Price Formation Enhancements

Working Group Session #7

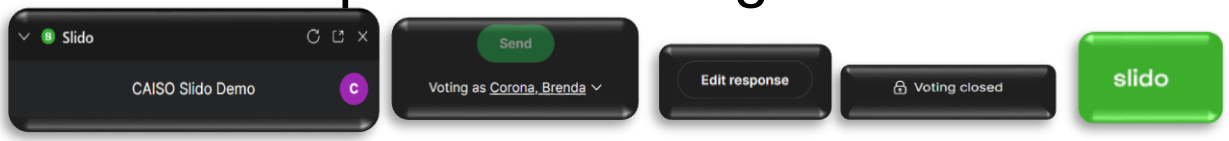
10/25/2023

Housekeeping reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- These collaborative working groups are intended to stimulate open dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Note: The ISO encourages any verbal or written agreements to comments made during this working group session.
- You may also send your question via chat to either Brenda Corona or to all panelists.

Instructions for WebEx

- The “raise hand” icon is located in the lower tool bar. You will hear a beep tone when you are un-muted; at that time please state your name, and question. Attendees dialed in on the phone only press #2 will hear a notification when you are un-muted; at that time please state your name and question.
- WebEx platform will **LOCK** and mute you if you mute yourself once you have finished your question. Do not mute yourself until you have completed your question or comment.
- Polling App: *Slido* you can select the answer to the question.
- Virtual Attendees will see questions on right screen above the chat window.



- In-Person Attendees will use the passcode to login from a device to answer questions

Today's Working Group Agenda

Time	Topic	Presenter
1:00 – 1:05	Welcome, Today's Agenda, Stakeholder Process Overview	Brenda Corona
1:05 – 1:15	Today's Goals / Next Session	Juan Buitrago
1:15 – 2:30	Review of Existing ISO (CAISO) Mechanisms	Sylvie Spewak
2:30 – 2:50	Overview of Existing ISO (comparative) Scarcity concepts	James Friedrich
2:50 – 3:55	CAISO Drafted Problem Statements : Stakeholder Discussion	Juan Buitrago
3:55 – 4:00	Next Steps	Brenda Corona

ISO Policy Initiative Stakeholder Process

We are here

Stakeholder meetings, working groups and workshops may occur throughout the stakeholder process.

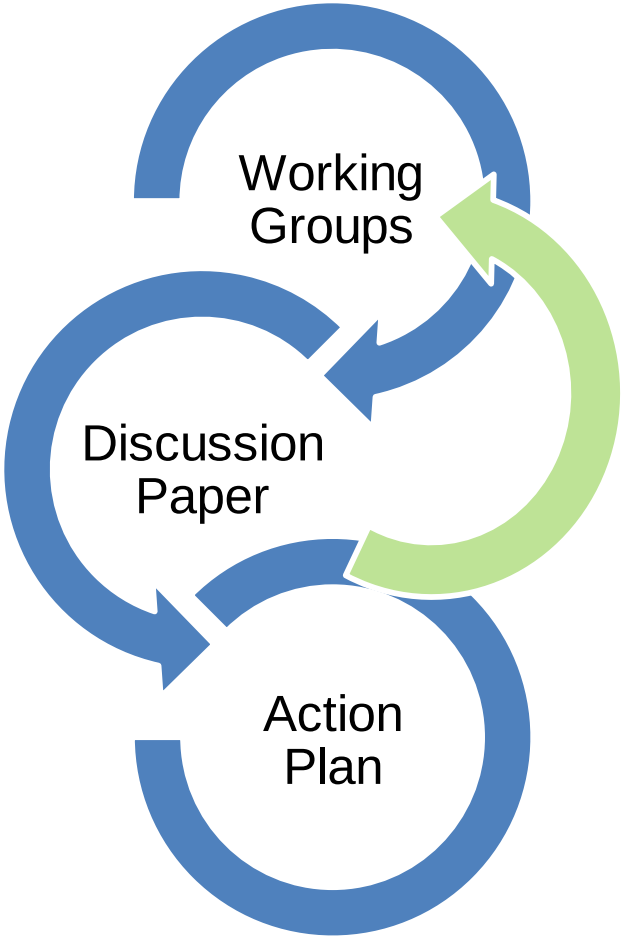
- Working groups will inform the Phase 1 straw proposal
- The ISO will take notes and produce reports of each of our working group meetings.

Working Group Deliverables

Action Plan: A bridge between the working groups and a straw proposal, the Action Plan will inform the policy direction for Price Formation Enhancements Phase 2 stakeholder initiative.

