

The Western EIM, Energy Markets and Trading

Scott Harvey
Northwest Public Power Association
2016 Power Supply Conference
Portland, Oregon
August 2, 2016



Critical thinking at the critical time™

Scott Harvey is or has been a consultant on electricity market design and transmission pricing, market power or generation valuation for Allegheny Energy Global Markets; American Electric Power Service; American National Power; Aquila Merchant Services; Avista Corp; California ISO; Calpine Corporation; Centerpoint Energy; Commonwealth Edison; Competitive Power Ventures; Conectiv Energy; Constellation Power Source; Coral Power; Dayton Power and Light; Duke Energy; Dynegy; Edison Electric Institute; Edison Mission; ERCOT; Exelon Generation; General Electric Capital; GPU; GPU Power Net Pty Ltd; GWF Energy; Independent Energy Producers Association; ISO New England; Koch Energy Trading; Longview Power; Lubbock Power & Light; Merrill Lynch Capital Services; Midwest ISO; Morgan Stanley Capital Group; National Grid; New England Power; New England States Committee on Electricity; New York Energy Association; New York ISO; New York Power Pool; Ontario IESO and IMO; PJM; PJM Supporting Companies; PPL; Progress Energy; Public Service Company of New Mexico; Reliant Energy; San Diego Gas & Electric; Sempra Energy; Mirant/Southern Energy; Texas Utilities; Transalta Energy Marketing; Transcanada Energy; Transpower of New Zealand Ltd; Tucson Electric Power; Westbook Power; Williams Energy Group; and Wisconsin Electric Power Company. The views presented here are not necessarily attributable to any of those mentioned, and any errors are solely the responsibility of the author. The views presented here are the individual views of the author and do not reflect the collective opinion of the California ISO market surveillance committee.

TOPICS

- The Western EIM
- Price Transparency
- Impact of the EIM on Trading and Contracting
- Trading Hubs and the EIM

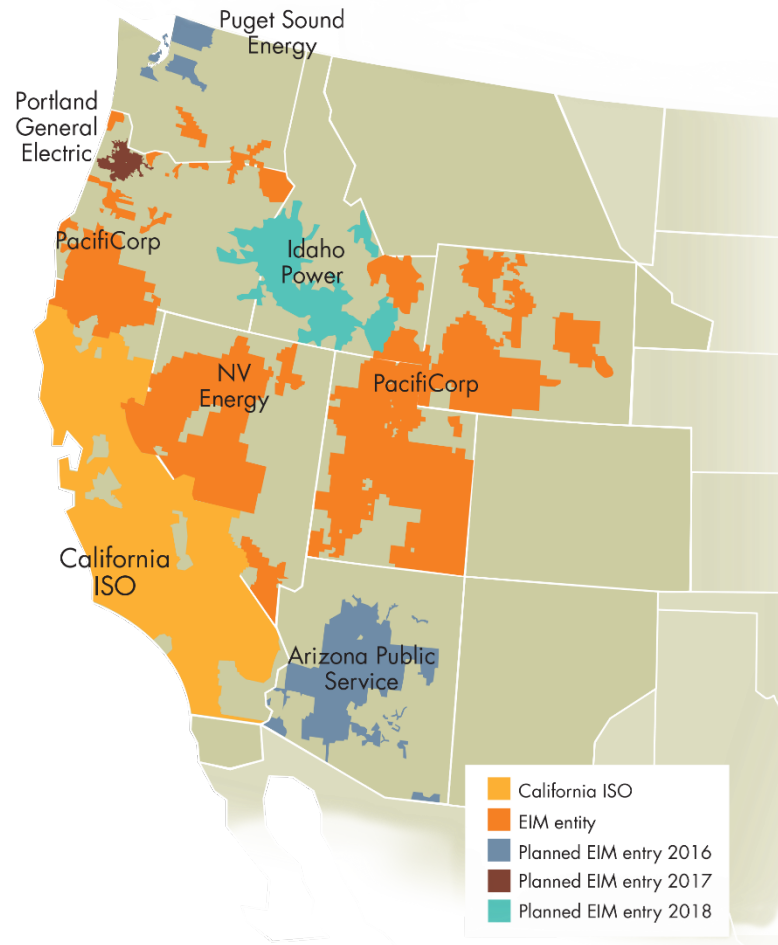
THE WESTERN EIM

Activation of the Western EIM with the participation of the California ISO and PacifiCorp on November 1, 2014 was an important step in the evolution of western power markets.

- The Nevada companies began participating in the Western EIM in December 2015.
- Puget Sound Energy and Arizona Public Service will begin participating in the Western EIM in Fall 2016; Portland General Electric in Fall 2017, and Idaho Power in Spring, 2018.

THE WESTERN EIM

The EIM already covers a broad footprint in WECC, and that footprint will expand substantially in the next few years.



THE WESTERN EIM

Participation in the Western EIM helps the EIM entities and other EIM participants reduce rate payer costs in several ways that are easy to visualize:

