



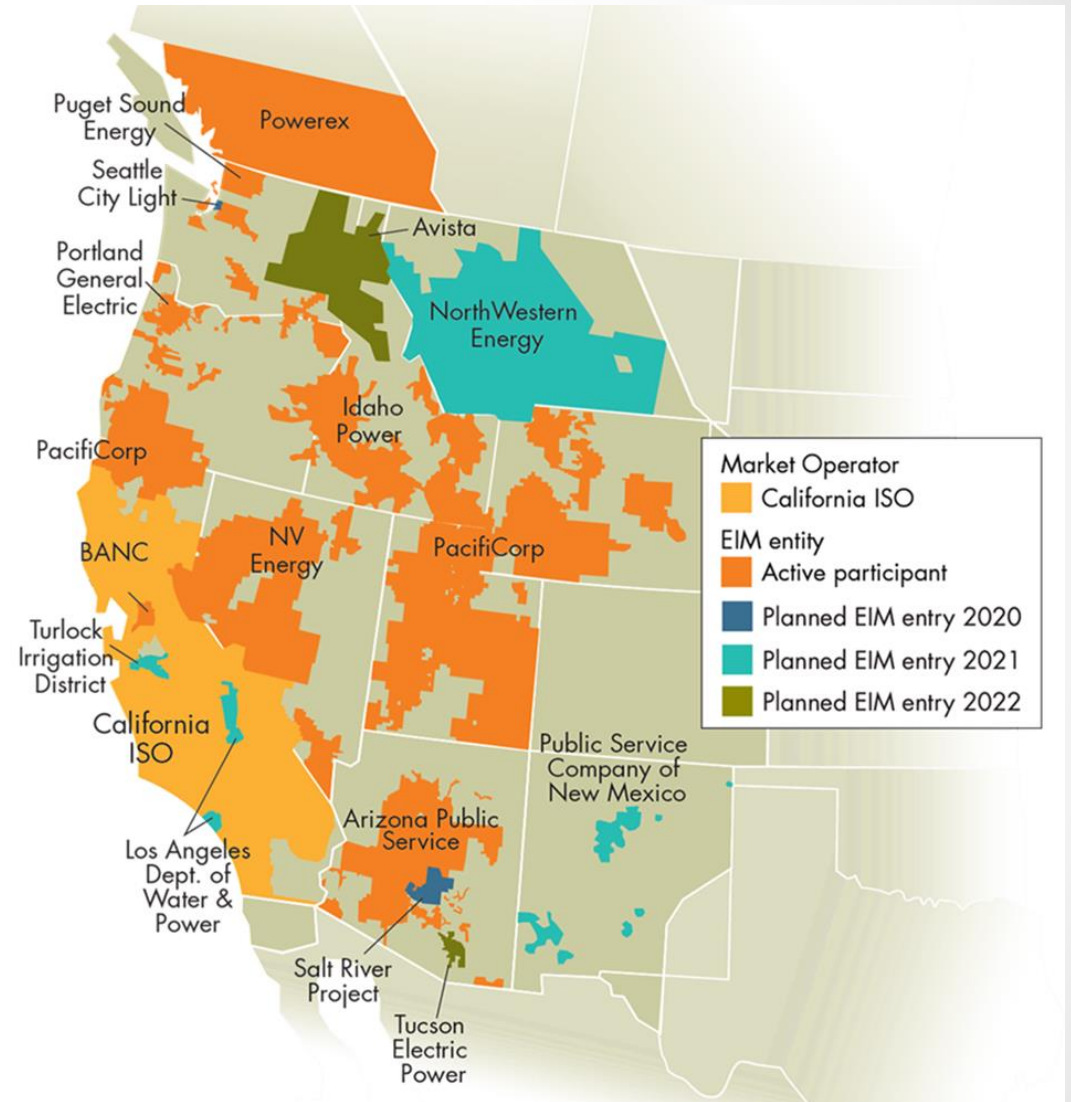
Extended Day-Ahead Market:

