



# Discussion Regarding Uneconomic Adjustment Policy & Parameter Tuning

Market and Product Development Team

Joint MSC/Stakeholder Meeting

September 25, 2008



# Uneconomic Adjustment Policy/Parameter Tuning Overview/Context

Greg Cook  
Manager, Market Design and Regulatory Policy

Uneconomic Adjustment Policy and Parameter Tuning  
Joint Stakeholder/MSC Meeting

September 25, 2008

# Two Track Process

- Track 1: Uneconomic Adjustment Policy
  - July Board Decision – modify tariff to allow adjustment of self schedules before utilizing all economic bids (consistent with prudent operating practice)
  - October Board Meeting – resolve uneconomic adjustment policy issues raised by stakeholders and the MSC
    - Setting real-time prices when there is supply shortfall,
    - Pricing run parameter for transmission constraints relaxed in the scheduling run,
    - Energy price cap/floor to limit potentially extreme LMPs
    - Enforcing energy limits for use limited resources in Residual Unit Commitment (RUC),
    - Providing financial “firmness” to holders of ETC/TOR if valid IFM self-schedules are unbalanced by Uneconomic Adjustment in the IFM, and
    - Process for maintaining and revising parameter values.

# Two Track Process Continued

- Track 2: Parameter Tuning
  - Set Parameter Values in software that provide results consistent with MRTU tariff provisions and prudent operating practices
    - Include recommended parameter values in market simulation
    - Analyze extreme cases to determine effectiveness of parameter values

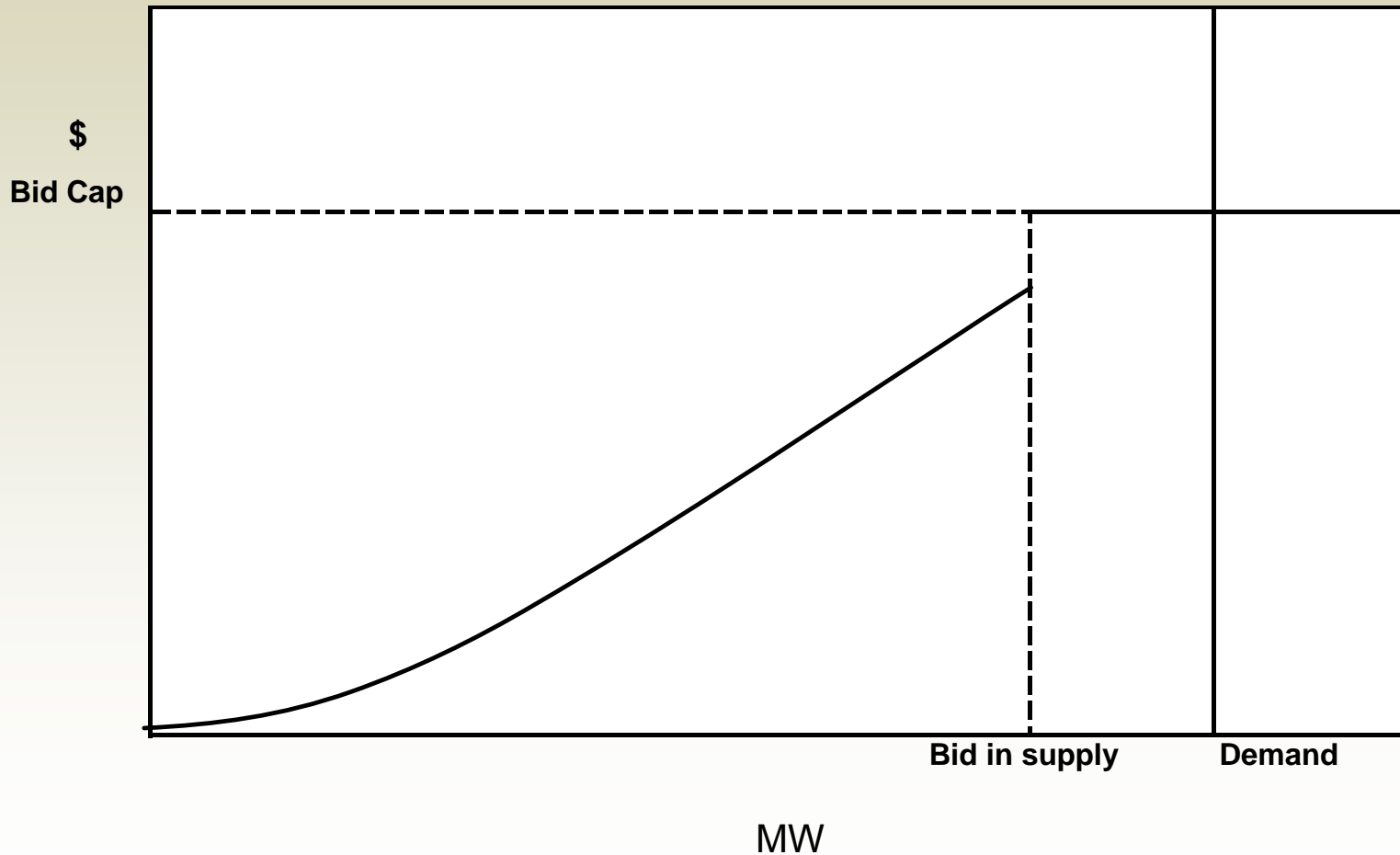
# Remaining Schedule

- Track 1: Uneconomic Adjustment Policy
  - Draft Final Proposal Posted September 19
  - MSC/Stakeholder Meeting September 25
  - Written comments due October 3
  - Publication of final proposal October 17
  - Tariff language posted October 18
  - CAISO Board meeting October 28-29
  - FERC tariff filing October 31
  
- Track 2: Parameter Tuning
  - Draft final parameter values and supporting analysis paper posted in early November
  - Final values to be used in MRTU start-up posted by mid December

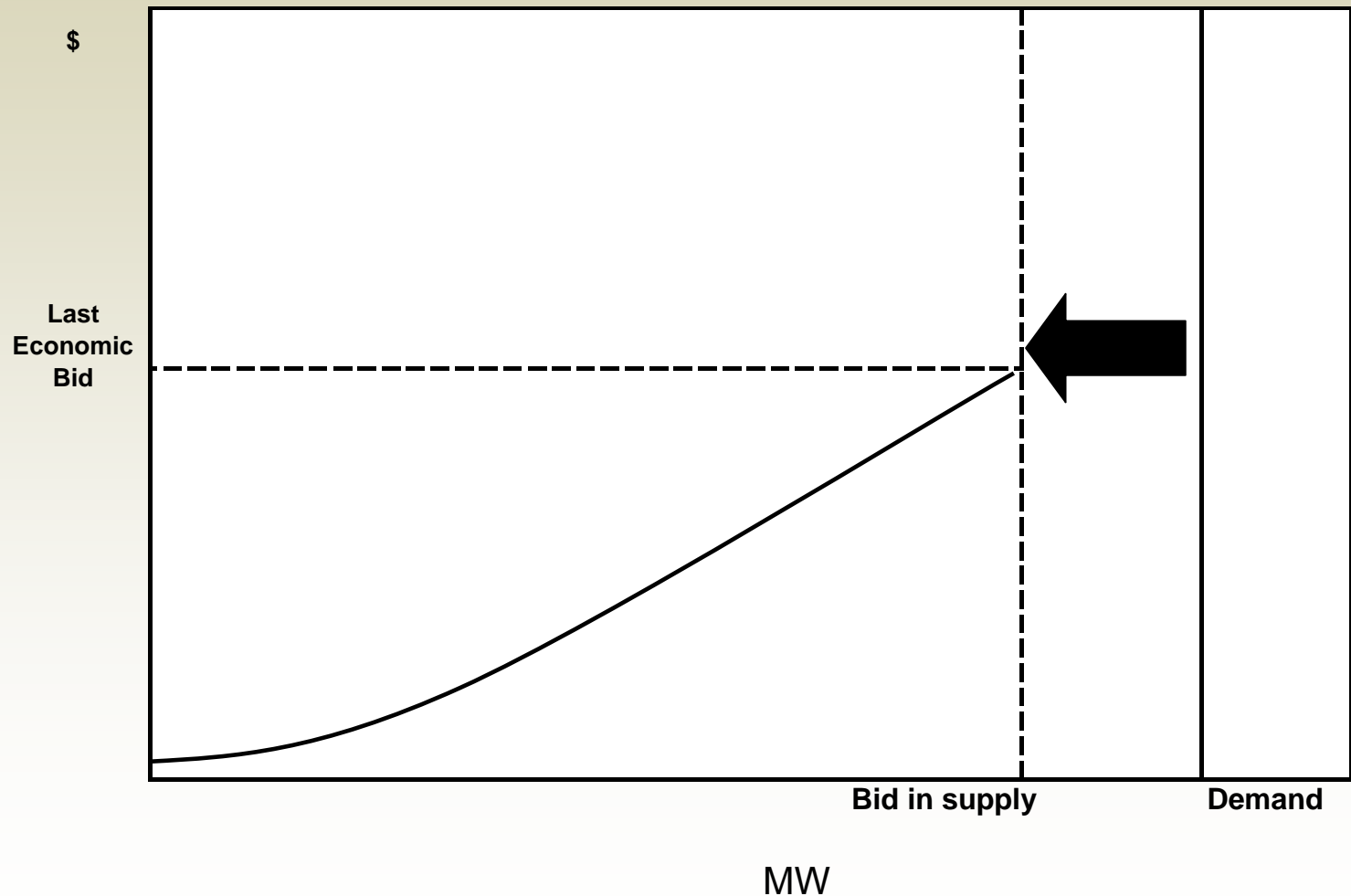
# Scarcity Pricing Provisions at MRTU start-up and MAP (~12 months later)

- MRTU Start-up
  - Limited Scarcity Pricing of Energy
  - No Reserve Scarcity Pricing
  
- MAP
  - Continued Limited Scarcity Pricing of Energy (no change)
  - Implementation of Reserve Scarcity Pricing

