Market Efficiency Update

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2022/23 Market Efficiency Cycle

2022/2023 RTEP Window Overview

- Posted update to the Market Efficiency Base Case (PROMOD 11.4 XML format)
  - Posted Sensitivity Scenarios.
  - Activated Bus/Hub reports in the Base Case.
  - Updated some generation settings to stay consistent with previous models.
  - Applied rating corrections based on feedback received.
- Posted Market Efficiency Sensitivity Scenarios.
- Market Efficiency Training scheduled for November 29, 2022.
- Final Market Efficiency Base Case and Congestion Drivers to be posted before the start of 2022/23 Long-Term Window.

Market Efficiency Sensitivity Scenarios

Sensitivity	Range
Load Sensitivity	Plus or Minus 2%
Gas Sensitivity	Plus or Minus 20% Henry Hub
FSA Sensitivity	Add all units with FSA or suspended ISA status

PJM reserves right to add sensitivities as necessary.

Base Case Preliminary Results - Simulated Congestion [1]

Constraint [3]	Congested Area	Type	Historical 2021 Day Ahead Congestion	Historical 2022 (through Sep) Day Ahead Congestion	Simulated 2027 Congestion	Simulated 2030 Congestion	Comment
Black Oak-Bedington Interface		Inter	$ -	$ 72,436,702	$ 54,119,278	$ 97,404,855	2022 Reliability Window 1 – Black Oak 500kV Voltage Drop
BC-PEPCO Interface		Inter	$ 4,065	$ 262,743	$ 27,128,125	$ 1,488,360	-
Safe Harbor-Graceton 230 kV	PPL-BGE	Line	$ 25,862,337	$ 18,926,344	$ 23,435,336	$ 16,239,930	2022 Reliability Window 1
Messick Road to Morgan 138 kV	APS	Line	$ -	$ -	$ 19,167,071	$ 36,863,712	2022 Reliability Window 1
Dumont-Stillwell 345 kV	AEP-NIPS	M2M	$ 2,034,732	$ 2,381,596	$ 11,568,222	$ 13,427,287	2022 Multi-Driver Window 1
AP South Interface		Inter	$ 465,361	$ 55,483,098	$ 7,885,910	$ 19,389,792	-
AEP-DOM Interface		Inter	$ 323,916	$ 23,390,296	$ 7,393,603	$ 30,019,220	-
Olive-University Park 345 kV	AEP-CE	M2M	$ -	$ 75,167	$ 4,918,360	$ 12,482,576	2022 Multi-Driver Window 1
Lincoln-Straban 138 kV	METED	Line	$ 375,627	$ 2,033,549	$ 3,194,140	$ 8,875,815	2022 Reliability Window 1
Germantown-Straban 138 kV	METED	Line	$ 323,093	$ 2,856,930	$ 2,935,052	$ 10,166,810	2022 Reliability Window 1

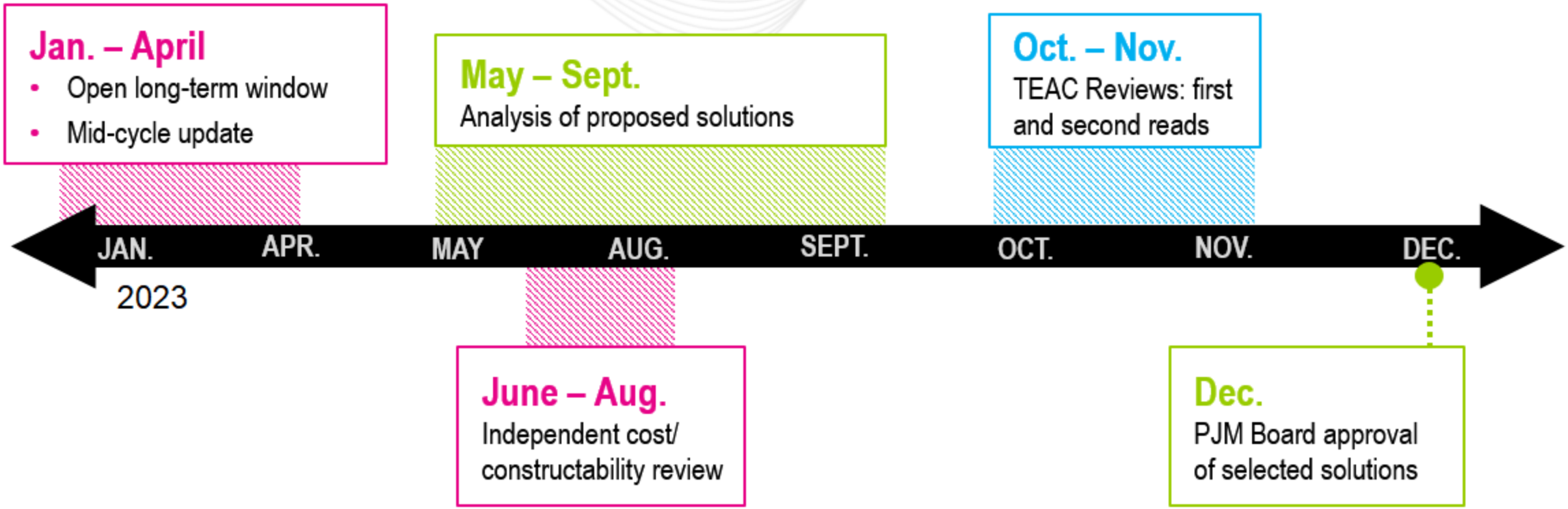
Notes:

