



California ISO
Shaping a Renewed Future

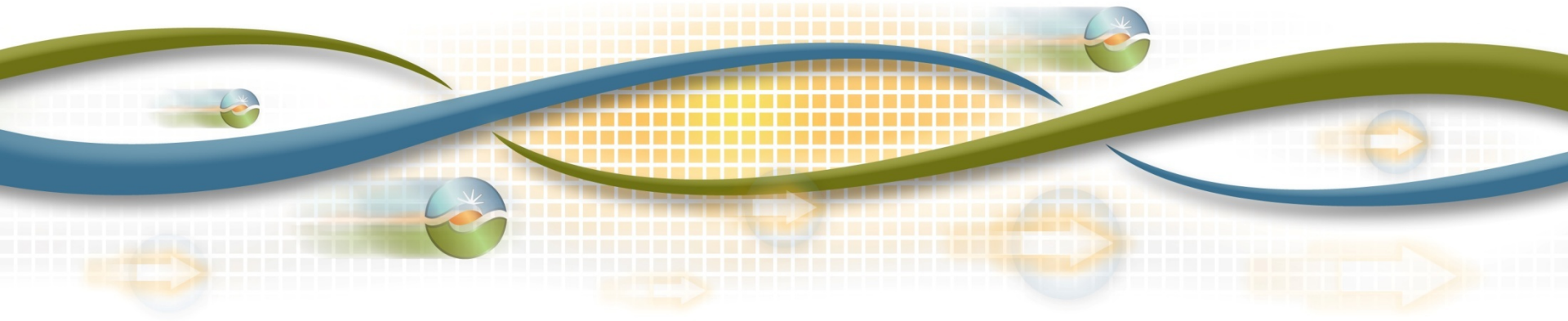
Discussion on load granularity refinements

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Market Surveillance Committee Meeting

General Session

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Background on load granularity refinements initiative

- FERC's original MRTU decision required ISO to increase number of LAPs in Release 2.
- Conducted two pricing studies, 2010 and 2013
- In February 2014, ISO filed for waiver of requirement for disaggregation which was denied in June.
 - Granted one year extension to disaggregate or seek further relief
 - ISO will make a FERC filing around June 3, 2015

FERC instructed that any subsequent pricing study to support a new request must include

- Detailed description of underlying data
- Analysis of reasonable range of different alternate levels of disaggregation
- Focused discussion on areas with large price differences
- Analysis of entire ISO footprint, including SDG&E service territory
- Properly supported estimates of implementation costs for different levels of disaggregation

Pricing study

Analyzed day-ahead nodal energy prices from 2011-2014

- ISO generally schedules 98% of real-time need through the day-ahead market.
- Analyzed nodal LMPs using four methods, geographically and temporally.

1. Simple average LMPs

- Provides indication of price dispersion seen across the system and potentially identifies areas with higher/lower average LMPs

2. Percent of load by difference of nodal and DLAP LMPs

- Shows the quantity of load not receiving accurate price signal, which could potentially benefit from disaggregation

Pricing study - continued

3. Conducted a regression analysis on nodal LMPs from 2011-2014

- Shows how well nodal LMPs track DLAP LMPs

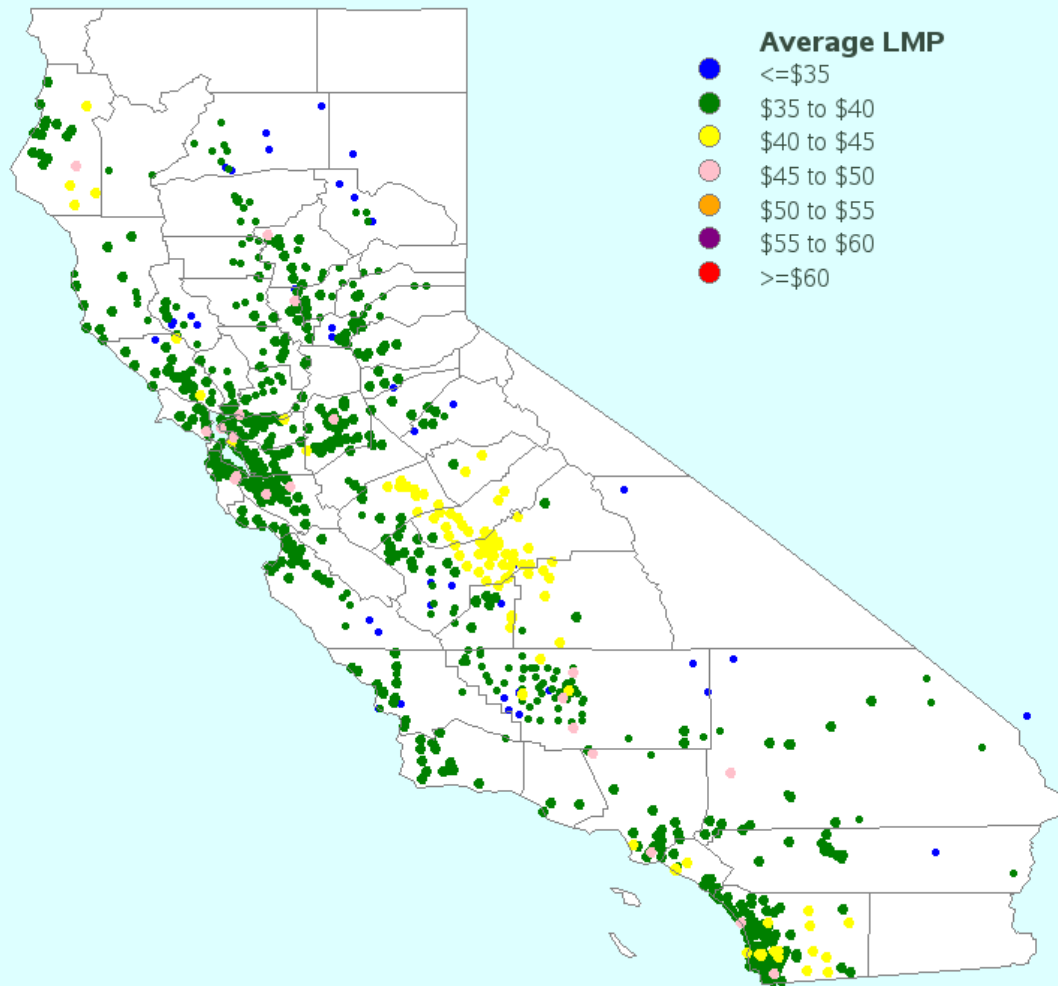
4. Volatility of nodal LMP differences from DLAP LMP