# Limited Scarcity Pricing of Energy in MRTU Real-time Dispatch

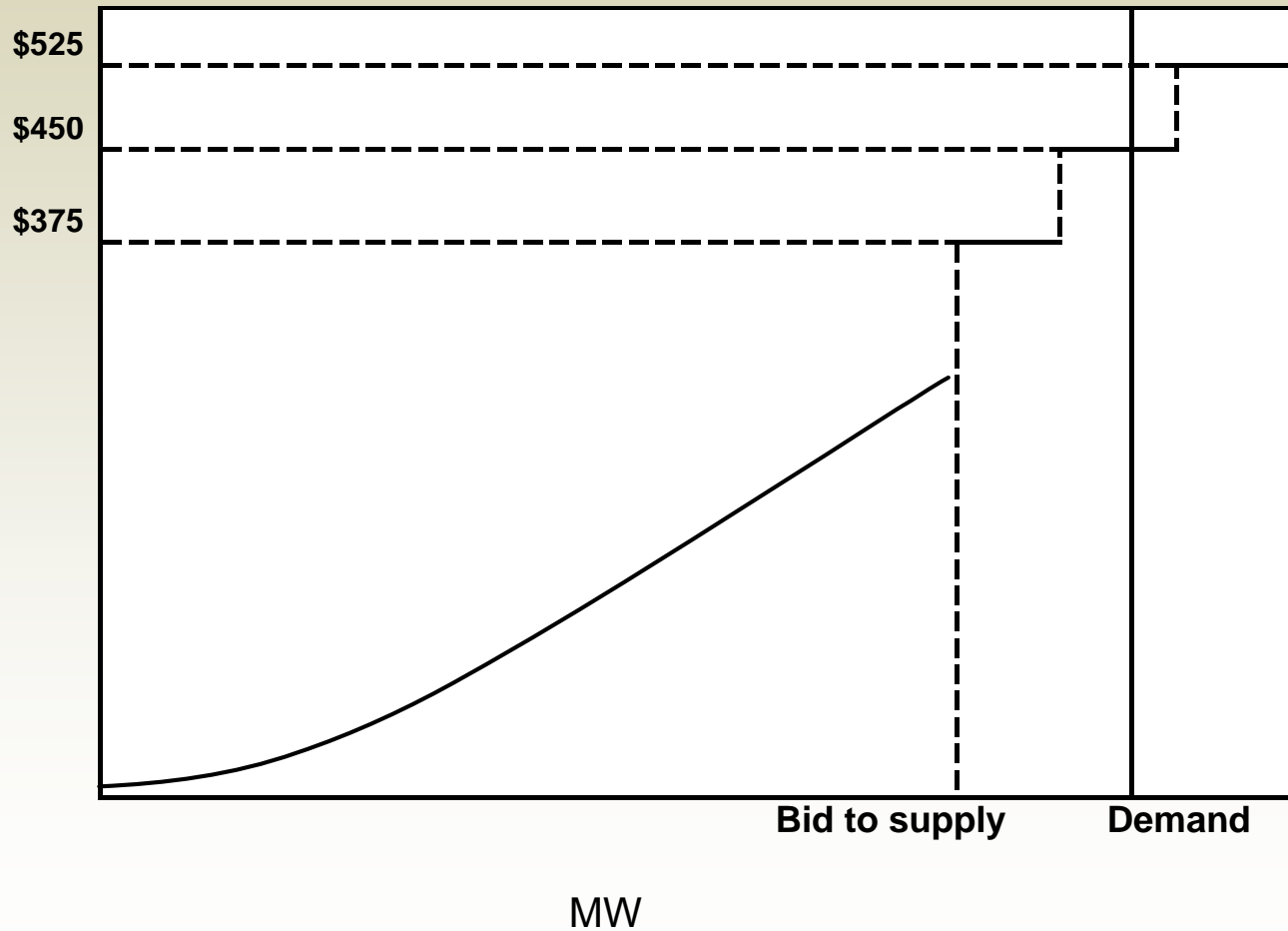


# MRTU A/S Pricing under Supply Shortage





# Reserve Scarcity Pricing (MAP)





# Clarification of Some MRTU Ancillary Services Pricing Issues

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Principal Market Developer

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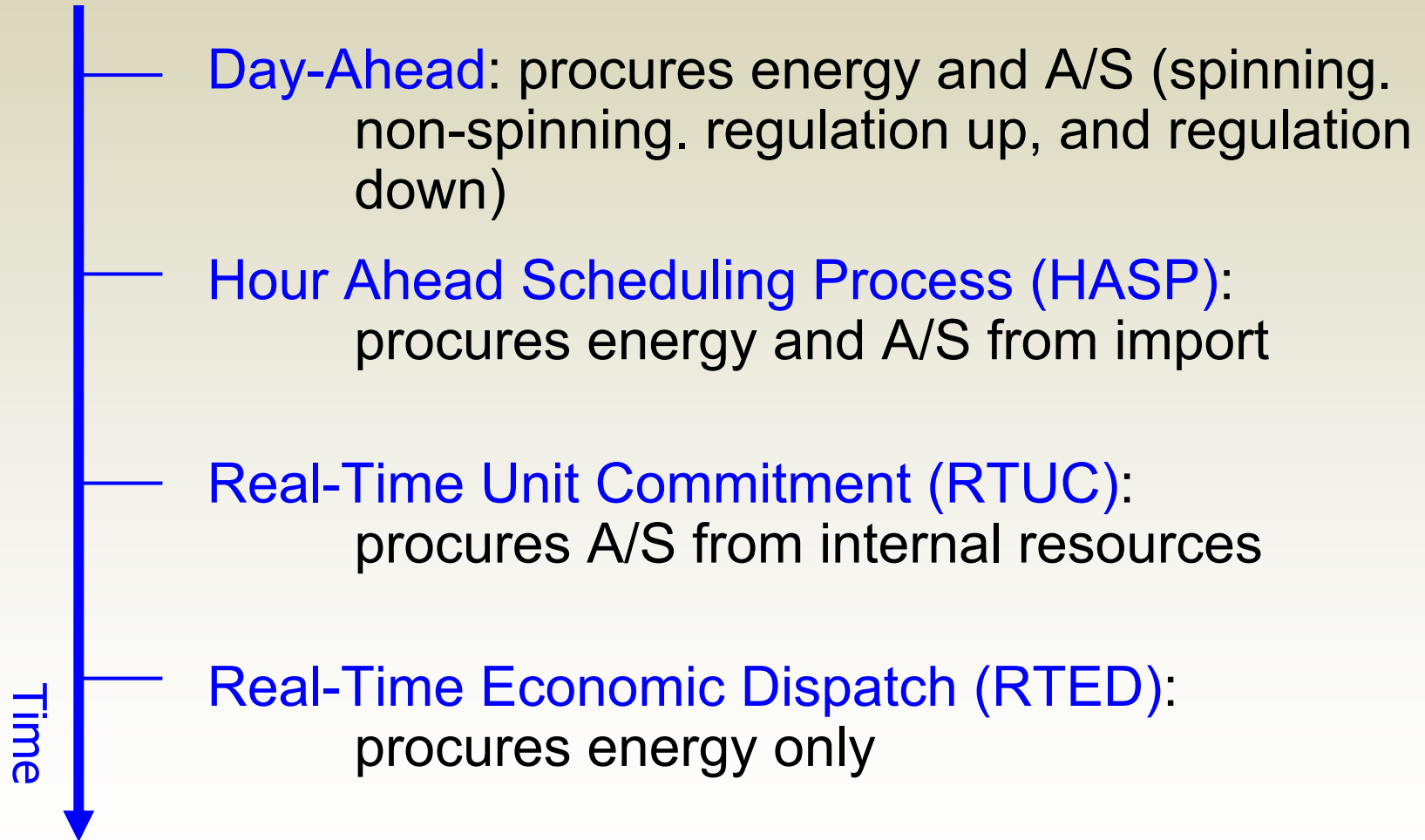
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# Stakeholders asked the following questions about A/S pricing under MRTU:

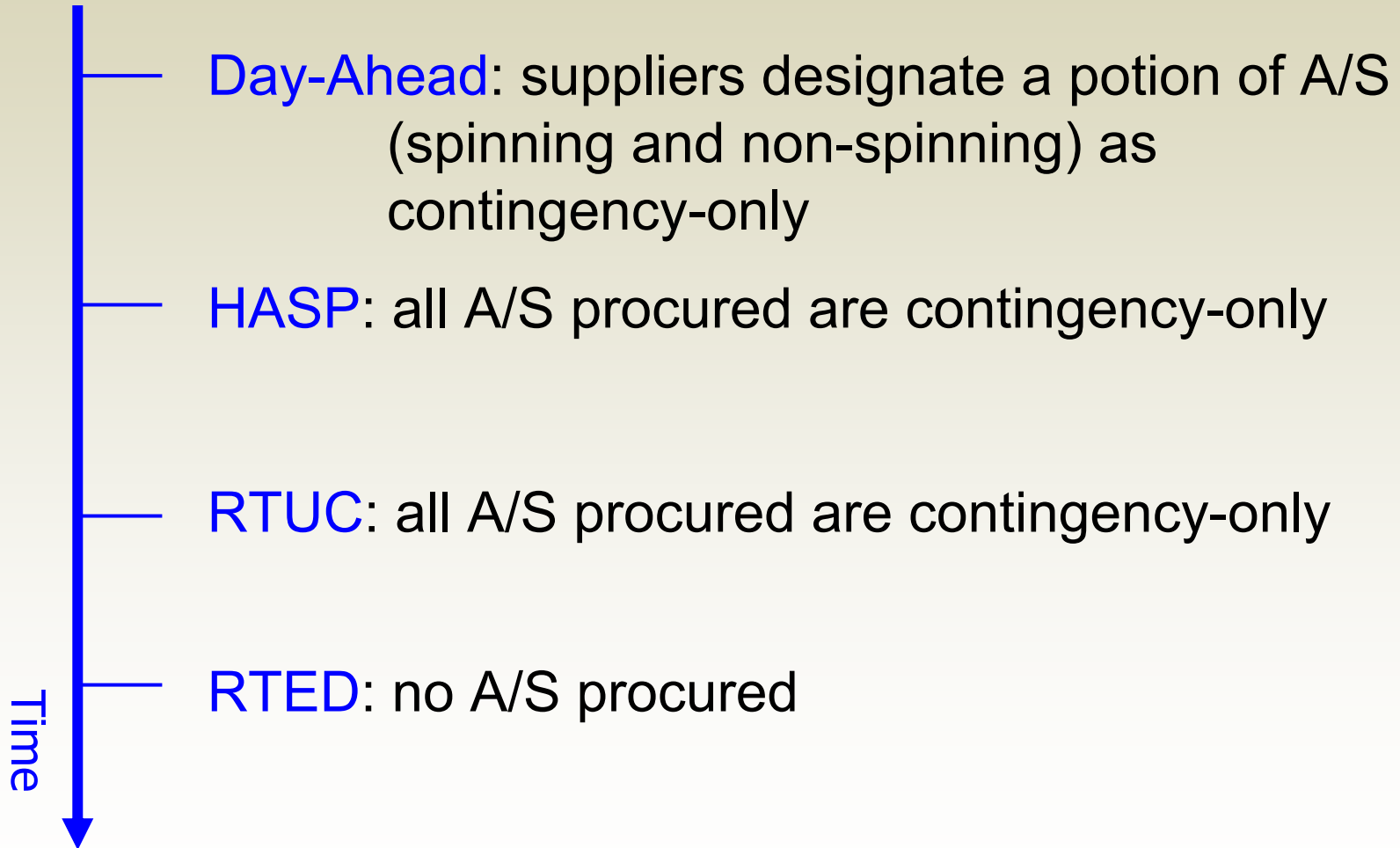
- Will the “limited scarcity pricing” of energy under MRTU affect ancillary services (A/S) prices?
- Why is the A/S penalty price zero instead of bid cap in Pricing Run?
- Will Pricing Run with zero A/S penalty price preserve Scheduling Run A/S procurements?
- What will change after the Reserve Scarcity Pricing is implemented?

- Will the “limited scarcity pricing” of energy under MRTU affect A/S prices?

# The CAISO procures A/S in markets before Real-Time Economic Dispatch.



# A portion of A/S procured are contingency-only reserves.



# The “limited scarcity pricing” of energy applies only to RTED.

“If Contingency Only reserves are dispatched in response to a System Emergency that has occurred because the CAISO has run out of Economic Bids when no Contingency event has occurred, the RTED will Dispatch such Contingency Only reserves using maximum Bid prices as provided in Section 39.6.1 as the Energy Bids for such reserves and will set prices accordingly.”

- MRTU Tariff Section 38.4

# Raised energy bids of contingency-only A/S will affect only energy prices in RTED.

- No A/S procured in RTED
- A/S prices not affected by the “limited scarcity pricing” of energy



- Why is the A/S penalty price zero instead of bid cap in Pricing Run?

# According to Tariff there is no A/S scarcity pricing under MRTU.

- Only the “limited scarcity pricing” of energy approved by FERC
- No administratively determined A/S prices
  - Per FERC September 21, 2006 Order
- A/S prices (ASMPs) set by marginal economic bids
- Combination of reduced A/S requirement and zero A/S penalty price in Pricing Run– a way to achieve above guidelines

- Will Pricing Run with zero A/S penalty price preserve Scheduling Run A/S procurements?

# Scheduling Run identifies A/S supply deficiency and A/S procurements.

- Minimum A/S requirement – a constraint with a slack variable:

$$\sum_i AS_i + Slack \geq AS_{Req} \quad i - suppliers$$

- A high penalty price for the slack variable
- $Slack > 0$  when supply is insufficient
- A/S procurements  $\sum_i AS_i$

# Pricing Run preserves A/S procurements from Scheduling Run.

- Minimum A/S requirement – a “hard” constraint with a “S” variable (with a small  $\varepsilon$  upper bound):

$$\sum_i AS_i + S \geq AS_{Req} - Slack$$

$$S \leq \varepsilon$$

- Zero penalty price for the “S” variable
- Pricing Run results in the same procurements,  $\sum_i AS_i$ , as in Scheduling Run

- What will change after the Reserve Scarcity Pricing is implemented?

# What will change after Reserve Scarcity Pricing is implemented?

- No change to the “limited scarcity pricing” of energy
- Administratively determined A/S scarcity prices instead of zero A/S penalty price in Pricing Run
- No change to the consistency of A/S procurement between Scheduling Run and Pricing Run

# Questions





# Energy Limits in RUC

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Lead Engineering Specialist  
Market & Product Development

MSC/Stakeholder Meeting on Parameter Maintenance  
September 25, 2008

# Enforcing Energy Use Limits in RUC

- Energy Limit is submitted to IFM by use-limited resources (e.g., hydro).
- A previous compliance filing on RUC participation needs further clarification. Discussion of RUC eligibility (section 31.5.1.1) includes:
  - “... System Resources eligible to participate in RUC will be considered on an hourly basis; that is, RUC will not observe any multi-hour block constraints and the Energy Limits that may have been submitted in conjunction with Energy Bids to the IFM. ...”
- Provision has proven problematic in market simulation: RUC can reserve capacity that RTM can't dispatch.
- Will include clarification in tariff clean-up that Energy Limits will be observed in RUC. Testing shows software does enforce Energy Limits in RUC.
- Will determine penalty price for Energy Limit: currently \$1000.



