System Market Power Discussion

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TOPICS

- 3 Pivotal Supplier Test
- Changing Supply Demand Balance in the CAISO
- Analysis of High Priced Hours
- High Priced Import Supply
- System Market Power Mitigation

THREE PIVOTAL SUPPLIER TEST

The three pivotal supplier test is a very conservative test for the possible ability to exercise market power.

- The test is designed to err towards over identifying the potential for the exercise of material market power because it is not possible to apply a more sophisticated test in the time frame of the day-ahead market or real-time.

- Given this design, a failure to pass the three pivotal supplier test does not indicate that a market is structurally non-competitive, it indicates that there is a potential for non-competitive outcomes, depending on factors not considered by the test.

THREE PIVOTAL SUPPLIER TEST

The conservatism of the three pivotal supplier test was noted in the MSC's June 27, 2013 Report on the Three Pivotal Supplier Test, which observed:

"Three pivotal supplier tests can be overly conservative for at least two reasons. First, if all suppliers in a market have similar costs of providing counterflow on a given constraint, a three pivotal supplier test would be extremely stringent. This because it suggests a potential for the exercise of market power even in situations in which the fringe has enough capacity to completely replace the output of the two largest suppliers and most of the output of the third largest suppliers. In other words, the underlying residual demand curve is in fact quite elastic or price responsive. Hence suppliers will only pass a three pivotal supplier test when there is an extremely large amount of surplus supply."

1. James Bushnell, Scott Harvey, Benjamin Hobbs and Shmuel Oren, "Report on the Appropriateness of the Three Pivotal Supplier Test and Alternative Competitive Screens, " June 27, 2013 p. 16.

THREE PIVOTAL SUPPLIER TEST

The 2013 report went on to observe that there were three reasons that a three pivotal supplier test was not necessarily overly conservative in practice:

“First, in practice, all suppliers generally do not have the same costs of providing counterflow on a given constraint and no workable method exists to accurately account for these cost differences in applying pivotal supplier tests…Second, because pivotal supplier tests are applied to individual constraints, there is a potential for competition to be less effective than suggested by the result of a pivotal supplier test because some of the counterflow potentially available from fringe suppliers to reduce congestion on a particular constraint cannot be dispatched because the output of the fringe is limited by another transmission constraint.…Third, although it might be preferable from a theoretical standpoint to apply a single or two pivotal supplier test together with another test that evaluates the potential for the joint exercise of market power, it is not workable to apply multiple tests within the timeframes of the day-ahead market or the real-time dispatch.”

1. James Bushnell, Scott Harvey, Benjamin Hobbs and Shmuel Oren, “Report on the Appropriateness of the Three Pivotal Supplier Test and Alternative Competitive Screens, “ June 27, 2013 p. 16-17.

THREE PIVOTAL SUPPLIER TEST

Hence, it needs to be kept in mind in reviewing 3 pivotal supplier test results that the three pivotal supplier test is designed to over identify the potential for the exercise of market power in order to account for factors it does not consider:

- the costs of the competitive fringe, and
- the existence of other transmission constraints

and because it is not possible to apply multiple tests for the possession of market power within the time frame of day-ahead and real-time markets.

After the fact analysis of the potential for the exercise of market power is not limited by the time frame of the day-ahead market and can evaluate:

- The actual residual demand curve for each large supplier;
- The actual level of market concentration, as measured by an HHI index or another measure;
- The impact of offers on market clearing prices.

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CHANGES IN MARKET CONDITIONS

The California ISO Department of Market Monitoring [1] and others have pointed out that are a number of potential changes in market conditions that could impact expected price levels and the level of competition.

- Retirement of existing gas fired generation located inside California and its replacement with:
  – Non-gas fired types of RA resources
  – Gas fired RA generation located outside California
  – Demand response

1. See California ISO, Department of Market Monitoring, “System market power trends and issues, July 15, 2019.

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CHANGES IN MARKET CONDITIONS

Replacement of gas fired generation owned by pivotal suppliers with other RA resources should reduce market concentration and raise pivotal supplier indexes

- However, if gas fired generation is replaced in the RA market with resources that cannot meet load during high net load hours, then the California ISO will not have enough RA capacity to meet customer load, and prices will rise whether or not there is a potential for the exercise of system market power.

CHANGES IN MARKET CONDITIONS

Replacement of gas fired RA generation located within California and owned by pivotal suppliers with gas fired RA generation located outside California should reduce market concentration and raise pivotal supplier indexes.

- However, with the current IFM offer structure for import supply, gas fired generation located outside California cannot be scheduled in the CAISO IFM based on start-up costs, minimum load levels and minimum run times unless the IFM is expanded to cover regions outside California;

- In effect, import suppliers today must offer supply using 1 part bids as under the CAISO 1998-2000 market design;

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CHANGES IN MARKET CONDITIONS

- If the geographic scope of the CAISO IFM does not expand, the IFM offer structure for all imports, or at least RA import supply offers, could be modified to allow external resources to submit three part offers and other physical parameters;
- These changes in offer structure would be necessary in any case in order to apply market power mitigation to external resources in the IFM. There is no workable method to apply cost based market power mitigation to external gas fired RA resources without taking account of commitment costs.

CHANGES IN MARKET CONDITIONS

Replacement of gas fired RA generation owned by pivotal suppliers with demand response should reduce market concentration and raise pivotal supplier indexes.