- Indicates if the instances of significant differences between nodal LMPs and DLAP LMPs are concentrated in a few locations or distributed among several nodes
- If concentrated, could potentially create new LAP accordingly

Pricing study - continued

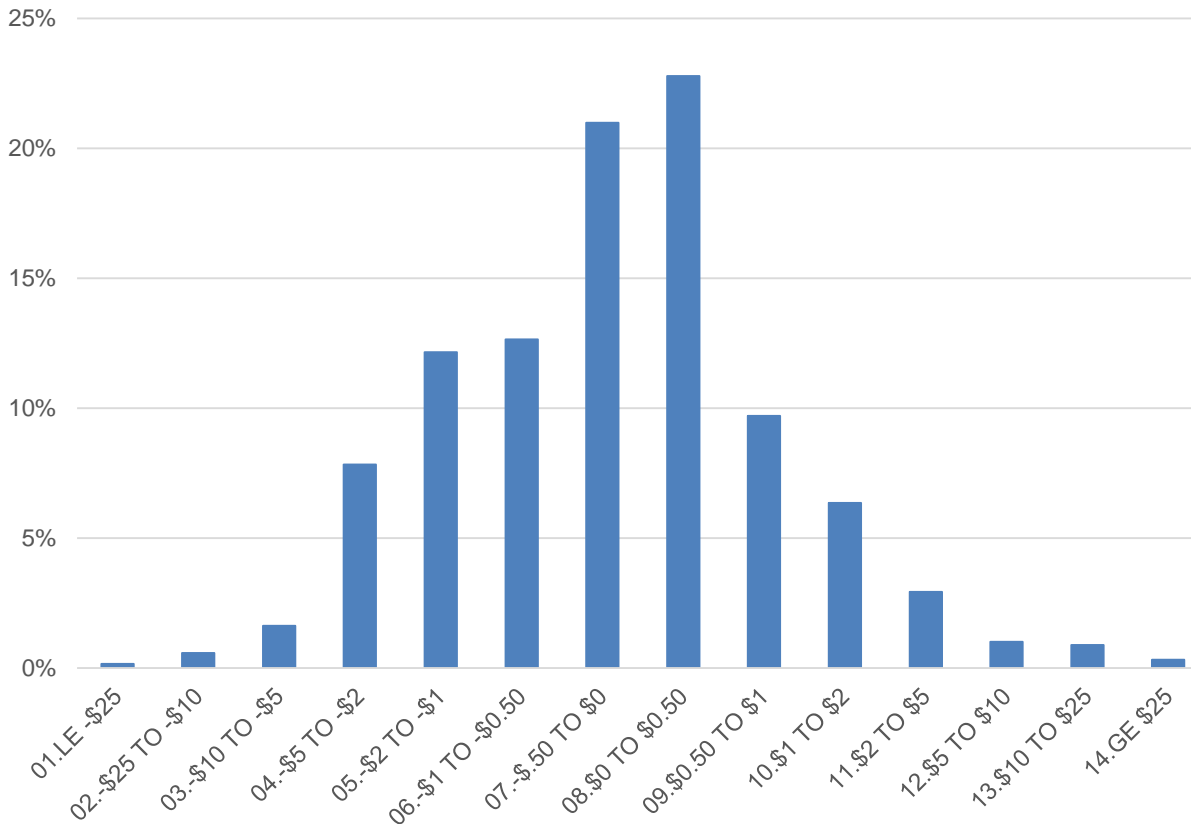
- The ISO would consider further disaggregation if:
 1. Material price dispersion exists,
 2. Is consistent over time, and
 3. Is geographically distinct
- Under these circumstances, higher level of granularity for bidding and scheduling could provide more accurate price signals, incent investment, and generate market benefits.
- Provided that benefits exceed implementation and maintenance costs, disaggregation may be valuable.
- The following pricing study results, estimated costs and benefits can be used to make an educated decision in regards to disaggregation.

Simple average nodal LMPs 2011-2014



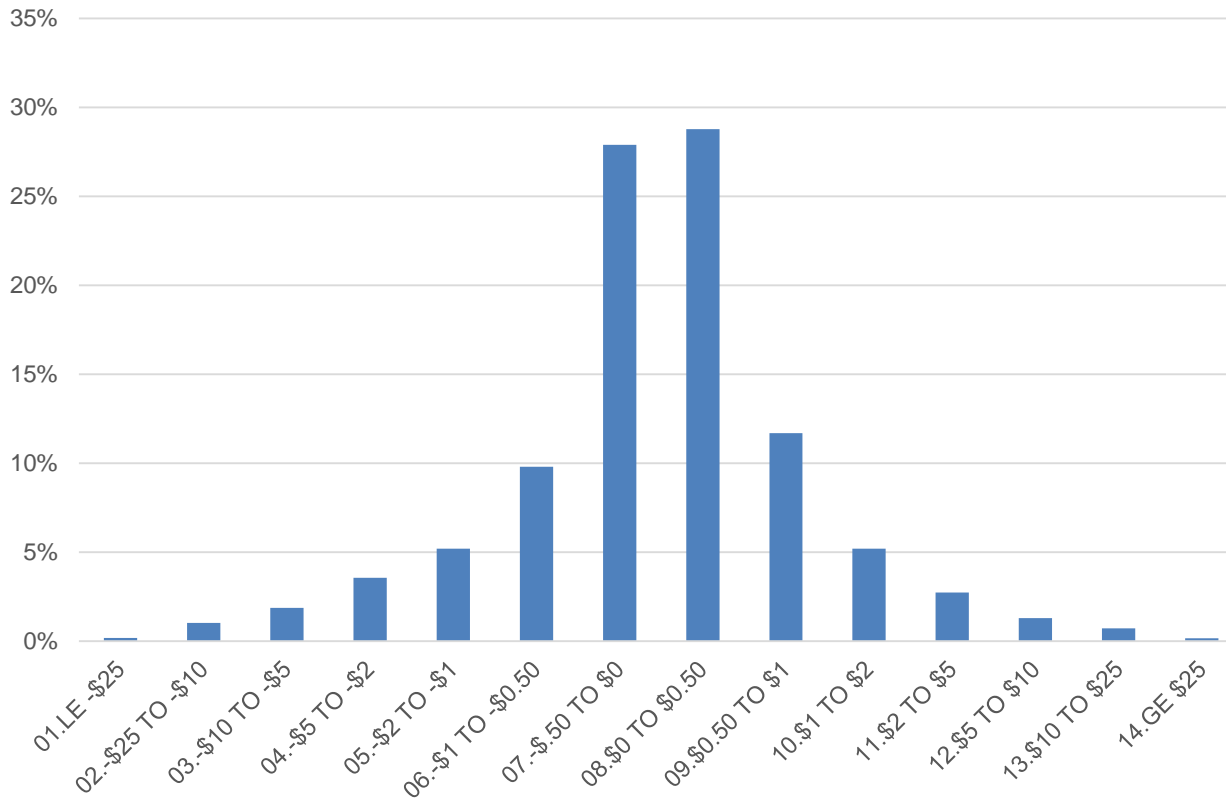
- Most nodes statewide are, on average, between \$35/MWh and \$45/MWh
- Greater Fresno area nodes priced in the \$40/MWh-\$45/MWh range
- A few scattered higher priced (pink) and lower priced (blue) nodes

