PJM White Paper

Transource Independence Energy Connection Market Efficiency Project

PJM Interconnection
November 15, 2018

This page is intentionally left blank.

Contents

Highlights

- PJM Interconnection's latest re-evaluation of the Transource Independence Energy Connection project (Transource project) shows that it continues to offer economic benefits in the region and resolves burgeoning reliability issues.
- The Transource project will enhance competition by allowing power from low-cost generators to flow to consumers in areas of eastern PJM.
- The benefit/cost ratio of the most recent re-evaluation – excluding the reliability benefits – is 1.40, exceeding the 1.25 ratio necessary to remain in the PJM Regional Transmission Expansion Plan (RTEP).
- Without the Transource project, PJM has identified reliability violations on five major transmission facilities on the regional bulk power system as early as 2023. PJM would have to quickly implement solutions to these potentially costly issues to maintain reliability. This equates to direct reliability benefits to consumers in Pennsylvania and Maryland.
    - The 500 kV Peach Bottom-to-Conastone line is forecast to overload, as would a 500 kV/230 kV transformer at Three Mile Island.
    - Three 115 kV transmission lines in Adams County, Pa., are forecast to overload.
- The Transource project will also increase the maximum megawatts that can be imported under peak conditions into the Baltimore Gas and Electric Co. (BGE) Load Deliverability Area (LDA). This increase in the Capacity Emergency Transfer Limit (CETL) will result in benefits to the regional capacity market in 2023.

Executive Summary

PJM Interconnection solicits and authorizes transmission expansion projects for a variety of purposes: To ensure the reliability of the regional high-voltage transmission system so enough electricity is available for consumers, and to minimize the risk of disruptions. PJM also seeks to improve the efficiency of the high-voltage transmission system to enhance competition. Market efficiency projects increase the ability of low-cost generators to supply electricity to the market by relieving constraints in the transmission system and allowing power to flow to consumers across the region. Under Order No. 2000, the Federal Energy Regulatory Commission (FERC) established the framework for regional transmission organizations in the United States. A goal of Order No. 2000 was to promote efficiency in wholesale electricity markets and ensure that electricity consumers pay the lowest price possible for reliable service. FERC said that competition in the wholesale markets is the best way to protect the public interest and achieve the lowest-cost reliable service. The Transource Independence Energy Connection project (IEC), is a market efficiency project that would establish two new 230 kV transmission lines across the Pennsylvania-Maryland border. It would allow low-cost power to flow into areas of eastern PJM, especially parts of Maryland and Northern Virginia and into the District of Columbia, relieving longstanding transmission system bottlenecks that, without relief, are forecast to continue into the future. Each year PJM staff analyzes the economic value of approved market efficiency projects.

The re-evaluation of the Transource project in September 2018 and a ratio update in October 2018, continued to find that it would provide benefits that extend across a wide area, including areas of Pennsylvania and Maryland.

I. Introduction

Transmission congestion arises when least-cost energy cannot be delivered to the consumer because of physical limitations to the electric transmission system. Indeed, recent history drives home the economic impact of congestion. Congestion across the four 500 kV transmission lines comprising the AP-South Interface along the Pennsylvania-Maryland border has imposed economic transmission constraint costs totaling approximately $800 million from 2012 through 2016[1]. These costs are ultimately borne by residents, commercial businesses and industrial customers in eastern PJM.

PJM's forward-looking studies have also identified persistent congestion on the AP-South Interface over a 15-year planning horizon. Those studies drove PJM's request during a 2014/2015 window for solicitation of technical solutions to alleviate the identified persistent congestion. Based on subsequent evaluation of the proposals received, PJM recommended the Transource project[2] – shown on **Map 1** – to alleviate AP-South congestion allowing lower-cost energy to be delivered efficiently and reliably to consumers.

The Transource project – also known as Project 9A – is expected to provide economic benefits at least 25 percent higher than the cost of the project. PJM uses this 1.25 benefit/cost threshold criterion in its FERC-approved planning process to evaluate market efficiency proposals for potential recommendation to the PJM Board of Managers (Board). With the Board's approval, recommendations become part of the Regional Transmission Expansion Plan (RTEP).

Since 2016, PJM has evaluated the need for the Transource recommended project four times, the most recent in September 2018. All four evaluations – the original justification and three subsequent re-evaluations, shown in **Table 1** – confirmed the project provided significant economic benefits and passed the required 1.25 benefit/cost threshold. The re-evaluations have continued to reaffirm the PJM Board's August 2016 approval of the Transource project.

[1] Data drawn from State of the Market Reports published by PJM's market monitoring unit, Monitoring Analytics.
[2] The Transource project was originally designated Project 9A within the context of PJM's RTEP process and has appeared in PJM documentation labelled as such.

