



California Independent System Operator Corporation

California ISO

**Assessment of potential competitiveness
in the Western Energy Imbalance Market:**

Avangrid Renewables Balancing Area

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Department of Market Monitoring

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1 Introduction

This report provides an analysis of potential market power in the Western Energy Imbalance Market (WEIM) within the Avangrid Renewables, LLC (AVRN) balancing authority area (BAA). The analysis uses data provided by Avangrid from July 2020 to June 2022. The report assesses the potential competitiveness of the Avangrid area in the WEIM based on the expected amount of competitive supply that may be transferred into the Avangrid area from the broader WEIM footprint, compared to an approximation of imbalance demand that is expected to be served by the WEIM in the AVRN BAA.¹

This analysis indicates that the Avangrid area will likely be structurally competitive in most intervals in the WEIM when WEIM transfer capacity is available in the range of the estimated levels provided by Avangrid.² The analysis further indicates that during the likely limited number of intervals when the Avangrid area may be structurally non-competitive, the CAISO's market power mitigation processes provide highly effective mitigation of the potential to exercise market power.

1.1 Western Energy Imbalance Market

In the California ISO area, the majority of demand is met by supply procured or scheduled in the day-ahead market. The CAISO's real-time markets serve primarily to adjust and optimize unit commitments and dispatches in response to changes in system and market conditions and information.

In the WEIM, however, almost all system load is served by resources identified in the base schedules of the WEIM entities in each BAA. These base schedules are not determined by the automated market systems of the CAISO and are not settled by the CAISO or paid the WEIM prices. The WEIM is a real-time market which starts from the base schedules for these BAAs and then adjusts and optimizes to best meet the imbalance needs of the aggregate WEIM area.

In all WEIM areas, only a small portion of total energy produced and consumed is settled by the CAISO and paid based on WEIM prices. Generating resources that receive or pay the WEIM price are scheduled by the WEIM entity. The only generation settled on WEIM prices is the incremental amount scheduled in the WEIM relative to each resource's base schedule. If market power is exercised in the WEIM, it is exercised on those WEIM imbalance quantities. Any measure of competition or market power should be centered on those quantities as the measures of supply and demand.

For a seller to have structural market power in the WEIM, some kind of barrier must limit supply from new or outside (third-party) entities. The limited nature of electric transmission can create potential market power in some regions. Any area that can be isolated by limited transmission can be subject to high prices and the effects of uncompetitive behavior if a single seller controls enough generation in the area behind the constraint.

¹ The report uses hourly schedules and the hourly actual data provided by Avangrid to estimate hourly imbalance demand for the BAA. These data approximate the 15-minute and 5-minute imbalance demand that will be served by the WEIM.

² Before participation in the WEIM begins, only an estimate of WEIM transfer limits is known. Actual transfer capacity available to Avangrid in the WEIM will vary by hour and interval, based on the utilization of their transmission rights prior to WEIM. However, due to the significant amount by which the estimate of WEIM transfer capacity exceeds estimated imbalance demand, the findings of this analysis are likely robust to some degree of inter-hour variation in WEIM transfer capacity.

Transfers in the 15-minute and 5-minute WEIM processes allow competitively priced sources of power to flow between BAAs, providing access to the BAA for competitive resources from outside areas. The limits of the transfers cap the amount of competitive supply that can be supplied from outside the BAA. In the WEIM 15-minute and 5-minute markets, competitive supply available to meet incremental demand is the transfer capacity that is incremental to the quantity of transfers occurring in the prior market. If the imbalance demand in a given market is greater than the incrementally available import transfer capability, some supply from within the BAA is necessary to meet imbalance demand.

A market is not structurally competitive if a single producer can determine market outcomes. In a structurally competitive market, demand can be met without supply from that single producer. If demand cannot be met without that key producer, that producer is said to be *pivotal*. They can effectively dictate the market price. A *pivotal supplier* test compares demand to competitive supply in order to determine if the key supplier is pivotal. Competitive supply used in the pivotal supplier test consists of supply that can reach the market but is not controlled by the key supplier.

In most WEIM areas, the additional imbalance needs that cannot be met by transfers from other areas would have to be met by the WEIM entity's generation. In an interval where the imbalance demand is greater than the incremental transfer limits, the WEIM entity could theoretically set prices up to the bid cap, knowing that they are pivotal and at least one of their resources would need to be dispatched to meet imbalance energy demand. In such intervals, the WEIM entity could determine market outcomes and set market prices at extremely high levels in the absence of any special market power mitigation provisions.