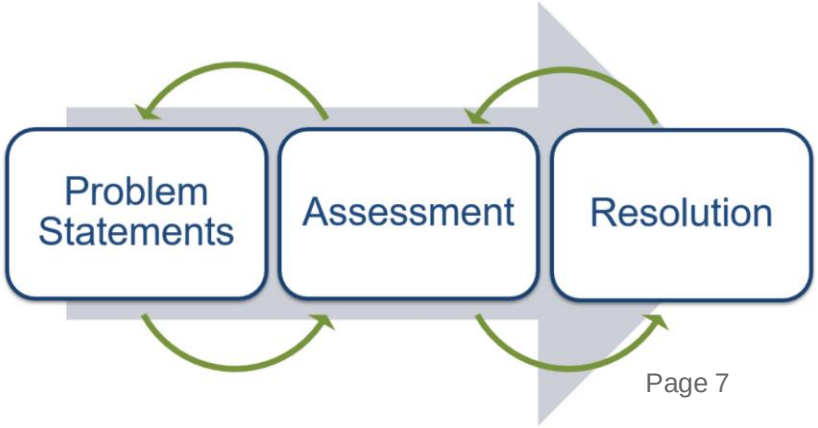
The action plan will recap all perspectives shared in the working group process and identify the policy direction/basis of the straw proposal

You will have an opportunity to provide written comment on the Action Plan



Working Group Progress to date

- Frame/Level Set on Policy Area **[Done!]**
- Issue/Challenge Identification**[In progress]**
- Problem statements **[In progress]**
  - Problem Statements translate issues into actionable items
- Assessment **[Starting]**
  - Validate problem statements as represented
  - Identify ways to measure the issues or asses the impact of potential solutions
  - Align on priorities and prepare for solution development
- Resolving the issues **[Hold]**
  - Identify existing opportunities
  - Develop solutions



Goals of Today's Working Group Session

The Working Group structure is meant to embrace flexibility to allow organic and robust conversation on the topics at hand – it is still key for us to drive towards solutions collaboratively

- **Begin Thematic Sessions: Review of Existing ISO Market Mechanism**
  - Review of CAISO Market Mechanisms for Scarcity Pricing
  - Explore existing scarcity pricing concepts
  - Set foundation for comparative analysis

- **CAISO Drafted Problem Statements**
  - Meant to serve as conversation starters
  - Need stakeholder feedback!
    - Share your positions
    - Share data needed
    - Measurable actions that come to mind

Price Formation Enhancements

Staff Discussion on Scarcity Pricing Market Mechanics

Working Group #7

October 25, 2023

Scarcity prices are effectuated in different ways

- Reserve shortage pricing (operating reserve demand curves)
- Power balance constraint violations
- Specific events such as load shedding or activation of demand response
- FERC Order 831 conditions

To understand scarcity pricing market mechanics, we need to review the concept of “surplus variables”

- Markets need a mechanism to deal with constraint violations to ensure the optimization can always find a solution
- To address constraint violations, markets use surplus variables (“slack”, “penalty” variables)
- The surplus variable is integrated into the optimization's objective function with an associated penalty cost.
  - The higher the penalty cost, the less likely the optimization problem will violate the constraint.

To understand scarcity pricing market mechanics, we need to review the concept of “surplus variables”

- When the market solves, the surplus variable captures the degree to which its corresponding constraint is violated.
  - If a constraint is not violated, the surplus variable will take a value of zero.
  - If a constraint is violated, the surplus variable takes value, and the penalty price associated with the surplus variable gets added to the total cost of the solution.

To understand scarcity pricing market mechanics, we need to review the concept of “surplus variables”

- Surplus variables and penalty prices have different functions between the **scheduling run** and the **pricing run**
  - Penalty prices in the scheduling run determine the relative scheduling priority (i.e, which constraints/requirements to relax first)
  - The surplus variable values in the scheduling run are passed to the pricing run and “fixed” within a small range
  - Penalty prices in the pricing run determine the binding prices

Reserve shortage pricing (operating reserve demand curves)