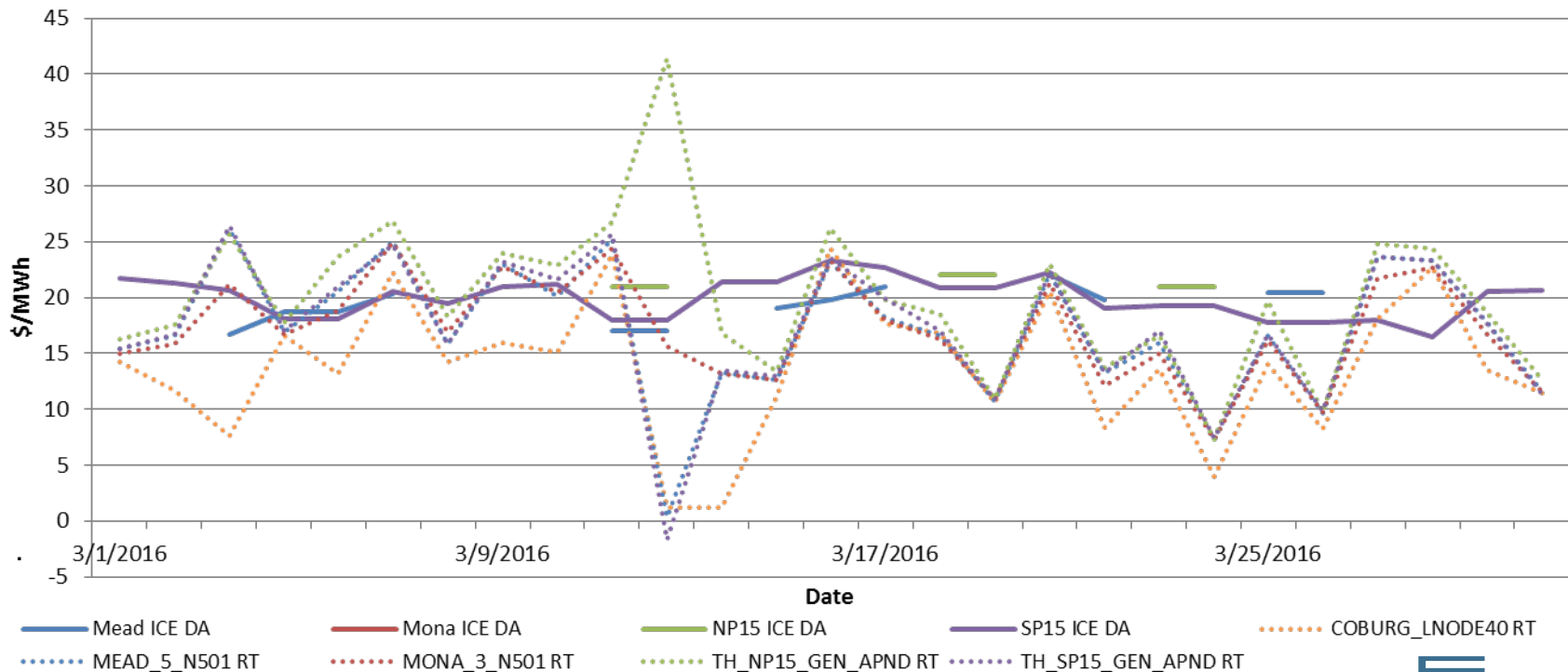
- Balancing variations in intermittent output within their individual balancing authority areas at lower cost;
- Enabling fuller utilization of the transmission system in real-time;
- Allowing better use of surplus intermittent resource output in adjacent balancing authority areas to reduce the output of thermal generation in real-time.

PRICE TRANSPARENCY

The operation of the Western EIM also provides price visibility for all utilities and generators in the WECC, without regard to whether they are EIM participants.

- Unlike bilateral trading platforms, the EIM posts prices every day, every 15 minutes, at every location.

ICE Day Ahead and CAISO Daily Average 15 Minute Prices for Select Hubs Peak Hours, March 2016



TRADING AND CONTRACTING

Implementation of the western EIM also has the potential to benefit trading and forward contracting within the EIM footprint and thereby reduce costs in ways that are a little more subtle than the production cost savings noted above.

- At present, forward power contracts within the region can be booked out day-ahead in the bilateral market if the day-ahead price of power is lower than the cost of the generation that would be used to cover the contract.
- It is more difficult, however, for contract parties, even balancing authority area operators, to cover their contract deliveries with purchases of lower cost spot market energy on an hourly, 15 minute or five minute basis during the operating day.

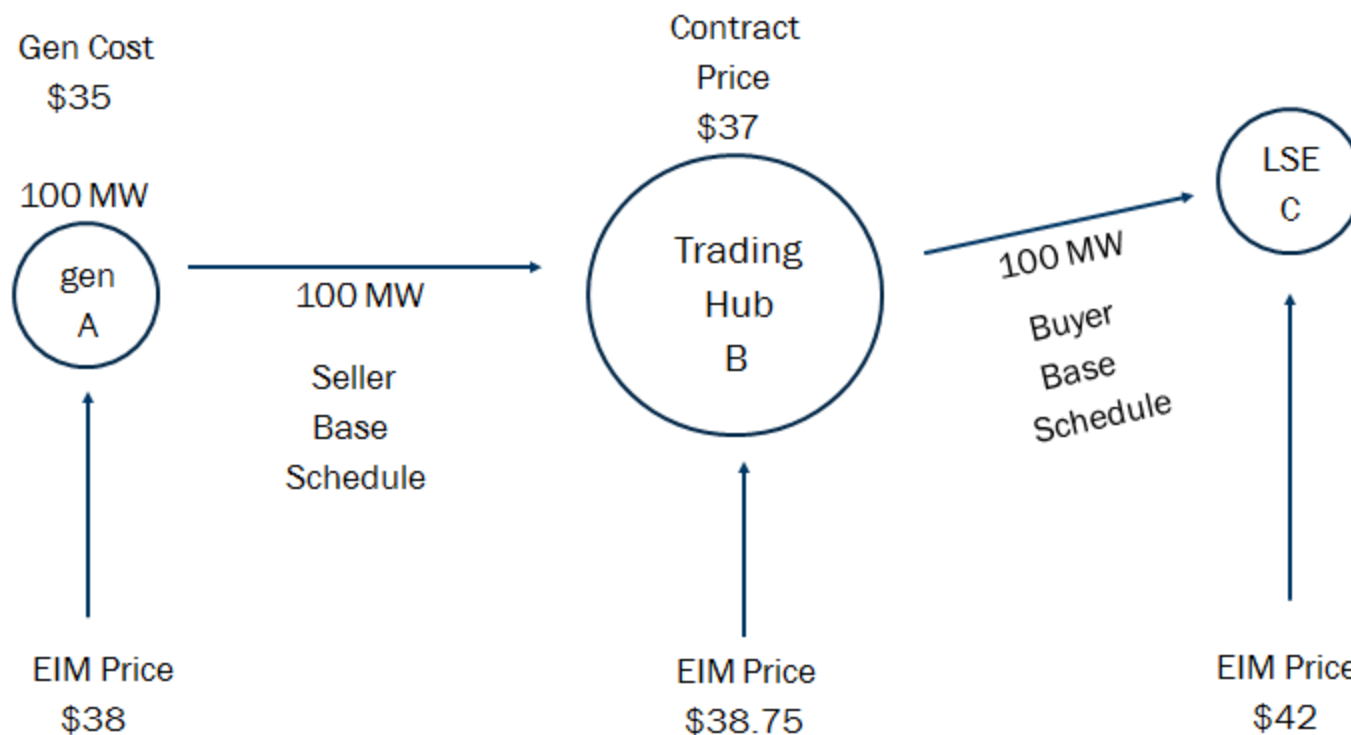
TRADING AND CONTRACTING

Sellers obligated to deliver power under forward contracts at locations within the EIM footprint can choose to cover those contracts with their own generation or with lower cost spot market purchases on a 15 minute or 5 minute basis by participating in the EIM spot market.