Map 1 IEC Project – AP-South Interface Congestion Solution

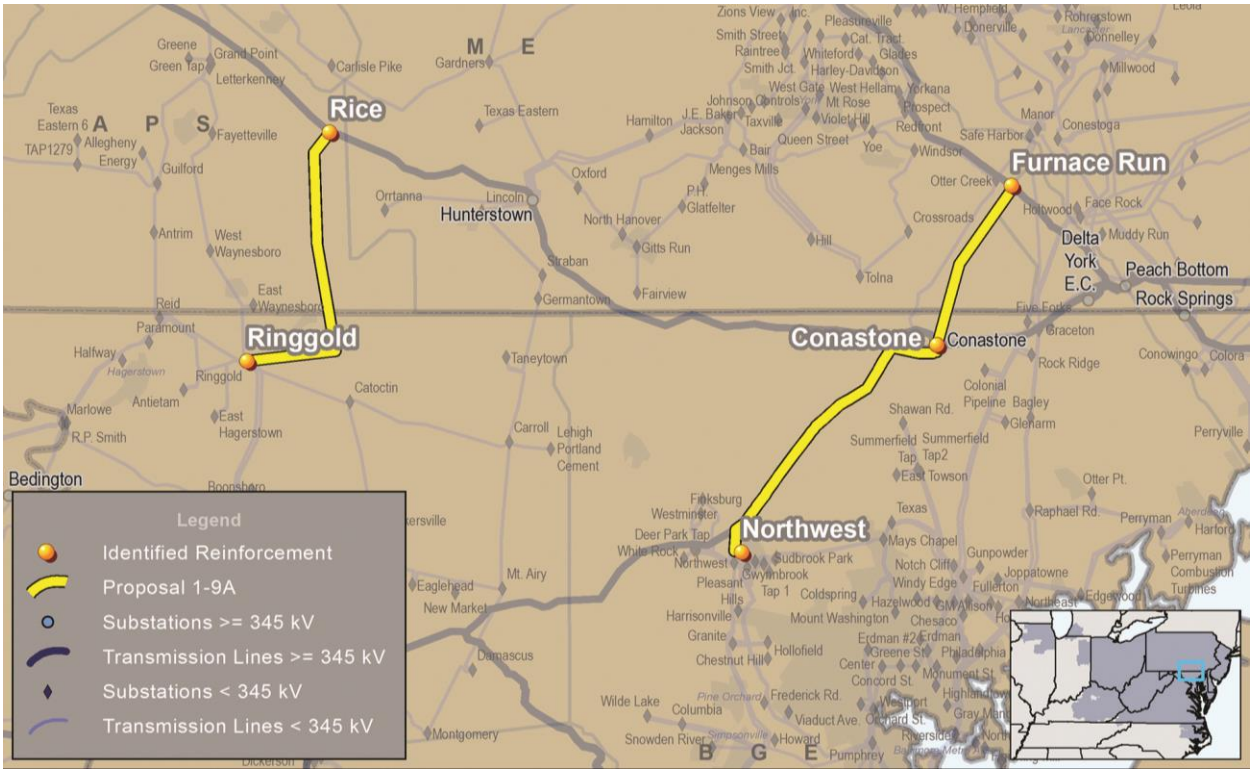


Table 1 IEC Benefit/Cost Ratio Evaluation History

IEC Evaluation	Benefit / Cost Ratio	Benefit ($M)	Cost ($M) Revenue Requirement	Nominal Project Cost ($M)
Original August 11, 2016 – Board Presentation	2.48	$1,188.00	$478.15	$340.60
Re-Evaluation No. 1 September 14, 2017 – TEAC Presentation	1.30	$600.73	$462.87	$340.60
Re-Evaluation No. 2 February 8, 2018 – TEAC Presentation	1.32	$611.48	$462.87	$340.60
Re-Evaluation No. 3 September 13, 2018 – TEAC Presentation	1.42	$707.29	$497.62	$366.17
Ratio Update October 16, 2018	1.40	$707.29	$505.85	$372.20
		Present value of load payment benefit (for zones where payments decreased)	Present value of the 15-year annual revenue requirement for IEC project	