- However, if gas fired generation is replaced in the RA market with demand response resources that will not reduce load during the high net load hours, then the California ISO will not have enough RA capacity to meet customer load, and prices will rise whether or not there is a potential for the exercise of material system market power.
- And if the demand response resources offer supply at very high prices, then energy prices will be higher than is the case today on high load days.

CHANGES IN MARKET CONDITIONS

If the supply demand balance outside California tightens, expected prices will rise, so it will be more expensive to contract forward for power and California prices will have to be higher, perhaps much higher, to attract non-RA import supply during the operating day.

- A tighter expected supply demand balance outside California will increase the potential for significant increases in market prices if there are unfavorable developments such as low hydro years or resource outages, whether or not there is a potential for the exercise of material system market power.
- All of these potential changes in market conditions are reasons that it is important that California load serving entities hedge the energy market cost of meeting a significant portion of their net load in some manner.

HIGH PRICED HOURS

Whether the exercise of system market power has contributed to high prices and what factors may have enabled the exercise of system market power are empirical questions.

The Market Surveillance Committee has limited resources to investigate these questions so I have focused on a review of two sets of hours during 2018.

- The first are the 13 hours in which one or more of the SCE, SDG&E or PG&E LAP prices exceeded $500;
- The second are the 20 hours during 2018 in which the California ISO Department of Market Monitoring found a difference of $20 or more between an IFM clearing price calculated using unmitigated offer prices and an IFM clearing price calculated using the lower of the unmitigated offer price or the default energy bid for each gas fired resource.

There is some overlap in these hours.

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HIGH PRICED HOURS

This review has focused on examining three issues in these hours.

- Was local market power mitigation appropriately triggered by the existence of transmission congestion?

- Was the level of import supply constrained by congestion on one or more of the major interties or constrained by congestion internal to the CAISO, potentially contributing to an exercise of system market power?

- Is it clear that IFM market prices materially exceeded the competitive level in these hours, reflecting the exercise of system market power?

LOCAL MARKET POWER MITIGATION

Was local market power mitigation appropriately triggered by the existence of transmission congestion?

- The CAISO LMPM design developed in 2011 and implemented in stages over following years was intended to insure that LMPM would be triggered by congestion without regard to where the transmission constraint and resource were located relative to the system reference bus. This intent does not ensure that the software has performed as intended

- We therefore reviewed the pattern of congestion between the LAPs and between the LAPs and the Palo Verde, Malin and NOB ties to identify hours with material congestion.

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LOCAL MARKET POWER MITIGATION

In assessing whether market prices may have been materially impacted by the exercise of system market power, it is important to assess whether there are any indications that local market power mitigation was sometimes not triggered when it should have, thereby contributing to high prices.

- The performance of the two reference buses used to trigger local market power mitigation was examined by the CAISO in 2011, with the conclusion that the two reference nodes were sufficient to trigger mitigation and determine an appropriate competitive LMP price.[1]
- It is appropriate to validate these conclusions as part of the current system market power evaluation by examining whether there was congestion relative to the interties or across the LAPS in any of the high priced hours in which LMPM did not trigger.

1. See, Lin Xu, "A Retrospective Analysis of Local Market Power Mitigation Enhancements," May 9, 2011 pp.7; Lin Xu, "Addendum" June 23, 2011 pp. 4-6.

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LOCAL MARKET POWER MITIGATION

We therefore examined whether local market power mitigation was appropriately triggered in the hours in which it was apparent from the LAP and intertie congestion components that there was material congestion within California.

- The CAISO provided us with data on whether LMPM was triggered (and additional data on which constraints and whether the 3PS was passed or failed).

- Our conclusion is that LMPM was triggered in every one of the high price hours in which there was material transmission congestion and there were no apparent issues with reference bus location.

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LOCAL MARKET POWER MITIGATION

We first examined whether there appeared to be congestion within the CAISO that should have triggered LMPM in the hours in which one or more LAP prices exceeded $500 in 2018.

