



Market Efficiency Update

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Transmission Expansion Advisory Committee
Market Efficiency Special Session

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- Congestion Drivers Criteria
- M2M Constraints
- Overview of Posted Market Efficiency Base Case
- MEPETF Proposed Changes
- Market Efficiency Sensitivities
- Market Efficiency Registration
- Review Simulated Congestion Outputs

Objective of PJM Market Efficiency

Operating Agreement : 1.5.7 Development of Economic-based Enhancements or Expansions

*(b) Following PJM Board consideration of the assumptions, the Office of the Interconnection shall perform a market efficiency analysis to compare the costs and benefits of: (i) accelerating reliability-based enhancements or expansions already included in the Regional Transmission Plan that if accelerated also could relieve one or more economic constraints; (ii) modifying reliability-based enhancements or expansions already included in the Regional Transmission Plan that as modified would relieve one or more economic constraints; and (iii) adding new enhancements or expansions **that could relieve one or more economic constraints**, but for which no reliability-based need has been identified. Economic constraints include, but are not limited to, constraints that cause: (1) significant historical gross congestion; (2) pro-ration of Stage 1B ARR requests as described in section 7.4.2(c) of Schedule 1 of this Agreement; or (3) **significant simulated congestion as forecasted in the market efficiency analysis**. The timeline for the market efficiency analysis and comparison of the costs and benefits for items 1.5.7(b)(i-iii) is described in the PJM Manuals.*

(c) The process for conducting the market efficiency analysis described in subsection (b) above shall include the following:

*(i) **The Office of the Interconnection shall identify and provide to the Transmission Expansion Advisory Committee a list of economic constraints to be evaluated in the market efficiency analysis.***

Economic Justification for Market Efficiency

Operating Agreement : 1.5.6 Development of the Recommended Regional Transmission Expansion Plan

*(i) The recommended plan shall identify enhancements and expansions that relieve transmission constraints and which, **in the judgment of the Office of the Interconnection, are economically justified**. Such economic expansions and enhancements shall be developed in accordance with the procedures, criteria and analyses described in Sections 1.5.7 and 1.5.8 of this Schedule 6.*

- In determining eligible congestion drivers PJM will consider all binding flowgates internal to the PJM footprint (including tie lines), current active Market-to-Market flowgates listed in the NERC book of flowgates, and potential future Market-to-Market flowgates between PJM and MISO
- Eligible congestion drivers are selected to focus proposals on significant issues
 - Identified coincident with the opening of market efficiency proposal window
- Only proposals which address one or more of these PJM identified congestion drivers will be evaluated
 - If the proposal does not substantially address a PJM identified congestion driver, or is otherwise substantially deficient or is seriously flawed, it will be rejected and the proposer will be notified
- Facilities below these thresholds are not anticipated to pass the benefit/cost threshold because of the expected cost of an upgrade

- **Market Efficiency Criteria**
 - Annual simulated congestion frequency of at least 25 hours in each 2023 and 2026 study years
 - Congestion threshold
 - Lower voltage facilities: minimum of \$1 million congestion in each 2023 and 2026 study years
 - Regional facilities: minimum of \$10 million congestion in each 2023 and 2026 study years
 - Interregional facilities: minimum of \$0.5 million congestion in each 2023 and 2026 study years (lower threshold as there may be interregional benefits in addition to the regional benefits)
- Congestion for 2029 study year is considered more speculative and therefore will be monitored in future analysis

PJM may not recommend proposals for certain facilities meeting the criteria due to following exceptions:

- Congestion is significantly influenced by a FSA generator or a set of FSAs
- Majority of the congestion was already addressed in previous window(s)
- Simulated congestion for future study years displays a declining trend

Note: PJM reserves right to add other exceptions as necessary.



Interregional Market Efficiency Project (IMEP) Study

- PJM and MISO will conduct a two year Interregional Market Efficiency Project (IMEP) study in 2018/2019
- Issues identification and benefit determination conducted in each regional process consistent with current effective JOA

- Study progresses in parallel through PJM and MISO regional processes
- Each RTO will develop an economic model and identify issues for which upgrades are being solicited
 - Model and issues identification consistent with region process and practice
- Targeted Market Efficiency Projects (TMEP) are not included in the long term window
- Per PJM-MISO JOA, Interregional Proposals must
 - Address at least one identified issue in each region (could be same issue if identified by both RTOs)
 - be submitted to both PJM and MISO Regional Windows
- PJM and MISO will follow the effective JOA language when analyzing and recommending Interregional Proposals