Percent of PG&E 2011-2014 load by difference of nodal LMPs relative to DLAP LMPs



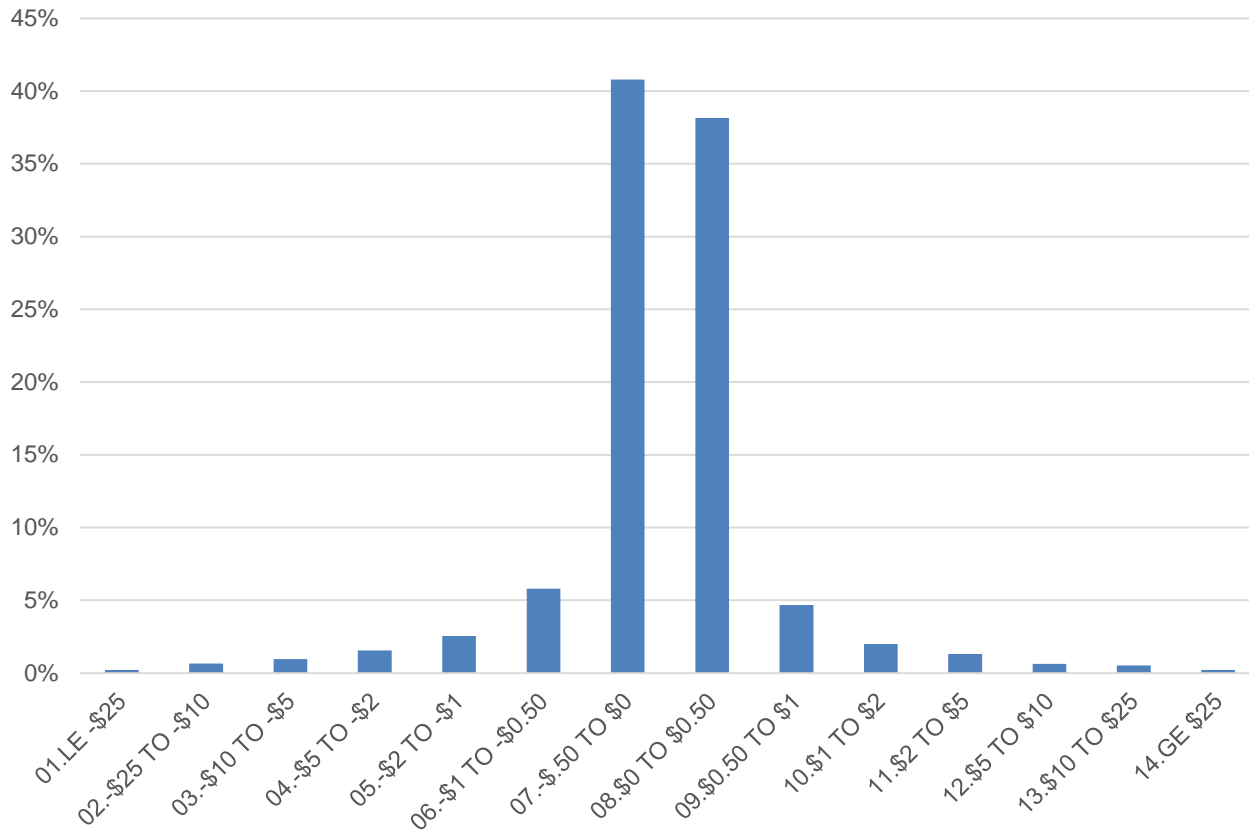
- 44% of load at nodal LMPs within \$0.50 of DLAP LMP
- 85% of load at nodal LMPs within \$2 of DLAP LMP, which represents about 5% of a day-ahead LMP

Percent of SCE 2011-2014 load by difference of nodal LMPs relative to DLAP LMPs



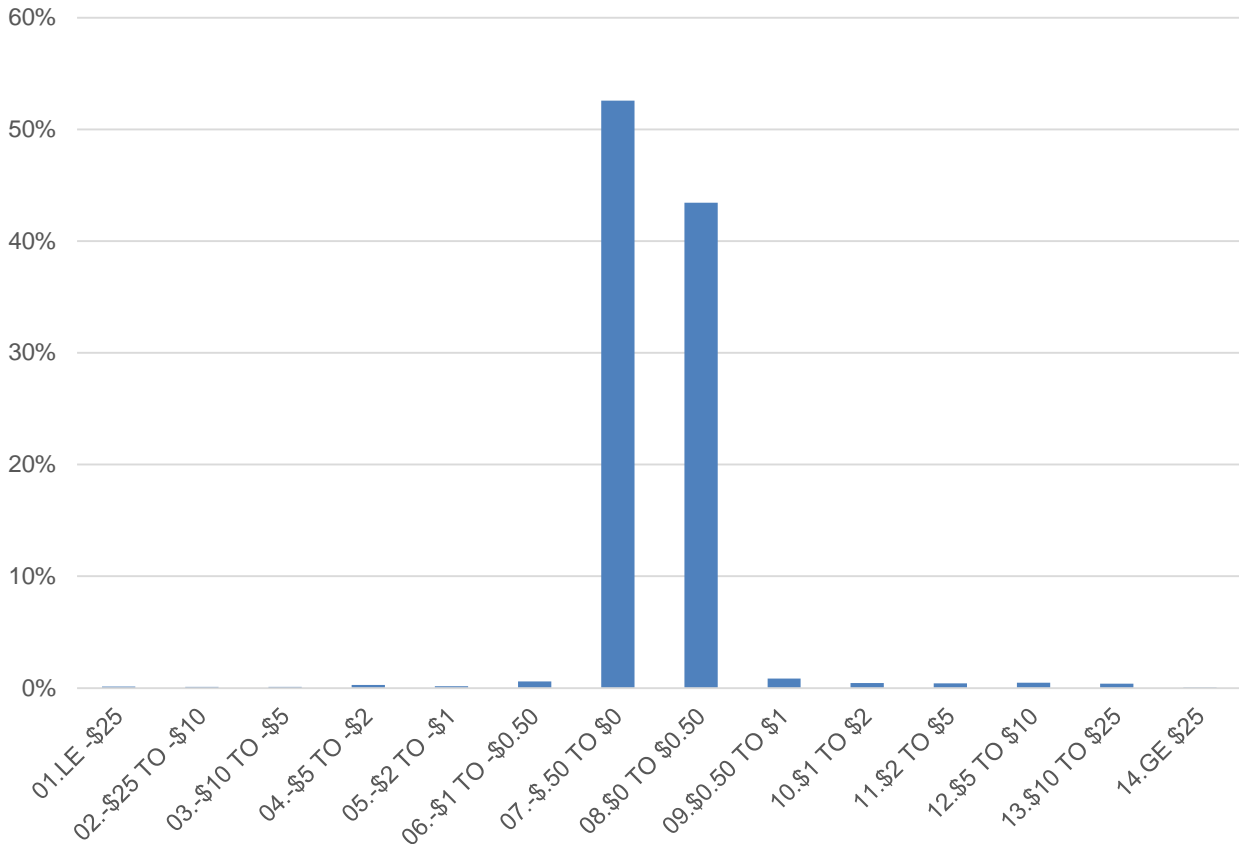
- 57% of load at nodal LMPs within \$0.50 of DLAP LMP
- 89% of load at nodal LMPs within \$2 of DLAP LMP

