Price Formation Enhancements

Technical Workshop #2

12/16/2022

Housekeeping reminders

- This call is being recorded for informational and convenience purposes only. Any related transcriptions should not be reprinted without ISO's permission.
- Meeting is structured to stimulate dialogue and engage different perspectives.
- Please keep comments professional and respectful.
- Please try and be brief and refrain from repeating what has already been said so that we can manage the time efficiently.

Instructions for raising your hand to ask a question

- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon  located on the top right above the chat window. Note: #2 only works if you dialed into the meeting.
  - Please remember to state your name and affiliation before making your comment.
  - If you need technical assistance during the meeting please send a chat to the event producer.
  - You may also send your questions via chat to **Brenda Corona** or to all panelists.

CAISO Policy Initiative Stakeholder Process

We are here

Agenda

Time	Topic
1:00 – 1:05	Welcome and stakeholder process
1:05 – 1:15	Workshop #2
1:15 – 1:45	Fast Start Pricing
1:45 – 2:15	Examples
2:15 – 2:50	Other Stakeholder Suggested Proposals
2:50 – 3:00	Next Steps

Workshop #2 planned discussion

- Expand examples to discuss fast-start pricing elements
- **Disclaimer:** while this presentation discusses implementation of fast-start pricing, that does not mean that CAISO has made the decision to do so.
- Workshop #3 will expand examples to include multi-interval dispatch and flexible ramping product

Why fast-start pricing?

FERC NOPR (12/30/2016)

- *"Fast-start resources are unique because they are often dispatched to their inflexible minimum or maximum operating limits, and are thus not eligible to set the locational marginal price (LMP)."*

- *"Fast-start resources are typically committed in real-time, very close to the interval when they are needed. As a result, the cost to commit these resources is incurred at roughly the same time the incremental energy costs are incurred, which raises the question of whether the commitment costs should be included in the LMP."*

- *"[Fast-start] pricing is designed generally to recognize that fast-start resources are, for all intents and purposes, the marginal resource used to meet the next increment of energy or operating reserves demand."*

Basic components of fast-start pricing

- Minimum output limit relaxation
  - Prices are set as though fast-start resources can be dispatched across their entire capacity range by reducing their minimum operating limits (Pmin) to 0. This makes it easier or possible for the resource to become the marginal generator and set the price.
- Inclusion of commitment costs in pricing
  - Marginal prices incorporate start-up and minimum load costs.

Additional considerations

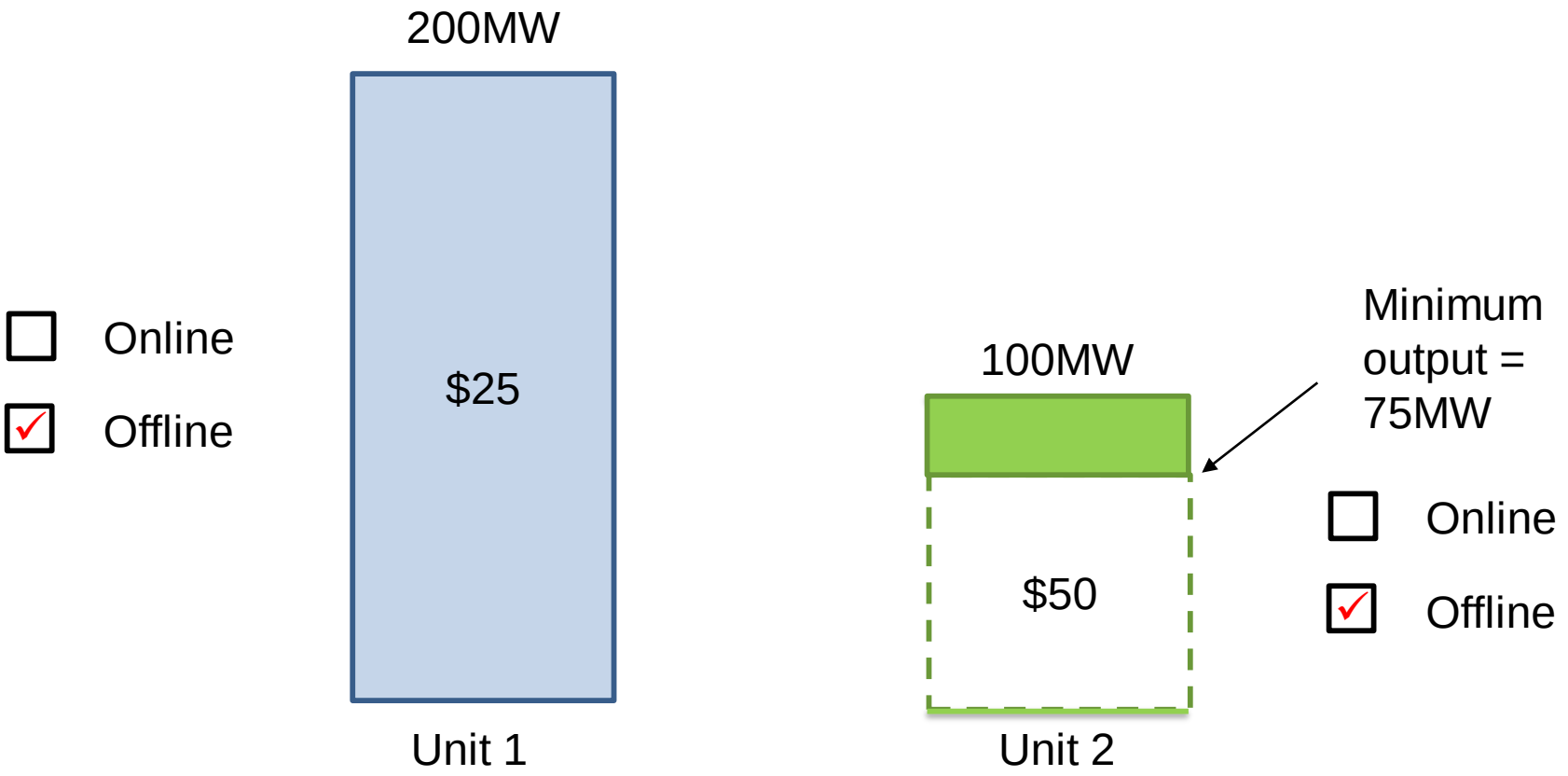
- Fast-start pricing requires that unit commitment/dispatch and pricing be determined through two separate market runs
  - CAISO market uses two processes, a **scheduling run** and a **pricing run**, to determine the awards (dispatches) and prices

- A fast-start resource's supply curve must be defined differently in the pricing run than the supply curve used in the scheduling run.
  - The modified supply curve must be monotonically non-decreasing
  - The cost of running the unit at its maximum output (Pmax) must be the same when using the modified supply curve as when using the actual supply curve. Otherwise, the market will have made the unit more or less expensive than it should be in the pricing run.