# Pricing Parameters on Transmission Constraints: IFM

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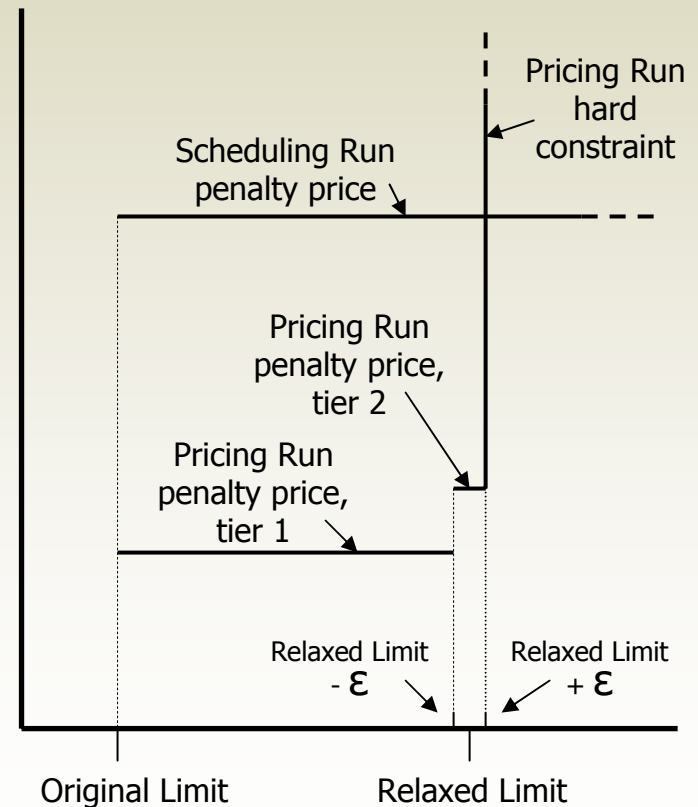
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# Pricing Run Values for Relaxed Transmission Constraints in IFM

- Current values use 2-tier penalty-price in pricing run (\$1500 & \$5000, explained in next slide). CAISO is considering \$500 for both tiers.
- Setting pricing run values for relaxed transmission constraints involves trade-offs:
  - Avoid triggering perception of “scarcity prices”, and allow redispatch costs (i.e., “last economic signal”), instead of penalty prices, to set LMPs if redispatch cost is relatively low during transmission overloads, vs.
  - Aligning LMPs with operational needs, and avoiding uplift payments and incentives for deviations from schedules due to mismatch of scheduling & pricing.
- CAISO recommended values for transmission penalty price to date have favored aligning with operational needs, and avoiding uplift and schedule deviations.

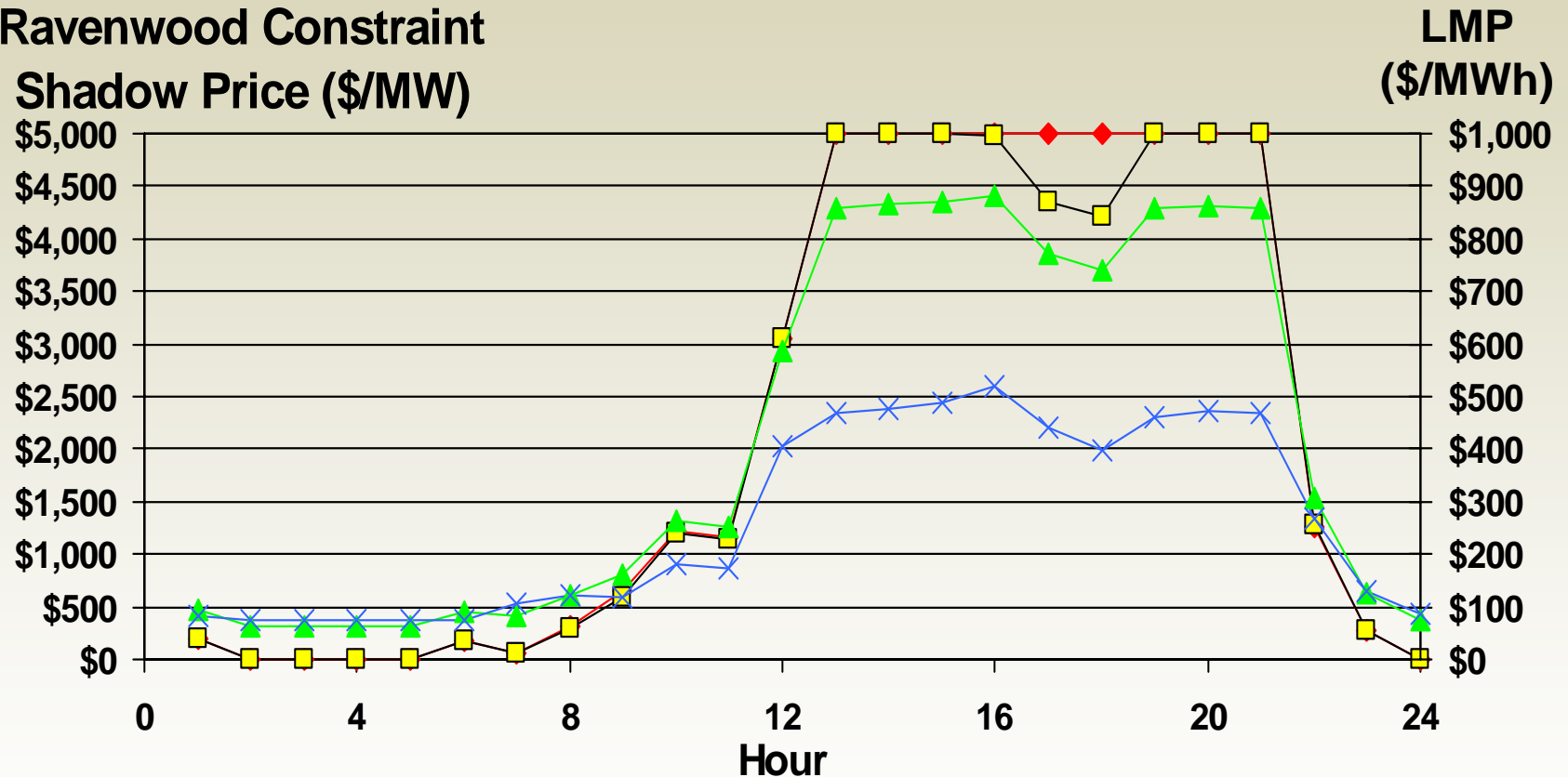
# Regardless of its level, the pricing run penalty price for transmission may not reduce final prices.

- In scheduling run, a single penalty price determines any needed constraint relaxation. Constraint is relaxed when redispatch cost rises to penalty price.
- Pricing run has 2-tier penalty price, then hard constraint:
  1. Tier 1: original limit to relaxed limit minus small decrement ( $\epsilon$ ).
  2. Tier 2: narrow range at relaxed limit ( $\pm \epsilon$ ).
  3. Beyond relaxed limit  $+ \epsilon$ , no further relaxation in pricing run: hard constraint, infinite penalty price.
- Little change in redispatch cost in scheduling vs. pricing run. If tier 2 price less than redispatch cost, scheduling run determines the constraint shadow price.



With transmission penalty price in pricing run = \$1500/MW, LMPs can drop slightly during overloads.

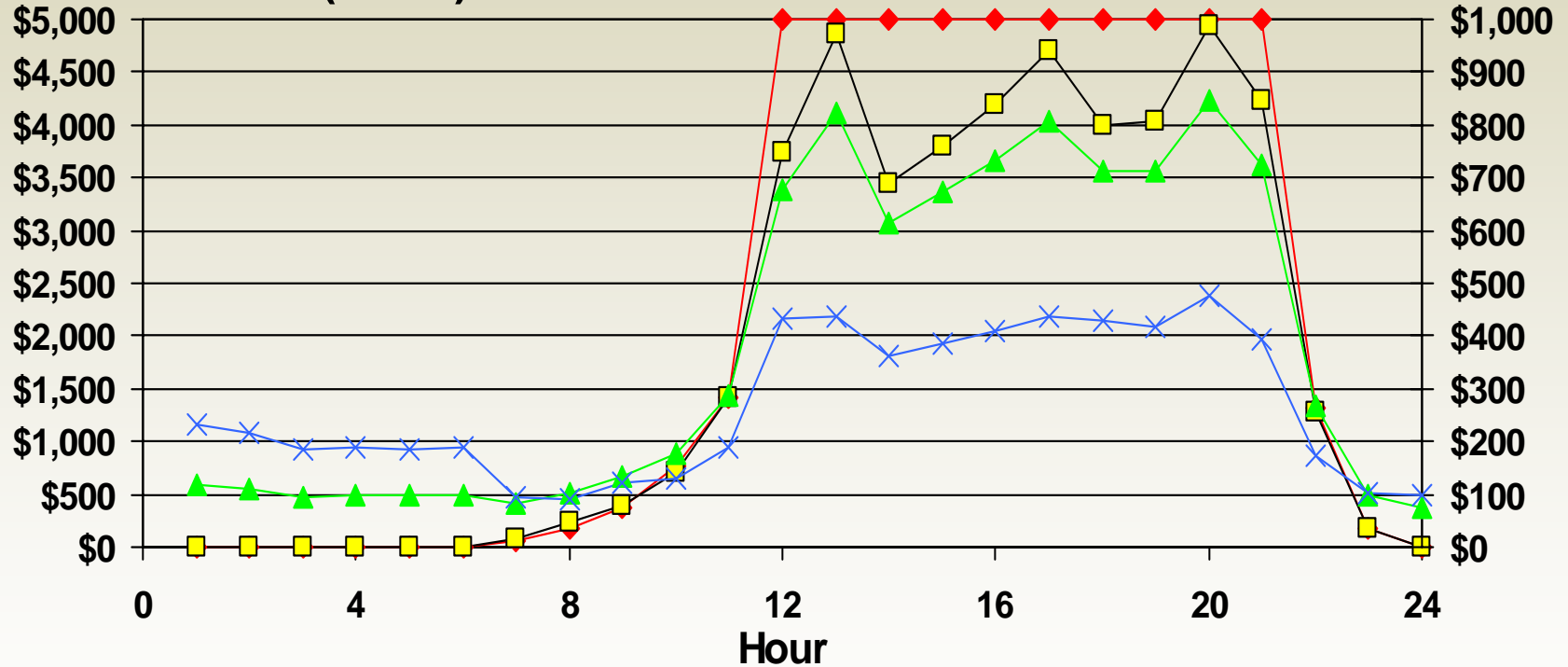
## Ravenwood Constraint Shadow Price (\$/MW)



- ◆ Scheduling Run Shadow Price
- Pricing Run Shadow Price
- ▲ San Francisco Generation LMP
- × Pittsburg Generation LMP

With transmission penalty in pricing run = \$500/MW, reductions in LMPs during overloads are larger.

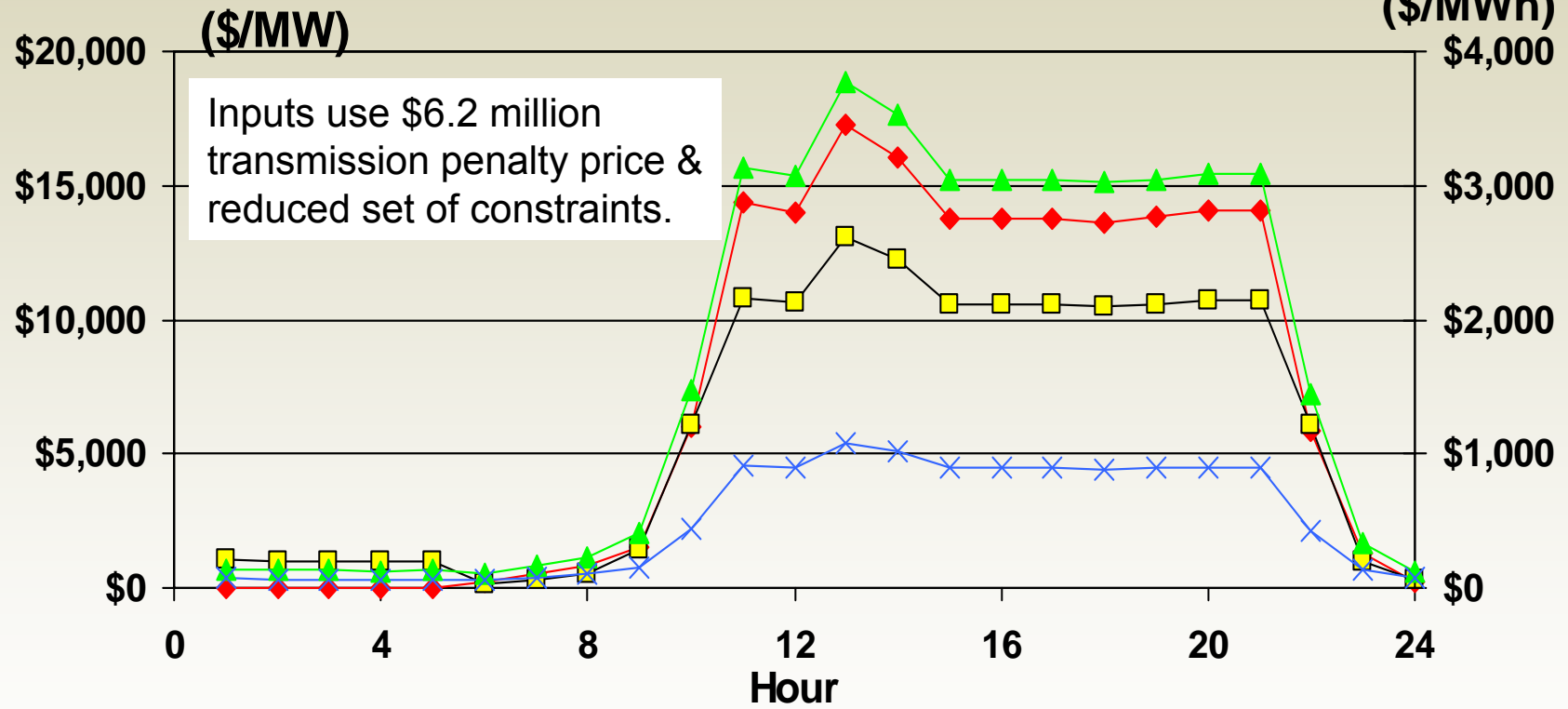
## Ravenwood Constraint Shadow Price (\$/MW)



- ◆ Scheduling Run Shadow Price
- Pricing Run Shadow Price
- ▲ San Francisco Generation LMP
- × Pittsburg Generation LMP

If scheduling run's transmission penalty price is high, using even \$500/MW in pricing run doesn't limit LMPs.