Feasibility Assessment Update from EIM Entities



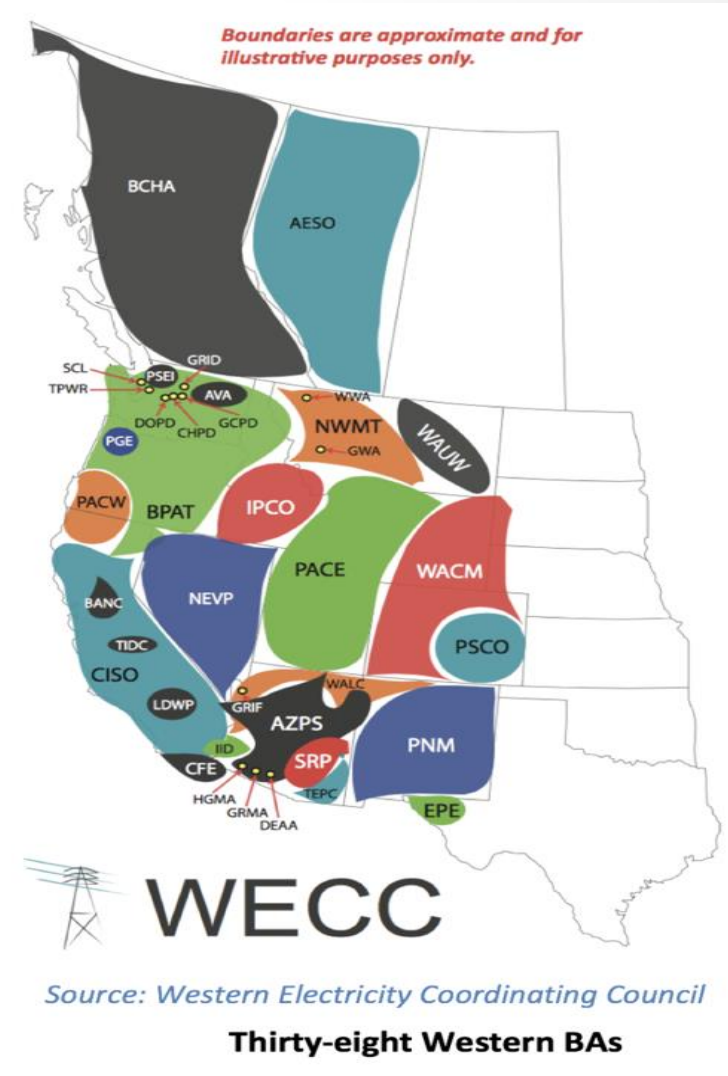
What is EDAM?

- Extended Day-Ahead Market
- A market services concept
- Similar to EIM:
 - Voluntary
 - Additional, incremental benefits
 - Use of existing infrastructure
- EDAM would be an *additional* market service layered on top of EIM
- EIM would continue to respond to imbalances between day-ahead and real-time



What is EDAM Not?

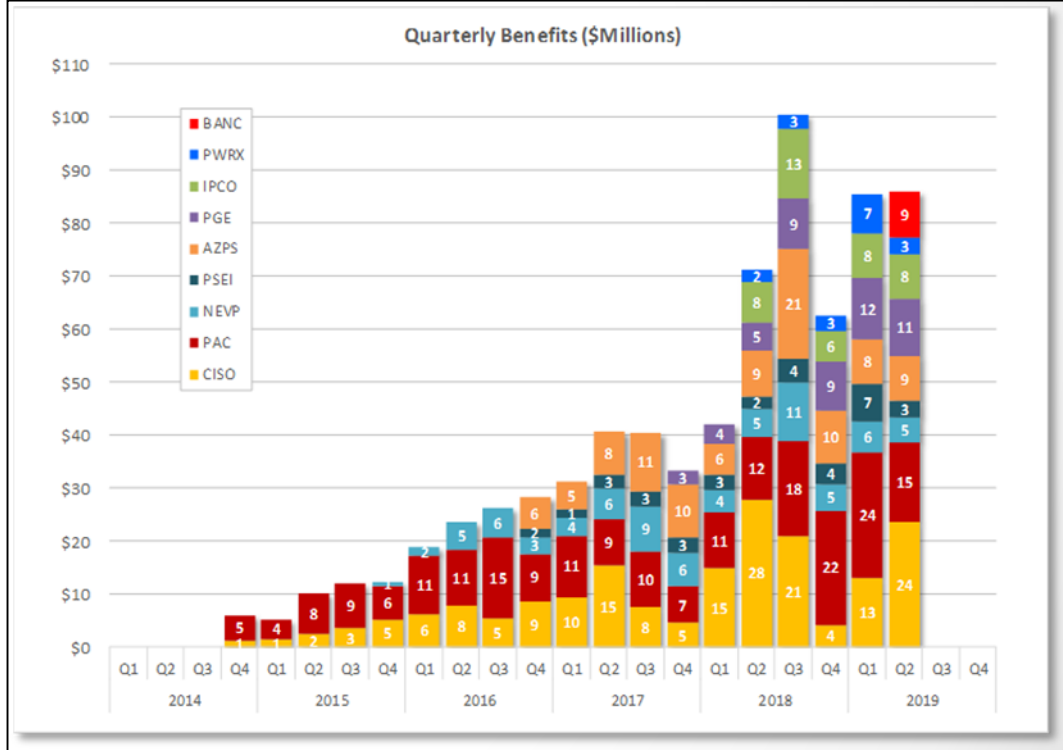
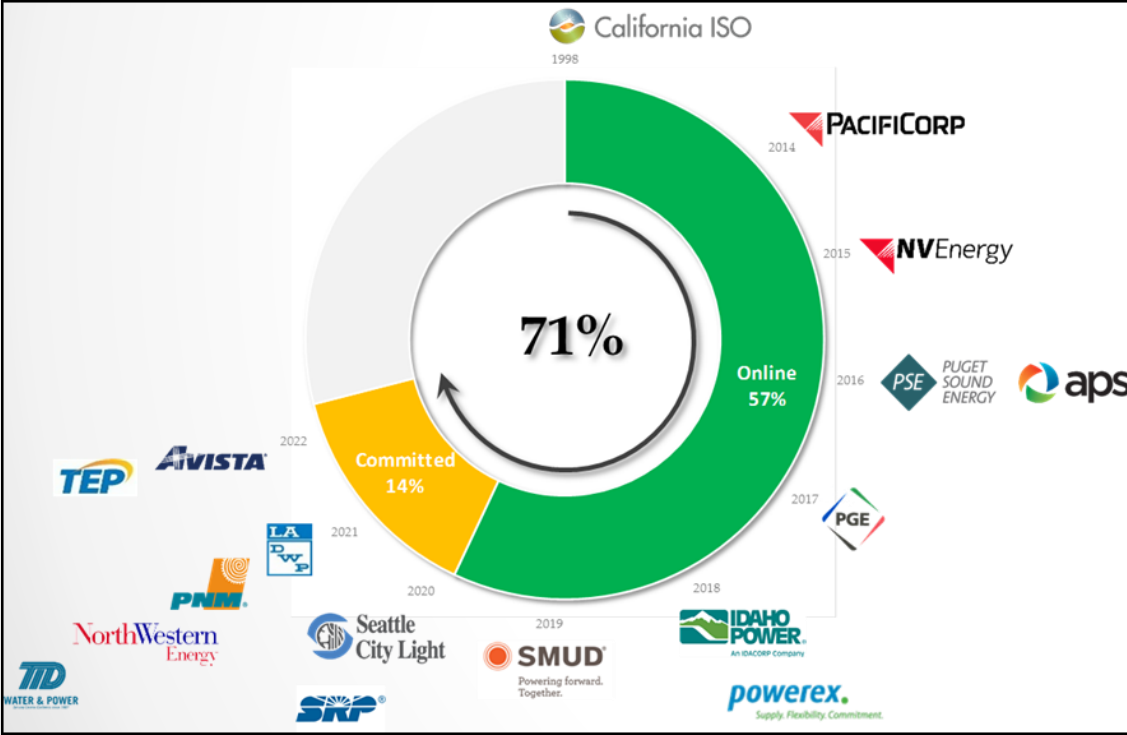
- EDAM is not equivalent to becoming a full member of CAISO (or any other RTO)
 - Transmission control, planning and cost allocation remains with member utility.
 - It is unlikely that EDAM will result in a single, unified transmission rate across the EDAM footprint.
 - Resource Adequacy and Resource Planning will continue to remain with member utilities and their respective regulating authorities.
- **EDAM is not intended to result in any changes to state regulatory authority**



