FERC Docket EL18-34-000
Fast-Start Resources

Anthony Giacomoni

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Session Objectives

- Review motivation for the FERC Order regarding fast-start resources
- Review PJM's current special-pricing treatment
- Review other ISO/RTO special-pricing treatments for fast-start resources
- Review an example of other ISO/RTO special-pricing treatment for fast-start resources
- Review PJM's proposed response to the FERC Order

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What Is a Fast-Start Resource?

Fast-start resources can start up quickly and typically have shorter minimum run times than other resources.

Definitions of fast-start resources vary across ISOs/RTOs

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History of the FERC Fast-Start NOPR

Context: Operating characteristics of fast-start resources prevent them from setting price.

Requested Action: In 2016, the FERC asked PJM to improve price formation by:

- Enabling fast-start resources to set price more often
- Reflecting the cost of fast-start deployment through transparent price signals

Motivation

Fast-start pricing can improve performance incentives for all resources during tight system conditions.

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FERC Docket EL18-34-000

- FERC withdrew the 2016 fast-start pricing NOPR
- Requested PJM to investigate revising its Tariff to:
  1) Allow full economic minimum relaxation for fast-start resources
  2) Expand the units eligible for special pricing treatment to all fast-start resources
  3) Consider fast-start resources within dispatch in a way that minimizes production cost
  4) Allow fast-start resource commitment costs to be reflected in prices
  5) Include a minimum run time and start-up time requirement in the definition of a fast-start resource

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PJM Combustion Turbine Special-Pricing Treatment

Combustion turbines are usually offered as inflexible (i.e., block-loaded, where economic minimum = economic maximum). This means they cannot set price naturally

- For block-loaded combustion turbines that are eligible to set price, relax their economic minimum by a specific factor (currently 0.8)
- The wider the relaxed dispatchable range, the better chance a resource has to set price.
  - But with a wider dispatchable range, the dispatch solution may be far below its economic minimum.

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History of PJM Combustion Turbine Special-Pricing Treatment

- Special-pricing treatment was implemented over 12 years ago to allow block-loaded combustion turbine resources to set price.
- Relaxation factor was set to 0.9 until last year, when it was decreased to 0.8.

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Shortcomings of Current Methodology

- Combustion turbines are generally unable to set price even though they are committed and dispatched economically.
- Relaxing economic minimum values in the dispatch solution distorts the system energy balance and can lead to inefficient system dispatch.
- Distortions must be managed by regulation at potentially higher cost than a balanced energy dispatch.

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How Do Other ISOs/RTOs Treat Fast-Start Resources?

- Each ISO/RTO considers start-up and no-load costs in its commitment process for fast-start resources.
- However, treatment of fast-start resource start-up and no-load costs varies among ISOs/RTOs in the dispatch and pricing processes.

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CAISO Fast-Start Resources

- Special pricing treatment for committed Constrained Output Generators
- Resource must elect constrained output generator status (currently, this option is rarely used)
- For a committed constrained output generator:
  - **Day-Ahead Market:** Economic minimum is relaxed to 0 in the dispatch and pricing processes.
  - **Real-Time Market:** Economic minimum is relaxed to 0 only in the pricing process.

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CAISO Fast-Start Resources

Committed constrained output generator's submitted energy offer is replaced by a calculated energy bid:

- For dispatch range between 0 and economic minimum:

Calculated energy bid = minimum load cost/economic minimum

- For the 0.01 MW between economic minimum and economic maximum:

Calculated energy bid = max{submitted bid price, minimum load cost/economic minimum}

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ISO New England Fast-Start Resources

- Special pricing treatment for fast-start resources in real-time market only
  - Resources with start-up times that do not exceed 30 minutes
- Separate dispatch and pricing runs
  - Dispatch run: no changes are made to resource offers.
  - Pricing run: fast-start resource economic minimums are relaxed to 0.
    - Start-up costs are amortized over economic maximum and minimum run time and added into energy offers.
    - No-load costs are amortized over economic maximum and added into energy offers for all online hours.
- Lost opportunity cost paid when dispatch signals are not profit maximizing

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MISO Fast-Start Resources

- Special pricing treatment for resources with start-up times that do not exceed 30 minutes
- Separate runs for dispatch and pricing:
  - Committed fast-start resources are **qualified** for special pricing treatment.
  - Not-committed fast-start resources:
    - If they can relieve transmission, energy or reserve constraint violations, **qualified** for special pricing treatment
    - Otherwise, **not qualified** (output fixed at 0 MW in pricing)
  - Slow-start resources **not qualified** for special pricing treatment

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MISO Fast-Start Resources

- In pricing run, **qualified** fast-start resources are allowed to be partially committed (integer relaxation).
  - Economic minimums are relaxed to 0 MW.
  - Commitment costs are amortized over economic maximum and added to energy offers for both **qualified** committed and not-committed resources.