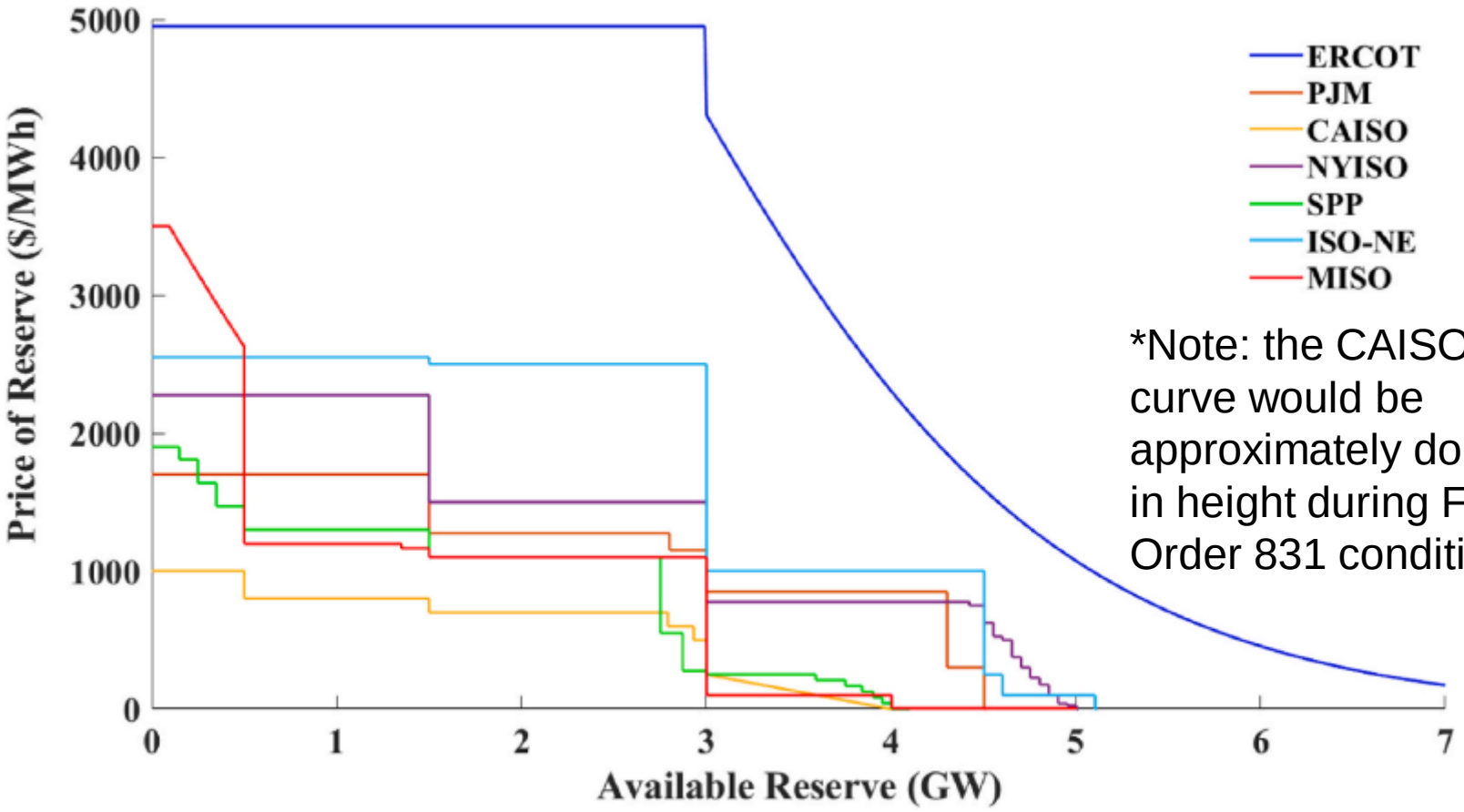
- CAISO has a **Scarcity Reserve Demand Curve** that applies during periods in which supply is insufficient to meet the minimum procurement requirements for ancillary services

- When supply is insufficient to meet any of the CAISO's ancillary service requirements within an ancillary service region or sub-region, the Scarcity Reserve Demand Curve will clear the ancillary services market with administratively determined prices.

Reserve	Demand Curve Value ($/MWh)					
	Percent of Max Energy Bid Price		Max Energy Bid Price = $750/MWh		Max Energy Bid Price = $1000/MWh	
	Expanded System Region	System Region and Sub-Region	Expanded System Region	System Region and Sub-Region	Expanded System Region	System Region and Sub-Region
Regulation Up	20%	20%	$150	$150	$200	$200
Spinning	10%	10%	$75	$75	$100	$100
Non-Spinning						
Shortage > 210 MW	70%	70%	$525	$525	$700	$700
Shortage > 70 & < = 210 MW	60%	60%	$450	$450	$600	$600
Shortage □ 70 MW	50%	50%	$375	$375	$500	$500
Upward Sum	**100%**	**100%**	**$750**	**$750**	**$1,000**	**$1,000**
Regulation Down						
Shortage > 84 MW	70%	70%	$525	$525	$700	$700
Shortage > 32 & < □ 84 MW	60%	60%	$450	$450	$600	$600
Shortage □ 32 MW	50%	50%	$375	$375	$500	$500

Source: California ISO Business Practice Manual for Market Operations Version 79, page 181 and CAISO Tariff section 27.1.2.3.5.

