

Exh. MGW-4
Docket UE-25____
Witness: Michael G. Wilding

**BEFORE THE WASHINGTON
UTILITIES AND TRANSPORTATION COMMISSION**

WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,

Complainant,

v.

PACIFICORP dba
PACIFIC POWER & LIGHT COMPANY

Respondent.

Docket UE-25____

PACIFICORP

EXHIBIT OF MICHAEL G. WILDING

Brattle EDAM Simulations: PacifiCorp Results 2024 Updated IRP

April 2025

Brattle EDAM Simulations: PacifiCorp Results **2024 Updated IRP**

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SEPTEMBER 2024

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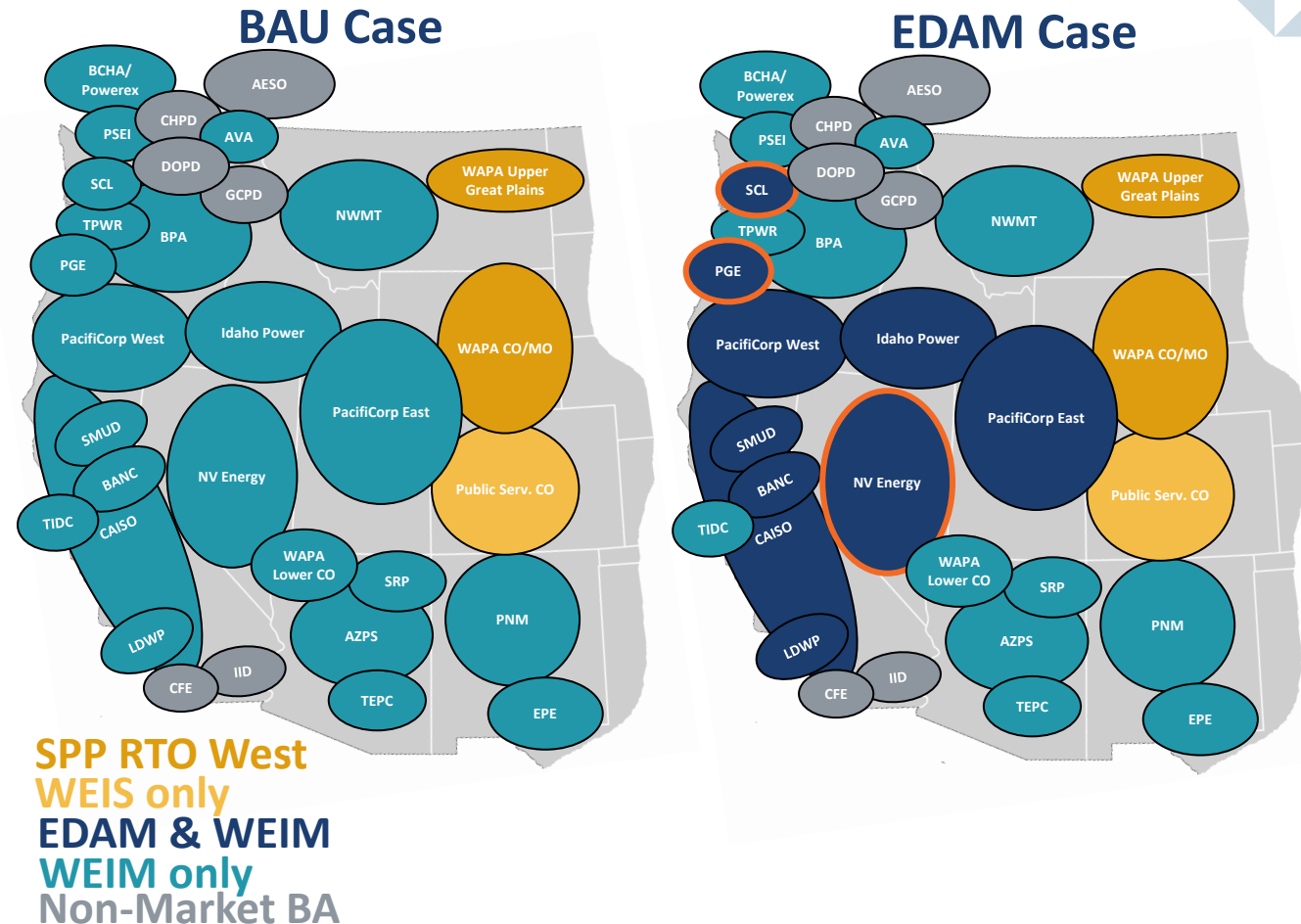
PACIFICORP



2024 Updated IRP Study Case Footprint Summary

As in our 2023 study, we modeled an EIM-only BAU case and a case in which a limited EDAM footprint forms in 2032

- The simulated EDAM footprint expanded to include all announced EDAM joiners and Seattle City Light (**new additions highlighted in orange**)
- Unlike the 2023 Study, this updated study also includes the SPP West RTO and WEIS footprints. SPP West RTO is expected to be operational before 2032



Updated PacifiCorp EDAM Benefits

PacifiCorp's modeled EDAM net benefits nearly doubled from \$181 million to \$359 million in the updated cases relative to the 2023 study

PAC's benefit increase is driven by a large reduction in their Adjusted Production Cost (APC) and an increase in congestion revenue.

- The reduction in APC nearly doubled.
- Wheeling revenue, bilateral trading value, and EIM congestion revenues impacts have remained about the same
- **EDAM revenues increased by \$120 million/year**
 - \$88 million of this is revenue on paths with new members of the EDAM footprint in this study
 - \$32 million of this revenue is on paths with entities that were in the EDAM footprint for the 2023 study

Summary of PacifiCorp Benefits (\$ Millions)

Benefit Metric	2023 Study	2024 Updated IRP
EDAM Benefits		
Adjusted Production Cost	\$64	\$117
EDAM Congestion Revenues	\$37	\$141
EDAM Transfer Revenues	\$238	\$254
Total EDAM Benefits	\$339	\$511
Other EDAM Related Impacts		
Reduced Wheeling Revenues	\$8	\$16
TRR Settlements [1] & [2]	(\$6)	**
Impact on EIM Congestion Revenues	(\$12)	(\$5)
Impact on CAISO DA Tieline Trading Value	(\$1)	(\$9)
Reduced Bilateral Trading Value [3]	(\$147)	(\$154)
Net EDAM Benefits	\$181	\$359

Notes:

[1]: TRR settlements (hold harmless for wheeling revenues) are zero for the EDAM footprint.

[2]: ** We did not refresh our estimate of TRR settlement impacts for the 2024 updated cases due to a lack of historical wheeling revenue data from all utilities in the assumed EDAM footprint.

[3]: Reduced bilateral trading values of exports and imports from the BAs of EDAM members, including impacts on trades by third-party marketers.

Updated EDAM Footprint Benefits

Modeled EDAM net benefits for the entire footprint more than doubled from \$437 million to \$889 million in the updated cases relative to the 2023 study

Footprint benefits are driven by large APC savings and EDAM market revenues

- **APC benefits** have more than doubled
 - These benefits, like 2023, include renewable curtailment PTC value, worth \$271 million from over 9 TWh of reduced curtailments
- **The larger EDAM footprint is driving increases in both EDAM congestion and transfer revenues**
 - New footprint members account for more than \$200 million of the increase in trading revenues
- Expanding the footprint has also increased wheeling revenue and bilateral trading value losses

Summary of EDAM Footprint Benefits (\$ Millions)

Benefit Metric	2023 Study	2024 Updated IRP
EDAM Benefits		
Adjusted Production Cost	\$134	\$647
EDAM Congestion Revenues	\$269	\$519
EDAM Transfer Revenues	\$409	\$444
Total EDAM Benefits	\$812	\$1,610
Other EDAM Related Impacts		
Reduced Wheeling Revenues	(\$103)	(\$208)
TRR Settlements [1] & [2]	\$0	\$0
Impact on EIM Congestion Revenues	(\$16)	\$18
Reduced Bilateral Trading Value [3]	(\$256)	(\$531)
Net EDAM Benefits	\$437	\$889

Notes:

[1]: TRR settlements (hold harmless for wheeling revenues) are zero for the EDAM footprint.

