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System Operator Corporation

MRTU Locational Market Power Mitigation Study

**Dept. of Market Monitoring
Market Surveillance Committee Meeting
November 13, 2006
(Revised 11/14/2006)**



Overview

I. Review of MRTI Local Market Power Mitigation (LMPM) and LECG Concern #2

- **Previously discussed at March 15, 2005 MSC meeting**
- **Modification in mitigation rule adopted to mitigate concern**
- **CAISO committed to study residual concern prior to MRTU implementation**

II. Study Methodology

III. Initial Results

IV. Potential Concerns & Further Analysis



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I. Review of MRTU LMPM and LECG Concern #2



Summary of Market “Passes”

Pass	Description
Pass 1	Pre-IFM Pass with only competitive transmission constraints enforced.
Pass 2	Pre-IFM Pass with all transmission constraints enforced (using Unmitigated Bids). If unit is “dispatched up” in Pass 2 (relative to Pass 1), incremental dispatch is considered reliability dispatch and is subject to bid price mitigation rules.
Pass 3	Integrated Forward Market (IFM). Includes any bid price mitigation applied based on Pass 2 results.
Pass 4	Residual Unit Commitment (RUC)



Local Market Power – Energy Bid Mitigation Rules

- Dispatches made in Pass 1 (application of competitive constraints) are considered ‘in economic merit order’.
- Subsequent incremental dispatches made in Pass 2 (application of all constraints) beyond the competitive dispatch levels are considered ‘out-of-sequence’, or ‘not in economic order’.
- Units with incremental out-of-sequence dispatches in Pass 2 will have the entire portion of the unit’s energy bid curve above the Pass 1 dispatch mitigated to the higher of the highest priced bid dispatched in Pass 1 or the applicable Default Energy Bid.



Example of Residual Concern #2

- Assume there is a load pocket with:
 - 495 MW of load
 - Two 300 MW steam units with reference price of \$50/MW
 - 200 MW of gas turbines with reference price of \$150/MW
- If the steam units submitted an offer price of \$200/MW and the gas turbines were bid in at \$150/MW:
 - In Pass 2:
 - The gas turbines would be dispatched for 200 MW, and
 - One steam unit would be dispatched for 300 MW and therefore mitigated to \$50/MW for the entire 300 MW of output.
 - In Pass 3:
 - The steam unit will be dispatched to 300 MW;
 - The gas turbines will be dispatched to 195 MW; and
 - Prices will be set by the gas turbines at \$150, even though the entire load could have been met by both steam units at a price of \$50.



Comments on Residual Concern #2

- **To be a profitable strategy,**
 1. The local constraint could be solved without the use of the unit being economically withheld; and
 2. The supplier would need to have a unit that is relatively low cost compared to the next best competitive alternative; and
 3. The supplier has other units in the same vicinity that are scheduled at a sufficiently high enough level that the profit from raising the price exceeds the lost profit opportunity of the unit that is economically withheld.
- **In addition, this would be limited to circumstances where the local market power is not being addressed by RMR contracts or LSE Resource Adequacy contracts.**
- **DMM/MSO previously concluded that it seemed unlikely that these sets of circumstances will occur frequently.**



ISO Recommendation for Addressing the Residual Issue with Concern #2

- **Maintain PJM-like LMPM with the modification of mitigating the entire bid curve above the Pass 1 dispatch level.**
- **Utilize ISO LMP studies over the next year to undertake an assessment of the extent to which this residual concern is likely to occur.**
- **If the residual concern is more significant than expected, the ISO will consider options to address it, including adopting the NY-like Market Power Mitigation approach.**



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II. Study Methodology



Modeling Components

- **CAISO Full Transmission Network Model**
- **Generating Units Production Information (Pmax, Pmin, heat rate, offer curves, etc)**
- **Imports/Export through Inter-ties**
- **Constraint, Interface and Nomograms**
- **Load forecast**
- **Study Time Horizon: 4PM, September 5, 2006**
- **Scenarios for Pass1, Pass2 and IFM runs**



CAISO Full Transmission Network Model

- **3800 nodal buses**
- **5040 transmission lines and transformer (60-500KV)**
- **19 regions (eg, PBY_Bay, SCSO_LAO, SDG_SDGE)**
- **664 generating units**
- **40 Interfaces (grand-fathered paths)**
- **62 Constraints**
- **Same as CAISO LMP Study 3B model with forecast 2006 condition in transmission topology and upgrades**



Generation & Supply

- **664 generating units of types including peaker, thermal, hydro, nuclear, biomass, cogeneration, geothermal, solar, and wind.**
- **Non-thermal units bid in zero price (supply quantity = metered generation)**
- **Hydro supply quantity is based on 2004 Hour-ahead level for a “medium” hydro level**
- **Import and Exports:**
 - Net historical Hour Ahead scheduled quantity bid at zero
 - Real time energy bids included at historical bid price/quantity (aggregated by tie-point)
 - Includes incs and decs



Thermal Units – Marginal Costs

- **Key type of units that set the Market Clearing Price.**
- **Fuel price is assumed \$6.35/MMBtu for natural gas and a high price \$16/MMBtu for the oil.**
- **Incremental Heat Rate “capped” during adjustment to ensure monotonicity:**
 - 8,500Btu/kWh for combined-cycle units
 - 12,000 Btu/kWh for steam turbine
 - 17,000 Btu/kWh for gas turbine.
- **VOM (Various Operation & Maintenance) cost is assumed \$4/MWh for gas turbine and \$2 for combined-cycle and steam turbine units.**

