Memorandum

To: ISO Board of Governors and Western Energy Markets Governing Body

From: Eric Hildebrandt, Executive Director, Market Monitoring

Date: February 5, 2025

Re: **Department of Market Monitoring update**

This memorandum does not require ISO Board of Governors or WEM Governing Body action.

EXECUTIVE SUMMARY

This memo highlights key trends in the recent performance of the California ISO and the Western Energy Imbalance Market (WEIM). The memo includes highlights of market performance in the fourth quarter of 2024, along with an update on the growth of output from renewables and battery storage capacity in 2024.

- In 2024, the California ISO and other balancing areas in California accounted for about 36 percent of total WEIM load, followed by the Pacific Northwest (29 percent), the Desert Southwest (22 percent), and the Intermountain West (13 percent).
- In Q4, prices in the 15-minute market across the WEIM averaged about $39, down 31 percent from the prior year, due mainly to lower natural gas prices.
- During the mid-day hours (9 to 16) when solar production is highest, an average of over 1,300 MW was transferred out of the California ISO area through the WEIM in Q4. During these mid-day hours, an average of over 760 MW was transferred into the Pacific Northwest from other regions.
- During the evening hours with high net loads (19-22), most inter-regional transfers came from the Desert Southwest (665 MWh) and Intermountain West regions (173 MWh), while most of the inter-regional transfers out into other balancing areas were imported into California areas (925 MWh).
- In 2024, the average hourly generation from renewable resources in the WEIM footprint increased by about 2,941 MW (8 percent) compared to 2023. Wind and solar generation accounted for most of this growth, with increases of 826 MW and 1,833 MW, respectively. Hydro generation continues to account for over half of the renewable generation in the WEIM, increasing by about 2 percent to an average of 21,205 MW per hour.
- Battery storage capacity in the ISO balancing area increased by 4,000 MW (45 percent) in 2024, and now totals over 13,000 MW. Battery capacity in other WEIM

balancing areas now exceeds 5,000 MW – or about twice the amount of battery capacity in 2023. Almost all of this battery capacity is located in Desert Southwest balancing areas

MARKET PERFORMANCE

Loads

Figure 1 shows the average monthly loads for the regions of the Western Energy Imbalance Market (WEIM) that the Department of Market Monitoring (DMM) uses to aggregate and report on WEIM market performance.

- In 2024, the California ISO and other balancing areas in California accounted for about 36 percent of total WEIM load.[1]
- Balancing areas in the Desert Southwest comprised about 22 percent of average WEIM load.[2]
- Areas in the Pacific Northwest represented about 29 percent of load.[3]
- Areas in the Intermountain West accounted for about 13 percent of total load.[4]

Total load for all of these regions averaged over 78 GW in 2024, with a simultaneous peak of 135 GW on July 10, 2024.

As shown in other sections of this memo, prices and transfers between each of these regions are distinctly different, and reflect the different resource conditions and transmission limitations between the balancing areas in these different regions.

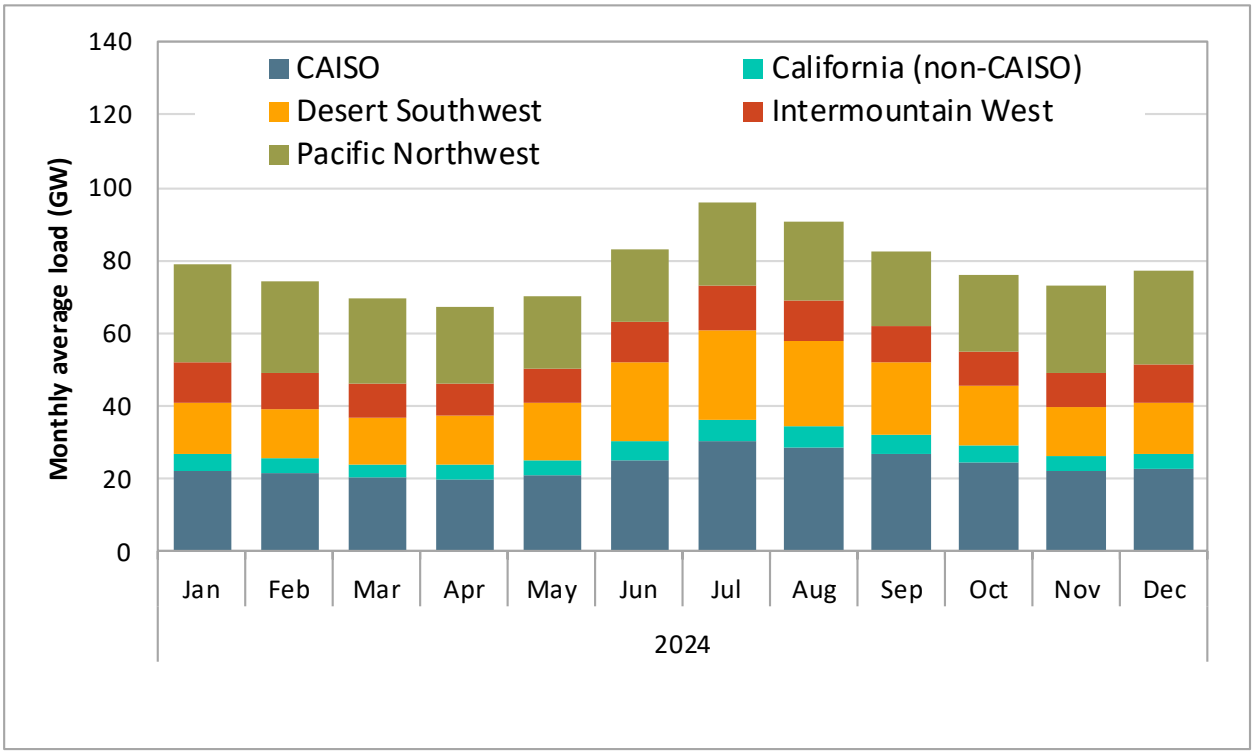
[1] Other balancing areas in California are Balancing Authority of Northern California (BANC), Los Angeles Department of Water and Power (LADWP), and Turlock Irrigation District (TIDC).