### Constraint Shadow Price



- ◆ Ravenswood Nomogram
- ▲ Potrero 3 Generator
- Pittsburg - E. Shore 230 kV line
- × Metcalf Energy Center





# Pricing Parameters on Transmission Constraints: RTM

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September 25, 2008

(Slides will be available at the meeting)



# Use of Bid Cap for Energy Balance in RTM

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September 25, 2008

(Slides will be available at the meeting)



# Price Cap and Floor to Limit Extreme LMPs & ASMPs

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September 25, 2008

# LMP Price Cap and Floor are needed to limit impacts of potentially extreme prices.

- Extreme prices observed in Market Simulation
  - Five-minute interval LMPs \$thousands/MWh in RTD, due to
    - Ramping constraints interacting with tight energy supply
    - Inter-hour interchange ramping interacting with inter-hour changes in inter-tie capacity
  - Hourly LMPs above \$2000 in IFM, due to
    - High volume of self-scheduled load + major generator outages
- Objective: protect market from unreasonable extreme prices that result from complex constraint interactions without constraining price signals
- Two possible strategies –
  1. Targeted mechanisms to address specific causes
  2. General mechanism to limit resulting LMPs

# A general mechanism is preferable to solutions targeted to specific causes.

- Possible targeted mechanisms to reduce impact of ramping constraints in RTD:
  - Set 5-minute LMPs based on single-interval pricing run rather than total optimization horizon
  - Switch off ramping constraints for pricing purposes
- Disadvantages of narrowly targeted solutions
  - Infeasible IFM schedules or RT dispatches
  - Larger discrepancies between dispatch and pricing
  - Difficult to implement
  - Ineffective if extreme prices arises from other causes
- Simple price cap and floor minimize these disadvantages

# Other features of proposed Price Cap & Floor

- Proposed values +/- \$2500 allow ample room for needed price signals
  - Test evidence indicates the purely economic solutions (i.e., without uneconomic adjustments) may rarely yield LMPs outside the +/- \$2000 range
- Proposed cap would apply to Ancillary Service prices (ASMPs) as well as LMPs
- Subject to determination of implementability, aggregated prices (LAPs, Trading Hubs) would be calculated using LMPs truncated at the cap & floor.
- Reliance on price cap will NOT substitute for diligent investigation by CAISO of extreme price

results.



# Treatment of ETC/TOR Self-Schedules: Scheduling

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September 25, 2008

# Analytical Results for Honoring ETC/TOR Schedules:

Some stakeholder comments asked the CAISO to analyze an alternative using high penalty prices to protect ETC and TOR self-schedules.

- Case 1: Review of radial case
- Case 2: Comparison of CAISO and Alternative parameters – network case with severe transmission derates
- Case 3: Comparison of CAISO and Alternative parameters – network case with moderate transmission derates



# Test cases compare the CAISO-recommended parameter values with alternatives by CCSF.

Penalty Price Description	CAISO Proposal, Scheduling Run	CCSF Alternative, Scheduling Run	CAISO Proposal, Pricing Run	CCSF Alternative, Pricing Run
Market energy balance	6500	6,201,500	1500	500
Transmission constraints: intertie scheduling	7000	6,202,000	7000	500
RMR pre-dispatch	-6000	-6,201,000	-30	-30
Transmission constraints: branch, corridor, nomogram	5000	6,200,500	1500, 5000	500
TOR self-schedule	4500, -4500	6,200,000, -6,200,000	500, -30	500, -30
ETC self-schedule	3200, -3200	155,000, -155,000	500, -30	500, -30
Generic self-schedule	1600, -550	1550, -550	500, -30	500, -30

# Case 1: For simple, radial network, CAISO discussed self-schedule adjustments on 5/13/08.

Example: Blythe intertie (radial) capacity is reduced to 100 MW. (Penalty price on transmission constraint is sufficient to enforce the constraint.)

- Case 1a: All self-schedules are feasible, and economic bids are limited to enforce binding intertie constraint. (Imports are shown with positive sign.)
- Case 1b: ETC self-schedule increases to 150 MW. Other (generic) self-schedules must be reduced, to the point where the constraint is enforced.
- Case 1c: Reduced export bids require reduction of the ETC self-schedule, after other self-schedules are reduced to zero MW.

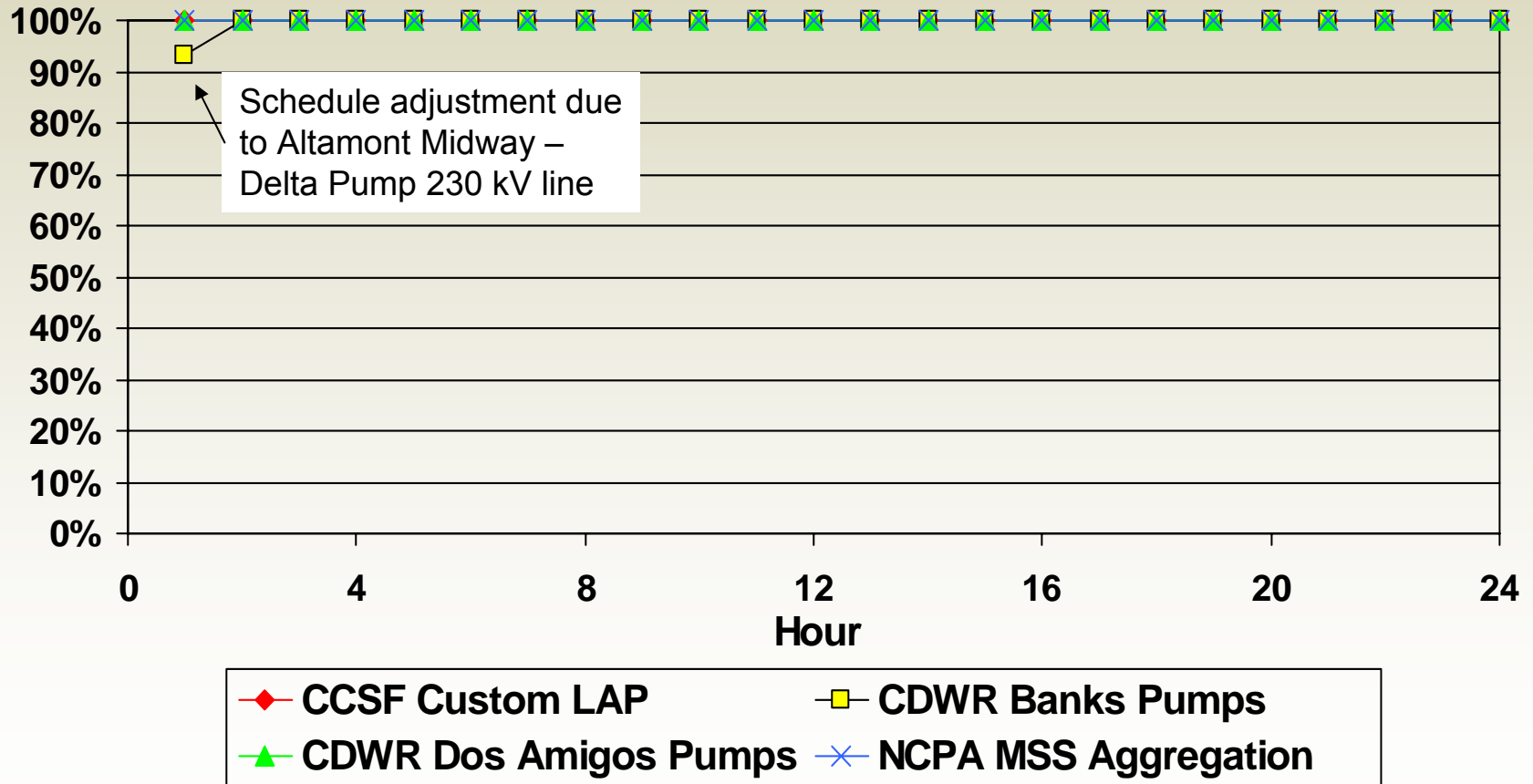
	1a: Economic bids are limited	1b: Generic self-schedules are constrained	1c: ETC self-schedules are constrained
Final schedules for economic bids	-59 MW	-80 MW	-12.5 MW
Final generic self-schedules	154 MW	30 MW	0 MW
Final ETC self-schedules	5 MW	150 MW	112.5 MW
Intertie shadow price (scheduling)	\$55.36/MW	\$601.42/MW	\$3254.81/MW
Scheduling run LMP	\$2.87/MWh	-\$550/MWh	-\$3200/MWh
Pricing run LMP	\$2.87/MWh	-\$30/MWh	-\$30/MWh

## Case 2: To test ETC priority, CAISO added severe constraints to Parameter Tuning test case.

- This test case modifies transmission constraints as:
  - Tesla – Ravenswood 230 kV: 230 MW
  - Crockett – Sobrante 230 kV: 5 MW
  - Claremont – Station D 115 kV: 12 MW
  - North of SONGS corridor: 500 MW
  - Blythe corridor: 100 MW
  - Altamont Midway (30580 ALTM MDW) – Delta Pump 230 kV: 10 MVA
  - Los Banos – Dos Amigos 230 kV: 10 MVA
  - Midway – Buena Vista 230 kV: 10 MVA
  - Hyatt – Table Mt. 230 kV: 10 MVA
  - Mead – Camino 230 kV: 10 MVA
  - Path 15 and 26 corridors: 10 MW each
- Due to test case setup, all ETCs have same priority. For illustration: this test case uses \$3600/MWh.
  - No TOR resources have LMPs subject to schedule adjustments.
  - Note: DA Market schedule adjustments do not necessarily translate to actual RT curtailments, which may be subject to specific operating and interconnection agreements with TO or CAISO.