Percent of SDGE 2011-2014 load by difference of nodal LMPs relative to DLAP LMPs



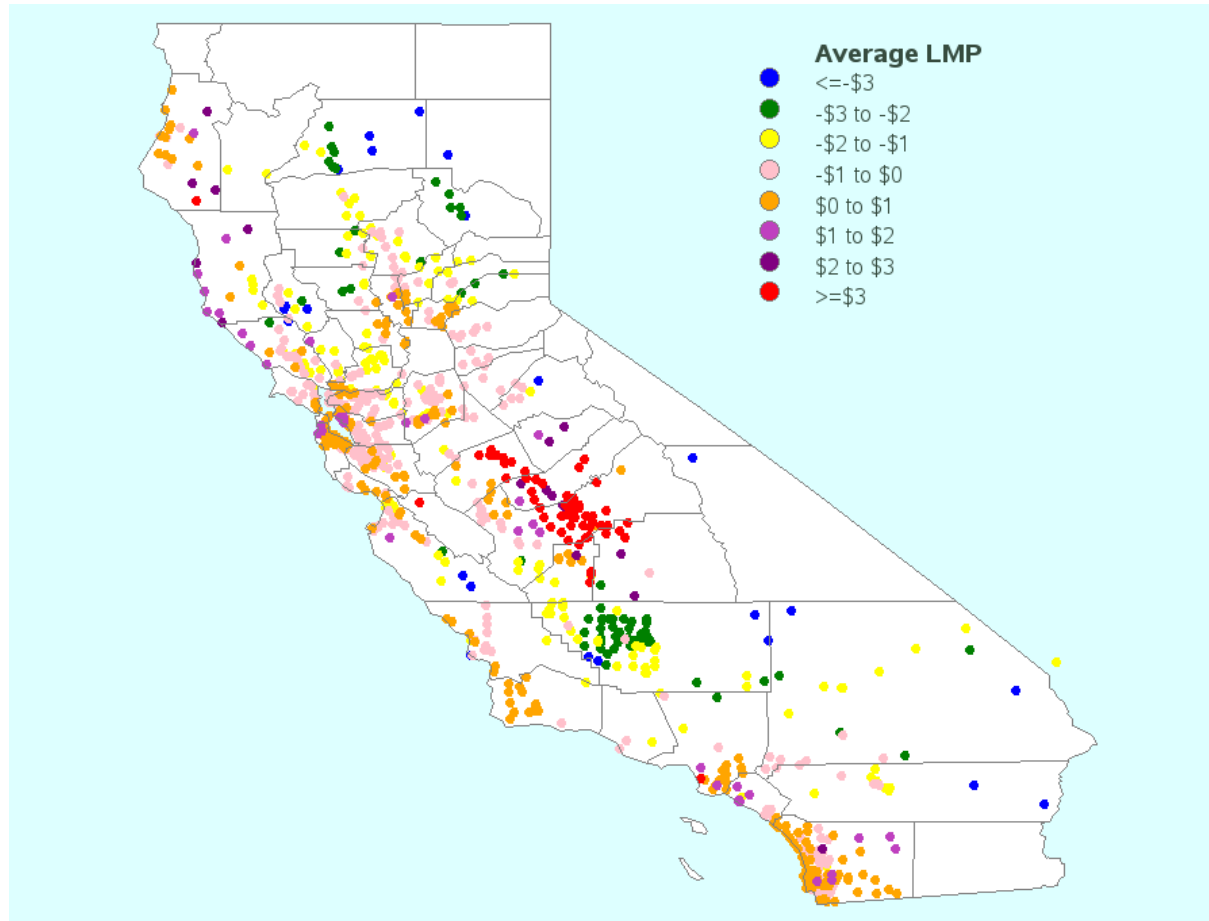
- 79% of load at nodal LMPs within \$0.50 of DLAP LMP
- 94% of load at nodal LMPs within \$2 of DLAP LMP