Potential Future Market-to-Market Flowgates Identification Steps

- Using the same topology as the Market Efficiency process, PJM will define its control areas to align with the CMP processes as described in the MISO-PJM JOA, Attachment 2, Section 3.2.1
- Monitored facilities included in MISO's Market Efficiency process will be combined with the set of contingencies used in both PJM's and MISO's Market Efficiency processes to establish the domain of flowgates that will be tested for eligibility
- Each of these flowgates will be studied in a sensitivity analysis that will establish the flowgates as congestion drivers should they meet either study criteria:
 - GLDF Threshold Study
 - TDF Threshold Study

- **GLDF Threshold Study**
 - Under the historical control area representation, if any two PJM generating stations at electrically unique locations have a Generation-to-Load Distribution Factor (GLDF) that is 5% or greater, this flowgate will be eligible to be an identified congestion driver in the Market Efficiency process
- **TDF Threshold Study**
 - Under the historic control area representation, if any historical control area to historical control area transaction (Generation-to-Generation transfer) has a 5% or greater Transfer Distribution Factor (TDF), this flowgate will be eligible to be an identified congestion driver in the Market Efficiency process

- Posted updated 2023 Base Case (XML files PROMOD 11.1.13 format)
 - Includes MISO feedback received by Oct 11th
 - Includes PJM stakeholders feedback received by Oct 23nd
 - Model includes all years: 2019, 2023, 2026, 2029
 - Also posted updated noFSA case (PROMOD XML file to remove FSA units)
 - <https://www.pjm.com/planning/rtep-development/market-efficiency/economic-planning-process.aspx>
- Posted Additional Files
 - Updated event file
 - 15-years Monte Carlo outage library
 - Current Congestion Output Report (simulated years 2023 and 2026)
- Final Base Case to be posted before the start of Long-Term Window

- Posted Market Efficiency Assumptions Whitepaper
 - <https://www.pjm.com/-/media/committees-groups/committees/teac/20181011/20181011-2018-market-efficiency-analysis-assumptions.ashx>
 - Recently announced First Energy retirements not included (network upgrades not finalized at this time)
- Financial parameters, Discount Rate, Carrying Charge Rate, and NSPL based on the Transmission Cost Information Center spreadsheet
 - <http://www.pjm.com/planning/rtep-upgrades-status/cost-allocation-view.aspx>
 - Discount Rate: 7.37%
 - Carrying Charge Rate: 12.84%



MEPETF Proposed Changes - FSA Modeling

Component	Status Quo	PJM Modification	PJM Reasoning
FSA Modeling	Consider all FSA and Suspended ISA resources at time of case build	By default, exclude from the base case the FSA and Suspended ISA resources, and their associated network upgrades at time of case build. FSA sensitivity studies will be used for proposal evaluations, but not for B/C ratio test.	Including FSAs in the Market Efficiency Base Case can result in unrealistic estimates of specific benefits for any system reinforcement due to having significantly more generation than the reserve requirement.
FSA Exception	If FSA or Suspended ISA resources are excluded from the base case at time of case build, TEAC should be notified.	If FSA or Suspended ISA resources are included in the base case at time of case build or mid-cycle update, TEAC will be notified and the assumptions will be reviewed at TEAC on an as needed basis.	In the case of including FSA or suspended ISA resources in the base case, TEAC will be notified and the assumptions will be reviewed at TEAC
Criterion to Include FSAs	Not defined. PJM practice includes all.	In case of a reserve deficiency, include FSA and Suspended ISA resources (as well as the expected network upgrades) ranked by their commercial probability, until the reserve requirement is met.	In the case of including FSA or suspended ISA resources in the base case, TEAC will be notified and the assumptions will be reviewed at TEAC



MEPETF Proposed Changes - Benefit Adjustment

Component	Status Quo	PJM Modification	PJM Reasoning
Benefit Adjustment for In-Service Date*	N/A	Energy benefits of projects that are proposed to be in service later than the RTEP year will be adjusted to account for any savings forgone due to later in-service date.	It is PJM's goal to address Market Efficiency constraints via transmission solutions by the RTEP year, and to incentivize projects that are designed and proposed to be in service by the RTEP year. Therefore, PJM will adjust energy benefits of projects that are proposed to be in service later than the RTEP year to account for any savings forgone due to later in-service date.

- OA revisions were endorsed at September MC for December 1, 2018 effective date
- Any potential changes will be effective for 18/19 Long Term Window

* Includes 15-year cap.

Will be used as sensitivity if only one proposal per target congestion driver.