1) Preliminary results, not final congestion drivers. List of constraints and congested areas may change in the final base case.

2) Table identifies correlated historical constraints with 2027 PROMOD simulated congestion in the same area/group.

3) Included only flowgates with hr bindings > 25 hrs. and annual simulated congestion > $1 million.

2022/23 Long-Term Window – Timeline



2022 Acceleration Analysis of RTEP Reliability Projects

Acceleration Analysis of Reliability Upgrades

- Scope
  - Determine which Reliability upgrades, if any, have an economic benefit if accelerated or modified.
- Study Assumptions
  - Analysis utilized the most recent Market Efficiency Base Case available.
  - 2023 and 2027 set of input assumptions used to study impacts of approved RTEP projects.
- Process
  - Compare market congestion for near term vs. future topology.
  - Estimate economic impact of accelerating planned reliability upgrades.

Acceleration Analysis Status

- Finalized PROMOD modeling work for 2023 and 2027 (AS-IS topology) cases.
- Completed PROMOD simulations
  - 2023 and 2027 study years with 2023 Topology (AS-IS Topology).
  - 2023 and 2027 study years with 2027 Topology (RTEP Topology).
- Compared the board approved reliability upgrades with the congestion reductions between the AS-IS and the RTEP Base cases.

Acceleration Analysis Results: 2023 Study Year

Congestion Decreases Associated With Approved Reliability Projects - 2023 Study Year			2023 Study Year			Upgrade Associated with Congestion Reduction	ISD
			2023 Topology	2027 Topology	Congestion Savings ($ Millions)		
Constraint Name	AREA	TYPE	Year 2023 Congestion ($ Millions)	Year 2023 Congestion ($ Millions)			
HOPEWELL - CHESTERFIELD A 230 KV	DOM	LINE	$7.7	$0.0	$7.7	B3694 (10-13): Reconductor approximately 2.9 miles of 230 kV line. Upgrade station equipment at Chesterfield and Hopewell.	2026
HOPEWELL - CHESTERFIELD B 230 KV	DOM	LINE	$1.9	$0.0	$1.9	B3694 (10-13): Reconductor approximately 2.9 miles of 230 kV line. Upgrade station equipment at Chesterfield and Hopewell.	2026

Note: For a particular flowgate, the congestion savings for the study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.

Acceleration Analysis Results: 2027 Study Year

Congestion Decreases Associated With Approved Reliability Projects - 2027 Study Year			2027 Study year			Upgrade Associated with Congestion Reduction	ISD
			2023 Topology	2027 Topology	Congestion Savings ($ Millions)		
Constraint Name	AREA	TYPE	Year 2027 Congestion ($ Millions)	Year 2027 Congestion ($ Millions)			
HOPEWELL - CHESTERFIELD A 230 KV	DOM	LINE	$3.4	$0.0	$3.4	B3694 (10-13): Reconductor approximately 2.9 miles of 230 kV line. Upgrade station equipment at Chesterfield and Hopewell.	2026
HOPEWELL - CHESTERFIELD B 230 KV	DOM	LINE	$0.5	$0.0	$0.5	B3694 (10-13): Reconductor approximately 2.9 miles of 230 kV line. Upgrade station equipment at Chesterfield and Hopewell.	2026

Note: For a particular flowgate, the congestion savings for the study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.