Percent of VEA 2011-2014 load by difference of nodal LMPs relative to DLAP LMPs



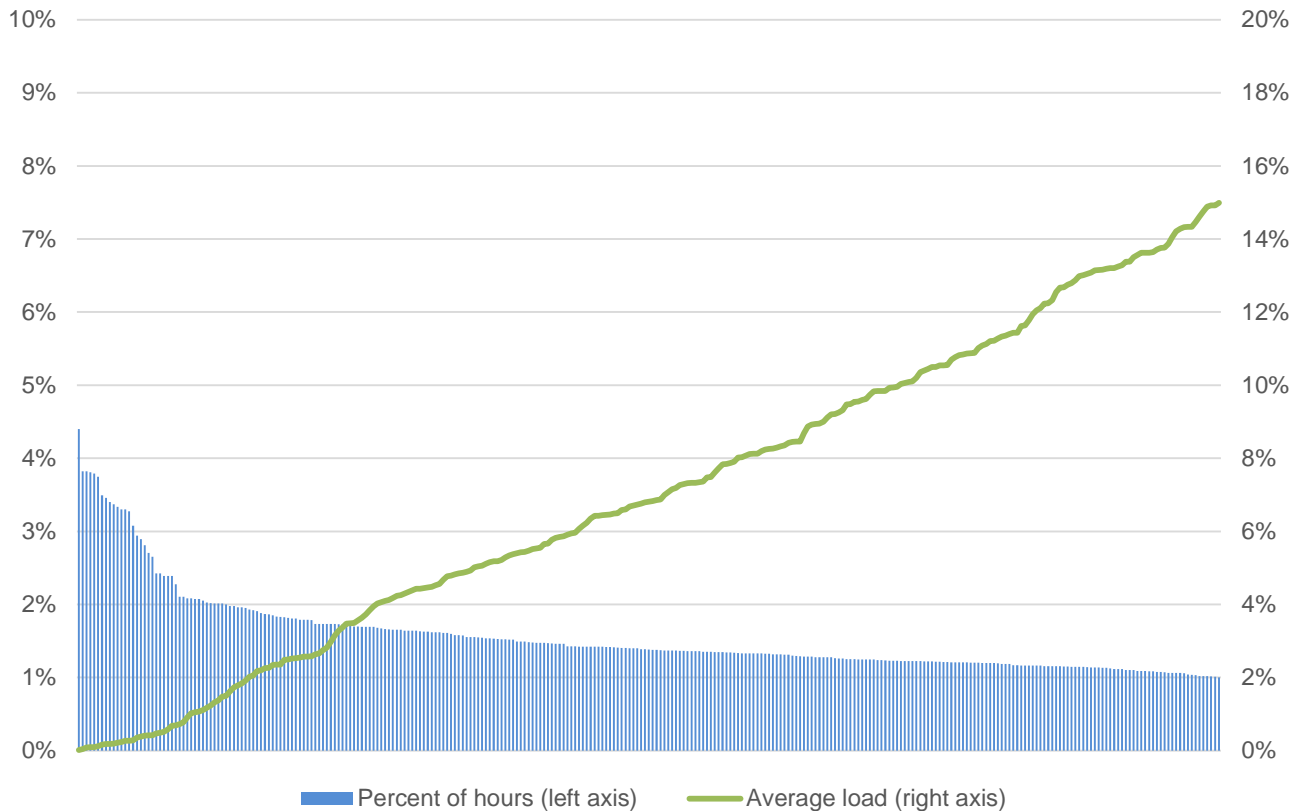
- 96% of load at nodal LMPs within \$0.50 of DLAP LMP
- 98% of load at nodal LMPs within \$2 of DLAP LMP

Average difference of nodal LMPs to DLAP LMPs (2011-2014)



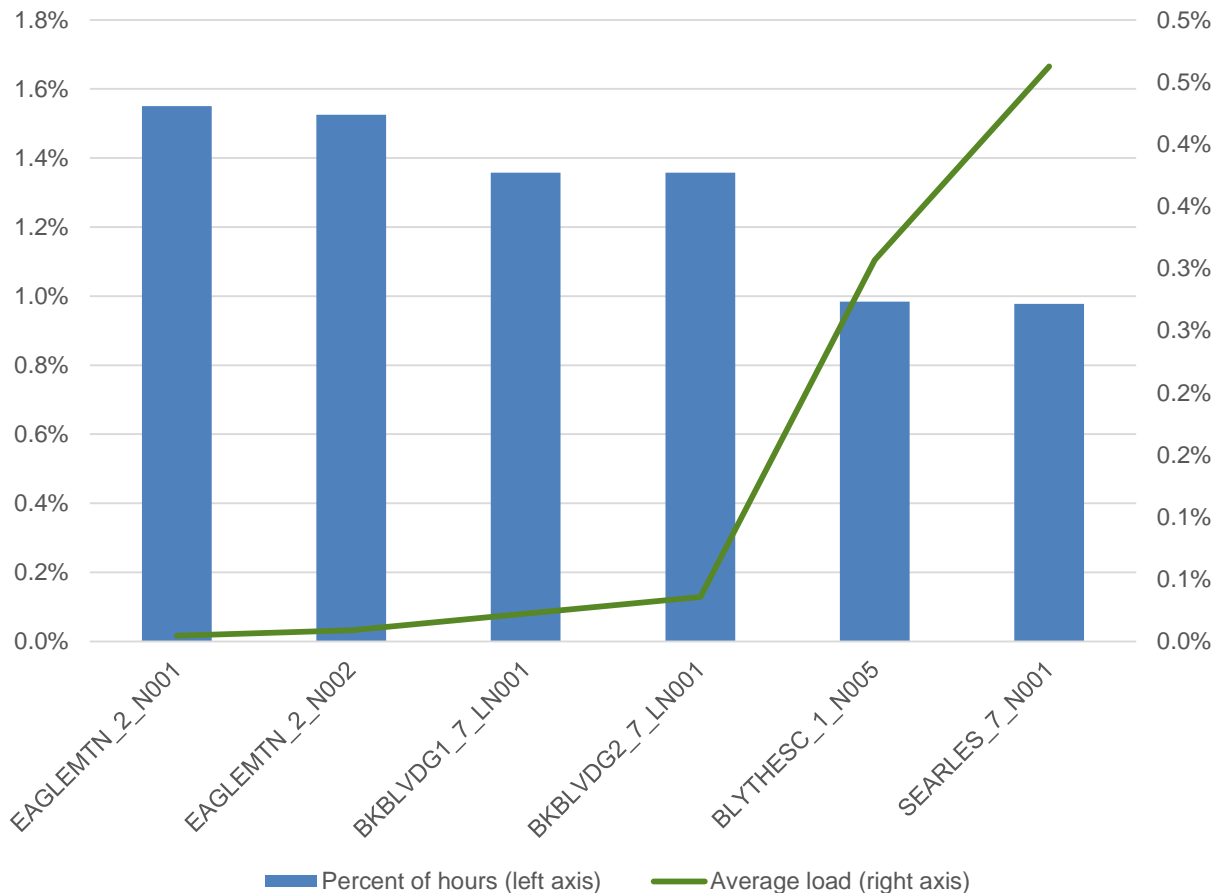
- Greater Fresno area has higher nodal LMPs relative to the DLAP LMP
- Most price differences are scattered throughout the state
- Yearly analysis shows high price differences occurred in 2014