		PGE DLAP		SCE DLAP		SDGE DLAP		Gas Price	Malin		Palo Verde		NOB		LMPM	3PS	Competitive
Day	Hour	LMP	LMP_CONG	LMP	LMP_CONG	LMP	LMP_CONG	SCE day ahead	LMP	LMP_Cong	LMP	LMP_Cong	LMP	LMP_Cong	Trigger	Fail	LMP Low
July 24, 2018	17	$413.72	$ (24.87)	$ 497.46	$ 15.42	$ 510.39	$ 16.42	$ 39.3060	393.453	-23.87695	439.4118	-9.94873	420.7826	-39.72104	1	1	Probably not
July 24, 2018	18	$584.09	$ -	$ 629.01	$ -	$ 587.24	$ (58.01)	$ 39.3060	554.3132	0	590.7118	0	567.7948	-33.88558	1	1	Probably not
July 24, 2018	19	$885.62	$ -	$ 934.72	$ -	$ 948.46	$ -	$ 39.3060	839.1694	0	887.1743	0	903.2064	0	1	1	Probably not
July 24, 2018	20	$946.36	$ -	$ 999.98	$ -	$1,007.51	$ -	$ 39.3060	893.0245	0	949.1933	0	966.7093	0	1	1	Probably not
July 24, 2018	21	$597.79	$ -	$ 638.17	$ -	$ 647.07	$ -	$ 39.3060	500	-63.51568	602.4604	0	614.6539	0	1	1	Probably not
July 25, 2018	15	$142.18	$ (62.16)	$ 252.42	$ 36.01	$ 543.14	$ 319.57	$ 19.4740	140.7259	-52.32638	238.9438	33.98911	250	41.13452	1	1	Should be
July 25, 2018	16	$219.43	$ (66.38)	$ 346.42	$ 39.08	$ 621.64	$ 306.32	$ 19.4740	205.2828	-62.71641	270.7142	-18.75855	254.1939	-41.39703	1	1	Should be
July 25, 2018	17	$325.23	$ (66.99)	$ 458.74	$ 41.71	$ 728.81	$ 298.10	$ 19.4740	303	-64.4637	392.9202	0	341.1535	-59.40773	1	1	Should be
July 25, 2018	18	$500.06	$ (30.75)	$ 584.51	$ 19.52	$ 601.00	$ 18.91	$ 19.4740	467.5152	-30.16281	534.5738	0	515.2783	-27.20567	1	1	Somewhat lower
July 25, 2018	19	$737.28	$ -	$ 773.80	$ -	$ 794.27	$ -	$ 19.4740	690.6413	0	738.7283	0	749	0	1	1	Probably not
July 25, 2018	20	$847.21	$ -	$ 885.55	$ -	$ 905.34	$ -	$ 19.4740	303	-486.52225	848.6928	0	858.5401	0	0	0	Probably not
August 7, 2018	19	$444.13	$ (154.74)	$ 707.70	$ 97.43	$ 708.60	$ 92.27	$ 27.3342	437.99	-131.24625	666.4392	81.38414	527.92	-64.1657	1	1	Should be
August 7, 2018	20	$485.41	$ (120.10)	$ 698.12	$ 79.61	$ 698.20	$ 75.52	$ 27.3342	475.048	-101.44653	662.039	67.32774	494.36	-106.36214	1	1	Should be

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LOCAL MARKET POWER MITIGATION

Of the 13 hours in which prices exceeded $500 in one more LAPS, there were five hours in which the LAP congestion components indicate the existence of significant congestion within the CAISO.

- CAISO data shows that LMPM was triggered and the 3PS test failed on one or more constraints in all of these hours.
- In these five hours the clearing prices for the SCE and SDGE LAPs were materially constrained up relative to prices for the PG&E LAP, so the competitive LMP should have been substantially lower than the mitigated clearing price in the SCE and SDGE LAPs.
- Hence, the offers of gas fired resources located in the SCE and SDG&E LAPS should have been mitigated to their default energy bids or to competitive LMP prices that were materially lower than the LAP clearing price.
- The implication is that the prices in these hours were set by offers mitigated down to the level of the default energy bids, by price capped load bids, or by virtual demand or supply bids.

LOCAL MARKET POWER MITIGATION

CAISO data shows that LMPM was triggered and the 3PS test failed on one or more constraints in all of the remaining 8 hours.

- However, in at least 7, and perhaps all 8 of these remaining hours, the competitive LMP was likely high enough that the clearing price in the constrained areas was likely set by resources mitigated to the competitive LMP rather than to the level of their default energy bid.

- Hence, the offers of resources in the SCE and/or SDGE LAPs would have been mitigated to levels at which the transmission constraints were just slightly non-binding.

LOCAL MARKET POWER MITIGATION

We also examined whether there appeared to be congestion within the CAISO that should have triggered LMPM in the hours in which the prices calculated by DMM using unmitigated offer prices and using the lower of the unmitigated offer price and the default energy bid for gas fired resources differed by $25 or more in 2018.

- There were 16 such hours.
- While LMPM appears to have triggered in all of these hours, in 14 of these hours the competitive LMP was likely high enough that the clearing price in the constrained area would have been set by resources mitigated to the competitive LMP rather than by default energy bids.

LOCAL MARKET POWER MITIGATION

- In two of these hours (hours 7 and 19 on February 21) the clearing prices for the SCE and SDGE LAPs were materially constrained up relative to the PG&E LAP, so the competitive LMP should have been substantially lower than the mitigated clearing price in the SCE and SDGE LAPs.
  - The offer prices of gas fired resources located in the SCE and SDG&E LAPs should have been mitigated in these hours to their default energy bids or to competitive LMP prices that were materially lower than the LAP clearing price.
  - The implication is that the prices in these two hours were set by offers mitigated down to the level of the default energy bids, by price capped load bids, or by virtual demand or supply bids.

LOCAL MARKET POWER MITIGATION

It would also provide a check on the performance of the LMPM design to calculate the competitive LMP for each LAP based on the competitive LMP actually applied at each node, in the hours in which the competitive LMP should have been materially below the LAP clearing prices.

- This calculation would either confirm that the competitive LMPs used in the mitigation process were at least roughly consistent with expectations or indicate that there is some kind of unintended outcome that needs to be examined.

We have not done this.

IMPORT COMPETITION

Was the supply of imports on one or more major ties constrained by congestion on the interties or by congestion internal to the CAISO, potentially contributing to an exercise of system market power?

- We examined the congestion components at the LAPs and three major interties (Palo Verde, Malin and NOB) relative to the reference bus
  - during the 13 hours with one or more LAP prices above $500, and
  - during the 16 hours in which the prices calculated by DMM using unmitigated offer prices and using the lower of the unmitigated offer price and the default energy bid for gas fired resources differed by $25 or more in 2018.