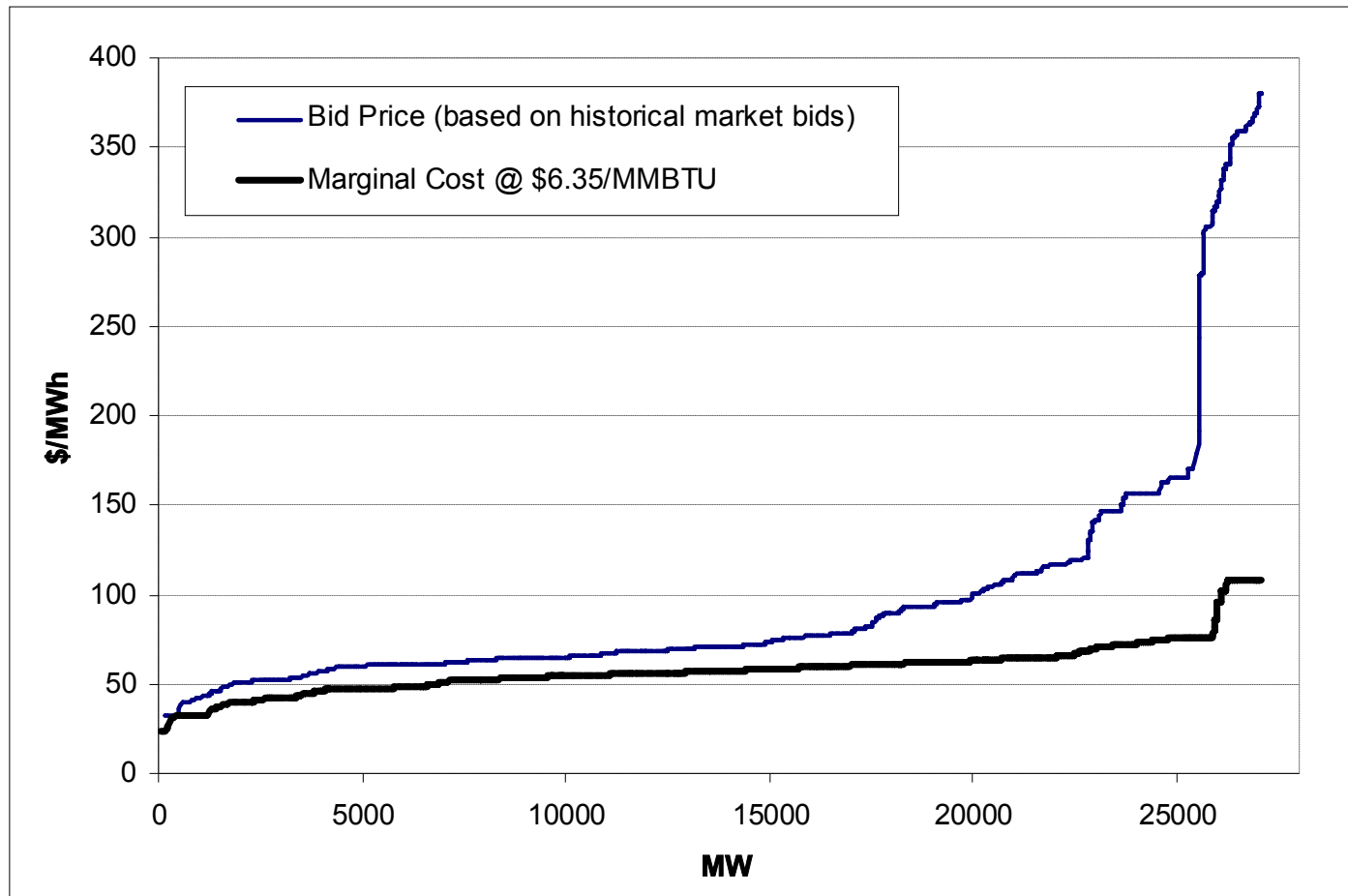


Thermal Units - Offer Prices

- **Marginal Cost Bid**
 - Incremental Heat Rate * Fuel Price + VOM
- **Default Energy Bid (DEB)**
 - Set to Marginal Costs + 10%
 - Assumes owners select Cost-based DEB Option
- **Historical Market Bids**
 - Heat-rate based marginal costs, plus an “adder” representing the average markup of each unit’s real time energy bids over marginal costs during high load hours of summer 2006 (in \$/MWh).
- **Schedule M**
 - Average price at full output; applies to RMR 2 units only



Thermal Units Offer Price Curve (aggregated)



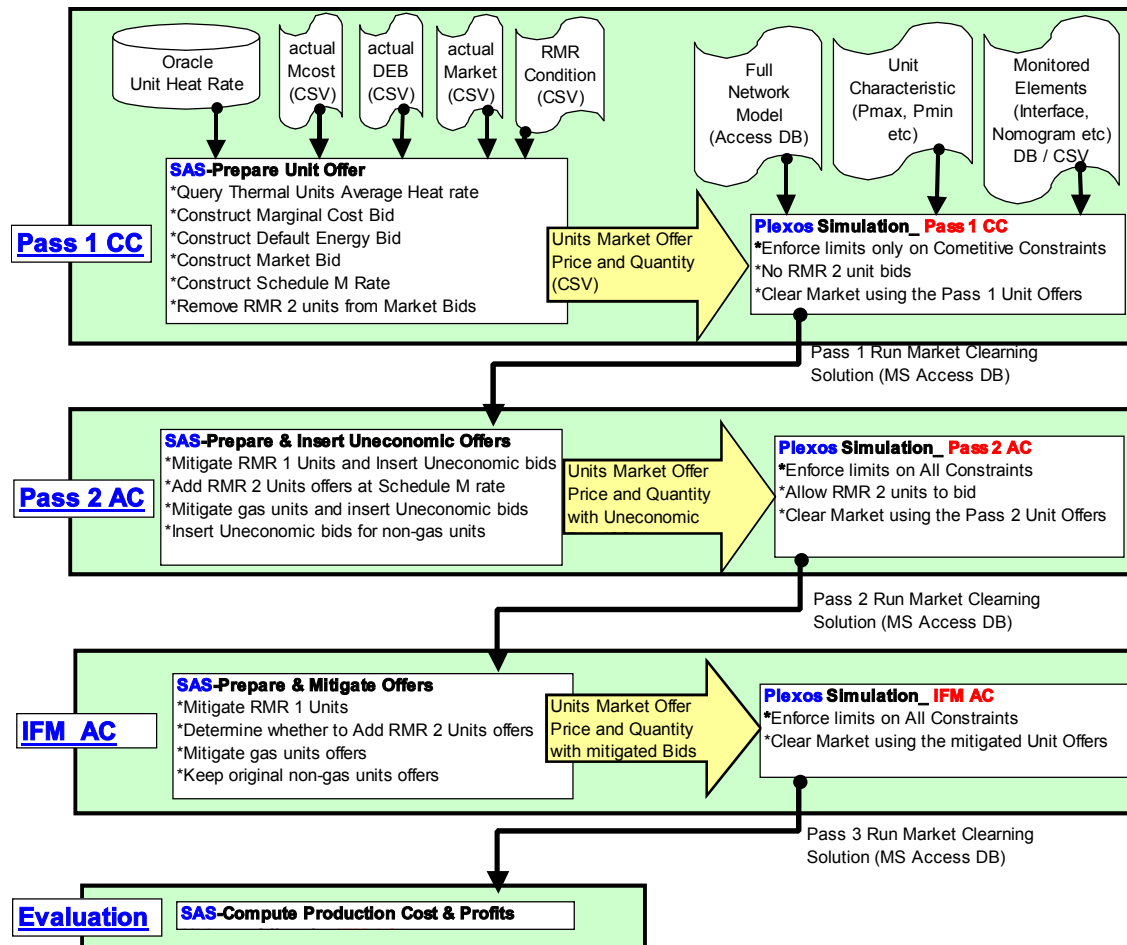


Competitive Paths

- **Since CPA study has not been completed, the list of competitive paths is default to current inter-zonal paths:**
 - only grand-fathered paths modeled as Interface in Plexos simulation tool (Path 26, Path 15, inter-ties)
- **Candidate Competitive Paths**
 - 20 Constraints
 - 110 Transmission lines & transformers
- **Deemed Non-competitive Paths**
 - 42 Constraints
 - 4930 transmission lines & transformers



