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Essential Role of Markets

Western Electricity System Integration Workshop

December 2, 2022

Prepared for:

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Principal
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Contents

ENERGY STRATEGIES

Energy Market Services: A *Generic* Reference Sheet

Market Service	Bilateral Market	Real-Time Market	Day-Ahead Market	RTO
Centrally optimized dispatch	No central optimization	Centrally optimized real-time dispatch; day-ahead unit commitment not optimized	Centrally optimized real-time dispatch and day-ahead unit commitment/dispatch	
Transmission wheeling	Fee applies to all transactions	No fee for in-market real-time transactions	No or nominal fee for in-market real-time and day-ahead transactions	No wheeling fees (except for exports)
Transmission available to market	Transmission rights required for all transfers	Can vary widely depending on market design – some or all capacity could be available		Transmission capacity available up to reliability limit
Transmission planning	Local planning by individual transmission providers; regional planning and interregional coordination under Order 1000 remain as they are today			Joint transmission planning by RTO; some lower voltage transmission planning remains at the local level
Tariffs and Operational Control of Transmission	Individual transmission providers retain control and have tariffs			RTO provides functional control of system, joint tariff
Reliability Obligations and Balancing Authority Boundaries	BAs are retained, have primary reliability obligations			RTO has primary reliability obligations; BAs consolidated
Ancillary Services and Co-Optimization	No optimization, reserve sharing groups	Can have optimization and ancillary service products		Ancillary service co-optimization and provision in the market
Resource Adequacy Function *Note: separate RA programs could also be developed and overlayed across these markets*	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. Depending on design, could impact long-term resource adequacy planning	Market can include its own longer-term resource adequacy requirements that must be achieved
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

ENERGY STRATEGIES

Energy Market Services: Where things stand today (roughly)

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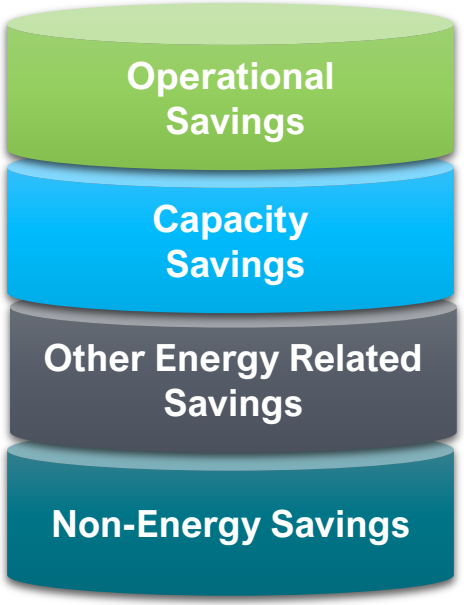
What incremental benefits can we expect from adding market services?

Energy Market Benefits: Categorizing Savings

- **Energy markets produce efficiencies (and savings) by changing the way we operate and plan our systems**
  - Not all such savings are quantifiable and some of the largest are commonly overlooked
- **While they are often the most referenced benefit category, operational savings from energy markets generally reflect a relatively small portion of the total benefits created by organized wholesale energy markets**



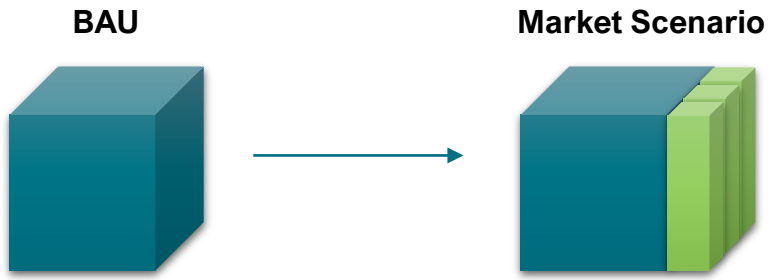
Market Benefit Categories	Description
Operational Savings	Savings due to more efficient dispatch (via SCED), more efficient management of transmission capacity, lower operating reserve requirements, removal of transmission wheeling costs within market footprint, decrease in trading friction
Capacity Savings	Savings due to lower and regionally shared planning reserve requirements caused by geographical diversity of loads (and generation)
Other Energy Related Savings	Savings due to more efficient planning of the transmission system, access to lower-cost public policy resources, environmental benefits of reduced emissions, new market products (e.g., hourly vs. block), increased automation of system operations
Non-Energy Savings	Savings due to lower electricity prices causing indirect economy-wide benefits such as new jobs, changes to household spending, and economic growth