Reserve shortage pricing in ISO/RTO markets

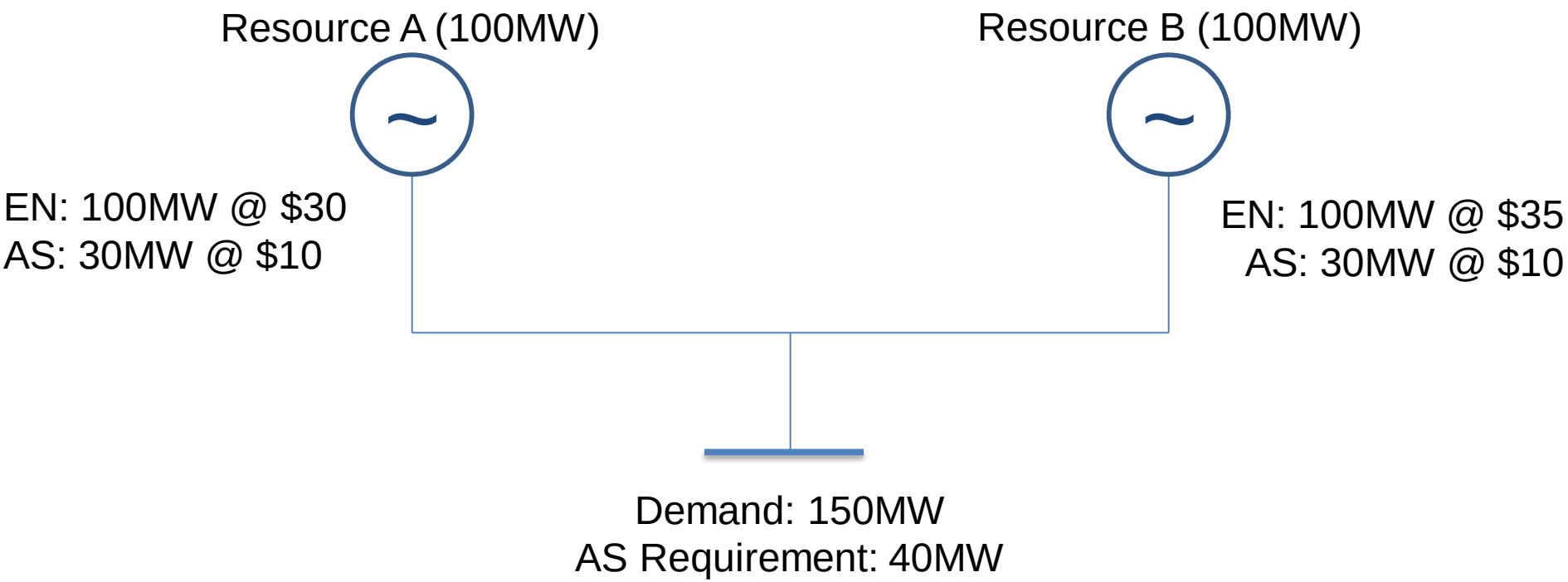


*Note: the CAISO curve would be approximately doubled in height during FERC Order 831 conditions

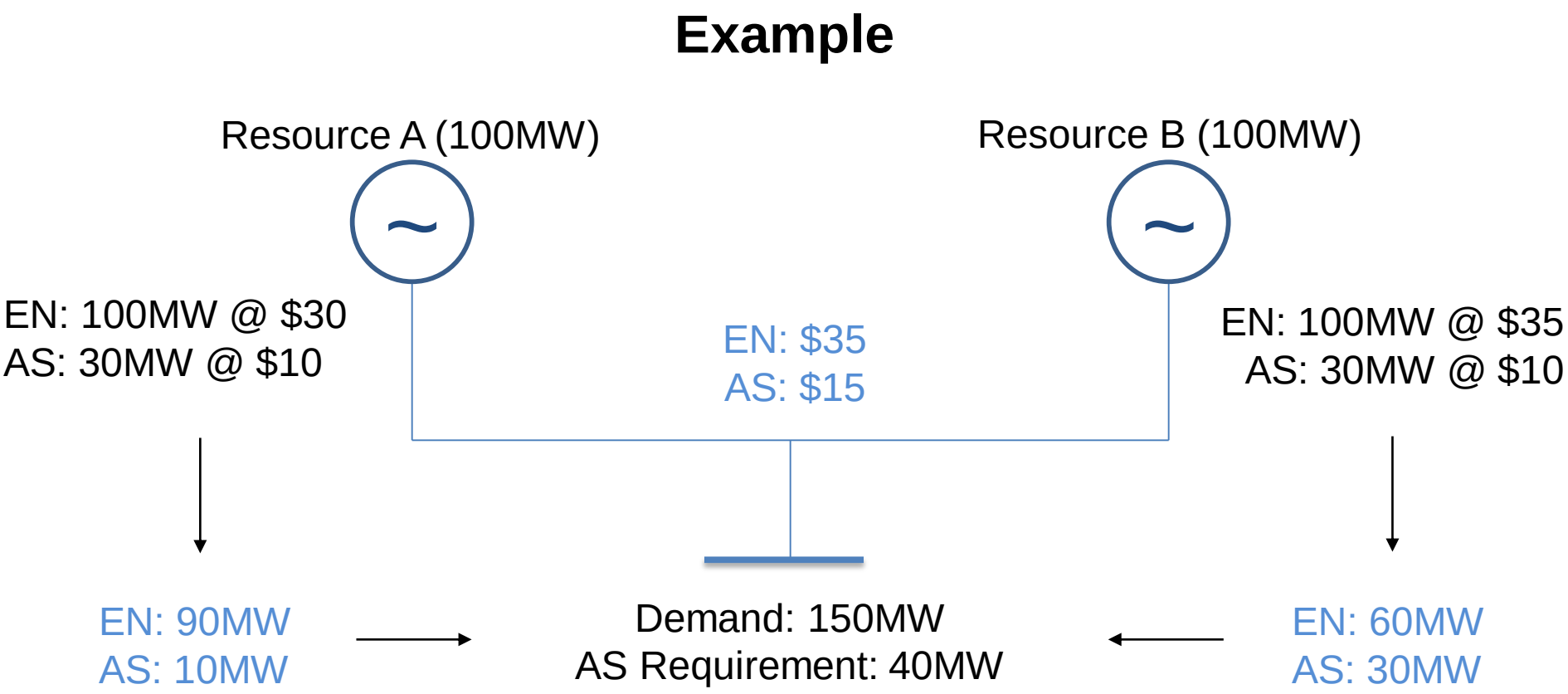
Mehrtash, Mahdi, Benjamin F. Hobbs, and Erik Ela. "Reserve and energy scarcity pricing in United States power markets: A comparative review of principles and practices." *Renewable and Sustainable Energy Reviews* (2023)

Reserve shortage pricing effectuates energy scarcity pricing through co-optimization