The Western EIM is growing and delivering benefits

71% of electricity demand in the western interconnect is served by entities that are either participating in the EIM or committed to by 2022.

As of June 2019, the EIM has reported \$736 million in gross benefits since it started.



EDAM could provide incremental benefits and build upon infrastructure already in place for the EIM.

Potential benefits of EDAM

- Potential production cost savings through
 - More efficient Day-Ahead hourly trading and use of available transmission through an organized market
 - More efficient day-ahead unit commitment
 - Co-optimized footprint wide resources for a more efficient and cost effective day-ahead solution
- Potential environmental benefits such as reduced renewable curtailment
 - Diversity of imbalance reserves

The EDAM Feasibility Assessment evaluated the conceptual potential of the EDAM proposal

- The EDAM Feasibility Assessment is a high-level modeling study intended to inform EIM Entities and their interest in proceeding to a market design process.
- The EIM Entities contracted with The Brattle Group (“Brattle”) and Energy+Environmental Economics (“E3”) to conduct the assessment based on production cost modeling and other data analysis.
- The EIM Entities understand that CAISO will conduct the EDAM market design in a public stakeholder process that will allow the EIM Entities to evaluate their own individual expected benefits and costs associated with participation in a potential EDAM.

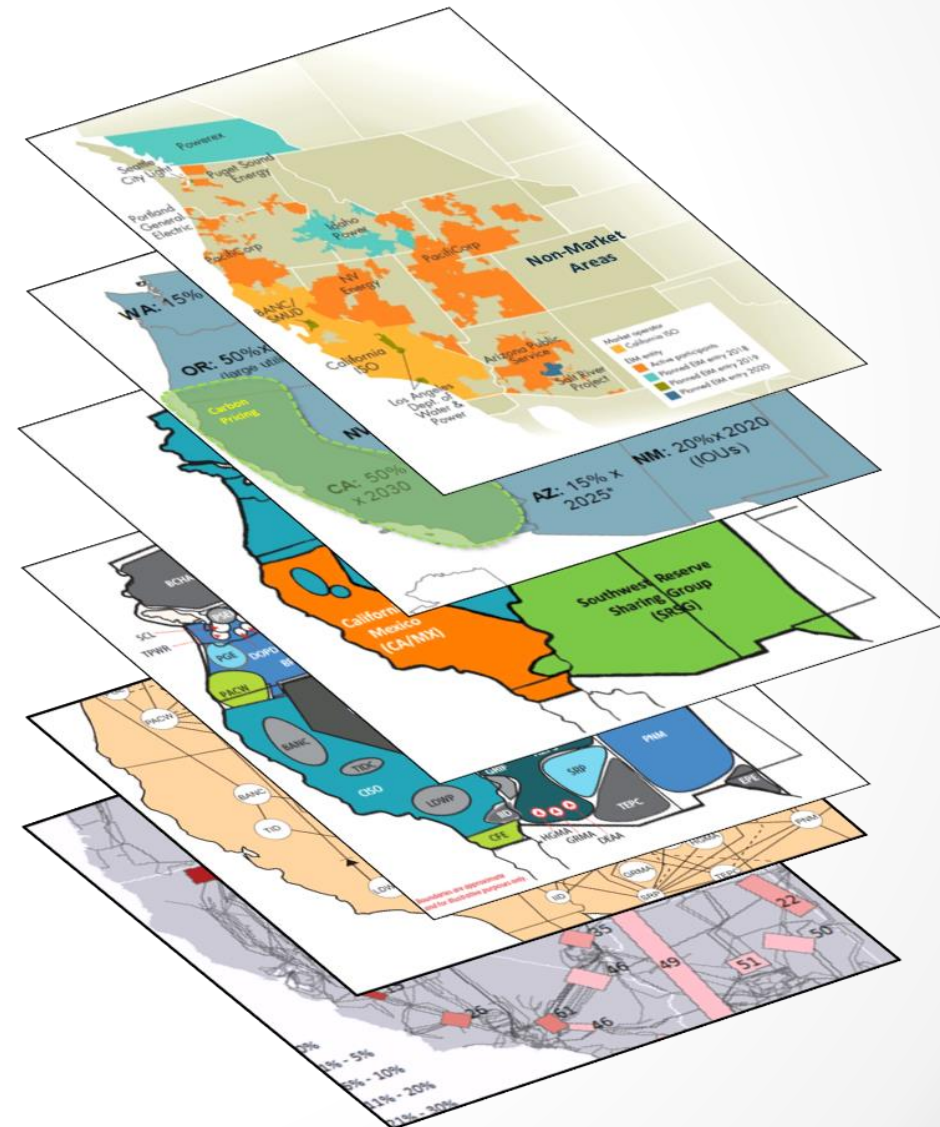
EDAM Feasibility Assessment Framework

- Designed to study annual WECC-wide commitment and dispatch cost impact of expanding the EIM to the day-ahead market.
- Estimates system-wide impacts based on the difference between simulations of 2028 EDAM and business-as-usual (BAU) cases.
- Every EIM participant with a signed implementation agreement as of the start of the study was assumed to participate in the EDAM against a baseline of continuation of the current market structure
- Primary focus on production cost savings, but other potential savings were considered.