[2]: ** Brattle did not re-estimate TRR revenues for this case as we do not have everyone's historic wheeling revenue data.

[3]: Reduced bilateral trading values of exports and imports from the BAs of EDAM members, including impacts on trades by third-party marketers.

Drivers of PacifiCorp's EDAM Benefits

The drivers of PAC's customer savings are similar to those in the 2023 study

PacifiCorp East: PACE's benefits are driven by **increased economic dispatch of gas resources into the rest of the EDAM footprint** and **increased sales revenue on renewable generation**

- PACE receives \$163 million in increased sales revenues on \$82 million in increased generation costs, with average day-ahead sales prices increasing from the BAU case to EDAM from \$23/MWh to \$29/MWh
- PAC's transmission system is also extremely valuable in EDAM, connecting to more EDAM members than anyone else (*SMUD is only participant in assumed footprint to which PAC does not directly connect*)

PacifiCorp West & Washington: PACW and PAWA benefits are largely driven by reduced generation and purchase costs, which the addition of Bridger CCUS reducing PACW's reliance on market purchases

- PACW is both able to reduce its generation 360 GWh in EDAM (saving \$16.4 million) and time purchases better to buy 539 GWh more in EDAM, but for \$12.2 million less than in the BAU case
- In the 2023 study, PACW + PAWA benefits were driven by reduced generation costs offset by higher EDAM purchase costs, spending \$82 million less on generation and only paying \$57 million more in purchase costs

Modeling Updates for PacifiCorp

- **Updated Resource Mix:**

- Wind: Capacity **increased** from 6.5 GW to 9.2 GW
- Solar: Capacity **decreased** from 6.5 GW to 4.7 GW
- Battery: Capacity **decreased** from 3.5 GW to 2.3 GW
- Nuclear: Capacity **decreased** from 688 MW to 350 MW, reflecting changes in planned build-out of SMRs
- Gas and Coal: Capacity **increased** from 7.3 GW of thermal units to 7.6 GW, including the new Bridger carbon capture units which are must-run

- **Removal of NOX Pricing:**

- Summer NOX pricing was removed to reflect changes in regulations, giving PACE more opportunity to run and sell coal generation

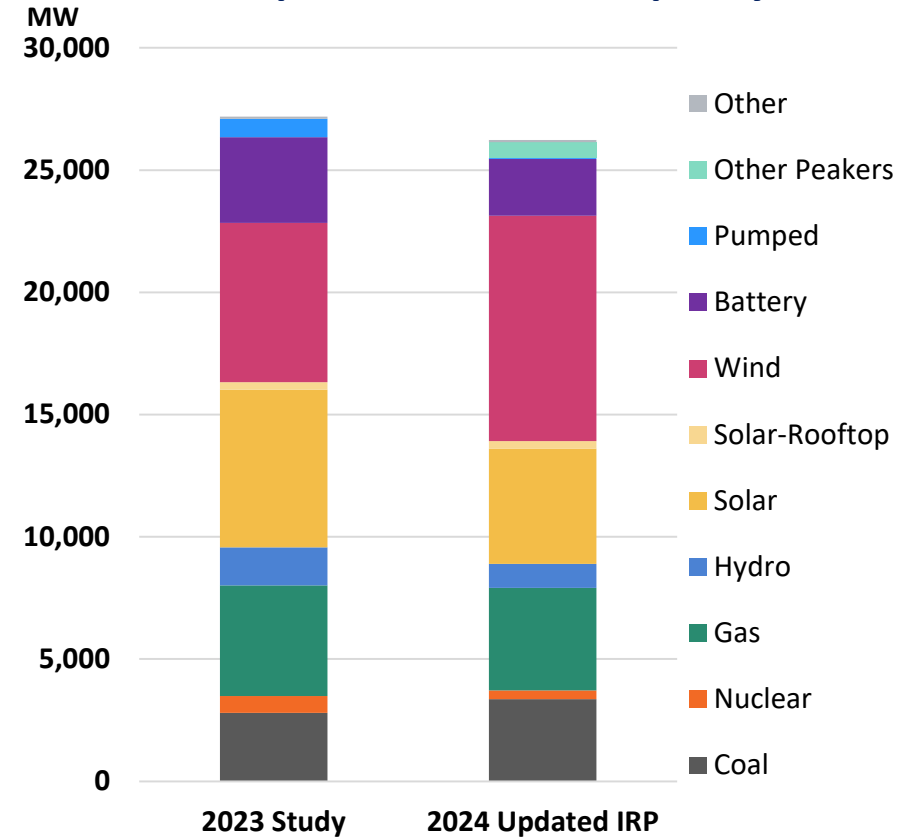
- **Load Updates:**

- Modeled load increased from about 75 TWh to 84 TWh and was updated in each portion of the PAC balancing authority
- Modeled peak for PacifiCorp increased from 11.8 GW to 13.5 GW

- **Improved Nodal Modeling:**

- We used nodal data provided by PAC to improve our resource location mapping for additional modeling accuracy