Examples

- Same generator assumptions as workshop #1
- Two generators (200MW baseload and 100MW peaker) serving 250MW of demand
  - Unit 2 will have economic minimum of 75MW throughout
- Assume offers reflect actual costs and no market power
- Start up time = 0 minutes

Example #1 – Status Quo
Demand = 250MW



How should we dispatch these units to serve 250MW of demand while minimizing production costs?

Example #1 – Status Quo
Demand = 250MW

Market needs to dispatch Unit 2 to its economic minimum in order to meet the demand. Unit 1 would serve the incremental demand and set the price at $25.

☑ Online
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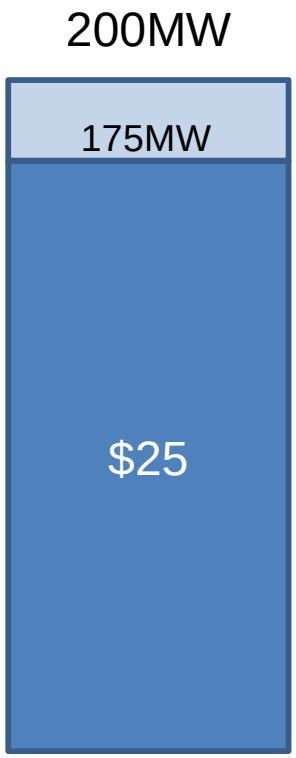

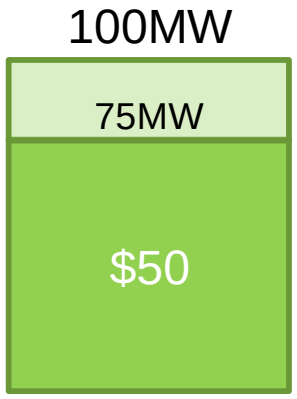

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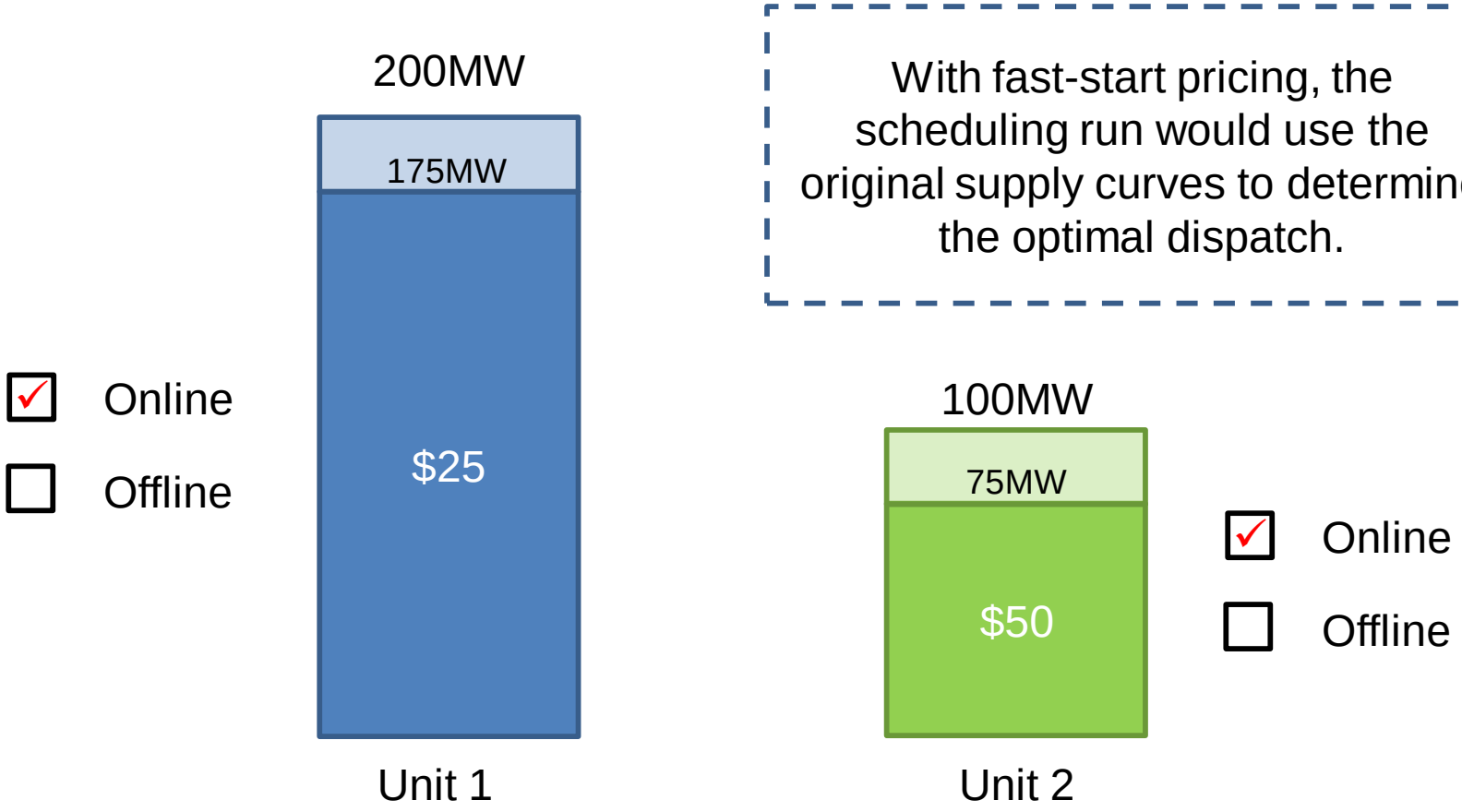
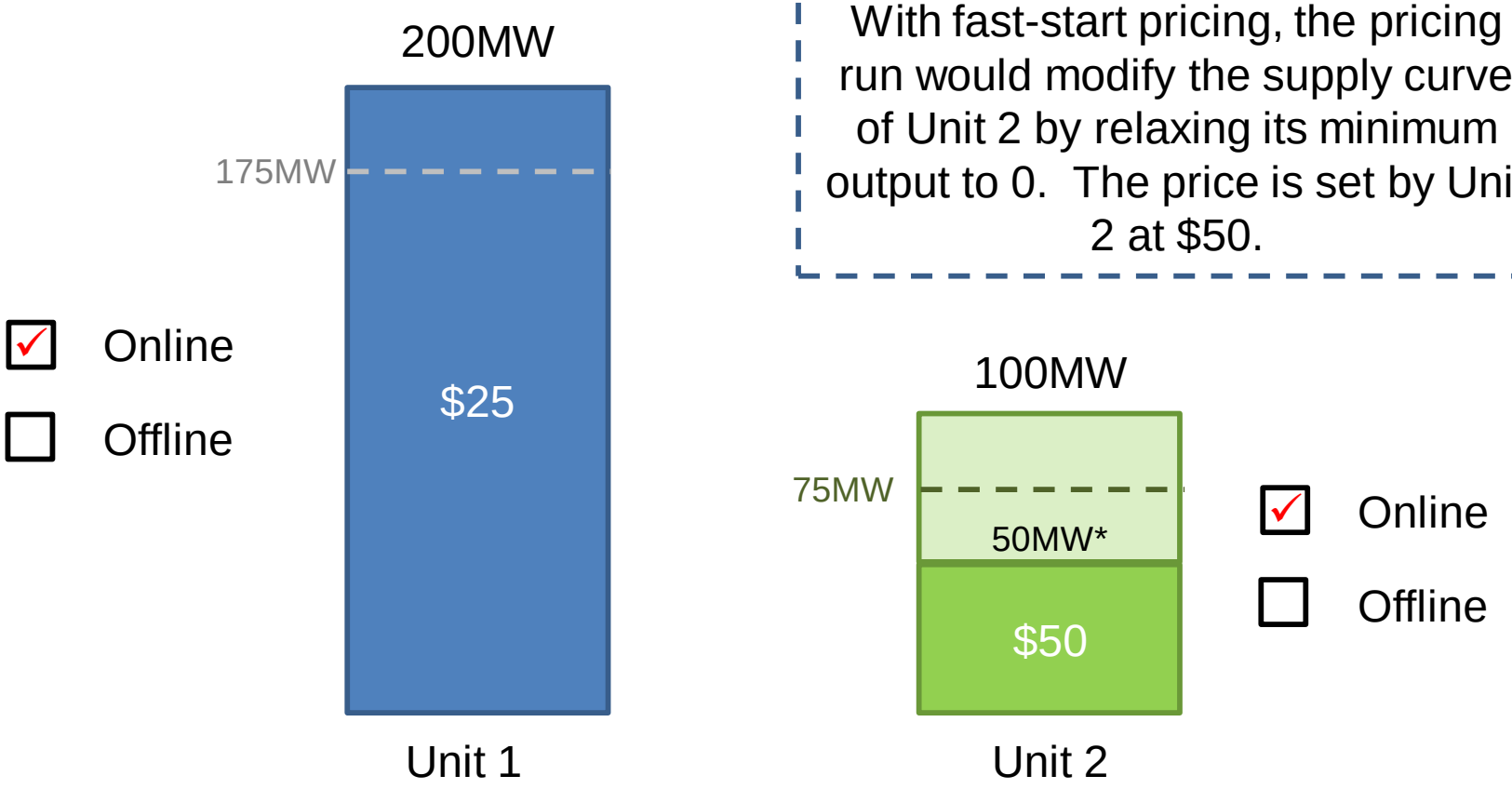
Example #1 – Minimum Output Relaxation (Scheduling Run) | Demand = 250MW