Reliability Benefits

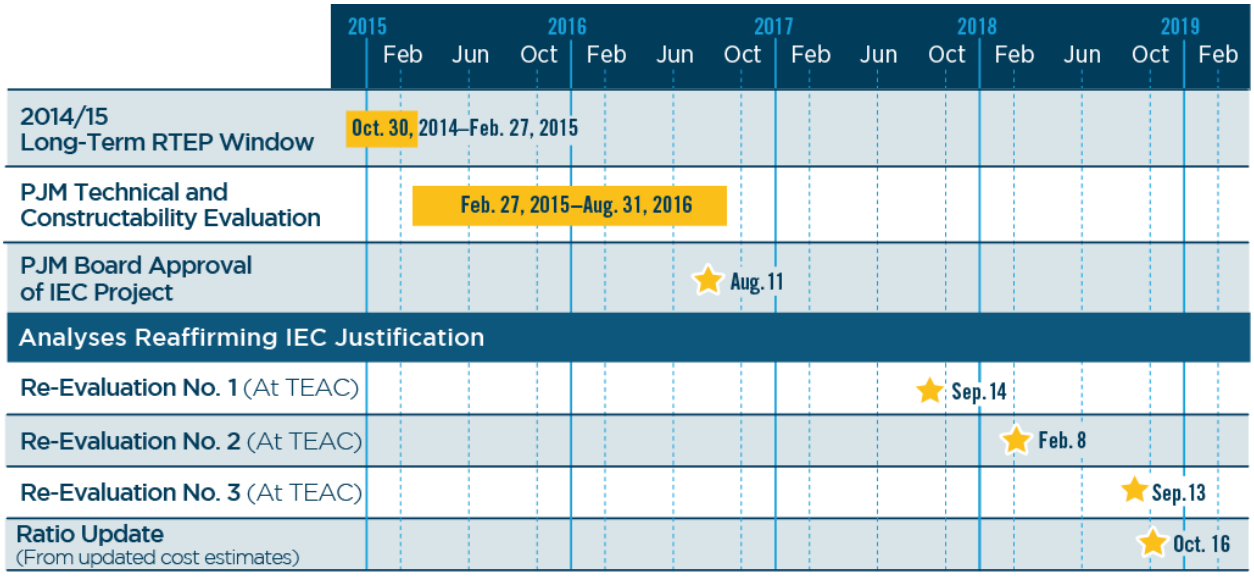
The Transource project was approved by the PJM Board in 2016 as the more efficient, cost-effective project to address persistent congestion identified in forward-looking economic studies on the AP-South Interface. While not needed to address reliability criteria violations at that time, PJM noted that the project would inherently enhance system reliability by introducing additional transmission network paths. In parallel with the September 2018 benefit/cost ratio re-evaluation, PJM assessed the extent to which the Transource project provides identifiable reliability benefits. Power flow results have confirmed that the Transource project does indeed solve identified 2023 overloads on a 500 kV line, a 500/230 kV transformer and other transmission facilities.

II. Third Re-Evaluation Reaffirms Transource Project

PJM recommended the Transource project from among 41 developer proposals formally submitted as part of a solicitation window from Oct. 30, 2014 through Feb. 27, 2015. Initial evaluation of the Transource project proposal yielded a benefit/cost ratio of 2.48. Given that the ratio exceeded PJM's Tariff-specified 1.25 threshold for market efficiency projects, the result justified the Transource project approved by the PJM Board in August 2016, as shown in the timeline in **Figure 1**.

Based on established RTEP planning practice – consistent with the PJM Operating Agreement (OA) – PJM conducted subsequent re-evaluations, also shown in the **Figure 1** timeline. PJM conducted studies in September 2017 and February 2018 to re-evaluate the Transource project under updated project cost and simulation input parameters. Those re-evaluations yielded benefit/cost ratios of 1.30 and 1.32, respectively, as summarized earlier in **Table 1**. As **Table 1** also shows, PJM has completed a third September 2018 re-evaluation reaffirming project justification with a benefit/cost ratio equal to 1.42, decreasing slightly to 1.40 in October 2018 with updated cost estimates from Transource for its portions of the project. The project also addresses emerging reliability issues and, as mentioned later, provides capacity market benefits in the BGE LDA.

Figure 1 IEC Approval Timeline



Benefit/Cost Ratio Reaffirms Need

PJM updated its production cost simulation models again in September 2018 to reflect the most recently updated input parameter information: AP-South reactive interface limits, transmission topology, interchange with adjoining systems, natural gas and other fuel price forecasts, emissions forecasts and interconnection generator statuses. The updated analysis yielded a net load payment benefit of $707.29 million.

From a project cost perspective, the September 2018 re-evaluation included a project cost estimate of $366.2 million, reflecting a $26 million increase over the $340.6 million project estimate used in the May 2016, September 2017 and February 2018 evaluations. The largest cost-estimate changes were due to the following increases: $6 million for the Furnace Run tie-in, $11.2 million for the Rice tie-in and $7.4 million to reconductor and rebuild the Conastone-Northwest 230 kV transmission line.

These updated benefit and cost values yielded a benefit/cost ratio of 1.42, reaffirming again the Board's approval of the Transource project. PJM also notes that congestion savings are estimated at over $860 million over 15 years, providing additional economic benefit.

In October 2018, PJM received updated cost estimates from Transource for its portions of the project, which increased the total estimated project cost from $366.2 million to $372.2 million. A project cost breakdown as of October 2018 is provided in APPENDIX A1. That cost increase had the effect of reducing the benefit/cost ratio slightly from 1.42 to 1.40.