Energy Market Benefits: Study Framework

- **Operational benefits of new wholesale energy markets are commonly quantified using production cost modeling software**
  - These simulation tools are “security constrained economic dispatch” models that perform an optimization not unlike the market engines used by RTOs/ISOs

BAU scenario must endeavor to capture system and market functionality as they exist today (or are expected to exist in the future):
- ✓ Transmission expansion
- ✓ Generation mix
- ✓ Policy requirements
- ✓ Load forecasts
- ✓ Ancillary services

Study Setup



BAU - Market Scenario = Benefit $$$

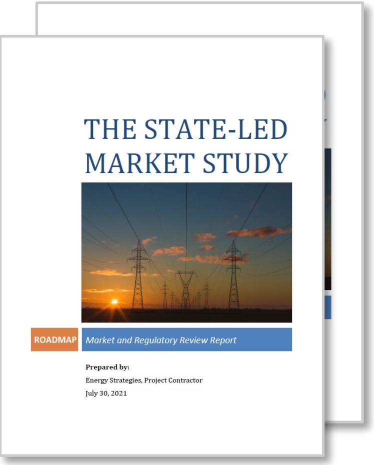
Market modeling “**modules**” bolted on to BAU scenario to reflect new wholesale energy market function. Can include modeling of:
- ✓ Wheeling cost
- ✓ Transmission availability
- ✓ Ancillary service products
- ✓ BA consolidation

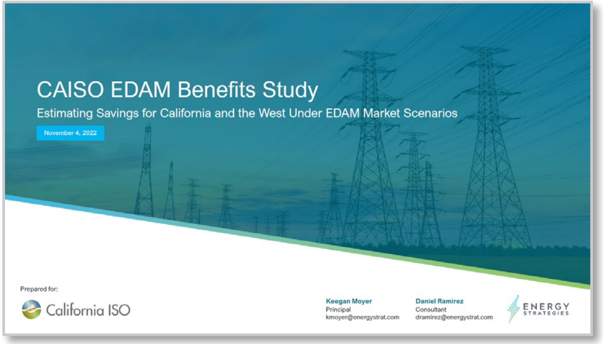
Typical Software

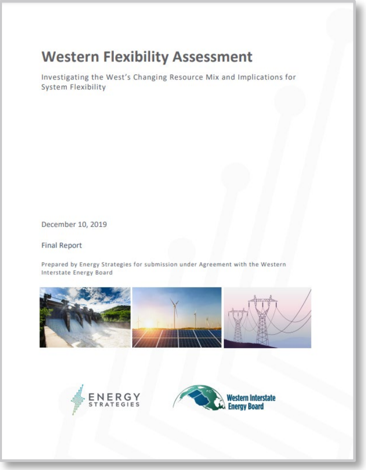
- GridView
- PROMOD
- PLEXOS
- PSO
- …etc.

ENERGY STRATEGIES

Energy Market Benefits: Related Studies by Energy Strategies







- Materials from these studies were used to inform today's comments on market services, benefits, and implications for policy & planning

