

Market Efficiency Update

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20/21 Long Term Window

- Market Efficiency Input Assumptions presented at TEAC meetings June through August
 - 20/21 Market Efficiency Analysis Assumptions [whitepaper](#) was shared with the PJM board for consideration at the September Board meeting and posted with the October TEAC materials
- Market Efficiency Training, available [here](#) completed October 20th
- Long-Term Window Materials Posting Schedule
 - Retooled PROMOD model to be posted during the month of November (XML format)
 - XML files compatible with PROMOD 11.3
 - ME Window Congestion Drivers, ME Window Base Case, and Sensitivity scenarios to be posted in December, before start of 20/21 Long-Term Window

- Retooled model includes (to-be posted during November)
 - MISO data update
 - Updated PJM Generation Expansion (ISA/FSA status, retirements)
 - Updated topology using the retooled 2025 powerflow from Transmission Planning
 - Also updated PJM line ratings and contingency definitions
 - ABB-Hitachi PROMOD data updates (heat rates, generator outages)
 - Updated PROMOD setup
- Final sensitivity cases to-be posted during November



Base Case Updated Preliminary Results - 2025 Simulated Congestion*

| Group** | Correlated Historical Constraints*** | Congested Area | Type | Historical 2019 Day Ahead Congestion | Historical 2020 Day Ahead Congestion | Simulated 2025 Area Congestion* |
|---------|--|------------------------|------|--------------------------------------|--------------------------------------|---------------------------------|
| 1 | Harwood to Susquehanna #1 230 kV | PPL | Line | \$ 4,587,972 | \$ 16,157,914 | Yes |
| 1 | Harwood to Susquehanna #2 230 kV | (Susq. Group) | Line | \$ 1,466,849 | \$ 3,290,309 | |
| 2 | Cumberland to Juniata 230 kV | PPL (Juniata group) | Line | \$ 3,516,896 | \$ 6,368,984 | Yes |
| 2 | Dauphin to Juniata 230 kV | | Line | \$ - | \$ 472,479 | |
| 2 | Juniata #1 500/230 kV | | XFRM | \$ - | \$ 46,886 | |
| 2 | Juniata #2 500/230 kV | | XFRM | \$ - | \$ 2,836,659 | |
| 3 | Plymouth Meeting to Whitpain #3 230 kV | PECO | Line | \$ 1,572,531 | \$ 3,104,181 | Yes |
| 3 | Plymouth Meeting to Whitpain #4 230 kV | | Line | \$ 938,713 | \$ 654,931 | |
| 4 | Cherry Run to Morgan 138 kV | APS | Line | \$ 883,588 | \$ - | Yes |
| 4 | Jct. to French's Mill 138 kV | | Line | \$ 116,952 | \$ 345,506 | |
| 4 | Gore to Stonewall 138 kV | | Line | \$ 818,902 | \$ 177,599 | |
| 4 | Messick Road to Morgan 138 kV | | Line | \$ 263,290 | \$ - | |
| 4 | Messick Road to Ridgeley 138 kV | | Line | \$ 1,704,272 | \$ 462,027 | |
| 5 | Kammer North (Bus 1 & 3) to Natrium 138 kV | AEP | Line | \$ 178,984 | \$ 36,523 | Yes |
| 6 | Quad Cities to Rock Creek 345 kV | CE-ALTW | M2M | \$ 896,048 | \$ 427,688 | Yes |
| 7 | Muskingum River to Beverly 345 kV | AEP | Line | \$ - | \$ - | Yes |
| 8 | Muskingum River to Waterford 345 kV | AEP | Line | \$ - | \$ - | Yes |

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

**Table identifies correlated historical constraints with 2025 PROMOD simulated congestion in the same area/group.



2020 Annual Reevaluation of Market Efficiency Projects

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 reevaluation is not required for projects that have commenced construction or have received state siting approval.

Analysis will utilize the most recent Market Efficiency case available.