Volatility of nodal LMP differences greater than \$25 PGAE 2011-2014



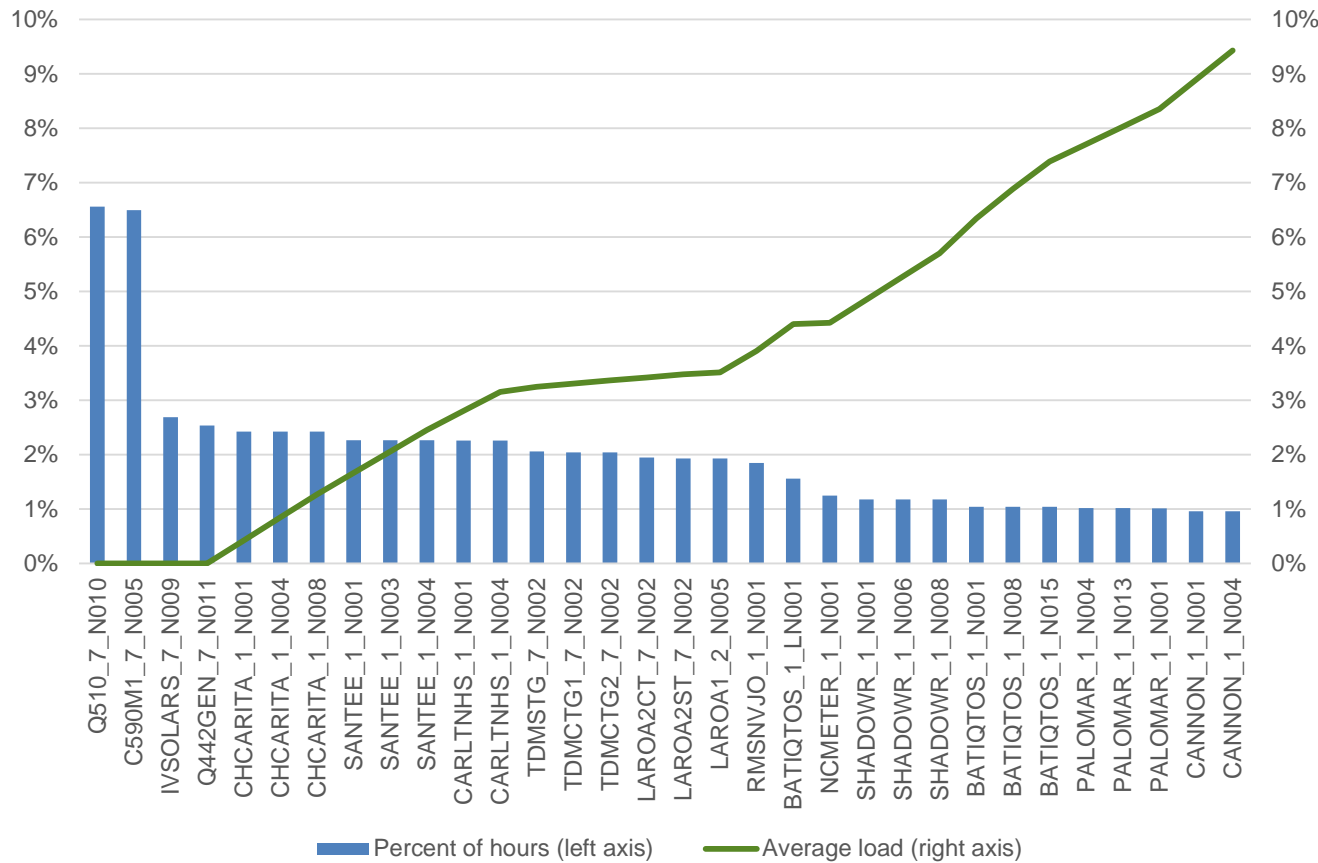
- 18% of nodes in PGAE had at least 1% of hours where nodal LMP differed from DLAP LMP by more than \$25/MWh
- On average, 15% of PGAE load is located at those nodes.

Volatility of nodal LMP differences greater than \$25 SCE 2011-2014



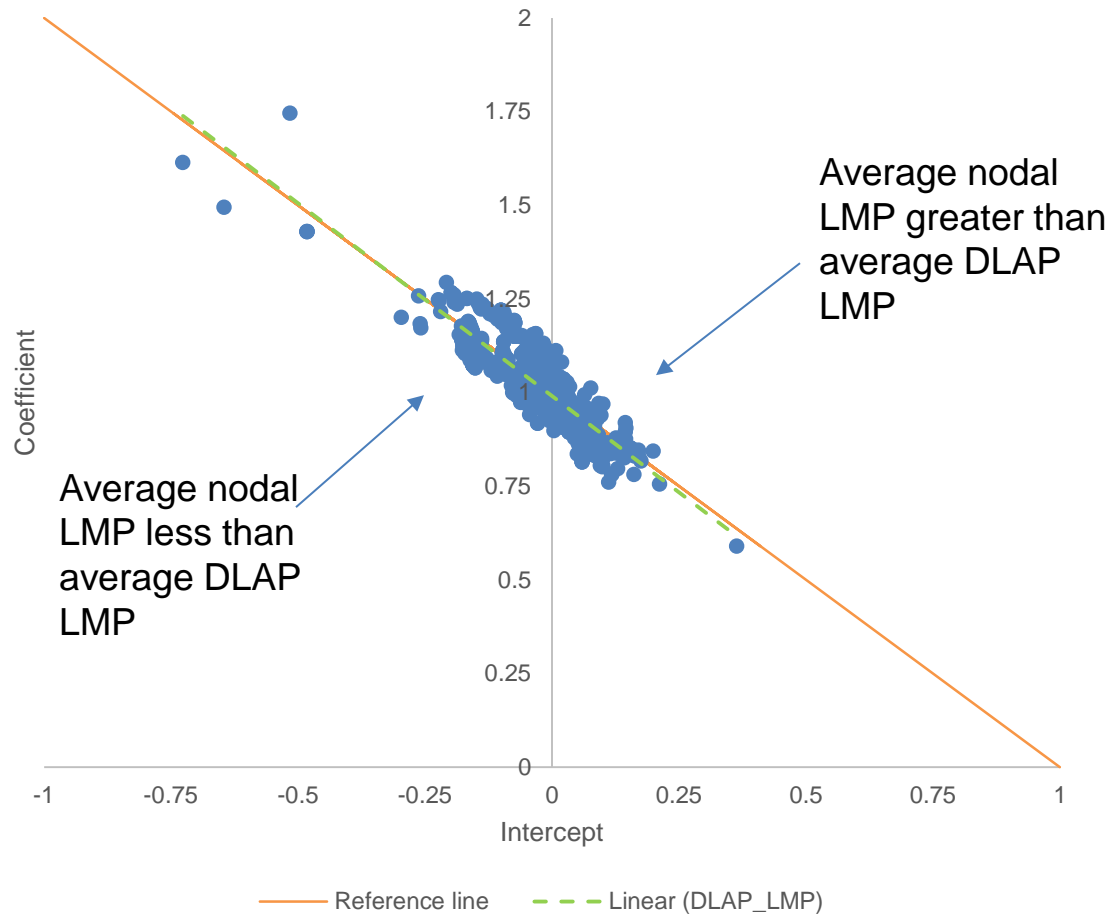
- Less than 3% of nodes in SCE had at least 1% of hours where nodal LMP differed from DLAP LMP by at least \$25/MWh
- On average, 0.5% of SCE load is located at those nodes

