Section 13: Market Efficiency Analysis

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13.0: Overview

PJM's Regional Transmission Expansion Plan (RTEP) Process includes market efficiency analysis, the goal of which is to accomplish the following objectives:

1. Determine which reliability upgrades, if any, have an economic benefit if accelerated.

2. Identify new transmission upgrades that may result in economic benefits.

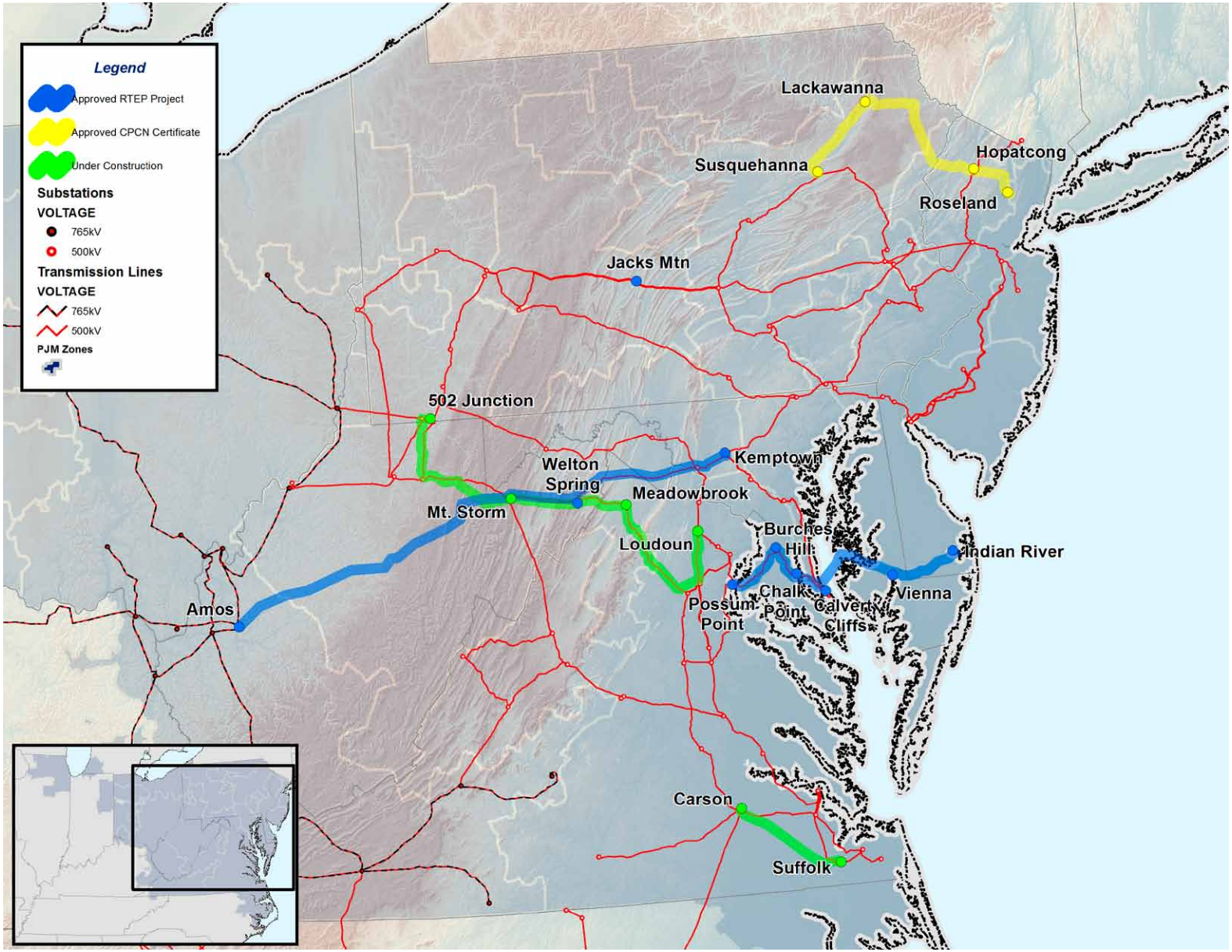
3. Identify economic benefits associated with modification to reliability-based enhancements already included in RTEP that when modified would relieve one or more economic constraints. Such upgrades resolve reliability issues but are intentionally designed in a more robust manner to provide economic benefits in addition to resolving those reliability issues.