Sensitivity	Range
Load Sensitivity	Plus or Minus 2%
Gas Sensitivity	Plus or Minus 20% Henry Hub
No FSA Sensitivity	Remove all units with FSA or suspended ISA status

Note: PJM reserves right to add sensitivities as necessary.

- Register for the 2018/19 RTEP Market Efficiency Window at
 - <http://www.pjm.com/planning/competitive-planning-process.aspx>
- In the CEII Request form write “Access to the 2018-19 Long Term RTEP Window” as the description of the information requested
- Everyone must register to access the data regardless of prior participation in the PJM Competitive Process

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Competitive Planning Process

The PJM competitive planning process implements FERC Order 1000. The process affords non-incumbent transmission developers an opportunity to participate in the regional planning and expansion of the PJM bulk electric system. By publishing a set of criteria violations and soliciting solutions from competing transmission developers, PJM and the FERC hope to encourage innovative, cost effective and timely solutions to the challenges of building and maintaining a highly reliable electric system.

PJM will announce in the [Transmission Expansion Advisory Committee \(TEAC\)](#) its intention to solicit competitive solutions to identified planning needs. The "windows" for submitting such solutions fit into three categories and follow the 18-month and 24-month planning cycles as described in Manual 14F: [Clean](#) [WEB](#) | [Clean](#) [PDF](#).

Planning Cycles	Standard Window Length	Required In-Service Date (Years)
Long Term - considers reliability criteria violations, economic constraints, system conditions and public policy requirements	120 days	> 5
Short Term - considers reliability criteria violations	60 days	3-5
Immediate-Need Reliability - considers reliability criteria violations	Shortened	< 3

While PJM endeavors to adhere to the standard length of the proposal windows, unique situations do arise. When adhering to the standard window length would be unnecessarily burdensome on the transmission developers, PJM may elect to modify the length of a proposal window. Any such changes will be made clear when the proposal window is announced.

Current Windows

2018/19 Long Term RTEP Window 1

OPEN 11.1.2018
 CLOSED 2.28.2018

2018/19 Long Term Window 1

[Market Efficiency Economic Models](#) - requires additional level of CEII specifically for market efficiency data and active license with Ventyx for PROMOD and nodal data

2018 Window 1

[Problem Statement](#)

[With Analytical Files - V6](#) [EXE](#) (26.0 MB) - requires CEII

?
Planning Community

[Training Video](#) | [User Guide](#) [PDF](#)
Register for community

Window Registration

To gain access to a RTEP planning cycle window & analytical data:

- Submit the [Critical Energy Infrastructure Information request](#).
Ask for access to "yyyy RTEP Proposal Window."
Specify the RTEP cycle ("yyyy") of interest.
- Complete the [Non-Disclosure Agreement](#).

- Market Efficiency Web Page located at
 - <http://www.pjm.com/planning/rtep-development/market-efficiency.aspx>
- Data will be posted before November 1st 2018
 - Market Efficiency Base Case files for all study years (XML format)
 - Access requires CEII confirmation (PJM and MISO)
 - Access requires PROMOD vendor (ABB) confirmation
 - PROMOD input files: .lib, .eve
 - Benchmark test case and results
- Auxiliary Files
 - Input Assumptions Summary
 - Updated Modeling Document which will provide details of setup and modeling methods
 - Benefit/Cost Evaluation Tool
 - ARR Data

- Final Market Efficiency 2018/19 base case, problem statement, congestion drivers, and required documentation to be posted before November 1st 2018
- PROMOD modeling sensitivity cases will be posted
- Long-Term Market Efficiency Window opens November 1st 2018