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NYISO Fast-Start Resources

- Special pricing treatment for block-loaded resources (mostly gas-turbines)
- Separate runs for dispatch and pricing

Note: NYISO also received an order regarding fast-start resources from FERC

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Dispatch run: Determines dispatch signals sent to resources

- Committed block-loaded resources output fixed at economic maximum
- Not-committed (offline) resources:
  - 10-minute resources with capacity less than or equal to 80 MW — economic minimum relaxed to 0 MW
  - All other resources — output fixed at 0 MW

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Pricing run – determines energy and reserve prices

- Committed block-loaded resources:
  - Economic minimums are relaxed to zero — may set price.
  - Commitment costs (start-up and no-load) are not considered.
- Not-committed 10-min. resources with capacity not exceeding 80 MW are **qualified** for price setting.
  - Economic minimums are relaxed to zero — may set price.
  - Commitment costs are amortized over economic maximum and added into energy offers.

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ISO/RTO Fast-Start Pricing Summary

	PJM	CAISO	ISO-NE	MISO	NYISO
Separate Pricing and Dispatch Runs			●	●	●
Economic Minimum Relaxation	○	●	●	●	●
Includes Start-up and No-Load Costs		○	●	●	○

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OTHER ISO/RTO FAST-START PRICING EXAMPLES

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Approximate Extended Locational Marginal Pricing

- Currently, both ISO New England and MISO use different forms of Approximate Extended Locational Marginal Pricing for fast-start resources
- Run separate dispatch and pricing runs

Note: Approximate Extended Locational Marginal Pricing is the term MISO uses to describe its pricing methodology. ISO New England does not use this terminology.

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Separate Dispatch and Pricing Runs

Dispatch Run

- Make no modifications to resource parameters
- Determine desired dispatch points
- Do not calculate prices

Pricing Run

- Modify resource parameters
- Calculate prices

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Example #1a – ISO New England

- Load equals 365 MW
- **Policy:** Offline resources **do not** participate in pricing
- **Policy:** Fixed costs (start-up and no-load) are considered in setting the price.
- Assume all resources are eligible for fast-start pricing treatment

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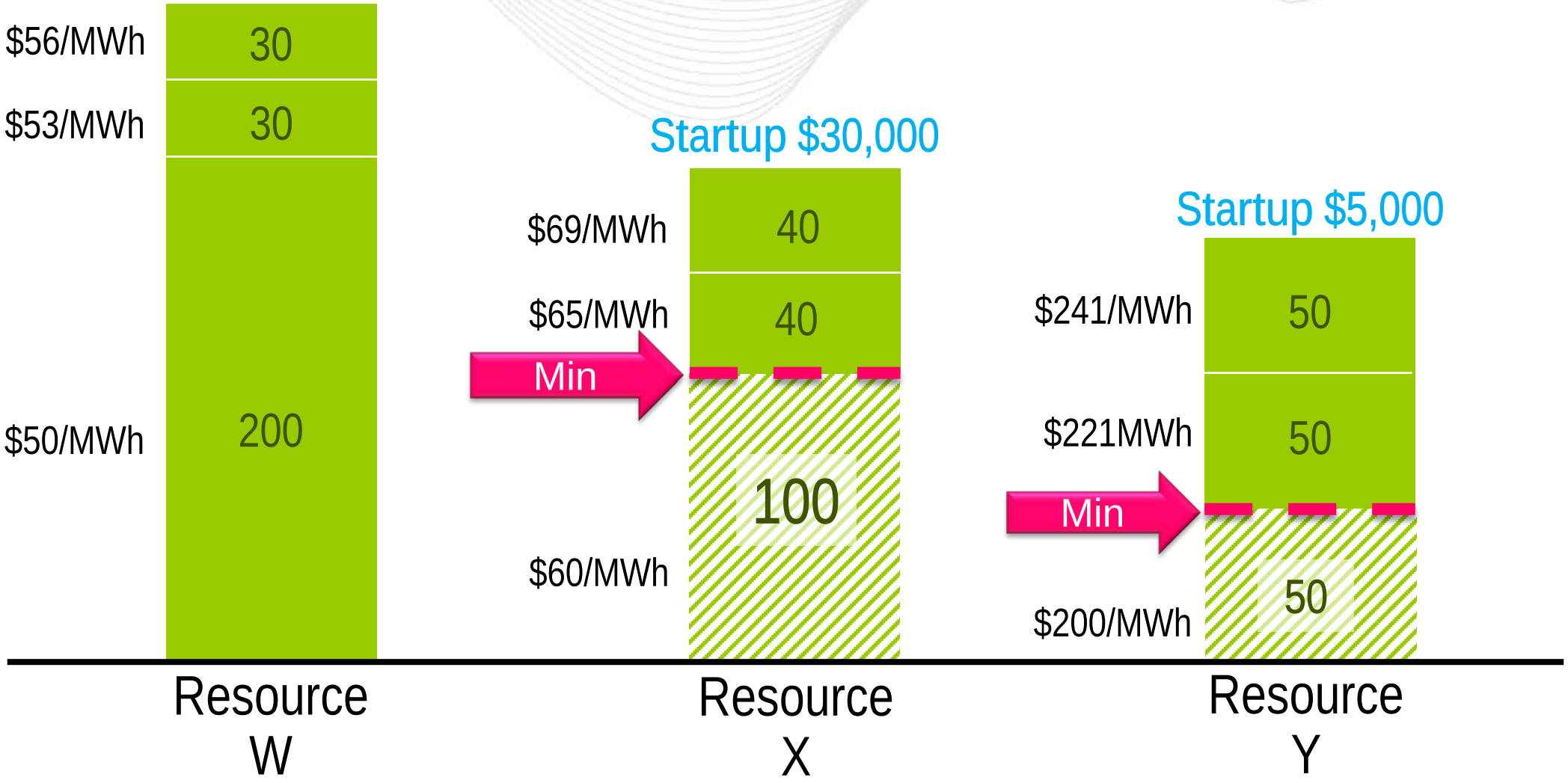
Example #1a: Offer Blocks (MW) & Fixed Costs