Example



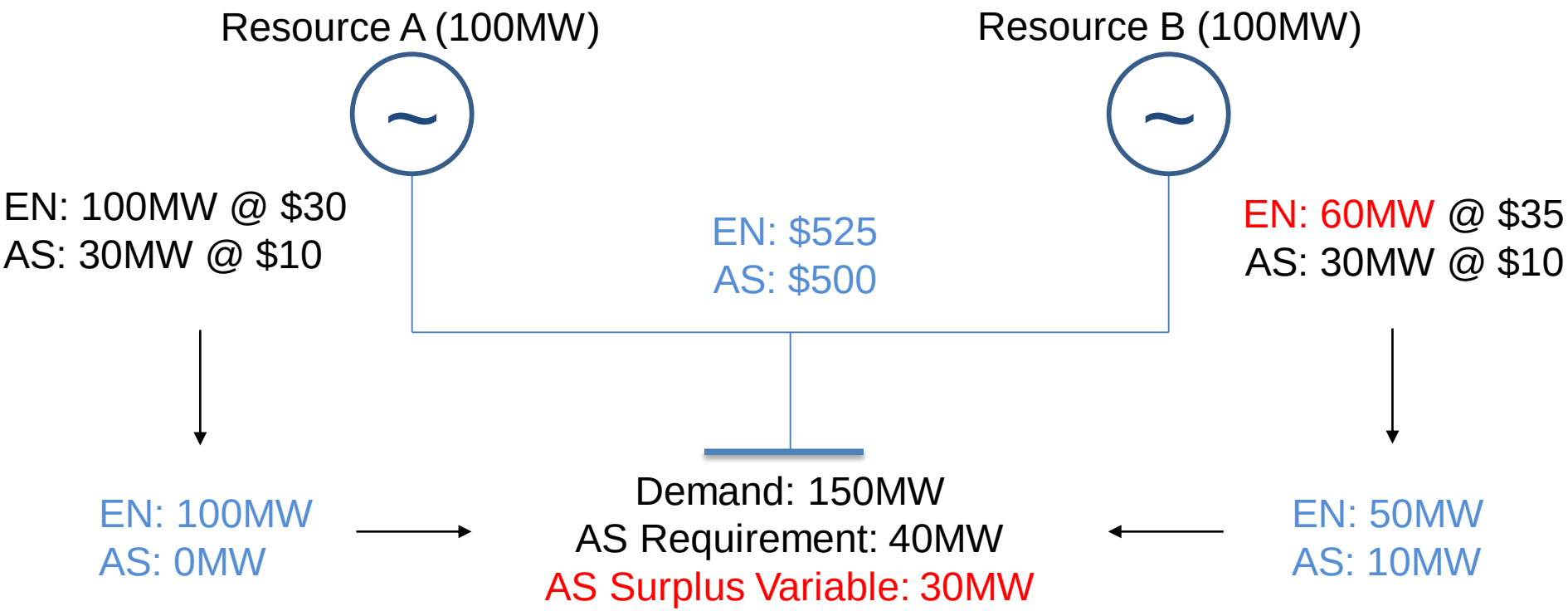
Reserve shortage pricing effectuates energy scarcity pricing through co-optimization



Reserve shortage pricing effectuates energy scarcity pricing through co-optimization

Assume a reserve violation penalty price of $500

Example



Reserve shortage pricing effectuates energy scarcity pricing through co-optimization

Summary

- The market optimization ensures that market awards are allocated in such a way that the resulting prices make suppliers indifferent between providing energy or reserves based on their bid costs.

- In the previous example, the energy price needs to be at least **$490** higher than the energy bid of the marginal unit (Resource B)

Flexible ramping product demand curve

- The flexible ramping product procurement demand curve contributes to scarcity pricing signals in the real-time market

- Mechanism is very similar to previous example

Power balance constraint violations

- Power balance constraint violations work in similar ways to the process described previously

- When the power balance constraint is violated, a surplus variable takes value and the associated penalty price gets added to the total cost of the solution
  - The penalty price is $1000 or $2000, depending on the conditions (more later)

Why the power balance constraint violation penalty price is not a “price cap”

- If the power balance constraint violation penalty is set at $1000/MWh, it means that the market is willing to incur a cost of up to $1000/MWh for any imbalance of supply and demand.

- However, this does not necessarily cap the market price of energy at $1000.
  - Congestion and losses could push LMPs higher in some locations
  - Reserve shortage pricing could lead to lead to energy opportunity costs that push energy prices above $1000

Why the power balance constraint violation penalty price is not a “price cap”

- Penalty prices are integrated into the market solution (dual values or shadow prices) and are not administrative caps (i.e., the market ignores the market price solution and inserts some other price)

Specific events such as load shedding or activation of demand response

- CAISO market does not have any unique pricing rules during load shedding events (i.e., prices are still determined as outputs of market optimization)

- CAISO market does have a few mechanisms to sustain emergency price levels during emergency events

Specific events such as load shedding or activation of demand response

- When CAISO "arms load" to meet contingency reserve requirements, the market will release contingency reserves as energy and put the energy bids into the bid stack at the relevant penalty price ($1000 or $2000)

- RDRR (emergency demand response resources) must submit bids at or above 95% of the relevant bid cap

- Demand response is accounted for in the load forecast to prevent “double counting”

FERC Order 831 Conditions

- Raises the energy bid cap from $1,000/MWh to $2,000/MWh. Suppliers can submit energy bids above $1,000/MWh based on verifiable actual or expected costs.