With fast-start pricing, the scheduling run would use the original supply curves to determine the optimal dispatch.

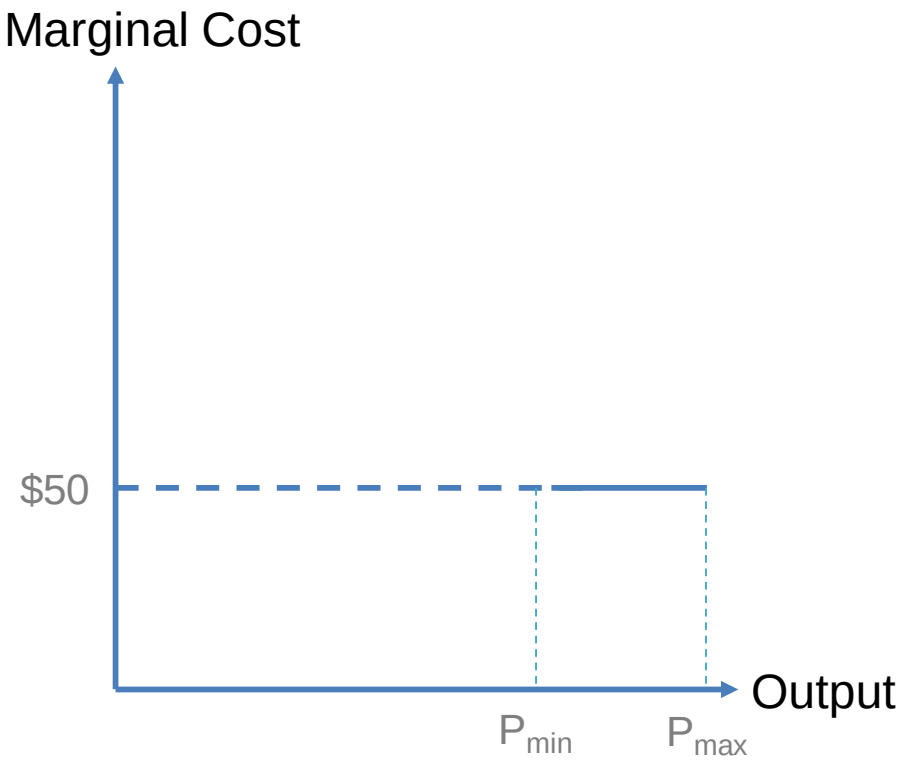
Example #1 – Minimum Output Relaxation (Pricing Run) | Demand = 250MW



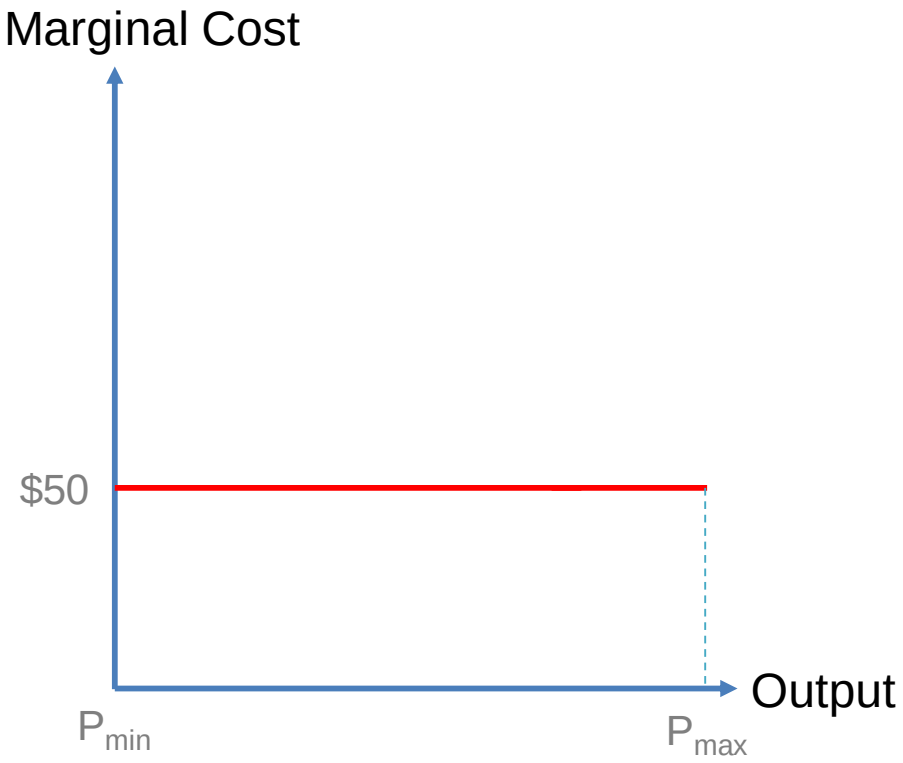
With fast-start pricing, the pricing run would modify the supply curve of Unit 2 by relaxing its minimum output to 0. The price is set by Unit 2 at $50.