Any resource that is "committed" must run at least at its minimum



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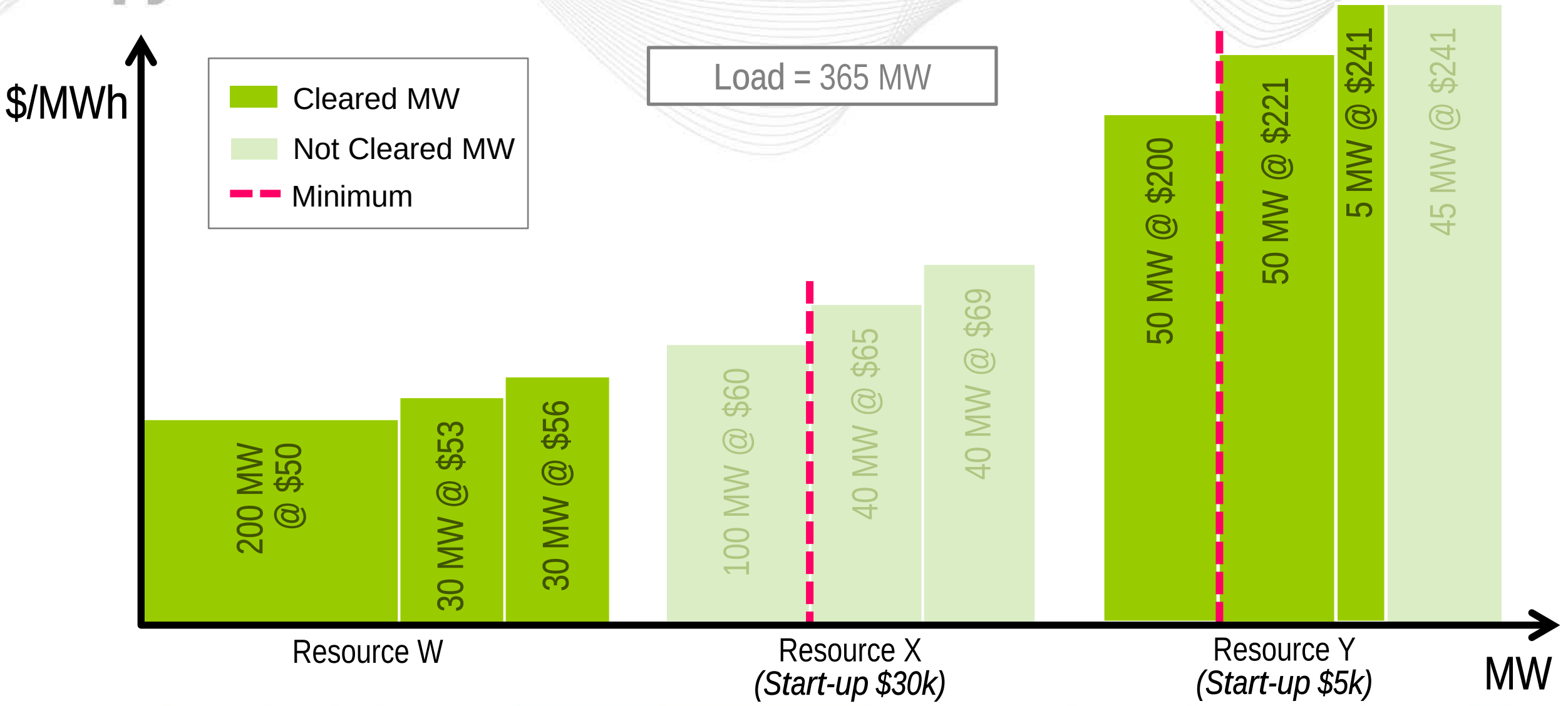
The Commitment and Dispatch Run: Example #1a