[2] Desert Southwest includes Arizona Public Service (AZPS), El Paso Electric Company (EPE), Nevada Power Company (NEVP), Public Service Company of New Mexico (PNM), Salt River Project (SRP), Tucson Electric Power (TEPC), and Western Area Lower Colorado (WALC).

[3] Pacific Northwest includes Avangrid Renewables (AVRN), British Columbia Hydro Authority (BCHA), Bonneville Power Administration (BPA), PacifiCorp West (PACW), Portland General Electric (PGE), Puget Sound Energy (PSEI), Seattle City Light (SCL), and Tacoma Power (TPWR).

[4] Intermountain West includes Avista Corporation (AVA), Idaho Power Company (IPCO), NorthWestern Energy (NWMT), and PacifiCorp East (PACE).

Figure 1. Monthly average 5-minute market load by region (GW)

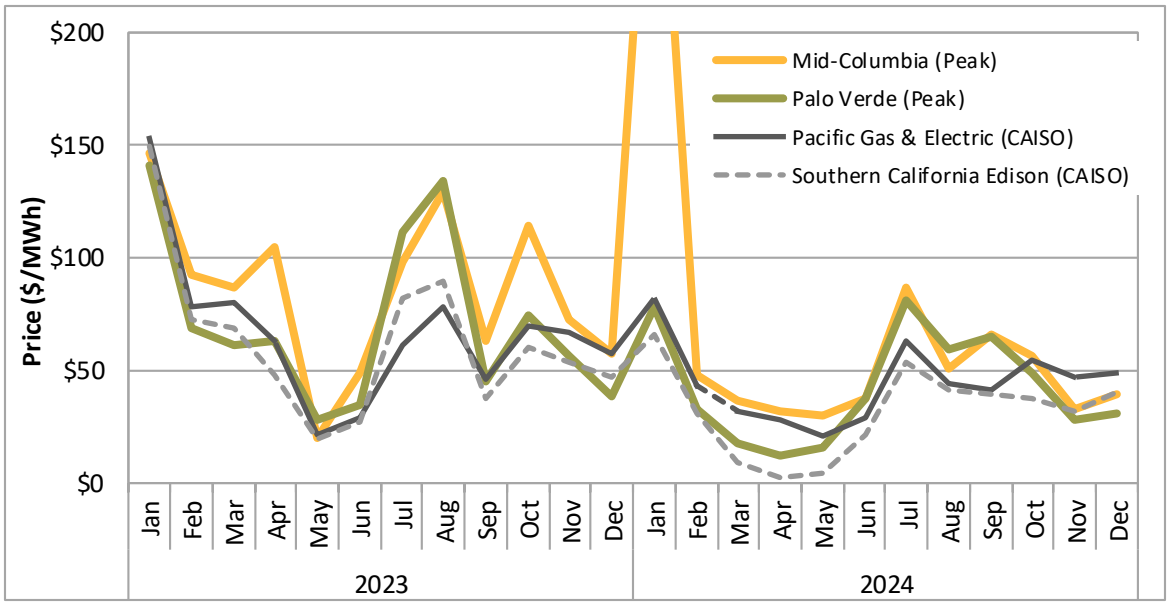


Day-ahead prices

While the California ISO has a full hourly day-ahead market, the rest of the Western states rely upon bilateral markets for trading on a day-ahead basis. The most transparent and liquid market for day-ahead energy is for 16 hour blocks of energy traded on the Intercontinental Exchange (ICE). Figure 2 compares the average monthly prices for peak hour blocks of power traded on ICE at the Mid-Columbia and Palo Verde hubs to average prices for these same hours in the ISO's day-ahead market energy at the Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) default load aggregation points.

As shown in Figure 2, prices in the ISO's day-ahead market in the Pacific Gas and Electric area have tended to be lower than prices on ICE for peak power at Mid-Columbia for most months over the last two years. Similarly, day-ahead prices for Southern California Edison have tended to be lower than prices on ICE for peak power at the Palo Verde trading hub. However, this trend reversed in the last quarter of 2024, with average peak prices in the ISO's day-ahead market of $50/MWh for PG&E and $37/MWh for SCE, compared to bilateral ICE prices of $43/MWh at Mid-Columbia and $37/MWh at Palo Verde.

Figure 2. California ISO day-ahead market vs. day-ahead ICE market trading hub prices (Peak hours 7-22)



Figures 3 and 4 compare these day-ahead prices traded on ICE at the Mid-Columbia and Palo Verde trading hubs to 15-minute prices in the WEIM for the Pacific Northwest and Desert Southwest, respectively. These figures also show a comparison of average peak hour prices in the ISO's day-ahead and 15-minute markets for the PG&E and SCE areas. As shown in these figures, 15-minute prices in the WEIM tend to be lower than day-ahead prices in bilateral regional markets and the ISO's day-ahead market.

Real-time market prices by region

As shown in Figure 5, prices in the 15-minute market across the WEIM were relatively low and stable in the fall months of 2024. In the fourth quarter, average 15-minute prices in the total WEIM footprint were about $39/MW, down 31 percent from the prior year, due mainly to lower natural gas prices.

Figure 3. Mid-C ICE market prices vs. Pacific Northwest 15-minute market prices (Peak hours 7-22)