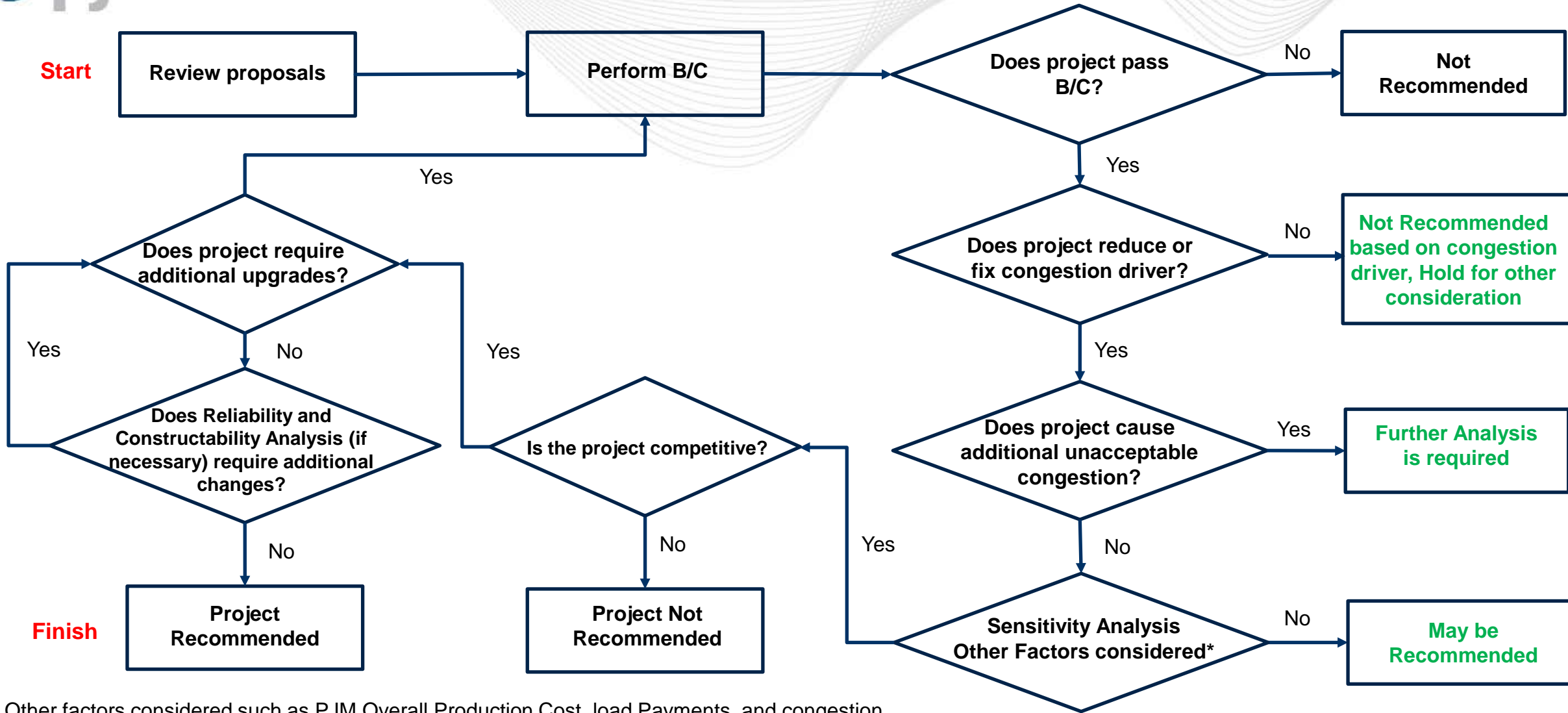
Appendix A

Proposal Analysis - Process Overview

- Step 1: Review submitted project data
 - PJM will contact project sponsor for further clarification as needed
- Step 2: First pass of project evaluations assuming proposer supplied data
- Step 3: Group projects by target congestion driver
- Step 4: Perform detailed analysis
 - Analyze proposals including mid cycle incremental updates
 - Sensitivity runs: load forecast, gas forecast, etc.



Project Selection – Multiple Proposals per Congestion Driver



* Other factors considered such as PJM Overall Production Cost, load Payments, and congestion

- Project must reduce or relieve economic congestion on identified PJM constraints
- Project's Benefit/Cost Ratio > 1.25
 - Various scenario analysis may be performed
- Cost
 - Consistent with the OA Schedule 6 section 1.5.7 (g), for a Market Efficiency proposal with costs in excess of \$50 million, an independent review of such costs will be performed
- Projects may be further analyzed for other secondary considerations
 - Zonal/Total Savings
 - Risk Evaluation
 - Sensitivity Evaluation
 - Reliability Impacts