Mitigation Implementation Flow Chart





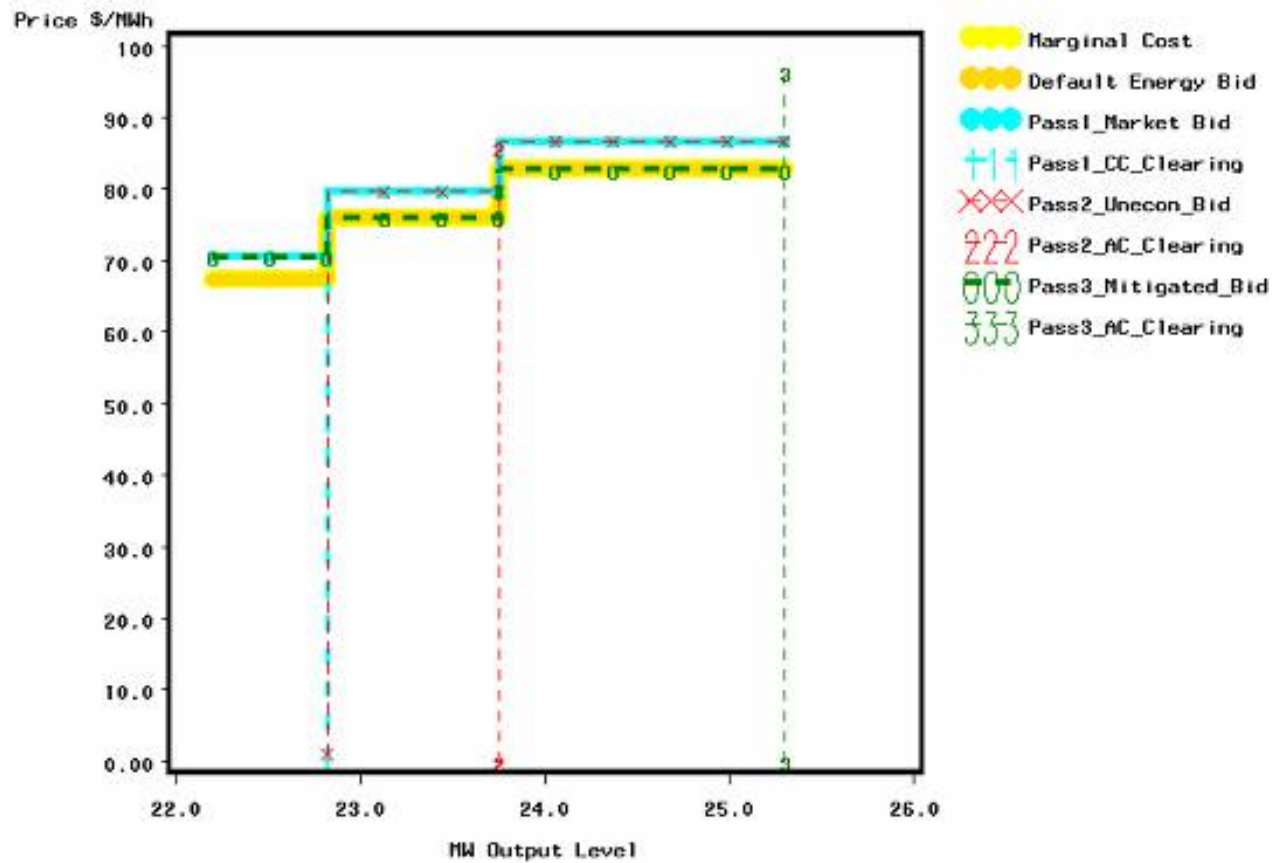
Mitigation Implementation Rules

	Pass 1 CC (Competive Constraint)	Pass 2 AC (All Constraints)	IFM AC_mitigated (Integrated Forward Market)
RMR 1	Market Bid	If MCQ1 = 0 -Use MCost	If deltaMCQ = 0 -keep market bid
		If MCQ1 > 0 -\$.9999 P for Q <=MCQ1 -mitigate Mkt bid P for Q > MCQ1: max{ min[mkt bid, MCost], P_MCQ1}	If deltaMCQ > 0 -keep P for Q <=MCQ1 -mitigate Mkt bid P for Q > MCQ1: max{ min[mkt bid, MCost], P_MCQ1}
RMR 2	No bid	Schedule M	If MCQ2 = 0 -no bid
			If MCQ2 > 0 -keep Schedule M
Residual Supply Units (gas)	Market Bid	If MCQ1 = 0 -keep Market Bid	If deltaMCQ = 0 -keep market bid
		If MCQ1 > 0 -\$.9999 P for Q <=MCQ1 -keep Mkt bid on Q > MCQ1	If deltaMCQ > 0 -keep P for Q <=MCQ1 -mitigate Mkt bid P for Q > MCQ1: max{ min[mkt bid, DEB], P_MCQ1}
Other non-gas	actual bid	If MCQ1 = 0 -Keep actual Bid	-keep acutal bid
		If MCQ1 > 0 -\$.999 P for Q <=MCQ1 -keep actual bid on Q > MCQ1	

Acronym	Description
P	Offer/Bid Price (\$/MWh)
Q	Offer/Bid Quantity (MW)
MCQ1	Market Cleared Quantity (MW) Pass 1 CC
MCQ2	Market Cleared Quantity (MW) Pass 2 AC
P_MCQ1	Offer/Bid Price (\$/MWh) for MCQ1
deltaMCQ	MCQ2 - MCQ1
MCost	Maginal Cost
Schedule M	average Heat Rate(at full MW output) * fuel price
DEB	Default Energy Bid