*The dispatch quantities in the pricing run are not binding

Unit 2 Supply Curve

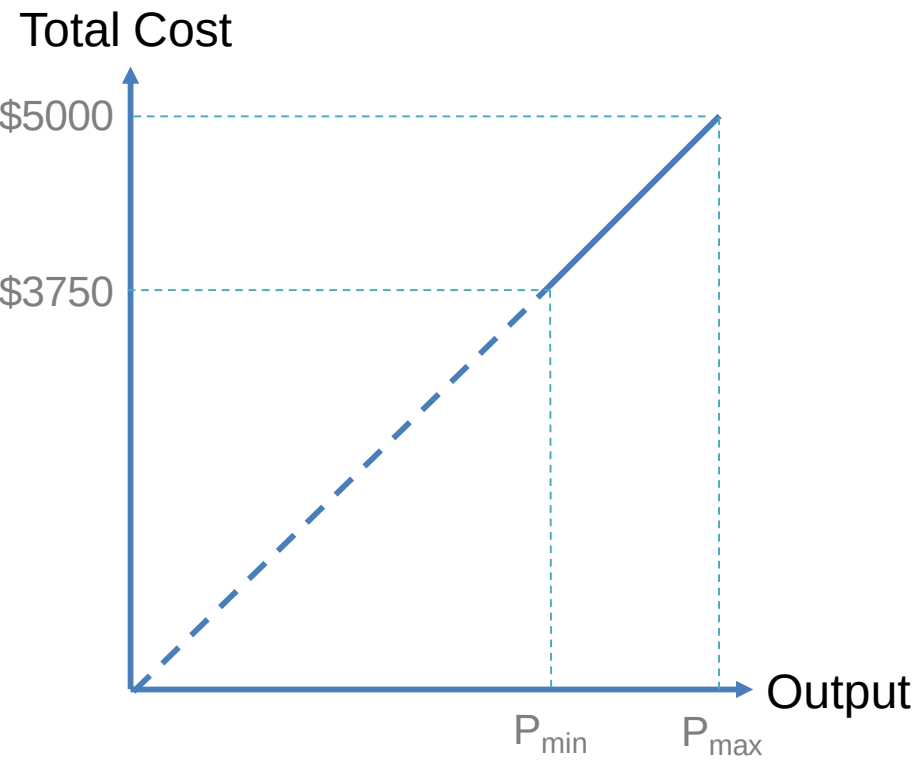


Scheduling Run

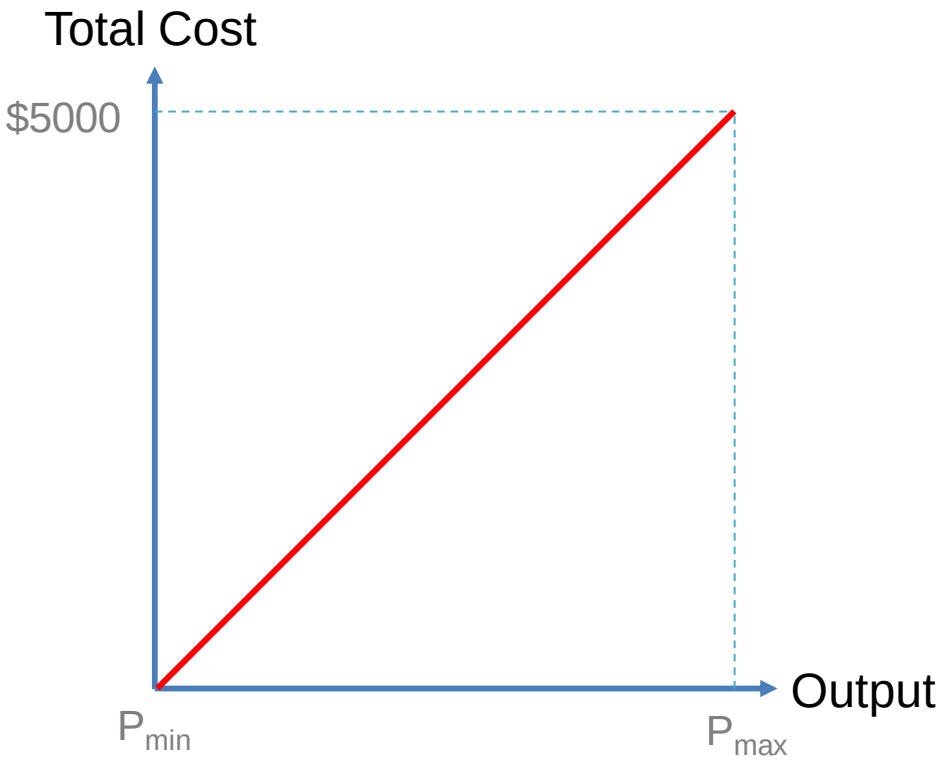


Pricing Run

Unit 2 Total Cost Curve



Scheduling Run



Pricing Run

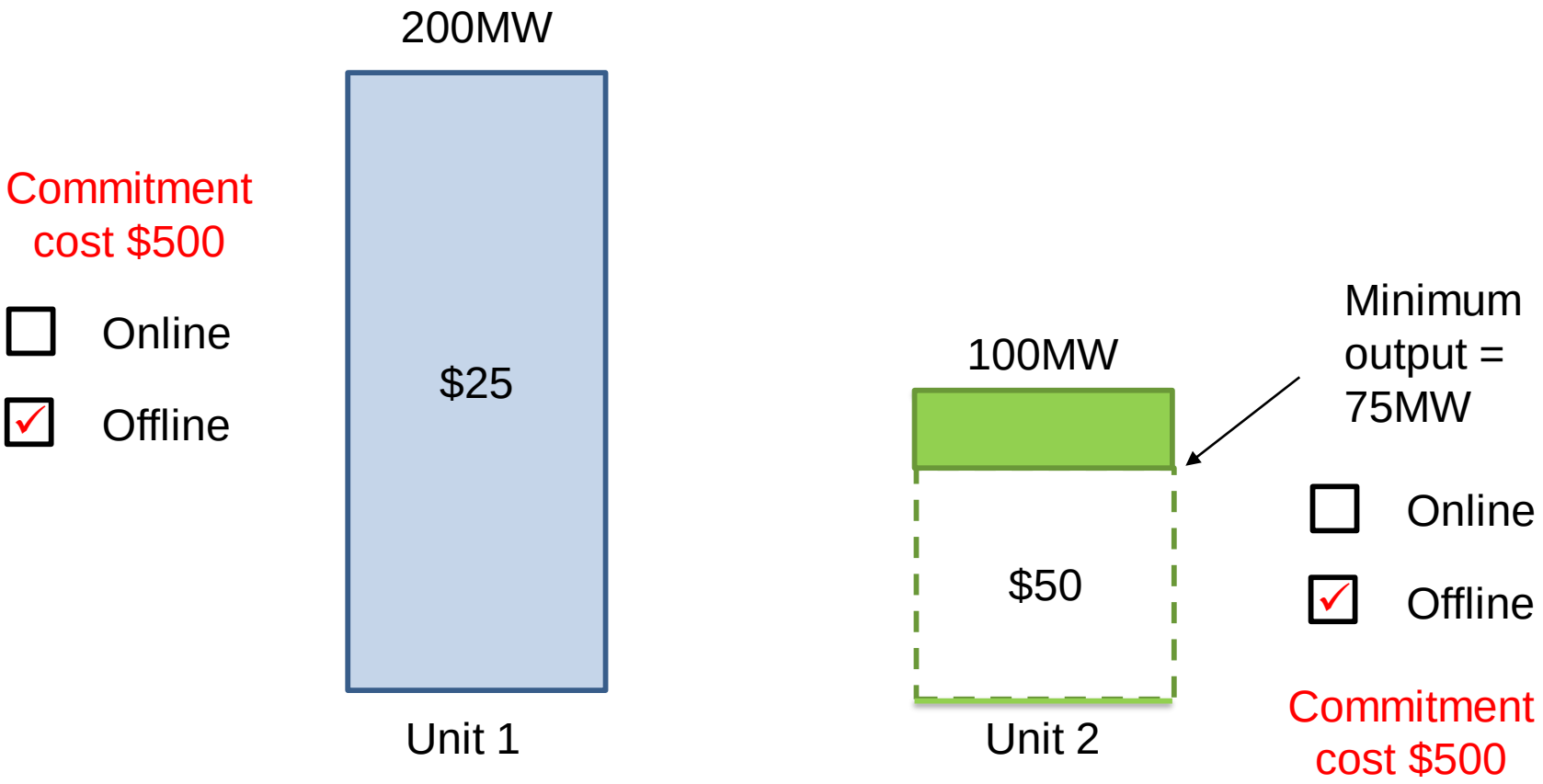
Principle #3: Prices should incentivize participants to follow their market schedules and dispatch

- When dispatch and pricing are determined through separate processes, generators may not have a price incentive to follow the dispatch signal.