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Pricing Run Offer Modifications for Example #1a

- Offline resource X **does not** participate in pricing.
- Relax economic minimums to 0 for pricing calculations:
  - Minimum generation level of Y is relaxed to 0 for pricing calculations.
- Start-up cost of Y is proportionally distributed to its MW.
  - The bid blocks of Resource Y can be equivalently modified to incorporate the proportional start-up costs.

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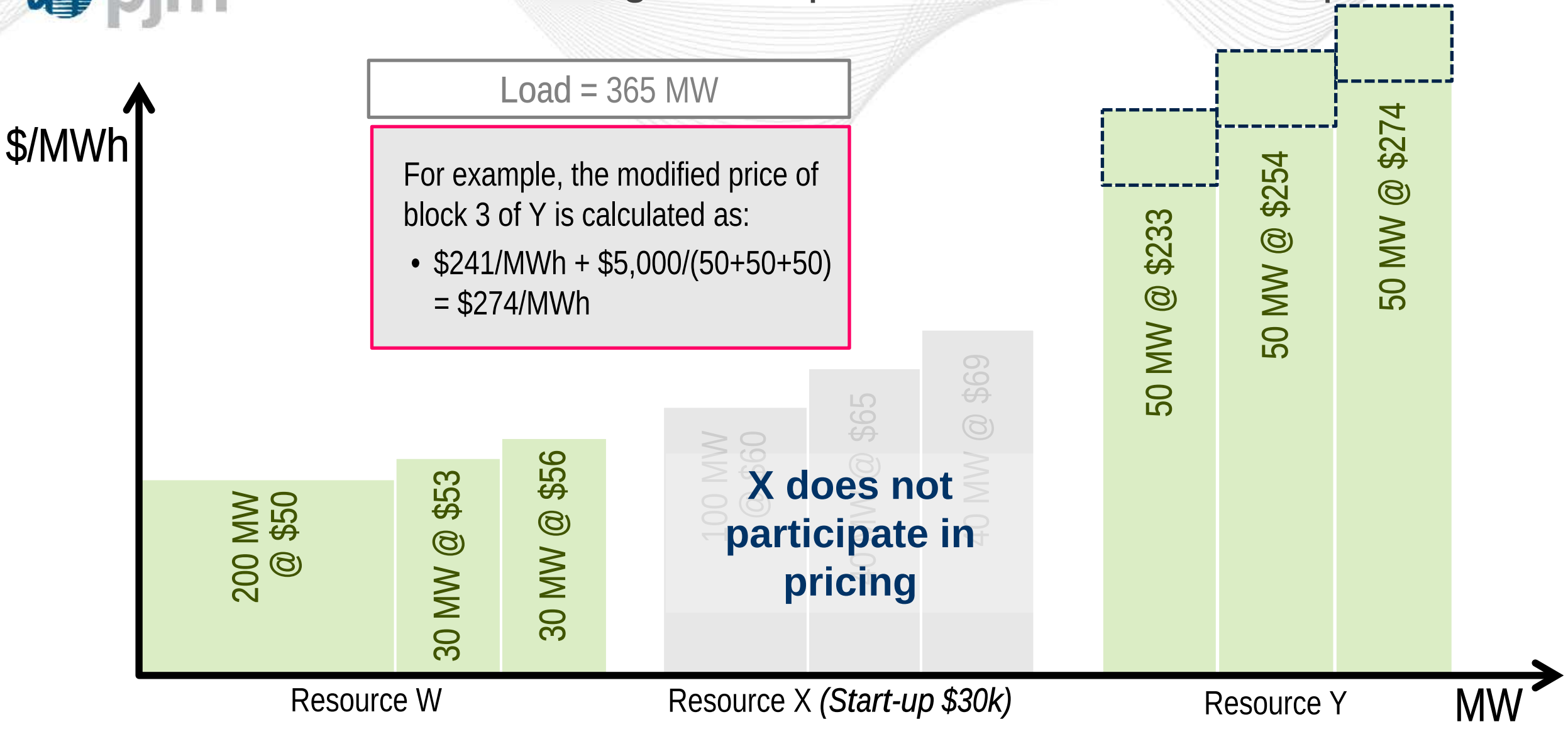
Pricing Run Equivalent Offers for Example #1a

