noteboom, T Van Blaricom, K McRunnel, J Apperson, M Empey, P Etingov
D Warady, R Brush, J Newkirk, P William, M Landau, H Owen, W Morter, K Haragu, J Portouw, K Downe, S Sorey

October 2013

NV Energy-ISO Energy Imbalance Ma Economic Assessment

March 25, 2014

Energy+Environmental Economics

ABB

Production Cost Savings Offered by Regional Transmission and a Regional Market in the Mountain West Transmission Group Footprint

PREPARED FOR

Basin Electric Power Cooperative
Black Hills Corporation
Colorado Springs Utilities
Platte River Power Authority
Public Service Company of Colorado
Tri-State Generation and Transmission Cooperative
Western Area Power Administration

PREPARED BY

Judy W. Chang
Johannes P. Pfeifenberger
John Tsoukalis

DECEMBER 1, 2014

THE Brattle GROUP

THE STATE-LED MARKET STUDY

ROADMAP *Market and Regulatory Review Report*

Prepared by:

Energy Strategies, Project Contractor

July 30, 2021

THE STATE-LED MARKET STUDY

ROADMAP *Technical Report*

Prepared by:

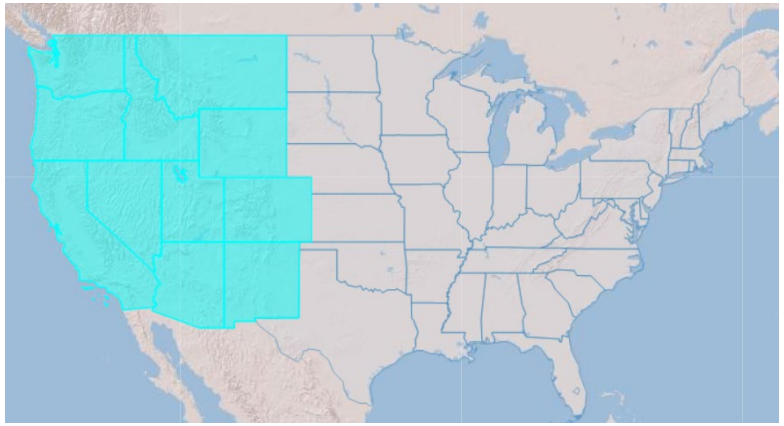
Energy Strategies, Project Contractor

July 30, 2021

State-Led Market Study made possible through DOE grant

- **The last several years have featured numerous discussions and initiatives related to the formation of coordinated wholesale trading markets in the West**
- **The Utah Governor's Office of Energy Development, in partnership with State Energy Offices of Idaho, Colorado, and Montana, applied for and received a grant from the US DOE to facilitate a 2+year state-led assessment of organized market options**
- **The project is called *Exploring Western Organized Market Configurations: A Western States' Study of Coordinated Market Options to Advance State Energy Policies***
  - ❖ Or "State-Led Market Study"
- **The project provides Western States with a neutral forum, and neutral analysis, to independently and jointly evaluate the options and impacts associated with new or more centralized wholesale energy markets and potential footprints**
- **Stakeholder meetings held throughout multi-year study process, with issuance of final reports on July 30, 2021**

State representatives from 11 Western States are participating in project



Lead Team

- **Representatives on Lead Team represent interest of their respective states but take all stakeholder input into consideration**
- **Work coordinated primarily through monthly calls**
- **Group made decisions by consensus**

State	Name	Organization
AZ Lead	Steve Olea	Arizona Corporation Commission
CA Lead	Grace Anderson	California Energy Commission
	Yulia Schmidt	California Public Utilities Commission
CO Lead	Erin O'Neill	Colorado Public Utilities Commission
	Keith Hay	Colorado State Energy Office
ID Lead	John Chatburn	Idaho Governor's Office of Energy and Mineral Resources
MT Lead	Jeff Blend	Montana Energy Office, Montana Department of Environmental Quality
	Ben Brouwer	Montana Energy Office, Montana Department of Environmental Quality
NM Lead	Erin Taylor	New Mexico Energy, Minerals and Natural Resources Department
	AnnaLinden Weller	New Mexico Energy, Minerals and Natural Resources Department
NV Lead	Hayley Williamson	Nevada Public Utilities Commission
	David Bobzien	Nevada State Energy Office
OR Lead	Kristen Sheeran	Oregon Energy and Climate Change Policy Advisory to Governor Kate Brown
	Letha Tawney	Oregon Public Utilities Commission
UT Lead	Chris Parker	Utah Department of Public Utilities
	Antonio Santos Aguilera	Utah Governor's Office of Energy Development
WA Lead	Steve Johnson	Washington Utilities and Transportation Commission
	Glenn Blackmon	Washington State Energy Office at the Department of Commerce
WY Lead		
	Bryce Freeman	Wyoming Office of Consumer Advocate

Agenda

1. Recap of study structure
2. Review of key technical results and findings
3. Market and Regulatory Scorecards

Recap of Study Structure

Background on Modeling Approach, Assumptions, and Questions

Study analyzed impacts of three "market constructs"

EIM/Real-Time Market

- ✓ Centrally optimized **real-time dispatch** – *Day-ahead unit commitment not optimized across market participants*
- ✓ **Individual** transmission tariffs
- ✓ Limited transmission **dedicated** to real-time market
- ✓ Balancing Authority Area (BAA) boundaries and associated reliability obligations **retained**
- ✓ Transmission providers **retain** operational control of transmission

Day-Ahead Market (DAM)

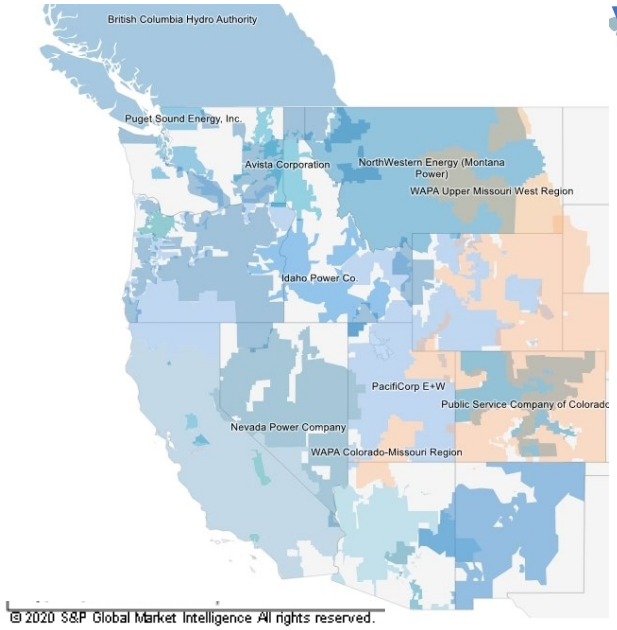
- ✓ Centrally optimized **real-time and day-ahead energy market**
- ✓ **Individual** transmission tariffs
- ✓ Limited transmission **dedicated** to market **at assumed rate** (other transactions must pay tariff rate for transmission)
- ✓ BAA boundaries and associated reliability obligations **retained**
- ✓ Transmission providers **retain** operational control of transmission

RTO

- ✓ Centrally optimized **real-time and day-ahead energy market**
- ✓ **Joint transmission tariff** for participants in a given footprint
- ✓ Transmission used **up to reliability limit**
- ✓ BAA boundaries and reliability obligations **consolidated**
- ✓ **Joint transmission planning** and cost allocation
- ✓ Transmission providers **transfer operational contro**l of transmission

Market Constructs + Footprints = “Market Configurations”

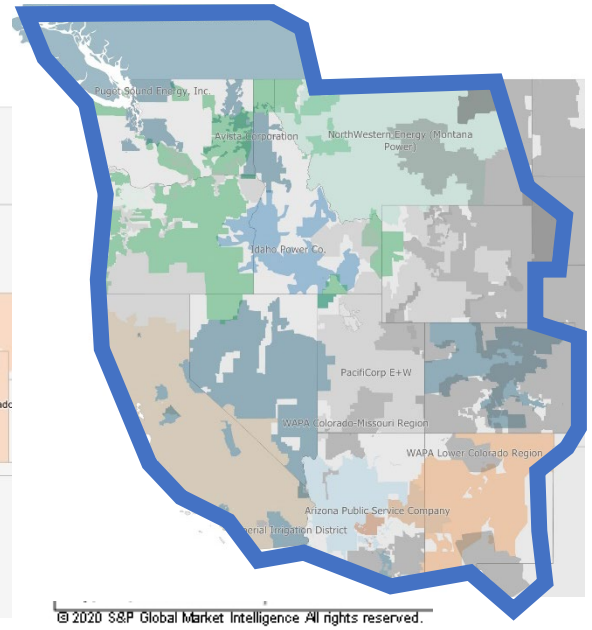
Status Quo



EIM entities that have announced intent to sign EIM Implementation Agreement (or equivalent)*

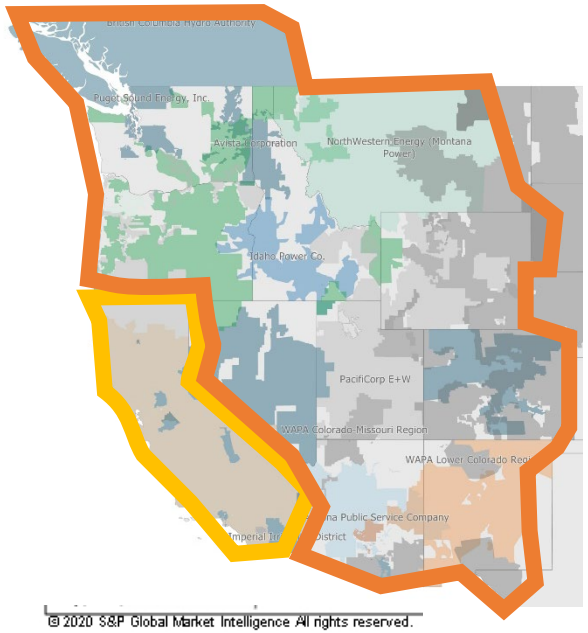
*Announcements that were made before the end of 2019 are included in the Status Quo footprint.