PJM's 2010 market efficiency analysis evaluated several upgrades for inclusion in the PJM RTEP based on the economic benefits they are projected to provide. These economic upgrades relieve congestion and appear throughout the PJM footprint. The results for these studies are still under review.

For reference, Map 13.1 shows PJM Board approved RTEP Backbone Upgrades to resolve reliability criteria violations considered as part of PJM's 2010 market efficiency analysis.

Preliminary 2011 PJM RTEP process analysis suggests that the need for the PATH line has moved several years beyond 2015. The outlook for a slower economic recovery – reflected in the reduced load growth rates in PJM's January 2011 published forecast – has led the PJM Board to direct transmission owners to suspend efforts on the PATH line pending a more complete analysis in 2011 of all RTEP upgrades, including MAPP. **Section 5** of this report discusses the PATH suspension.

Map 13.1: PJM Board Approved Backbone Upgrades



The right-of-way route shown on this map is for illustrative purposes only and may not depict the actual route that may eventually be chosen. Substation locations may also be modified if more beneficial connections are determined by PJM.

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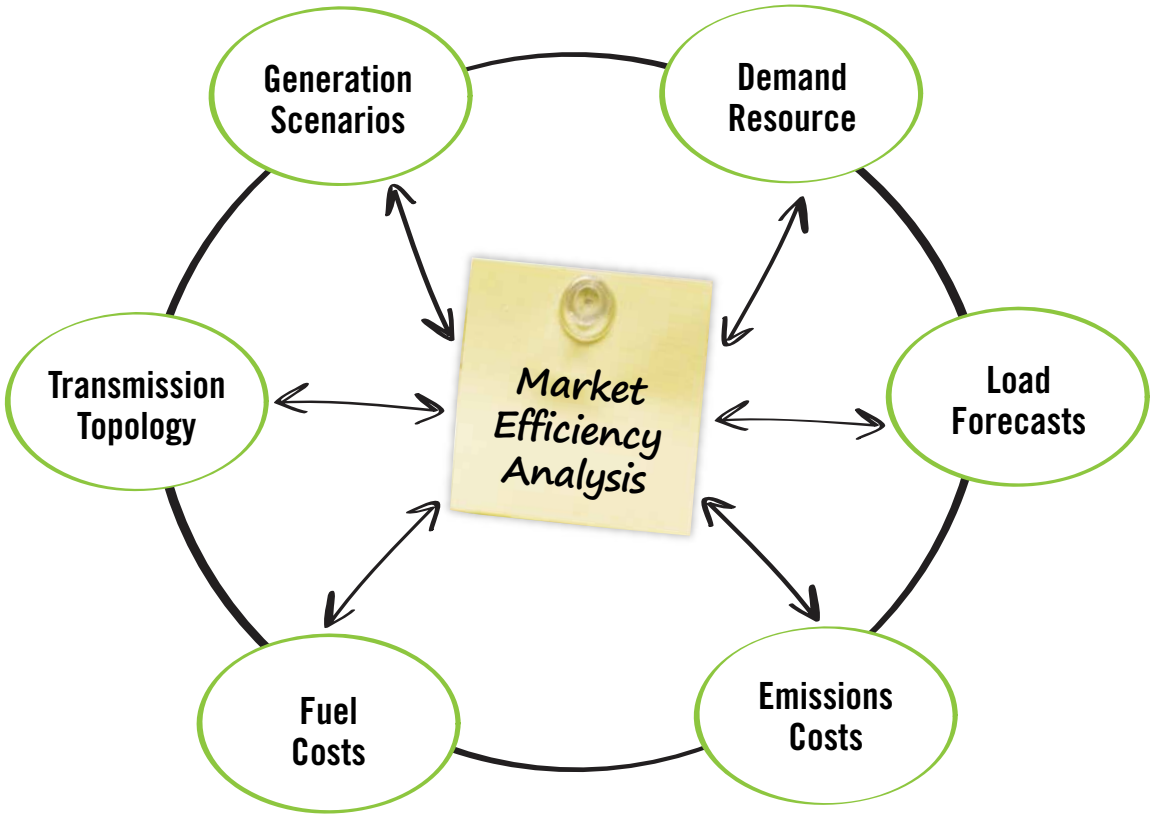
13.1: Simulation Methodology and Assumptions

