Update on PJM Price Formation Efforts

PJM Interconnection, L.L.C

February 22nd, 2019

- Briefly review recent price formation discussions and developments
  - FERC Docket EL12-34-000 (Fast Start Pricing)
    - PJM Proposal
  - Formation of the Energy Price Formation Senior Task Force
    - Reserve Pricing

- Constraint Penalty Factor
- Impacts on Market-to-Market coordination

FERC requested PJM to investigate revising its Tariff to:

1) Expand the units eligible for special pricing treatment to all fast-start resources

2) Include a minimum run time and start-up time requirement in the definition of a fast-start resource

3) Allow full economic minimum relaxation for fast-start resources

4) Allow fast-start resource commitment costs to be reflected in prices

5) Consider fast-start resources within dispatch in a way that minimizes production cost

PJM has proposed (pending FERC approval) that resources that meet the following criteria be eligible for Fast Start pricing:

- Startup + Notification Time of 2 hours or less & Minimum Run Time of 2 hours or less

  – Aligns with the set of resources that are eligible to be committed in IT SCED

- Online

- Scheduled by PJM

- Block-loaded or non-block loaded

Many discussion topics including the following

- Updating Operating Reserve Demand Curves (ORDC)

- Additional Locational Reserves Zones

- Consolidation of Tier 1 and Tier 2 Reserves

Mid-Atlantic Dominion (MAD) Sub-Zone

Most Limiting Interface
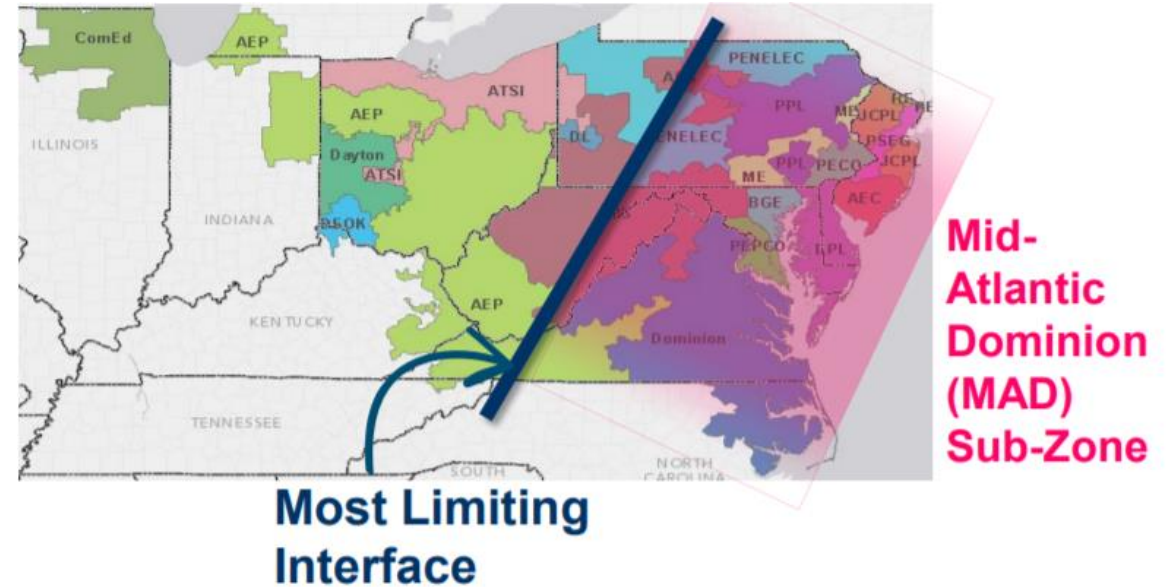
- Transmission Constraint Penalty Factors are parameters used by the Security Constrained Economic Dispatch (SCED) applications to determine the maximum cost of the re-dispatch incurred to control a transmission constraint

- Historically, Constraint Relaxation Logic has applied when SCED cannot control a transmission constraint

- PJM stakeholders have approved tariff changes that allow the Transmission Constraint Penalty Factor to set the shadow price of a transmission constraint when the constraint cannot be adequately controlled
  - Changes Approved by FERC on 1/08/2019, implemented on *internal* constraints only on 2/1/2019