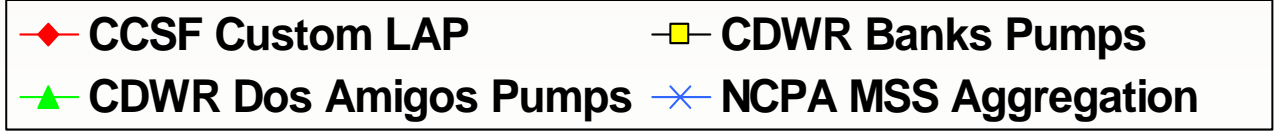
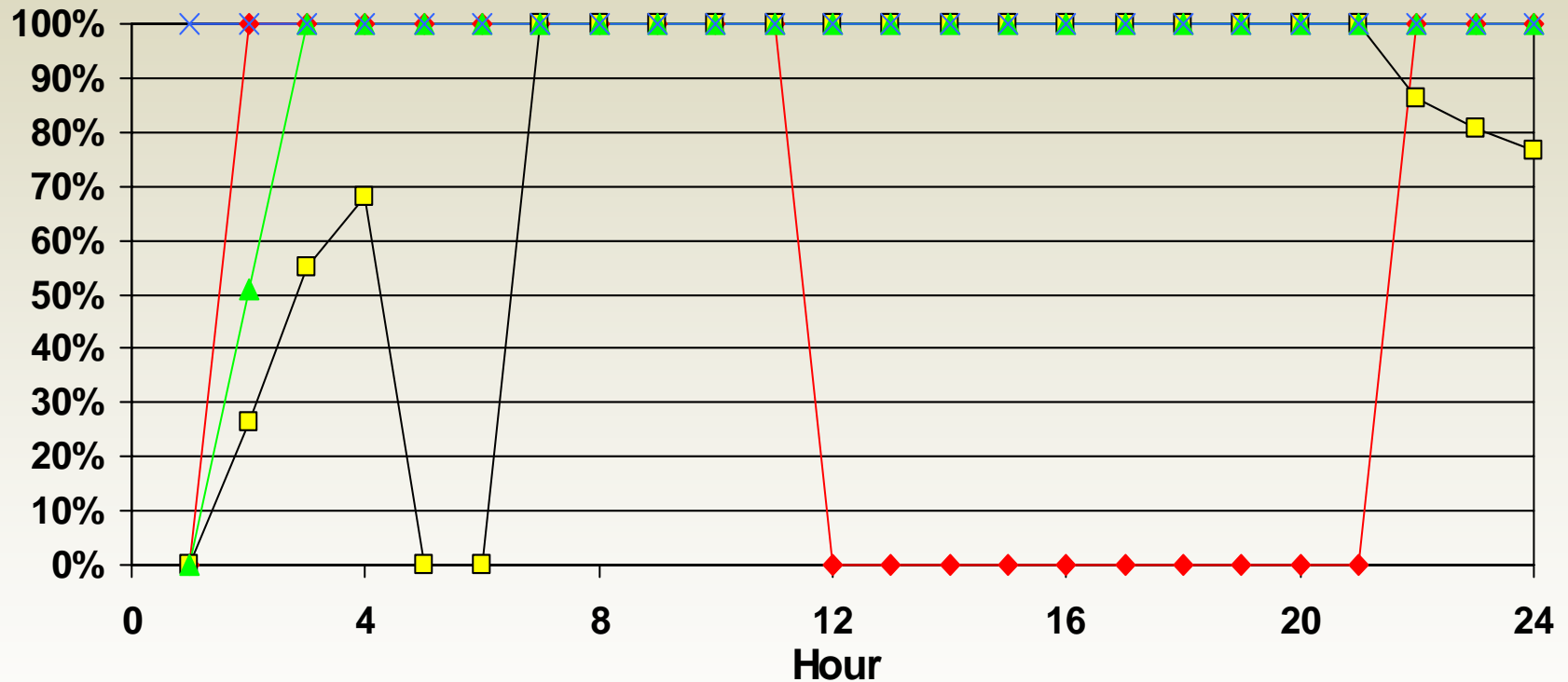
# Self-scheduled load has little curtailment with CAISO's recommended values.

## Scheduled % of Submitted Self-Schedules



# Self-scheduled load has significant curtailments using Alternative value of \$155,000 for ETC adjustment.

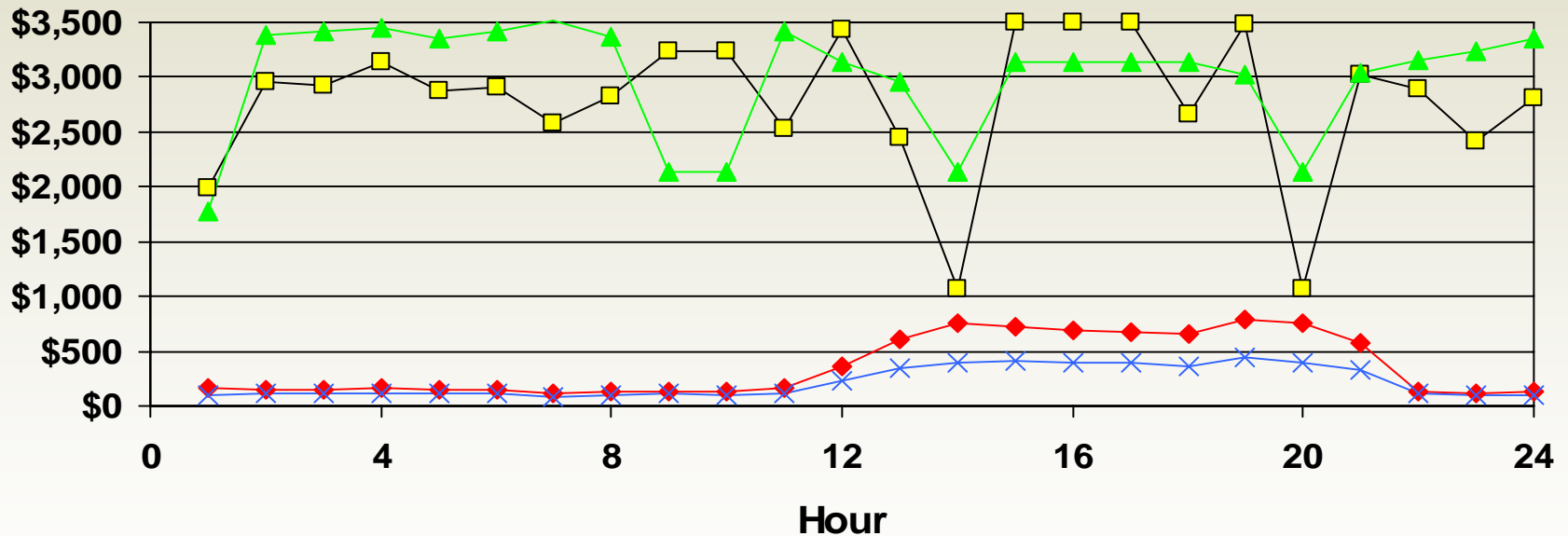
## Scheduled % of Submitted Self-Schedules



# LMPs reflect shadow price of transmission and shift factor (a.k.a. effectiveness) of resources.

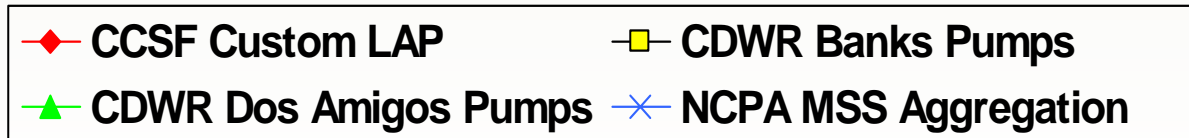
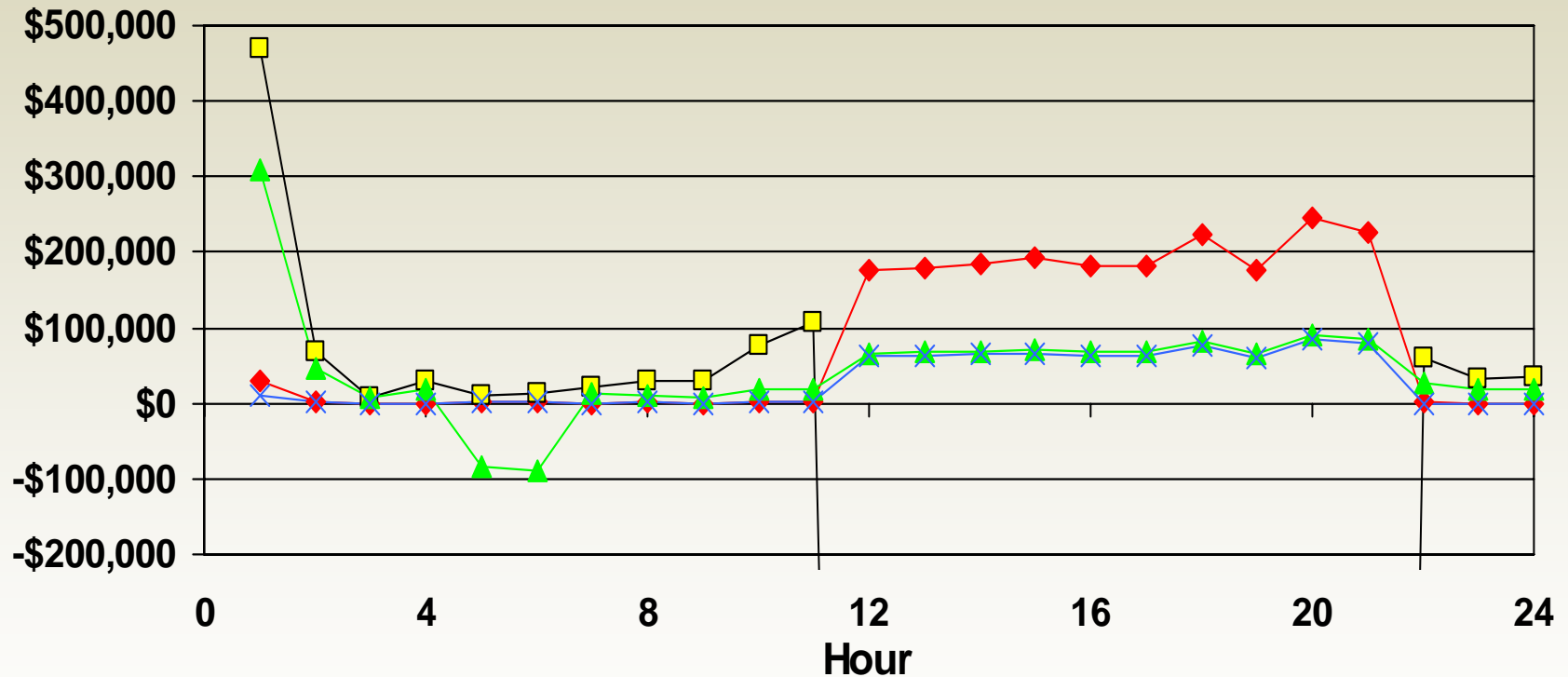
These LMPs result from CAISO recommendations and the severe constraints in this test case.

## LMPs for Custom LAPs



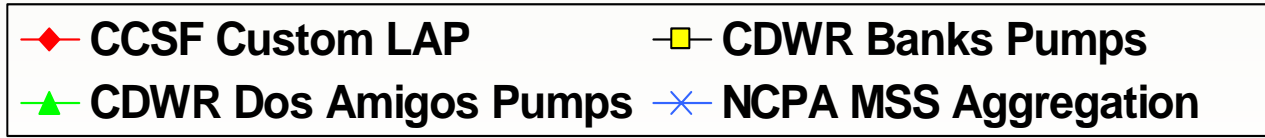
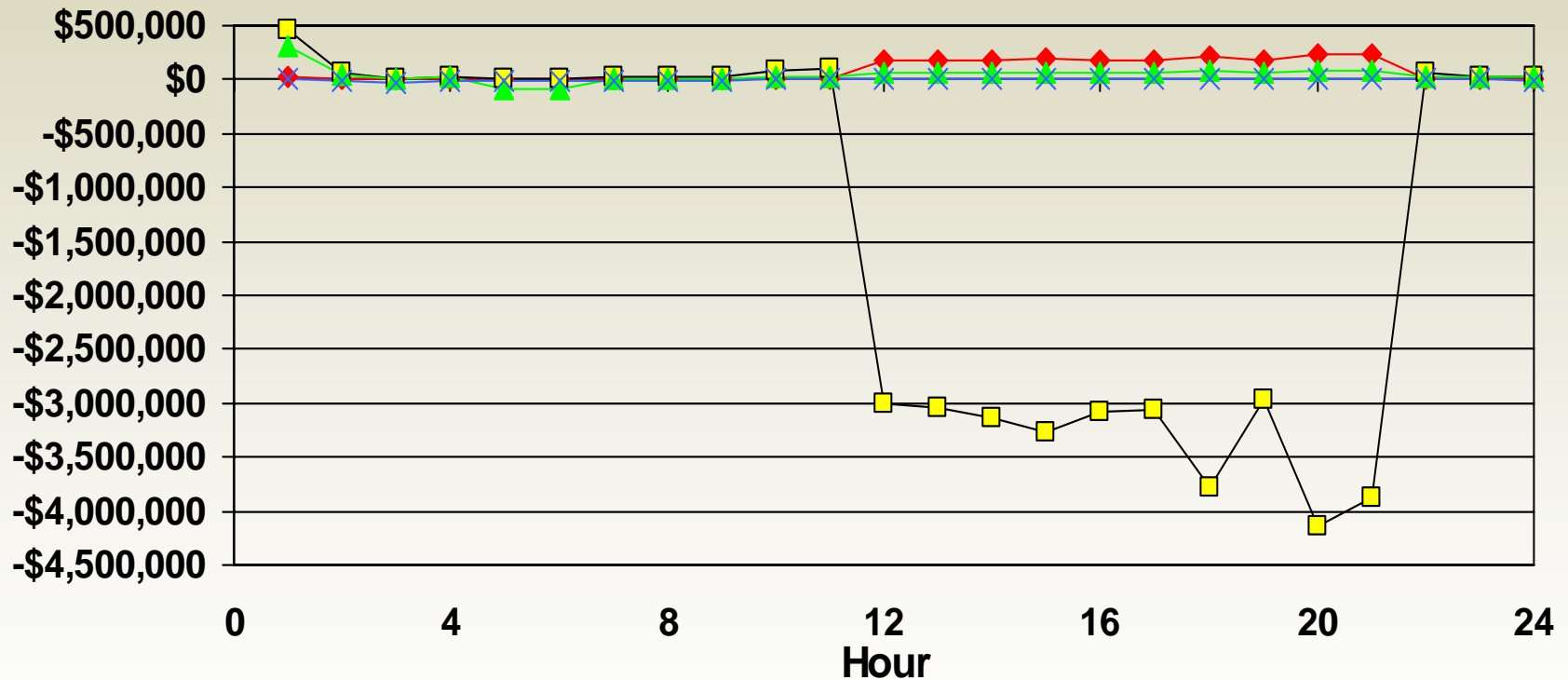
# Alternative \$6.2 million transmission penalty price in scheduling run results in extreme LMPs.