- Unit 1 is dispatched to 175 MW, below its maximum capacity of 200 MW. Its marginal cost is $25/MWh, but the LMP is $50/MWh. It would be profitable for Unit 1 to ignore the market dispatch and produce at 200 MW.

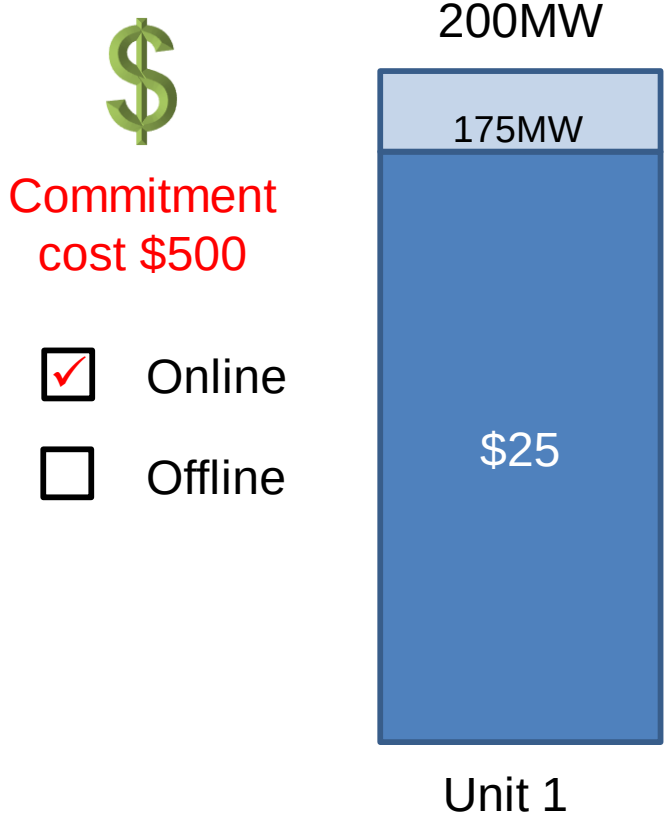
- Fast-start pricing requires opportunity costs payments or financial penalties to incentivize generators not to deviate from their dispatch.
  - Payments are typically based on opportunity cost. For Unit 1, this would be 25 MW * ($50/MWh - $25/MWh) = $625.

Example #2 – Status Quo
Demand = 250MW

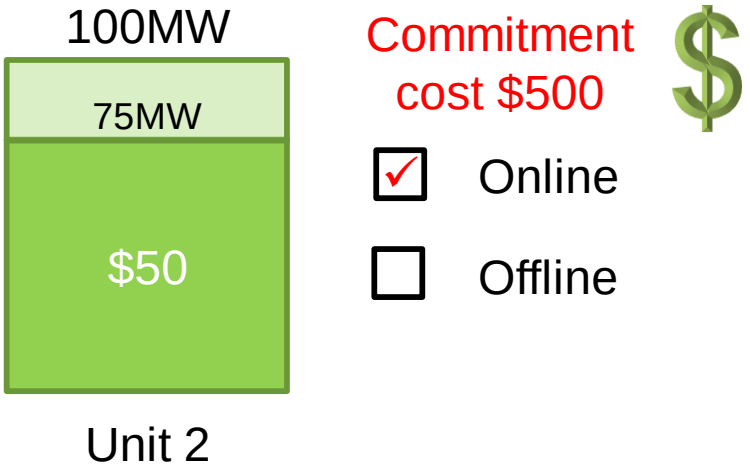


How should we dispatch these units to serve 250MW of demand while minimizing production costs?