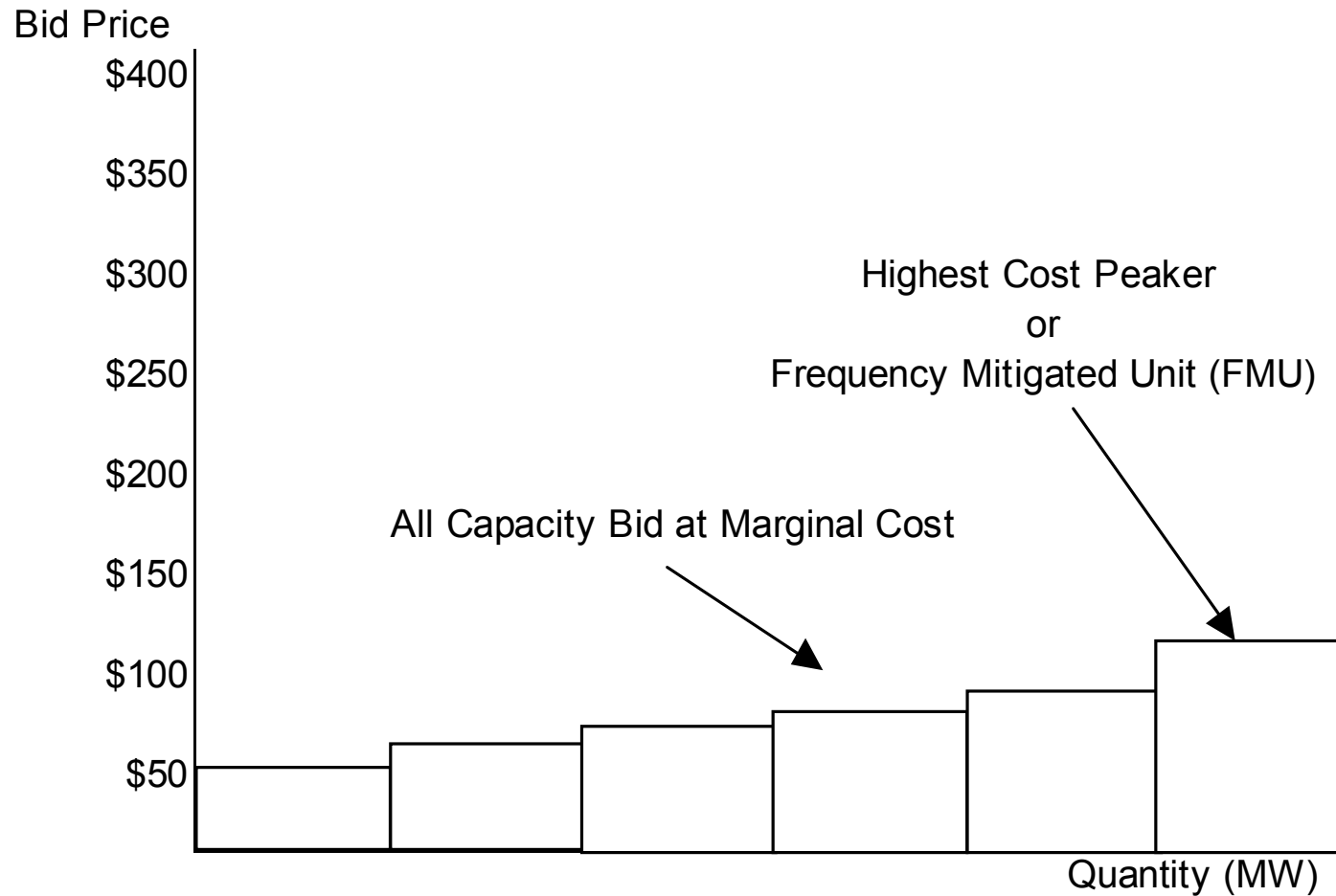


Unit Offer Price Mitigation Plot



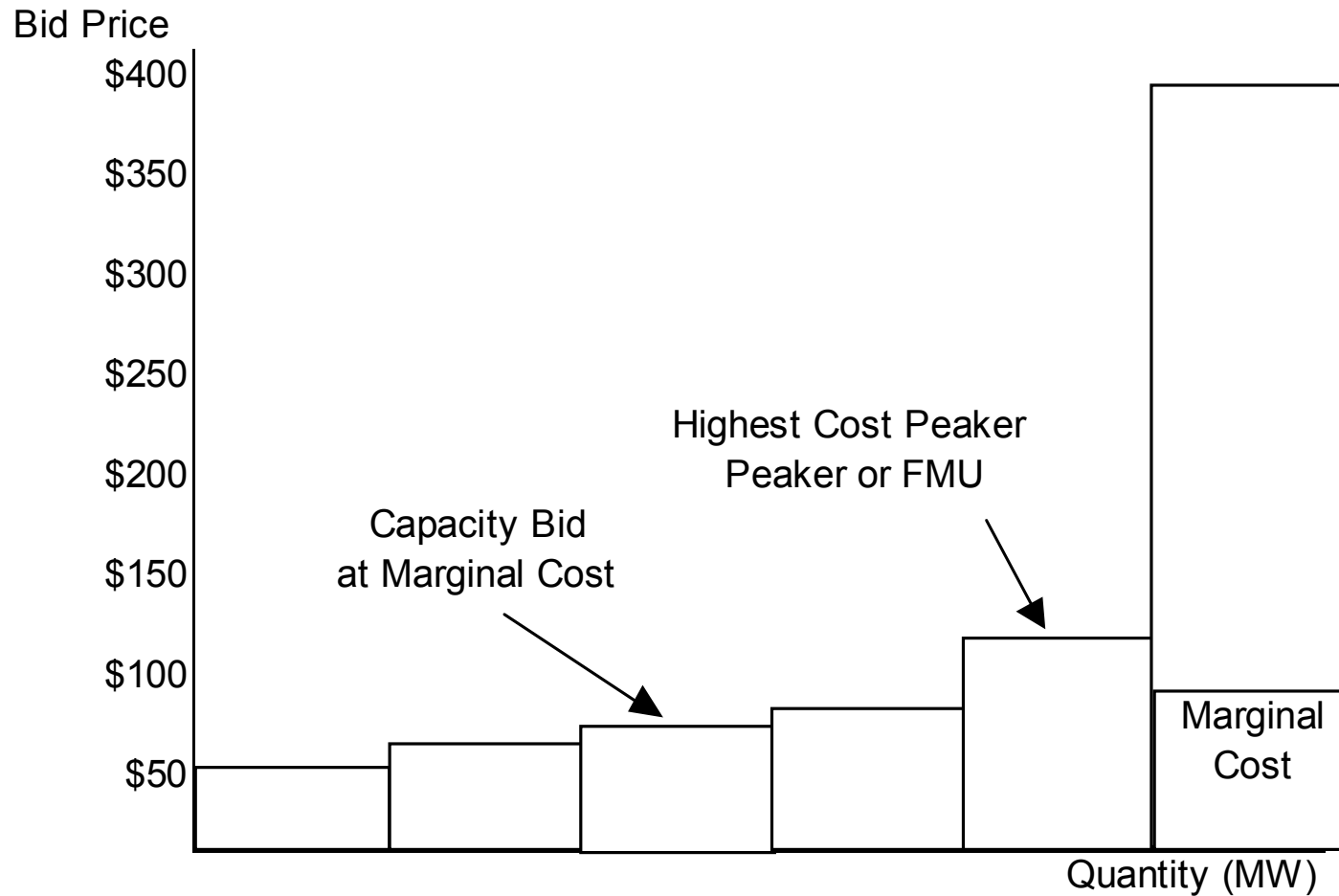


Individual Supplier Bidding Strategy 1 (Competitive Baseline)



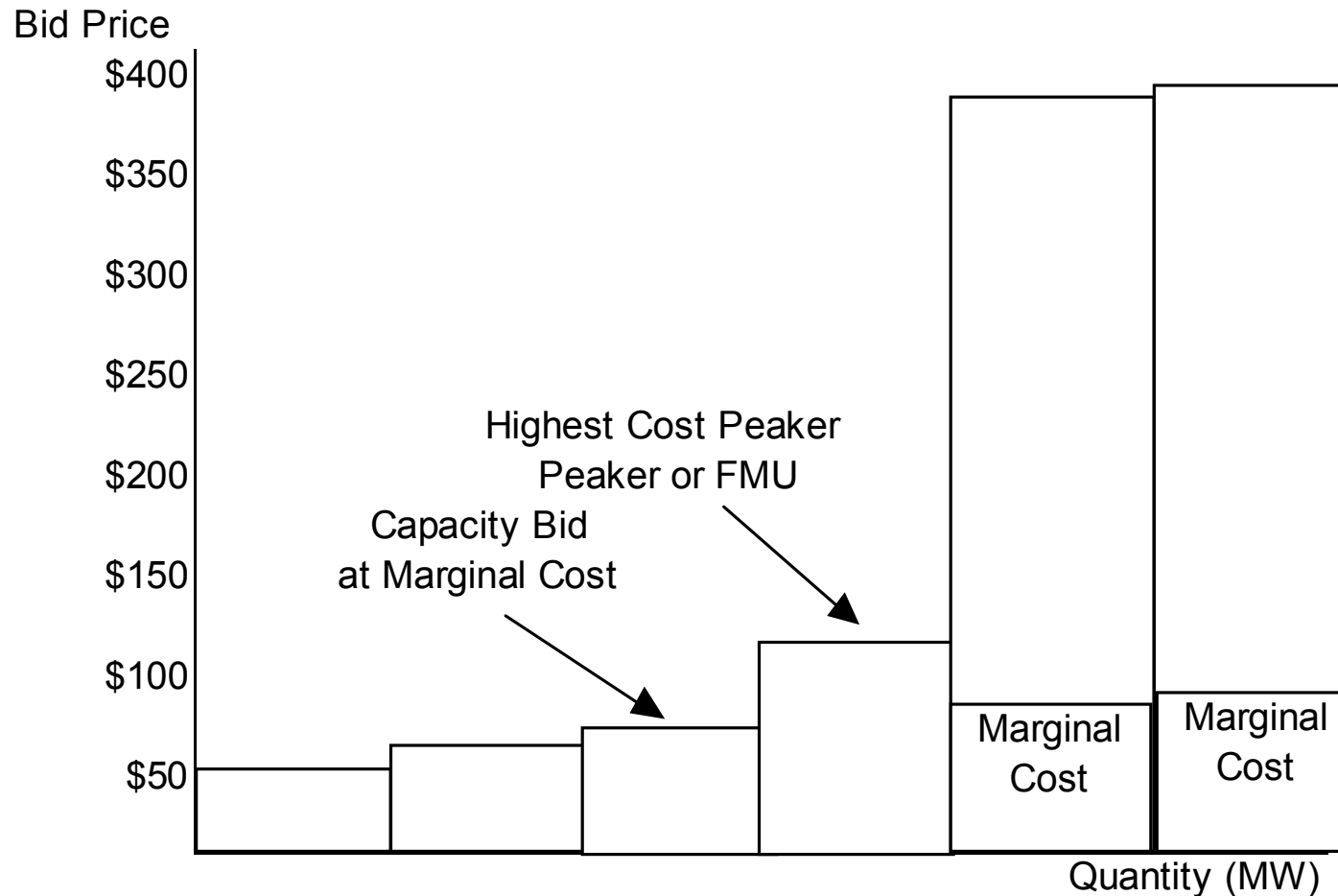


Individual Supplier Bidding Strategy 2 (Economic Withholding)