PJM market efficiency analysis employs a market simulation tool that models hourly security-constrained generation commitment and dispatch over a defined future annual period. Economic benefits of transmission upgrades are determined by comparing results of simulations with and without defined transmission upgrades.

PJM's 2010 market efficiency analysis included market simulations for 2010, 2013, 2016 and 2019. Prior to the initiation of each annual market efficiency analysis, the PJM Transmission Expansion Advisory Committee (TEAC) reviews and the PJM Board approves key analysis parameters including fuel costs, emissions costs, future generation scenarios, load forecasts and Demand Resource projections, shown in Figure 13.1.

Figure 13.1: Market Efficiency Analysis Parameters



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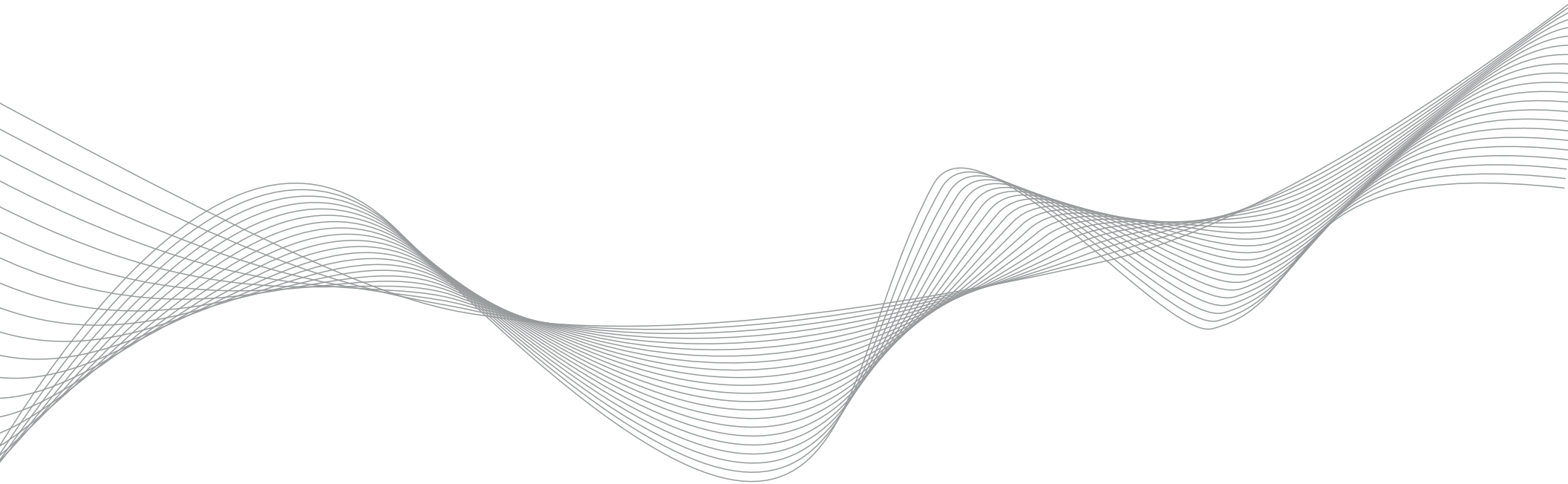

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13.2: 2010 RTEP Market Efficiency Analysis