One Market



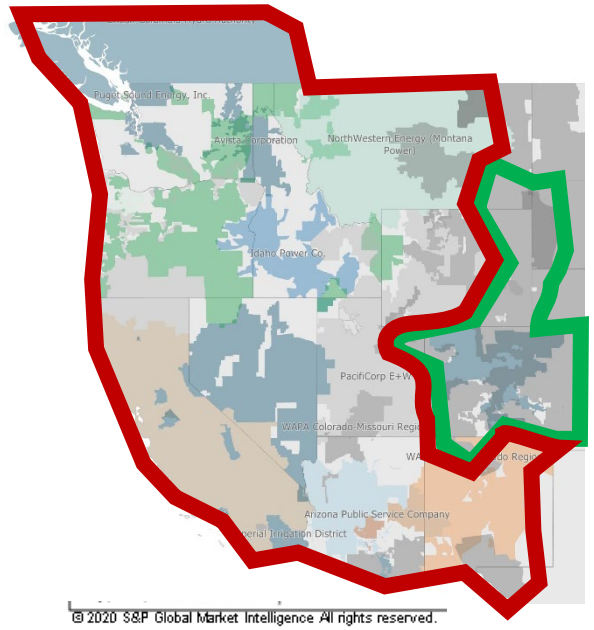
Studied in 2020 and 2030 timeframe

Two Market A



Only studied in 2030 timeframe

Two Market B



Only studied in 2030 timeframe

Summary of Market Modeling Assumptions

Assumption	Market Construct		
	EIM Markets	**Day-ahead Markets**	**RTO Markets**
Real-time intra-market trading costs	No cost for market transactions	$3/MWh for market transactions above EIM-levels (which are $0/MWh)	No cost for all transactions
Day-ahead intra-market trading costs	Tariff rate + $4	$3/MWh for market transactions	No cost for all transactions
Real-time trading costs for market exports and out-of-market transactions	Tariff rate + $2	Tariff rate + $2	Tariff rate + $2 (exports only)
Day-ahead trading costs for market exports and out-of-market transactions	Tariff rate + $4	Tariff rate + $4	Tariff rate + $4 (exports only)
Transmission available for market transactions	~15% of inter-area transfer capability for real-time transactions	~70% of inter-area transfer capability for day-ahead transactions, 15% for real-time	100% of inter-area transfer capability for day-ahead and real-time transactions
CAISO export limit	Real-time: 7000 MW Day-ahead: 2000 MW	Real-time: No limit Day-ahead: No limit, except for 2 Market A which has 7,000	Real-time: No limit Day-ahead: No limit, except for 2 Market A which has 7,000
Operating reserves	BA and reserve sharing group obligations retained		BAs consolidated and reserves held across market footprint
Flexibility reserves	BA-level constraint based on sub-hourly demand and wind/solar volatility and forecast error		BAs consolidated and reserves held across market footprint

Study considers limited set of market benefits and costs in state-level analysis

Market benefits and costs:

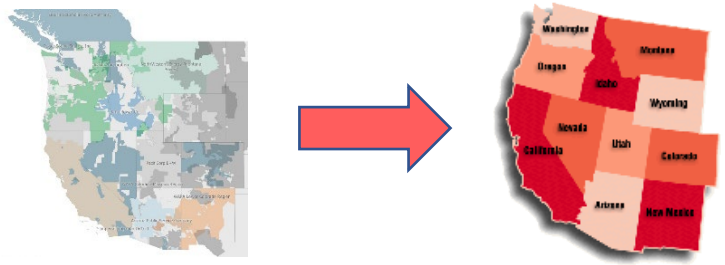
Estimated in study

- ✓ **Production cost savings, which capture:**
  - More efficient trade due to reduced transmission wheeling
  - Optimized unit commitment and dispatch
  - Reduced operating and flexibility reserves
  - Reduced curtailment
- ✓ **Capacity savings**
  - Reduced capital investment due to load diversity
- ✓ **Market start-up/administrative costs**

Not estimated in study

- × **Other market efficiencies: transparency, independence, transmission planning savings**
- × **Policy-driven resource procurement savings**
- × **Reliability benefits**
- × **Transmission cost allocation**
- × **Many unquantifiable factors**

Balancing area-level benefits/costs are estimated then allocated to each applicable state

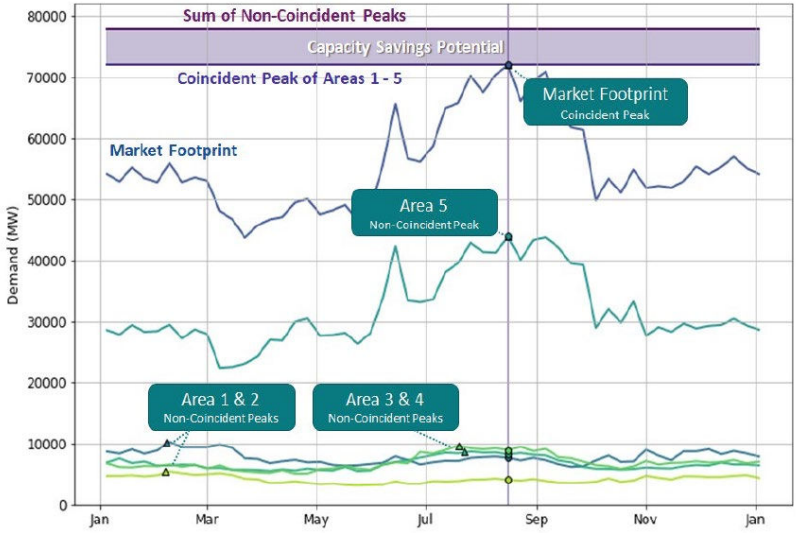


Other results incorporated into market analysis:

- ❖ Generation dispatch, by type and state (and WECC-wide)
- ❖ Congestion and utilization of transmission paths
- ❖ GHG emissions by state

Capacity benefits methodology includes a range of estimated achievable benefits for each market construct

- Assumes that in ***RTO scenarios, 100% of calculated load diversity benefits*** can be realized
- Assumes that ***day-ahead market*** scenarios result in realized ***savings of 0-50%*** of calculated load diversity benefit, recognizing:
- **Real-time only markets** are unlikely to results in significant capacity savings, therefore we assume they can achieve only **0-10% of load diversity benefits**



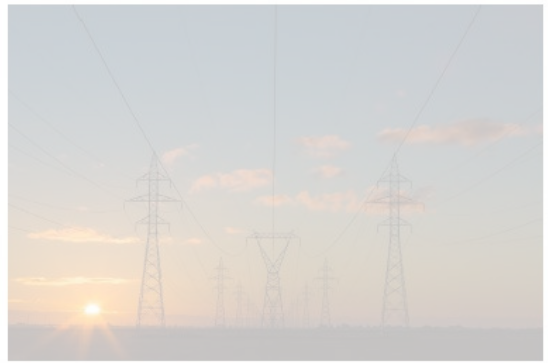
Achievable Benefits as a % of Calculated Load Diversity Savings

RTO	**100%**
Day-ahead	**0-50%**
Real-time	**0-10%**

Approach bounds range of capacity benefits provided by various markets such that stakeholders can draw their own conclusions about what level of benefits is most appropriate.

Key Study Results

THE STATE-LED MARKET STUDY



ROADMAP *Market and Regulatory Review Report*

Prepared by:
Energy Strategies, Project Contractor
July 30, 2021

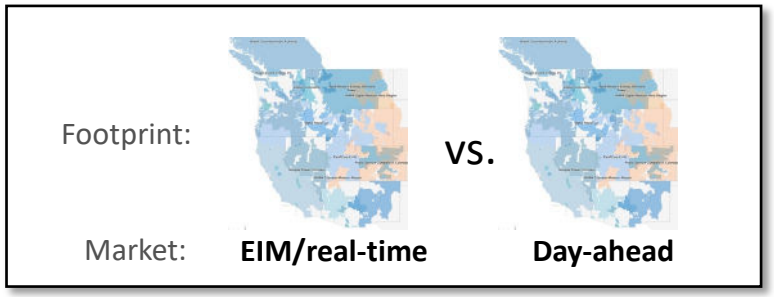
THE STATE-LED MARKET STUDY

ROADMAP *Technical Report*

Prepared by:
Energy Strategies, Project Contractor
July 30, 2021

Question #1: Assuming no change in market footprints from the Status Quo, what benefits are expected from adding day-ahead energy market services to the West's real-time markets?

Case Compare Key



- Expanding services to day-ahead results in approximately $47 million per year of operational savings and as much as $596 million per year in capacity savings, totaling over **$642 million** of annual gross benefits for the West
- System emissions and curtailments fall 0.3% and 6%, respectively, due to the day-ahead market construct
- After accounting for potential capacity benefits of the day-ahead market, **gross benefits for all states are positive**
  - Most states see minor (<1%) changes in operational costs due to the day-ahead market construct
- The incremental cost to implement the day-ahead market for the Status Quo footprint is estimated **between $76-226 million per year**, which is less than the annual gross benefits of $642 million estimated in this study

2030 Status Quo Day-ahead Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	($11)	$56	$45	
CA	$63	$91	$153	
CO	$3	$41	$44	
ID	$2	$44	$45	
MT	$1	$18	$19	
NM	$1	$32	$33	
NV	($13)	$25	$12	
OR	$1	$63	$64	
UT	$3	$28	$30	
WA	($4)	$189	$184	Estimated Ongoing Cost
WY	$2	$9	$10	
TOTAL	**$47**	**$596**	**$642**	$76-226

| Note: Only high-end capacity savings are shown |

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
Status Quo Day-ahead	$643		$47		$596	$77 - 226	194	2.71%

Slide revised on 7/28/21

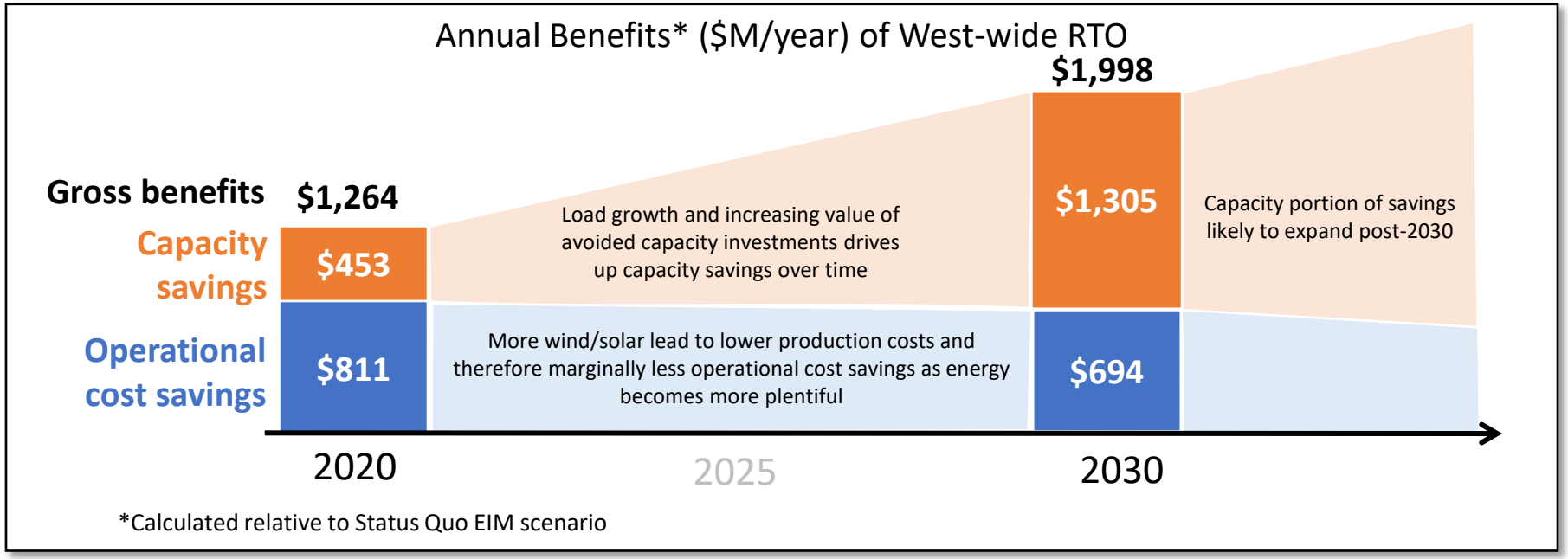
Question #4: What is the trajectory of benefits for a west-wide RTO?