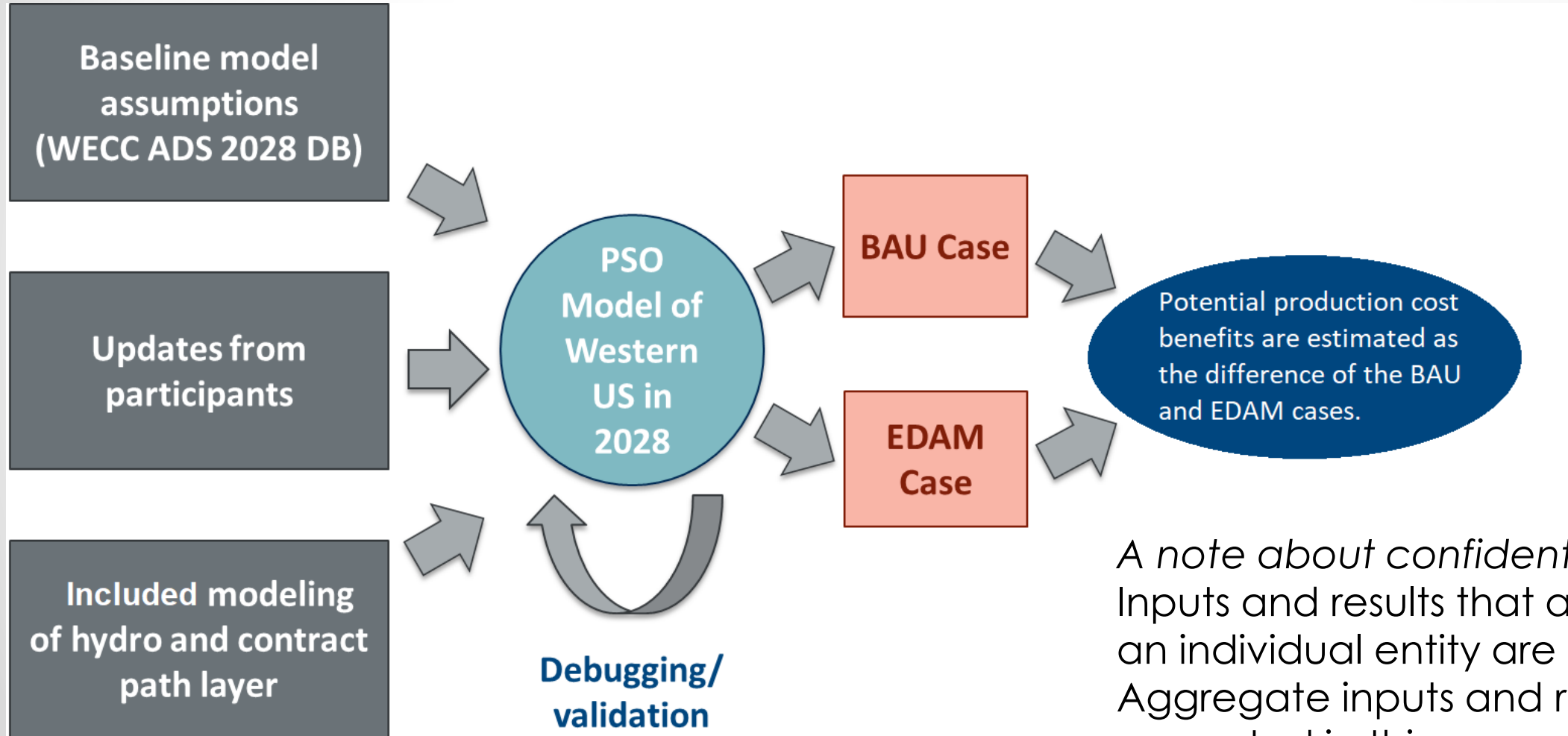
Modeling the WECC System & Markets

The WECC is a large and complex system with multiple functional layers

- Complex power system with ~20k buses, ~25k lines, ~5k generators, 38 balancing areas (BAs), multiple reserve sharing groups, diverse state policies
- The feasibility assessment modeled WECC with detailed representations of six layers of how utilities across WECC relate to and transact with each other



EDAM production cost model development process relied on input from EIM entities

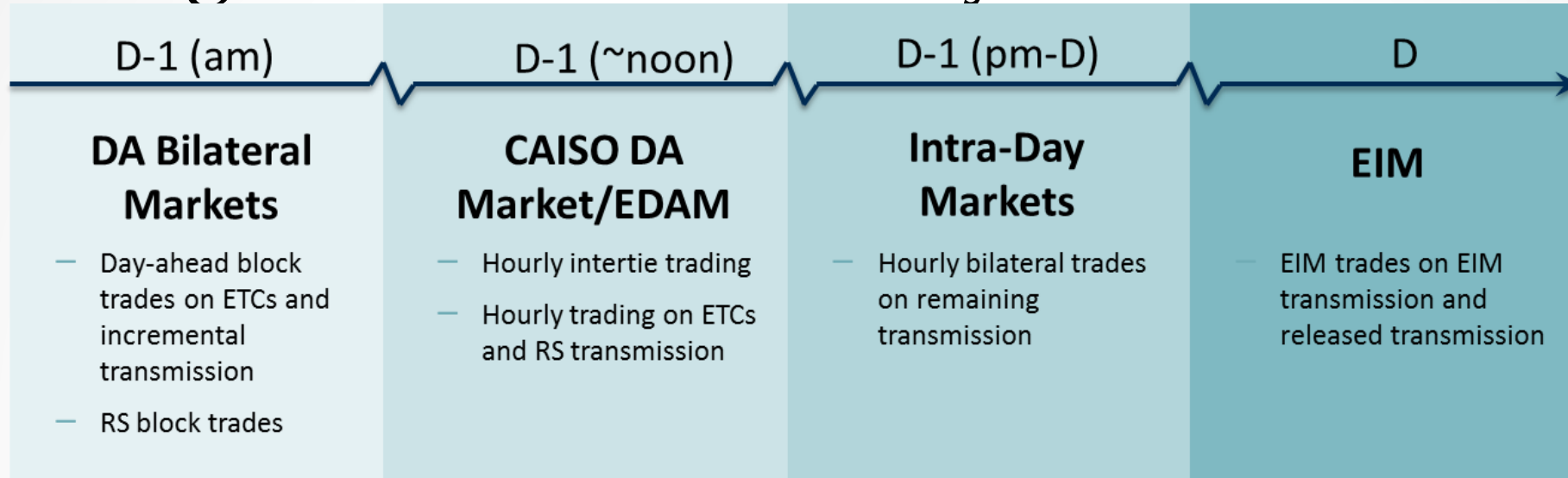


A note about confidentiality:
Inputs and results that are specific to an individual entity are confidential. Aggregate inputs and results are presented in this presentation.

The Feasibility Assessment includes a resource sufficiency step in the EDAM case

- Resource Sufficiency is used to ensure sufficient resources made available to meet load and reserve obligations in each BAA
 - Enables reliability and fairness
- Assumed each BAA has sufficient capacity to cover:
 - Contingency Reserves and regulation
 - Uncertainty of DA Load and VER forecasts
 - A limited quantity of replacement reserve to cover real-time forced outages beyond 60-minute contingency period
- Assume EDAM could provide diversity benefits by
 - Reducing total quantity of reserves needed to cover forecast error and replacement reserve across EDAM footprint
 - More efficiently allocate reserves for forecast error and replacement reserves across EDAM footprint
- EDAM did not assume co-optimization of contingency reserves
 - Most entities already participate in reserve sharing

Trading timeframes and cycles in the model



BAU Case



EDAM Case



RS- Resource Sufficiency, UC- Unit Commitment, D- Dispatch, EIM- Energy Imbalance

Feasibility Assessment Results

- Like similar model studies, potential aggregate results are subject to necessary simplifications and assumptions. The EIM Entities understand the Feasibility Assessment results are directionally relevant but not at a decision support level of detail.
- Estimated total production cost savings are in the range of \$119 – \$227 million per year for a range of scenarios that test certain assumptions.
- Significant drivers include assumptions made for natural gas prices, restrictions on CAISO export limits, and costs associated with transmission.
- The feasibility assessment also concludes that EDAM has the potential to reduce greenhouse gas emissions and curtailments of non-emitting variable energy resources.