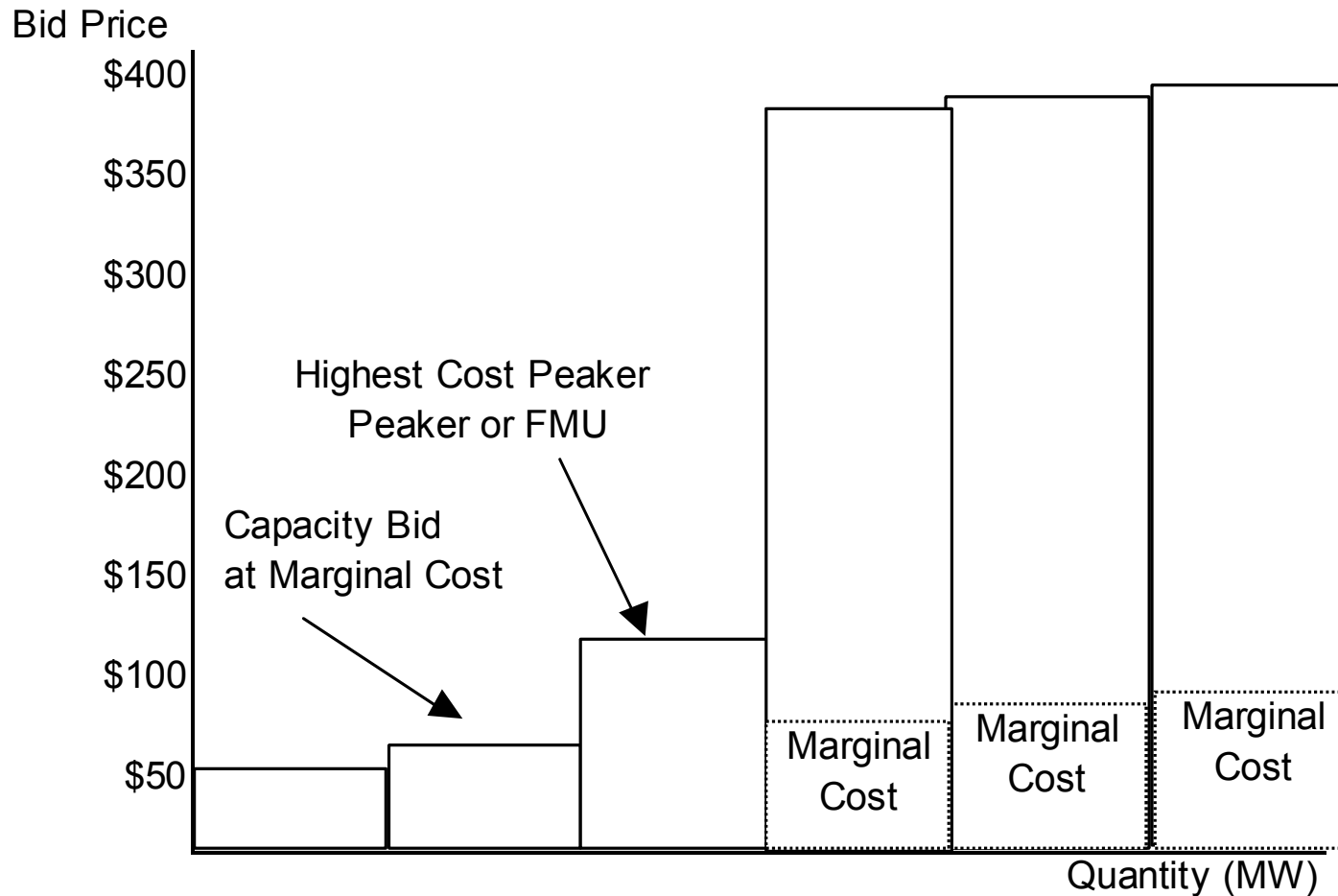


Individual Supplier Bidding Strategy 3 (Economic Withholding)



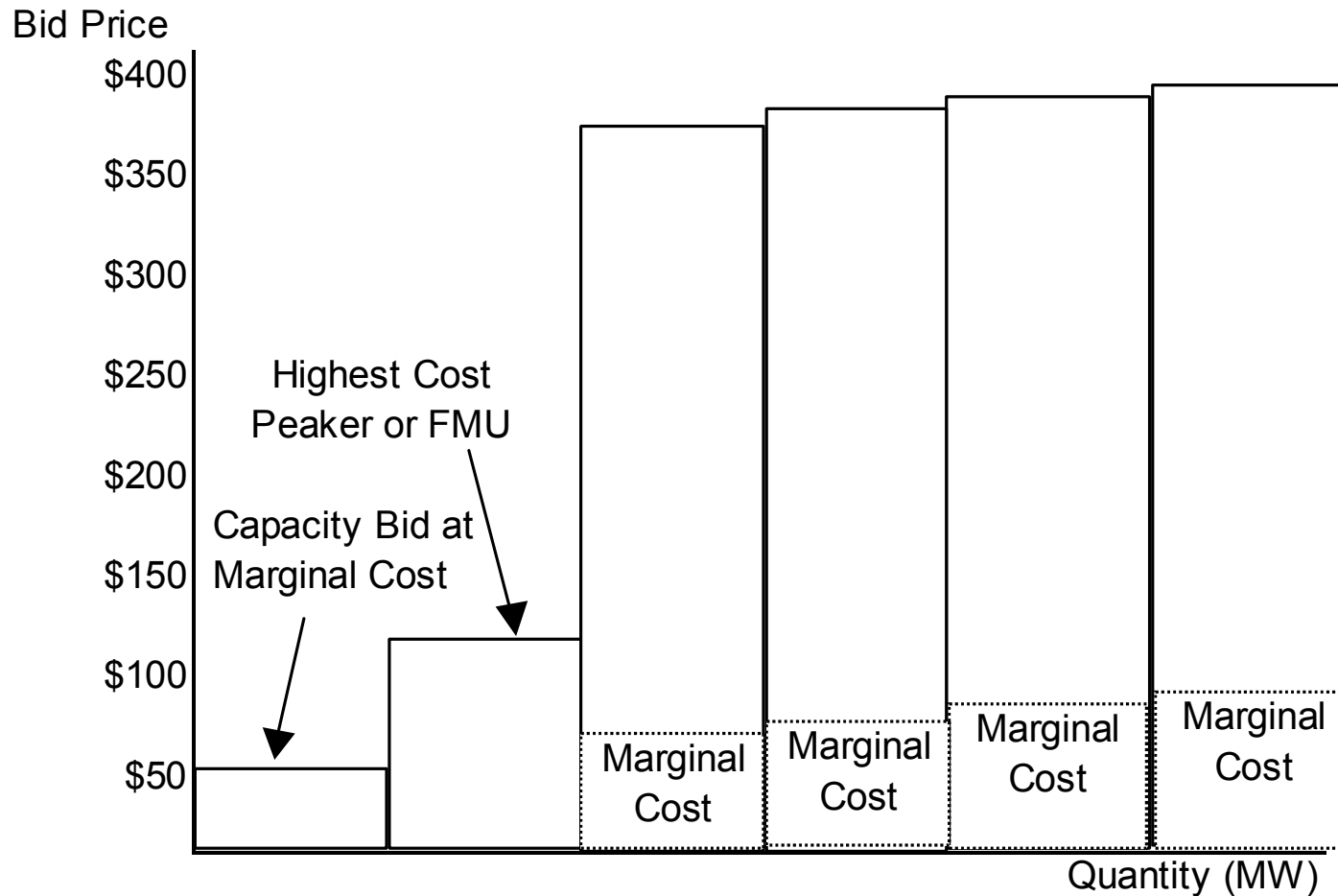


Individual Supplier Bidding Strategy 4 (Economic Withholding)





Individual Supplier Bidding Strategy 5 (Economic Withholding)