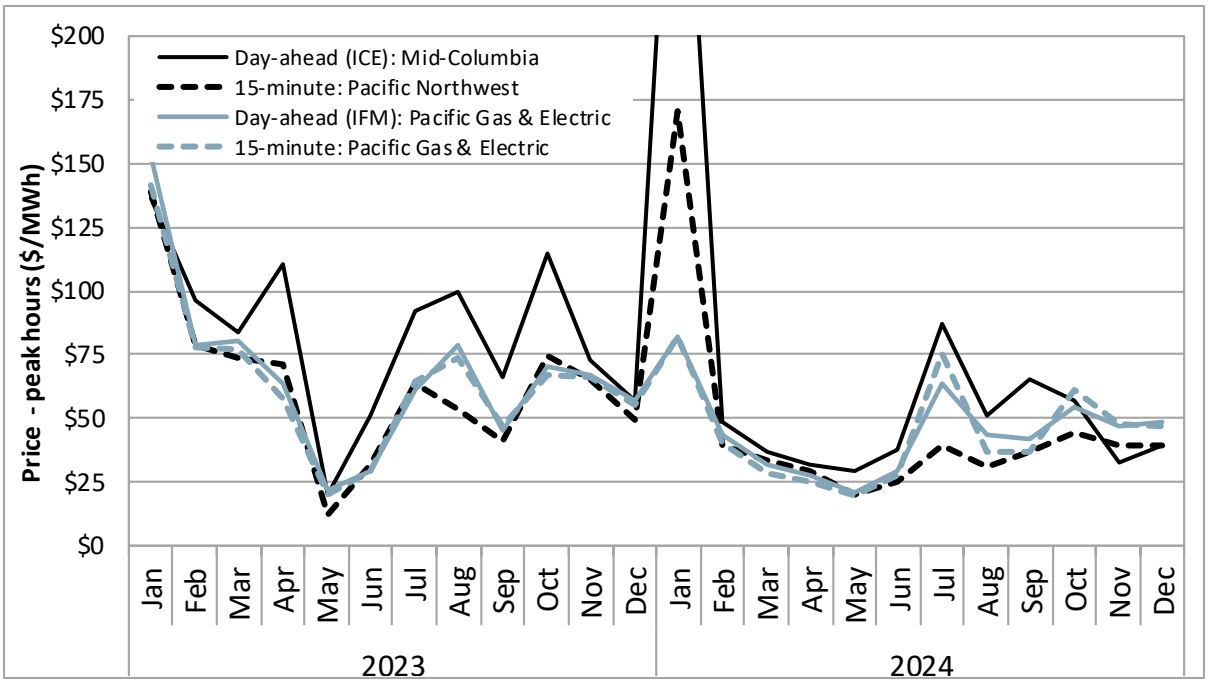


Figure 4. Palo Verde ICE market prices vs. Desert Southwest 15-minute market prices (Peak hours 7-22)

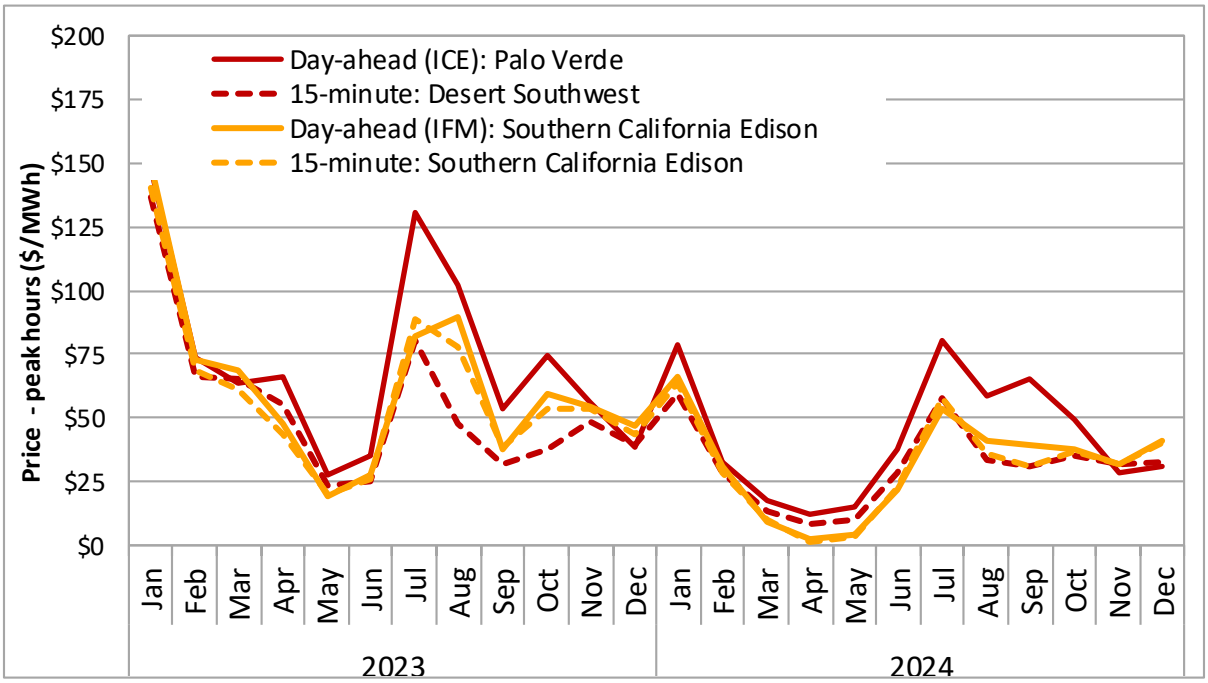
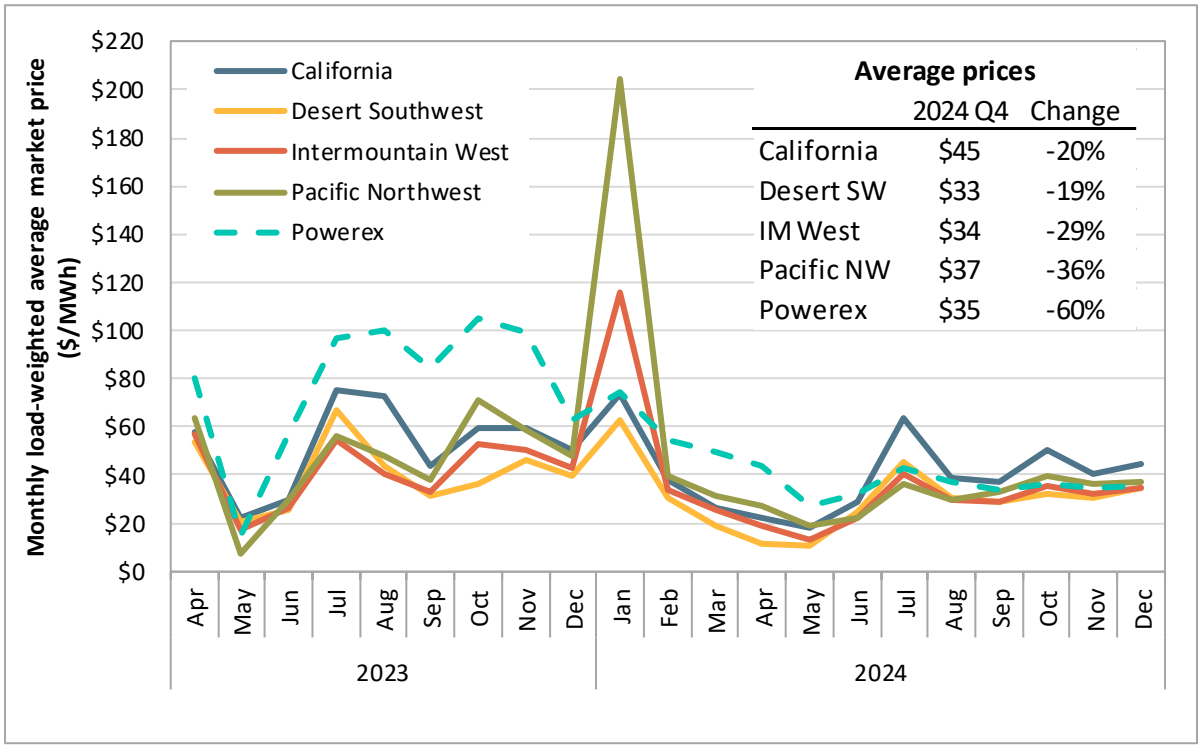