Feasibility Assessment Scenario Analysis

Feasibility Assessment scenarios were constructed to evaluate a range of input assumptions.

Input/Scenario	1	2	3	4
Natural Gas Price	Original WECC ADS	Original WECC ADS	Original WECC ADS	Updated CEC
CAISO Net Export Limit	UC Only	UC + Dispatch/EIM	UC + Dispatch/EIM	UC + Dispatch/EIM
EDAM Bucket 3 Hurdle Rate	\$3/MWh	\$3MWh	\$0MWh	\$3/MWh
Potential Production Cost Reduction	\$119M/yr	\$125M/yr	\$126M/yr	\$227M/yr

Estimated potential production cost reductions were calculated for the entire WECC region and assumed all EIM Entities who participated in the assessment join the EDAM.

EDAM could reduce investment costs for some entities

- Reduction in wind and solar curtailments with EDAM could reduce the investment costs associated with meeting jurisdictional policy for some participating entities.
- The Feasibility Assessment modeling found that EDAM could reduce the curtailment of Variable Energy Resources by about 1-2 TWh/yr across the EDAM footprint.
- Translating the estimated reduced VER curtailment into potential investment cost savings depends on many factors that are hard to quantify, including variable jurisdictional policies, REC markets, and forward-looking assumptions about market design.
- Although EDAM results may inform procurement and infrastructure development, no attempt was made to quantify any longer term investment benefits.

Conclusion

- The EDAM Feasibility Assessment supports the potential to realize incremental WECC-wide benefits from EDAM as compared to business-as-usual.
- Feasibility assessment results are only indicative and based on assumptions that may not reflect the ultimate market design – this is only the beginning of a substantial and complex process.
- The EIM Entities look forward to participation with all stakeholders in the process to define the market design.

How to get your questions answered

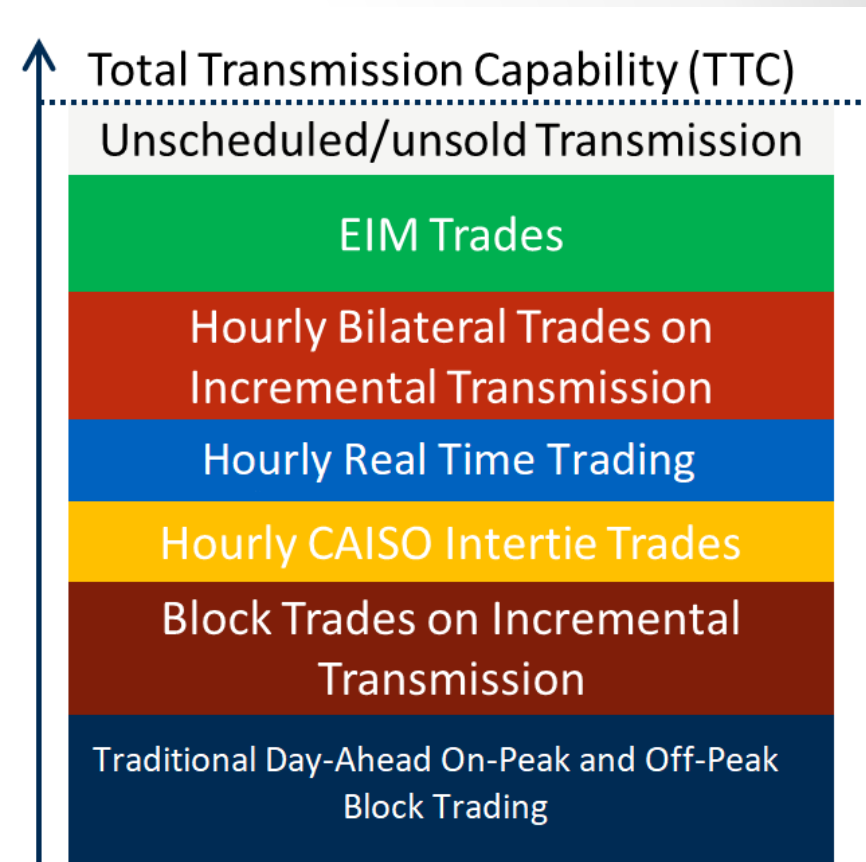
- Email your questions to initiativecomments@caiso.com. Please include 'EDAM Feasibility Assessment' in the subject line by Thursday, October 10th, 2019.
- EIM Entities will compile the questions and produce a question and answer matrix that will be posted by CAISO.