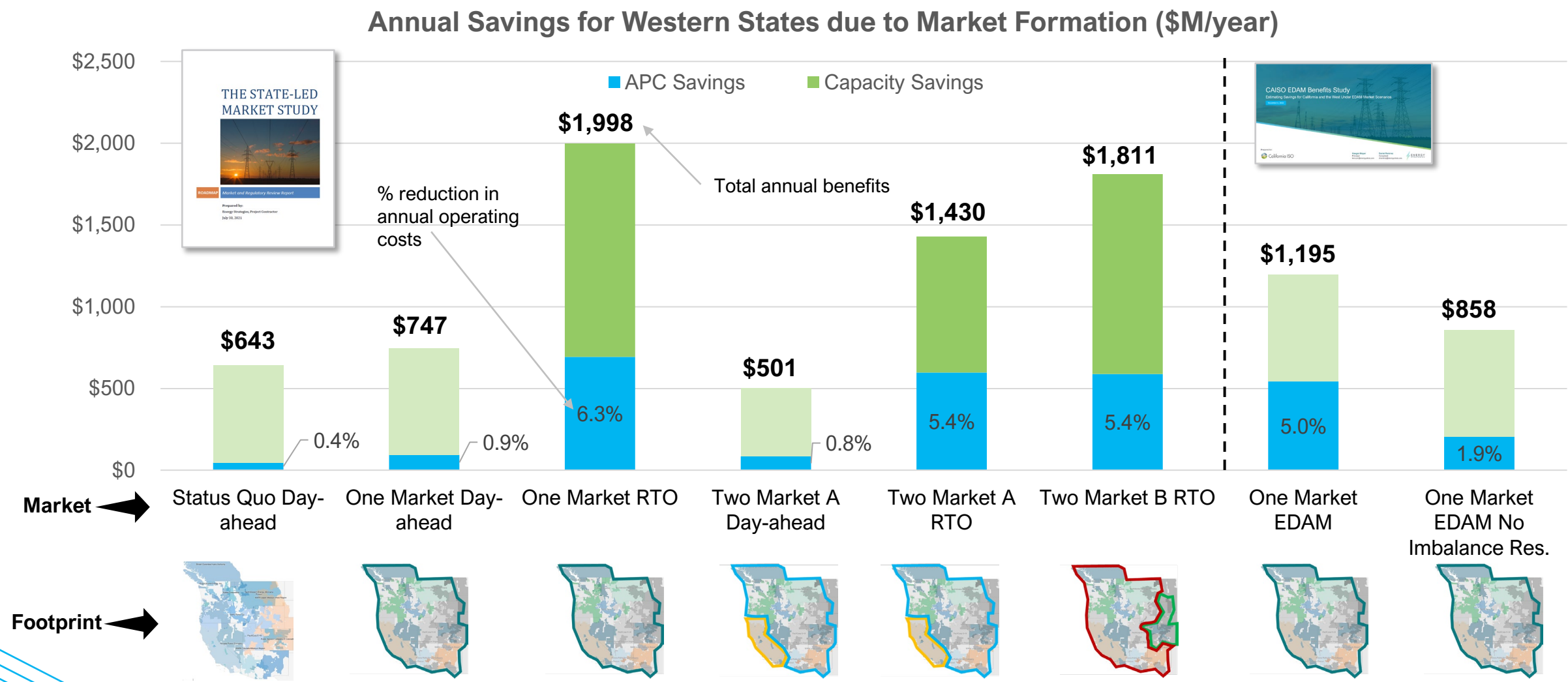
Other important and relevant regional work covered in ACR 188