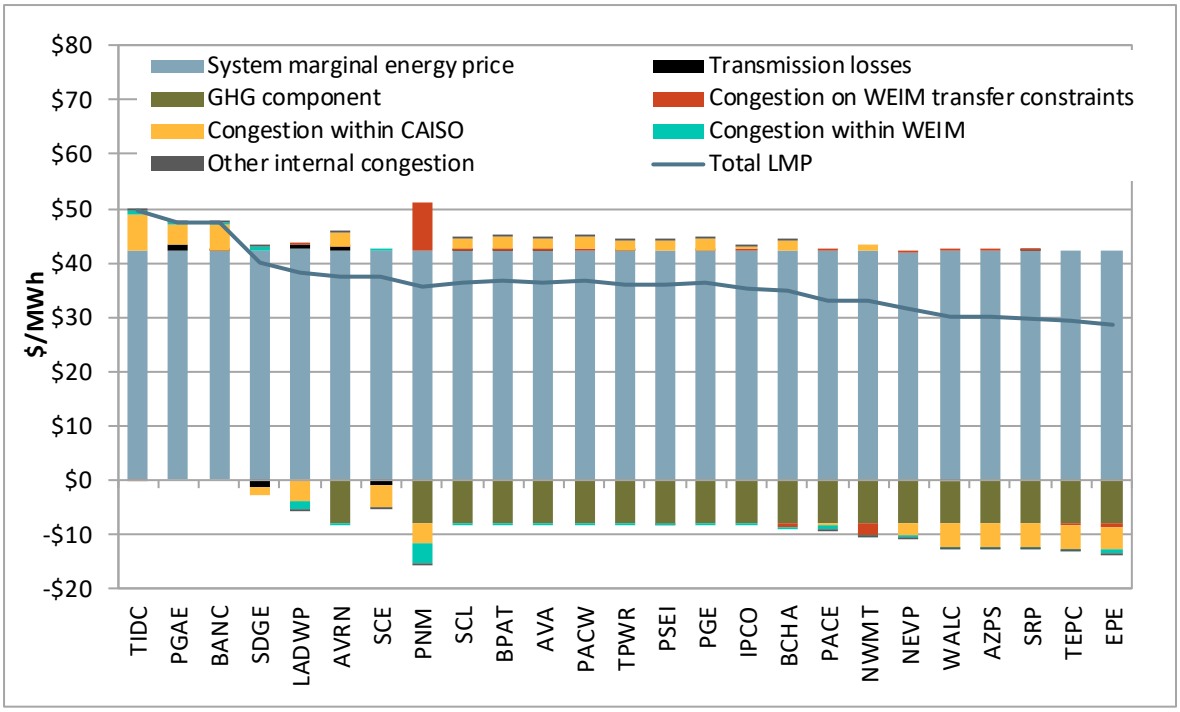
Figure 5. Weighted average monthly 15-minute market prices by region



Average real-time prices in the California balancing areas were higher than in the rest of the WEIM during the second half of 2024. The major driver of higher prices in California is greenhouse gas (GHG), as shown in Figure 6. The GHG component of electricity prices reflects the additional costs associated with complying with California's cap-and-trade program, which requires entities to purchase allowances for their carbon emission to serve load of WEIM balancing areas within California. In Q4, the GHG component accounted for about $8/MWh of the difference between prices in California relative to other WEIM areas.

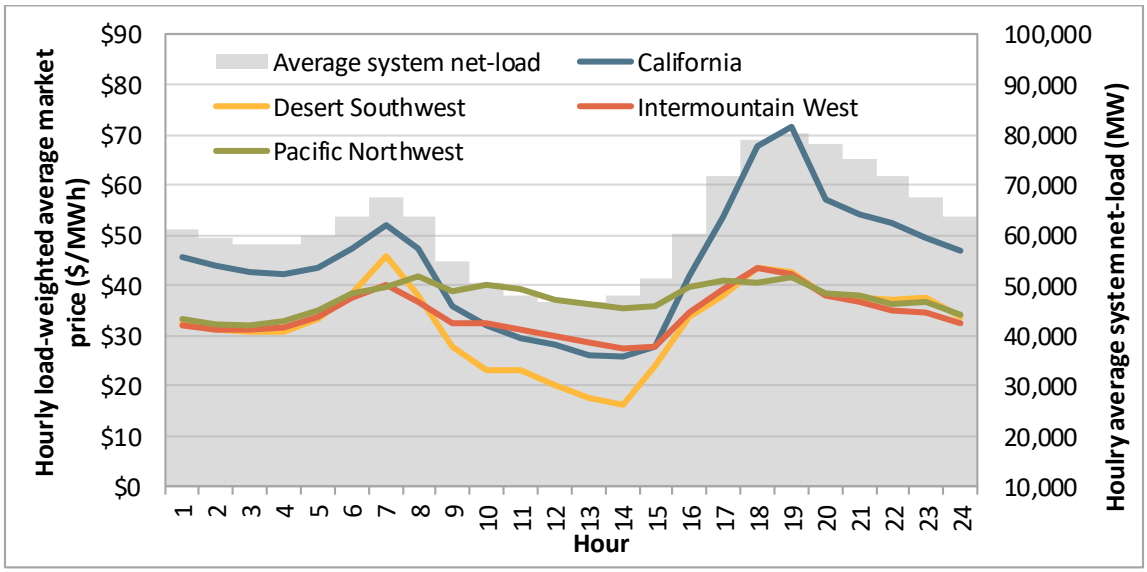
Other major factors causing price differences between WEIM areas in the fourth quarter of 2024 include the high level of excess solar power during the mid-day hours in Southern California, and transmission limits within the ISO between the Pacific Northwest and the Desert Southwest. As shown in Figure 6, congestion within the ISO balancing area in the south-to-north direction during Q4 drove average prices up in the PG&E area by about $3.60, and drove prices in the SCE area down by about $4/MWh relative to the average WEIM system marginal energy price. South-to-north congestion within the ISO drove prices in the Pacific Northwest up by about $2/MWh and drove prices in the Desert Southwest down by over $4/MWh relative to the average system energy price.