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IMPORT COMPETITION

There was no pattern of the CAISO as a whole being consistently being insulated from competition from import supply on the major ties during hours with high prices, but imports were impacted by congestion in a number of hours.

- The SCE and/or SDGE LAPS were materially constrained up relative to supply from both PG&E and the interties during 5 hours, hours 15-17 on July25 and Hours 19 and 20 on August 7, but this mitigation was internal to the CAISO and triggered the exercise of local market power mitigation based on competitive LMPs that should have been well below the clearing prices in the constrained LAPs.
- There was no congestion on the major ties on hours 19 and 20 on July 24 or hour 19 on July 25.

IMPORT COMPETITION

- There was some congestion on the interties relative to the reference bus during hour 17 on July 24 and hour 18 on July . This was likely just congestion relative to the SCE and SDG&E LAPs, but this should be confirmed.
- There was significant congestion at Malin during hour 21, and at NOB during hour 18 on July 24.
- There was very large congestion at Malin, but not at Palo Verde or NOB during hour 20 on July 25.

Overall, the CAISO does not appear to have been insulated from import supply from the rest of the WECC by congestion on the major ties during these hours, but there was congestion on individual interties during some of these hours.

IMPORT COMPETITION

Overall, the CAISO does not appear to have been insulated from import supply from the rest of the WECC by congestion on the major ties during 16 hours with the largest differences between prices calculated using unmitigated offer prices and price calculated using the lower of the unmitigated offer price and the default energy bid but congestion does appear to have insulated the CAISO from import supply on the major ties during some of these hours.

- There was no congestion relative to the system reference bus at any of the three major ties during 6 of these hours.
- There was congestion relative to the reference bus during hours 7 and 19 on February 21, but this reflected congestion internal to the CAISO which triggered LMPM in the SCE and SDGE LAPs and the competitive LMP should have been well below the LAP prices.
- There appears to have been congestion on imports from NOB and Malin during hour 19 on August 8, while there was export congestion at Palo Verde.

IMPORT COMPETITION

- Imports from NOB appear to be constrained by congestion during hour 20 on August 10, at Malin during hour 21 on July 24 and hour 21 on July 25, and at NOB during hour 18 on July 24.
- There was some congestion relative to the reference bus at all three interties during hour 17 on July 24 and hour 17 on July 23, but more detailed analysis would be necessary to confirm whether this was only congestion relative to Southern California.

Hence, congestion appears to have limited import supply to California as a whole on one of the major ties during a number of these hours, but only during hour 19 on August 8 does it appear imports on more than one major tie were limited by transmission congestion.

SYSTEM MARKET POWER

The final question to address is whether there is evidence of a material exercise of system market power.

- The primary evidence bearing on the question is analysis undertaken by the CAISO Department of Market Monitoring.

SYSTEM MARKET POWER

We understand that the CAISO Department of Market Monitoring has been unable to rerun the IFM market engine to replicate day-ahead market outcomes using default energy bids for a couple of years.

- As explained in the 2018 Report on Market Issues & Performance, the DMM has, as a substitute, carried out two simulated dispatches to meet IFM load bids using the bid stack of IFM supply. One dispatch uses unmitigated offer prices, and the second dispatch uses the lower of the unmitigated offer prices or the default energy bid.
- An important design element of the DMM analysis is that it compares simulated prices to simulated prices. This is a good structure which reduces the potential for spurious conclusions that would be likely if simulated prices were compared to actual market prices (because actual market prices are likely to differ from simulated prices for many reasons unrelated to the level of offer prices).

SYSTEM MARKET POWER

While the simulated dispatch does not directly take account of commitment costs or ancillary service requirements, my understanding is that the DMM has accounted for these factors by limiting the bid stack to resources that were committed in that hour of IFM and by excluding from the bid stack capacity segments scheduled to provide ancillary services in the IFM.

- We observed that the DMM calculations compare simulated outcomes to simulated outcomes, which by itself reduces the likelihood of finding spurious differences in price levels.
- In addition, however, we think the DMM methodology for accounting for commitment costs and ancillary service requirements in the dispatch simulations is a good approach, given the inability to rerun the actual IFM. This approach reduces the potential for spurious conclusions that could arise if the resources dispatched to meet load in the simulations differed materially from the resources actually scheduled to meet load in the IFM.

SYSTEM MARKET POWER

- This methodology for accounting for commitment costs and reserve schedules could understate the impact of the exercise of system market power if it were exercised in part through inflated commitment costs, and the inability to re-optimize reserve schedules based on default energy bids could raise the clearing price calculated using the lower of the unmitigated offer price or the default energy bid.
- However, we do not believe there is a better approach the Department of Market Monitoring could have taken to accounting for commitment costs and reserve schedules without rerunning the actual IFM model.
- The inability to account for transmission congestion in these calculations might either increase or decrease the difference in the calculated clearing prices.

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EVIDENCE OF SYSTEM MARKET POWER

The findings from the DMM analysis were reported in the California ISO's Department of Market Monitoring's 2018 Annual Report on Market Issues & Performance and in presentations at previous MSC meetings. [1]

- The California ISO Department of Market Monitoring made available to the MSC the hour by hour simulated clearing prices, as well as historical gas prices and LAP prices.
- We reviewed this data, particularly the 20 hours in 2018 in which the clearing price calculated using the unmitigated offer prices exceeded the clearing price calculated using the lower of the unmitigated offers or the mitigated offer by $20 or more.