1.2 Demand for imbalance energy

The relevant demand for each portion of the CAISO's multi settlement markets involves the sum of *changes* between two market solutions. In the CAISO, the 15-minute market demand is equal to (1) the sum of all generation in the 15-minute market *minus* (2) the sum of all generation in the day-ahead market. This represents the incremental energy dispatched by the 15-minute market to meet incremental demand in the 15-minute market. Using the changes to generation to quantify imbalance energy demand accurately captures the quantity of imbalance energy dispatched by the market. This approach is preferable to comparing load forecasts across markets, as the load forecast in each market can underestimate or overestimate the actual market demand due to possible changes in self-schedules, renewable output, resource outages, and other factors. This is particularly true in the case of Avangrid, because it is a generation-only BAA, and therefore does not have load forecast data.

In the WEIM, entities do not participate in the day-ahead market, but instead submit hourly base schedules that are treated very much like day-ahead market schedules in the CAISO. For each WEIM BAA, the imbalance quantity demanded in the 15-minute WEIM market is equal to changes made by the market between base schedules and the final 15-minute schedules. Similarly, the imbalance quantity demanded in the 5-minute WEIM market is equal to changes made by the market between the 15-minute and 5-minute schedules.

For an entity that has not yet begun participation in the WEIM, there are no historical data of WEIM base schedules, 15-minute WEIM generation dispatches, or 5-minute WEIM generation dispatches from which to estimate imbalance demand. In lieu of actual WEIM market data, we can approximate the imbalance demand expected to be served by the WEIM through the use of historical hourly imbalance demand data provided by the incoming WEIM entity.

2 Supply and demand in the energy imbalance market

For this report, DMM analyzed historical imbalance demand derived from data provided by Avangrid, expected WEIM import transfer limits, and generation ownership in the AVRN BAA. These data are compiled for July 2020 through June 2022.

2.1 Demand for imbalance energy

DMM calculated Avangrid’s historical imbalance demand by subtracting the area’s *actual* non-dispatchable output from their *scheduled* non-dispatchable output.³ Figure 1 shows the distribution of the hourly demand for imbalance energy in the AVRN BAA for this roughly two-year period in MW. Actual WEIM imbalance demand will occur at 15-minute and 5-minute granularity, and the amount of intra-hour variation is unknown. However, assessing the best available hourly data is likely to provide a reasonable approximation of what may materialize in the WEIM. Table 1 provides summary statistics for these data.

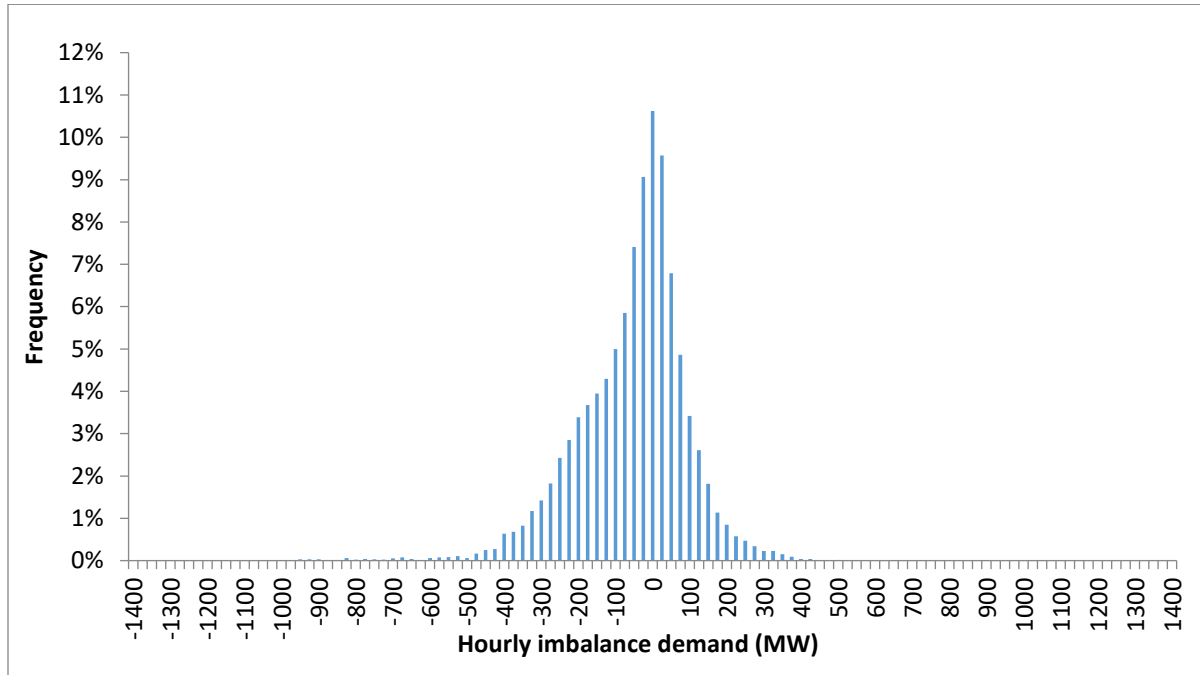
As seen in Figure 1, historical hourly demand for imbalance energy in the AVRN BAA is approximately normally distributed relatively close to 0. However, the distribution is left skewed with an average of -42 MW and a median of -17 MW. This implies more intervals of negative imbalance demand than positive, which is reflected in Table 1. As seen in Table 1, imbalance demand was only positive in 44% of intervals and averaged about 78 MW during those positive intervals.