Volatility of nodal LMP differences greater than \$25 SDGE 2011-2014



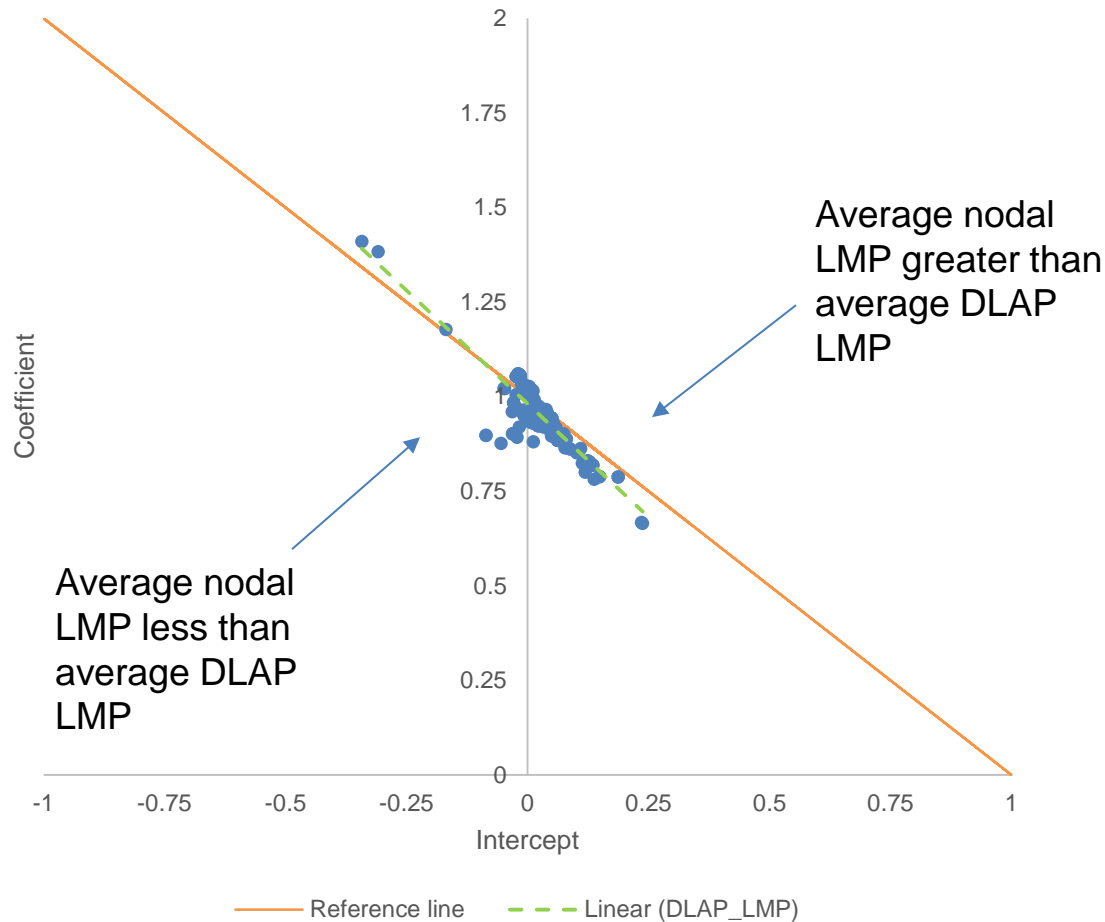
- 10% of SDGE nodes had at least 1% of hours where nodal LMPs differed from DLAP LMPs by at least \$25/MWh
- On average, 9.5% of SDGE load is located at those nodes

Regression analysis – PGAE (2011-2014)



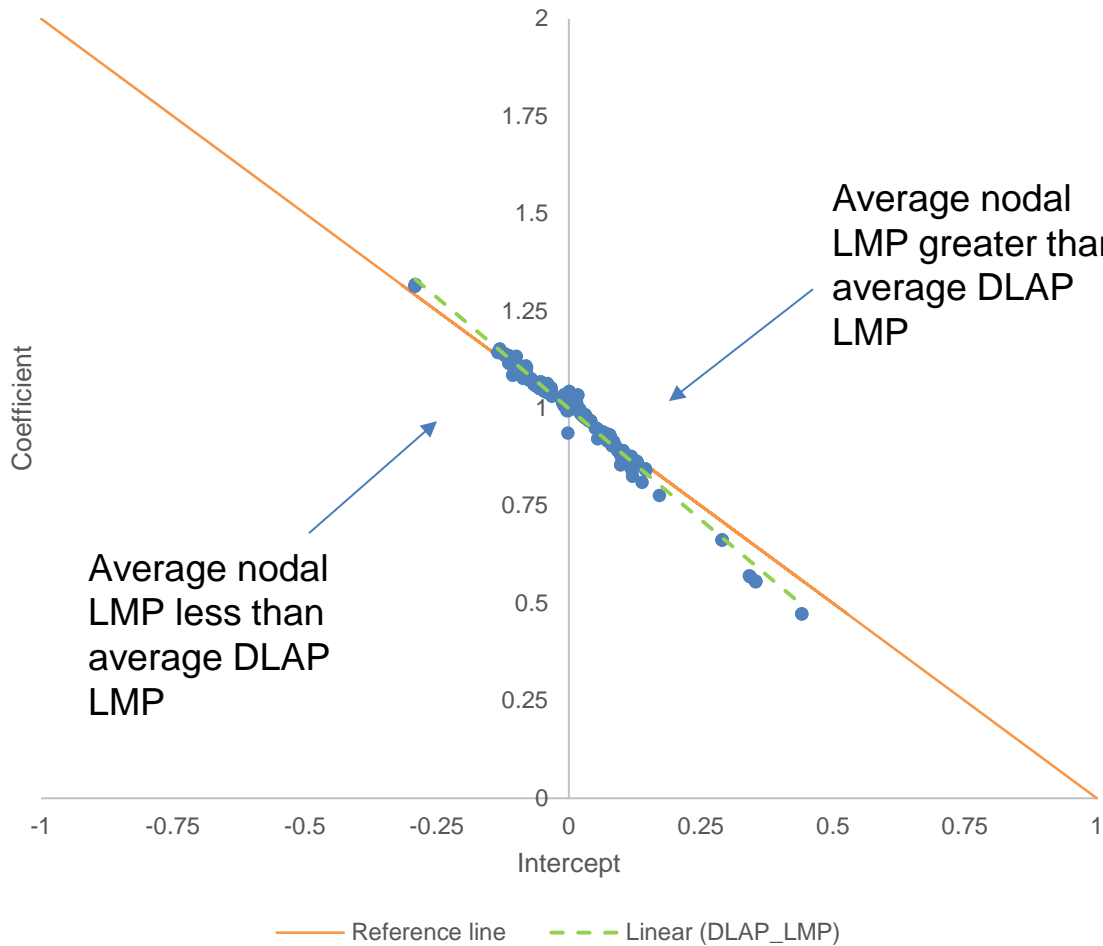
- One regression for each load node in PGAE DLAP
- Clustered near the reference line and close to (0,1) indicates average nodal LMPs close to average DLAP LMP.
- Green line would fall on the reference line if average LMP equals average DLAP LMP