- Results indicate that the gross benefits of a single-footprint RTO are forecasted to increase from $1.3 billion per year in 2020 to **$2 billion per year by 2030**.
  - This forecast of gross benefits exceeds estimated ongoing costs by $1.5 billion per year, or more, and all states are estimated to have positive gross benefits due to the RTO
- Capacity savings due to load diversity benefits **make up 65%** of RTO market benefits by 2030 (versus 35% in 2020)
- By contrast, operational savings are forecasted to **decrease** in the coming years as load is increasingly served by zero-marginal cost resources that offset fuel and operational expenses that make up dispatch savings
  - ❖ Less fuel burn and more efficient thermal dispatch in the BAU means relatively fewer operational savings can be realized due to RTO formation

2030 One Market RTO Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$59	$117	$176	
CA	$288	$190	$478	
CO	$62	$98	$160	
ID	($8)	$88	$80	
MT	$10	$36	$46	
NM	$43	$70	$113	
NV	($5)	$50	$45	
OR	$80	$127	$207	
UT	$43	$56	$99	
WA	$102	$449	$552	Estimated Ongoing Cost
WY	$19	$23	$43	
TOTAL	$694	$1,305	**$1,998**	$187-513

- The west-wide RTO scenario also caused a reduction in curtailments of 2.9 TWh, dropping system-wide curtailments from 2.9% to 1.6%
- The RTO scenario decreased CO_2 emissions by 3.2 million tons annually, a reduction of 2%
  - ❖ In 2020, the One Market RTO Scenario caused emission reductions of only 1.5 million tons, which suggests the environmental benefits of a west-wide RTO will increase over time



Summary of Findings

1. **New day-ahead markets could result in $642 million per year of savings if existing market footprints are retained and market services are expanded**
   - ❖ **Crucial that load diversity benefits** and associated capacity savings be achieved under the market's design
   - ❖ Regarding footprints, a **west-wide day-ahead** market results in $747 million of annual benefits, which is $247 million per year greater than a scenario in which California and the rest of the West operate in two parallel day-ahead markets.
2. **A west-wide RTO provides even greater savings, estimated by the study at ~$2 billion of gross benefits per year, which exceeds the high-end benefits of a west-wide day-ahead market by roughly $1.3 billion per year**
   - ❖ Results also demonstrate that **significant benefits are possible regardless if one or two RTO footprints materialize**.
   - ❖ However, a single-market system drives between $187-569 million greater savings than the two-market configurations of an RTO.
   - ❖ The technical portion of this study **does not consider a host of other benefits** that may be maximized by a consolidated RTO footprint (such as transmission planning, public policy resource access, etc.).
   - ❖ The RTO scenario with the lowest benefits considered in this study was the one in which California operated a single-state RTO and the rest of the West operated in parallel with a separate RTO. This scenario still produced $1.4 billion in annual gross benefits.

Summary of Findings (cont.)

3. **Results suggest that significant operational savings and capacity benefits occur even under scenarios in which two Western markets operate in parallel**
   - ❖ However, modeling of market-to-market seams present in these scenario may be optimistic as practical experience suggests that "unmodelable" interaction between markets could limit benefits realized by each market.
   - ❖ Additionally, this effort did not quantify other types of market benefits (e.g., public policy resource access) that may be maximized by a larger market footprint.
4. **The RTO framework led to meaningful reductions in curtailments and emissions**
   - ❖ Based on the 2020 and 2030 study results, the ability of new or expanded markets to help reduce system-wide emissions and better integrate renewables is growing.
5. **While modeling did indicate that RTO benefits are lower with a west-wide carbon price in place, the most substantial category of benefits – capacity savings – was not impacted and the RTO market configurations still produced significant savings on the order of $1.1 – 1.7 billion per year**
   - ❖ The west-wide carbon price had substantial impact on total carbon emissions, driving them down by 17-22%.

Summary of Findings (cont.)

5. New transmission capacity enhanced the performance and economic benefits of new and expanded energy markets

- In all cases, economic benefits increased by $81-107 million per year when a larger 2030 transmission buildout was assumed.
- Note that this study is not seeking to perform a transmission benefits analysis and did **not** assess other categories of benefits tha may be provided by transmission expansion.

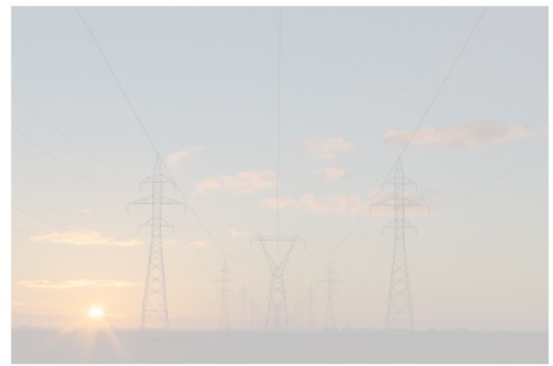
Market and Regulatory Review Scorecards

THE STATE-LED MARKET STUDY

ROADMAP *Market and Regulatory Review Report*

Prepared by:
Energy Strategies, Project Contractor
July 30, 2021

THE STATE-LED MARKET STUDY

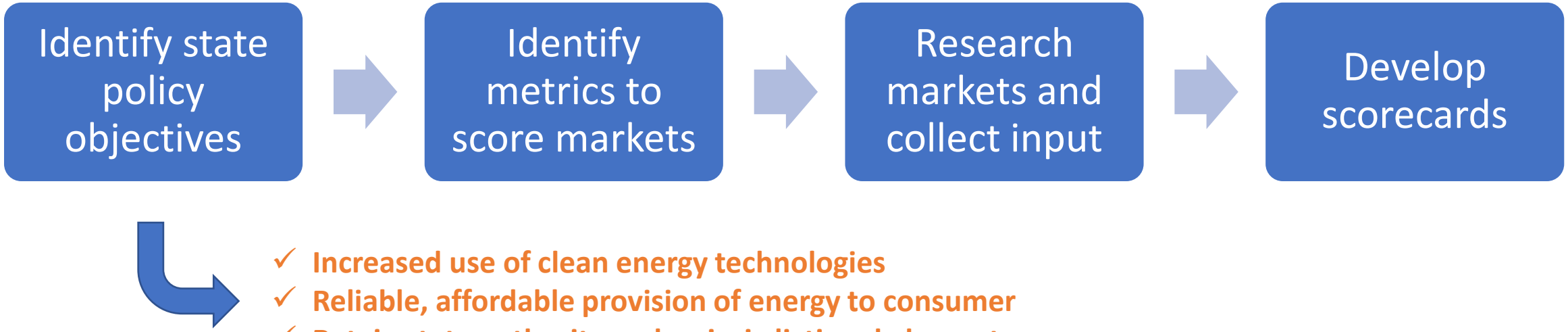


ROADMAP *Technical Report*

Prepared by:
Energy Strategies, Project Contractor
July 30, 2021

Overview of Market & Regulatory Review

- "Market & Regulatory Review" designed to address qualitative aspects of the Request from the Lead Team
  - ❖Evaluation of how ***different potential wholesale market structures*** might facilitate achievement of each ***state's energy policy objectives*** and how the market constructs may impact ***state jurisdiction*** in key area
  - ❖Complements technical study by focusing on qualitative factors



Key Assumptions & Caveats in Developing the Scorecards

- Scorecards capture ***relative differences*** between market structures and are indicative & directional
- ***Analysis required assumptions about what services would be included in each market and conclusions were based on those assumptions***
- In considering state authority, Scorecard focuses on impacts to utilities that are regulated by state utility commissions
- Impacts to "state authority" are not specific to an individual market or governance structure and had to consider the ***range of potential market structures that could exist***

Scorecard for Increased use of Clean Energy Technologies

Increased Use of Clean Energy Technologies	Bilateral	Real-Time	Day-Ahead	RTO
Efficient grid operation which allows low (and zero) marginal cost resources to be dispatched and reduces overall costs of integrating clean energy technologies	*Fair*	*Good*	*Very Good*	*Excellent*
Lower barriers to access new generation in high-quality renewable resource locations	*Poor*	*Poor*	*Good*	*Excellent*
Opportunities for clean electricity resources to be added to the grid (e.g. direct customer access to renewable/clean resource power purchase agreements)	*Good*	*Good*	*Very Good*	*Excellent*
Provides financing opportunities and a variety revenue stream opportunities for clean electricity technologies	*Fair*	*Good*	*Very Good*	*Excellent*
Economically facilitates emissions reduction goals/requirements via market signals	*Fair*	*Good*	*Very Good*	*Excellent*
Transparent and timely information on pricing, resource operations, and emissions	*Fair*	*Good*	*Very Good*	*Excellent*

Scorecard for Reliable, Affordable Provision of Energy to Consumers

Ability of Market Construct to Support Reliable, Affordable Provision of Energy to Consumers	Bilateral	Real-Time	Day-Ahead	RTO
Efficient grid operation which reduces costs and increases flexibility of transactions	*Fair*	*Good*	*Very Good*	*Excellent*
Ability to unlock full potential of existing generation (lowering costs) and to decrease generation capital costs/investments	*Poor*	*Fair*	*Good*	*Very Good*
Ability to unlock full potential of existing transmission system (lowering costs) and to decrease transmission capital costs/investments	*Fair*	*Good*	*Very Good*	*Excellent*
General ability to support reliable operations	*Good*	*Very Good*	*Very Good*	*Excellent*
Visibility into electric system conditions to improve reliability	*Fair*	*Good*	*Very Good*	*Excellent*
Transparent and timely information available to state PUCs, consumer advocates and other stakeholders	*Fair*	*Good*	*Very Good*	*Excellent*
Long-term mechanisms to support a system with adequate electric resources	*Fair*	*Good*	*Good*	*Very Good*
Increased opportunities for cost-effective demand-side resource participation	*Fair*	*Good*	*Very Good*	*Excellent*

Ability of Market Construct to Retain State Regulatory Authority on Key Jurisdictional Elements	Bilateral	Real-Time	Day-Ahead	RTO
Ability for state to retain authority over resource adequacy	Good – Excellent	Good – Excellent	Good – Very Good	Poor – Good
	As it exists today, the interconnected nature of the Western grid, including complexities around regulation of multi-state utilities, may limit the practical impact of state authority over resource adequacy. Market development, up to and including an RTO, can provide similar levels of "good" state authority, provided the market design includes best practices for informed engagement and authority of a Regional State Committee over resource adequacy matters. One individual state's ability to affect overall change on resource adequacy will depend on the market's governance, design and make-up.			
Ability for state to retain authority over the resource mix of utilities it regulates	Good – Excellent	Good – Excellent	Good – Excellent	Fair – Very Good
	As it exists today, the interconnected nature of the Western grid, including complexities around regulation of multi-state utilities and generation units with multiple owners, may serve as limitations on the practical authority states have over the resource mix of regulated utilities. Market development, up to and including an RTO, can provide similar levels of state authority over the resource mix, though market prices and market rules may impact resource mix decisions. The addition of market elements that are more likely to affect resource mix decisions (such as inclusion of a capacity market) can serve to reduce state's practical authority over the resource mix. States can improve their market experience by participating in market design and discouraging market elements that would serve to impact state's practical authority over the resource mix.			
Ability for state to retain authority over transmission planning and prudence/cost recovery for transmission investments	Good – Very Good	Good – Very Good	Good – Very Good	Fair – Good
	As it exists today, states have various roles in transmission planning (with FERC-jurisdictional utilities adhering to FERC transmission planning Orders such as Order 890 and 1000), but states generally retaining siting authority for transmission. FERC has jurisdiction over rates and services for electric transmission in interstate commerce, but most states continue to determine how transmission costs are (or are not) passed on into retail electric rates. Market development, up to and including an RTO, can provide similar levels of "good" state authority over transmission planning and cost allocation, provided the market includes best practices for informed engagement and authority of a Regional State Committee over transmission-related matters.			
Ability for state to retain authority over retail electric rates	Good – Excellent	Good – Very Good	Good – Very Good	Fair – Good
	The interconnected nature of the Western grid, including complexities around regulation of multi-state utilities, may serve as limitations on the practical authority a state has over retail electric rates, even when they have full legal authority over these matters. Market development should not change the legal authority of states over retail electric rates. Though as more inputs into the ratemaking process come from a market, a state's ability to challenge costs may be diminished in practice. Market constructs, up to an RTO, can provide strong state authority on retail electric rates. States can improve their market experience through strong engagement in the market processes and through careful consideration of any proposals to unbundle retail rates.			
Ability for states to be involved in the process of obtaining approval to participate in the market construct	Fair	Good – Very Good	Good – Very Good	Excellent
	State approval of market participation is almost certainly required for an RTO, while varying degrees of state approval may be necessary for other market constructs. States can utilize the approval process to place conditions on a decision to enter a market, which can help improve state retention of jurisdiction in the other metrics within this scorecard.			