Acceleration Analysis Results and Next Steps

- Acceleration analysis has been completed
  - Project B3694 - parts (10,11,12,13), a $12.29 million reconductoring of approximately 2.9 miles of Chesterfield and Hopewell A and B 230 kV lines with upgrade of associated station equipment, shows congestion benefits if accelerated before current schedule.

  - Dominion currently evaluating the feasibility of accelerating this project.

2022 Annual Re-evaluation of RTEP Market Efficiency Projects

Re-evaluation Overview

- PJM is required by Schedule 6 of the Operating Agreement (OA) to "annually review the cost and benefits" of Board-approved market efficiency projects that meet certain criteria to assure that a project continues to be cost beneficial.

- The annual re-evaluation is not required for projects already in-service, that have commenced construction, or have received state siting approval.
  - See Appendix A for list of projects with status of In-Service, Under Construction or Cancelled.

- Analysis utilized the most recent Market Efficiency case available.

Re-evaluation Assumptions

- Analysis performed with the posted Market Efficiency Base Case (October 2022):
  - Topology based on the powerflow from the 2022 Reliability Window 1
    - Does not include any reliability solutions expected to be recommended to the Board for review and approval as part of the 2022 Reliability Window 1 (proposals currently under evaluation).
    - Includes transmission upgrades as of end of September 2022.
  - It reflects recently requested generator deactivations and associated network upgrades.
  - For more details see Market Efficiency Assumptions Whitepaper (September 2022)

- Project costs reflect the most recent quarterly update.

Re-evaluation of Projects with EP* Status and Capital Cost < $20 Million

- Projects not under construction or without a CPCN, and with capital costs less than $20 million will have projected costs updated and using previously determined benefits should maintain a benefit-to-cost ratio greater than 1.25.

- Current cost estimates for the projects below have not changed since the project evaluation and therefore these projects continue to maintain a benefit-to-cost ratio greater than 1.25.

PJM Window Project ID	Baseline#	Type	Area	Constraint	Status*	ISD	Cost ($MM)	B/C Ratio	Description
202021_1-704	b3697	Upgrade	PECO	Plymouth - Whitpain 230 kV	EP	6/1/2025	.62	75.30	Replace station equipment at Whitpain and Plymouth 230 kV
202021_1-218	b3698	Upgrade	PPL	Juniata - Cumberland 230 kV	EP	12/31/2023	8.99	11.28	Reconductor 14.2 miles of Juniata-Cumberland 230 kV
202021_1-651	b3702	Upgrade	DOM	Charlottesville – Proffit 230 kV	EP	11/1/2023	11.38	16.05	Install series reactor on Charlottesville – Proffit 230 KV

**EP - Engineering and Procurement Status*

Re-evaluation of Transource IEC (9A) Project

- On September 22, 2021, the PJM Board endorsed PJM's recommendation to suspend the Transource IEC (9A) Project, due to siting risks, in order to remove it from the models pending any future developments in the regulatory process.

- Transource IEC (9A) Project re-evaluation results October 2022:
  - B/C Ratio = **2.48**
  - In-Service Cost = $428.76 Millions

Re-evaluation	Benefit / Cost Ratio November 2022 (In-Service Project Cost)	Notes
Project 9A Base Case Analysis	2.48	B/C Ratio (Sunk Costs Excluded*) = 3.64 In-Service Project Cost: $428.76 MM Project Cost With Sunk Costs Excluded: $292.49 MM Sunk Cost: $136.27 MM

** Sunk costs represent $136.27 MM unavoidable costs ($428.76 MM In-Service Cost).*

Appendix A
Market Efficiency Projects
In-Service, Under Construction or Cancelled