PacifiCorp Installed 2032 Capacity



Other Modeling Updates Since 2023 Study

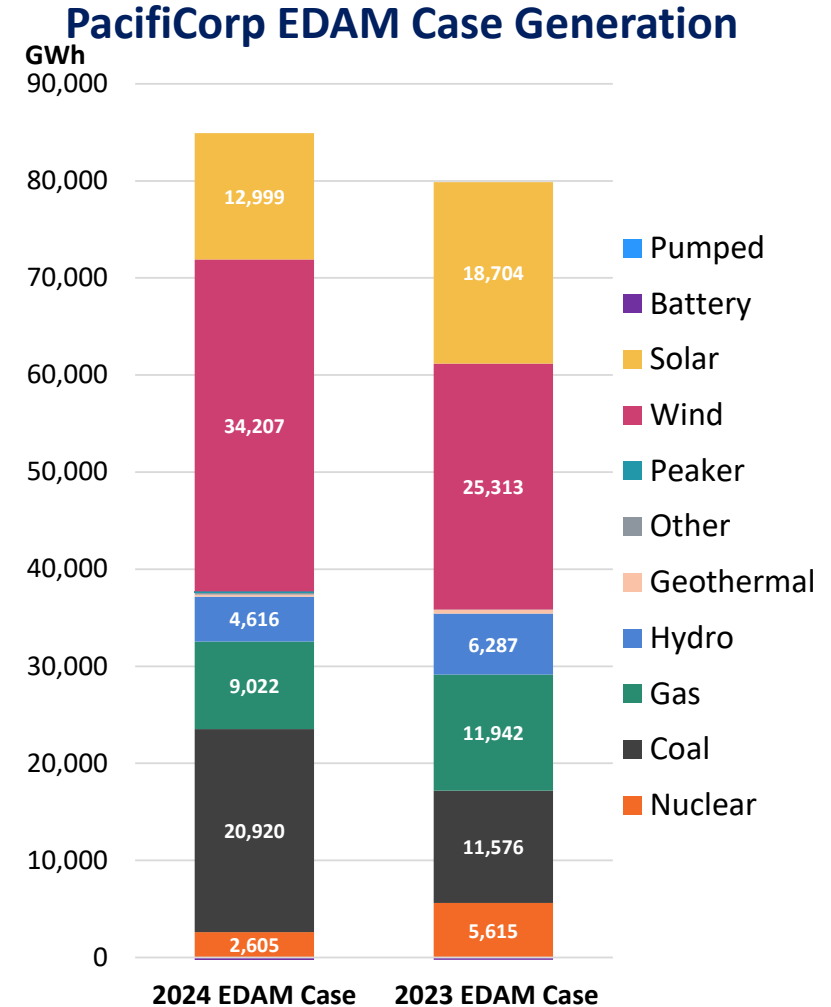
- **Resource Mix Updates:** We updated the model for new resource plans, increasing the renewables in the WECC
 - CAISO resource mix updated to the 2023-2024 TPP, adding ~9 GW of solar, ~3.3 GW of wind, and other geothermal and battery capacity
 - Nevada resource mix updated by the NV Energy (NVE) IRP team for the 2024 IRP, adding new storage, solar, and wind
 - New study participants (e.g., PGE, NVE) provided updated information on their resource mix
 - We also made updates to other entities that have released new IRPs, including PSEI, TEPC, and AZPS
- **New Transmission Projects:** The WECC also has higher transfer capacity between key regions
 - TransWest Express added, providing PacifiCorp larger transfer capacity with CAISO
 - Greenlink added, increasing NVE transfer limits
 - SWIP North added, providing Idaho Power a direct CAISO connection
 - Cross-Tie added, providing PacifiCorp larger transfer capacity with Nevada
- **Larger EDAM Footprint:**
 - Portland General Electric and NVE have both announced their intent to join EDAM and SCL is included in the market as well.
- **Data from New Study Participants and Updates in other Areas of the WECC:**
 - Additional study participants, including PGE, and NVE provided clarity on key transmission limits with Bonneville Power and other WECC BAs
 - We built into the model the SPP West RTO and WEIS market with PSCO, which is announced to be online ~2028
 - All BAAs now have forecast uncertainty for load and renewables, where previously this was the case only for study participants & CAISO

Detailed PacifiCorp Results

Generation Results (1 of 2)

PacifiCorp is both heavier on renewables and thermal generation than the 2023 study

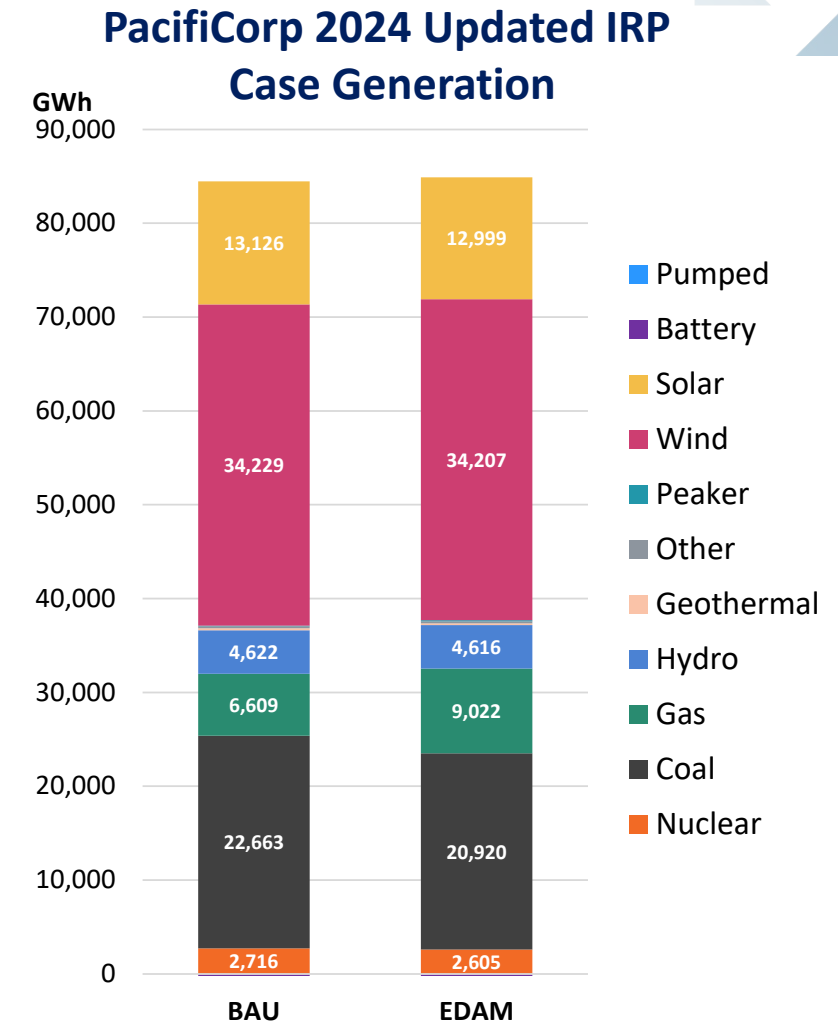
- **Increased wind capacity** is driving a 9 TWh increase in wind generation, mostly in PacifiCorp East
 - Some of this increase in renewable generation is offset by **reduced solar capacity**, especially in PacifiCorp East in Utah
 - This has little effect on PAC given how over-supplied the EDAM footprint is with solar midday, leaving room for cheap market purchases
- **Bridger 3 and 4's carbon capture** tax credit is driving them to generate 6 TWh of coal than in the 2023 study
 - **Gas** generation ramps down to accommodate this cheaper coal
- **Hydro** generation declined, consistent with the PAC-provided hydro capacity updates
- **Nuclear** generation also declined due to the removal of one SMR from the resource mix



Generation Results (2 of 2)

PacifiCorp generation patterns remain similar moving from the BAU case to the EDAM case

- **Thermal generation** ramps up 0.7 TWh from BAU to EDAM, vs. 0.6 TWh in the 2023 study
 - This increase in generation is driven mainly by gas output and the larger EDAM footprint outside the GHG zone, especially Nevada
 - ▶ This allows PAC to sell coal and gas to more BAAs in the EDAM but outside the GHG zone
 - PACE sales to Nevada increase 1.5 TWh in the EDAM case and PACW sales to Portland increase over 1 TWh
- **There is no large change in renewable curtailments in EDAM for PacifiCorp, similar to the 2023 study**
 - Total EDAM footprint curtailments fall about 9 TWh, nearly double the 2023 study (concentrated in CAISO)