- The California ISO's real-time EIM dispatch will dispatch EIM resources down relative to their base schedule whenever their bids show it would be cheaper to buy power to cover their schedule in the fifteen minute market (FMM/RTPD) than to generate the power using their own generation resources.
- The California ISO's real-time EIM dispatch will also dispatch EIM resources down relative to their Fifteen Minute Market schedule whenever the resources' bids show it would be cheaper to buy power to cover their schedule in the five minute market (RTD) than to operate their own generation.

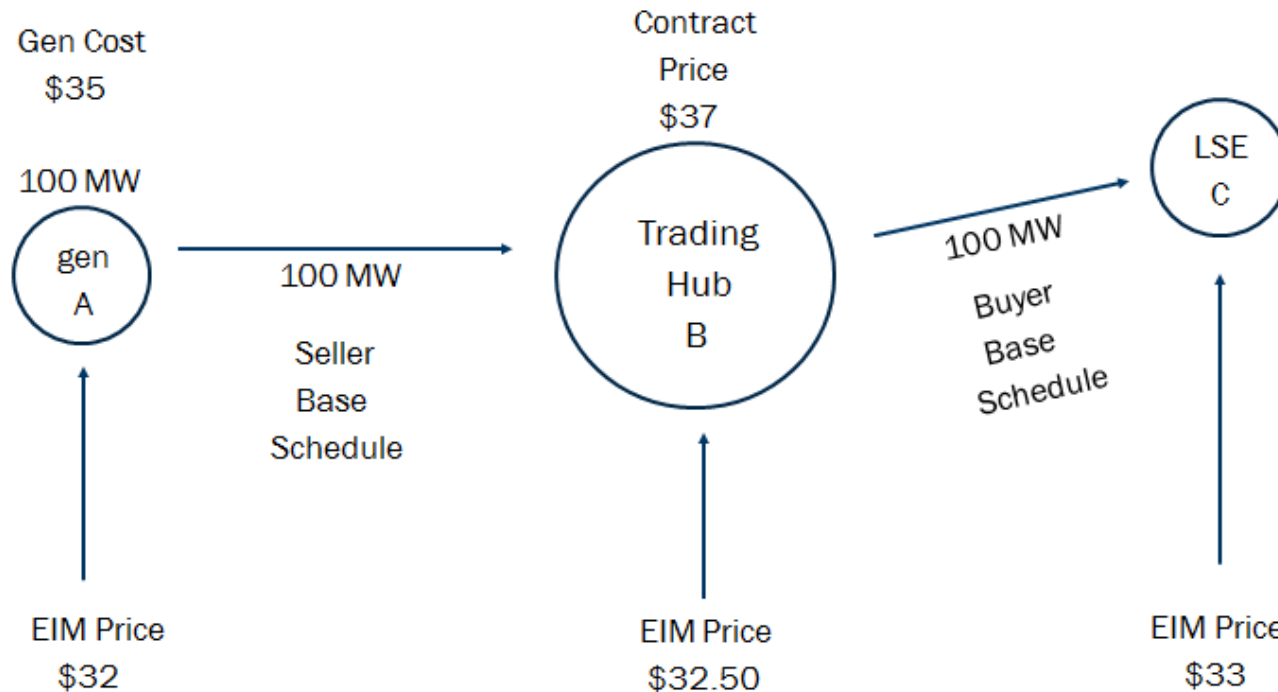
TRADING AND CONTRACTING

There is no obligation for parties with bilateral contracts to participate in the EIM spot market. The EIM design readily accommodates bilateral transactions, whether or not the contract parties choose to actively participate in the EIM.



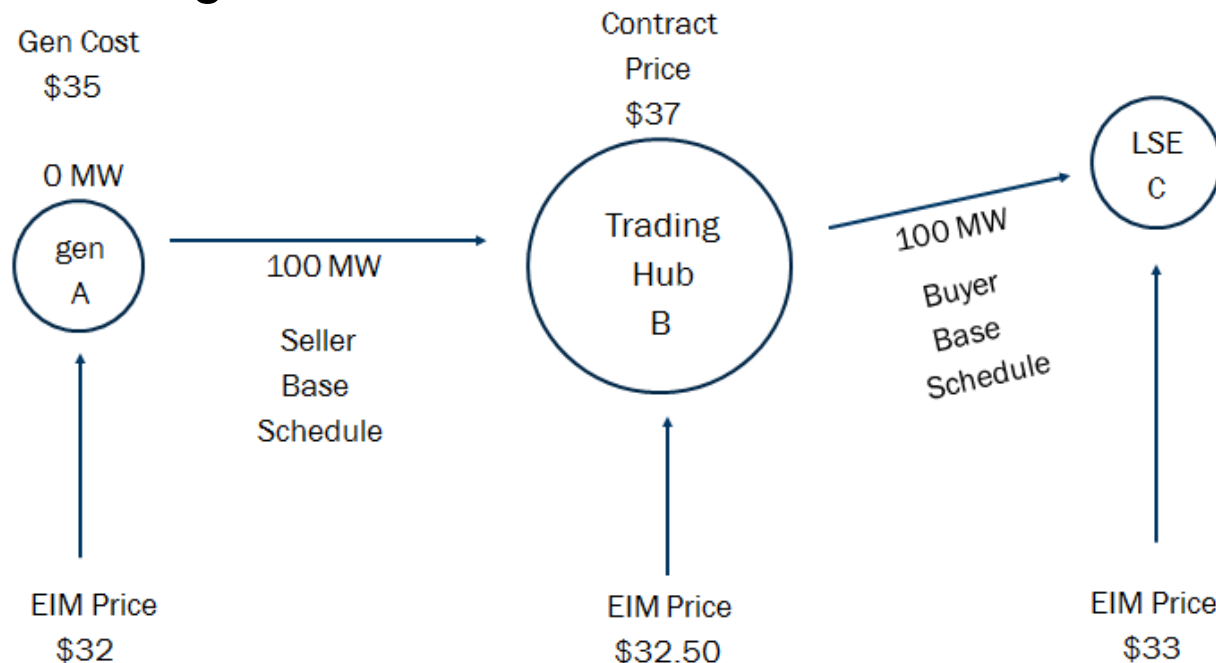
TRADING AND CONTRACTING

There is no obligation for a generator to participate in the EIM real-time dispatch and reduce output when the EIM price is less than the generator's incremental cost. Suppliers can choose to cover their base schedules using their own generation without regard to EIM spot prices.