- Pricing Formation
  - PJM and MISO discussing impacts to M2M Coordination
  - Currently utilizing prices formulated in dispatch runs

- Transmission Constraint Penalty Factors
  - Currently still allowing Constraint Relaxation Logic
  - Working on updates to JOA language and software changes to allow disabling of CRL
  - MISO and PJM exploring enhancements to manage power swings that may be exasperated without CRL

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Purpose & Key Takeaways

Purpose:

Update MISO Price Formation with focus on Extended LMP (ELMP)
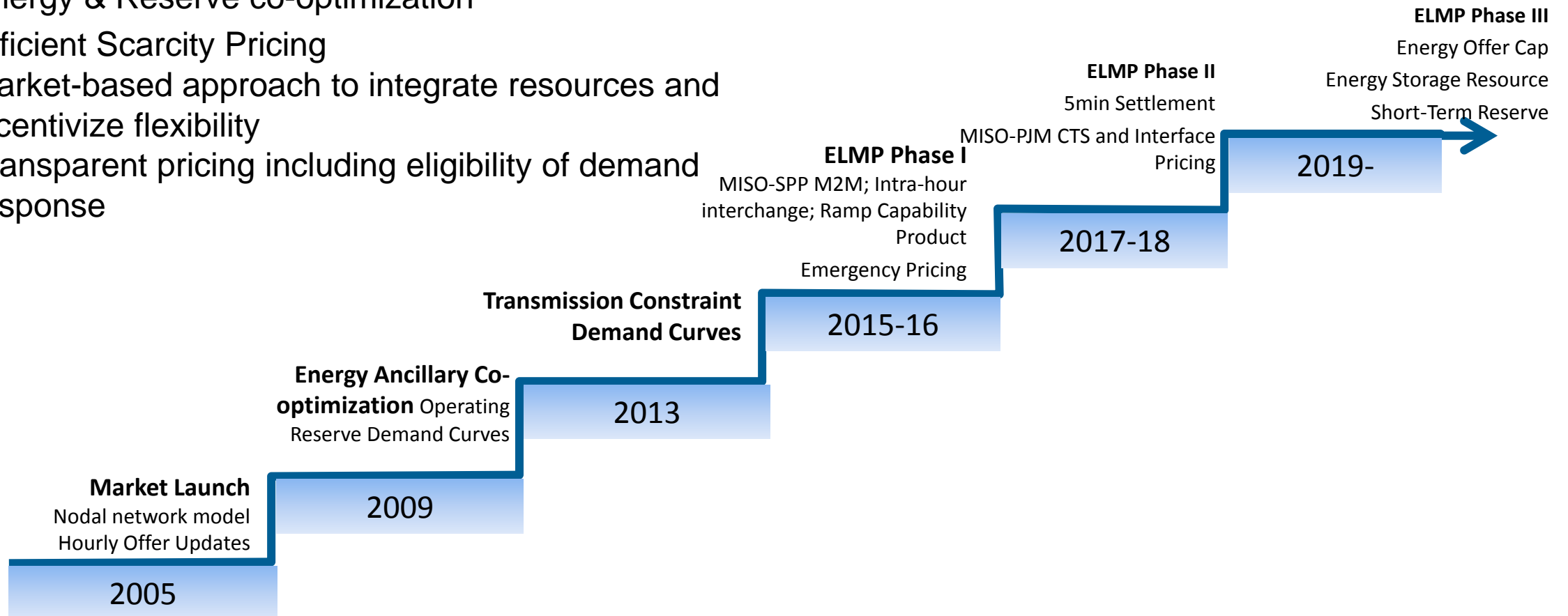
Key Takeaways:

- MISO developed ELMP to allow Fast Start Resource to set prices including their commitment costs
  - Phase I: March 01, 2015
  - Phase II: May 01, 2017
  - Phase III: Evaluating implementation of short-term enhancements
- Other Price Formation efforts include Transmission Constraint Demand Curves

MISO Price Formation – *Develop transparent market prices reflective of marginal system cost*