Figure 6. Average monthly 15-minute market prices by balancing area
October–December 2024



As shown in Figure 7, prices in the Desert Southwest are driven lower than other WEIM areas during the mid-day hours. However, due to transmission limits in the south-to-north direction, prices in the Pacific Northwest tend to remain higher than other WEIM areas during the peak solar mid-day hours.

Figure 7. Weighted average hourly 15-minute market prices by region
October–December 2024



WEIM transfers

Transfers between different areas of the WEIM in Q4 reflect the prices and supply conditions summarized in other sections of this memo.

As shown in Figure 8, during Q4, the California ISO area (light blue bars) accounted for most of the inter-regional transfers to other balancing areas in other regions during the mid-day hours (9 to 16), when solar production is highest. During these hours, an average of over 1,300 MW was transferred out of the California ISO area in Q4. During these mid-day hours, an average of over 760 MW was transferred into the Pacific Northwest from other regions (green bars).

During the evening hours with high net loads (19-22), most inter-regional transfers came from the Desert Southwest (665 MW) and Intermountain West regions (173 MW), with balancing areas in California accounting for most of the transfers from balancing areas in other regions (925 MW).

Figure 8. Average dynamic inter-regional WEIM transfers by hour 5-minute market, October–December 2024

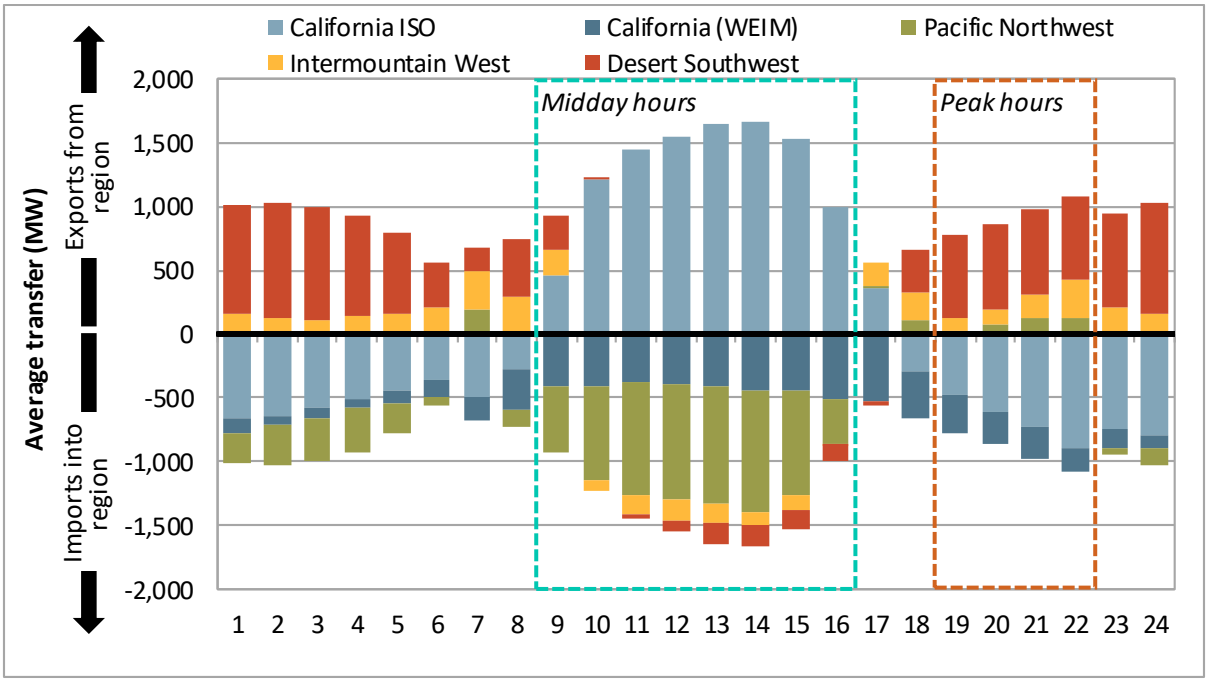


Figure 9 and 10 provide a more detailed summary of the difference in transfers between different balancing areas during the mid-day and peak net load hours during the fourth quarter of 2024.