- Sets the power balance penalty price used by the market from $1,000/MWh to $2,000/MWh and scales related price parameters accordingly when (1) A resource has submitted a cost-verified energy bid greater than $1,000/MWh or (2) CAISO has calculated a "maximum import bid price" greater than $1,000/MWh.

Existing ISO Market Mechanisms cont'd

Existing Scarcity Pricing Concepts

Working Group #7

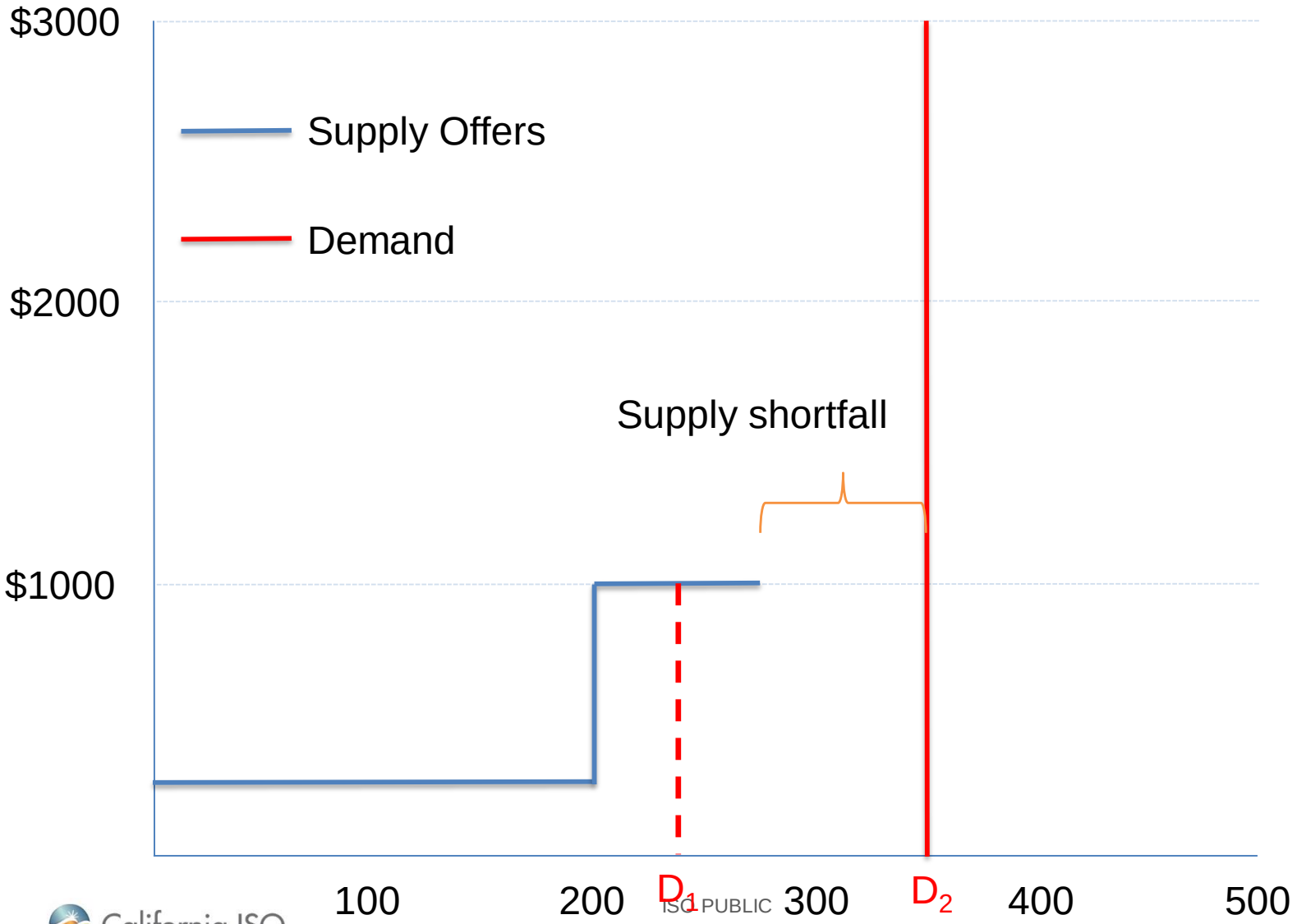
October 25, 2023

Demand is ‘inelastic’