13.2.0 – Overview

PJM's 2010 market efficiency analysis assessed the economic impact of all upgrades identified as part of PJM's RTEP process up through and including those identified as part of the 2009 RTEP cycle. This collective set of upgrades included the following backbone transmission lines:

- 502 Junction - Loudoun 500 kV Line (TrAIL) (Modelled beginning in study year 2013)
- Carson - Suffolk 500 kV Line (Modelled beginning in study year 2013)
- Amos - Kemptown 765 kV Line (PATH) (Modelled beginning in study year 2016)
- Susquehanna - Roseland 500 kV Line (Modelled beginning in study year 2016)
- Possum Point – Calvert Cliffs 500 kV Line, HVDC from Calvert Cliffs to Vienna/ Indian River (MAPP) (Modelled beginning in study year 2016)

Results have indicated that approved RTEP upgrades will significantly reduce PJM constrained operations. Such system conditions can and often require generation re-dispatch out-of-merit order incurring congestion costs to maintain transmission facilities within prescribed facility ratings.

PJM 2010 market efficiency analysis has shown that system congestion costs fall to levels approximately 40 percent lower than costs expected absent the upgrades, under the same generation and load scenarios.

In addition, PJM continued in 2010 to evaluate market efficiency proposals submitted by stakeholders to address congestion in future years. PJM performed benefit-to-cost threshold tests to determine their possible additional consideration for RTEP inclusion.

13.2.1 – 2010 and 2013 Study Year Results

Market efficiency studies assess transmission system impacts of approved backbone upgrades keeping all other input assumptions constant for a given study year. Market simulations for study years 2010 and 2013 were conducted under two transmission topology models:

- 2010 "as-is" PJM transmission system topology.
- 2014 RTEP PJM transmission system topology (includes all upgrades up through the 2009 RTEP process cycle including the TrAIL project and the Carson - Suffolk line)

Preliminary 2011 PJM RTEP process analysis suggests that the need for the PATH line has moved several years beyond 2015. The outlook for a slower economic recovery – reflected in the reduced load growth rates in PJM's January 2011 published forecast – has led the PJM Board to direct transmission owners to suspend efforts on the PATH line pending a more complete analysis in 2011 of all RTEP upgrades, including MAPP. **Section 5** of this report discusses the PATH suspension.

Figure 13.2 shows actual PJM system congestion costs for years 2006, 2007, 2008, 2009 and 2010 and congestion costs derived from market simulations for years 2010 and 2013 using the above two transmission topologies.

2010 Study Results

The 2010 study results shown in Figure 13.2 indicate that approved backbone upgrades significantly reduce system congestion costs. Simulations using a 2010 transmission system topology show PJM system congestion costs of nearly $1.7 billion. PJM system congestion costs for study year 2010 are reduced below $1 billion when a 2014 RTEP transmission topology is modeled.

2013 Study Results

Study year 2013 simulations, made using a 2010 transmission system topology, show PJM system congestion costs of about $3 billion. Congestion costs are reduced to nearly $1.9 billion when the 2014 RTEP transmission topology described above is modeled.