Figure 9. Average 5-minute market WEIM exports (mid-day hours, October–December 2024)

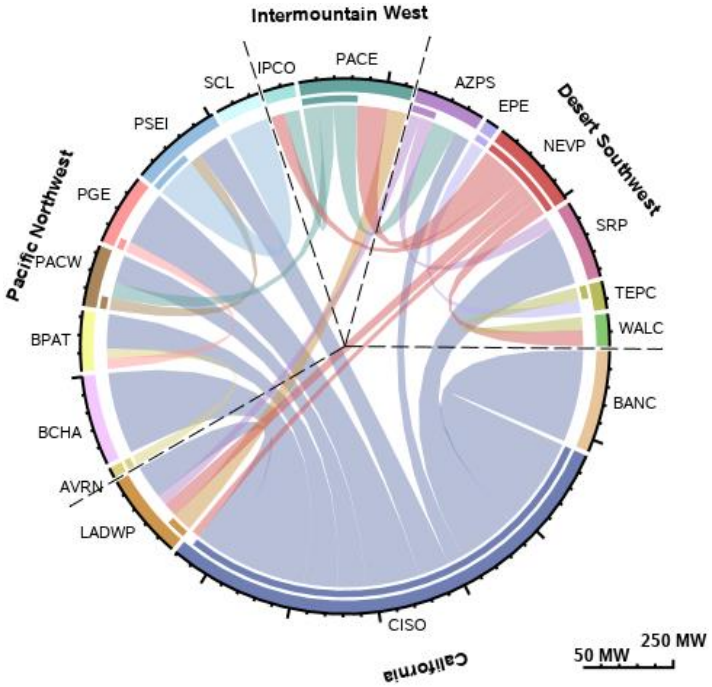
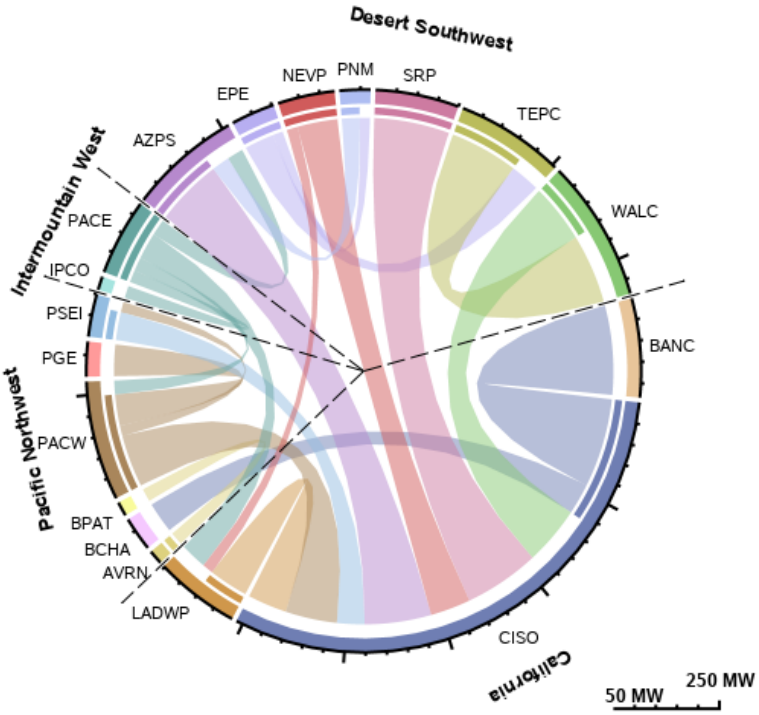


Figure 10. Average 5-minute market WEIM exports (peak net load hours, October–December 2024)



Renewable resources

In 2024, the average hourly generation from renewable resources in the WEIM footprint increased by about 2,941 MW (8 percent) compared to 2023. Wind and solar generation accounted for most of this growth, with increases of 826 MW and 1,833 MW, respectively. Hydro generation continues to account for over half of the renewable generation in the WEIM, increasing by about 2 percent to an average of 21,205 MW per hour.

As shown in Figures 11 through 12, most of the increase in solar generation in 2024 came from the California and Desert Southwest regions. Generation from solar resources made up 43 percent of all renewable output in California balancing areas, increasing by 876 MW (18 percent) compared to 2023. Average hourly wind generation increased by 207 MW (8 percent) in California areas. Solar generation per hour increased by 725 MW and accounted for 50 percent of the renewable fuel mix in the Desert Southwest region in 2024.

As shown in Figure 13, average hourly renewable generation in the Intermountain West region increased by 470 MW (11 percent) relative to 2023. Hourly solar output grew by about 181 MW (29 percent), with wind increasing by about 168 MW (11 percent).

As shown in Figure 14, hydroelectric generation represented 81 percent of all renewable generation in the Pacific Northwest, with average hourly hydro generation increasing by 520 MW (4 percent) in 2024. Average wind generation in the Pacific Northwest region increased by about 457 MW (23 percent), with solar increasing by just 53 MW to 242 MW.

Battery storage capacity

Battery storage capacity has been the fastest growing type of supply in the California and Desert Southwest regions, reflecting how battery storage is being added to better manage and utilize the large amounts of solar energy in these regions.

- As shown in Figure 15, the ISO balancing area battery capacity increased by 4,000 MW (45 percent) in 2024, and now totals nearly 13,000 MW.
- As shown in Figure 16, battery capacity in other WEIM balancing areas now exceeds 5,000 MW – or about twice the amount of battery capacity in 2023. Most of this battery capacity is located in Desert Southwest balancing areas

Almost all battery capacity in the ISO balancing area is bid and scheduled through both the day-ahead and real-time energy markets. Most battery capacity in other WEIM areas are scheduled to charge and discharge through base schedules submitted prior to each operating hour. A very limited amount of this capacity is economically bid into the WEIM, and then dispatched above or below base schedules.