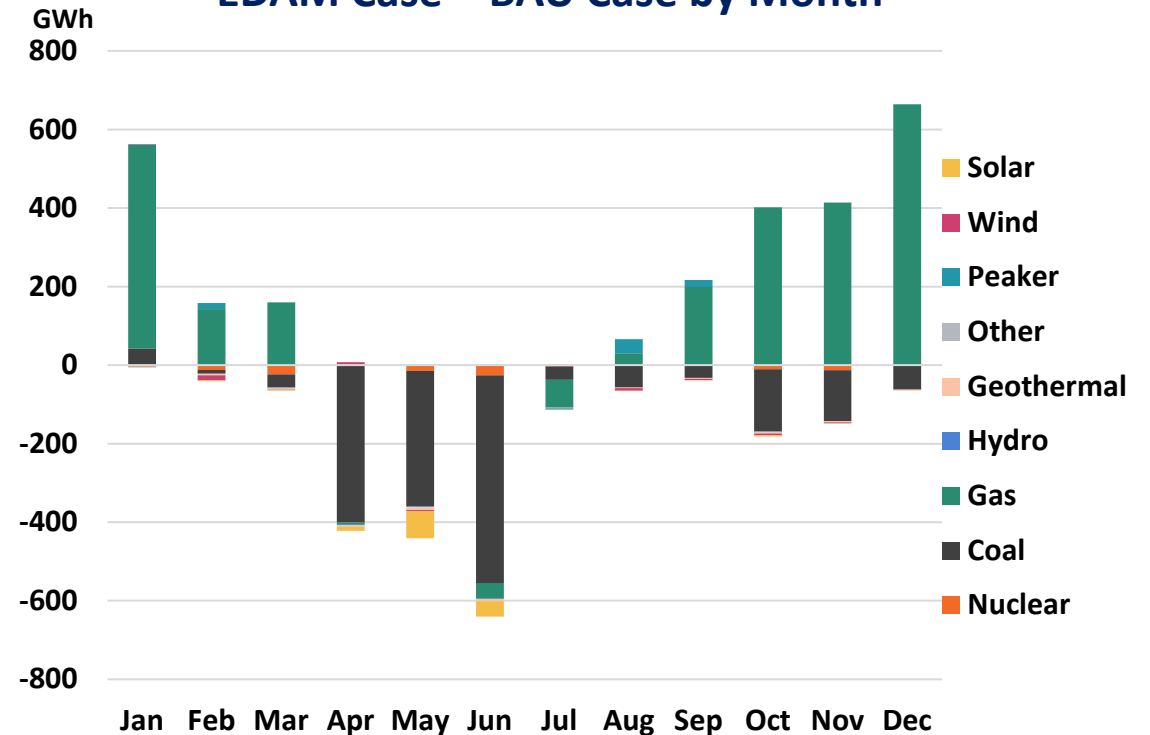


Seasonal Generation Results

PacifiCorp generation movement is highly seasonal, matching WECC and EDAM dynamics

- **Thermal generation** ramps up during non-spring months, when gas is more likely to be on the margin and more opportunities to increase thermal dispatch efficiency in the EDAM footprint emerge
- **Coal generation ramps down in the spring**, when the EDAM footprint has excess solar, wind, and hydro, especially from CAISO
 - The CAISO net export constraint in BAU restrains CAISO renewable surplus exports during spring, which is released in EDAM scenario
- **PAC non-emitting peakers ramp up mostly in February and August during the extreme weeks**, providing value in periods of system stress

PacifiCorp 2024 Updated IRP Case Generation
EDAM Case – BAU Case by Month

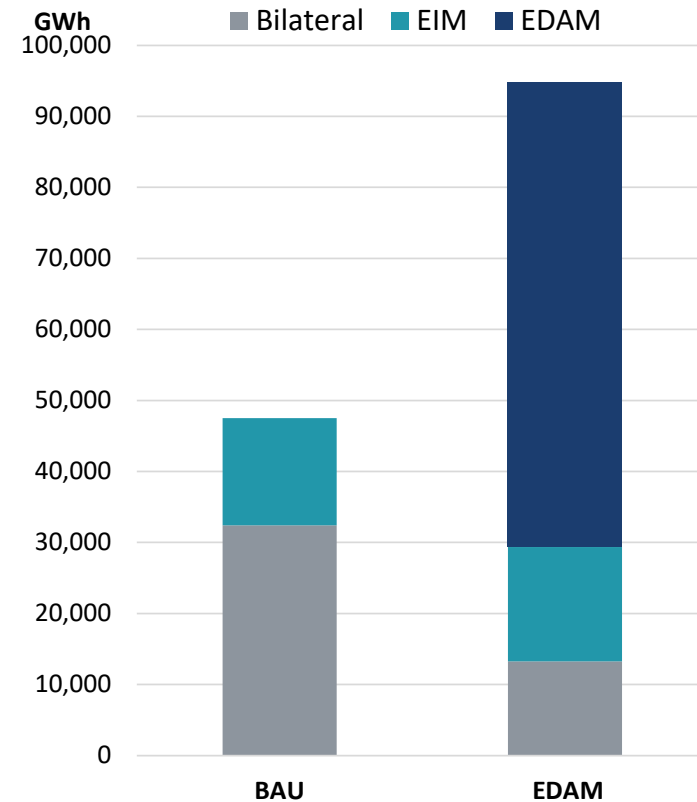


PacifiCorp and EDAM Trade Volumes

PacifiCorp trading volumes double from the BAU case when joining EDAM with more than 65 TWh of trading in the market.

- For the entire market footprint, EDAM trading doubles from **56 TWh** in the 2023 study to **119 TWh** in the 2024 Updated IRP study due to the expanded membership in the market.
- PAC's **bilateral trades** fall ~60% in EDAM as many trading partners join EDAM and the economic opportunity for trading is greater in the market.
- PAC's **EIM trades** are about the same in the BAU case and EDAM case.
- PAC's **EDAM trades** total about 65 TWh, which is about half of all market trades in the entire footprint due to PAC's interconnection with almost all EDAM members.

**PacifiCorp Total Updated IRP
Case Trading Volumes**

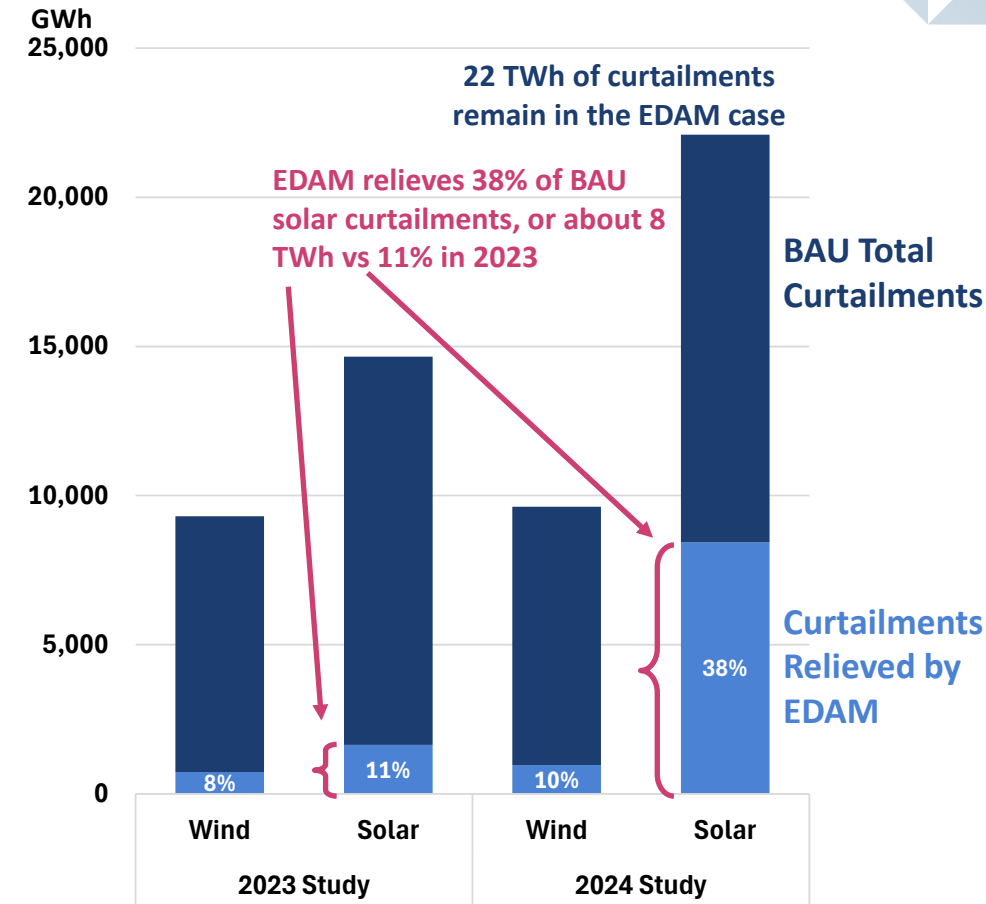


EDAM Curtailment Reductions

The formation of EDAM reduces curtailments within the market footprint by more than 9 TWh