Regression analysis – SCE 2011-2014



- Most of the points are clustered around (0,1), indicating average nodal LMP equals average DLAP LMP
- A few outliers skew the green line off of the reference line.

Regression analysis – SDGE 2011-2014



- Most of the points are clustered around (0,1), indicating average nodal LMP equals average DLAP LMP
- A few outliers skew the green line off of the reference line.

Greater Fresno area

- The Greater Fresno area had higher than average nodal LMPs and the difference of nodal LMPs to PG&E DLAP were on average more than \$3/MWh.
- Unusual congestion during summer of 2014 contributed to the high price dispersion.
 - 230kV and 115kV transmission lines with high shadow prices impacted nodal LMPs more than DLAP LMP.
 - Drought conditions and outages further exacerbated conditions.
- 2012-2013 Transmission Planning process (TPP) identified and approved several projects that were reliability driven.
 - Gates – Gregg 230kV line in service 2022
- The TPP, which looks out several years, does not show continued congestion or an economic need for additional transmission upgrades after the reliability driven projects are in service.

Pricing study results - Conclusion

- Inefficient to create new load zones based on price dispersion that is inconsistent and unpredictable (i.e. Greater Fresno area)
- Price differences between nodal LMPs and DLAP LMPs exist, but are minimal and limited to a few months
- Average nodal LMPs track average DLAP LMPs
- Nodal volatility is not isolated to a few nodes in distinct locations

Estimated implementation costs

- Collected estimated implementation costs from eight stakeholders and the ISO
 - 4 levels of disaggregation and 9 categories
 - One-time costs: Costs that will only be incurred during implementation.
 - Capital costs: Costs for capital goods that will be incurred during implementation, but may be re-incurred as those goods needs to be updated/replaced
 - ISO has asked for additional information to clarify estimates

	Slight disaggregation	Fully nodal
One-time costs	\$3.15 million	\$14.61 million
Capital costs	\$18.6 million	\$132.6 million
Annual costs	\$2.47 million	\$12.62 million

Benefits

- Potential Benefits

- More accurate wholesale price signals incent investment decisions.
- Improved congestion hedging
 - CRR allocation
 - Revenue inadequacy
- More efficient day-ahead market outcomes
- Reduce the subsidization of high-price areas by low-price areas.

- Estimating benefits

- Incremental to same benefit that can be realized through existing market products and/or processes
- Focus on wholesale side benefits as retail benefits cannot be fully realized without regulatory changes to retail rate structure
- ISO has, to the best of its ability, estimated in dollars each incremental benefit

Estimated benefit – accurate price signals to incent investment

- **Transmission investment - \$0**
 - Transmission planning process already utilizes nodal LMPs
 - Accurate price signals are already utilized to make investment decisions.
- **Generation investment - \$0**
 - Nodal LMPs are posted on OASIS
 - Accurate price signals are available to inform investment decisions
- **Participating load - \$0**
 - Nodal LMPs are posted on OASIS
 - Can schedule and settle at CLAPs

Estimated benefit – Increased allocated CRRs

- Disaggregation could potentially increase amount of CRRs allocated in Tier 1 of annual process.
 - Improve LSEs hedge against congestion faced in day-ahead market.
 - Currently a binding constraint in the CRR model limits allocated CRRs.
 - Same binding constraint would only limit allocated CRRs sunked at the nodes which are limited by the constraint.
- Estimated benefit - \$1.08 million annually
 - Assume all CRRs not allocated in Tier 1 would be allocated (very conservative approach)
 - Average monthly auction price is expected value of hedge
 - Product of non-allocated CRRs and expected value of hedge estimates annual benefit

Estimated benefit – Improve CRR revenue inadequacy

- Revenue inadequacy is driven by differences in the CRR model and day-ahead market
 - Time lag between the CRR model and day-ahead market
 - CRR model cannot enforce all constraints in the day-ahead market, potentially releasing too many CRRs
 - Recent improvements to CRR model to improve revenue inadequacy
 - Enforcing more constraints and contingencies
 - Apply break even analysis on internal constraints
- Scheduling and settling load in day-ahead market at more granular locations would not have a significant impact on CRR revenue inadequacy.
- Estimated benefit - \$0

Estimated benefit – More efficient market outcome

- ISO is unable to conduct case study as initially intended
 - The new market model does not allow for the ISO run case studies based on historical data as hoped.
- Conducted frequency analysis for 2014
 - Less than 2% of hours had high congestion and DLAP bid marginal
- Estimated benefit in relation to changes in congestion costs
 - Would expect shadow price to decrease with a more efficient market solution
 - Average shadow price during hours when DLAP bid is marginal was higher than when DLAP bid is not marginal
- Estimated benefit \$0

Conclusion of study and assessment

- Pricing study results indicate minimal price disparity
 - No logical way to group nodes based on pricing study, short fully nodal
 - Potential benefits would be minimal
- Estimated implementation costs are
 - Considered to be on the low side by entities that submitted cost information, and
 - Far exceed estimated benefits
- Estimated benefits are
 - Incremental to what can be realized through other products/processes
 - Excludes retail side benefits
 - Conservative estimate
 - Do not outweigh estimated costs

Current ISO Proposal

The ISO is planning to recommend to the Board of Governors that the ISO keep the status quo and present a case to FERC that the current DLAPs are just and reasonable.