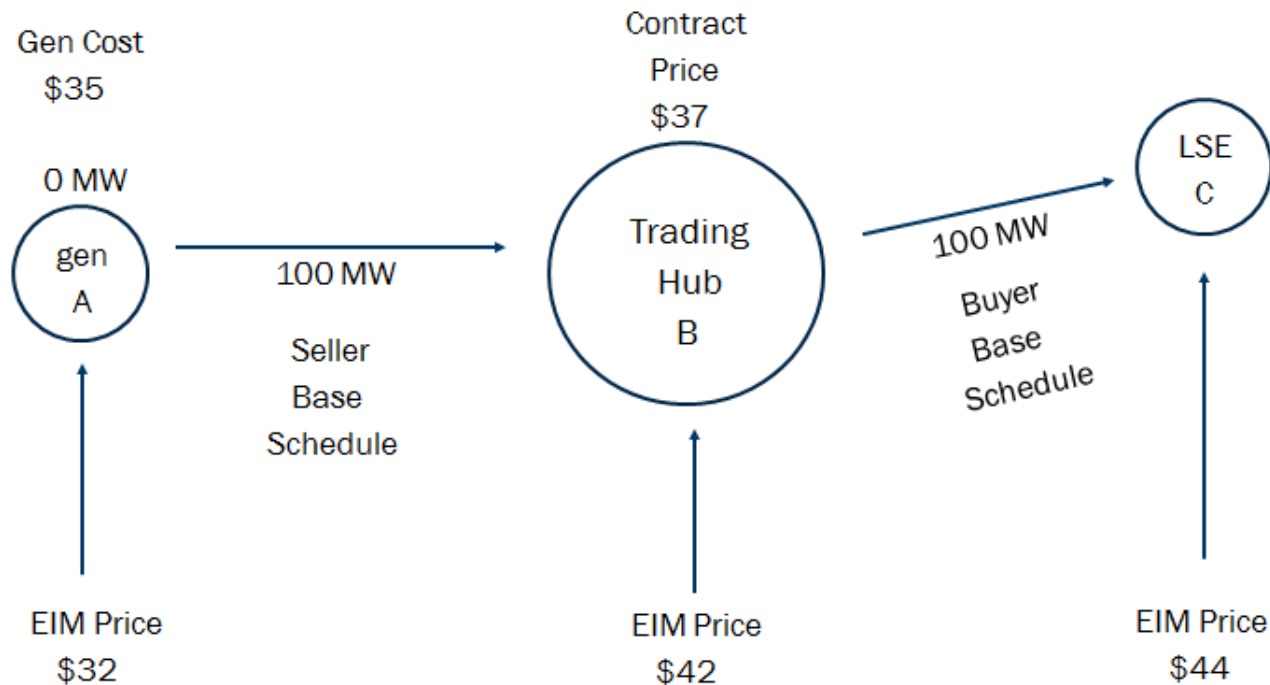
TRADING AND CONTRACTING

However, if a generator chooses to participate in the Western EIM's real-time dispatch, it would at times be able to cover forward contracts, or load serving obligations, for less than its incremental generating cost (including the opportunity cost value of water used to generate power) by purchasing power to cover its contract in the EIM spot market whenever the spot market price is less than its incremental generation cost.



TRADING AND CONTRACTING

A generator buying power in the EIM spot market to cover a contract will be hedged against congestion by its base schedule so the cost of covering its contract in the spot market would be the spot price at its location, \$32 in the example, even if there were congestion between the generator's location and the point of sale at the trading hub.



TRADING AND CONTRACTING

Contract parties can book out transactions day-ahead in the day-ahead bilateral market without the need to participate in the Western EIM spot market, and they will continue to be able to do this within the EIM market when they find this to be advantageous.

- Participation in the EIM real-time spot market provides an additional option for sellers to cover their forward contracts with cheaper power on a 15 minute basis, and even on a 5 minute basis, in real-time.
- Conversely, if a seller books out of its forward transaction day-ahead, it could realize additional value by participating in the EIM spot market in real-time and being dispatched to generate power whenever the price at its location exceeds its incremental generating costs.