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/ATS I | 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. Frankfort-University Park 345kV |
| 201617_1-3B | b2931 (RPM) | Upgrade | COMED | Pontiac to Brokaw 345 kV | UC | 6/1/2021 | Upgrade substation equipment at Pontiac Midpoint station |
| 201617_1-5E | b2992.1-4 | Upgrade | BGE | Conastone - Graceton - Bagley 230 kV | UC | 6/1/2021 | 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. |

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

- Projects with cost under \$20 million, prior to commencement of construction activities at the project site, are reevaluated using the original benefits and updated costs.
- Costs for these projects currently under PJM review.

| PJM Window Project ID | Baseline# | Type | Area | Constraint | Capital Cost* (\$ million) | Status | Projected ISD | Description |
|------------------------|-------------|---------|-------|----------------------------------|----------------------------|--------|--------------------------------|--|
| 201415_1-4I | b2697.1-2 | Upgrade | AEP | Fieldale to Thornton 138 kV | \$2.7 | EP | 1: 10/01/2020 2: 06/03/2021 | Mitigate violations identified by sag study to operate Fieldale-Thornton-Franklin 138 kV overhead line conductor at its max. operating temperature Replace terminal equipment at Danville and East Danville substations |
| 201617_1A_RP M_DEOK | b2976 (RPM) | Upgrade | DEOK | Tanners Creek to Dearborn 345 kV | \$0.60 | EP | 03/04/2021 | Upgrade terminal equipment at Tanners Creek 345kV station. Upgrade 345kV Bus and Risers at Tanners Creek for the Dearborn circuit. |
| 201819_HL_622 | b3145 | Upgrade | METED | Hunterstown to Lincoln 115 kV | \$7.21 | EP | 06/01/2023 | Rebuild the Hunterstown - Lincoln 115 kV line (No.962) (~2.6 mi.). Upgrade limiting terminal equipment at Hunterstown and Lincoln. |

*Capital costs under annual review by PJM
EP – Engineering Procurement

- Reevaluation for these projects currently under PJM review.

| PJM Window Project ID | Baseline# | Type | Area | Constraint | Capital Cost* (\$ million) | Status | Projected ISD | Description |
|-----------------------|-------------------------|------------|-------------|--|----------------------------|--------|--------------------------------|---|
| 201415_1-9A* | b2743.2-8, b2752.1-9 | Greenfield | APS/ BGE | AP-South | Under Review | EP | 1: 12/31/2021 2: 12/31/2022 | New double-circuit Rice – Ringgold 230 kV. New double-circuit Furnace Run - Conastone 230 kV. Reconductor Conastone – NWest 230 kV. |
| 201819_BT_481 | b3142 | Upgrade | NIPSCO | Michigan City – Trail Creek - Bosserman 138 kV | \$24.69 | EP** | 01/01/2023 | Rebuild Michigan City-Trail Creek - Bosserman 138 kV (10.7 mi) |

*Capital costs under annual review by PJM
 **Construction status under review by MISO
 EP – Engineering Procurement



2020 Acceleration Analysis

- Scope
 - Determine which previously approved Reliability upgrades, if any, have an economic benefit if accelerated or modified
- Study Years
 - 2021 and 2025 set of economic 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

- Work in progress
 - Finalize PROMOD modeling for AS-IS topology cases
 - Compile the list of potential candidates from previously approved reliability upgrades
- Next step - Complete PROMOD simulations
 - 2021 and 2025 study years with 2021 Topology (AS-IS Topology)
 - 2021 and 2025 study years with 2025 Topology (RTEP Topology)
- Acceleration analysis to be completed by December 2020

| Step | Timeline |
|--|---------------------------|
| Stakeholders Feedback | October 2020 |
| Post Preliminary Congestion Drivers | November 2020 |
| Finalize 2020 Reevaluation Analysis | December 2020 |
| Finalize 2020 Acceleration Analysis | November – December 2020 |
| Post Final Base Case and Target Congestion Drivers | December 2020 |
| Long Term Proposal Window | January 2021 - April 2021 |
| Analysis of Proposed Solutions | May – September 2021 |
| TEAC Reviews and Board Approval | October - December 2021 |

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Market Efficiency Update



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- V1 – 10/30/2020 – Original slides posted