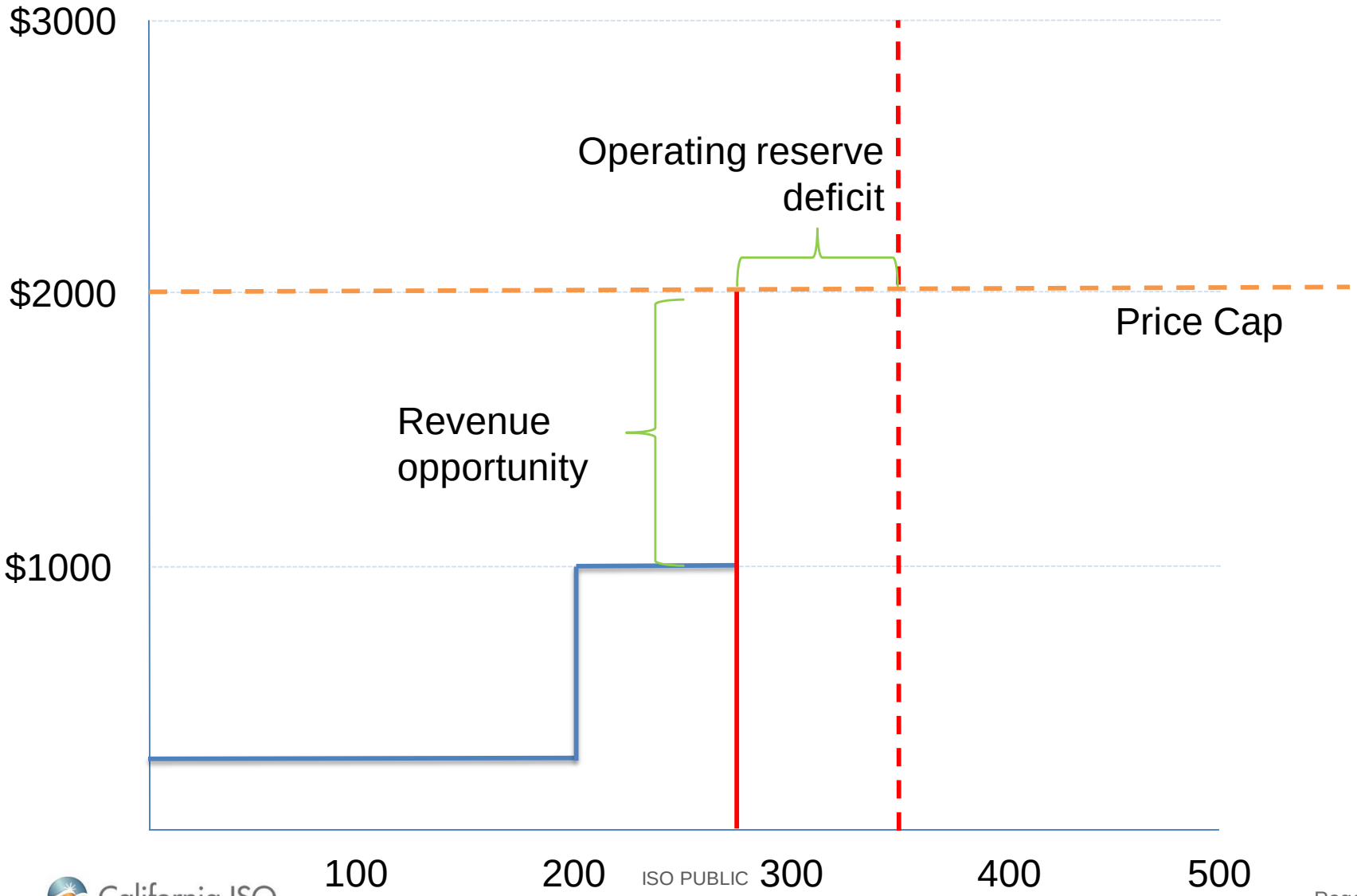
- Load does not react to real-time price signals
- Supply is managed through least cost dispatch and a uniform price auction


$3000
$2000
$1000
Supply Offers
Demand
Demand = 250MW
Price = $1000
100
200
300
400
500