TRADING AND CONTRACTING

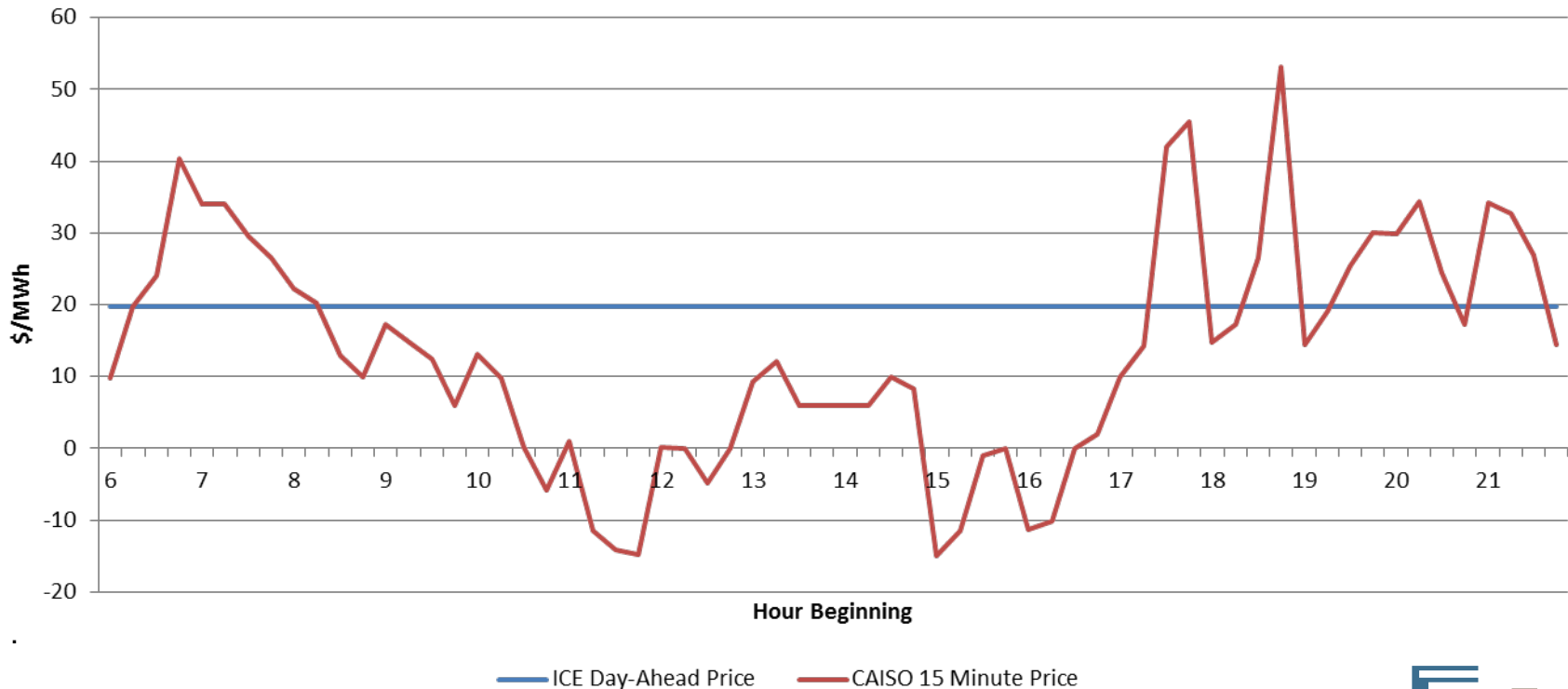
The EIM spot market provides a symmetric benefit to load serving entities that have bought power in forward markets that turns out to be in excess of their real-time needs.

- Such a load serving entity can use the purchased power to back down their internal generation, reducing its costs by the avoided incremental generation cost.
- The load serving entity could also bid its generation into the EIM spot market, in which case the purchased power would in effect be used to back down the load serving entity's generation whenever the cost of that generation exceeded the spot price and would be sold in the EIM spot market whenever the spot price exceeded the incremental cost of the load serving entity's generation.

TRADING AND CONTRACTING

Consider a hypothetical 100 megawatt on peak forward contract with a contract price at Mead of \$21 per megawatt hour. ICE reported day-ahead transactions for March 22, 2016 at Mead at \$19.75, which would have allowed the contract to be profitably booked out day-ahead.

Mead ICE Day-Ahead and CAISO 15 Minute Prices - Peak Hours, March 22nd 2016

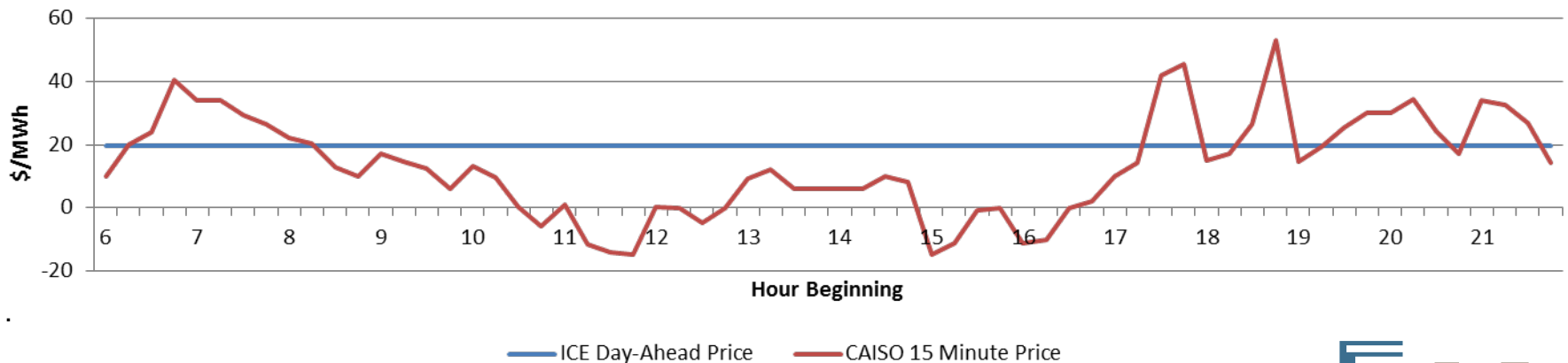


TRADING AND CONTRACTING

If the seller's incremental generation cost were \$18 per megawatt hour, however, it might choose to cover the forward sale by operating its generation, rather than buying power at \$19.75 per megawatt hour.

- If the seller operated its generation, it would cover the contract in real-time at a cost of \$18 per megawatt hour;
- If the seller bid its generation into the EIM spot market and bought power to cover the contract whenever the spot price was lower than its incremental generation cost, it would have been able to cover the contract at a cost of \$8.92 per megawatt hour.