Appendix

Modeling of Market Trading

- The model estimates the impact of an EDAM on trading efficiency
- EDAM enables hourly day-ahead trades through a centralized market operator.
- OATT still applies: transmission reservations on contract paths still required to move power.
- Other trade types modeled:
 - Traditional Day-Ahead On-Peak and Off-Peak blocks
 - Hourly real time trading
 - Hourly intertie bidding with CAISO
 - EIM

Types of Trades Modeled



The Feasibility Assessment includes a resource sufficiency step

- Resource needs for the day ahead forecast error and replacement reserves are calculated across the EDAM Footprint to capture a diversity benefit.
- All other reserves are modeled the same way in the BAU case.

Reserve Type	Reduced in EDAM?	Where calculated in the BAU case	Where calculated in the EDAM case
Forecast Error	Yes	Local	EDAM Footprint
Replacement Reserves	Yes	Local	EDAM Footprint
Contingency, Non-spin	No	Local	Local
Contingency, Spin	No	Local	Local
Regulation	No	Local	Local

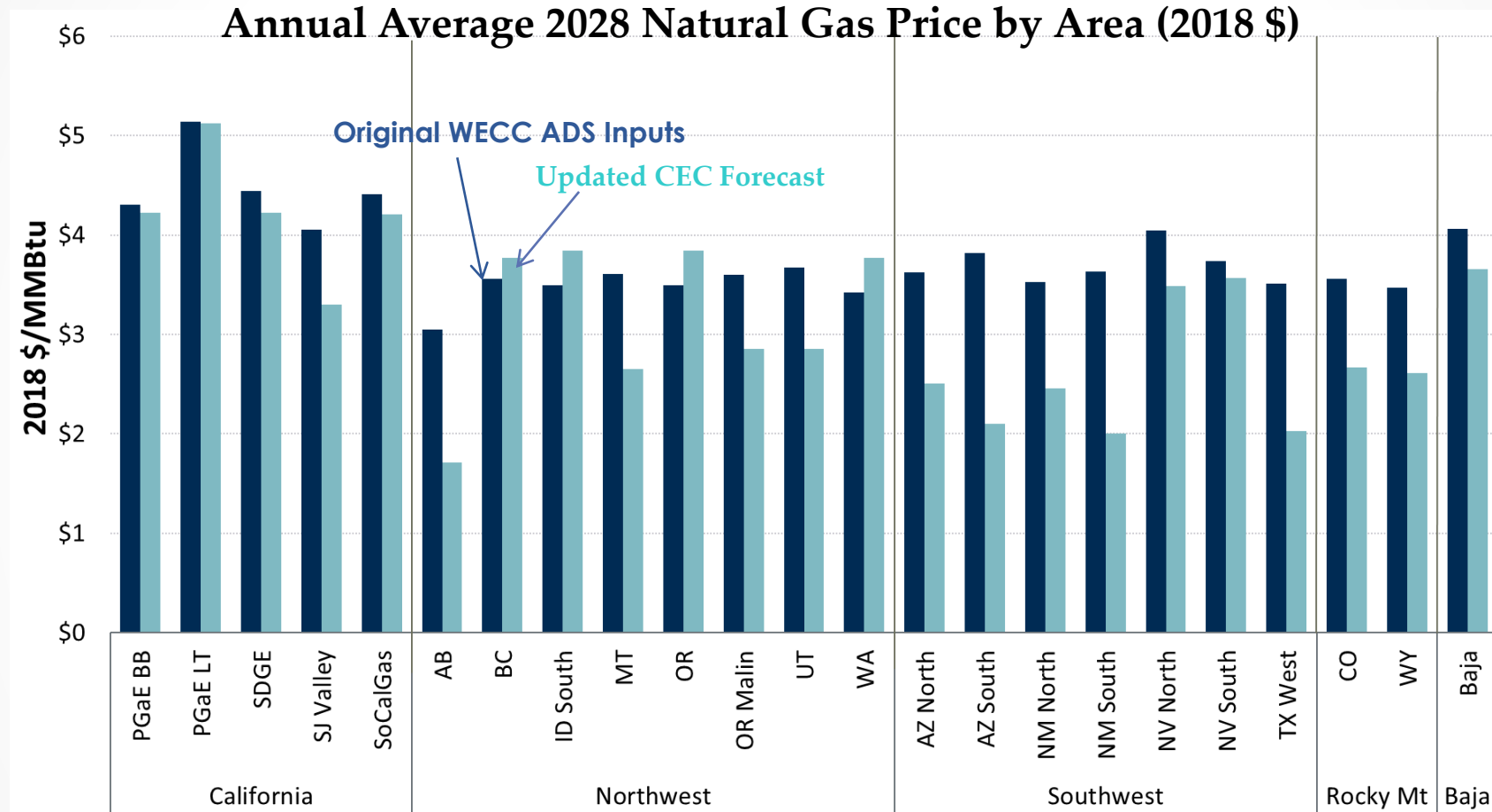
‘Local’ carrying of reserves means it can be carried on generation in the BAA, or on remotely owned/contracted generation.