Appendix B

2017 Historical Congestion



Top 25 Congestion Causing Constraints in 2017

Rank	Constraint	Type	Location	Approximate total Market Congestion (Millions)*	% of Total Congestion*	Comment
1	Braidwood - East Frankfort	M2M	ComEd	\$43.4	6.2%	RTEP upgrades expected to reduce congestion (s0756 breaker replacement).
2	Conastone - Peach Bottom	PJM Line	500	\$39.5	5.7%	RTEP upgrades expected to reduce congestion (b2766 substation equipment upgrade).
3	Emilie - Falls	PJM Line	PECO	\$25.1	3.6%	RTEP upgrades expected to reduce congestion (b2774 Emilie - Falls 138 kV line reconductoring). Partial congestion is outage related (work on Alburdis-Branchbu, Bustleto-Crosswic, Emilie-Roll, Crosswic-Wardav).
4	Graceton - Safe Harbor	PJM Line	BGE	\$23.9	3.4%	RTEP upgrades expected to reduce congestion (b2690 Graceton - Safe Harbor 230 kV line reconductoring). Partial congestion is outage related (work on Conaston-Ottcrkpl, Conaston-Peachbot, Manor-Safeharb, Conaston-Hunterst).
5	5004/5005 Interface	Interface	500	\$22.5	3.2%	West - East Transfers.
6	AP South	Interface	500	\$21.6	3.1%	RTEP upgrades expected to reduce congestion (b2752, b2743).
7	Westwood	M2M	MISO	\$19.6	2.8%	
8	Cherry Valley Transformer	M2M	ComEd	\$18.7	2.7%	RTEP upgrades expected to reduce congestion (s0900 parallel xfmr).
9	Carson - Rawlings	PJM Line	Dominion	\$18.2	2.6%	
10	Conastone - Otter Creek	PJM Line	PPL	\$15.1	2.2%	RTEP upgrades expected to reduce congestion (s0233 Otter Creek - Conastone 230 kV line rebuild). Partial congestion is outage related (work on Manor-Safeharb, Conaston-Hunterst).

*Data from 2017 State of Market Report



Top 25 Congestion Causing Constraints in 2017 (Cont'd)

Rank	Constraint	Type	Location	Approximate total Market Congestion (Millions)*	% of Total Congestion*	Comment
11	Conastone - Northwest	PJM Line	BGE	\$14.1	2.0%	RTEP upgrades expected to reduce congestion (b2752.7 Conastone - Northwest 230 kV lines reconductor/rebuild). Partial congestion is outage related (work on Conaston-Northwes, Brighton-Conaston).
12	Three Mile Island	Transformer	500	\$13.3	1.9%	Impacted by Three Mile Island retirement.
13	Butler - Shanorma	PJM Line	APS	\$11.4	1.6%	RTEP upgrades expected to reduce congestion (b2696 substation equipment upgrade at Butler, Shanor Manor and Krendale substations).
14	Lakeview - Greenfield	PJM Line	ATSI	\$10.8	1.5%	Partial congestion is outage related (work on Beaver-Davisbes, Hayes_FE-Davisbes, Lemoyne2 - Wfremont)
15	Alpine - Belvidere	M2M	MISO	\$10.8	1.5%	RTEP upgrades expected to reduce congestion (b2141 Construct Byron - Wayne 345 kV line).
16	Bedington - Black Oak	Interface	500	\$9.5	1.4%	West - East Transfers. Future reactive upgrades expected to reduce congestion.
17	Person - Sedge Hill	PJM Line	Dominion	\$9.3	1.3%	Partial congestion is outage related (work on Carson4-Rogersrd)
18	Lake George - Aetna	M2M	MISO	\$9.2	1.3%	
19	Batesville - Hubble	M2M	MISO	\$8.9	1.3%	RTEP upgrades expected to reduce congestion (b2634 Convert Miami Fort 345 kV substation to a ring bus).
20	Byron - Cherry Valley	M2M	MISO	\$8.0	1.1%	RTEP upgrades expected to reduce congestion (b2141 Construct Byron - Wayne 345 kV line).

*Data from 2017 State of Market Report



Top 25 Congestion Causing Constraints in 2017 (Cont'd)

Rank	Constraint	Type	Location	Approximate total Market Congestion (Millions)*	% of Total Congestion*	Comment
21	AEP - DOM	Interface	500	\$7.8	1.1%	West - East Transfers. Future reactive upgrades expected to reduce congestion.
22	Brunner Island - Yorkanna	PJM Line	Met-Ed	\$7.5	1.1%	RTEP upgrades expected to reduce congestion (b2691 Reconductor Brunner Island - Yorkanna 230 kV line).
23	Brokaw - Leroy	M2M	MISO	\$7.3	1.0%	
24	Loretto - Vienna	PJM Line	DPL	\$6.9	1.0%	Partial congestion is outage related (work on Nsalisbur-Pemberton)
25	Pleasant View - Ashburn	PJM Line	Dominion	\$6.8	1.0%	
Top 25				\$389.2		
Total Congestion				\$697.6		

*Data from 2017 State of Market Report

Questions?

Email: MarketEfficiencyGroup@pjm.com

- Revision History
 - V1 – 10/24/2018 – Original Version Posted to PJM.com