III. Reliability Benefits

In parallel with the September 2018 benefit/cost ratio re-evaluation, PJM also assessed the extent to which the Transource project provides concrete, identifiable reliability benefits. Power flow results have confirmed that the Transource project does indeed do so. System changes arising since 2016 – including topology additions and generator deactivations – are contributing to reliability criteria violations identified in the 2023 study year power flow analysis.[3] Absent the Transource project, baseline system enhancements would be required to address the following overloads shown on **Map 2**:

- TMI 500/230 kV transformer
- Peach Bottom-Conastone 500 kV line
- Hunterstown-Lincoln 115 kV line
- Lincoln Tap-Lincoln 115 kV line
- Lincoln-Straban 115 kV line

[3] More specifically, the analysis identified multiple reliability criteria violations under a combination of summer and winter generation deliverability tests.

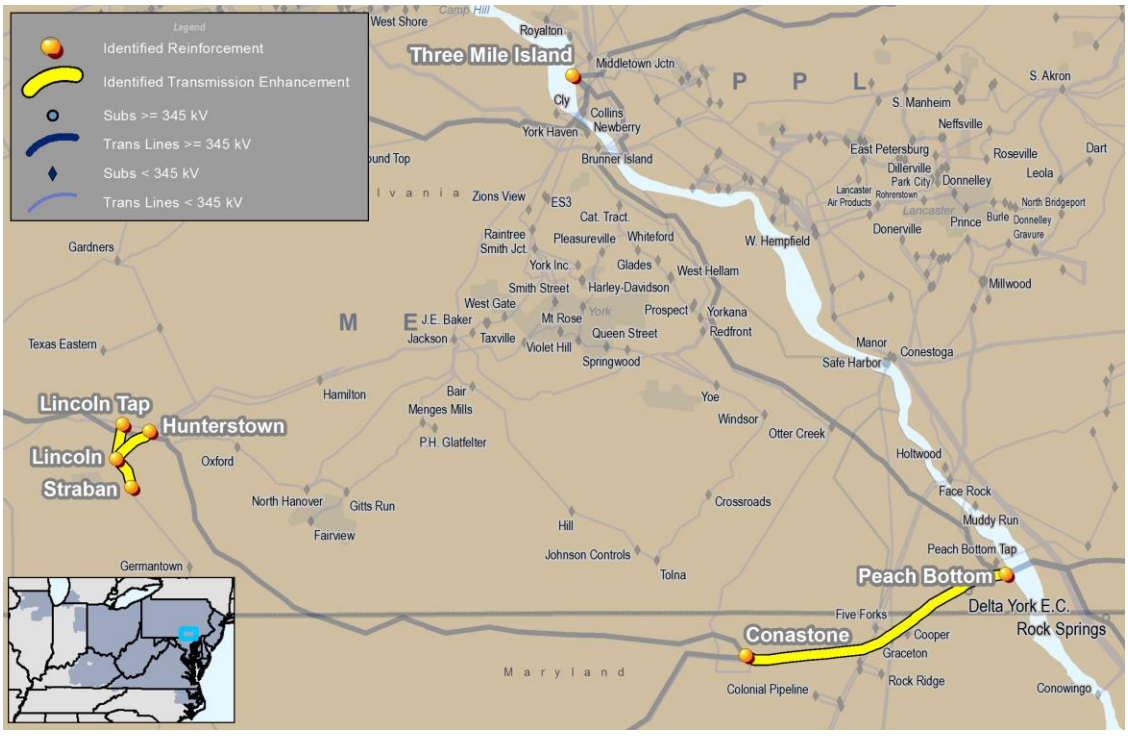
The Peach Bottom-Conastone 500 kV overload, in particular, draws attention. A solution and estimated cost for a violation of this scope are typically non-trivial. It highlights to an even greater degree the reliability benefit of implementing the Transource project.

Overloading electric transmission equipment, much like connecting too many appliances to a home extension cord, can cause the equipment to heat up beyond its limits and fail. This can result in damage to the system and widespread power outages. Without the Transource project, and absent other major infrastructure improvements, dispatchers would, in the near term, have to re-dispatch power generators around the trouble spots to avoid the overloads. This re-dispatch of generation would likely cause additional transmission system congestion and higher costs to consumers in areas of Maryland and Pennsylvania. Completing the Transource project would address the forecast reliability issues in Pennsylvania and Maryland and the accompanying congestion they could cause.

CETL Improvement Provides RPM Benefit

PJM notes that reliability studies also revealed that the addition of the Transource project increased the Capacity Emergency Transfer Limit (CETL[4]) for the BGE LDA, yielding Reliability Pricing Model (RPM) capacity market benefits in 2023. Access to lower-priced capacity resources outside the BGE LDA is likely to result in lower-capacity prices inside the BGE area.

Map 2 Reliability Criteria Violations – September 2018 Analysis Without IEC



[4] A CETL value represents the maximum megawatts that an LDA can import under specified peak load test conditions. Transmission system topology changes, load forecasts, generation additions and generation deactivations can all impact CETL values.