Comparing 2010 and 2013 Results

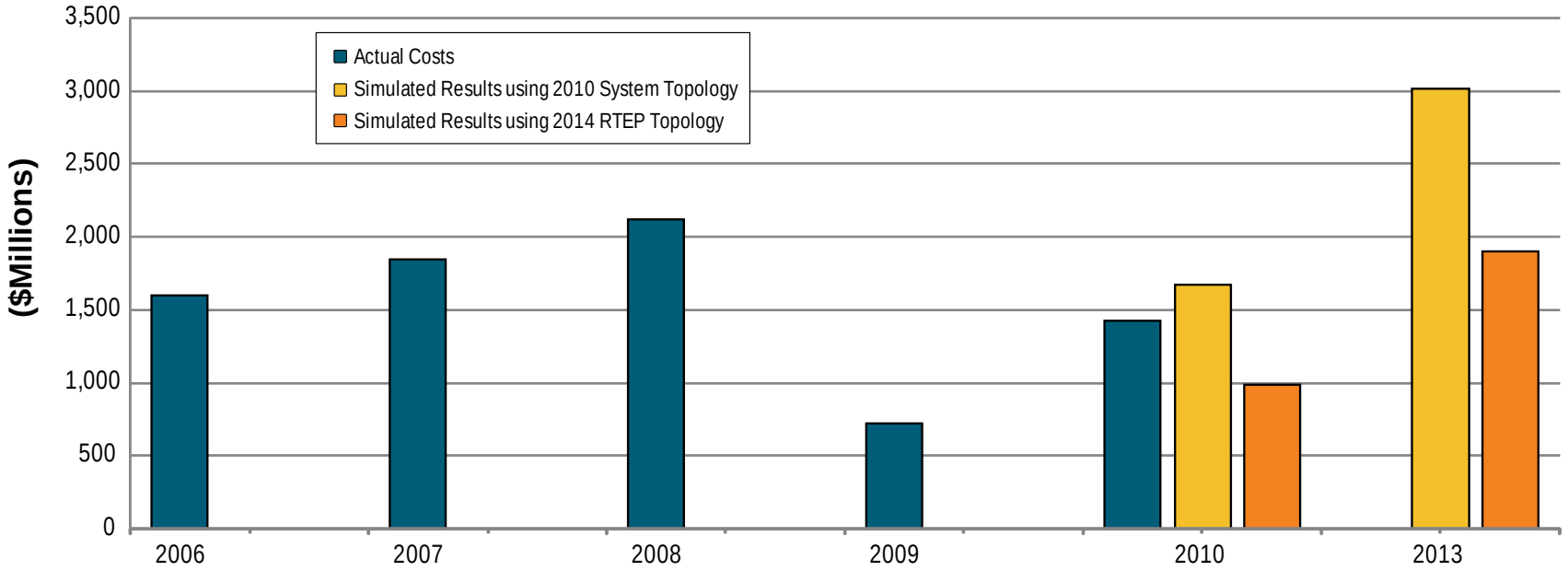
Figure 13.2 shows that actual congestion costs for 2010 have increased from 2009, mainly due to higher fuel prices, weather patterns and increased load levels. Market simulation results correctly predict these higher congestion cost levels for 2010 and also show increasing levels in 2013 due to projections of higher gas prices relative to coal prices and generation additions, primarily in the western part of the system.

While estimates of future congestion costs vary with changes in assumptions regarding key input parameters, the simulations show that the addition of the new transmission contained in the 2014 RTEP topology described above consistently reduce congestion costs to levels approximately 40 percent lower than congestion costs expected absent approved backbone upgrades.

13.2.3 – Stakeholder Proposed Upgrades

Any Transmission Expansion Advisory Committee (TEAC) member or other entity (consistent with PJM Operating Agreement Schedule 6 provisions), may formally submit alternative proposals for evaluation under the market efficiency analysis at any time. PJM's RTEP market efficiency planning analysis carries over from the RTEP cycle year into the first quarter of the following RTEP planning cycle year.