Mead ICE Day-Ahead and CAISO 15 Minute Prices Peak Hours, March 22nd 2016

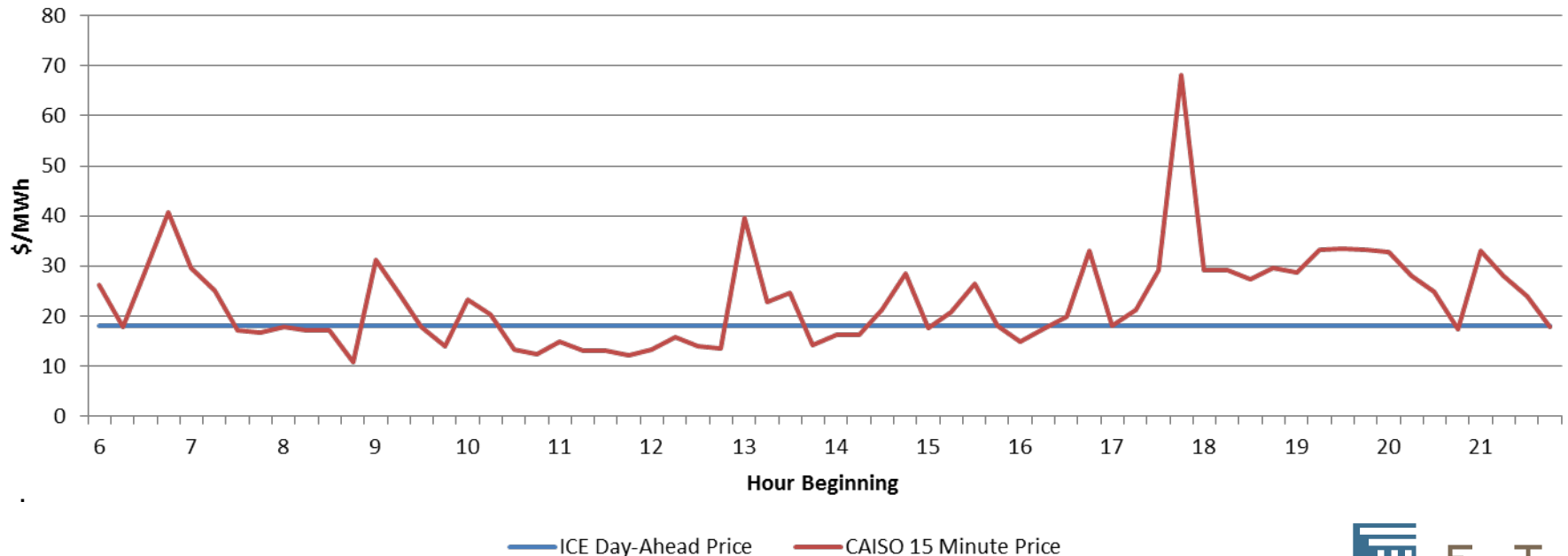


TRADING AND CONTRACTING

The savings from participation in the EIM market were particularly large on March 22 because RTPD prices averaged only \$13.27 per megawatt hour.

- The savings from participation in the EIM spot market depend on the variability of real-time prices, not just their average level;
- The RTPD prices averaged \$22.96 on March 9, compared to a day-ahead price on ICE of \$18 per megawatt hour.

Mead ICE Day-Ahead and CAISO 15 Minute Prices Peak Hours, March 9th 2016

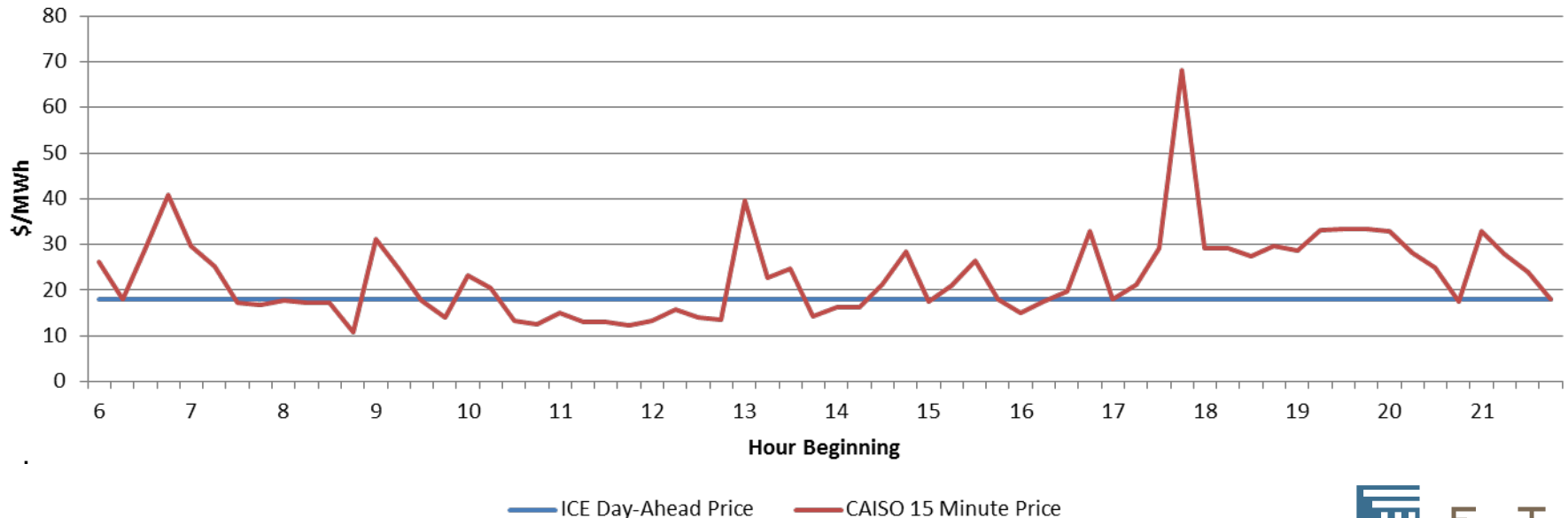


TRADING AND CONTRACTING

If this generator chose not to book out its sale day-ahead because its incremental cost was only \$17, it would still have been able to slightly reduce its cost of covering the contract by participating in the EIM spot market.

- The average cost of covering the contract by running its generation with a cost of \$17 or buying power in the EIM spot market would have been \$16.24, despite an average fifteen minute price of \$22.96 per megawatt hour.