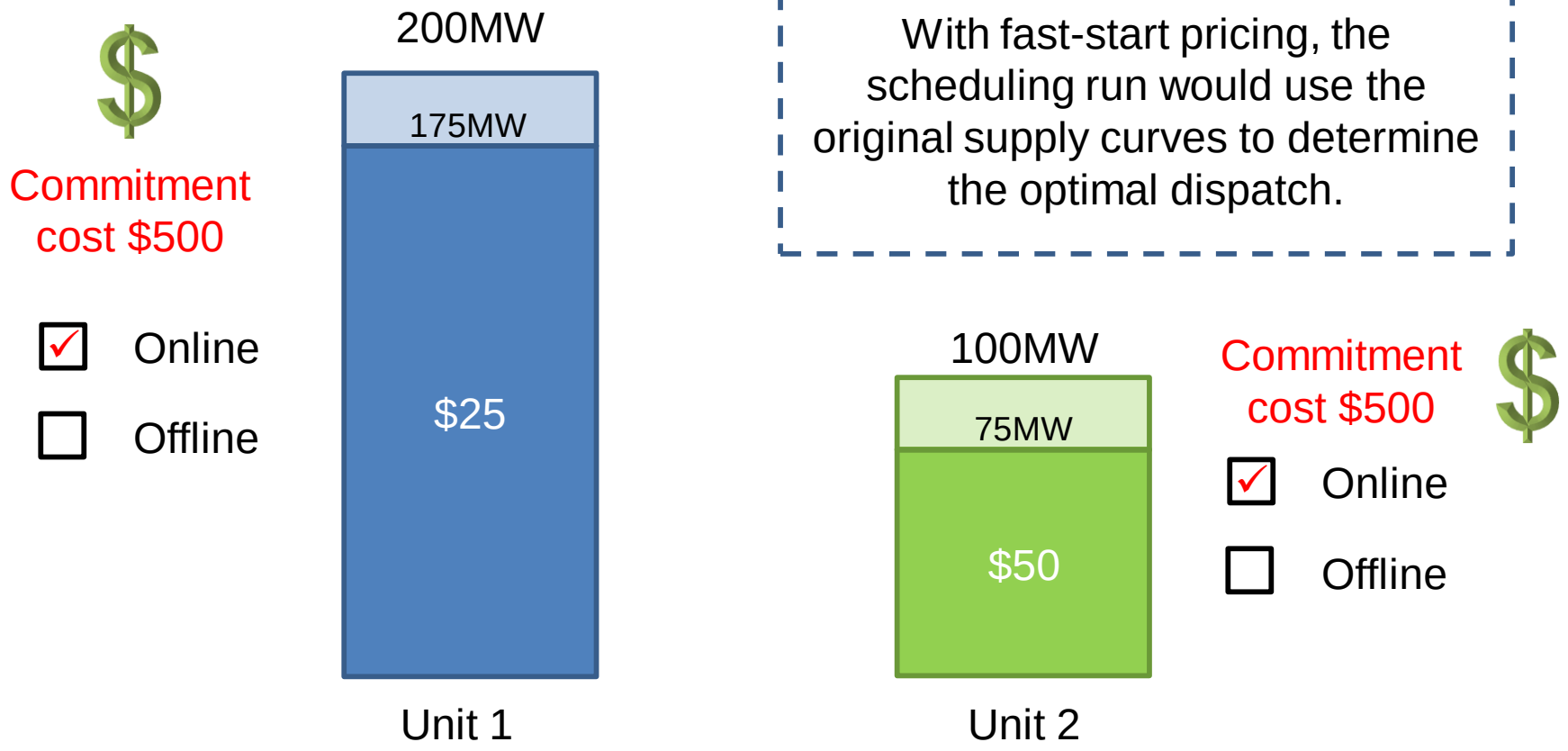
Example #2 – Status Quo
Demand = 250MW



Market needs to dispatch Unit 2 to its economic minimum in order to meet the demand. Unit 1 would serve the incremental demand and set the price at $25. Commitment costs do not factor into the price.

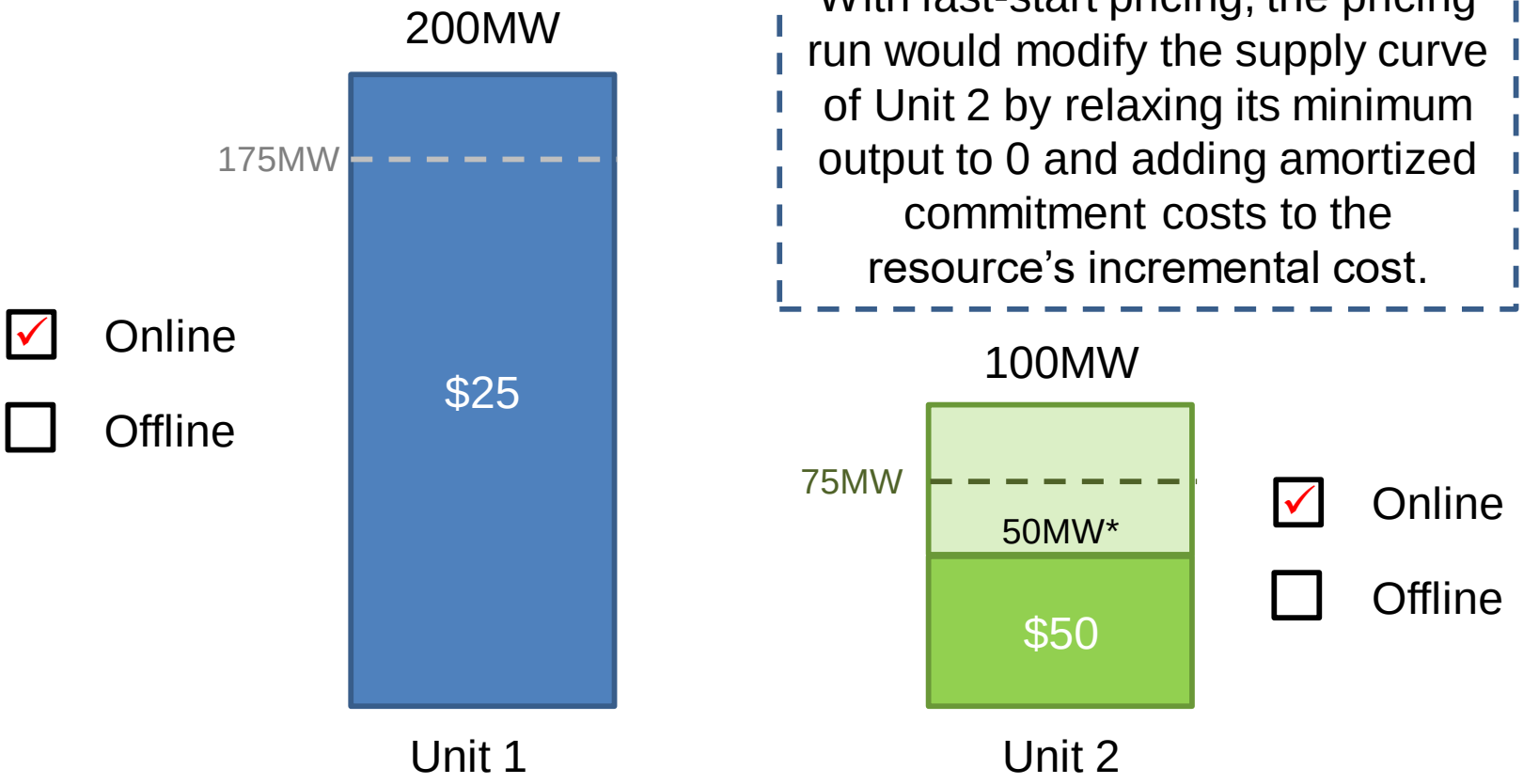


Example #2 – Minimum Output Relaxation and Inclusion of Commitment Costs (Scheduling Run) Demand = 250MW



Example #2 – Minimum Output Relaxation and Inclusion of Commitment Costs (Pricing Run) Demand = 250MW

With fast-start pricing, the pricing run would modify the supply curve of Unit 2 by relaxing its minimum output to 0 and adding amortized commitment costs to the resource's incremental cost.