- This is more than **3 times** the 2023 study reduction of ~2 TWh
- **In the 2023 study, the formation of EDAM reduced curtailments by 10% relative to the BAU vs. 30% in this study**
 - This increased reduction is coming from:
 - ▶ (1) The larger modeled EDAM footprint
 - ▶ (2) The increased transmission capability in EDAM via new TX projects
 - ▶ (3) And the changes in the modeled resource mix of many BAAs, including more storage capacity
- **In this study, there are still 22 TWh of curtailments in EDAM,** which could be reduced with an even larger EDAM footprint.
- Like the 2023 study, most of the curtailment reductions are in CAISO, especially solar
 - CAISO has more solar, wind, and storage capacity in this updated study, per their 2023-2024 TPP

Total Curtailments by Study, Case, and Resource Type in the EDAM Footprint



Emissions Impact of EDAM

The formation of EDAM is enabling a WECC-wide reduction in emissions of nearly 5 MMT in 2032 compared to the BAU Case, much higher than our 2023 estimate of 0.3 MMT

- The 2023 study found a smaller reduction in curtailments from EDAM and less coal to gas switching, reducing emissions less compared to this updated sensitivity
 - Coal dispatch declines about 4 TWh WECC-wide from the BAU case to the EDAM case
 - About 2 TWh of this coal decline is from PacifiCorp directly, with most of the rest coming from WACM, TEPC, and SRP
- Emissions in PacifiCorp fall 0.76 MMT compared to the BAU case, mostly due to coal to gas switching
 - 2023 study found only a 0.04 MMT decrease
 - Bridger 3 and 4 in this model count as having no emissions due to their modeled carbon capture systems

Total Emissions in Million Metric Tons (2032)

Case	EDAM			WECC		PacifiCorp			
	EDAM GHG Region	EDAM Non-GHG Region	Total EDAM	Total EIM	Total WECC	PAWA	Rest of PACW	PACE	Total PAC
BAU Case	14.27	31.25	45.52	82.87	149.94	0.03	1.39	18.02	19.44
EDAM Case	11.57	31.55	43.12	79.14	145.05	0.02	1.17	17.49	18.68
EDAM - Status Quo	-2.70	0.31	-2.40	-3.73	-4.89	-0.01	-0.22	-0.53	-0.76

PacifiCorp East APC Benefit

PacifiCorp East's APC benefit of \$59.7 million is driven by:

- (1) **\$82 million** generation cost increase to produce more power for off-system sales
- (2) **\$1 million** purchase power cost increase from higher purchasing offset by lower purchase prices
- (3) **\$142 million** sales revenue increase from a 3.4 TWh increase in sales volumes and \$5.6/MWh increase in average sales price in the DA, offset by reduced RT sales and sales prices
 - As in the 2023 study, additional sales largely in fall and winter, with August – March accounting for nearly the entire increase

Adjusted Production Cost Comparison for PACE

Cost Components			GWh			\$/MWh			Total (\$1000s/Year)		
			Status Quo	EDAM	Difference	Status Quo	EDAM	Difference	Status Quo	EDAM	Difference
Production Cost	(+)	[1]	63,924	64,724	800	\$8.46	\$9.62	\$1.16	540,804	622,670	\$81,866 (1)
Purchases Cost	(+)	[2]									
Day-Ahead Market + Bilateral		[3]	1,488	3,150	1,663	\$24.09	\$13.71	-\$10.39	35,839	43,175	\$7,336 (2)
Real-Time Market		[4]	2,880	3,399	519	\$29.89	\$23.46	-\$6.43	86,100	79,765	-\$6,335 (2)
Sales Revenue (Negative = Cost)	(-)	[5]									
Day-Ahead Market + Bilateral		[6]	11,879	15,228	3,349	\$23.28	\$28.87	\$5.58	276,580	439,578	\$162,998 (3)
Real-Time Market		[7]	2,756	2,389	-367	\$24.22	\$19.38	-\$4.84	66,751	46,293	-\$20,458 (3)
Total Cost (Negative Difference = Benefit)		[8]	53,657	53,657	0	\$5.95	\$4.84	-\$1.11	319,413	259,739	-\$59,674
% Change in APC											-18.7%

Note: Total production cost is calculated as the sum of [1] + [2] - [5] as sales are revenues, not costs. A positive \$ amount in sales is a benefit to the entity, while a positive in purchases is a cost.

PacifiCorp West APC Benefit

PacifiCorp West's APC benefit of \$37.3 million is driven by:

- (1) **\$16.4 million generation cost reduction** from a decline in gas generation of about 0.4 TWh
- (2) **\$21.7 million purchase cost reduction** from access to cheaper power in higher renewable periods,
- (3) **Minimal change in sales revenue** as PACW is almost always a buyer outside of the balancing market in our updated model

Adjusted Production Cost Comparison for PACW

Cost Components			GWh			\$/MWh			Total (\$1000s/Year)		
			Status Quo	EDAM	Difference	Status Quo	EDAM	Difference	Status Quo	EDAM	Difference
Production Cost	(+)	[1]	13,894	13,533	-360	\$11.12	\$10.20	-\$0.92	154,459	138,034	-\$16,424 (1)
Purchases Cost	(+)	[2]									
Day-Ahead Market + Bilateral		[3]	11,332	11,871	539	\$36.40	\$33.71	-\$2.68	412,445	400,223	-\$12,222 (2)
Real-Time Market		[4]	635	472	-163	\$39.96	\$33.62	-\$6.35	25,366	15,856	-\$9,510 (2)
Sales Revenue (Negative = Cost)	(-)	[5]									
Day-Ahead Market + Bilateral		[6]	0	0	0	\$0.00	\$0.00	\$0.00	0	0	\$0 (3)
Real-Time Market		[7]	270	286	16	\$24.09	\$19.73	-\$4.37	6,510	5,638	-\$872 (3)
Total Cost (Negative Difference = Benefit)		[8]	25,590	25,590	0	\$22.89	\$21.43	-\$1.46	585,760	548,475	-\$37,285
% Change in APC											-6.4%

Note: Total production cost is calculated as the sum of [1] + [2] - [5] as sales are revenues, not costs. A positive \$ amount in sales is a benefit to the entity, while a positive in purchases is a cost.