There are many hours with low residual supply index values and low or zero differences in the calculated clearing prices.

1. Amelia Blanke, California ISO, Department of Market Monitoring, "Analysis of system level market power," Market Surveillance Committee Meeting, June 7, 2019.

EVIDENCE OF SYSTEM MARKET POWER

The California ISO Department of Market Monitoring has given us permission to present the data below pertaining to the 20 hours with the largest price differences between the calculated clearing prices.

Year	Date	Hour	Base-case Price	Gas @ Min. (DEB,DA) Price	Markup	RSI_1	RSI_2	RSI_3	PG&E DLAP LMP IFM ($/MWh)	SCE DLAP LMP IFM ($/MWh)
2018	24Jul2018	21	$619.43	$500.00	$119.43	0.961	0.879	0.799	$597.79	$638.17
2018	26Jul2018	19	$324.99	$227.50	$97.49	0.973	0.896	0.819	$325.96	$342.06
2018	23Jul2018	18	$293.06	$226.16	$66.90	1.018	0.940	0.863	$265.15	$282.87
2018	25Jul2018	21	$450.00	$400.11	$49.89	0.938	0.858	0.780	$444.74	$465.38
2018	23Jul2018	20	$483.53	$437.50	$46.03	0.975	0.893	0.813	$460.96	$483.53
2018	24Jul2018	17	$478.17	$434.31	$43.86	0.974	0.900	0.827	$413.72	$497.46
2018	25Jul2018	22	$245.00	$206.04	$38.96	0.993	0.908	0.825	$221.17	$235.50
2018	26Jul2018	17	$213.18	$180.85	$32.33	1.003	0.928	0.853	$193.23	$260.25
2018	10Aug2018	20	$220.11	$188.00	$32.11	1.082	0.999	0.928	$221.00	$270.59
2018	08Aug2018	19	$346.11	$314.88	$31.23	0.992	0.910	0.844	$325.57	$365.82
2018	23Jul2018	19	$353.93	$324.00	$29.93	0.991	0.911	0.833	$329.12	$348.23
2018	23Jul2018	17	$230.16	$200.25	$29.91	1.034	0.956	0.878	$215.03	$243.47
2018	24Jul2018	19	$928.33	$899.00	$29.33	0.923	0.848	0.774	$885.62	$934.72
2018	21Feb2018	19	$171.00	$142.04	$28.96	1.197	1.122	1.074	$76.21	$343.53
2018	24Jul2018	18	$629.01	$601.96	$27.05	0.952	0.879	0.806	$584.09	$629.01
2018	21Feb2018	7	$169.94	$144.48	$25.46	1.267	1.183	1.122	$94.26	$189.99
2018	26Jul2018	20	$369.59	$346.26	$23.33	0.962	0.883	0.804	$361.82	$377.46
2018	27Jul2018	18	$179.50	$157.99	$21.51	1.068	0.990	0.911	$181.63	$196.83
2018	27Jul2018	19	$235.30	$214.59	$20.71	1.046	0.965	0.885	$219.86	$233.12
2018	28Jul2018	20	$145.00	$125.00	$20.00	1.073	0.982	0.906	$149.13	$154.44

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EVIDENCE OF SYSTEM MARKET POWER

We have a few observations about these results.

- There were only 20 hours over 2018 in which the difference in the calculated clearing prices was $20 per megawatt hour or more and the difference in the clearing prices was very small in most of the hours in which the 3 pivotal supplier index was less than 1.

- The 20 hours with the highest differences in clearing prices were all hours with high SOCAL citygate gas prices (there was only 1 hour among these 20 in which the SOCAL citygate gas price was less than $13 and it exceeded $8.50 on that day. Hence, these were all days on which the SOCAL Gas system was expected to be constrained, which would introduce uncertainty into the cost of buying gas in post IFM scheduling cycles.

EVIDENCE OF SYSTEM MARKET POWER

- LMPM appears to have triggered in all of the 20 hours with differences in estimated clearing prices of $20 or more, with some degree of mitigation applied to offers of resources located within the SCE and/or SDGE LAPs. There was substantial congestion in the IFM solution in two of these hours. The competitive LMP should have been well below actual SCE and SDG&E LAP prices and below the simulated clearing price in these two hours.

- Hours with differences in estimated clearing prices of $20 or more were not only hours with high gas prices in Southern California, all but one of these hours were also hours over the evening solar ramp in which the cost of meeting load would have been impacted by the cost of committing additional generation to run for several hours in order to meet peak load in a particular hour.

We discuss these four observations below.

EVIDENCE OF SYSTEM MARKET POWER

First, there were only 20 hours over 2018 in which the clearing price simulated using the unmitigated offer prices exceeded the clearing price simulated using the lower of the unmitigated offer price and the mitigated offer price for that gas fired resource by $20 per megawatt or more.

- There were 10 hours in which the difference in the calculated clearing prices exceeded $30 per megawatt hour.
- There were two hours in which the difference in the calculated clearing prices exceeded $90 per megawatt hour.

EVIDENCE OF SYSTEM MARKET POWER

DMM calculations indicate that a system market power test based on a 3 PS of 1 or less would have triggered in 310 hours in 2018.