IV. Background – Initial Evaluations Justifying Project Selection

PJM opened a long-term RTEP window from Oct. 30, 2014 through Feb. 27, 2015, to solicit, among other system needs, proposals to alleviate AP-South interface congestion identified in long-term simulation results, shown in **Table 2**. The AP-South Interface is shown on **Map 3**. PJM is required[5] to recommend transmission system enhancements to lower costs to customers if project benefits exceed costs by at least 1.25[6]. The benefit/cost calculation is described in APPENDIX A2: Benefit/Cost Ratio Calculation.

Submitted project proposals comprised system enhancements that would relieve congestion constraints for which no reliability-based RTEP project was already identified, as the 2014/15 Long-Term Window Problem Statement & Requirements document specified. PJM received 41 proposals to alleviate AP-South congestion. After extensive evaluation and stakeholder review, PJM selected and recommended the Transource project as approved by the PJM Board in August 2016.

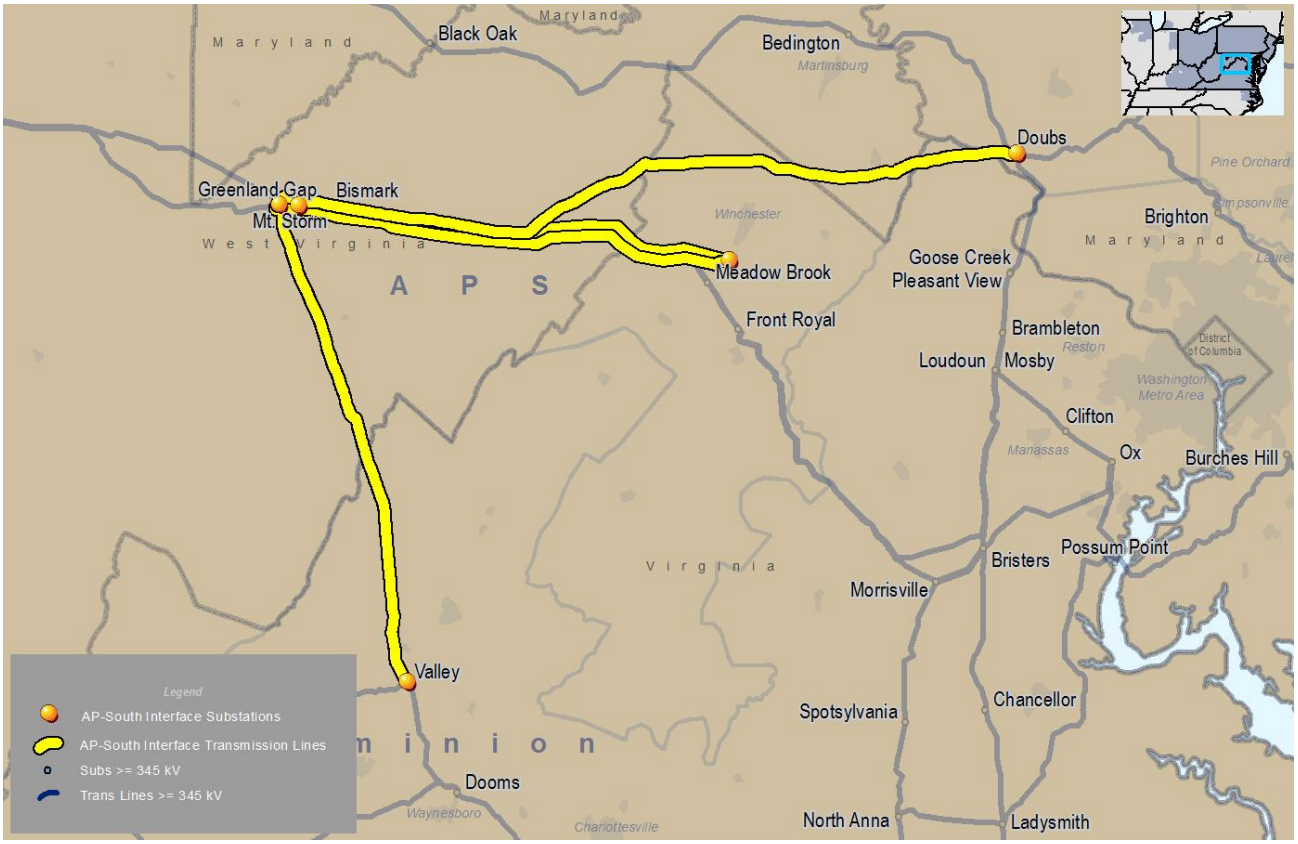
Table 2 Long-Term Simulated Congesion on the AP-South Interface

			Input Assumptions with 2019 Topology							
			2015		2019		2022		2025	
Limiting Facility	Type	Area(s)	Frequency (Hours)	Market Congestion ($M)	Frequency (Hours)	Market Congestion ($M)	Frequency (Hours)	Market Congestion ($M)	Frequency (Hours)	Market Congestion ($M)
AP-South for the loss of the Bedington-Black Oak 500 kV Line	Interface	PJM	1,525	$84.9	1,799	$110.2	1,503	$130.6	1,733	$182.3

[5] PJM's authority with respect to its planning process is based on its role as a FERC-approved RTO and its authority and responsibilities under the PJM Operating Agreement, the PJM Tariff and the PJM Consolidated Transmission Owners Agreement. The process is regulated by FERC. The final recommended RTEP is submitted to and approved by the PJM Board.