PacifiCorp Washington APC Benefit

PacifiCorp Washington's APC benefit of \$20 million is driven by:

- (1) **\$1.5 million** in generation cost reduction, from a decline in gas generation of about 50 GWh
- (2) **\$6.1 million** purchase cost decrease from a decrease in average day-ahead and real-time purchase price
- (3) **\$12.3 million** sales revenue increase, as PAWA sells its renewable and hydro generation for an average of \$5/MWh more, even with a small decline in real-time sales revenues

Adjusted Production Cost Comparison for PAWA

Cost Components			GWh			\$/MWh			Total (\$1000s/Year)			
			Status Quo	EDAM	Difference	Status Quo	EDAM	Difference	Status Quo	EDAM	Difference	
Production Cost	(+)	[1]	6,381	6,331	-50	\$0.86	\$0.64	-\$0.23	5,519	4,027	-\$1,492	(1)
Purchases Cost	(+)	[2]										
Day-Ahead Market + Bilateral		[3]	1,028	1,187	159	\$27.94	\$21.70	-\$6.24	28,727	25,757	-\$2,970	(2)
Real-Time Market		[4]	1,005	991	-14	\$32.65	\$29.85	-\$2.80	32,805	29,581	-\$3,224	
Sales Revenue (Negative = Cost)	(-)	[5]										
Day-Ahead Market + Bilateral		[6]	2,609	2,719	111	\$28.10	\$33.17	\$5.07	73,315	90,211	\$16,896	(3)
Real-Time Market		[7]	1,030	1,014	-15	\$25.65	\$21.53	-\$4.12	26,405	21,835	-\$4,570	
Total Cost (Negative Difference = Benefit)		[8]	4,776	4,776	0	-\$6.84	-\$11.03	-\$4.19	-32,669	-52,681	-\$20,012	
% Change in APC											61.3%	

Note: Total production cost is calculated as the sum of [1] + [2] - [5] as sales are revenues, not costs. A positive \$ amount in sales is a benefit to the entity, while a positive in purchases is a cost.

Additional Detail of PacifiCorp Results

PacifiCorp East Trading

PacifiCorp East increases trading volumes considerably in EDAM

- **Exports to EDAM members increase over 10 TWh, especially increasing to Nevada, CAISO, and PACW**
- **Imports from EDAM members increase almost 11 TWh**
 - PACE buys 5.4 TWh more from Nevada, mostly midday, reducing the impact of lower PAC solar capacity on midday costs
- **Exports to the SPP West RTO (via WACM) increase 2 TWh**
 - We model RTO intertie trading with reduced trading friction costs, making PACE a cheap export point to the thermal-heavy SPP West RTO

PACE Total Trading Volumes (GWh)

Partner	BAU		EDAM		EDAM - BAU	
	Export	Import	Export	Import	Export	Import
CAISO	1,005	2,498	3,698	4,752	2,692	2,254
LDWP	188	663	599	2,299	412	1,636
IPCO	2,670	996	1,513	2,227	-1,158	1,230
NEVADA	171	568	1,742	5,983	1,571	5,415
PACW	6,031	802	13,299	1,063	7,268	261
AZPS	1,360	1,558	1,916	2,445	556	888
NWMT	2,038	108	1,448	59	-590	-49
SRP	0	0	0	0	0	0
WALC	56	50	54	27	-2	-23
SPP RTO	2,065	567	4,077	778	2,011	211
Total	15,585	7,809	28,345	19,632	12,760	11,824

PacifiCorp West Trading

PacifiCorp West increases trading volumes mostly with PACE, PGE, and MidC

- Trading with PGE increases about 10 TWh as PGE serves as an exit and entry point with BPAT to the EDAM market
 - PGE trading includes MidC trading, as they are the only other counterparty in EDAM there now
 - ▶ 2023 study had limited Idaho Power trading capacity at MidC that is no longer modeled, per Idaho Power TTC updates
 - PACW imports from Idaho and PACE to wheel power into PGE, where it is sold into the Pacific Northwest
 - ▶ Lower friction access from PACW to the PNW would likely result in more of these transfers going directly to the PNW rather than via PGE

PACW Total Trading Volumes (GWh)

Partner	BAU		EDAM		EDAM - BAU	
	Export	Import	Export	Import	Export	Import
CAISO	0	42	0	44	0	1
IPCO	583	366	991	3,596	409	3,230
PACE	802	6,031	1,063	13,299	261	7,268
PAWA	220	343	0	720	-220	376
PGE	327	267	1,380	1,288	1,053	1,021
SCL	82	35	0	139	-82	104
Malin	0	532	0	286	0	-247
MidC	0	1,352	0	817	0	-535
MidC-NonGHG	773	3,131	9,561	2,348	8,787	-782
AVA	0	16	53	2	53	-15
BPAT	644	276	271	215	-373	-61
PSEI	0	0	0	0	0	0
Total	3,430	12,392	13,319	22,752	9,889	10,360

PacifiCorp Washington Trading

PacifiCorp Washington trading modestly impacted by EDAM due to GHG limits, but increases with other GHG zone members

- **PAWA increases trading on GHG paths with Malin counterparties, CAISO directly, and SCL**
 - The addition of SCL to the EDAM footprint gives PAWA another source of low-cost power, given SCL's abundance of cheap and flexible hydro
 - PAWA also buys midday solar from CAISO and the Malin counterparties

PAWA Total Trading Volumes (GWh)

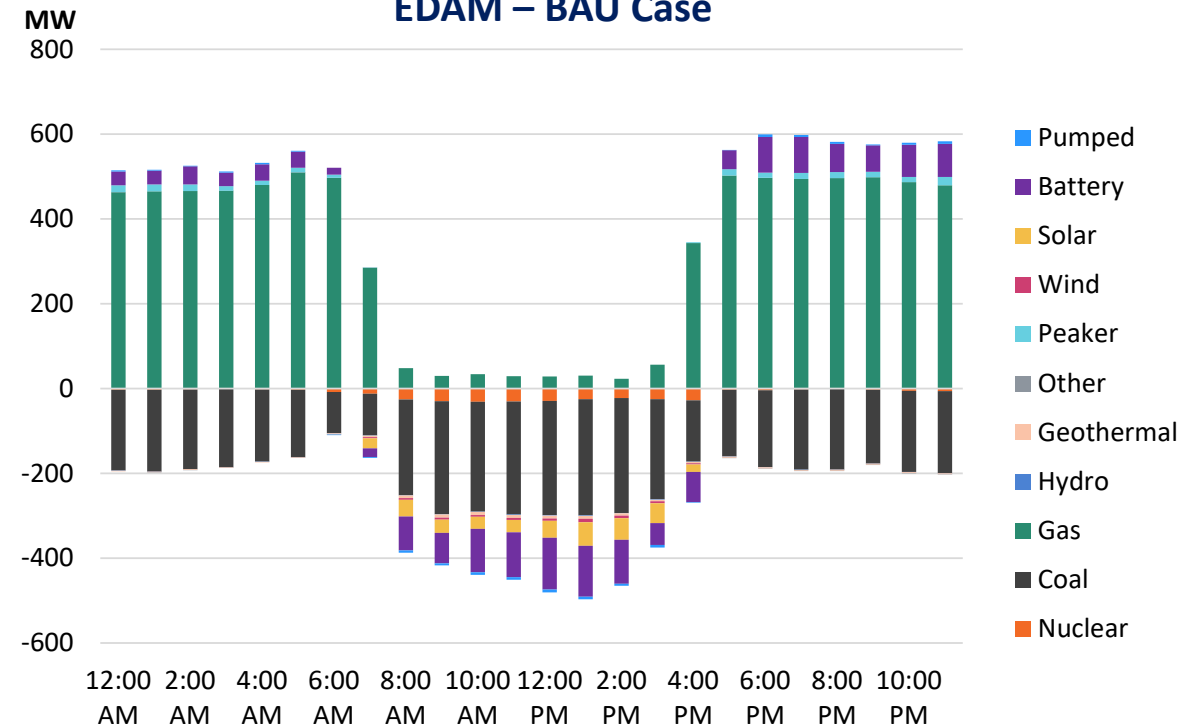
Partner	BAU		EDAM		EDAM - BAU	
	Export	Import	Export	Import	Export	Import
CAISO	88	67	335	125	247	58
IPCO	513	357	421	52	-91	-305
PACE	0	0	0	0	0	0
PACW	343	220	720	0	376	-220
PGE	586	460	529	0	-57	-460
SCL	26	38	436	471	410	434
Malin	1,043	733	1,222	895	179	162
MidC	1,625	408	1,192	1,364	-433	956
MidC-NonGHG	0	0	0	0	0	0
AVA	6	4	273	57	267	53
BPAT	53	390	30	639	-23	248
PSEI	0	0	0	0	0	0
Total	4,283	2,677	5,158	3,603	875	925