Mead ICE Day-Ahead and CAISO 15 Minute Prices Peak Hours, March 9th 2016

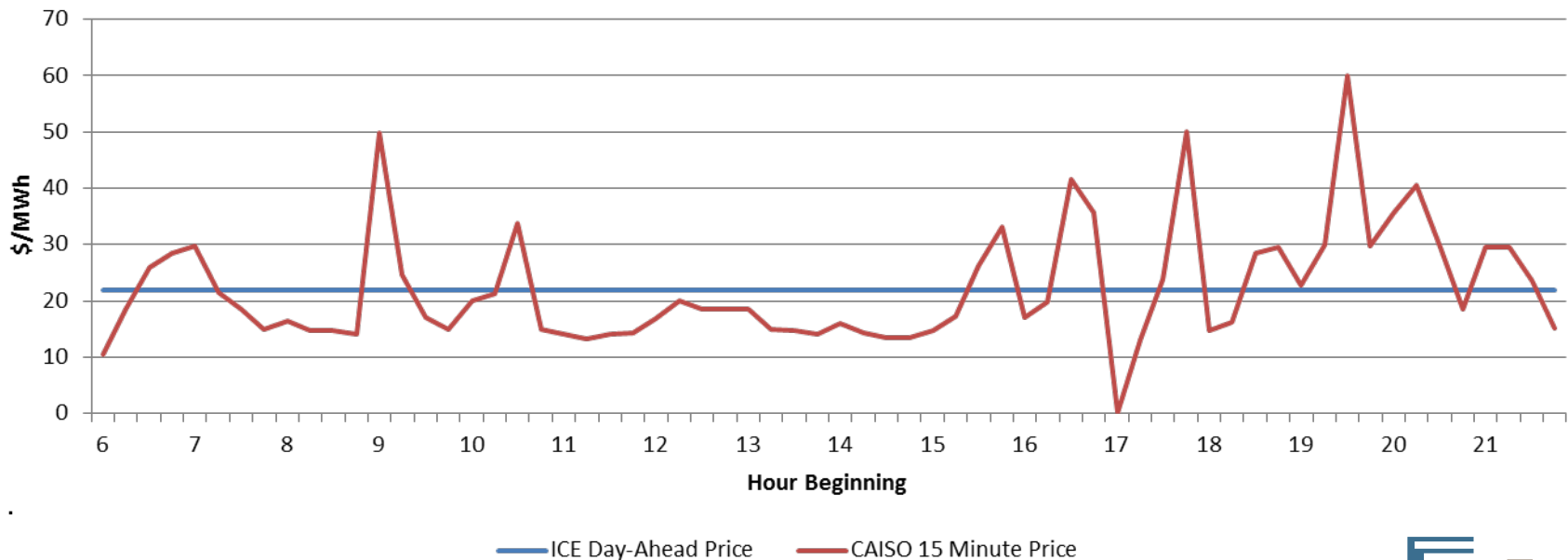


TRADING AND CONTRACTING

On March 21 the average 15 minute price was \$22.17 per megawatt hour, almost identical to the \$22 per megawatt hour day-ahead transaction price on ICE.

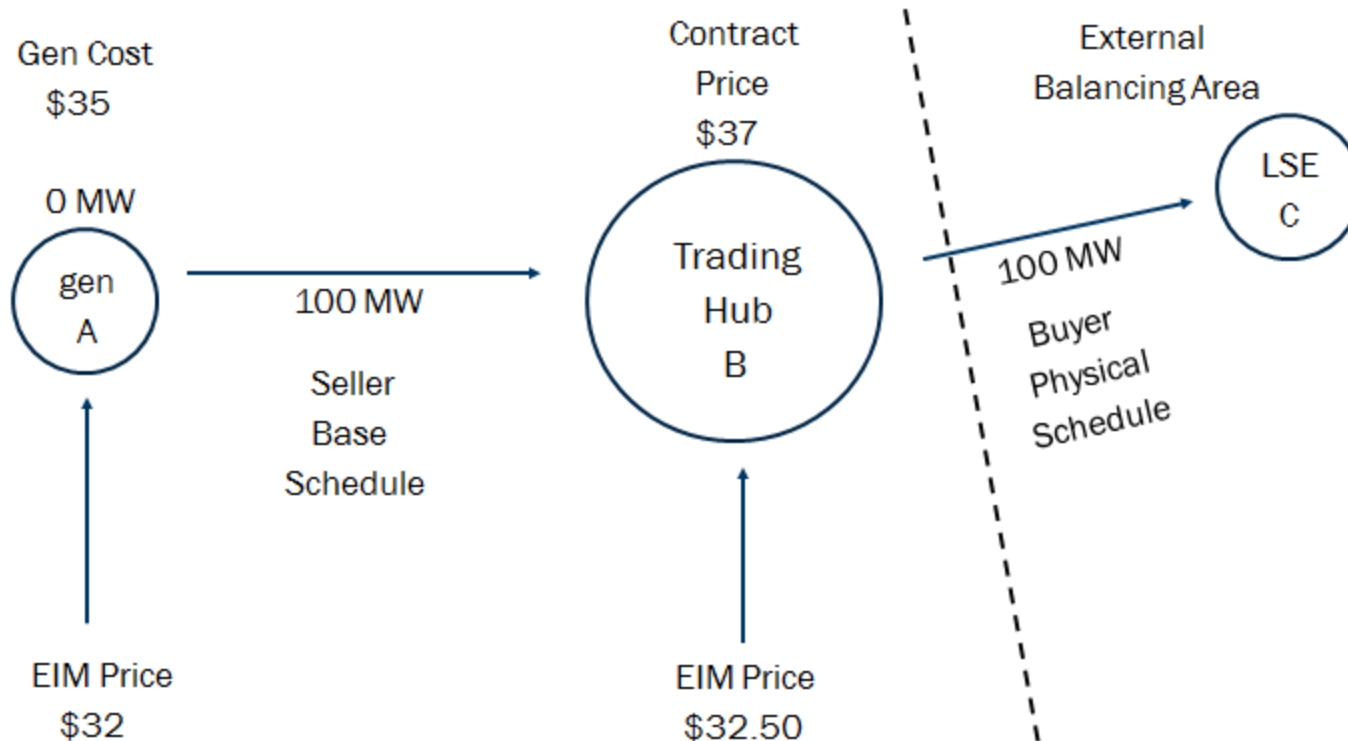
- A generator with an incremental generating cost of \$21 per megawatt hour would have been able to cover its contract at a cost of only \$17.66 per megawatt hour by participating in the EIM spot market.