Appendix

Supplemental Materials

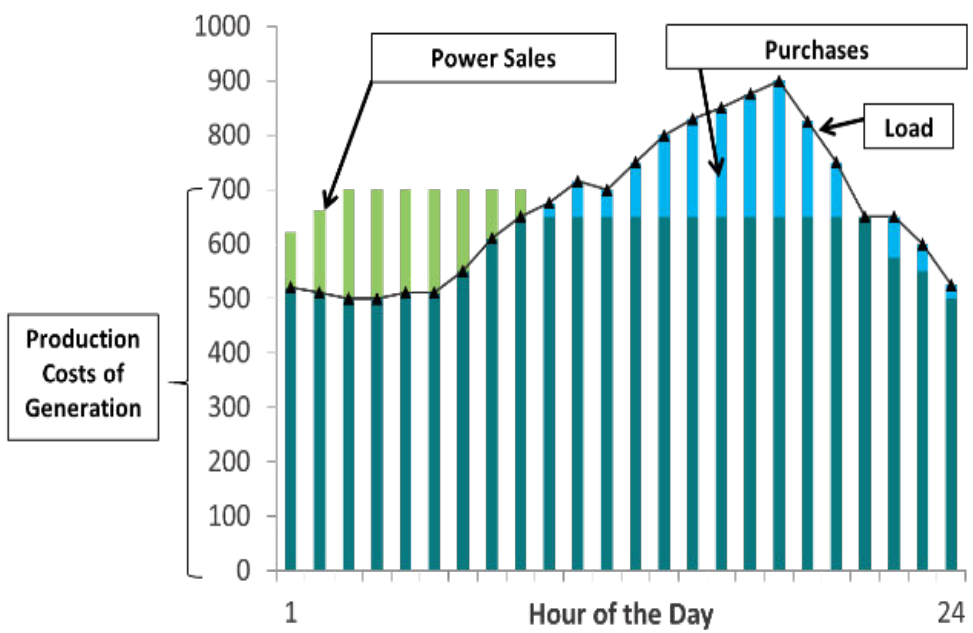
Core Questions

1. Assuming no change in market footprints from the Status Quo, what benefits are expected from adding day-ahead energy market services to the West's real-time markets?
2. Assuming a day-ahead market forms, how do the benefits of two market footprints compare with a single west-wide footprint?
3. How do the benefits of a west-wide RTO compare with a west-wide day-ahead market?
4. What is the trajectory of benefits for a west-wide RTO?
5. How are the benefits of an RTO impacted by market footprints?
6. How do market benefits change if more transmission is built?
7. How sensitive are RTO configurations to a Federal or West-wide carbon pricing regime?

Recap: Study uses Adjusted Production Cost as to Estimate Operational Savings

- **Adjusted production cost (APC) estimates the net costs for a given area to produce, buy, and sell power**
  - Calculated APC on a balancing authority basis and then allocated APC to each state on a load ratio share basis
- **Automatically corrects and internalizes economic benefit associated with opportunities to export (and increase revenues) or import (and avoid running local generation)**
- **Captures impacts to pricing**

APC Example



Production Costs of Generation — Fuel, Start-up costs, VOM

\+ Cost of Purchases

− Power Sales Revenues

= Adjusted Production Cost — Excludes carbon costs and emission import revenues

Market Configurations Studied in 2020 and 2030

Key

Benchmark

Study featured 16 unique market simulations across two study horizons

Study Year	Type	Market Scenario	Market Footprints			
			Status Quo	One Market	Two Market A (No CA Expansion)	Two Market B (Mountain West & CA Expansion)
2020	Core Studies	Real-time only	✓	✓		
		Day-ahead				
		RTO		✓		
2030		Real-time only	✓			
		Day-ahead	✓	✓	✓	
		RTO		✓	✓	✓
	Sensitivities	Real-time only (EIM)	A			
		Day-ahead				
		RTO		A & B	B	A & B

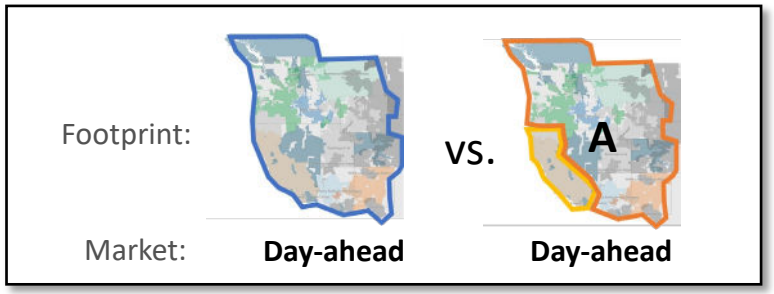
Sensitivity Key

A - Major Transmission Build
B - Carbon Price

Work plan was designed to address specific list of questions posed by Lead Team

Question #2: Assuming a day-ahead market forms, how do the benefits of two market footprints compare with a single west-wide footprint?

Case Compare Key



- For the day-ahead market construct, the single-footprint market had gross benefits of $247 million per year more than the two-footprint system
  - Note that there is no cost difference between these two systems since the entire region obtains day-ahead market services in both scenarios
- Most of incremental savings from the single-footprint market are due to the loss of load diversity caused by the the two-market footprint system
- All western states realize higher **gross benefits** in the one market day-ahead configuration
- Curtailments and emissions for the two day-ahead scenarios are similar

Difference in Annual Benefits: 2030 One Market Day-ahead - 2030 Two Market A Day-ahead

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)
AZ	($8)	$44	$36
CA	$23	$22	$45
CO	$1	$0	$1
ID	$2	$9	$11
MT	$1	$16	$18
NM	($4)	$31	$27
NV	($12)	$19	$7
OR	($1)	$25	$24
UT	($0)	$23	$23
WA	$7	$41	$48
WY	$0	$7	$7
TOTAL	$10	$237	**$247**

The table summarizes the *change in gross benefits and costs* of two day-ahead market scenarios – these are not gross benefits values for either scenario.

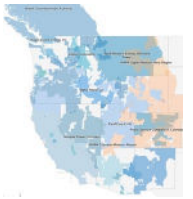
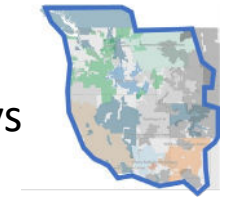
Estimated Ongoing Cost
$0

| Note: Only high-end capacity savings are shown |

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
One Market Day-ahead	$747		$95		$652	$85 - 254	193	2.62%
Two Market A Day-ahead	$501		$85		$416	$85 - 254	194	2.79%

Question #3: How do the benefits of a west-wide RTO compare with a west-wide day-ahead market?

Case Compare Key

Footprint:  VS 

Market: **EIM/real-time** **Day-ahead or RTO**

- The study estimates that a system-wide **RTO will produce 2-3x gross benefits** that what might be realized for a day-ahead market with the same footprint ($747 million per year vs. ~$2 billion per year of gross benefits)
  - The RTO is expected to be more expensive to implement, but these incremental costs appear to be made up by the added benefits (for both the high- and low-cost scenarios)
- Reductions in adjusted production cost account for 47% of the relative savings, while capacity benefits due to load diversity causes the remaining 53% of savings, which indicates **both value streams are key drivers of a west-wide RTO**
- An RTO relative to a day-ahead market also better reduces curtailment (43% vs. 9% reduction) and results in about 2.3 million short tons per year fewer CO_2 emissions

Difference in Annual Benefits: 2030 One Market RTO - 2030 One Market Day-ahead

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$71	$59	$130	
CA	$214	$95	$309	
CO	$35	$49	$84	
ID	($8)	$44	$35	
MT	$9	$18	$27	
NM	$40	$35	$75	
NV	$7	$25	$32	
OR	$78	$63	$141	
UT	$34	$28	$62	
WA	$105	$225	$330	Estimated Ongoing Cost
WY	$14	$12	$26	
TOTAL	$599	$652	**$1,251**	$102-259

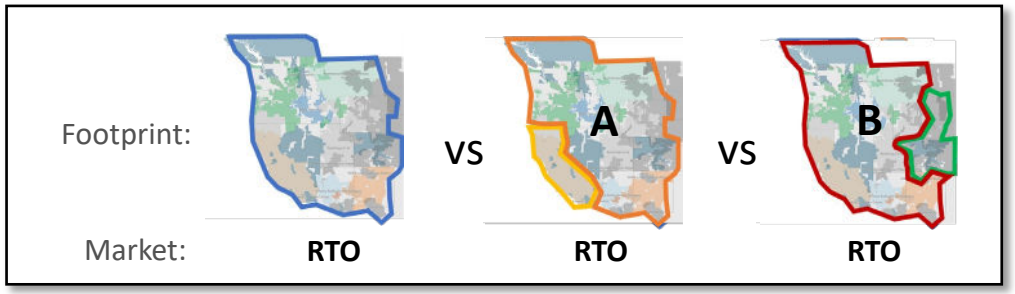
| Note: Only high-end capacity savings are shown |

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
One Market Day-ahead	$747		$95		$652	$85 - 254	193	2.62%
One Market RTO	$1,998		$694		$1,305	$187 - 513	191	1.63%

Slide revised on 7/28/21

Question #5: How are the benefits of an RTO impacted by market footprints?