In-Service, Under Construction or Cancelled Projects

PJM Window Project ID	Baseline#	Type	Area	Constraint	Status	ISD	Description
201415_1-2B	b2691	Upgrade	ME/PPL	Brunner Island to Yorkana 230 kV	IS	6/12/2017	Reconductor three spans limiting Brunner Island - Yorkana 230 kV line, add 1 breaker to Brunner Island switchyard, upgrade associated terminal equipment
201415_1-4J	b2698	Upgrade	AEP	Jacksons Ferry to Cloverdale 765 KV	IS	12/8/2017	Replace relays at Cloverdale and Jackson's Ferry substations
201415_1-10B	b2693	Upgrade	COMED	Wayne to South Elgin 138 kV	IS	11/1/2018	Replace L7915 B phase line trap at Wayne substation
201415_1-10D	b2728	Upgrade	COMED	Loretto to Wilton 345 kV (RPM)	IS	12/22/2017	Mitigate sag limitations on Loretto - Wilton Center 345 kV Line and replace station conductor at Wilton Center
201415_1-12A	b2689.1-3	Upgrade	DUQ	Dravosburg to West Mifflin 138 kV	IS	1: 3/2/2018 2: 6/8/2018 3: 12/6/2017	Reconductor ~7 miles of the Woodville - Peters 138 kV circuit. Reconfigure West Mifflin-USS Clairton 138 kV circuit. Upgrade terminal equipment
201415_1-13E	b2695	Upgrade	DPL	Worcester to Ocean Pines (I) 69 kV	IS	12/31/2017	Rebuild Worcester - Ocean Pine 69 kV ckt. 1
201415_1-18G	b2688.1-3	Upgrade	APS	Taneytown to Carroll 138 kV	IS	1: 10/5/2018 2: 4/18/2018 3: 5/25/2018	Upgrade terminal equipment on the Lincoln - Carroll 115/138kV path.
201415_1-2A	b2690	Upgrade	PPL/BGE	Safe Harbor to Graceton 230 kV	IS	10/18/2017	Reconductor two spans of the Graceton - Safe Harbor 230 kV transmission line
201415_1-18I	b2696	Upgrade	APS/ATSI	Krendale to Shanor Manor 138 kV	IS	12/10/2018	Upgrade 138 kV substation equipment at Butler, Shanor Manor and Krendale substations
201415_1-10J	b2692.1-2	Upgrade	COMED	Cordova to Nelson 345 kV	IS	5/8/2019	Replace station equipment at Nelson, ESS H-471 and Quad Cities. Upgrade conductor ratings of Cordova - Nelson, Quad Cities - ESS H-471 and ESS H-471 - Nelson 345 kV lines and mitigating sag limitations

In-Service, Under Construction or Cancelled Projects, cont.

PJM Window Project ID	Baseline#	Type	Area	Constraint	Status	ISD	Description
201415_1-11H	b2694	Upgrade	PECO	Peach Bottom 500 kV	IS	4/1/2019	Increase ratings of Peach Bottom 500/230 kV transformer
Optimal Caps	b2729	Upgrade	DOM	AP-South	IS	1/30/2020	New capacitor banks at Brambleton, Ashburn, Shelhorn and Liberty substations
201617_1-3A	b2930 AC1-223	Upgrade	COMED	E. Frankfort to University Park 345 kV	CANC	Cancelled	Upgrade capacity on E. Frankford-University Park 345kV
201617_1-3B	b2931 (RPM)	Upgrade	COMED	Pontiac to Brokaw 345 kV	IS	12/14/2020	Upgrade substation equipment at Pontiac Midpoint station
201617_1-5E	b2992.1-4	Upgrade	BGE	Conastone - Graceton - Bagley 230 kV	IS	6/10/2021	Reconductor the Conastone to Graceton 230 kV 2323 & 2324 circuits. Add Bundle conductor on the Graceton-Bagley-Raphael Road 2305 & 2313 230kV circuits. Reconductor Raphael Road - Northeast 2315 & 2337 circuits.
201819_BT_481	b3142	Upgrade	NIPSCO	Michigan City – Trail Creek - Bosserman 138 kV	UC	12/30/2022	Rebuild Michigan City-Trail Creek - Bosserman 138 kV (10.7 mi)
202021_1-756	b3701	Upgrade	APS	Junction - French's Mill 138 kV	UC	11/1/2022	Replace terminal equipment at French's Mill – Junction 138 kV

IS – In-service
UC – Under Construction
CANC - Canceled

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Revision History

- V1 – 10/27/2022 – Original slides posted
- V2 – 11/01/2022 – Updated the Re-evaluation table on slide 17 with the following:
  - » Corrected the column title to “Benefit/Cost Ratio
    November 2022
    (In-Service Project Cost)
  - » Added “Project Cost With Sunk Costs Excluded = $307.19 MM” to the “Notes” column
- V3 – 11/04/2022 – Updated the Re-evaluation table on slide 17 with the following:
  - » Corrected the following items:
    B/C Ratio (Sunk Costs Excluded*) = 3.64
    Project Cost With Sunk Costs Excluded: $292.49 MM
    Sunk Cost: $136.27 MM

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