CAISO ACR 188 Study List

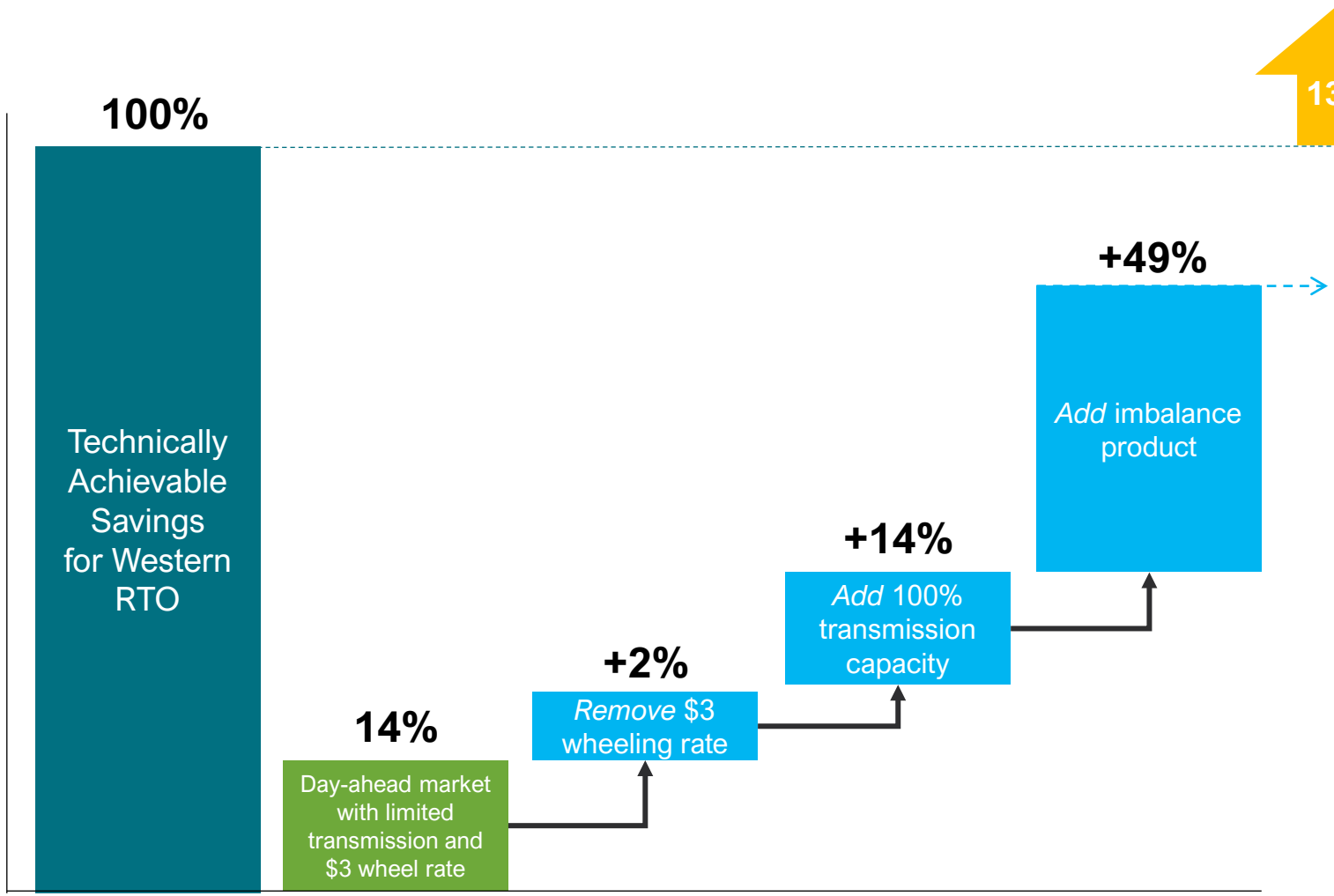
Type	Title	Year	Prepared for	Prepared by	Link
Legal	Enhanced Western Grid Integration: A Legal and Policy Analysis of the Effects on California's Clean Energy Laws	2017	Yale Environmental Protection Clinic	Juliana Brint, Josh Constanti, Franz Hochstrasser, and Lucy Kessler	"Enhanced Western Grid Integration: A Legal and Policy Analysis of the Effects on California's Clean Energy Laws", May 2017
Legal	Regulation and Markets: Ideas for Solving the Identity Crisis	2017	Wilkenson Barker Knaur	Tony Clark	"Regulation and Markets: Ideas for Solving the Identity Crisis ", July 2017
Legal	Evaluation of Jurisdictional and Constitutional Issues Arising from CAISO Expansion to include PacifiCorp Assets	2016	CAISO	Ann E. Carlson and William Boyd	"Evaluation of Jurisdictional and Constitutional Issues Arising from CAISO Expansion to include PacifiCorp Assets", August 1, 2016
Legal	Survey of Transmission Cost Allocation Methodologies for Regional Transmission Organizations	2011	DOE	National Renewable Energy Laboratory	https://www.nrel.gov/docs/fy11osti/49880.pdf
Market Proposa	A Proposal for Southwest Power Pool's Western Day-Ahead Market and Related Services [DRAFT]	2022	SPP	SPP Staff	"A Proposal for Southwest Power Pool's Western Day-Ahead Market and Related Services," Draft
Market Proposa	Benefits of the SPP RTO Expansion into the WEIS Footprint	2022	Western Area Power Administration	Brattle	https://www.wapa.gov/About/keytopics/Documents/2022-spp-rto-brattle-study.pdf
Market Proposa	NWPP Resource Adequacy Program - Detailed Design	2021	Northwest Power Pool	Northwest Power Pool	https://www.westernpowerpool.org/private-media/documents/2021-08-30_NWPP_RA_2B_Design_v4_final.pdf
Market Proposa	Extended Day-Ahead Market: Feasibility Assessment - Update from EIM Entities	2019	EIM Entities	Brattle Group and E3 Consulting	"Extended Day-Ahead Market: Feasibility Assessment - Update from EIM Entities", October 3, 2019
Market Proposa	Examination of Potential Benefits of an Energy Imbalance Market in the Western Interconnection	2013	DOE, PUC EIM Group	National Renewable Energy Laboratory	"Examination of Potential Benefits of an Energy Imbalance Market in the Western Interconnection", March 2013
Other	Pathways Towards Grid Decarbonization: Impacts and Opportunities for Energy Customers from Several US Decarbonization Approaches	2022	CEBA	Resources for the Future	https://cebi.org/research /pathways-toward-grid- decarbonization/
Other	In Support of Western Regional Resource and Transmission Planning Coordination	2021	Western Interconnection Regional Electricity Dialogue (WIRED)	Gridworks, Center for the New Energy Economy	"In Support of Western Reginal Resource and Transmission Planning Coordination", Octover 2021