Case Compare Key



- Gross benefits to the region are maximized if the West operates under a single RTO footprint
  - ❖ $2 billion in annual benefits for the west-wide RTO scenario exceeds benefits of two-market RTO systems by $569 million and $187 million for Two Market A and Two Market B footprints, respectively
  - ❖ Given the study's ongoing cost estimation methodology (which is agnostic on service provider and calculated on a $/MWh basis), additional benefits from the one market system do not have additional costs, as all three scenarios have the same load and, thus, same ongoing cost
- Of the two market footprints, Two Market B offers the most benefits ($381 million more than Two Market A)
  - ❖ This is primarily driven by load diversity benefits that are realized due to the broad geographic diversity of Two Market B
  - ❖ Two Market A breaks off diverse southwest loads, which costs the system diversity benefits and savings
- The three RTO cases were the best performing scenarios in terms of emissions and curtailments
  - ❖ The west-wide footprint was more effective at reducing CO2 emissions and integrating renewables

Difference in Annual Benefits: 2030 One Market RTO - 2030 Two Market A RTO

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$17	$87	$105	
CA	$119	$44	$163	
CO	($7)	$0	($7)	
ID	($8)	$17	$10	
MT	($1)	$33	$32	
NM	($1)	$61	$60	
NV	($33)	$38	$5	
OR	($3)	$50	$47	
UT	($2)	$47	$45	
WA	$14	$82	$96	Estimated Ongoing Cost
WY	($0)	$14	$14	
TOTAL	**$95**	**$473**	**$569**	$0

Difference in Annual Benefits: 2030 One Market RTO - 2030 Two Market B RTO

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$1	$0	$1	
CA	$16	$0	$16	
CO	$69	$82	$151	
ID	($2)	$0	($2)	
MT	$4	$0	$4	
NM	$1	$0	$1	
NV	$0	$0	$0	
OR	($0)	$0	($0)	
UT	$8	$0	$8	
WA	($1)	$0	($1)	Estimated Ongoing Cost
WY	$10	$0	$10	
TOTAL	**$105**	**$82**	**$187**	$0

Difference in Annual Benefits: 2030 Two Market B - 2030 Two Market A RTO

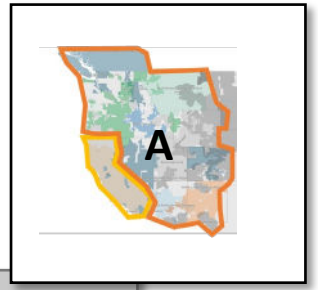
State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$16	$87	$104	
CA	$103	$44	$146	
CO	($75)	($82)	($157)	
ID	($5)	$17	$12	
MT	($5)	$33	$28	
NM	($2)	$61	$59	
NV	($33)	$38	$5	
OR	($3)	$50	$47	
UT	($10)	$47	$37	
WA	$15	$82	$97	Estimated Ongoing Cost
WY	($10)	$14	$4	
TOTAL	**($10)**	**$391**	**$381**	$0

Carbon Sensitivity: Background and Purpose

- **Core scenarios assumed that California was only state with carbon policy that requires emitting generators to procure allowances based on their emissions**
  - Allowance price of **$62/metric ton** (MT) in 2030 is modeled as carbon adder that impacts the marginal cost required to dispatch an emitting generator
- **Carbon sensitivity assumes that a federally mandated carbon price is implemented across the Western states**
  - Price assumed to be **$41/MT**, based on average 2030 carbon price sourced from a survey of 11 recent integrated resource plans
  - Price was applied to emitting generators in WECC and California, with adjustments to California generators to ensure that there was not a net reduction to the California carbon price (e.g., the higher $62/MT price is retained) – *see subsequent slide*
- **Intent of study is to <u>determine if RTO market benefits are impacted</u> by a federal carbon price**
  - Key case comparisons are as follows:

Core Studies		Sensitivity
One Market RTO Benefits	Vs.	One Market RTO ***w/ Carbon Price*** Benefits
Two Market A RTO Benefits	Vs.	Two Market A RTO **w/ *Carbon Price*** Benefits
Two Market B RTO Benefits	Vs.	Two Market B RTO ***w/ Carbon Price*** Benefits

Carbon Sensitivity Results



Core Studies: Two Market A RTO Benefits

Vs.

Sensitivity: Two Market A RTO **w/ *Carbon Price*** Benefits

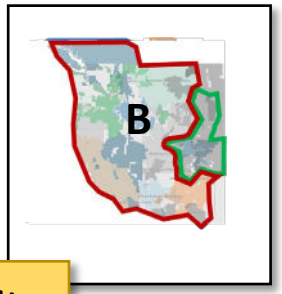
2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
Two Market A RTO	$1,430		$598		$831	$187 - 513	192	1.89%
Two Market A RTO *Carbon*	$1,163		$332		$831	$187 - 513	160	1.76%
	Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM						*Million short tons*	*% RE generation*

- **Adding a $41/MT carbon price to the west reduced the estimated benefits for an RTO with the Two Market A footprint**
  - ❖ Significant impacts observed at state-level
- **Adjusted production cost savings *decreased* by $266 million (relative to a Two Market A RTO without a west-wide carbon price) while capacity savings were unchanged**
  - ❖ Note that carbon costs are excluded from the calculation of APC
- **The carbon price reduced emission by roughly 32 million tons, a reduction of 17%**
  - ❖ The emission reduction is primarily driven by shifting generation dispatch away from high emitting resources (due to their increasing marginal cost of energy caused by the carbon price)

2030 Two Market A RTO Carbon vs. No Carbon Cost Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$109	$0	$109	
CA	$121	$0	$121	
CO	($132)	$0	($132)	
ID	($194)	$0	($194)	
MT	($139)	$0	($139)	
NM	($26)	$0	($26)	
NV	$138	$0	$138	
OR	$80	$0	$80	
UT	($66)	$0	($66)	
WA	($74)	$0	($74)	Estimated Ongoing Cost
WY	($82)	$0	($82)	
TOTAL	($266)	$0	**($266)**	0

Carbon Sensitivity Results



Core Studies

Two Market B RTO Benefits

Vs.

Sensitivity

Two Market B RTO ***w/ Carbon Price*** Benefits

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
Two Market B RTO	$1,811		$589		$1,223	$187 - 513	191	1.65%
Two Market B RTO *Carbon*	$1,706		$484		$1,223	$187 - 513	161	1.45%

Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM | *Million short tons* | *% RE generation*

- **Adding a $41/MT carbon price to the west reduced the estimated benefits for an RTO with the Two Market B footprint**
  - ❖ Significant impacts observed at state-level
- **Adjusted production cost savings *decreased* by $105 million relative to a Two Market B RTO without a west-wide carbon cost, while capacity savings were unchanged**
  - ❖ Note that carbon costs are excluded from the calculation of APC
- **The carbon price reduced emission by roughly 40 million tons, a reduction of 21%**
  - ❖ The emission reduction is primarily driven by shifting generation dispatch away from high emitting resources (due to their increasing marginal cost of energy caused by the carbon price)

2030 Two Market B RTO Carbon vs. No Carbon Cost Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$40	$0	$40	
CA	$172	$0	$172	
CO	($55)	$0	($55)	
ID	($181)	$0	($181)	
MT	($138)	$0	($138)	
NM	($28)	$0	($28)	
NV	$201	$0	$201	
OR	$62	$0	$62	
UT	($39)	$0	($39)	
WA	($69)	$0	($69)	Estimated Ongoing Cost
WY	($69)	$0	($69)	
TOTAL	($105)	$0	**($105)**	0

Transmission Sensitivity Results

Core Studies

Status Quo Real-time Benefits

Vs.

Sensitivity

Status Quo *w/ transmission* Benefits

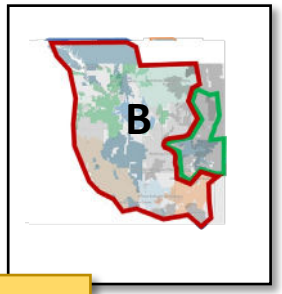
2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
Status Quo Real-time/EIM *Transmission*	$107		$107		$0	$0 - 0	193	2.47%
	Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM						*Million short tons*	*% RE generation*

- **A larger transmission buildout by 2030 helps improve the operational efficiency of the Status Quo real-time market scenario**
- **Adjusted production cost savings *increased* by $113 million while capacity savings were not quantified for Status Quo EIM scenario as this was the reference case**
  - ❖ Note that capacity savings were unchanged because we conservatively assumed the transmission overlay did not impact inter-area transfer capability
- **The transmission buildout also led to fewer emissions and curtailments**
- **Additional transmission caused most state's adjusted production cost to decline by ~0-4%**

2030 Status Quo EIM Transmission Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	($5)	$0	($5)	
CA	$8	$0	$8	
CO	$4	$0	$4	
ID	$18	$0	$18	
MT	$8	$0	$8	
NM	$2	$0	$2	
NV	$11	$0	$11	
OR	$10	$0	$10	
UT	$9	$0	$9	
WA	$38	$0	$38	Estimated Ongoing Cost
WY	$4	$0	$4	
TOTAL	**$107**	**$0**	**$107**	0

Transmission Sensitivity Results



Core Studies

Two Market B RTO Benefits

Vs.

Sensitivity

Two Market B ***w/ transmission*** Benefits

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
Two Market B RTO	$1,811		$589		$1,223	$187 - 513	191	1.65%
Two Market B RTO *Transmission*	$1,892		$670		$1,223	$187 - 513	190	1.43%

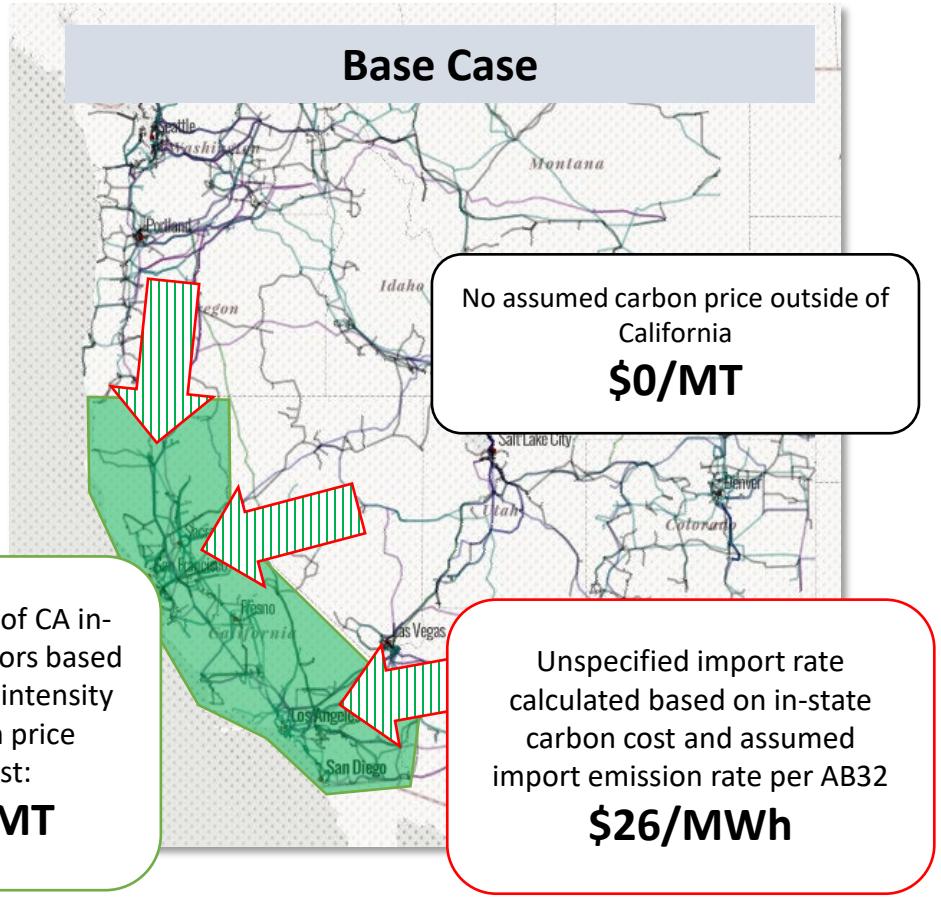
Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM | *Million short tons* | *% RE generation*