Mead ICE Day-Ahead and CAISO 15 Minute Prices Peak Hours, March 21st 2016



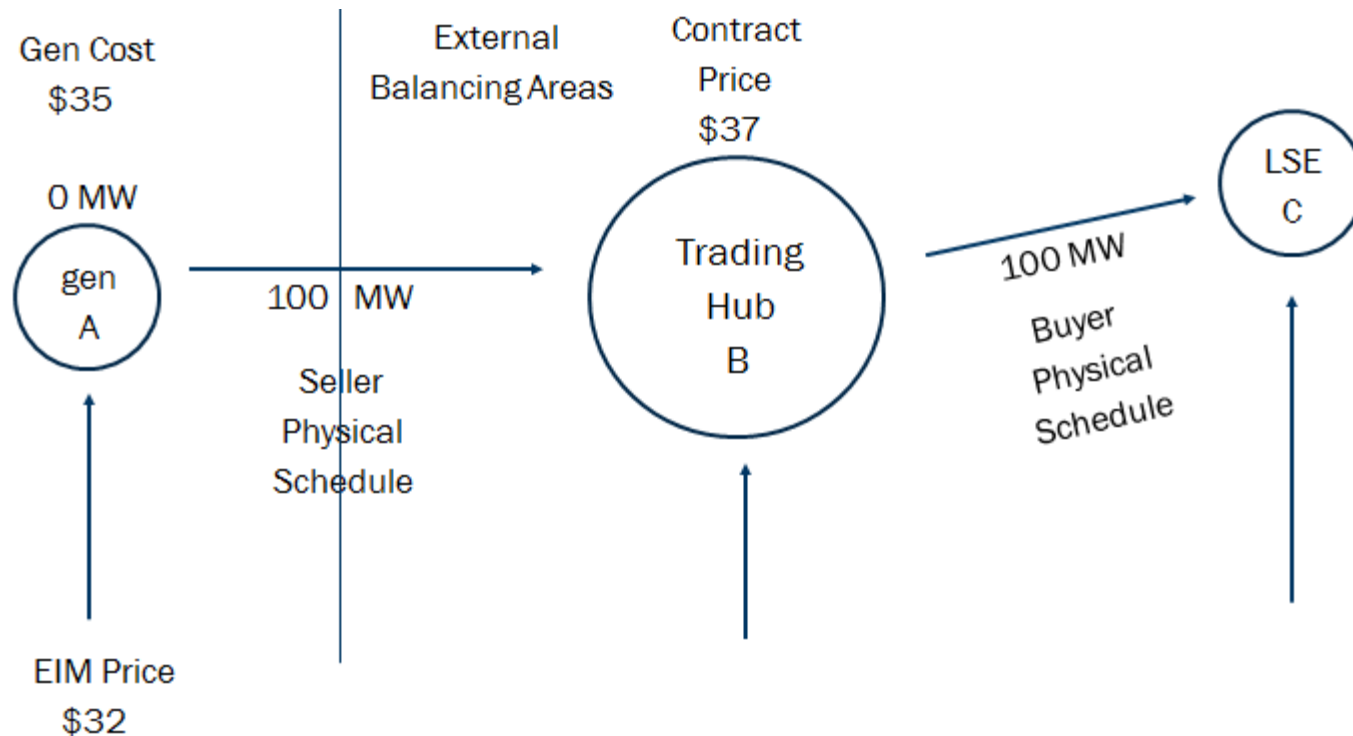
TRADING HUBS AND THE EIM

This ability to reduce the cost of covering forward power sales by participating in the EIM spot market does not require that the contract sink be within the EIM footprint. The same cost savings would accrue if the power sunk in a balancing area external to the EIM footprint.



TRADING HUBS AND THE EIM

This ability to reduce the cost of covering forward power sales by participating in the EIM spot market also does not require that the point of sale be within the EIM footprint. The same cost savings would accrue if the point of sale were a trading hub external to the EIM footprint.



TRADING HUBS AND THE EIM

The economics of participating in the EIM spot market to reduce the cost of covering either load serving obligations or forward power contracts do not depend on where the generation is located relative to the load or contract delivery point.

- The base schedule hedges the seller on congestion between the generator and the delivery point.
- The resource is dispatched based on its bid relative to the EIM price at its location, the FMM price in RTPD and the five minute price in RTD.
- The point of delivery under the contract or the location of the load serving obligation has no impact on the dispatch.

TRADING HUBS AND THE EIM

These beneficial impacts of EIM expansion on trading in WECC flow from same fundamentals that drive the production cost savings from EIM participation and expansion:

- As generators use the EIM to reduce the cost of covering bilateral contracts by dispatching their generation down and purchasing power when EIM spot prices are low, they will provide a market for otherwise surplus intermittent output, reduce intermittent output curtailments, and reduce the frequency that intermittent resource output is sold at negative prices.
- As more suppliers participate in the EIM with resources that are not needed to cover contracts or provide reserves, allowing that generation to be dispatched up when EIM spot prices are high, this will improve the WECCs ability to balance load and generation when intermittent resource output falls, and reduce the height of price spikes.

TRADING HUBS AND THE EIM

Participation in the EIM will also permit resource operators to conserve the dispatch of hydro generation during low hydro years, or periods of the year, to the hours when the hydro generation has the most value, covering sales and load serving obligations with purchases from the EIM spot market when the cost of spot energy is lower than the value of their water.

- The EIM spot market will also provide a broader market for run of river hydro during off-peak hours when it may be competing with high wind output within the local balancing authority area.
- The impact of the Western EIM on trading will become larger as the EIM footprint expands to include both more dispatchable and intermittent generation and to include more established trading hubs.

COMPASS LEXECON-FTI CONSULTING-ELECTRICITY

Joseph Cavicchi	jcavicchi@compasslexecon.com	617-520-4251
Bert Conly	bert.conly@fticonsulting.com	214-397-1604
Scott Harvey	scott.harvey@fticonsulting.com	617-747-1864
William Hogan	William_Hogan@Harvard.edu	617-495-1317
Joseph Kalt	jkalt@compasslexecon.com	617-520-0200
Susan Pope	susan.pope@fticonsulting.com	617-747-1860
Ellen Smith	ellen.smith@fticonsulting.com	617-747-1871
Jeffrey Tranen	jtranen@compasslexecon.com	212-249-6569
Kevin Wellenius	kevin.wellenius@fticonsulting.com	207-495-2999

See papers @
<http://Impmarketdesign.com>