Other	Potential customer benefits of interregional transmission	2021	American Council on Renewable Energy (ACORE)	Submitted by General Electric International	"Potential customer benefits of interregional transmission", November 29, 2021
Other	Transmission Benefits All Users of the Power Grid	2021	Grid Strategies	Michael Coggin	"Transmission Benefits All Users of the Power Grid", October 11, 2021
Other	Prospect of a New Western Regional Transmission Organization	2021	Congressional Research Service	Congressional Research Service	"Prospect of a New Western Regional Transmission Organization", September 8, 2021
Other	Designing the 21st Century Electricity System	2021	CEBA	Grid Strategies	https://cebi.org/research /designing-the-21st- century-electricity-system/
Other	GHG Accounting Working Group Report				…state.edu/wp-content/uploads/2021/01/final-…ED-GHG-accounting-work-group.pdf
Other	Renewable Energy Policy Pathways Report				…esearch /renewable-energy- policy-pathways-…
Other	Grid Vision: The Electric Highway to a 21st Century Economy				…Electric Highway to a 21st Century Economy", May …
Other	Improving Transmission Planning: Benefits, Risks, and Cost Allocation				…mission Planning: Benefits, Risks, and Cost …ber 6, 2019
Other	A Regional Power Market for the West - Risks and Benefits				…r Market for the West - Risks and Benefits", July …
Periodic report	WEIM Quarterly Reports				…eports, 2014 through 2022
Policy	Regional Transmission Organization Study: Oregon Perspecti…				…ission Organization Study: Oregon Perspectives", …
Policy	Arizona Corporation Commission docket memo from Office … Chairwoman Lea Marquez Peterson				…on Commission re: Docket E-00000A-21-0271, …
Policy	CO PUC, Commission Decision Determining Market Participa… is in the Public Interest				…ssion Decision Determining Market Participation is …est," November 12, 2021
Policy	Colorado Transmission Coordination Act: Investigation of Wholesale Market Alternatives for the State of Colorado (CO PUC)				…Transmission Coordination Act: Investigation of …t Alternatives for the State of Colorado,"
Policy	Staff paper: Qualitative Assessment of Potential Reliability Benefits from a Western Energy Imbalance Market				…litative Assessment of Potential Reliability Benefits from a Western Energy Imbalance Market", February 26, 2013
Technical	Regional and Interregional Transmission Have Significant Economic Value	2022	US Department of Energy (DOE)	Lawrence Berkeley National Laboratory (LBNL)	"Regional and Interregional Transmission Have Significant Economic Value", August 1, 2022
Technical	Western RTO Economic Impact Study	2022	Advanced Energy Economy	Energy Strategies, LLC, and Peterson & Associates	"Western RTO Economic Impact Study - Region-Wide Analysis", July 27, 2022
Technical	WECC 2040 Clean Energy Sensitivities Study	2022	Western Electricity Coordinating Council	WECC	%2Furldefense.com%2Fv3%2F__https%3A%2Fgcc02.safelinks.protection.outlook.com%2F%3Furl=https*3A*2F*2Fwww.wecc.org*2FAd…