Table 1: Hourly imbalance demand (MW)

Average	Median	Intervals demand positive	Average positive demand	Percentiles		
				90th	95th	97th
-42	-17	44%	78	114	163	202

³ Scheduled non-dispatchable output includes schedules from non-dispatchable resources and scheduled imports. Actual non-dispatchable output includes actual generation from non-dispatchable resources and actual imports.

**Figure 1: Hourly demand for imbalance energy for the AVRN BAA
July 2020 to June 2022**



2.2 Competitive supply of imbalance energy

The competitive supply available to meet WEIM internal imbalance demand consists of supply that is not controlled by the generation arm of the WEIM entity for that BAA or one of its affiliates. In many WEIM areas, most or all of the available competitive supply is from outside the WEIM BAA in the form of WEIM transfers. WEIM import transfer capacity represents supply that is incremental to base schedules and available to meet imbalance demand.

To determine the competitive supply that will potentially be available to the AVRN BAA in the WEIM, we consider the WEIM import transfer capacity that Avangrid expects to be available in the WEIM. These data provided by Avangrid represent an estimate of expected import transfer capacity for study purposes. Actual WEIM transfer capacity will vary by hour and interval, based upon how Avangrid utilizes their long-term transmission rights prior to the imbalance market. Table 2 shows an annual estimate of WEIM import transfer capacity expected by Avangrid from all interconnected BAAs.⁴

⁴ Avangrid provided hourly transmission reservation data for 2021, for reservations associated with long term transmission rights held on the Bonneville Power Administration (BPA) transmission system. These data included how each set of transmission rights was utilized on a daily basis, and included the amount of remaining available unreserved transmission for each hour. It is assumed that any remaining transfer capacity associated with these transmission rights could be redirected to facilitate import transfers from BPA in the WEIM. Our analysis averaged the hourly availability associated with each set of transmission rights and aggregated these values together to calculate the average total hourly available transmission Avangrid had in 2021. This value is used as an estimate of Avangrid’s WEIM import transfer capacity.

Table 2: Potential competitive supply from WEIM into AVRN (MW)⁵

Source	Expected WEIM Transfer Capacity
BPA	1,074

In addition to WEIM imports, the competitiveness of the AVRN BAA could be further increased by the presence of dispatchable WEIM-participating third-party generation in the BAA. Table 3 summarizes the ownership of incrementally dispatchable generation expected to participate in the WEIM in the AVRN BAA, and shows that all dispatchable participating capacity is owned by Avangrid.⁶ This implies that the competitive supply for imbalance energy in the WEIM will come only from WEIM import transfers.

Table 3: Ownership of dispatchable generation in AVRN BAA expected to participate in WEIM

Fuel Type	WEIM participating capacity (MW)	Ownership
Natural gas	625	AVRN

As shown in Table 2, total estimated competitive supply through WEIM import transfer capability is expected to significantly exceed historical hourly imbalance demand shown in Table 1. While Table 3 highlights there is currently no planned WEIM participation by third-party generators in AVRN BAA, any future access to this form of competitive supply will only increase the competitiveness of Avangrid in the WEIM.

⁵ The AVRN BAA is located within the BPA BAA and thus their reservations utilize BPA's transmission system so it is assumed their expected transfer capacity will be entirely from BPA.

⁶ Capacity from WEIM participating resources that are not expected to be available for incremental dispatch is not reflected here. This includes wind and other renewable resources.

3 Structural market competitiveness

3.1 Pivotal supplier test

The pivotal supplier test for structural market power in the WEIM asks this question: could imbalance demand within the WEIM BAA have been met by transfers of competitive supply from other unaffiliated BAAs? If so, then the WEIM entity was not pivotal in that interval and could not have successfully raised prices at that time. In a structurally competitive market, the exercise of market power would be difficult and opportunities to do so would be rare.