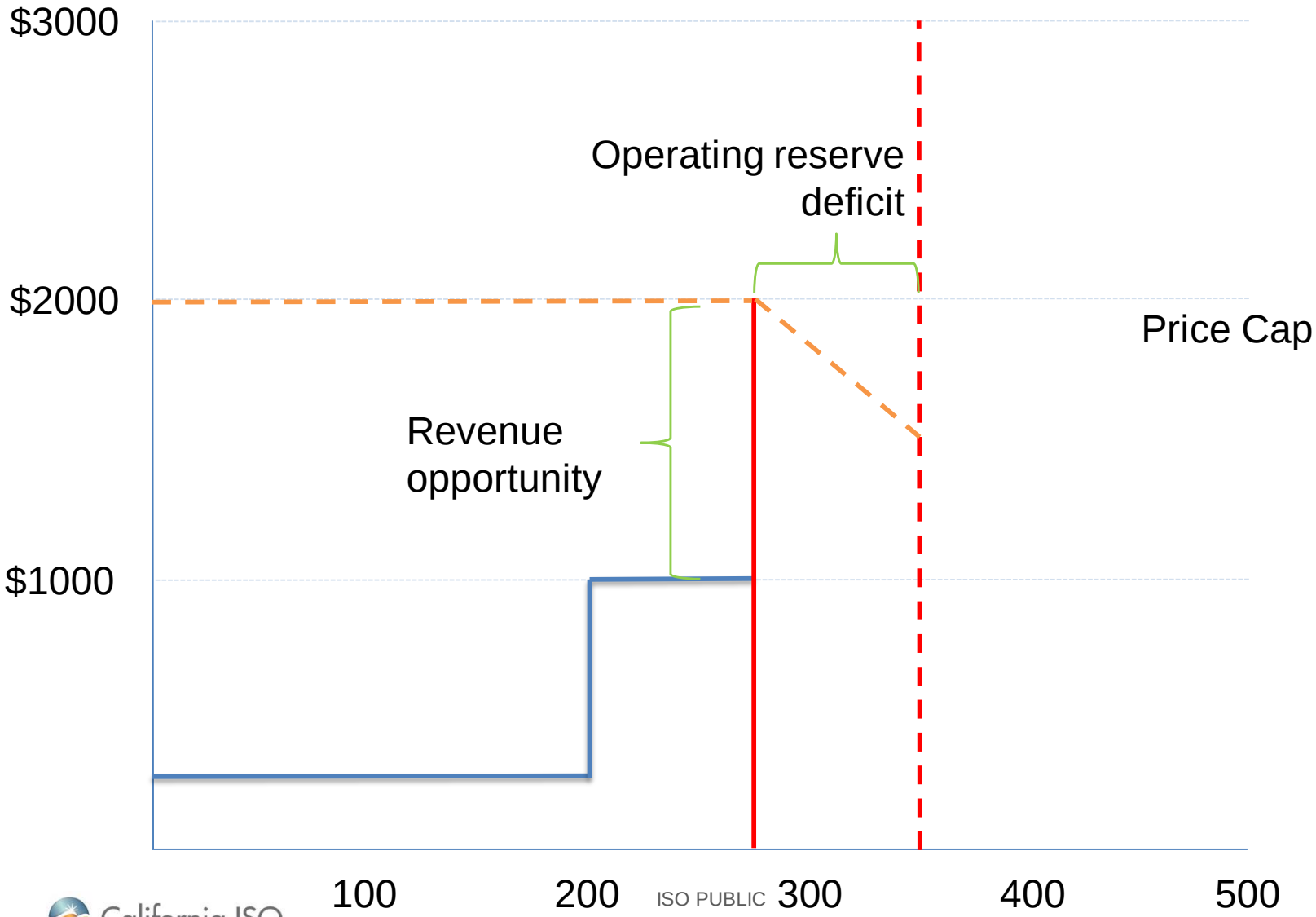
What would happen at 350MW?



Price cap and operating reserves



ORD reduces incentives for market power



Review of Existing ISO Market Mechanisms Stakeholder Feedback

Are there any areas covered today requiring additional context?

We will be sending a SurveyMonkey to those in attendance to capture/address additional needs for information timely as well

PFE CAISO Drafted Problem Statements

Stakeholder Discussion on CAISO drafted Problem Statements

Working Group #7

October 25, 2023

Problem Statement #1
Scarcity Pricing

The Scarcity Reserve Demand Curve applies inconsistently in the real-time market.

- Market impacts: real-time market energy and reserve prices do not consistently incorporate the scarcity value of reserves and thus do not consistently reflect short term operating conditions

Problem Statement #2
Scarcity Pricing

Current mechanisms to allow market prices to rise in advance of reserve shortage conditions are insufficient

- Market impacts: Insufficient time for market participants to respond to and resolve impending shortages; results in wild swings in RTM prices rather than gradual rise and fall, which creates a confusing and unpredictable price signal

Problem Statement #3
Scarcity Pricing

Administrative penalty prices may be out-of-date in context of tighter supply across the West.

- Market impacts: In tight system conditions, suppliers may have opportunities to engage in more profitable transactions outside the CAISO market, reducing the supply available to the market to resolve shortages across the WEIM

Problem Statement #4
Scarcity Pricing

Market lacks mechanisms to ensure appropriate prices during emergency events such as activation of non-market demand response, strategic reserve resources, and curtailed demand.

- Market impacts: The market may not associate emergency prices with the activation of emergency resources and, as a last resort, demand curtailment. This means the market price signal may not reflect short term operational conditions.

Problem Statement #5
BAA-Level MPM

The Dynamic Competitive Path Assessment tests BAAs in isolation and does not consider external available supply.

Market impacts: Increase resilience against potential over-mitigation (frequency) of WEIM BAAs

Problem Statement #6
BAA-Level MPM

The DCPA does not apply to the CAISO BAA and is always considered "competitive"

Market impacts: May lead to under-mitigation in the CAISO and to WEIM areas during conditions where the CAISO BAA is not itself structurally competitive.

Next steps

Revise Working Group schedule

- To be posted to initiative page
- Prepare presentations on scope items

Upcoming PFE Working Group Sessions

- Upcoming Thematic Session – How to Reflect Value of Reliability
- More?

For reference

- Comments due for Working Group Session #6 is Nov 3.
- Visit initiative webpage for more information: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Price-formation-enhancements
- If you have any questions, please contact Brenda Corona at bcorona@caiso.com or isostakeholderaffairs@caiso.com

- *Energy Matters* blog provides timely insights into ISO grid and market operations as well as other industry-related news

http://www.caiso.com/about/Pages/Blog/default.aspx.

Read a recent article featured in the blog:

October 10, 2023

Leadership, Markets, Operations, Transmission

Working with stakeholders toward a "significantly reformed interconnection process"

By Danielle Osborn Mills Principal, Infrastructure Policy Development

Since working with stakeholders to identify the best ways to address overheated interconnection queues in 2022 and 2023, the California Independent System Operator (ISO) recently released its new Straw Proposal designed to greatly improve the overall efficiency ...

READ MORE

- Subscribe to Energy Matters blog monthly summary