## LMPs for Custom LAPs



Some extreme LMPs from Alternative transmission penalty price could not appear on previous graph.

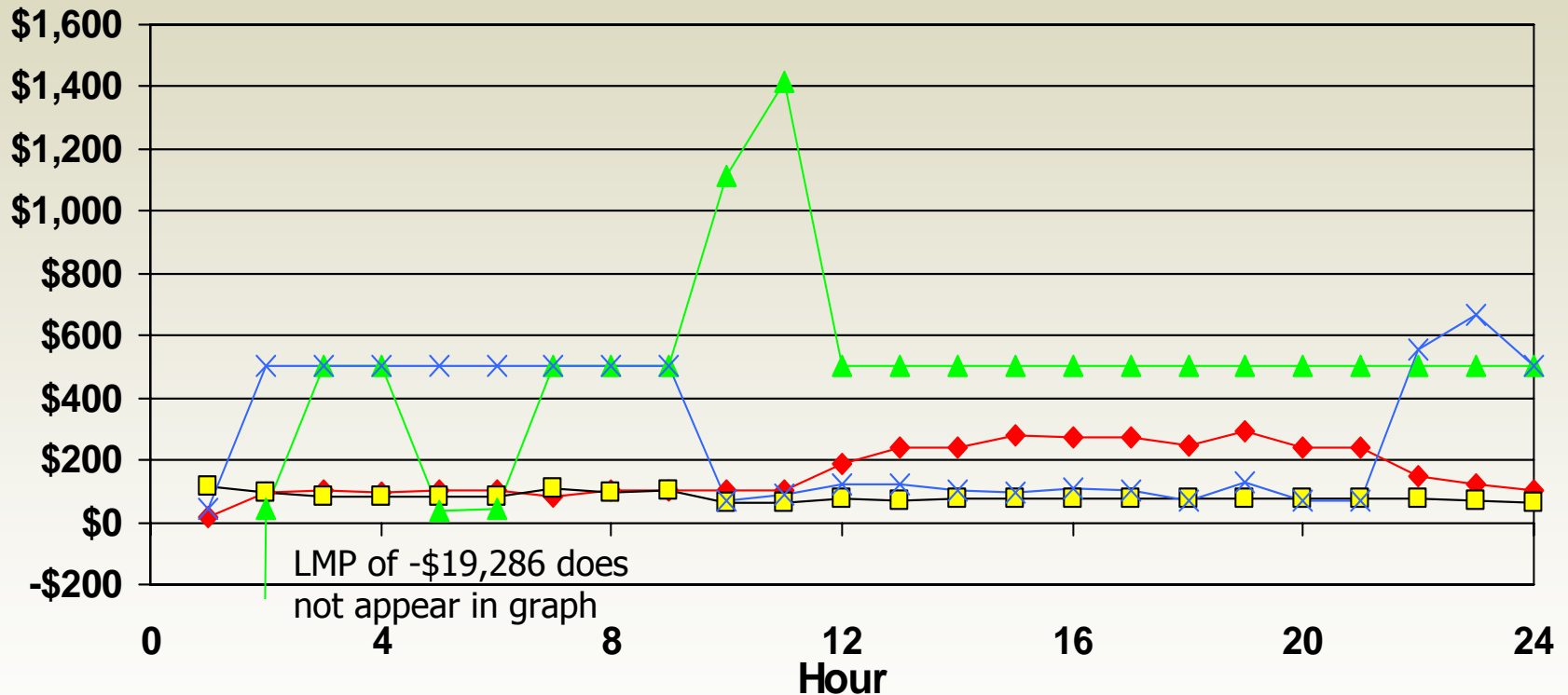
### LMPs for Custom LAPs





# LMPs for Default LAPs are also more extreme using Alternative values.

## LMPs for Default LAPs

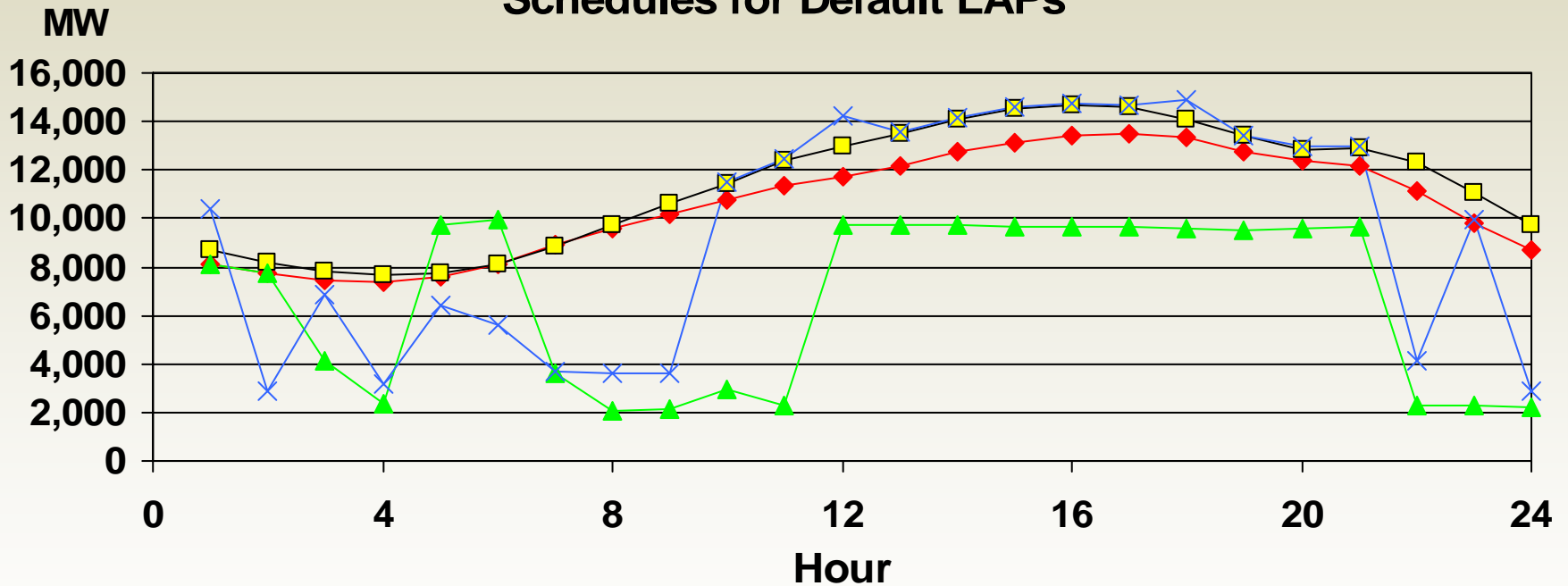


- ◆ PG&E Default LAP, CAISO parameters
- ◆ PG&E Default LAP, CCSF parameters
- SCE Default LAP, CAISO parameters
- ✕ SCE Default LAP, CCSF parameters

# Extreme LMPs from Alternative penalty prices lead to severely curtailing Default LAP load.

Data exclude Custom LAPs & MSS LAPs. Submitted self-schedules exclude economic bids. Final schedules include economic bids.