Figure 11. Average monthly renewable generation in the California region

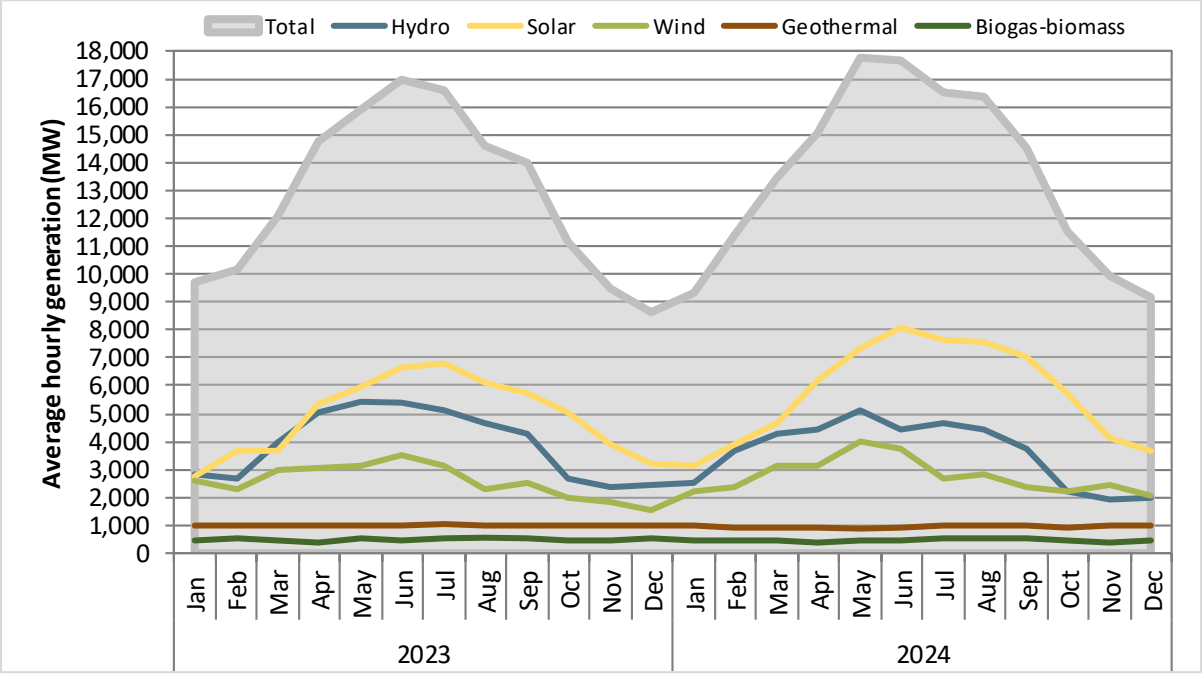


Figure 12. Average monthly renewable generation in the Desert Southwest region

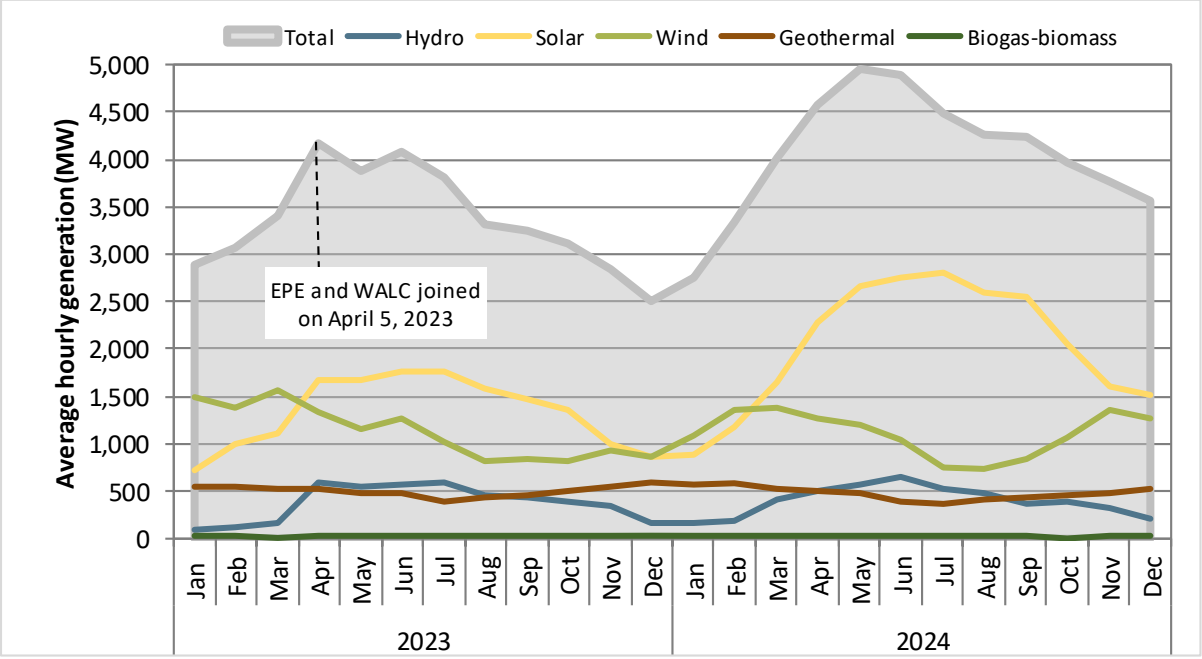


Figure 13. Average monthly renewable generation in the Intermountain West region