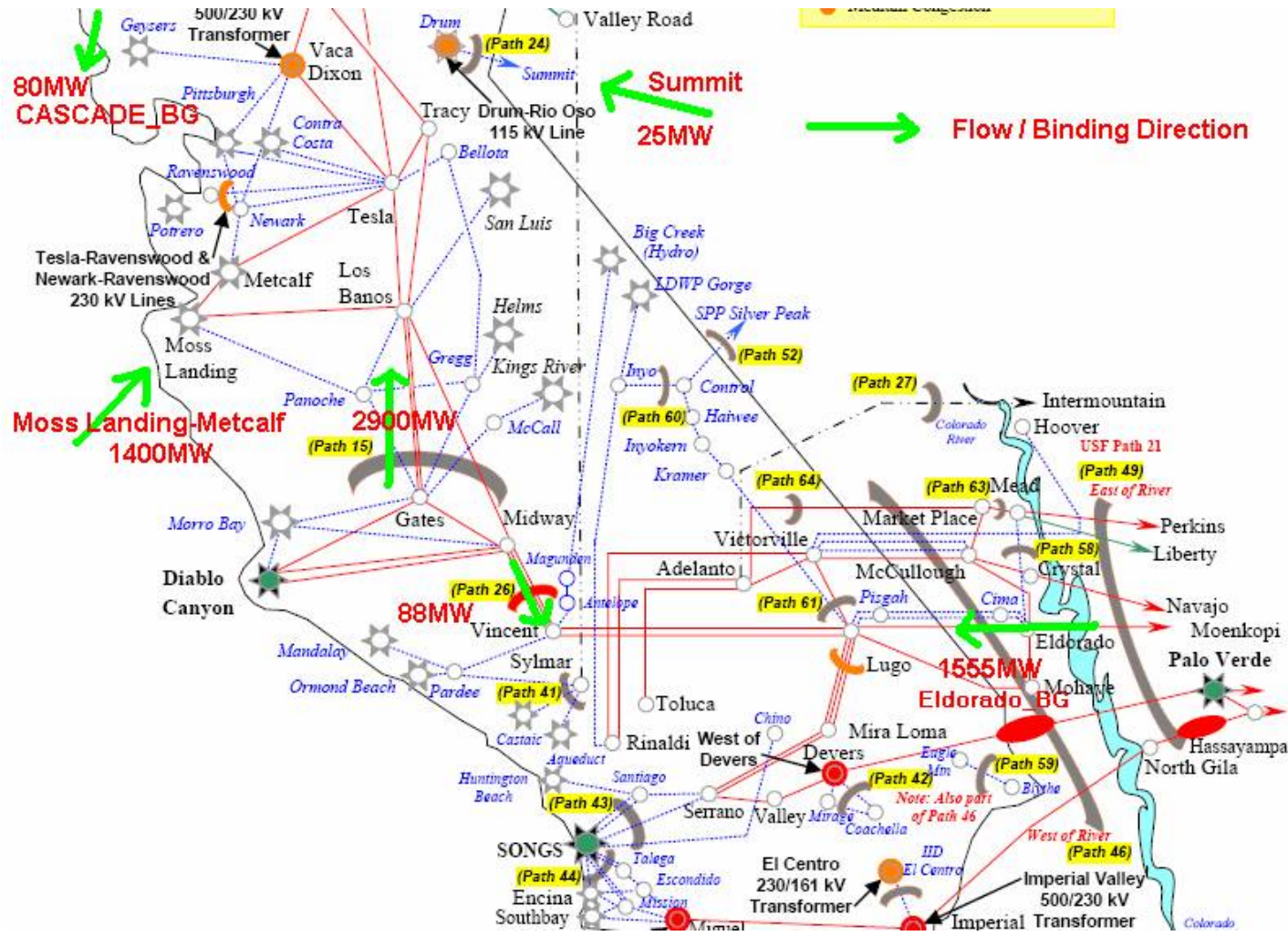
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III. Results



California Transmission Under Historical Case





Summary of Findings

- **Very limited potential for exercise of unilateral market power using specific strategy identified by LECG**
 - Results show only one supplier could profitably employ strategy
 - Ability of this supplier to employ strategy largely due to relatively high bids of other major supplier in load pocket (based on historical data)
 - Under assumption that other major supplier in load pocket bids close to marginal costs, strategy cease to be profitable
 - Supplier's market power could also be mitigated by having a portion of portfolio under RMR or tolling contracts



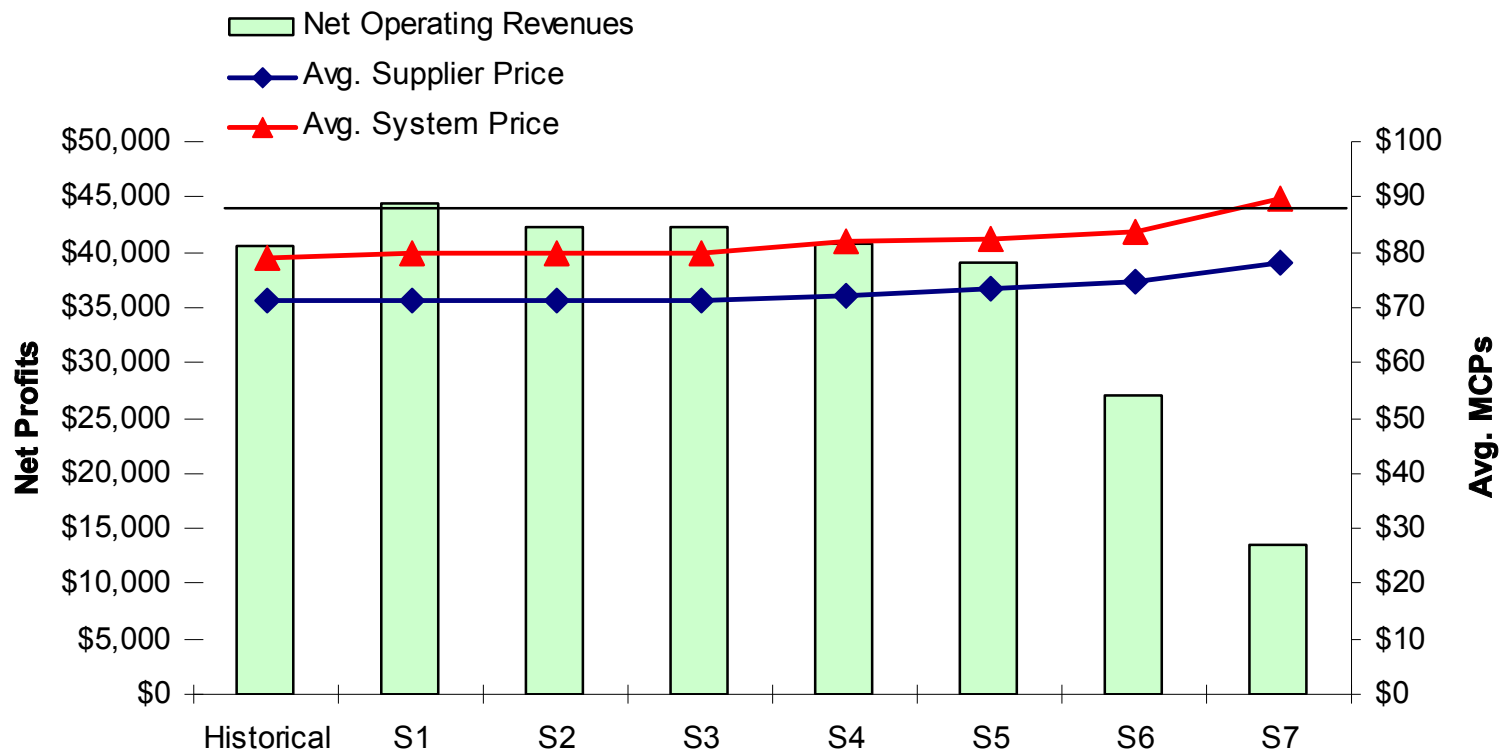
Summary of Findings (Continued)

- **Limited potential for exercise of unilateral market power using specific strategy identified by LECG attributable to:**
 - Congestion model suggests that individual suppliers in major load pockets not absolutely “pivotal” under system conditions modeled
 - Competitive bid prices for most alternative suppliers (based on bids from summer 2006)
 - Relatively small difference in DEBs for units in suppliers portfolio (under Cost-based and even FMU Options)
 - In a limited number of cases, bid mitigation was triggered and effectively mitigate the market power.