- The difference between the clearing price calculated using the unmitigated offer price and the lower of the unmitigated offer price and the default energy bid (as calculated by DMM without accounting for the impact of LMPM on offer prices):
  - exceeded $ 0 in 244 of these hours,
  - was $1 or more in 185 of these hours,
  - was $2 or more in 129 hours, and
  - was $5 or more in 73 of these hours

At a 10,000 mmbtu heat rate, the calculated price differences could be accounted for in nearly 2/3 of these hours by a 20 cent per mmbtu difference in the expected price of gas and would have been accounted for by a 50 cent per mmbtu difference in more than 75% of these hours.

EVIDENCE OF SYSTEM MARKET POWER

In evaluating the implications of the small magnitude of most of the calculated price differences it is important to take account of some implications of the gas scheduling process and the methodology DMM used to calculate the DEB based clearing price.

- The California IFM market closes after the most liquid morning gas trading period, with IFM schedules posted in time for gas fired generators to schedule gas in the evening cycle or in the market day intraday cycles.
- While the DEB is calculated based on an index of gas prices in the morning trading period, gas fired generators have to submit IFM offer prices that in part reflect the opportunity cost of burning gas they purchased prior to submitting the bids, and that in part reflect the expected cost of buying additional gas to schedule later cycles.

EVIDENCE OF SYSTEM MARKET POWER

On days when the interstate pipelines and SoCal Gas pipeline are not constrained, the supply of gas will generally be fairly liquid around the clearing price in the day-ahead market, so the cost of buying gas to schedule in the later cycles will usually not be materially higher than the cost in the morning gas market.

- On days when the interstate pipelines or the SoCal Gas pipeline are constrained, however, as evidenced by high SoCal citygate prices, the supply of gas will be less liquid around the morning clearing price and gas maybe available for scheduling in later cycles at materially higher prices or at materially lower prices, depending on how expected conditions have changed.
- This gas price uncertainty is relevant in assessing the significance of the hours in which the simulated clearing prices differed by amounts that would be consistent with very small differences between the gas price used to calculate the default energy bid and expected gas costs.

EVIDENCE OF SYSTEM MARKET POWER

While gas prices should not always be higher when buying gas for later pipeline cycles than in the morning trading period, it is important to recall that the DEB based clearing price is not calculated just using the default energy bid, it is calculated based on the lower of the unmitigated offer price or the default energy bid.

- If gas fired generators sometimes submit IFM offer prices for power reflecting higher expected gas prices in later cycles and sometimes submit offer prices for power reflecting lower expected gas prices in later cycles, the DMM methodology uses the unmitigated offer prices reflecting lower gas price expectations when they are lower than the DEB price but uses the DEB when the unmitigated offer prices reflect higher gas price expectations.

EVIDENCE OF SYSTEM MARKET POWER

- Moreover, if some suppliers submitted offers lower than the DEB and others submitted offers higher than the DEB, reflecting diverse gas price expectations, the DMM methodology would use the lower offers to calculate the mitigated clearing price and substitute the DEB for the higher offers.

- Hence, even if unmitigated offer prices were centered around a value below the DEB, the DMM methodology would find that unmitigated offers yielded a higher clearing price than the unmitigated offers, because the DMM methodology would only use the DEB when it was lower than the unmitigated offer price.

EVIDENCE OF SYSTEM MARKET POWER

- While the default energy bids include a 10% margin over the estimated cost based bid, the simulation methodology uses the lower of the unmitigated offer or the DEB to calculate the mitigated clearing price without regard to the level of the unmitigated offer relative to the DEB.

- A comparison of unmitigated and DEB based offer prices that would be less impacted by gas price uncertainty could be provided by calculating the clearing prices always using a DEB with a 10% margin and always using a DEB with a 0% margin, then comparing these two sets of clearing prices to the clearing prices calculated using actual unmitigated offer prices.

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EVIDENCE OF SYSTEM MARKET POWER

We examined the relationship between gas system constraints and the calculated difference between the clearing price calculated using unmitigated offer prices and the lower of the unmitigated offer prices and the default energy bid.

We limited the comparison to hours 16 to 21 when gas fired generation was likely to be needed to meet load.

	Difference in Simulated Price	
Socal citygate	All Months	Non-Summer(Oct-May)
Gas Price $20 or greater	$6.61	$.283 (6 observations)
Gas price $10 to $19.99	$6.02	$2.586 $2.408 combined
Gas price $5 to $9.99	$1.69	$1.00
Gas price < $ 5	$.90	$.80

High gas prices clearly appear to be associated with larger differences in the simulated prices. However, high gas prices can be correlated with other factors as well.

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HIGH GAS PRICES

Second, a related observation is that a significant commonality across the 20 hours with the largest differences in the calculated clearing prices is that these were all days with high gas prices on the SOCAL gas system.

- The lowest SoCal citygate price for any of these days was above \$8.50, and that was the only one of these 20 hours+ with a SoCal citygate price lower than \$13.
- The mitigated offer prices used in calculating these clearing prices reflect these high SoCal citygate prices, but they do not reflect the expected cost of buying gas in later cycles on days with tight gas market conditions.
- Is there only a potential for the exercise of material system market power on days with high gas prices or is there more potential for the expected cost of buying additional gas to exceed the default energy bid on these days?