*The dispatch quantities in the pricing run are not binding

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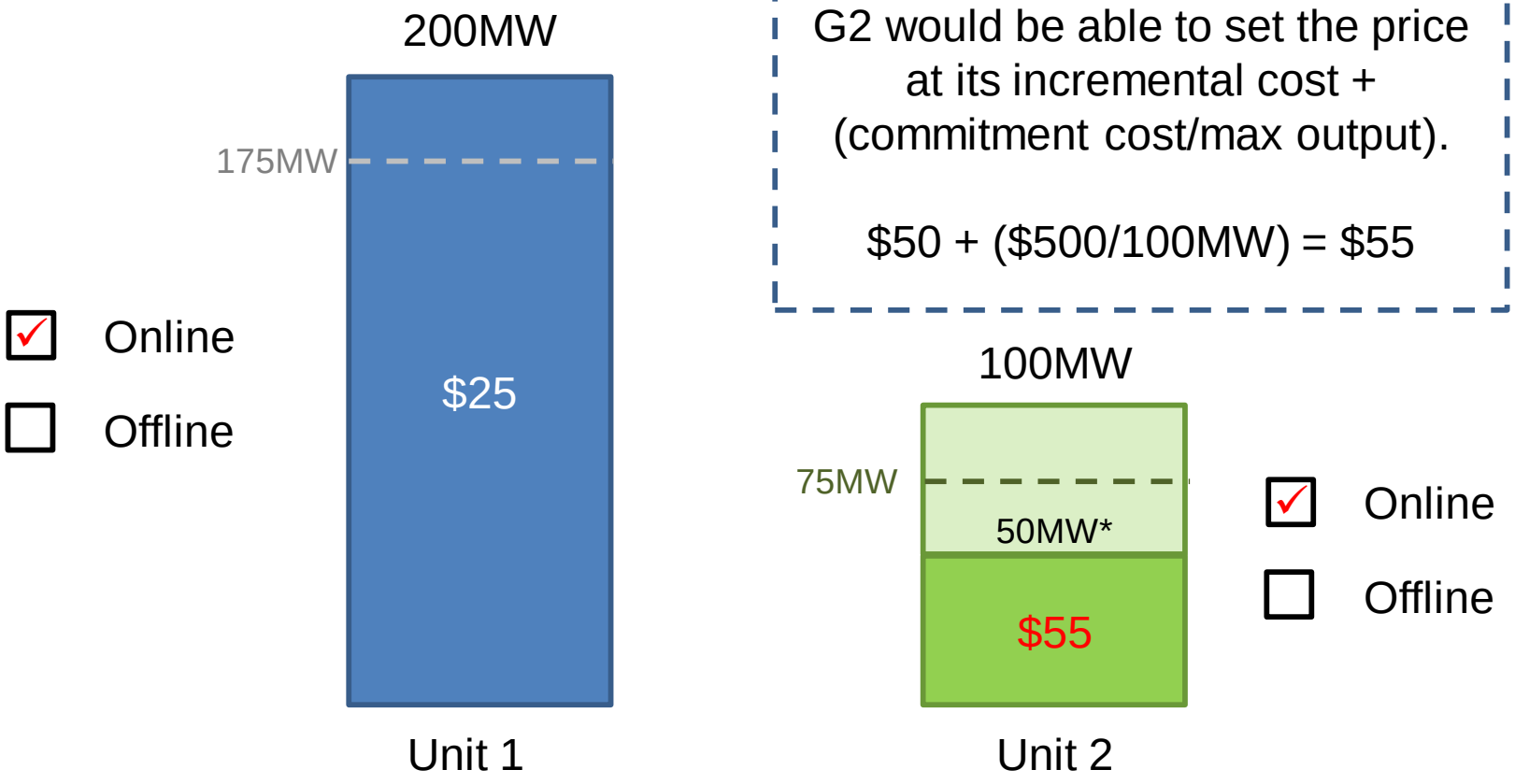

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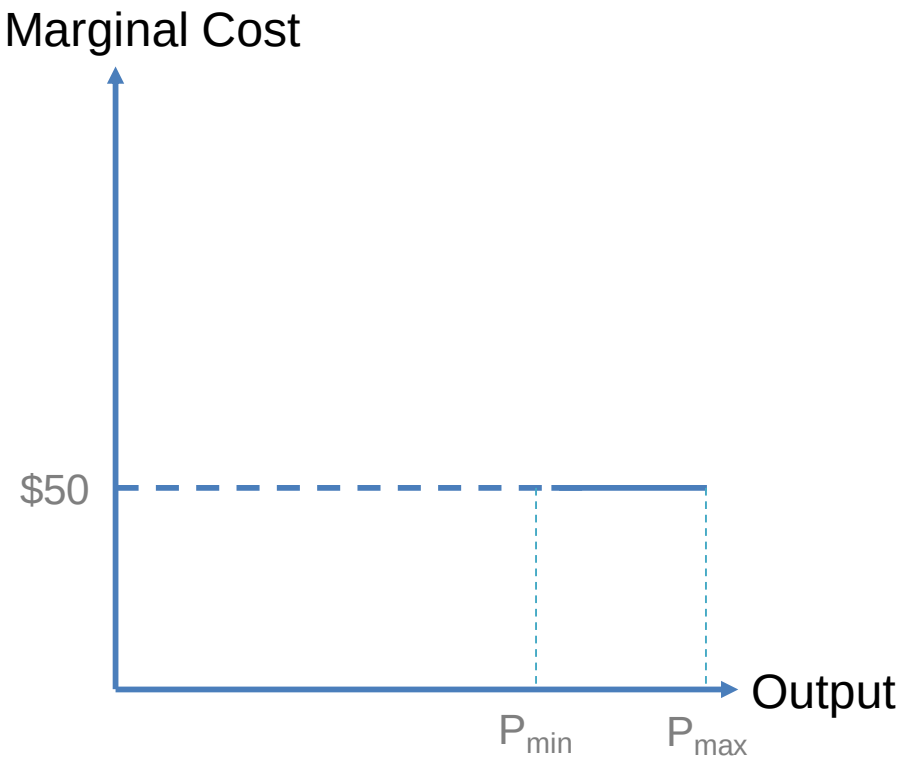
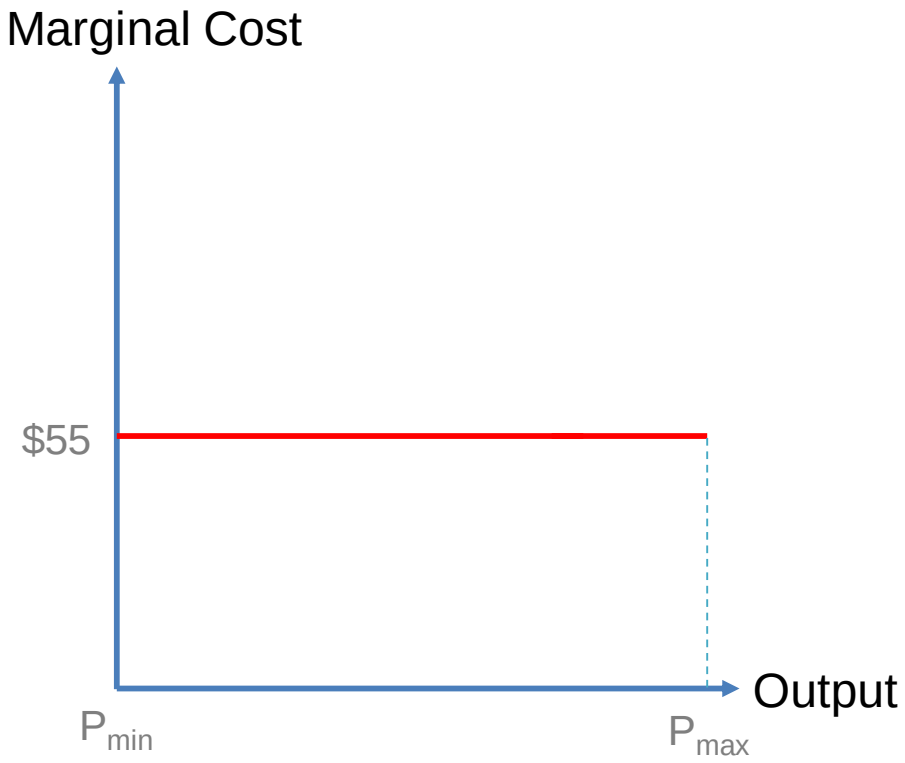
Unit 2 Supply Curve