Technical	The State-Led Market Study (Technical Report)	2021	DOE, State energy offices of Utah, Idaho, Colorado, and Montana	Energy Strategies, LLC	…8b/t/6148a012aa210300cbc4b863/1632149526416/Final+Roadma…
Technical	The State-Led Market Study (Regulatory Review)	2021	DOE, State energy offices of Utah, Idaho, Colorado, and Montana	Energy Strategies, LLC	…8b/t/6148a03ea5c43d63b2873506/1632149569046/Final+Roadma…
Technical	Colorado Transmission Coordination Act Evaluation of Market Alternatives	2021	Colorado Public Utilities Commission	Siemens	https://www.dora.state.co.us/pls/efi/efi_p2_v2_demo.show_document?p_dms_document_id=948065&p_session_id=
Technical	Implications of a regional resource adequacy program on utility-integrated resource planning	2020	DOE	UT Austin (Carvallo, Zhang, Leibowicz); LBNL; WIEB (Carr, Galbraith), Larsen	"Implications of a regional resource adequacy program on utility integrated resource planning," November 2020
Technical	WECC Reliability Implications of Expanding the EIM to Include Day-Ahead Market Service: A Qualitative Assessment	2020	Western Electricity Coordinating Council	WECC MIC MEA Working Group	%2Furldefense.com%2Fv3%2F__https%3A%2Fgcc02.safelinks.protection.outlook.com%2F%3Furl=https*3A*2F*2Fwww.wecc.org*2FRe…
Technical	Resource Adequacy Working Group Report	2020	WIRED	Center for the New Energy Economy	final-review-draft-WIRED-resource-adequacy-working-group.pdf (colostate.edu)
Technical	Western Flexibility Assessment: Investigating the West's Changing Resource Mix and Implications for System Flexibility	2019	Western Interstate Energy Board	Energy Strategies	"Western Flexibility Assessment: Investigating the West's Changing Resource Mix and Implications for System Flexibility", December 10, 2019
Technical	Resource Adequacy in the Pacific Northwest	2019	Puget Sound Energy, Avista, NorthWestern Energy, and the Public Generating Pool	E3	https://www.ethree.com/wp-content/uploads/2019/03/E3_Resource_Adequacy_in_the_Pacific-Northwest_March_2019.pdf
Technical	Resource Sharing Among the Pacific States	2018		Gridworks	Gridworks_ResourceAdequacy_online-2.pdf
Technical	Senate Bill 350 Study: The Impacts of a Regional ISO-Operated Power Market on California	2016	CAISO	Brattle Group, E3 Consulting, Berkeley Economic Advising and Research, Aspen Environmental Group	"Senate Bill 350 Study: The Impacts of a Regional ISO-Operated Power Market on California", July 8, 2016
Technical	Analysis of Benefits of an Energy Imbalance Market in the NWPP	2013	Northwest Power Pool	Pacific Northwest National Laboratory	"Analysis of Benefits of an Energy Imbalance Market in the NWPP", October 2013
Technical	WECC EDT Phase 2 EIM Benefits Analysis & Results (October 2011 Revision)	2011	Western Electricity Coordinating Council	E3 Consulting	"WECC EDT Phase 2 EIM Benefits Analysis & Results (October 2011 Revision)", October 11, 2011