Sample Results – Supplier A No Locational Market Power

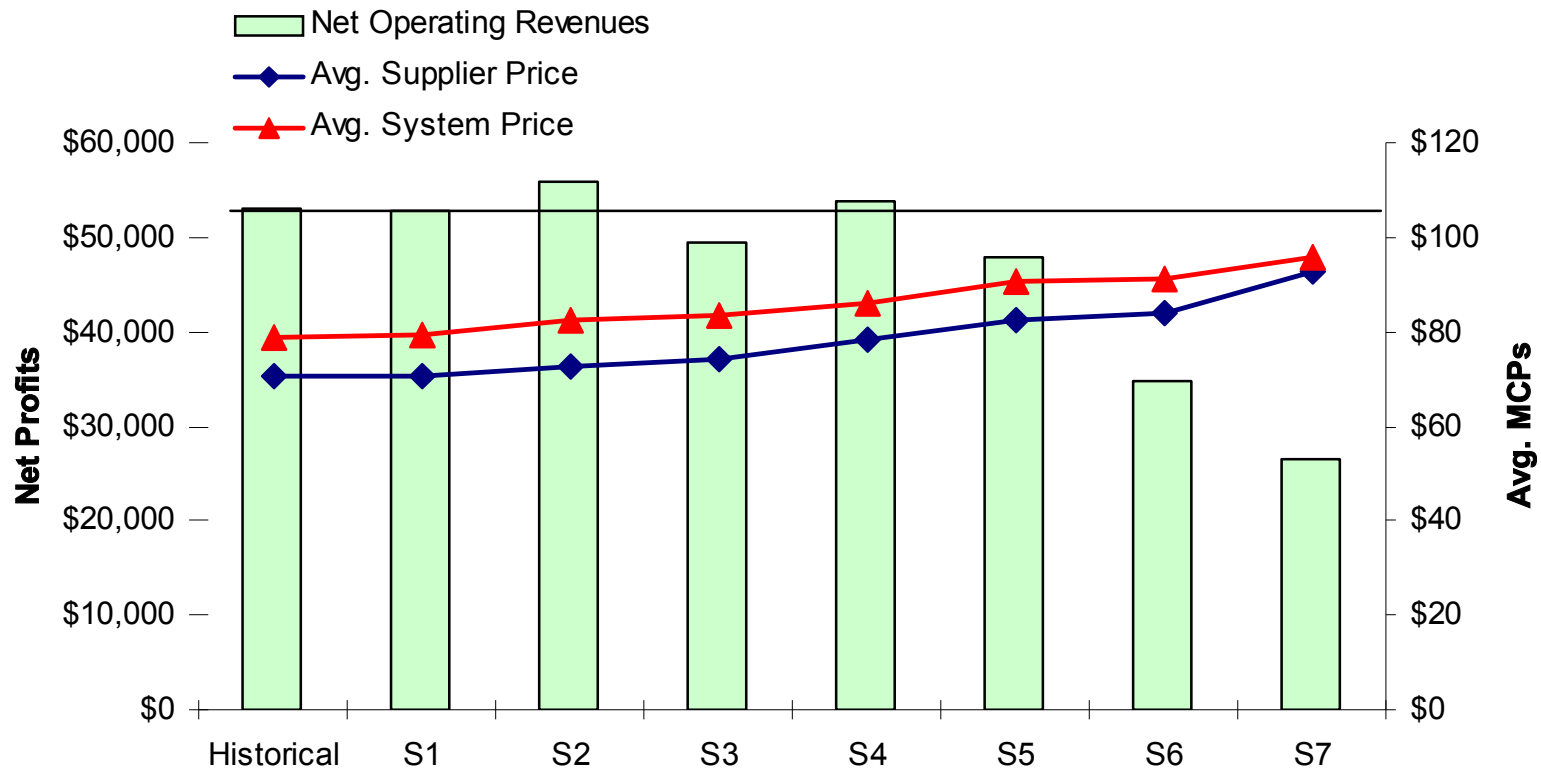
(All other suppliers' bids based on historical bid-cost mark-up)





Sample Results – Supplier B Minimal Locational Market Power

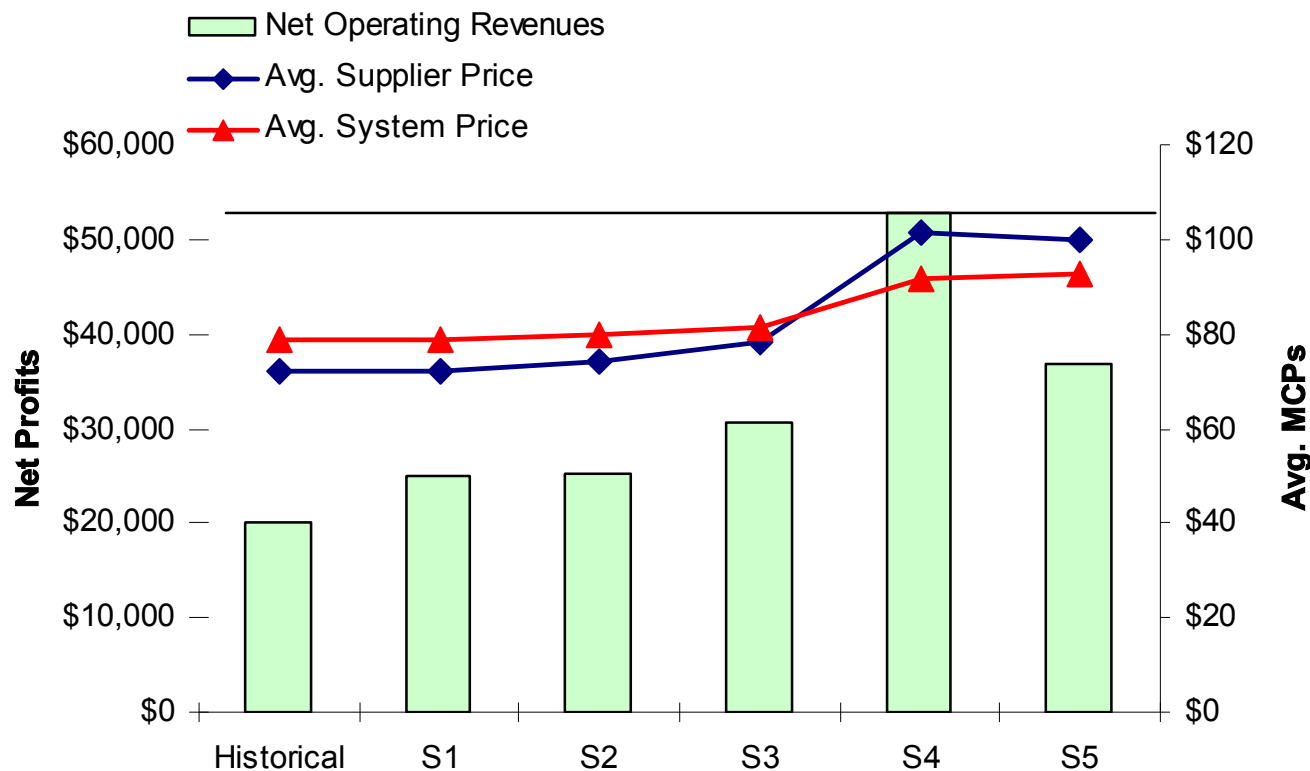
(All other suppliers' bids based on historical bid-cost mark-up)





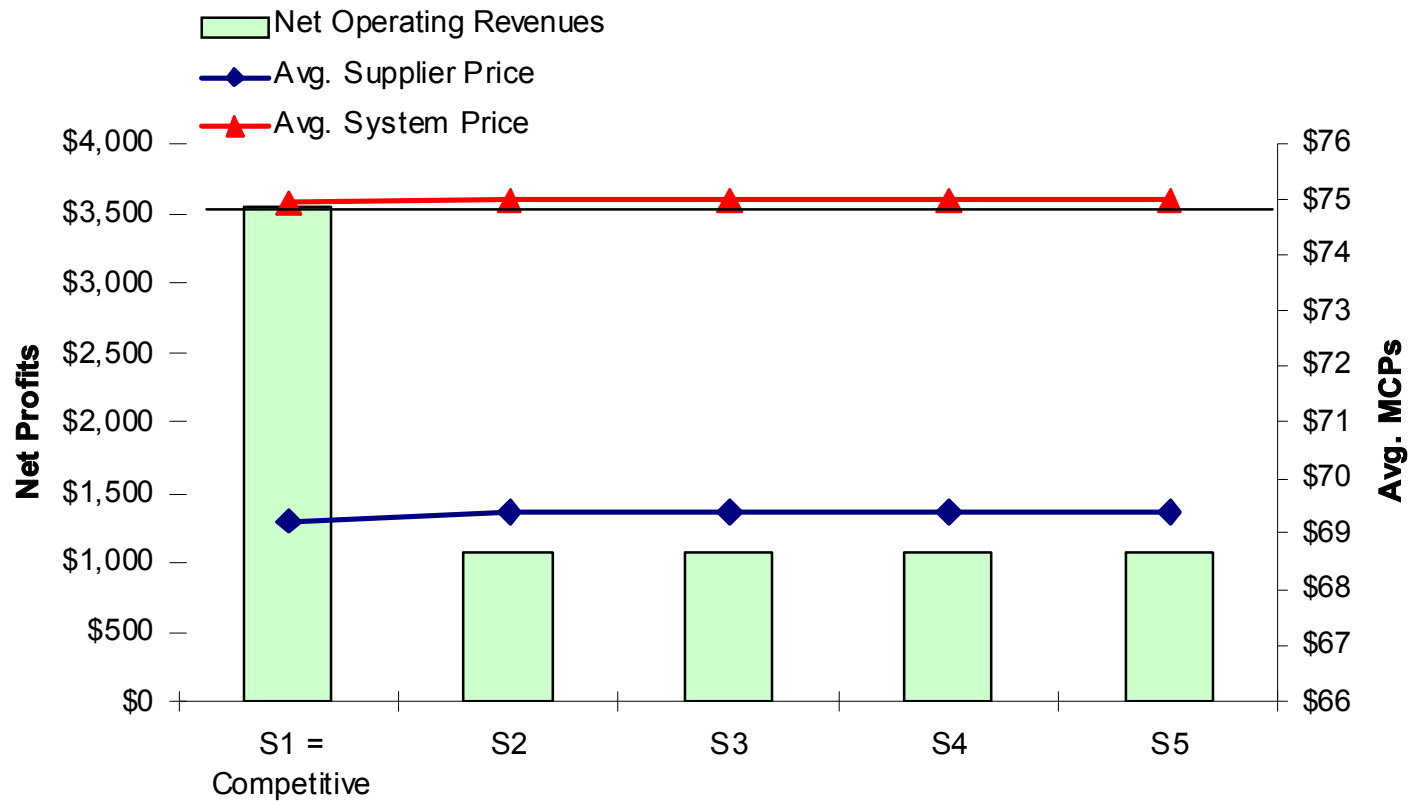
Sample Results – Supplier C Significant Locational Market Power