The pivotal supplier test can be performed using historical data for individual intervals in the WEIM by calculating how often the estimated competitive supply was able to meet imbalance demand in the AVRN BAA. When the level of competitive supply is below imbalance demand, Avangrid would be pivotal.

In the absence of WEIM market data for the AVRN BAA, we estimate the expected outcome of this test for the Avangrid area using current available data. This estimation compares the historical hourly imbalance demand data for the AVRN BAA to an estimate of the WEIM import transfer limits Avangrid expects will be available in the WEIM.

This analysis shows that throughout the study period, there were no hours where the estimated hourly imbalance demand was greater than the estimate of expected WEIM import transfer supply. This suggests that Avangrid may be reasonably expected to have access to competitive supply in the WEIM that significantly exceeds typical imbalance demand.

As noted above, WEIM import transfer limits can change hourly and across intervals, based on Avangrid's utilization of transmission rights on the relevant transmission paths. Further, imbalance demand may vary intra-hour by an unknown amount. Despite these caveats, the estimate based on available data should provide a reasonable expectation of overall competitiveness of the Avangrid area in the WEIM.

The expected structural competitiveness of the AVRN BAA in the WEIM can also be estimated based on statistical values of supply and demand. Figure 2 provides a comparison between estimated expected WEIM import transfer capacity, representing competitive supply, and the 95th and 99th percentile of historical hourly imbalance demand.⁷

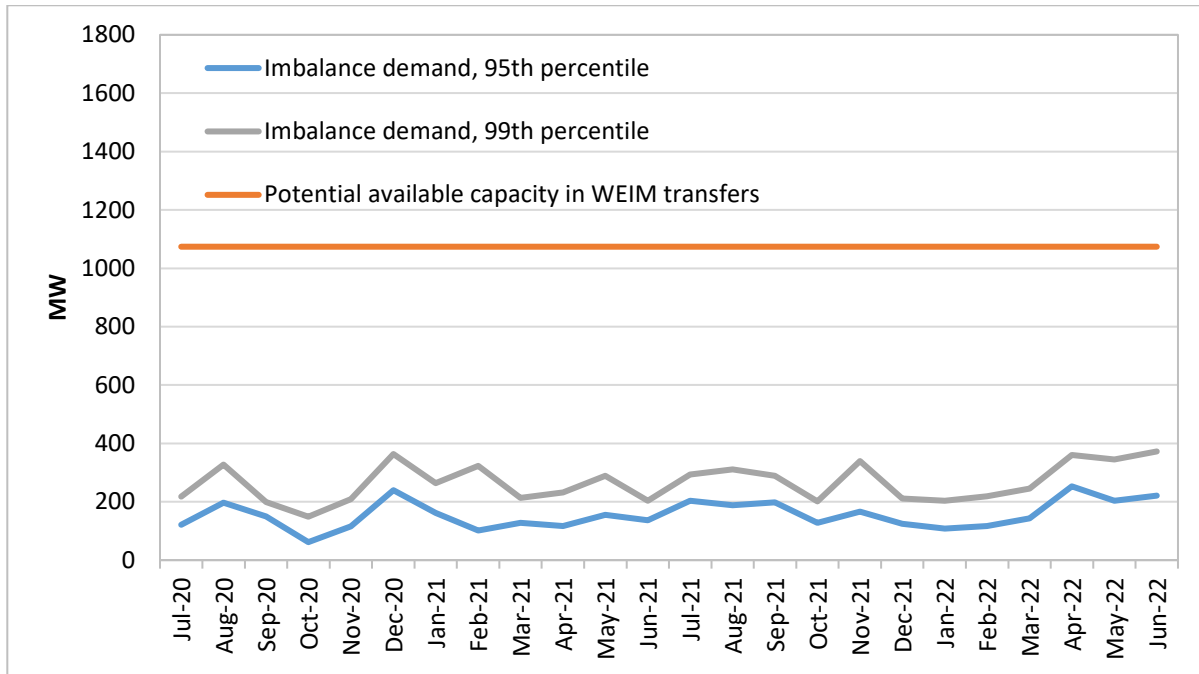
Estimated competitive supply exceeded both the 95th and 99th percentile of imbalance demand during each month of the study period. In the closest months, expected competitive supply was about three times the volume of the 99th percentile of imbalance demand.