Load = 365 MW

For example, the modified price of block 3 of Y is calculated as:

- $241/MWh + $5,000/(50+50+50) = $274/MWh



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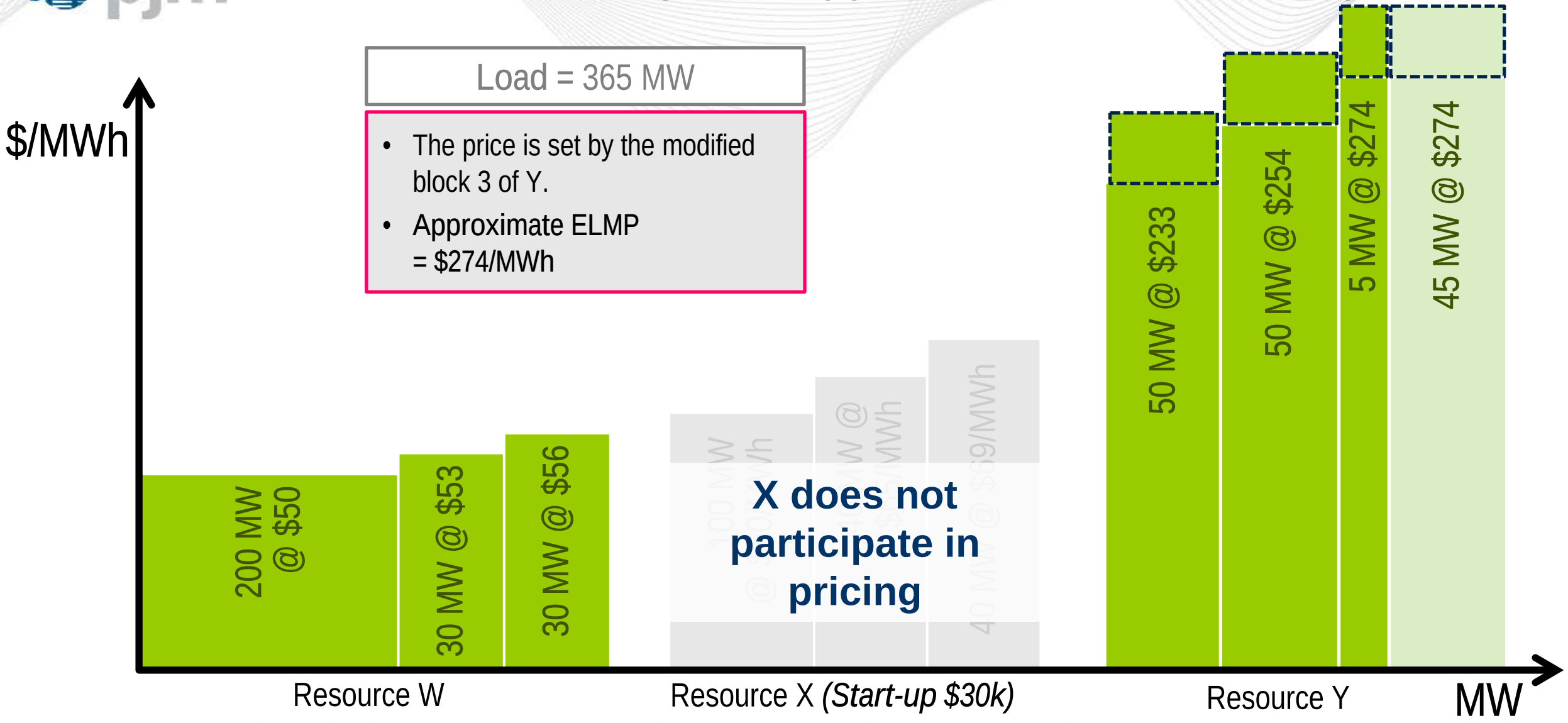
Pricing Run Approximate ELMP: Example #1a