[6] Governed by Section 1.5.7(d) of Schedule 6 to the PJM Operating Agreement.

Map 3 AP-South Interface

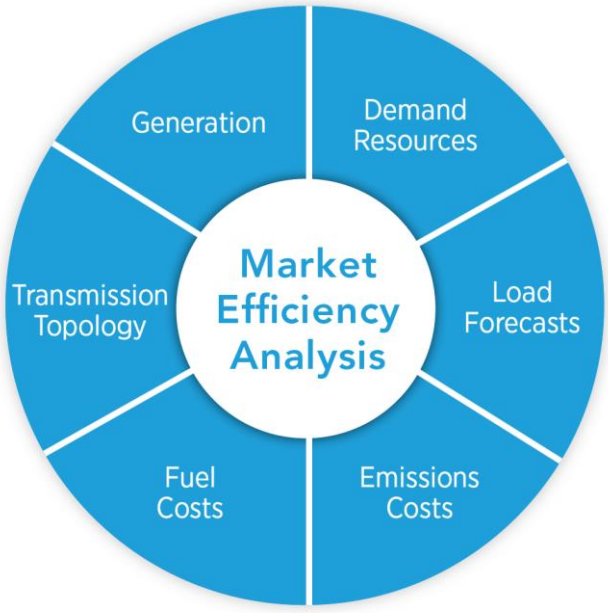


Congestion Relief

Congestion occurs when least-costly power available to serve load cannot be dispatched because transmission facility limits constrain power flow between two system points. This is the case with the AP-South Interface, shown earlier on **Map 3**. Power from lower-priced generating resources remote from eastern load centers, which include the Washington, D.C. and Baltimore metro areas, cannot flow freely to them. When this occurs, PJM's system operator must dispatch higher-cost resources to meet load at the receiving end of the constrained lines composing the AP-South Interface. The consequent locational marginal price (LMP) differences drive transmission congestion charges.

PJM market efficiency studies identified persistent congestion on the AP-South Interface over a 15-year planning horizon, shown earlier in **Table 2**. Production cost computer simulations show the extent of congestion under a given set of input parameters: fuel costs, emissions costs, load forecasts, demand resource projections, generation projections and expected future transmission topology, reflected in **Figure 2**.

Figure 2 Market Efficiency Analysis Parameters



Evaluating Proposals

Once the 2014/2015 long-term window closed, PJM evaluated proposals by comparing market efficiency simulation results with and without each project proposal over a 15-year horizon. The benefits yielded by these results were used to calculate a benefit/cost ratio for each project proposal to determine if further evaluation was justified.

Consistent with its FERC-approved process, PJM calculated each benefit/cost ratio by comparing the net present value of annual benefits determined for the first 15 years of project life to the net present value of the revenue requirement for the same 15-year period. Market efficiency transmission proposals that met the 1.25 benefit/cost ratio threshold were further assessed in order to examine their impact on system reliability, all prior to recommendation to the PJM Board for approval.

Reaching a recommendation for AP-South required a series of market efficiency studies and reliability analyses conducted over the course of 18 months, shown earlier in the **Figure 1** timeline. During those 18 months, PJM completed numerous analyses that first assessed which of the initial 41 projects met the 1.25 threshold and did not introduce additional reliability criteria violations that could not be alleviated themselves. Coupled with additional scenario studies that assessed the impact of load and natural gas price sensitivity and various proposal combinations, PJM ultimately determined that the Transource project met the benefit/cost threshold and provided the overall highest economic benefits.

Evaluating Constructability

Once the 2014/2015 Long-Term window closed, PJM proceeded with the analytical evaluation discussed above as well as constructability evaluation. More specifically, the PJM Operating Agreement Section 1.5.7(g) requires that PJM develop an independent cost estimate for market efficiency projects with cost estimates in excess of $50 million,

as was the case with the Transource project and several others. PJM engaged an independent consultant who verified that the proposed costs, schedule duration and risks for the Transource project were within expected ranges for a project of this scope.