PacifiCorp East Generation by Hour of Day

PacifiCorp East mainly uses EDAM to facilitate off-system gas generation sales

- **Gas dispatch increases mostly in the evenings** when the EDAM footprint needs generation, especially in the fall and winter
- **Coal generation is declining, *but only in the renewable heavy spring***
 - Coal actually increases slightly in winter and fall overnight as PACE sells more to other EDAM BAs
- *There's also a small increase in curtailments midday due to CAISO's hourly export limit being removed in EDAM*

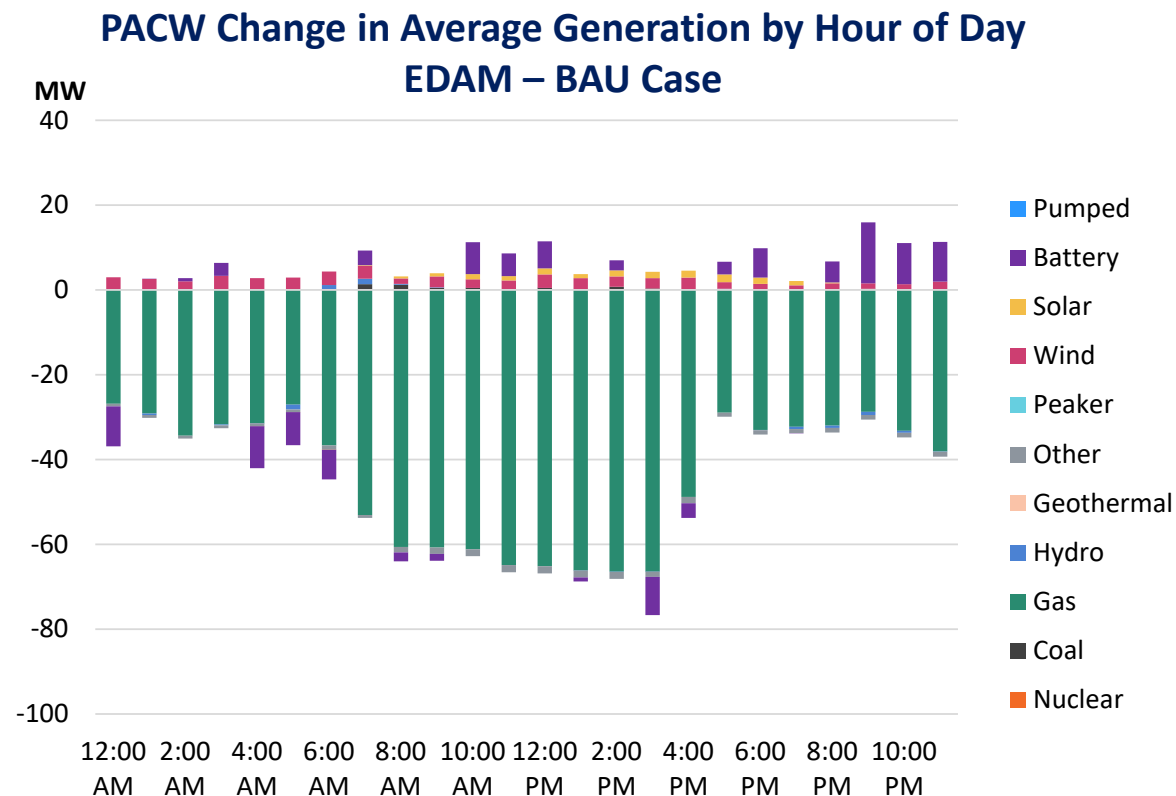
PACE Change in Average Generation by Hour of Day
EDAM – BAU Case



PacifiCorp West Generation by Hour of Day

PacifiCorp West mainly using EDAM to offset internal gas generation with cheaper purchases

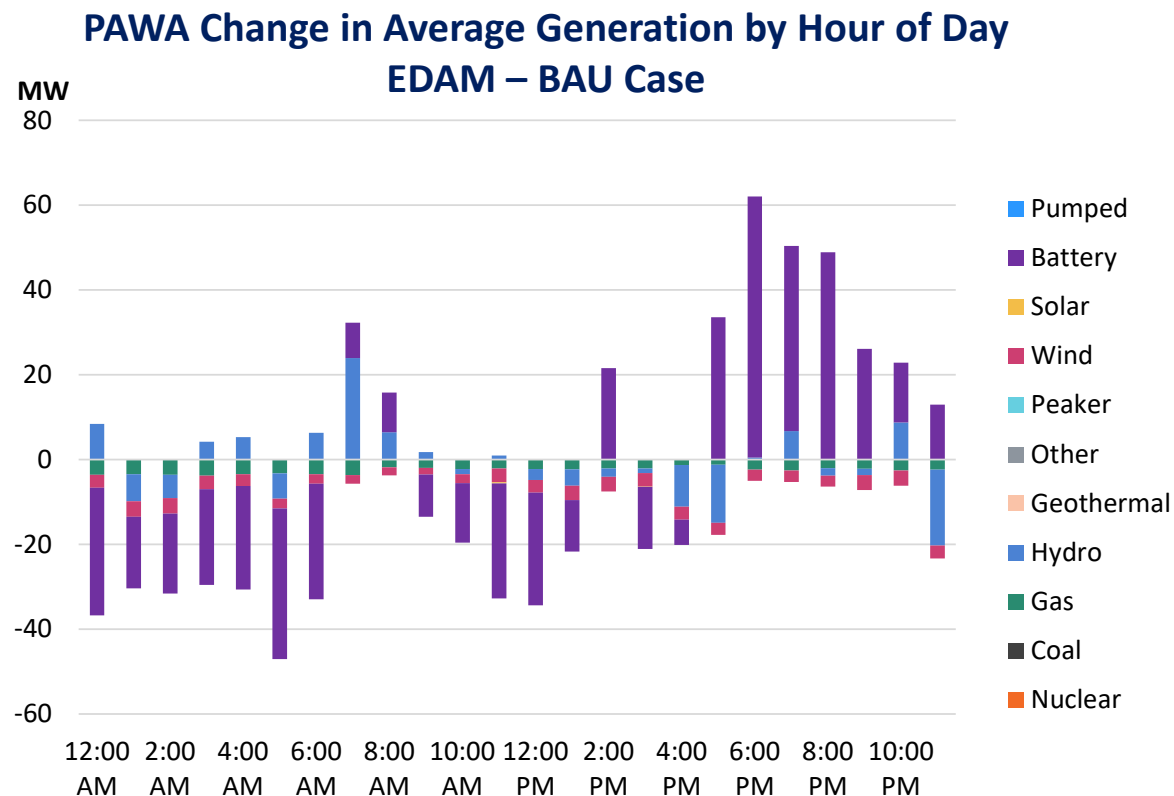
- **Largest offsets come in the middle of the day,** when PACW has access to abundant CAISO solar
- **Wind and solar curtailments drop slightly** for PACW, offset by a slight increase in PAWA



PacifiCorp Washington Generation by Hour of Day

PacifiCorp Washington mainly uses EDAM to shift storage and flexible hydro

- Storage and hydro dispatch shift to higher priced peak evening hours
- Gas generation at Chehalis slightly declines, but is minimal already in the BAU case due to high GHG zone emissions costs
 - GHG cost on Chehalis output is about \$30/MWh, keeping it below 100 GWh of production in all cases