Load = 365 MW

- The price is set by the modified block 3 of Y.
- Approximate ELMP = $274/MWh



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Approximate ELMP Pricing and Settlement: Example #1a

The **Approximate ELMP** is calculated at **$274/MWh.**

Asset	Commit.	Dispatch (MW)	Total Offer Cost ($)	Payment ($)	MWP ($)	LOC ($)
W	On	260	13,270	71,240	0	0
X	Off	0	0	0	0	7,960*
Y	On	105	27,255	28,770	0	1,485

Uplift = $9,445 in this example

**Note: ISO New England does not pay LOC to offline resources.*

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Example #1b – MISO

- **New Policy:** Offline resources **do** participate in pricing.
- MISO allows offline resources that meet certain eligibility requirements to participate in pricing. Assume resource X is eligible to set price.
- **Policy:** Fixed costs (start-up and no-load) are considered in setting the price.
- Relax economic minimums to 0 for pricing calculations

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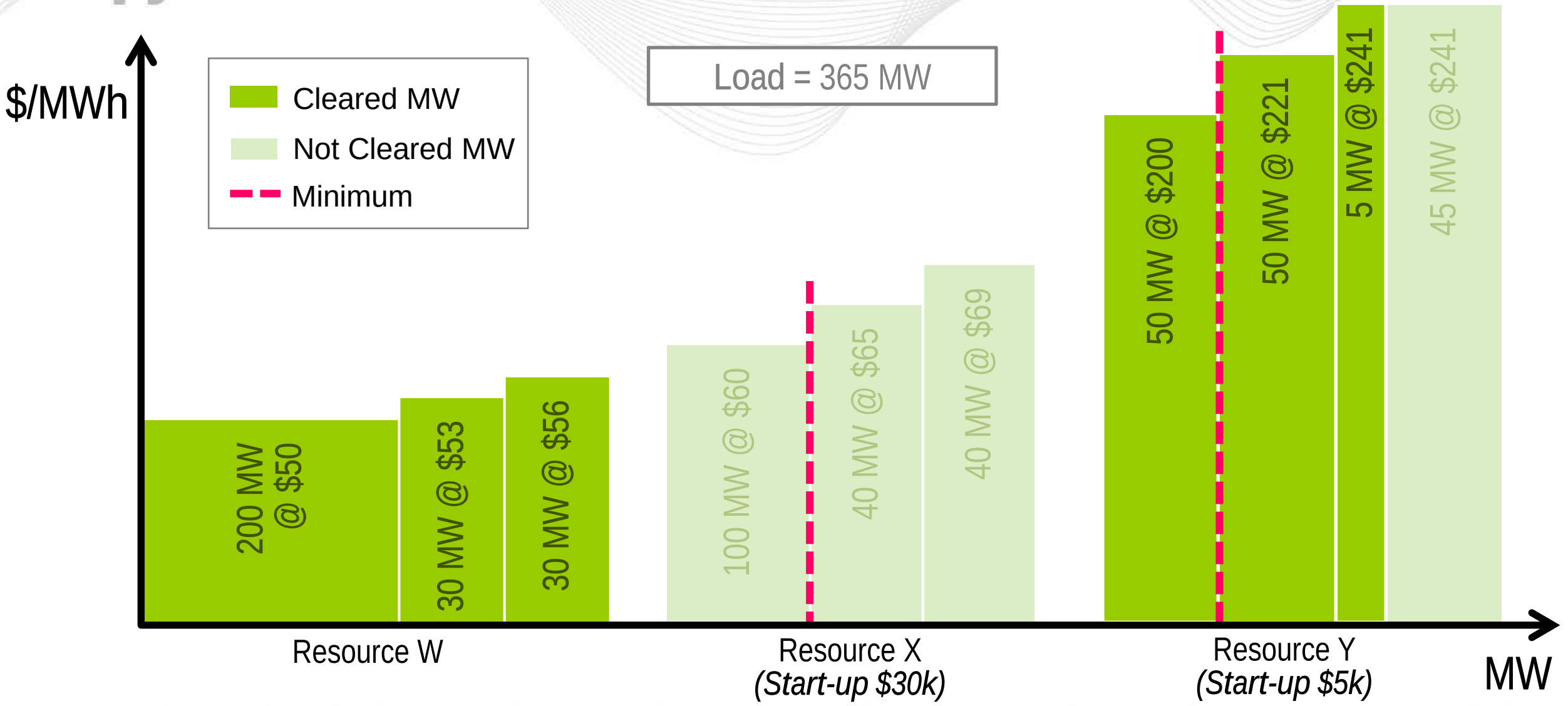
The Commitment and Dispatch Run: Example #1b