EDAM BA-to-BA Transmission Assumptions

Three sources of transmission capacity made available in the EDAM.

- Bucket 1: Resource sufficiency transmission
 - Transmission needed for transactions made prior to EDAM to meet RS requirements
 - Could include long-term contracts for remote resources, block purchases from other BAAs, or purchases of dispatchable RS capacity that can be bid into EDAM (“Bid Range”)
- Bucket 2: “Donated” transmission contracts
 - Long-term and highly reliable transmission contracts that are voluntarily made available to enable EDAM transfers between BAAs
 - Entities need to consider various factors when determining the quantity of transmission rights (ETCs/ETSRs) to make available to EDAM and/or EIM
- Bucket 3: EDAM BA-to-BA transmission available from transmission provider
 - Highly reliable transmission that can be sold by the Transmission Provider for EDAM on a day-ahead basis at a pre-determined EDAM hurdle rate (\$3/MWh)
 - Includes export transmission from CAISO

Gas price assumptions

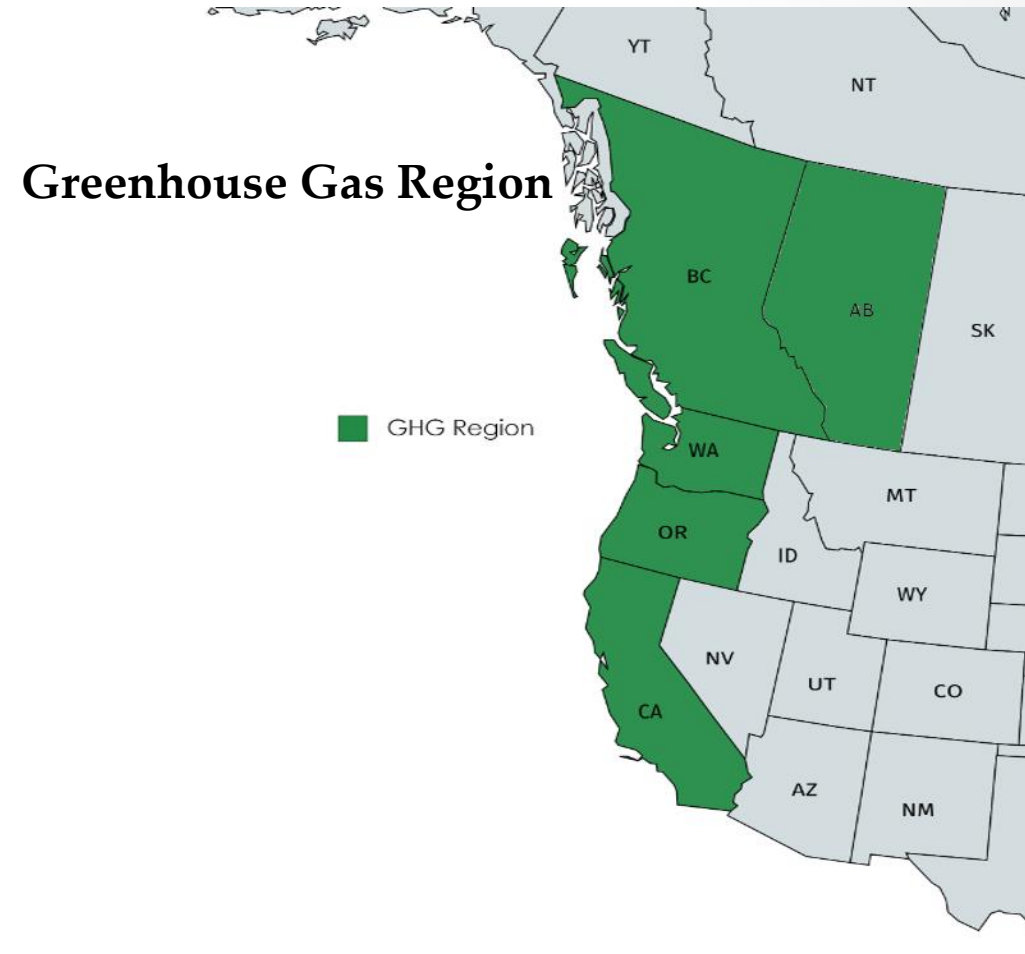


Two gas price assumption scenarios were modeled:

- 1) Gas prices in the 2028 WECC ADS database from the CEC gas price model.
- 2) Gas prices updated from the CEC's 2019 Forecast update, April 2019.

GHG Assumptions

- GHG prices only modeled in certain regions
 - California, Oregon, Washington, Alberta, and British Columbia
 - Assumes that in 2028 these regions participate in a market with the same GHG price
 - Assumed \$60/metric ton (2018\$) based on 2017 California Energy Commission's (CEC) high forecast.



CAISO net exports were limited to more closely resemble actual exports

- Imposing the CAISO export constraint in the BAU case has the intended effect, limiting net exports at 5,000 MW in the UC cycle and 7,000 MW in the dispatch and EIM cycles
- In the EDAM case, CAISO imports 3,400 GWh more and exports 2,400 GWh more relative to the BAU case (representing a 9% and 22% increase, respectively)