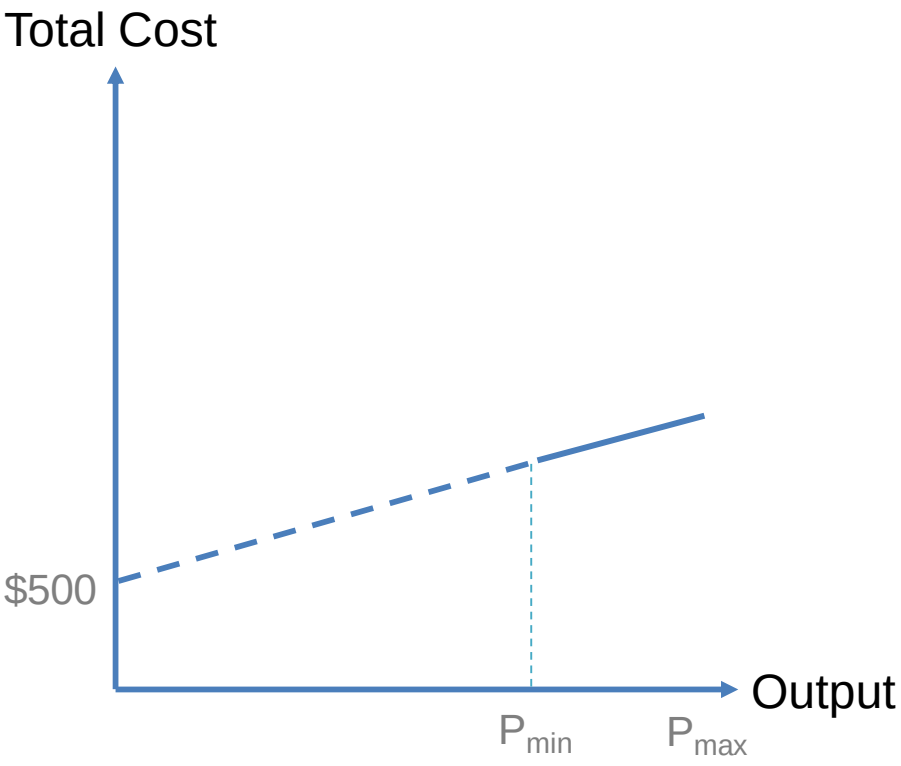


Scheduling Run

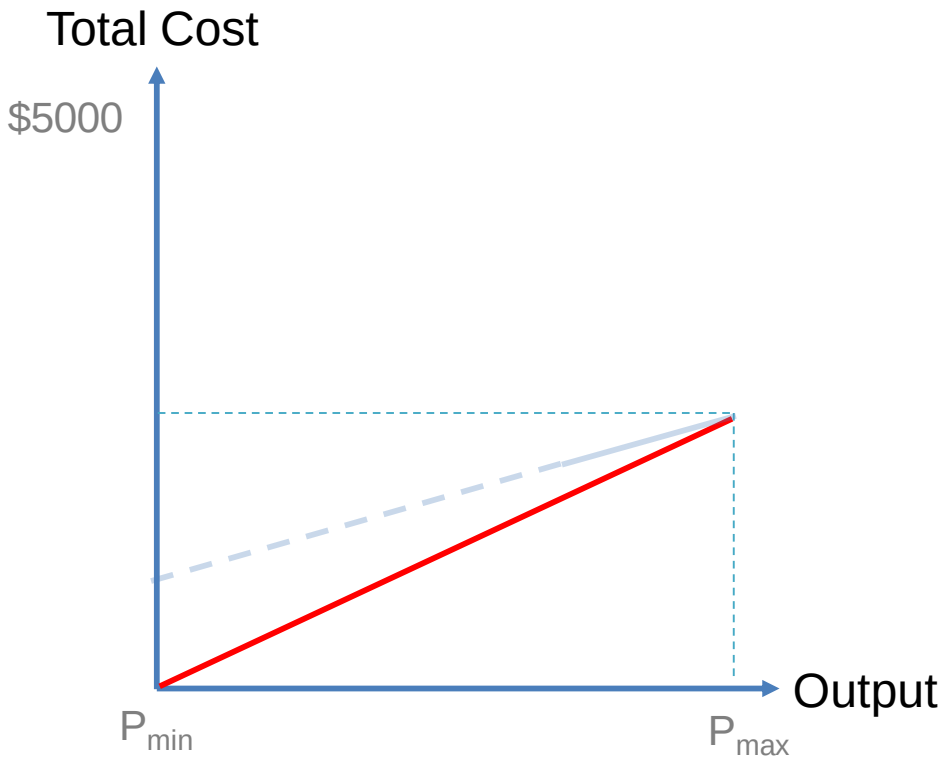


Pricing Run

Unit 2 Total Cost Curve



Scheduling Run



Pricing Run

Additional thoughts – Example #2

- Remember that *"the cost to commit these resources is incurred at roughly the same time the incremental energy costs are incurred, which raises the question of whether the commitment costs should be included in the LMP."*

- These examples assume Unit 2 is an eligible fast-start resource. Depending on the ISO's definition of fast-start resource, either one, both, or neither of the units in the example may be modeled differently for pricing purposes.

- How long do commitment costs remain in LMP price signal?

NEXT STEPS

Next Steps

- Visit initiative webpage for more information: California ISO - Price Formation Enhancements (caiso.com)

- If you have any questions, please contact isostakeholderaffairs@caiso.com