These results show that estimated WEIM supply and demand conditions were competitive during the study period for the AVRN BAA. Import transfer capacity at the estimated level, and values significantly

⁷ If we use the average demand over some period of time to compare to average transfer capacity, we will include the negative intervals and may provide an underestimate of the size of the market. Therefore, instead of comparing average competitive supply to average demand, we compare average competitive supply to imbalance demand during intervals with particularly tight supply conditions.

below the estimated level, would have allowed resources from other parts of WEIM to compete with resources controlled by Avangrid in all hours.

Figure 2: Avangrid hourly imbalance demand and expected WEIM import transfer capacity



3.2 Energy bid mitigation

This analysis based on estimated historical hourly imbalance demand and expected WEIM transfer capability suggests that the AVRN BAA is likely to be generally competitive in the WEIM. However, there still exists the possibility in the WEIM that during some intervals, Avangrid may become a pivotal supplier and competitive supply from the broader WEIM into the AVRN BAA may be limited by congestion. When this occurs, this potential structural market power would be mitigated by the CAISO’s real-time market power mitigation procedures. These bid mitigation procedures are triggered when congestion is projected in the real-time market.

When bid mitigation is triggered, bids of all supply within a BAA that is separated from the CAISO BAA are automatically subject to bid limits based on each resource’s marginal cost and competitive system prices. Thus, even when access to competitive supply is limited by congestion, effective market power mitigation ensures that the resulting price is typically still competitive.

DMM analysis shows that CAISO’s market power mitigation processes have a high degree of accuracy of congestion estimation for all existing WEIM transfer constraints. This reduces the possibilities of missed mitigation to a very low level for each of the existing WEIM BAAs in both the 15-minute and 5-minute market, as shown in Table 4 and Table 5.

**Table 4: Accuracy of congestion prediction by region on WEIM transfers, 15-minute market
July 2020 – June 2022⁸**

	Accurately predicted	Predicted but resolved	Under predicted
PACE	86%	10%	3%
PACW	88%	6%	6%
PGE	88%	6%	6%
BCHA	88%	7%	5%
PSEI	89%	7%	5%
IPCO	88%	7%	5%
TWPR	88%	8%	4%
SCL	89%	6%	5%
PNM	80%	15%	5%
AVA	88%	8%	4%
BANC	96%	1%	3%
NWMT	84%	14%	2%
NEVP	88%	8%	4%
TIDC	96%	2%	2%
SRP	87%	8%	5%
AZPS	95%	2%	3%
BANCSMUD	93%	5%	2%
LADWP	81%	13%	6%

⁸ Data for BANC ends March 2021, and are thereafter included with BANCSMUD. Data for BANCSMUD and TIDC begins March 2021. Data for PNM begins April 2021. Data for NWMT begins June 2021. Data for TPWR and AVA begins March 2022.

**Table 5: Accuracy of congestion prediction by region on WEIM transfers, 5-minute market
July 2020 –June 2022⁹**

	Accurately predicted	Predicted but resolved	Under predicted
PACE	65%	27%	8%
PACW	75%	18%	7%
PGE	75%	18%	7%
BCHA	73%	19%	8%
PSEI	77%	16%	7%
IPCO	77%	16%	6%
TWPR	80%	15%	5%
SCL	77%	16%	7%
PNM	53%	39%	8%
AVA	81%	13%	5%
BANC	76%	17%	7%
NWMT	75%	20%	5%
NEVP	76%	19%	6%
TIDC	70%	26%	4%
SRP	73%	20%	7%
AZPS	76%	20%	5%
BANCSMUD	80%	15%	5%
LADWP	61%	30%	9%

⁹ Data for BANC ends March 2021, and are thereafter included with BANCSMUD. Data for BANCSMUD and TIDC begins March 2021. Data for PNM begins April 2021. Data for NWMT begins June 2021. Data for TPWR and AVA begins March 2022.

4 Conclusion

This report provides analysis by DMM evaluating the potential for market power in the WEIM in the Avangrid area. Although Avangrid has not yet begun participation in the WEIM, and no market data are yet available, we analyzed estimated hourly imbalance demand derived from data provided by Avangrid, generation ownership in the AVRN BAA, and an estimated amount of WEIM import transfer capacity that Avangrid anticipates will be available in the WEIM.

This analysis indicates that the AVRN BAA is likely to be structurally competitive during almost all intervals in the WEIM. The estimated competitive supply expected to be available for transfer into Avangrid from the rest of the WEIM significantly exceeds estimated imbalance demand in the AVRN BAA.

The report also shows that CAISO's real-time market power mitigation procedures provide assurance that any potential market power in the AVRN BAA will be effectively mitigated when the Avangrid area is separated by congestion from the CAISO and other WEIM areas.