### Schedules for Default LAPs

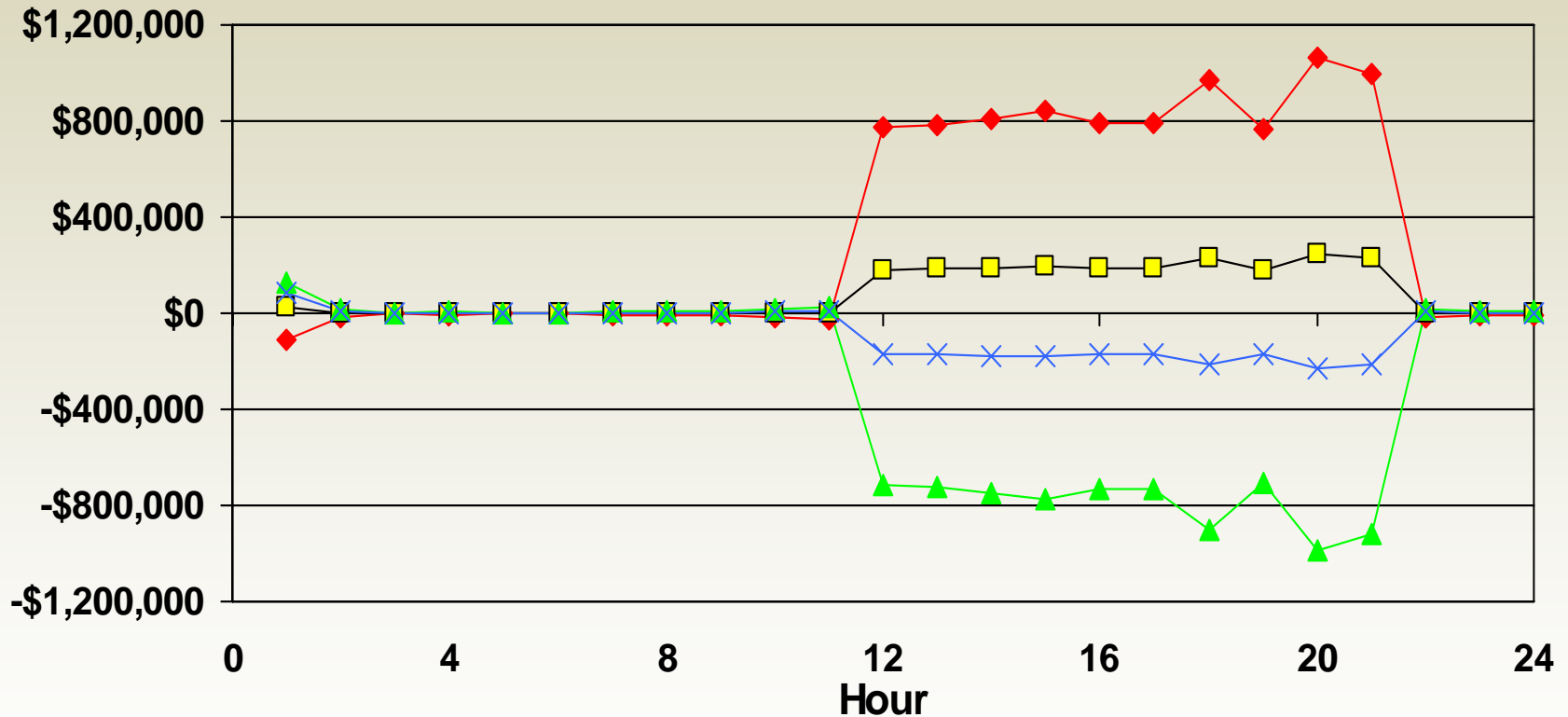


◆ Submitted self-schedules in PG&E LAP  
▲ Final Demand scheduled in PG&E LAP

■ Submitted self-schedules in SCE LAP  
× Final Demand scheduled in SCE LAP

# Extreme LMPs from Alternative's scheduling run transmission penalty price also affect generation.

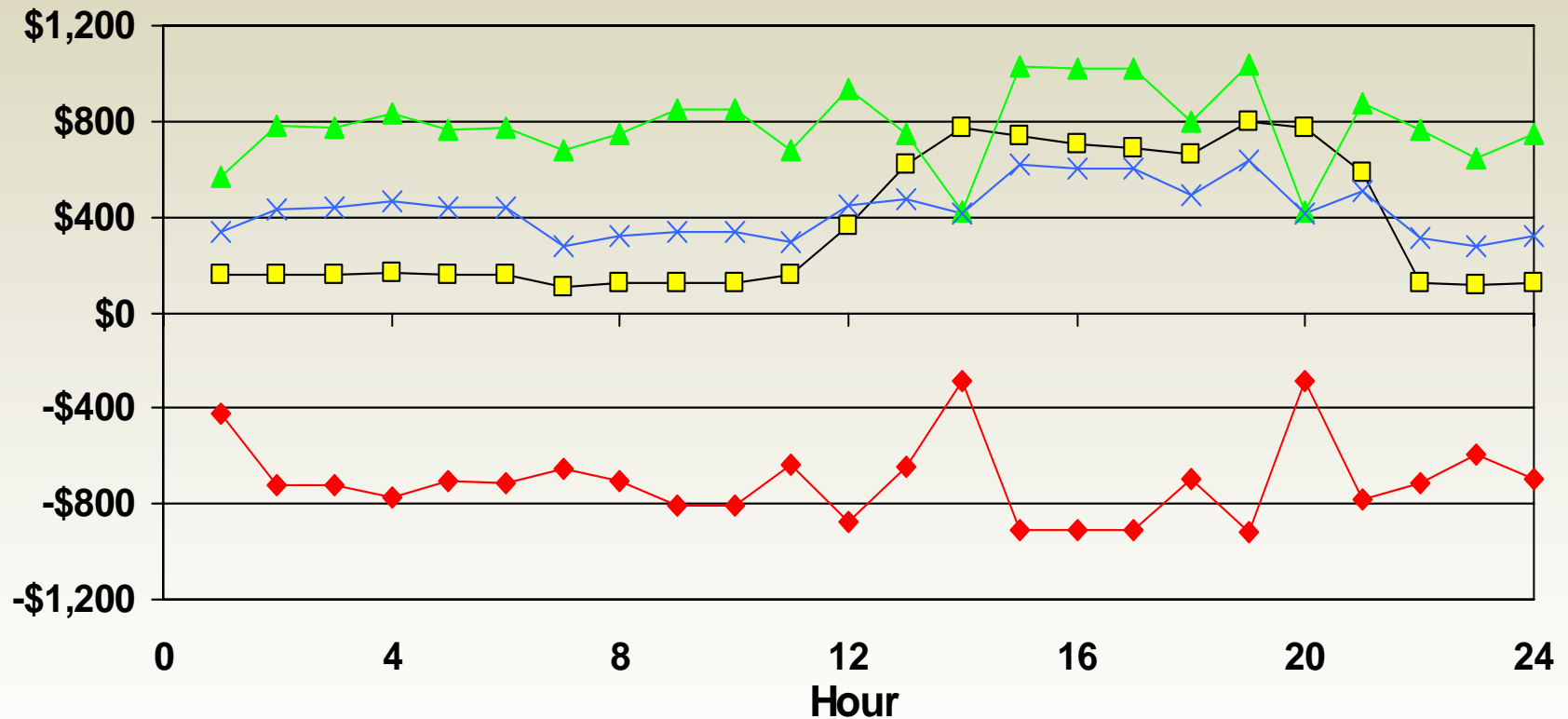
## LMPs for Generation



◆ Altamont Midway    □ Potrero 3    ▲ Contra Costa 6    × PE Berkeley cogeneration

Given the severe constraints in test case, CAISO's recommendations produce reasonable LMPs.

### LMPs for Generation



◆ Altamont Midway    □ Potrero 3    ▲ Contra Costa 6    × PE Berkeley cogeneration

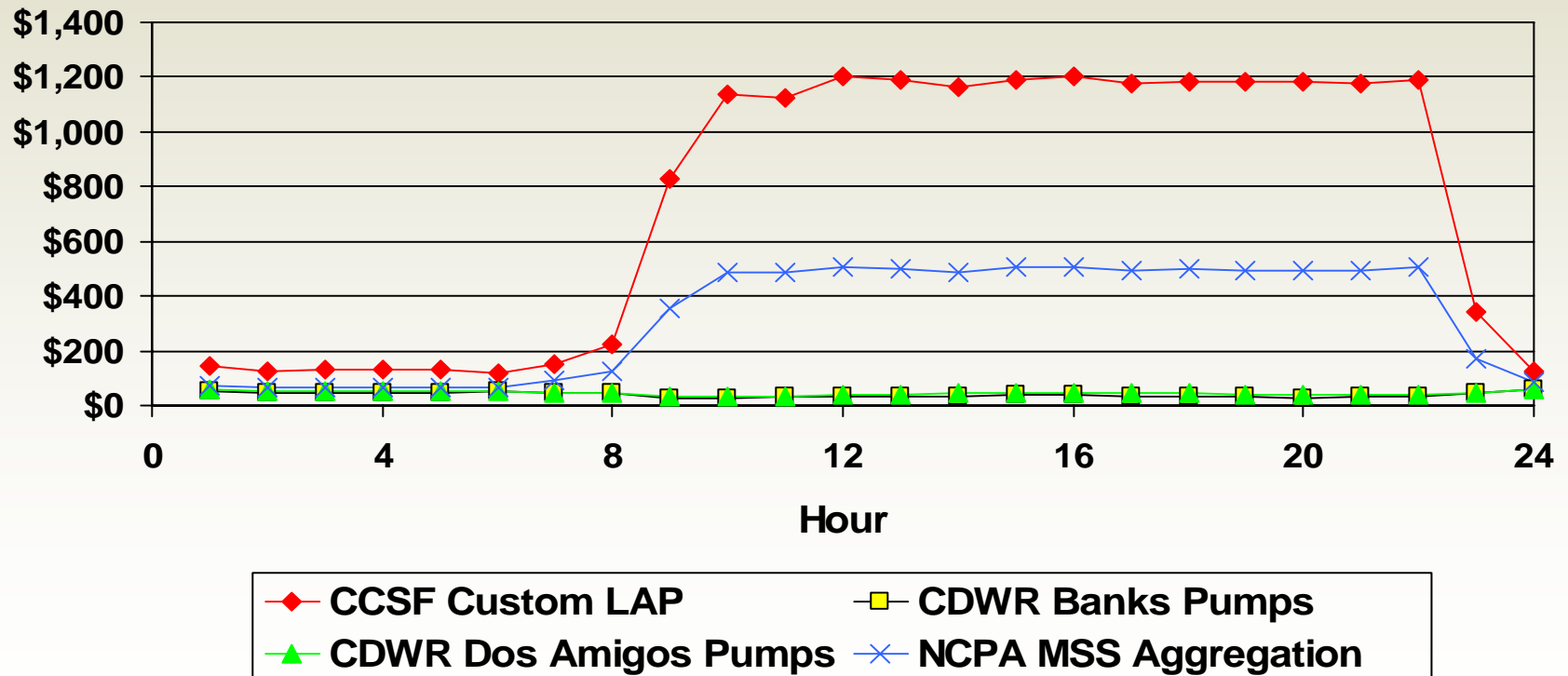
## **Case 3**: Using more realistic constraints, CAISO's values again produce more reasonable results.

- This test case modifies transmission constraints as:
  - Tesla – Ravenswood 230 kV: 230 MW
  - Pittsburg – E. Shore 230 kV: 25 MW
  - North of SONGS corridor: 500 MW
  - Blythe corridor: 100 MW
- Due to test case setup, all ETCs have same priority. For illustration: \$3600/MWh.
  - No TOR resources have LMPs subject to schedule adjustments.
- Presentation of results omits graphs of reduced load, because neither CAISO nor Alternative parameter values result in any reductions in load schedules.

# Case 3's LMPs reflect its constraints' shadow prices of transmission and effectiveness of resources.

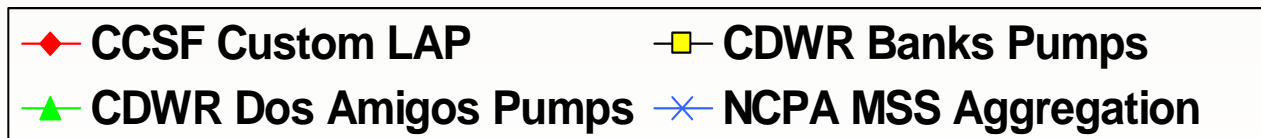
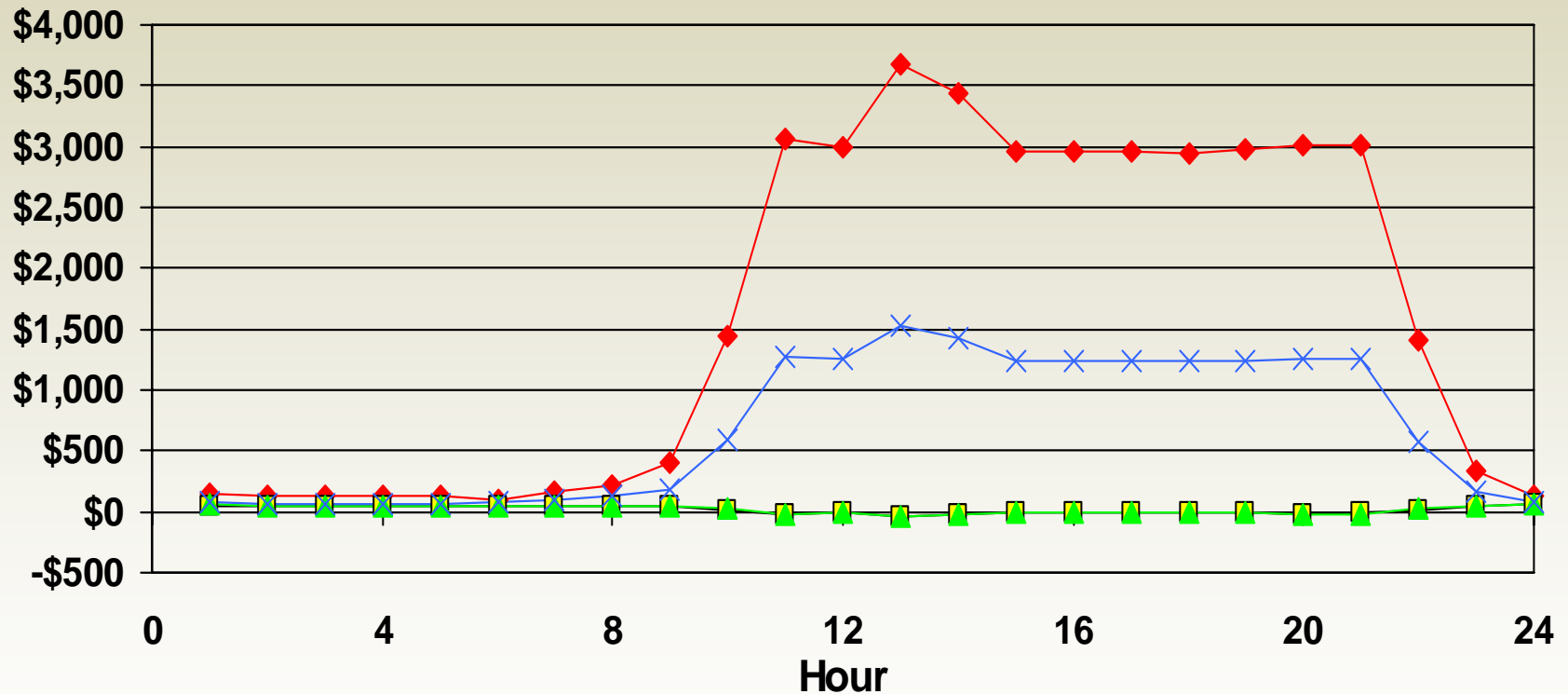
LMPs resulting from CAISO recommendations differ from case 2 due to case 3's transmission constraints.