HIGH GAS PRICES

Four of the 20 hours with the largest differences in clearing prices were on a Monday (July 23), a day of the week when the default energy bid is particularly likely to understate actual gas costs.

- Gas price data provided by the CAISO indicates that same day gas prices were far higher than the gas price used to calculate the default energy bid on July 23.
- IFM prices may have too low relative to the cost of buying gas to meet incremental load, not too high, on this day.

LOCAL MARKET POWER MITIGATION

Third, it is my understanding that the base case IFM simulations reported by the California ISO Department of Market Monitoring in the section 7.3.1 of the Annual Report on Market Issues & Performance are based on unmitigated bids, that is the offers do not reflect the extent to which offer prices were reduced by the application of local market power.

- While as we observed in the discussion above, LMPM will not necessarily be effective in preventing the exercise of system market power, it is intended to be effective in preventing the exercise of local market power.
- Calculating clearing prices using unmitigated offers on days on which LMPM triggered, particularly in hours in which the competitive LMP prices should have been far below the clearing prices in the constrained regions, potentially confuses evidence of a potential effort to exercise local market power with the exercise of system market power.

LOCAL MARKET POWER MITIGATION

- As discussed above there was substantial congestion between the PG&E and SCE LAPs on Feb 21 hours 7 and 19, two hours with differences in clearing prices that exceeded $20. Moreover, the competitive LMP should have been materially below the clearing prices in the SCE LAP in these hours.

- Even in hours in which the competitive LMP was above the default energy bids of most or even all resources within the constrained regions, the application of LMPM mitigation would generally have reduced offer prices (to the point that there was no longer congestion on non-competitive constraints).

LOCAL MARKET POWER MITIGATION

Hence, the difference between the clearing price calculated unmitigated offers and those calculated using the lower of the unmitigated offer and the default energy bids may overstate the impact of applying default energy based mitigation across the CAISO in these hours because some of those unmitigated offer prices were mitigated as a result of the application of LMPM.

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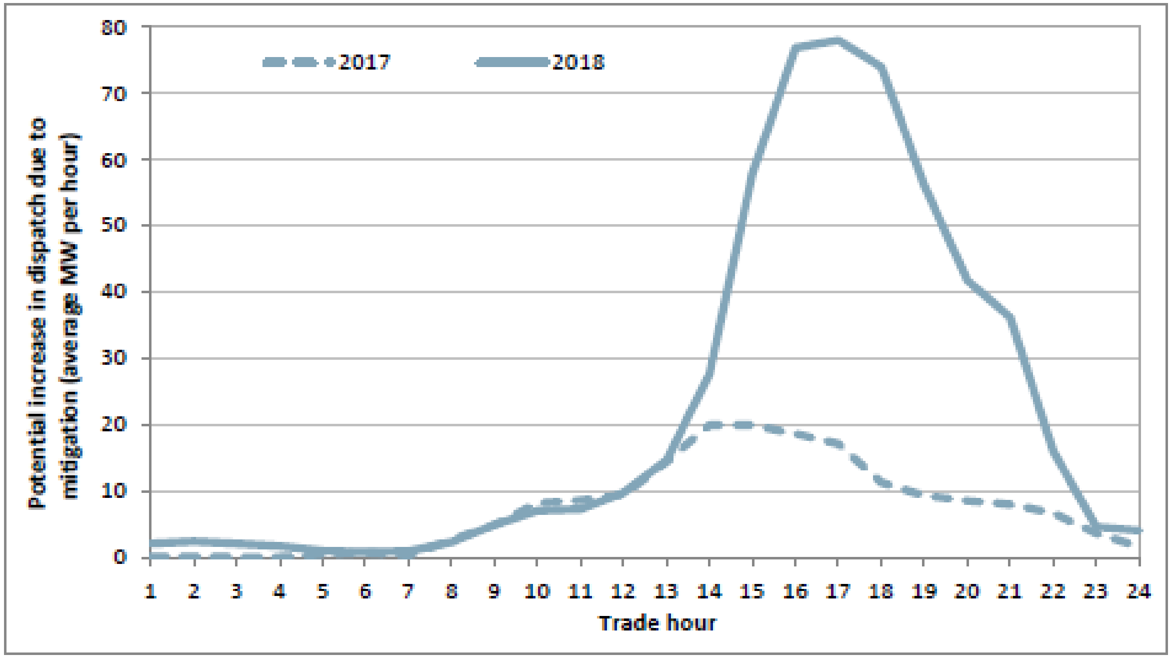
LOCAL MARKET POWER MITIGATION

Figure 7.9 in the DMM 2018 market report portrays the average megawatts amount per hour that resources were incrementally dispatched in the IFM pass based on mitigated offer prices.



LOCAL MARKET POWER MITIGATION

Figure 7.9 shows that that the level of incremental dispatch based on mitigated offer prices was substantially higher in 2018 than in 2017 and concentrated in the evening ramping hours, the same hours in which prices in DMM's base case dispatch exceeded prices calculated based on the lower of actual offers or default energy bids.

- It is my understanding that the megawatt amounts reported in figure 7.9 are the megawatt amount that resources were actually incrementally dispatched in the IFM pass based on mitigated offer prices.

- The total amount of megawatts that were mitigated may have been larger.

LOCAL MARKET POWER MITIGATION

The California ISO Department of Market Monitoring has provided us with data on the average amount of energy dispatched based on mitigated bids for the 24 hours of each day as portrayed in Figure 7-9, broken down by month rather than averaged over the year.