41 studies performed since 2017

Forecasted Benefits for Western States



Drivers of Operational Benefits By Market Feature



Building more transmission further increases savings

WECC-wide EDAM scenario from recent CAISO study achieved 78% of operational efficiencies of RTO

Important Notes:

- Results will vary by state – data presented is for combined Western States
- Data based on results from various WECC studies over the last two years
- "Planning efficiencies" not included, such as capacity benefits, access to public policy resources, etc.
- All comparisons are relative to status quo (real-time markets only)

Market Implications for Policy and Planning Decisions

- **Market formation and evolution in the West will impact resource procurement and policy choices**
- **For example:**
  - Public policy objectives that require very high penetrations of renewable energy are difficult to achieve absent a regional energy market (see *Western Flexibility Assessment*)
    - Similarly, energy markets allow policy makers to be more aggressive with the scope and timeline of carbon reduction initiatives
  - Markets will increase opportunities to procure geographically diverse renewable resources, which will help bring down the cost of achieving high renewable penetrations
  - Markets give clearer signals with regards to what transmission should be constructed, and when, which will result in unquantified but significant savings
  - Markets are likely to improve reliability of the Bulk Electric System
  - Market design and governance structures are key to maximizing state oversight/jurisdiction on issues that could impact implementation of policies

Thank You!

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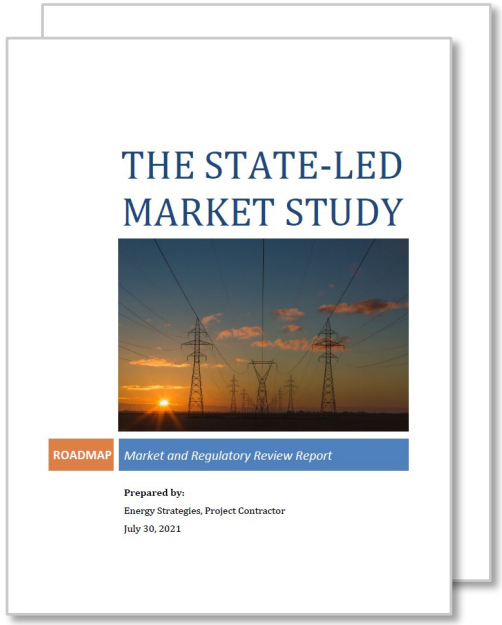
Appendices

Appendices

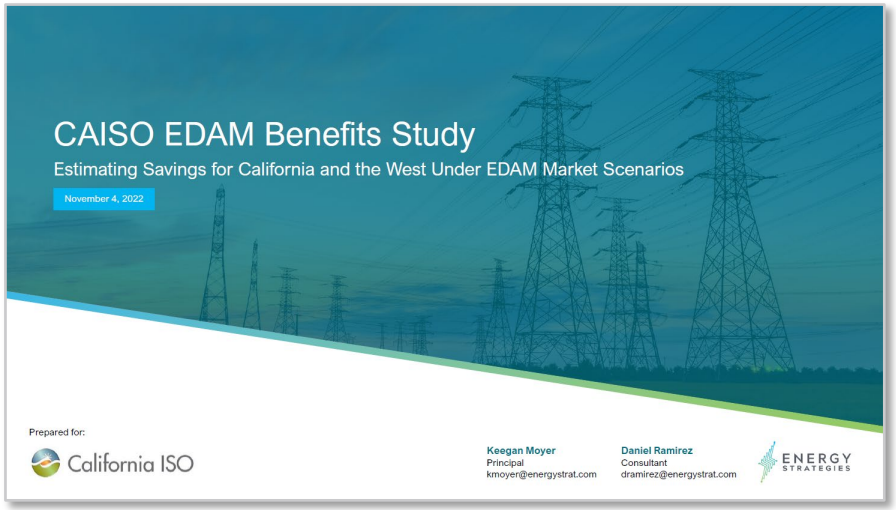
- **Links to studies referenced today:**

State-Led Market Study (2021)



Link to Market and Regulatory Review

CAISO EDAM Benefits Study (2022)



Link to recorded presentation

Western Flexibility Assessment (2019)