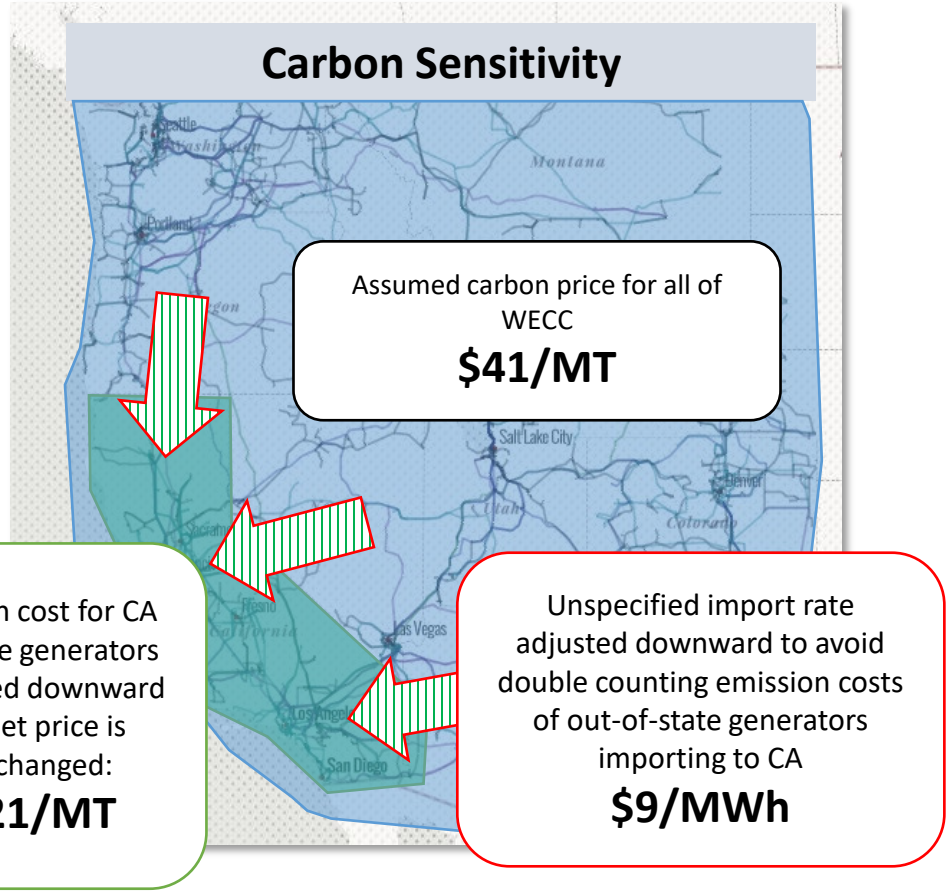
- **A larger transmission buildout by 2030 helps improve the operational efficiency of the Two Market B RTO scenario by $81 million per year**
  - ❖ Note that capacity savings were unchanged because we conservatively assumed the transmission overlay did not impact inter-area transfer capability
- **The transmission buildout reduced curtailment but didn't lead to a material change in carbon emissions**
- **Most states had APC reductions in the 0-2% range from adding transmission to the Two Market B RTO market construct, although there were some with larger savings due to the additional transmission (Washington and Montana)**

2030 Two Market B RTO Transmission vs. No Transmission Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	($7)	$0	($7)	
CA	($0)	$0	($0)	
CO	$8	$0	$8	
ID	$11	$0	$11	
MT	$8	$0	$8	
NM	($1)	$0	($1)	
NV	$5	$0	$5	
OR	$6	$0	$6	
UT	$6	$0	$6	
WA	$42	$0	$42	Estimated Ongoing Cost
WY	$5	$0	$5	
TOTAL	$81	$0	**$81**	$0

Carbon Sensitivity: Study Assumption





CA in-state/specified resources:	**$62/MT**	$21/MT + $41/MT = **$62/MT**
CA imports:	**$62/MT** ($26/MWh)	$21/MT ($9/MWh) + $41/MT = **$62/MT**
WECC system adder:	**$0/MT**	**$41/MT**

Carbon Sensitivity Results

Core Studies

One Market RTO Benefits

Vs.

Sensitivity

One Market RTO ***w/ Carbon Price*** Benefits

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
One Market RTO	$1,998		$694		$1,305	$187 - 513	191	1.63%
One Market RTO *Carbon*	$1,793		$489		$1,305	$187 - 513	159	1.47%

Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM | *Million short tons* | *% RE generation*

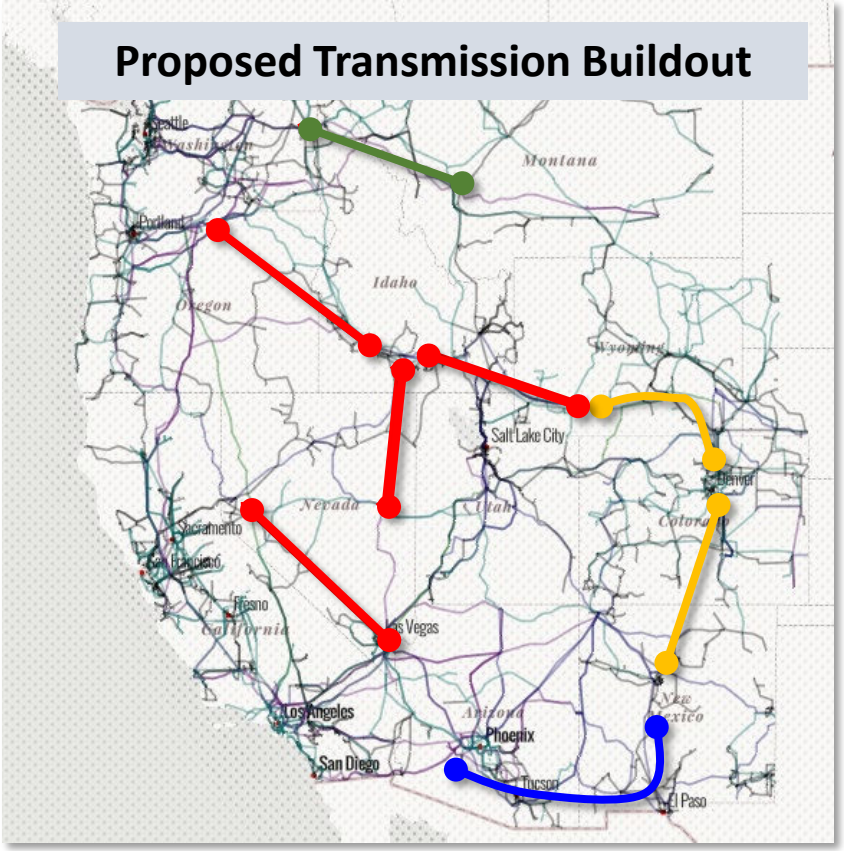
- **Adding a $41/MT carbon price to the west did not materially impact the estimated benefits of a west-wide RTO (One Market RTO)**
  - ❖ It did impact how benefits were estimated among states, however
- **Adjusted production cost savings *decreased* by $205 million (relative to a One Market RTO without a west-wide carbon price) while capacity savings were unchanged**
  - ❖ Note that carbon costs are excluded from the calculation of APC
  - ❖ Fewer dispatched savings can be achieved when supply curve is flattened due to the carbon price
- **The carbon price reduced emission by roughly 42 million tons – a reduction of 22%**
  - ❖ The emission reduction is primarily driven by shifting generation dispatch away from coal to gas, which have lower emission rates

2030 One Market RTO Carbon vs. No Carbon Cost Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	$48	$0	$48	
CA	$201	$0	$201	
CO	($152)	$0	($152)	
ID	($191)	$0	($191)	
MT	($142)	$0	($142)	
NM	($30)	$0	($30)	
NV	$223	$0	$223	
OR	$62	$0	$62	
UT	($56)	$0	($56)	
WA	($83)	$0	($83)	Estimated Ongoing Cost
WY	($84)	$0	($84)	
TOTAL	($205)	$0	**($205)**	0

Transmission Sensitivity: Purpose and Assumptions

- **Designed to investigate how market benefits change if major transmission upgrades, beyond what is included in the core studies, are placed into service before 2030**
  - ❖ Small changes to system topology likely won't impact study results, so study assumes a relatively large inter-state buildout that could occur in 2030 or beyond
- **The following buildout was added to Status Quo Real-time, One Market RTO, and Two Market B RTO studies:**



- Buildout features:
  - **Additional transmission capacity between Intermountain/PNW and Southwest markets**
  - **New interties to integrate Colorado into rest of WECC system**
  - **Transmission to connect New Mexico to DSW markets**
  - **Upgrades to Montana export path**
- While buildout is inspired by actual projects under development, it is not intended represent a comprehensive "plan" or preference for a given project or set of projects
- Core cases already include the following: Gateway South and Gateway West D.2, Ten West Link, various projects under construction
- **Key case comparisons are as follows:**

Core Studies		Sensitivity
Status Quo Real-time Benefits	Vs.	Status Quo Real-time ***w/ transmission*** Benefits
One Market RTO Benefits	Vs.	One Market RTO ***w/ transmission*** Benefits
Two Market B RTO Benefits	Vs.	Two Market B RTO ***w/ transmission*** Benefits

Transmission Sensitivity Results

Core Studies: One Market RTO Benefits

Vs.

Sensitivity: One Market RTO ***w/ transmission*** Benefits

2030 Scenarios (Footprint + Market Construct)	Total Benefits	=	APC Savings	+	Capacity Savings	Admin Cost Range	Carbon Emissions	Curtailments
Status Quo Real-time/EIM	$0		$0		$0	$0 - 0	194	2.87%
One Market RTO	$1,998		$694		$1,305	$187 - 513	191	1.63%
One Market RTO *Transmission*	$2,089		$784		$1,305	$187 - 513	190	1.39%
	Values are in $2020 and million/year and are calculated relative to Status Quo Real-time/EIM						*Million short tons*	*% RE generation*

- **A larger transmission buildout by 2030 helps improve the operational efficiency of a future west-wide RTO by about $90 million per year**
  - ❖ Note that capacity savings were unchanged because we conservatively assumed the transmission overlay did not impact inter-area transfer capability
- **The transmission buildout reduced curtailment but didn't lead to a material change in carbon emissions**
- **Most states had APC reductions in the 0-1% range from adding transmission to the One Market RTO market construct, although there were some with larger savings due to the additional transmission (Washington and Montana)**

2030 One Market RTO Transmission vs. No Transmission Annual Benefits

State	APC Benefit ($M)	Capacity Benefit ($M)	Total Benefit ($M)	
AZ	($9)	$0	($9)	
CA	$0	$0	$0	
CO	$5	$0	$5	
ID	$11	$0	$11	
MT	$10	$0	$10	
NM	($2)	$0	($2)	
NV	$7	$0	$7	
OR	$8	$0	$8	
UT	$6	$0	$6	
WA	$51	$0	$51	Estimated Ongoing Cost
WY	$3	$0	$3	
TOTAL	$90	$0	**$90**	$0

Assumptions of Key Attributes for Representative Market Constructs

Organized Market Type	Bilateral Market	Real-Time Market	Day-Ahead Market	RTO
Centrally optimized dispatch	No central optimization of electricity trades	Centrally optimized real-time dispatch; day-ahead unit commitment not optimized across participants	Centrally optimized real-time dispatch and day-ahead unit commitment	
Transmission tariffs	Individual transmission tariffs			Joint transmission tariff for participants in a given footprint
Transmission dedicated to market	Transmission rights required for all bilateral sales/purchases	Limited transmission dedicated to the market (other transactions must explicitly pay for transmission)		Transmission used up to reliability limit
Transmission Planning	Local transmission planning remains with individual transmission providers; regional planning and interregional coordination under Order 1000 remain as they are today			Joint transmission planning by RTO for full footprint for reliability, economic and public policy purposes; some lower voltage transmission planning remains at the local level (as is typical in RTOs)
Operational/Functional Control of Transmission	Remains with individual transmission providers			RTO has operational/functional control of transmission
Reliability Obligations and Balancing Authority Boundaries	As they are today			RTO has primary reliability obligations; BAs are consolidated