- These data appear to indicate that relatively large amounts of energy were dispatched based on mitigated offers during hours 14 through 21 during July 2018, exceeding an average level of 200 megawatts an hour in each of these hours, and exceeding 400 megawatts an hour on average over hours 15 through 18.
- The average level of mitigated energy dispatch estimated for August 2018 was much lower than estimated for July 2018, but still averaged more than 200 megawatts over hours 16 to 18.

LOCAL MARKET POWER MITIGATION

The level of these averages for the months of July and August 2018 suggests that the use of unmitigated offer prices in the clearing price simulations could have materially impacted the comparisons.

- It would be informative to examine the actual amount of energy dispatched based on mitigated offers in the specific hours with high prices during July and August 2018;
- If the level of mitigated dispatch is also high in those hours, that would suggest that it would be appropriate to recalculate comparisons of clearing prices using the offer prices that were actually used in the IFM, reflecting the impact of local market power mitigation.

COMMITMENT COSTS AND MARKET POWER

Fourth, the hours with differences in clearing prices in excess of $20 not only all fell on high gas price days, they were all evening ramp hours.

- The actual cost of meeting load in these hours not only reflected high incremental energy offers, it was also impacted by the high cost of committing additional generation to meet peak load in one or two hours on days with high gas prices (and hence higher start up and minimum load costs).
- While the unit commitment is fixed and hence the same between the calculation using unmitigated prices and the lower of unmitigated offers and the default energy bid, and hence these high commitment costs do not directly impact the clearing price comparisons, the level of commitment costs is important in understanding the level of actual LAP prices in these hours and would be important in applying market power mitigation to external resources.

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COMMITMENT COSTS AND MARKET POWER

- It is likely not economic to commit a combined cycle to meet load in the IFM if prices are materially above incremental costs only in one or two hours.

- While many of the hours with differences in the calculated clearing prices of $20 or more fell on the July 23-28 days on which there were a number of hours with high prices, some of the hours with large differences fell on days on which there are only a few very high price hours and commitment costs may have materially impacted supply.

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COMMITMENT COSTS AND MARKET POWER

Looking forward to years in which there may be greater dependence on imports to meet load over the evening solar ramp down, the CAISO should recognize that import suppliers are effectively offering supply using one part bids to reflect commitment costs.

- This design likely results in less elastic supply in the evening ramp hours, and may also contribute to imports that clear in the day-ahead market not flowing in real-time.
- This limitation of the current market design would be addressed by the expansion of the CAISO day-ahead market to cover additional balancing areas in the west.
- However, if the timing of that expansion is uncertain, the CAISO may want to in parallel develop the ability to commit import supply at interties based on three part bids, either just for RA imports or for any supplier that chooses to offer in this manner.

COMMITMENT COSTS AND MARKET POWER

- Such an ability to evaluate the commitment of intertie resources based on start-up and minimum load costs as well as incremental energy offer prices would be a precondition to the ability to apply market power mitigation to RA imports.

HIGH COST IMPORT SUPPLY

It is our understanding that some import supply offered to cover resource adequacy obligations is offered at or near the bid cap ($1000).

- These offers could be offered at the price cap to avoid being scheduled in the day-ahead market because there is no supply backing the resource adequacy contract.
- In addition, because real-time shortage pricing in the CAISO is capped at $1000, an import supplier that offers supply in the day-ahead market at $1000 is unlikely to incur material losses if its offer clears in the day-ahead market and the supplier is unable to deliver this power in real-time.

It is noteworthy in this context that the way real-time shortage pricing is implemented in NYISO, MISO, PJM, and ISO New England, as well as of course in ERCOT, an import supplier (as well as any other supplier) could pay much more than $1000 per megawatt hour for power scheduled in the day-ahead market that it is unable to supply in real-time.

HIGH COST IMPORT SUPPLY

This is not a good design from either a market or reliability perspective because there are low consequences to non-performance on days on which high IFM prices reflect expectations of stressed system conditions in real-time.

- Implementing an offer cap in the range of $500 to $600 per megawatt hour for RA resources, or at least RA imports and demand response, would sometimes attach larger consequences to non-performance when the FMM clears at high prices.

- However, the consequences of non-performance would still be small if the IFM clears at high prices determined by non-RA supply offers with the result that the difference between the IFM clearing price and potential FMM prices remains small.

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SYSTEM MARKET POWER MITIGATION

It appears that the CAISO was generally not insulated from import competition by transmission constraints during high priced hours during 2018, so import competition should have generally have constrained the exercise of system market power by generators located within California.

- However, there were some high priced hours in which transmission congestion appears to have insulated the CAISO from import competition at least to some extent.
- Moreover, the effectiveness of the competition provided by import supply could change in the future if the CAISO becomes materially more dependent on meeting net load with supply from resources located outside the CAISO control area.

SYSTEM MARKET POWER MITIGATION

If the CAISO and other stakeholders believe there is a potential for changes in market conditions that will materially increase dependence on imports and result in more hours in which the supply of imports is constrained by transmission congestion, the CAISO could develop an expanded LMPM design in which a 3PS would be triggered not only by material congestion within the CAISO but could also be triggered by material congestion on the major interties into California.

- This could probably be implemented with a minor change in the current LMPM design, adding particular major interties as reference buses against which congestion would be tested in applying LMPM.

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