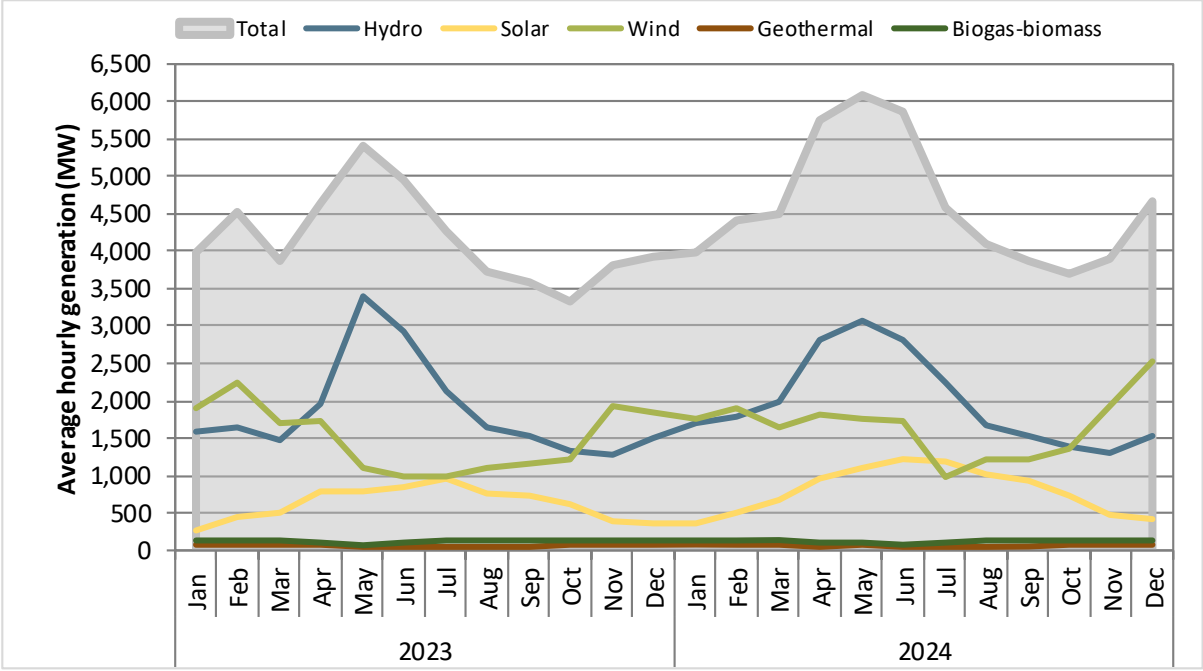


Figure 14. Average monthly renewable generation in the Pacific Northwest region

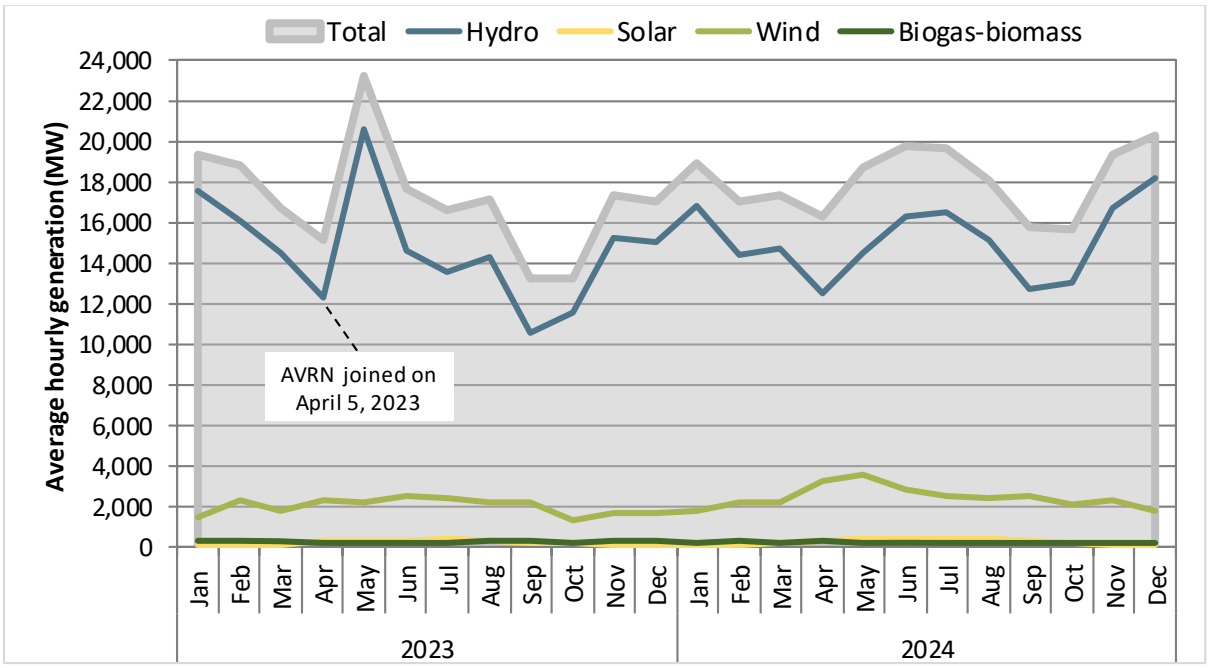


Figure 15. Battery storage capacity in California ISO

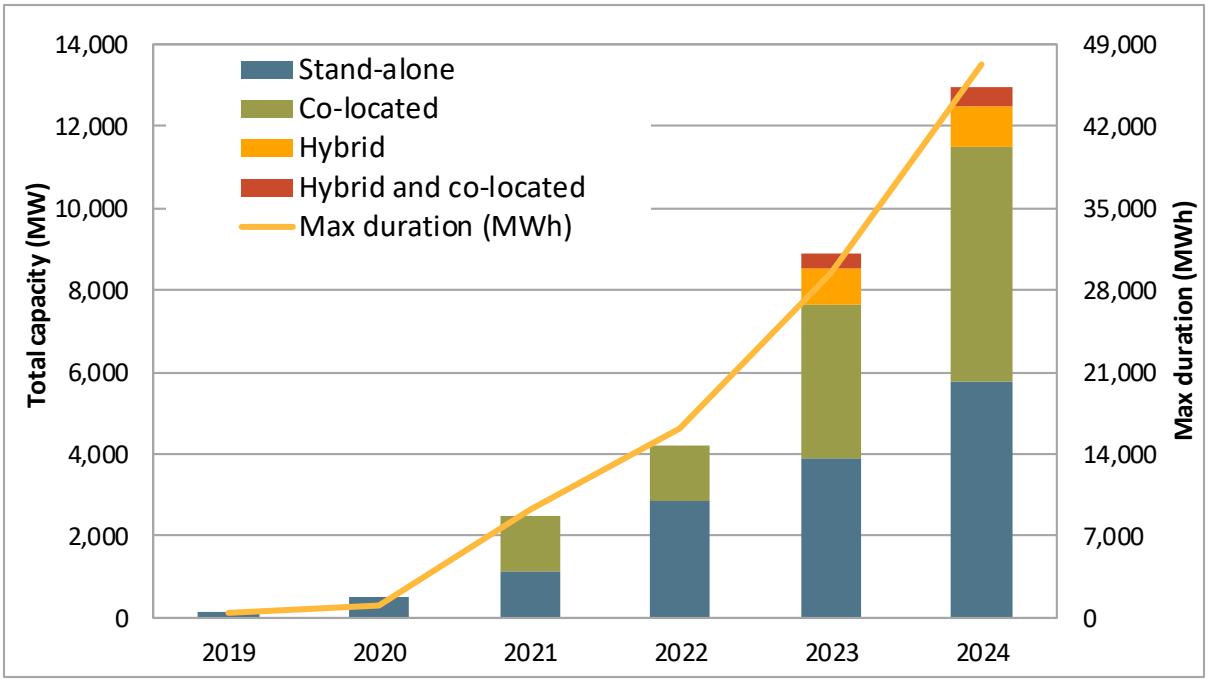


Figure 16. Battery storage capacity in other WEIM balancing areas (December 2024)