Assumptions of Key Attributes for Representative Market Constructs

Organized Market Type	Bilateral Market	Real-Time Market	Day-Ahead Market	RTO
Ancillary-Service Co-Optimization	No ancillary service co-optimization	Can, but does not have to, include ancillary service co-optimization and provision		Includes ancillary service co-optimization and provision in the market
Resource Adequacy Implications	Addressed by individual regulators; no market requirement	Market addresses intra-hour resource sufficiency, but does not impact long-term resource adequacy planning and processes	Market addresses day-ahead resource sufficiency, but does not impact long-term resource adequacy planning and processes	Market will include its own longer-term resource adequacy requirements that must be achieved (states may have more stringent requirements, though states' exact roles will depend on the governance structure)
Transparent Access to Market & Operational Information	Very little access to information, what is available is generally aggregated	Transparent access to pricing information for real-time transactions and transmission in the market	Transparent access to pricing information for day-ahead and real-time transactions and transmission in the market	Transparent access to pricing information for day-ahead and real-time transactions and transmission in the market
Ability for Large Commercial/Industrial Consumers to Enter into Power Agreements with Preferred Resource Types (outside of a utility green tariff program)	Unlikely (inability for resource to easily sell its output in a bilateral market)	Unlikely (resource can only easily sell its output in the real-time market)	Possible (resource can easily sell its output in the day-time market and trading hubs likely to be established)	Highly likely (resources can easily sell output to the RTO as we have seen in SPP, MISO, etc.)
Retail Choice	No change to existing retail choice programs and traditional, vertically-integrated utility service provision is assumed under these market structures (as retail choice is a separate policy consideration from market constructs)			

Market Factor Scorecard Approach & Ranking Metrics

- **Purpose of scorecards is to assess how regional market construct can support state policy priorities**
- Work Plan identified two overarching state energy policy priorities (which are not mutually exclusive, but each state may weight these priorities differently)
  - ❖ Increased Use of Clean Energy Technologies
  - ❖ Reliable, Affordable Provision of Energy to Consumers
- Scorecard for "Retaining State Authority on Key Jurisdictional Elements" added following stakeholder input
  - ❖ Metrics created from work that was identified in the Work Plan but was not envisioned as fitting under the Scorecard approach
- Work Plan outlined relevant metrics for each overarching policy goal (which have since been slightly reorganized/modified)
- Market constructs evaluated:
  - ❖ Bilateral Only
  - ❖ Real-Time Market
  - ❖ Day-Ahead Market
  - ❖ Regional Transmission Organization

Metrics for the Market Factor Scorecards

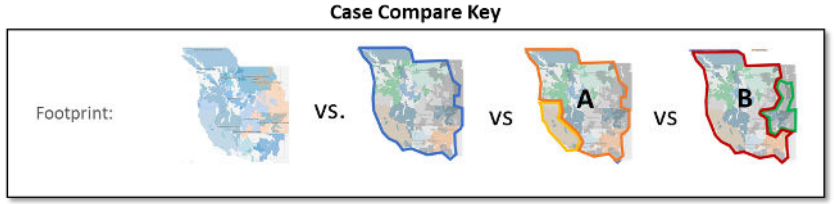
Icon	Meaning
Excellent 	Market construct is expected to substantially support achievement of this metric
Very Good 	Market construct is expected to mostly support achievement of this metric
Good 	Market construct is expected to somewhat support achievement of this metric
Fair 	Market construct is expected to minimally support achievement of this metric
Poor 	Market construct is not expected to support achievement of this metric

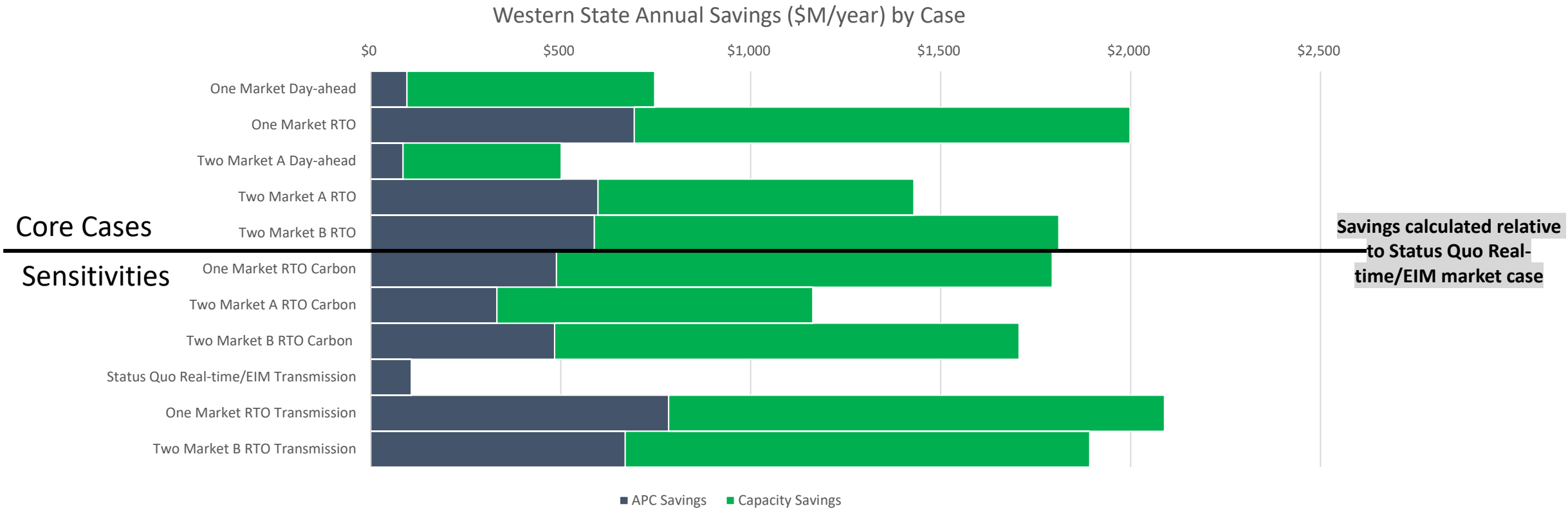
Retain State Authority on Key Jurisdictional Elements Scorecard

- This scorecard includes ***ranges of rankings*** to reflect the different potential market designs and governance structures that may exist (as a specific market proposal was not being evaluated)
  - ❖Scorecard also includes language to help highlight the nuance around these rankings
- The Market & Regulatory Review report includes a section on "special considerations" and "best practices" for retaining state authority
  - ❖Section addresses ways in which states can improve their RTO experience, which would likely, in turn, facilitate an RTO ranking on the high end of the range presented in the scorecard

- The Lead Team notes, in particular for the RTO market construct, that States may improve their RTO/ISO experience (helping achieve the higher end of these rankings) through:
  - ❖Careful State PUC consideration of conditions of approval of requests by jurisdictional utilities to join an ISO/RTO;
  - ❖Comprehensive review of the impacts of proposals to unbundle State PUC regulated rates; and
  - ❖Informed engagement by a State Commission in the planning, decisions and governance of an ISO/RTO (including participation in a "Regional State Committee")

Annual Savings of Western States due to Market Expansion – High-end Capacity Savings

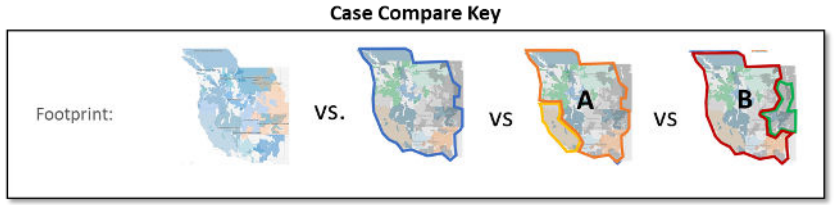


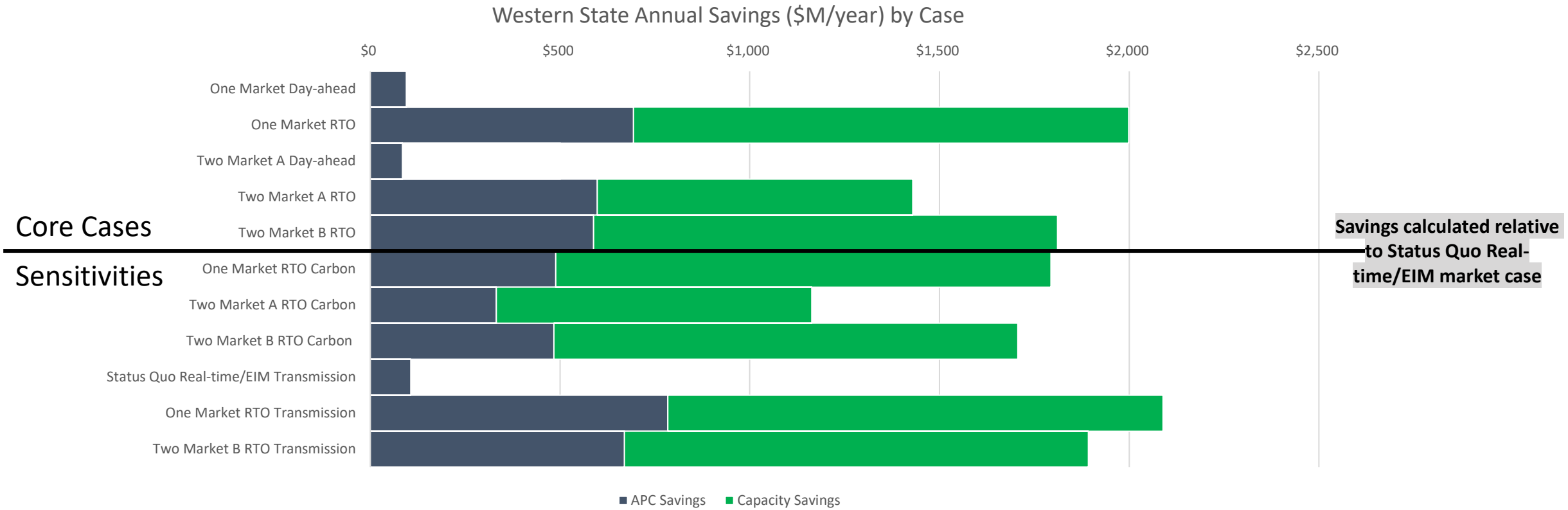


- **Capacity benefits in the form of avoided generation investment dominate savings for all scenarios**
- **RTO scenarios consistently achieve the highest level of savings**

Slide revised on 7/28/21

Annual Savings of Western States due to Market Expansion – Low-end Capacity Savings