Calculation of Benefits

Benefit Metric: Adjusted Production Cost

Adjusted Production Cost (APC) is a standard metric used to capture the direct variable energy-related costs from a customer impact perspective

The APC is the sum of production costs and purchased power less off-system sales revenue:

- (+) Production costs** (fuel, startup, variable O&M, emissions costs) for generation owned or contracted by the load-serving entities
- (+) Cost of bilateral and market purchases** valued at the BAA's load-weighted energy price ("Load LMP")
- (-) Revenues from bilateral and market sales** valued at the BAA's generation-weighted energy price ("Gen LMP")

The APC is calculated for the Status Quo Case and the RTO case to determine the RTO-related reduction in APC

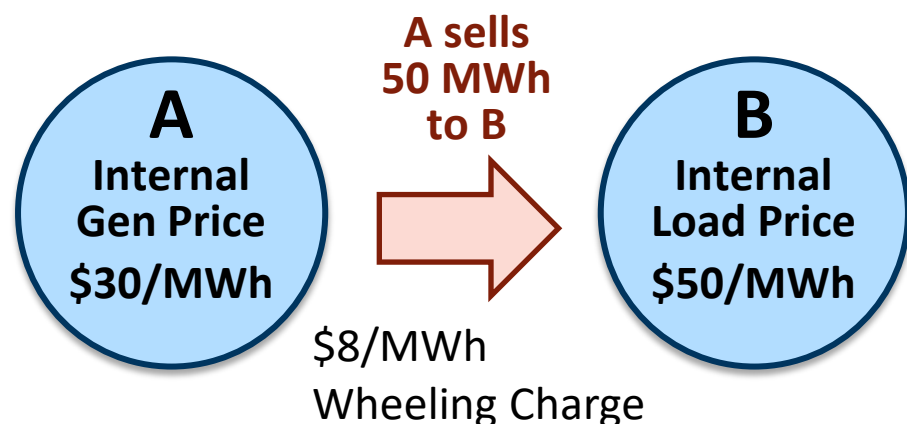
- By using the generation price of the exporter and load price of the importer for sales revenues and purchase costs, the APC metric does not capture wheeling revenues and the remaining portion of the value of the trade to the counterparties (see next slide)

Operational Benefit Metrics: Wheeling Revenues, Trading Gains

Based on the simulation results, we also estimate several additional impacts from increased trading facilitated by the market reforms, which is not fully captured in APC.

- **Wheeling Revenues:** collected by the exporting BAAs based on OATT rates
- **Trading Gains:** buyer and seller split 50/50 the trading margin (and congestion revenues in EIM/EDAM)

EXAMPLE: Bilateral Trade



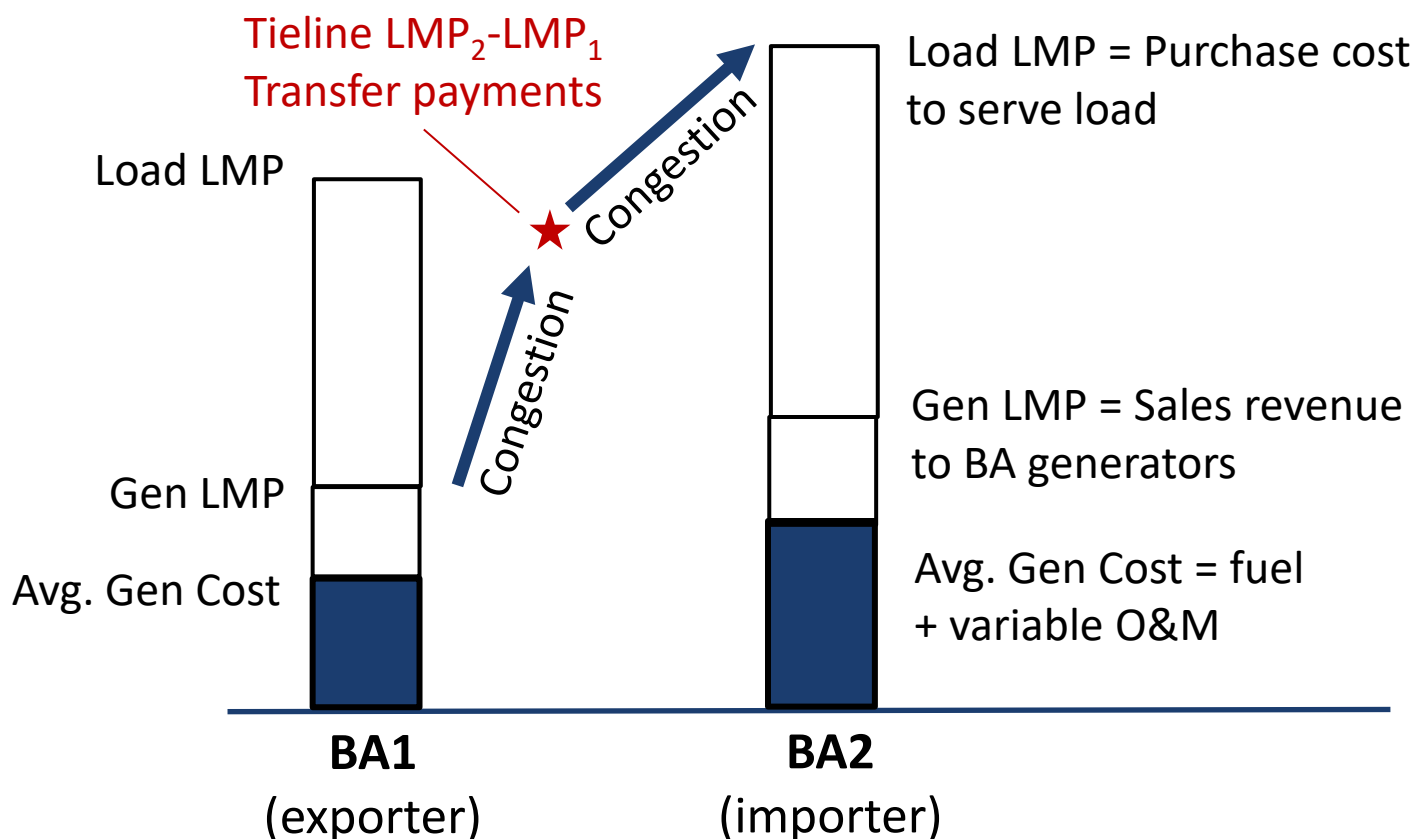
The APC metric only uses area-internal prices for purchase cost and sales revenues, which does not capture part of the value:

- A receives $\$30 \times 50 \text{ MWh} = \$1,500$ in APC sales revenues
- B pays $\$50 \times 50 \text{ MWh} = \$2,500$ in APC purchase costs
- ➔ $\$1,000$ of trading value not captured in APC metric

Trading value = $\$20/\text{MWh } \Delta \text{price} \times 50 \text{ MWh} = \1000

- Exporter A receives wheeling revenues: $\$8/\text{MWh} \times 50 \text{ MWh} = \400
- Remaining $\$600$ trading gain split 50/50: both A and B receive $\$300$

Illustration of APC and EDAM Congestion and Transfer Revenues



EDAM congestion and transfer revenues estimated based on individual tie line LMPs:

- **Congestion Payment (to exporter)**
= MW x (**Tie LMP₁** – Gen LMP₁)
- **Congestion Payment (to importer)**
= MW x (Load LMP₂ – **Tie LMP₂**)
- **Transfer Payment (split 50/50)**
= MW x (**Tie LMP₂** – **Tie LMP₁**)