## LMPs for Custom LAPs



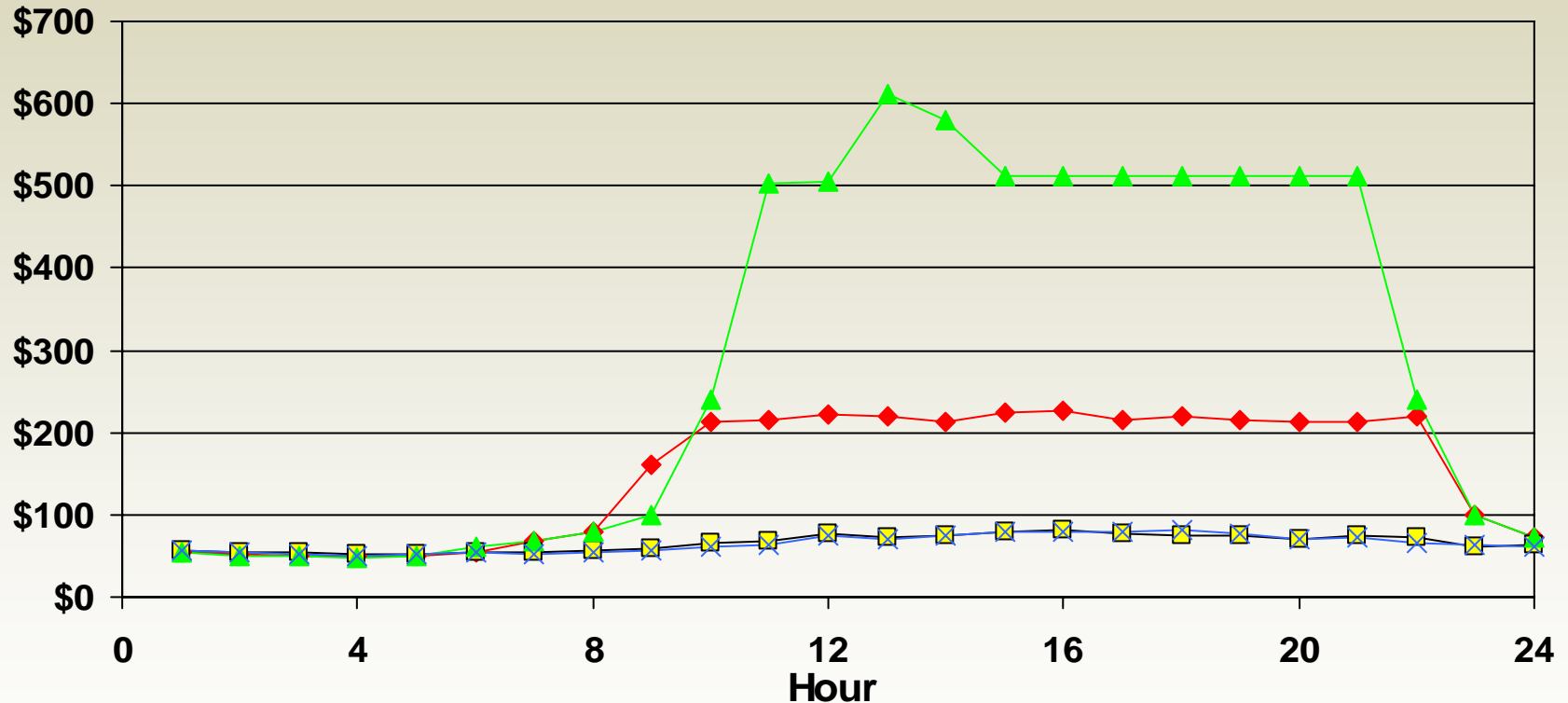
As in case 2, extreme LMPs result from Alternative \$6.2 million transmission constraint penalty price.

### LMPs for Custom LAPs



As in Case 2, LMPs for Default LAPs are also more extreme using Alternative values.

LMPs for Default LAPs

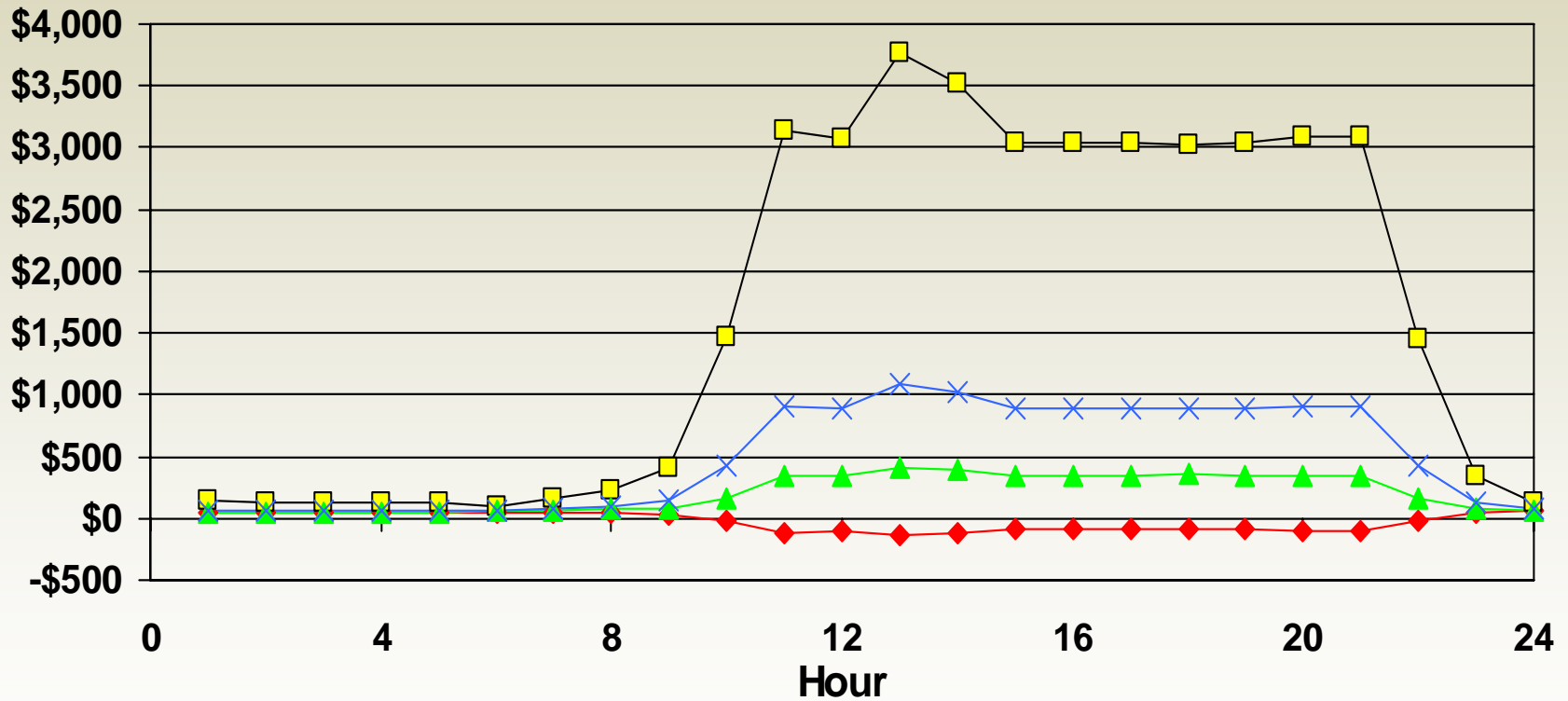


◆ PG&E Default LAP, CAISO parameters    □ SCE Default LAP, CAISO parameters  
▲ PG&E Default LAP, CCSF parameters    × SCE Default LAP, CCSF parameters



As in Case 2, extreme LMPs from Alternative's transmission penalty price also affect generation.

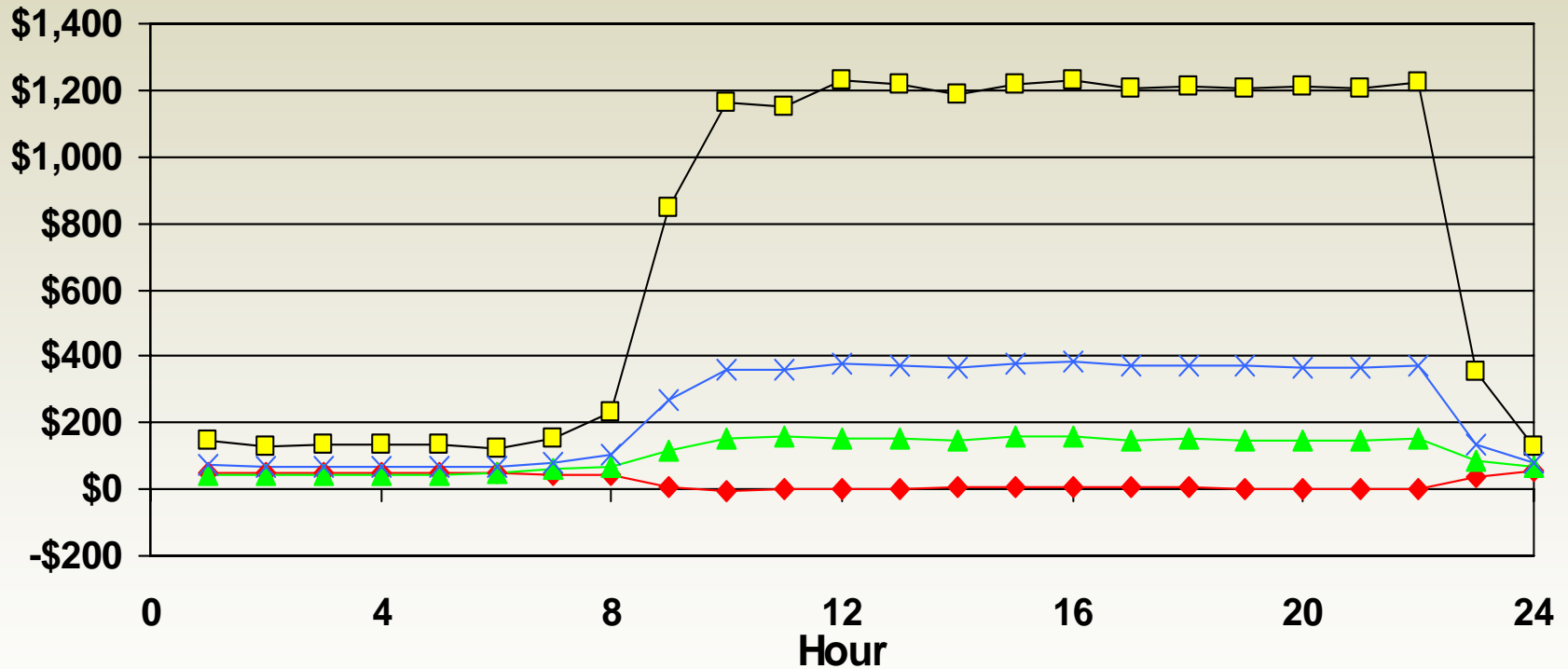
### LMPs for Generation



◆ Altamont Midway    ■ Potrero 3    ▲ Contra Costa 6    × Metcalf Energy Center

CAISO's recommendations produce more reasonable LMPs, given Case 3's constraints.

### LMPs for Generation



◆ Altamont Midway    □ Potrero 3    ▲ Contra Costa 6    × Metcalf Energy Center



# Treatment of ETCs/TORs: Financial Firmness

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# Financial Firmness for Existing Rights Schedules

- Uneconomic Adjustment may reduce submitted ETC/TOR self-schedules
- May result in unbalanced IFM schedule because IFM adjusts supply and load sides independently
- ETC/TOR load near a binding constraint likely to be more effective in relieving constraint than Default LAP load
- Unbalanced portion in IFM is subject to regular market settlement, with no Perfect Hedge benefit

# Concern may be addressed by providing financial firmness.

- Proposal: Settlement mechanism that enables rights holder to “cover” any unbalanced IFM schedule with Perfect Hedge by submitting supply self-schedule to RTM (HASP)
- Advantages of this approach –
  - Maintains Perfect Hedge benefits when existing rights self-schedules are unbalanced by the IFM
  - Feasible to implement
  - Does not compromise MRTU objective of feasible IFM schedules

# Example to illustrate Financial Firmness proposal

- Rights holder self-schedules 150 MW load & supply in IFM, and RT load = 150 MW
- Case 1: IFM reduces supply schedule to 130 MW
  - Rights holder self-schedules, and CAISO accepts, 20 MW additional supply in RTM
  - 20 MW RT supply balances 20 MW IFM load
  - All 150 MW RT load receives Perfect Hedge settlement
- Case 2: IFM reduces load schedule to 130 MW
  - Rights holder re-submits 150 MW supply self-schedule to RTM
  - All 150 MW RT load receives Perfect Hedge settlement

# Other features of Financial Firmness proposal

- Where IFM load schedule is balanced with RT supply schedule (or vice versa), Perfect Hedge settlement is based on IFM load price and RT supply price (or v.v.)
- To obtain Perfect Hedge for unbalanced portion of IFM schedule, existing rights holder needs to submit supply self-schedule to the RTM and have it accepted by CAISO
- Perfect Hedge settlement cannot apply to more MWh than final RT load, per load meter data.



# Ongoing Maintenance of Parameter Values

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MSC/Stakeholder Meeting on Parameter Maintenance  
September 25, 2008



# Maintenance of Parameter Values

- Where will parameters reside?
  - Certain key pricing provisions will be included in tariff
    - Energy Bid Cap for pricing energy shortfall in RTD
    - Energy Bid Cap for pricing relaxation of transmission constraint in RTD
    - Energy Bid Cap for pricing relaxation of transmission constraint in IFM (tentative)
  - Scheduling parameters will reside in BPMs
- How do they change?
  - BPM Change Management Process
  - May use expedited change process to address adverse system or market impacts
  - Participants will be notified of change prior to implementation
    - Unless situation requires change within market production process

# Maintenance of Parameter Values – 2

- What may trigger need to revise a parameter?
  - Adjustments to comparable resources deviate from tariff priorities
  - Constraint relaxation prior to exhausting effective economic bids
  - Solution infeasibility in overly constrained conditions
  - Chronic extreme prices
- How will CAISO develop change recommendation?
  - Detection and identification of problem
  - Diagnosis of cause related to parameter value(s)
  - Analysis of alternative parameter values, leading to recommendation
  - Discussion with stakeholders, per BPM change management process
  - Review of recommendation by key CAISO departments and executives
  - Notification of revised parameter value and planned date of change