PJM Board Approves the Transource Solution

The project was approved by the PJM Board in August 2016, with an estimated cost of $340.6 million and a required in-service date by June 1, 2020. Expected 15-year congestion and load payment savings were $622 million and $269 million, respectively. The Transource project as proposed by Transource Energy, LLC, was found to provide the more efficient and cost-effective benefits of the project proposals under consideration. The project includes a western component – Rice-Ringgold 230 kV line – and an eastern component – Furnace Run-Conastone-Northwest 230 kV line – shown earlier on **Map 1**, providing additional paths from the area 500 kV system to load on transmission at lower voltage levels. The project's elements are described in APPENDIX A3: IEC Project Components**.**

September 2017 Re-Evaluation

As part of its 2016/2017 market efficiency cycle – and consistent with established practice – PJM conducted a mid-cycle update to its production cost model to reflect the most recent updates to transmission topology, system loads, generation fuel costs, generation and emissions assumptions. New production cost simulations based on these updated parameters results yielded a $600.73 million present value of net load payment benefit (for zones where payments decreased). Nominal project cost remained at $340.6 million yielding a $462.87 million 15-year present value annual revenue requirement. The benefit/cost ratio calculation itself yielded a 1.30 value, reaffirming justification for the Transource project. Given that the cost estimate had not changed since the original 2016 calculation, the lower benefit/cost ratio was attributable to reduced load payment benefits based on updated production cost simulation input parameters.

February 2018 Second Re-Evaluation

PJM conducted a second re-evaluation in February 2018 to reflect the most recent market efficiency base case released on Jan. 9, 2018. Importantly, that case reflected the January 2018 PJM Load Forecast. New production cost simulations based on these updated parameters results yielded a $611.48 million present value of net load payment benefit (for zones where payments decreased). Project cost estimates had not changed since September 2017 – $340.6 million – yielding a $462.87 million 15-year present value annual revenue requirement. The benefit/cost ratio calculation itself yielded a 1.32 value, reaffirming justification for the Transource project. Given that the cost estimate had not changed since the original 2016 ratio calculation and September 2017 re-evaluation, the benefit/cost ratio – lower than the 2.48 original – was attributable to reduced load payment benefits based on updated production cost simulation input parameters.

September 2018 Third Re-Evaluation

PJM conducted a third re-evaluation during the summer of 2018. That study re-evaluated the Transource project under an updated project cost estimate of $366.17 million and simulation input parameters. (The increase in cost included in the September 2018 cost update was due to non-Transource project elements of the Transource project.) Doing so yielded a benefit/cost ratio equal to 1.42 and congestion savings estimated at more than $860 million over 15 years.

October 2018 IEC Benefit/Cost Ratio Update

In October 2018, Transource submitted updated cost estimates for its portion of the project, increasing the project capital cost from $366.17 million to $372.23 million. The updated cost estimates reduced the benefit/cost ratio from 1.42 to 1.40. A breakdown of individual element costs is included in APPENDIX A1.

PJM's Role

As background, PJM's federally authorized role in the RTEP process is to study the transmission system across its territory and identify the need for enhancements and expansions, solicit and evaluate proposals and designate developers (incumbent transmission owners and non-incumbent transmission developers) to implement Board-approved projects included in the RTEP. Given the long lead times required for new transmission facilities to reach commercial operation, PJM looks ahead up to 15 years to identify regional transmission expansion needs. PJM does not play a role in siting transmission facilities. The entity designated to build the RTEP project bears the responsibility to identify and secure rights of way and to obtain the necessary state and local approvals.

Conclusion

PJM's updated analyses continue to demonstrate that the Transource project continues to offer considerable economic and reliability benefits. For many years, the regional high-voltage transmission system has constrained the flow of the lowest-cost electricity into areas of eastern PJM, resulting in comparatively higher electric bills for customers who live in those areas. The Transource project will allow for a more efficient flow of low-cost energy into those areas. As a result, the project's benefits continue to justify the costs and it remains in PJM's RTEP. Today, such re-evaluations have also shown that the Transource project will address five identified reliability criteria violations that, if not addressed, could cause overloads on the transmission system as early as 2023. Additionally, the project will increase the Capacity Emergency Transfer Limit into the BGE LDA by 2023. As of September 2018, the project has submitted applications for certificates of public convenience and necessity before both the Pennsylvania Public Utility Commission and the Maryland Public Service Commission. If approved by the state regulators, the project may proceed. PJM will continue to re-evaluate the project periodically to ensure that, as system conditions evolve, the project remains beneficial to the region.