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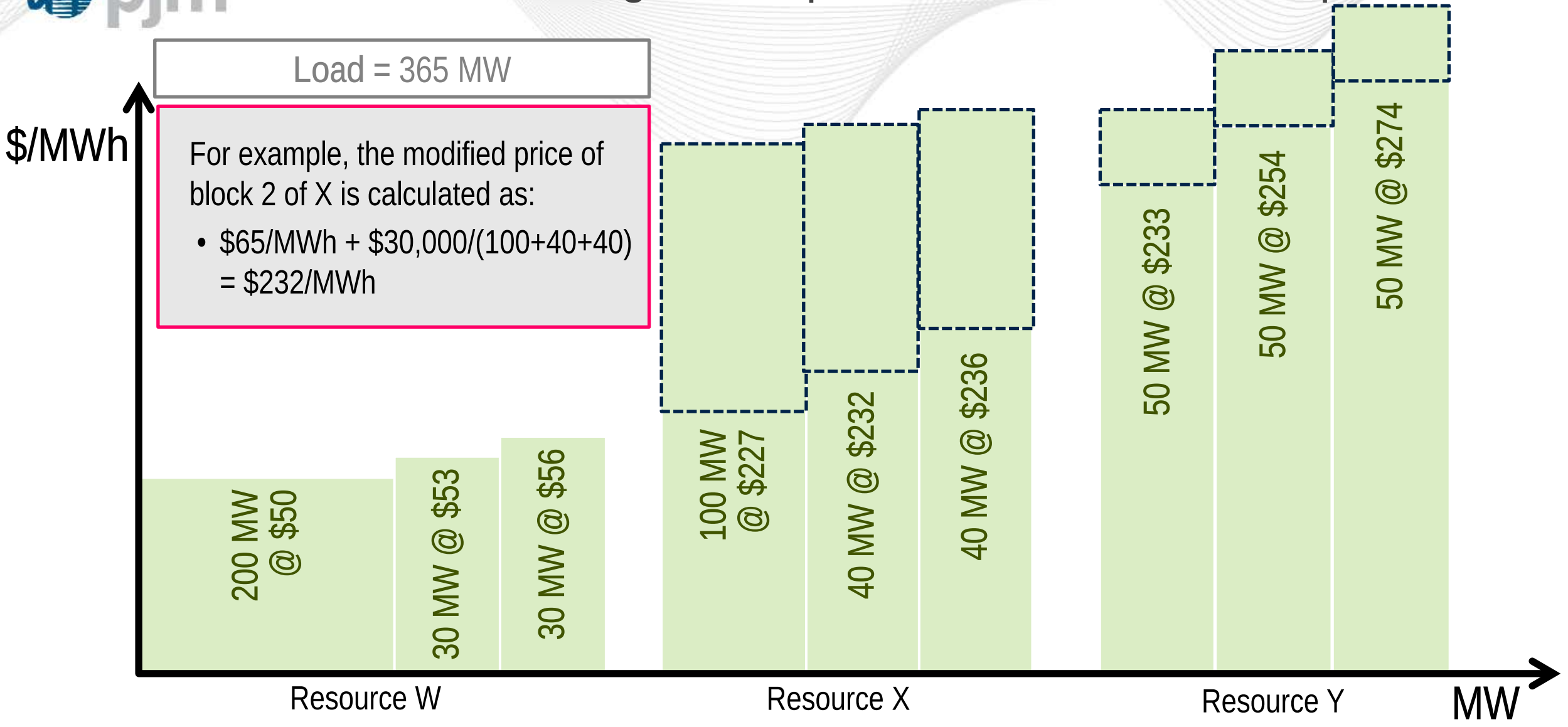
Pricing Run Equivalent Offers for Example #1b