(All other suppliers' bids based on historical bid-cost mark-up)





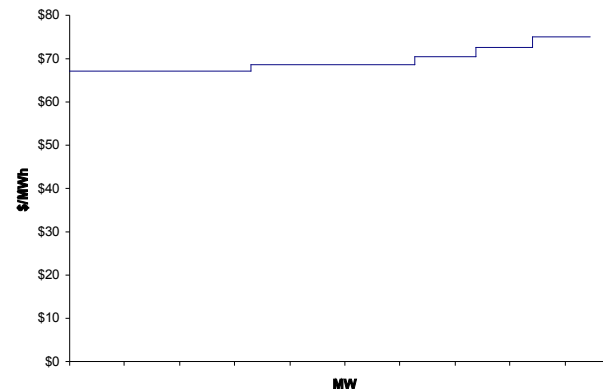
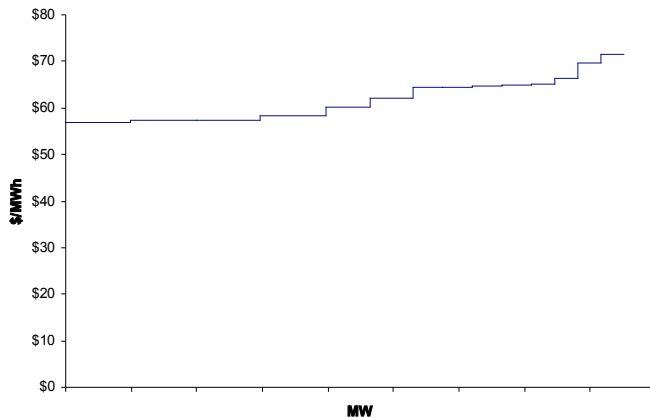
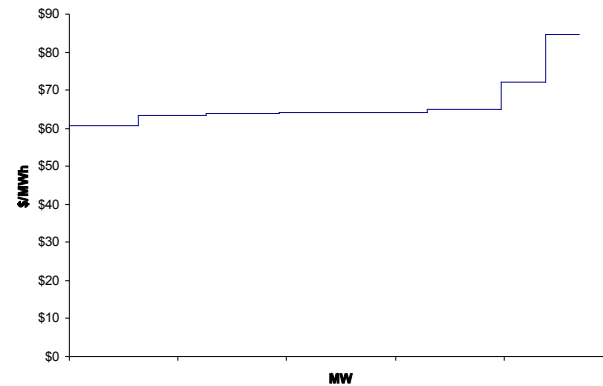
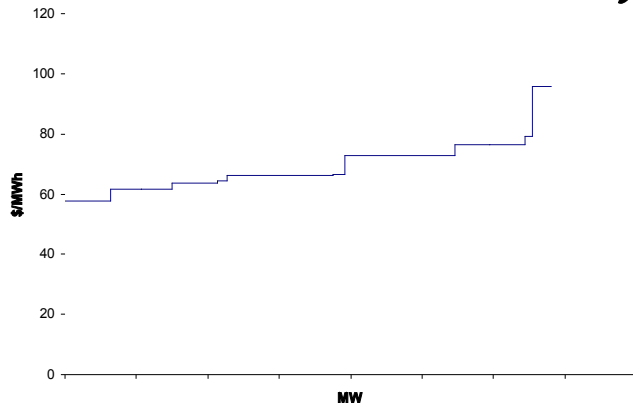
Sample Results - Supplier C No Locational Market Power (All other suppliers' bids based on marginal costs + 10%)





Cost-Based DEB Curves are Relatively Flat for Most Suppliers in Major Load Pockets

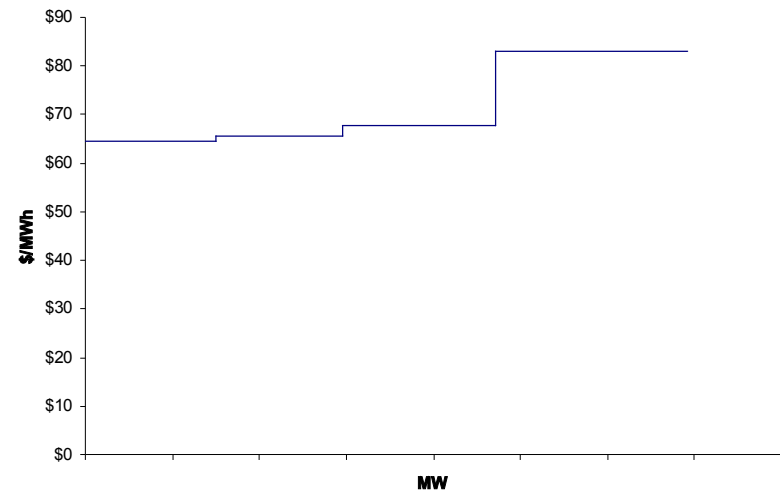
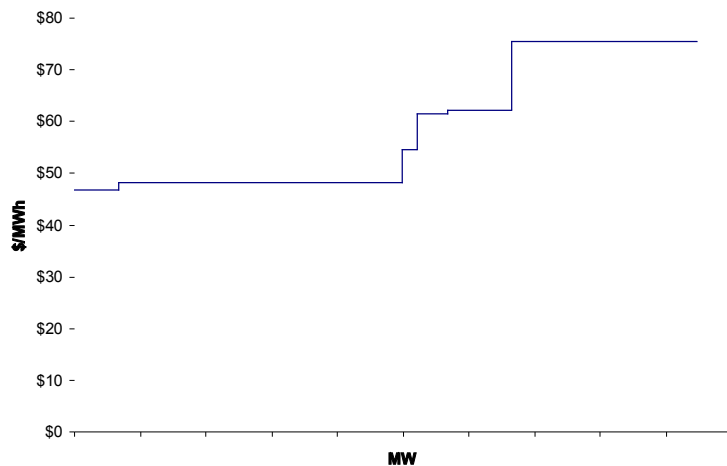
This limits ability to employ specific bidding strategy identified by LECG





Only Two Suppliers in Major Load Pockets Have Cost-Based DEB Curves with Significant Cost Differences

For these suppliers, ability to employ specific bidding strategy identified by LECG depends on how pivotal these suppliers are in meeting local needs.





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IV. Potential Concerns and Further Analysis

IV. Potential Concerns and Further Analysis

■ Review of Congestion Model

- Being done as part of CPM analysis
- Do results accurately reflect SCUC?

■ Bidding Behavior

- DEBs for some units may be much higher under LMP-based and Negotiated Option
- Potential for duopolistic bidding behavior
 - Most load pockets have only 2 major suppliers

■ Load and supply conditions

- Analysis based on relatively high load hour, but did not include potential generation and transmission outages