V. APPENDIX A1: October 2018 IEC Project Cost Breakdown

Upgrade ID	Description	TO/ Designated Entity	Full In-Service Year Estimate
b2752.7	Conductor/rebuild the two Conastone-Northwest 230 kV lines and upgrade terminal equipment on both ends.	BGE	$52.14
b2752.6	Conastone 230 kV substation tie-in work (install a new circuit breaker at Conastone 230 kV and upgrade any required terminal equipment to terminate the new circuit).		$6.14
b2752.5	Build new 230 kV double-circuit line between Furnace Run and Conastone 230 kV, operated as a single circuit.	Transource	$53.25
b2752.4	Upgrade terminal equipment and required relay communication at TMI 500 kV: on the Peach Bottom-TMI 500 kV circuit.	ME	$2.00
b2752.3	Upgrade terminal equipment and required relay communication at Peach Bottom 500 kV: on the Peach Bottom-TMI 500 kV circuit.	PECO	$2.00
b2752.2	Tie in new Furnace Run substation to Peach Bottom-TMI 500 kV.		$6.90
b2752.1	Tap the Peach Bottom-TMI 500 kV line and create new Furnace Run 500 kV and 230 kV stations. Install two 500/230 kV transformers, operated together.	Transource	$41.46
b2743.6.1	Replace the two Ringgold 230/138 kV transformers.	APS	$14.13
b2743.6	Reconfigure the Ringgold 230 kV substation to double bus double breaker scheme.		
b2743.7	Rebuild/reconductor the Ringgold-Catoctin 138 kV circuit and upgrade terminal equipment on both ends.		$47.04
b2743.5	Build new 230 kV double-circuit line between Rice and Ringgold 230 kV, operated as a single circuit.	Transource	$98.35
b2743.4	Upgrade terminal equipment at Hunterstown 500 kV: on the Conemaugh-Hunterstown 500 kV circuit.	ME	$0.20
b2743.3	Upgrade terminal equipment at Conemaugh 500 kV: on the Conemaugh-Hunterstown 500 kV circuit.	PENELEC	$0.20
b2743.2	Tie in new Rice substation to Conemaugh-Hunterstown 500 kV.		$15.16
b2743.1	Tap the Conemaugh-Hunterstown 500 kV line and create new Rice 500 kV and 230 kV stations. Install two 500/230 kV transformers, operated together.	Transource	$33.26
		Total	$372.2

VI. APPENDIX A2: Benefit/Cost Ratio Calculation

PJM uses a benefit/cost ratio test to determine whether an economic-based enhancement or expansion will be included in the RTEP. Specifically, to be included in the RTEP recommended to the PJM Board of Managers for approval, the relative benefits and costs of the economic-based enhancement or expansion must meet or exceed a benefit/cost ratio threshold of at least 1.25.

The benefit/cost ratio is calculated by dividing the present value of the total annual benefit for each of the first 15 years of the life of the enhancement or expansion by the present value of the total annual cost for each of the first 15 years of the life of the enhancement or expansion. Assumptions for determining the present value of the benefits and costs (e.g., discount rate and annual revenue requirement) are considered by the PJM Board of Managers each year to be used in the economic planning process.

The purpose of a benefit/cost ratio threshold is to hedge against the uncertainty of estimating benefits in the future and to provide a degree of assurance that a project with a 15-year net benefit near zero will not be approved. At the same time, the threshold is not so restrictive as to unreasonably limit the economic-based enhancements or expansions that would be eligible for inclusion in the RTEP.

Additional information explaining PJM's market efficiency process and the benefit/cost ratio in particular can be found in Manual 14B, "PJM Region Transmission Planning Process," Section 2.6 and Attachment E: https://www.pjm.com/-/media/documents/manuals/m14b.ashx

VII. APPENDIX A3: IEC Project Components

Project 9A, shown on **Map 1**, was approved by the PJM Board of Managers in August 2016 and includes the following components, designated to Transource and incumbent transmission owners as noted:

- The West Line: Approximately 27 miles of new double-circuit 230 kV alternating current overhead transmission line configured in a six-wired arrangement between the existing Ringgold Substation to a new Rice Substation that will tie into the existing Conemaugh-Hunterstown 500 kV line, assigned to Transource.
- The Ringgold Substation will be reconfigured and expanded to accommodate the new 230 kV circuit, assigned to APS.
- The new Rice Substation will include two 900 MVA, 500/230 kV transformers, one 230 kV breaker in a single bus configuration and three 500 kV breakers in a ring bus configuration, assigned to Transource.
- The East Line: Approximately 14.5 miles of new double-circuit 230 kV alternating current overhead transmission line configured in a six-wired arrangement between the existing Conastone Substation to a new Furnace Run Substation that taps the existing Three Mile Island-Peach Bottom 500 kV line, assigned to Transource.
- The new Furnace Run Substation will include two 900 MVA, 500/230 kV transformers, two 230 kV double-line terminal breakers and three 500 kV breakers in a ring bus configuration, assigned to Transource.
- The Conastone Substation will be expanded to accommodate the new double-circuit 230 kV lines and two new 230 kV breakers, assigned to BGE.
- Reconductor the Conastone-to-Northwest double-circuit 230 kV line, assigned to BGE.
- Replace the Ringgold No. 3 and No. 4 transformers with 230/138 kV autotransformers, assigned to APS.
- Reconductor the Ringgold-Catoctin 138 kV line, assigned to APS.