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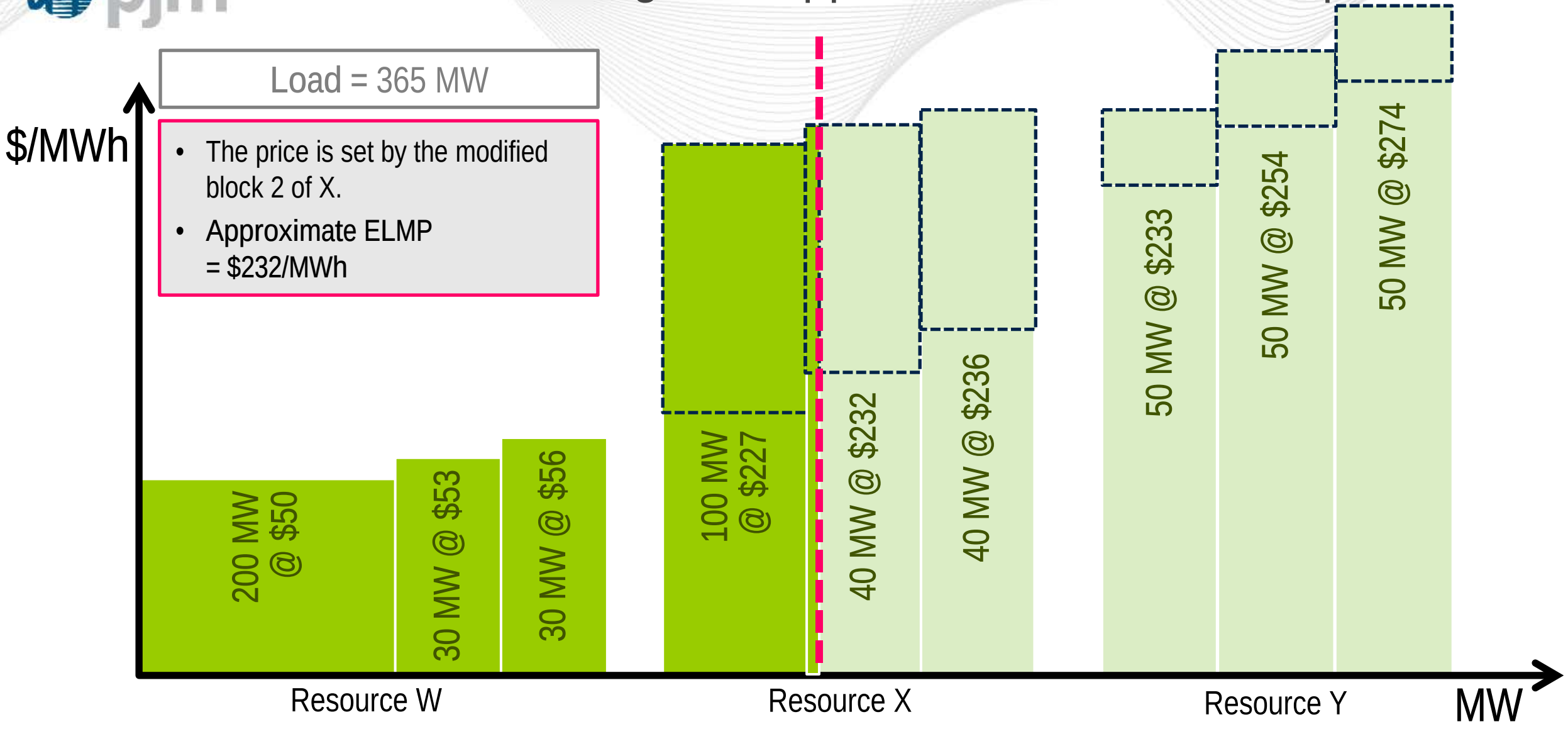
Pricing Run Approximate ELMP: Example #1b



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Approximate ELMP Pricing and Settlement: Example #1b

The **Approximate ELMP** is calculated at **$232/MWh.**

Asset	Commit.	Dispatch (MW)	Total Offer Cost ($)	Payment ($)	MWP ($)	LOC ($)
W	On	260	13,270	60,320	0	0
X	Off	0	0	0	0	400*
Y	On	105	27,255	24,360	2,895	0

Uplift = $3,295 in this example

**Note: MISO does not pay LOC.*

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Summary of Examples #1a & #1b

Load = 365 MW	Price ($/MWh)	Total Uplift Payment ($)
Marginal	241	3,970
Approximate ELMP (offline units cannot set price)	274	9,445
Approximate ELMP (offline units can set price)	232	3,295

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PJM Proposed Response to FERC Order

- PJM plans to file the following in its initial brief:
  1. Run separate pricing and dispatch runs
  2. Provide special pricing treatment in the pricing run for all fast-start resources with a minimum run time and start-up time that do not exceed 2 hours
  3. In the pricing run, allow fast-start resources to be partially committed (integer relaxation), which would allow their economic minimums to be relaxed to zero and their commitment costs to be included in prices
  4. Pay lost opportunity cost when dispatch signals are not profit maximizing

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