Figure 13.2: Actual and Simulated PJM System Congestion Costs – 2010 and 2013



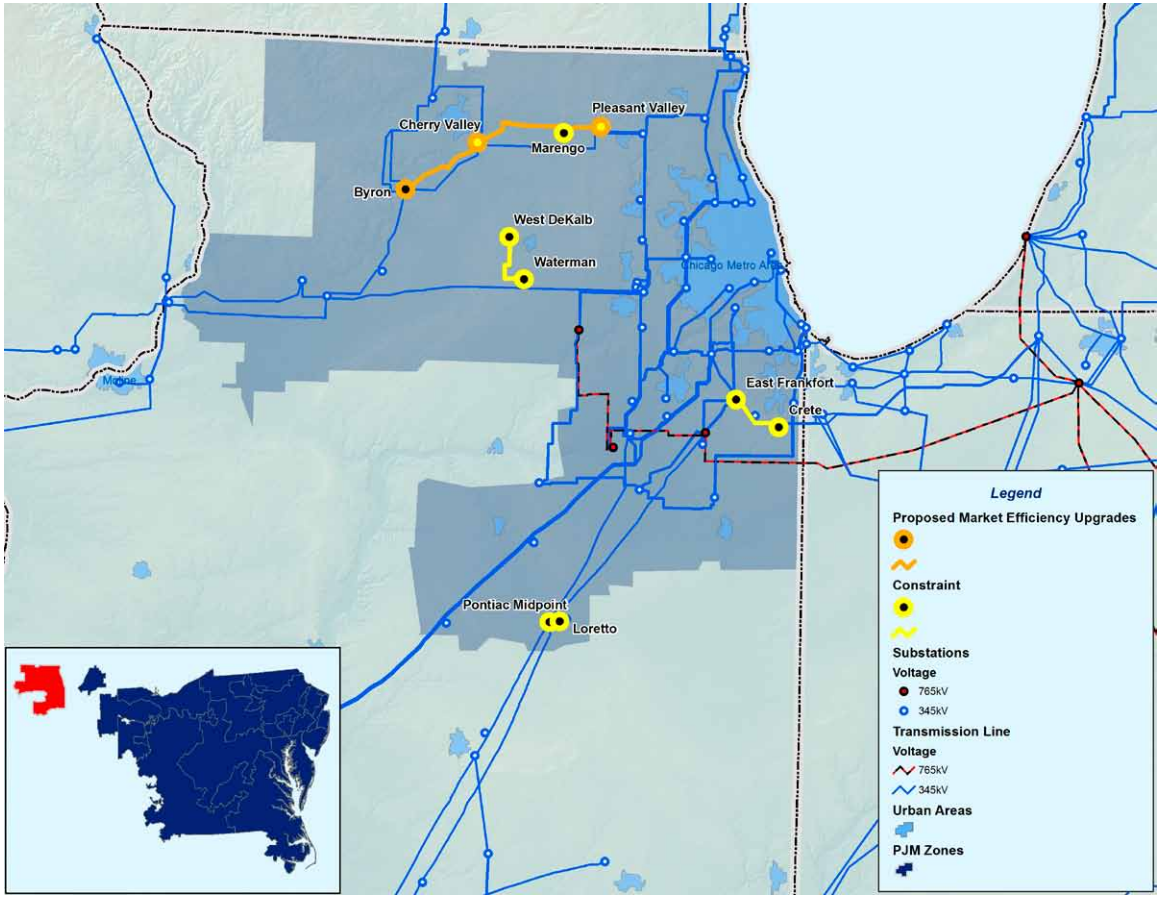
Benefit-to-Cost Analysis

Market efficiency transmission proposals that meet or exceed the 1.25 benefit-to-cost ratio threshold test are then further examined from a cost and reliability perspective prior to any RTEP recommendation to the PJM Board for approval.

PJM 2010 RTEP market efficiency analysis included market simulations and benefit-to-cost ratio calculations for transmission proposals submitted by stakeholders to address market efficiency. 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 a Benefit/Cost Ratio Threshold of at least 1.25:1. The Benefit/Cost Ratio is calculated by dividing the present value of the total annual benefit for each of the first fifteen years of the life of the enhancement by the present value of the total annual cost for each of the first fifteen years of the life of the enhancement.

Throughout 2010, PJM continued to evaluate stakeholder-proposed market efficiency upgrades to address congestion in three areas of PJM: ComEd Area, PPL/ METED/ PENELEC Area and Dominion / AEP Area. Initial benefit-to-cost results for the ComEd area have been completed. Similar analyses of proposed market efficiency upgrades for PPL/ METED/ PENELEC Area and Dominion /AEP Area are expected to be completed in early 2011.

Map 13.2: ComEd Market Efficiency Upgrade Proposals



NOTE

PJM Manual M14-B, Attachment E, which provides a detailed description of the benefit/cost ratio test, is available on PJM's website via the following URL link: http://pjm.com/~/media/documents/manuals/m14b.ashx..