Featured by:

- Energy & Reserve co-optimization
- Efficient Scarcity Pricing
- Market-based approach to integrate resources and incentivize flexibility
- Transparent pricing including eligibility of demand response

Market Launch
Nodal network model
Hourly Offer Updates

2005

Energy Ancillary Co-optimization Operating Reserve Demand Curves

2009

Transmission Constraint Demand Curves

2013

ELMP Phase I
MISO-SPP M2M; Intra-hour interchange; Ramp Capability Product
Emergency Pricing

2015-16

ELMP Phase II
5min Settlement
MISO-PJM CTS and Interface Pricing

2017-18

ELMP Phase III
Energy Offer Cap
Energy Storage Resource
Short-Term Reserve

2019-

Extended LMP (ELMP) – *Allow Peaking Resources and Demand Response to set prices*

Deficiencies of LMP and Lumpiness in Wholesale Electric Markets

Peaking Resources
- Certain peaking resource cannot fully set prices*
- Offline Fast Start Resources are not considered

Demand Response
Demand Response may not set prices

Uplift Payments
Inability to fully price costs results in uplift

- Allow online peaking resources to set prices, including their commitment costs
- Include offline Fast Start Resources in price setting

Allow Demand Response Resources to set prices

More costs reflected in prices and reduced uplift

Effectiveness of ELMP to reflect the true cost to meet demand

Production Experiences validate design objective – *Phase I modest results; Phase II captured broader benefits*

- Online Fast Start Resources (FSR)[*]: **Start up notification time of sixty (60) minutes or less; minimum run time of one hour or less**

Metric	Phase I	Phase II
FSR Capacity / Real-Time Participation	~ 2 GW / ~7%	~10 GW / ~23%
Online FSR Price Impact	~$1/MWh average increase over relevant Real Time Pricing intervals	~$3/MWh average increase over relevant Real Time Pricing intervals
Offline FSR Price Impact	~$35/MWh average decrease during relevant Real Time Pricing intervals	~$60/MWh average decrease during relevant Real Time Pricing intervals
RSG Make Whole Payment	~1% RSG reduction during expected periods	**~9% overall RSG reduction**

Note: Offline Fast Start Resources are still limited to 10 minutes start up and notification time and 1 hour min run time

MISO is Evaluating Implementation of three ELMP III Short-Term Enhancements

- Convex Envelope*: Implementation after Market System Enhancement

- Expand eligibility of Fast Start Resources to include Day-Ahead Committed ones (IMM 2015-1a): Near-term implementation

- Real-Time Regulation Enhancement: Near-term implementation

- *Relax ramp rate to allow FSR to set prices (IMM 2015-1b): MISO recommends further study*

Note: A recently developed convex primal formulation that better approximates or sometimes even exacts full ELMP

Transmission Constraint Demand Curve – *Specify how valuable it is to keep the flow below limit*

Example: TCDC for Group 1 Transmission Constraints (Tariff Schedule 28A)

Group 1		Type and Voltage (V)			
		V <= 100kV $/MWh	>100kV and <161kV $/MWh	>= 161kV $/MWh	IROL $/MWh
Binding Constraint Exceedance Percentage	>=102%	$500	$1,000	$2,000	$4,000
	>100% and <102%	$400	$700	$1,000	$3,000

- TCDC limits the re-dispatch of generating resources to manage the constraint when relief costs exceed the value the RTO placed on the constraint, and reflects the value into locational price differences
- Values based on voltage level of constraint and reliability impact, and increase with constraint exceedance to reflect the increasing risks

Links

- ELMP III white paper: https://cdn.misoenergy.org/20190117%20MSC%20Item%2005%20ELMP%20III%20Whitepaper315878.pdf
- ELMP Production Results: https://cdn.misoenergy.org/20180809%20MSC%20Item%2001h%20ELMP%20Phase%20II%20Post%20Implementation%20Analysis264270.pdf and https://cdn.misoenergy.org/2016-08-29%20Docket%20No.%20ER12-668-00050850.pdf
- ELMP: MISO Tariff Schedule 29A; TCDC: MISO Tariff Schedule 28A

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