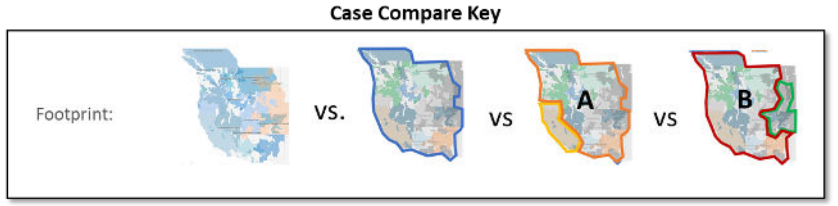


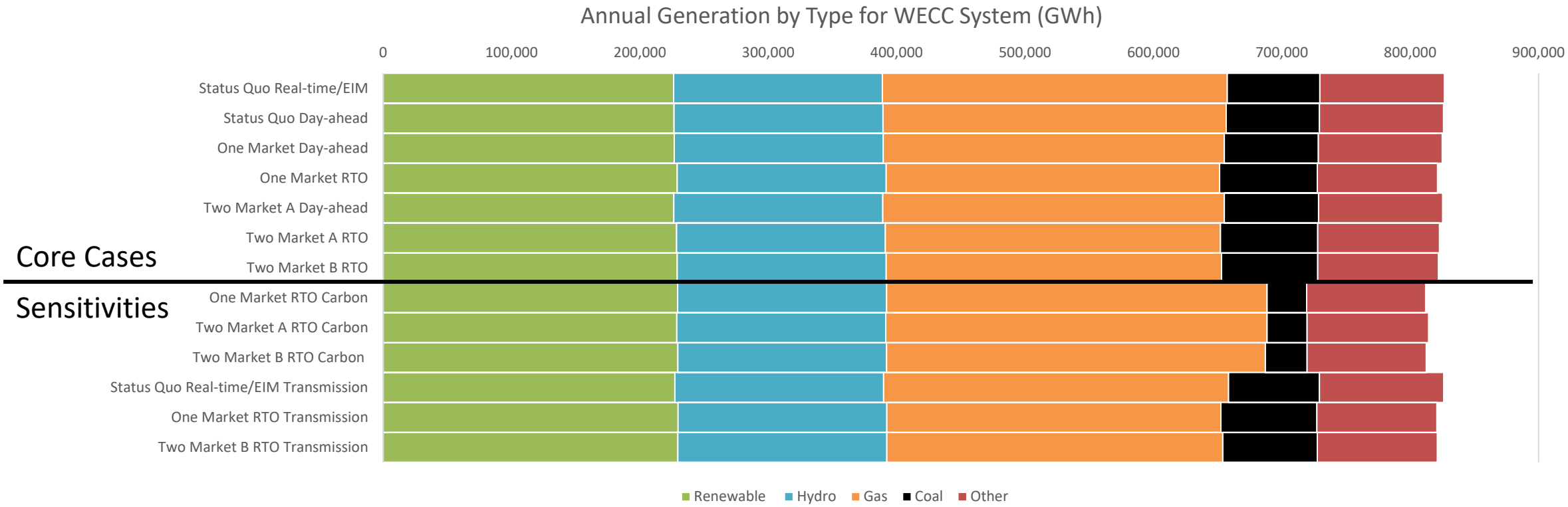


- **Low-end capacity savings for EIM and day-ahead market scenarios assume that no capacity benefits are realized because of these markets**
- **RTO capacity savings are unchanged even in this low-end scenario as it is assumed that there is very little risk that an RTO market not achieve substantial capacity benefits**
- **This causes the RTO scenarios to produce measurably higher benefits than all other scenarios**

Slide revised on 7/28/21

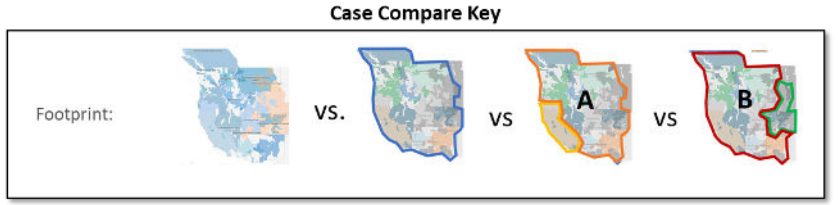
WECC Annual Generation for 2030 Core Cases and Sensitivities

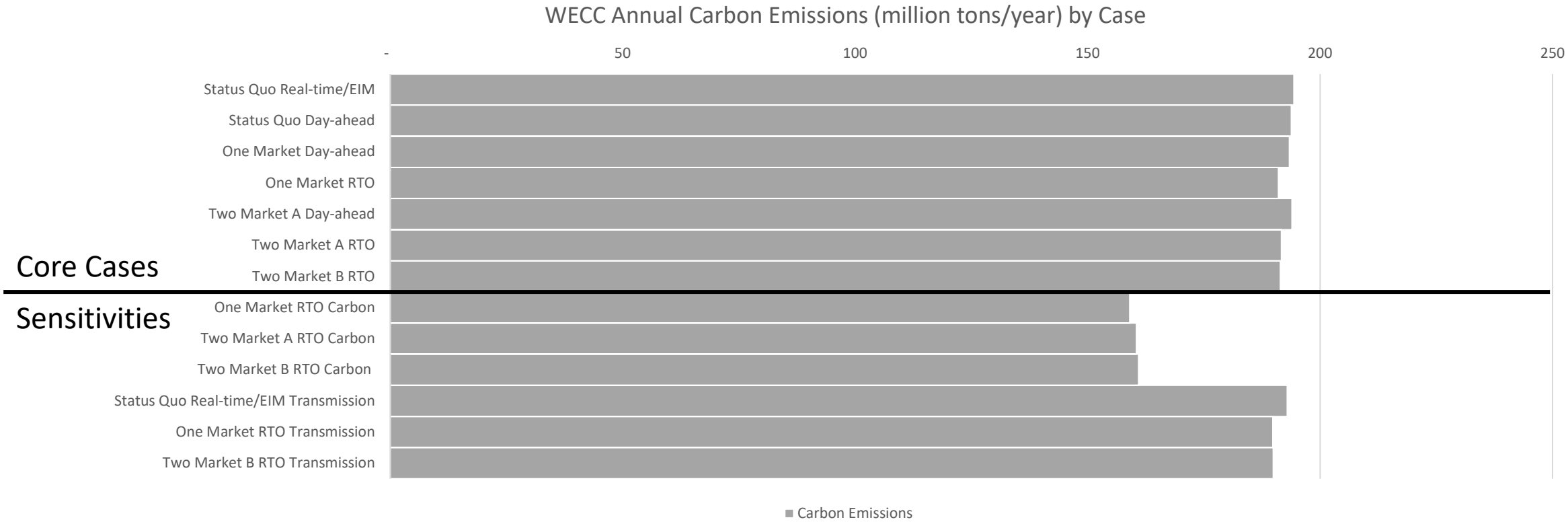




- **Relatively small changes in annual energy production by types due to regionalization**
- **Changes in total generation are due to different amounts of transmission losses occurring on the system, requiring more or less generation to serve load**
- **The carbon price sensitivity causes gas generation to displace coal generation**

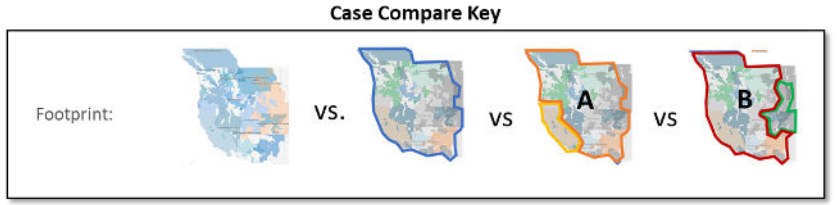
WECC CO_2 Emissions for 2030 Core Cases and Sensitivities

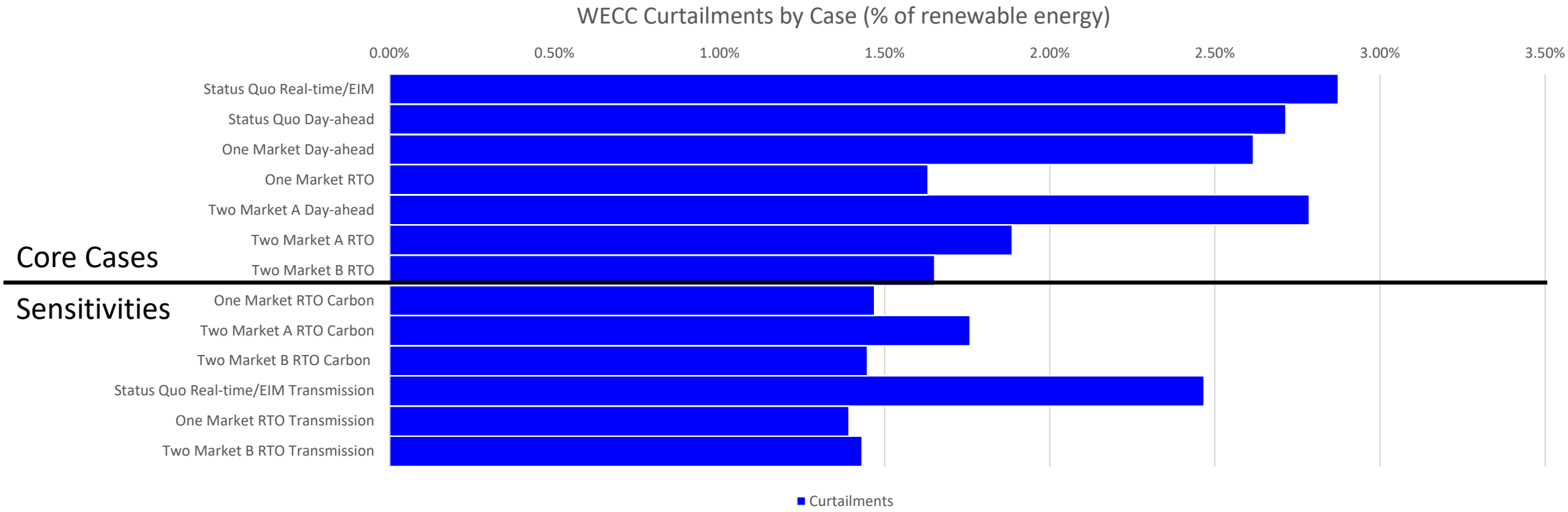




- **The carbon sensitivities are the only scenarios with noticeably lower carbon emissions**
- **The dispatch efficiencies enabled by the RTO scenarios also helped to reduce carbon emissions from the Status Quo, which had the highest emissions of all scenarios**

WECC Curtailments 2030 Core Cases and Sensitivities





- **The RTO transmission sensitivities have the lowest curtailment levels of all scenarios**
- **The carbon sensitivities also had lower curtailment levels and the core cases**

Additional Observations

- **The regional economic case for new/expanded markets is supported by the technical findings of the study:** At the regional level, there were not any market configurations in which the high-end ongoing incremental cost estimates to operate these markets eclipsed the high-end gross benefits estimated in this study.
- **Bigger is still better:** Gross benefits results support the perspective that bigger (in footprint) and more comprehensive (in services) markets are best suited to maximize benefits for the most Western states.
- **Alternative types of regional coordination could help achieve capacity benefits estimated in the study:** Material capacity savings could be achieved under even the most limited market frameworks so long as the proper capacity sharing and operational programs are in place.
- **Energy-rich future:** Given the rapidly evolving resource mix in the West, the study suggests that over time operational/dispatch savings from new regional markets is likely to decrease relative to present-day savings. However, integration benefits, reliability benefits, capacity savings from resource and load diversity, among a host of other benefit drives will replace and likely exceed any lost energy benefits caused by an evolving resource mix.
- **State-level metrics:** Observed reductions in regional production costs across all market footprints and constructs suggests that new and expanded markets generally lead to more efficient operations and use of the transmission system.
  - However, at the state-level, the APC metric, which takes into account power prices, purchases/sales and net long/short positions, is complicated to calculate and indicates that not all states may realize operational savings. Further, utilities may implement hedging or other trading strategies to minimize potential downsides, and these actions cannot be captured in the study.
  - Ultimately, targeted BA- or state-by-state studies of actual market proposals – versus the genericized options considered herein – are the best tool to determine if the benefits of new markets are likely to exceed their cost.