ComEd Area

Stakeholders submitted ten proposals for consideration as part of the market efficiency analyses performed in 2010 to address congestion on ComEd facilities, shown on Map 13.2.

Stakeholder proposals to address future congestion in ComEd included the following:

1. A new single 345 kV line from Byron to Cherry Valley to Pleasant Valley.

2. Variations of #1, including Cherry Valley - Pleasant Valley 345 KV, Byron - Pleasant Valley 345 kV, and Byron-Wayne 345 kV.

3. A new single or double 345 kV line from Pontiac Midpoint to Reynolds to Dumont.

4. A new single or double 345 kV line from Quad Cities to Kewanee to Pontiac Midpoint to Reynolds to Dumont along with 345/138 kV transformers at Kewanee station.

5. Various configurations of #3 and #4 above.

Three of these proposals passed PJM's market efficiency benefit-to-cost analysis test:

- A new Byron to Cherry Valley to Pleasant Valley 345 kV line, at a cost of $112.5 million, with a benefit-to-cost ratio of 1.57.

- A new Byron to Pleasant Valley 345 kV line, at a cost of $105 million, with a benefit-to-cost ratio of 2.02.

- A new Cherry Valley to Pleasant Valley 345 kV line, at a cost of $67.5 million, with a benefit to cost ratio of 3.04.

Each of these three configurations exceeded the 1.25 benefit-to-cost ratio threshold and has been proposed for completion by June 1, 2015.

Next steps in 2011 will include an independent review of costs necessary because expected costs exceed the codified Operating Agreement threshold of $50 million. PJM will also conduct a sensitivity analysis of key input assumptions and run reliability analysis. Then, based on cost review, sensitivity analysis, and reliability analysis PJM will develop a recommendation for PJM Board consideration.

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13.3: Market Simulation Model Input Assumptions

Prior to the initiation of each annual market efficiency analysis, the PJM Transmission Expansion Advisory Committee (TEAC) reviews and the PJM Board approves the key analysis input parameters. Such parameters include fuel costs, emissions costs, load forecasts and Demand Resource projections. Full details are described in the proceedings of the PJM TEAC available on PJM's website via the following URL link: http://www.pjm.com/committees-and-groups/committees/teac.aspx.

General Fuel Cost Assumptions

PJM uses a commercially available tool which includes fuel cost forecasts for each fuel type. Forecasts for short-term gas and oil prices were derived from NYMEX futures prices.

Long-term forecasts were obtained from a Ventyx fundamental forecast and reference case. Coal price forecasts were also obtained.

Load and Energy Forecasts

PJM's January 2010 PJM Load Forecast Report provided the load and energy data modeled in these market simulations. Energy Efficiency cleared in the RPM simulations are modeled as reduced load.

Demand Resources

The 2010 study year values were based on the sum of the Interruptible Load for Reliability (ILR) and Demand Resources per cleared and fixed resource requirement (FRR) from the 2010/2011 RPM auction.

Generation Modeling

The generation capacity modeled included in-service generation plus active queue generation with an executed Interconnection Service Agreement (ISA) minus expected future deactivations.

The net internal demand is consistent with the 2010 PJM Load Forecast Report and equates to the PJM Summer unrestricted peak forecast minus the projection of load management placed under PJM control. Overall, projected total capacity is expected to be able to meet expected reserve margin through 2013. The PJM reserve requirement exceeds the total capacity of installed generation by approximately 3,300 MW, 8,000 MW and 17,300 MW in the years 2016, 2019 and 2024, respectively.

New generation needed to maintain PJM's reserve margin in study years 2016, 2019 and 2024 was added to the model according to the location and fuel type of generation interconnection requests in recent PJM queues.

Emission Allowance Price Assumptions

PJM models three major effluents: SO_2, NO_x and CO_2. Each is assigned to generators based on generator location. Release rates and emissions allowance prices are derived from the Ventyx Advisors Group. A national CO_2 allowance trading program was assumed in-place starting with study year 2015.