

Market Efficiency Update

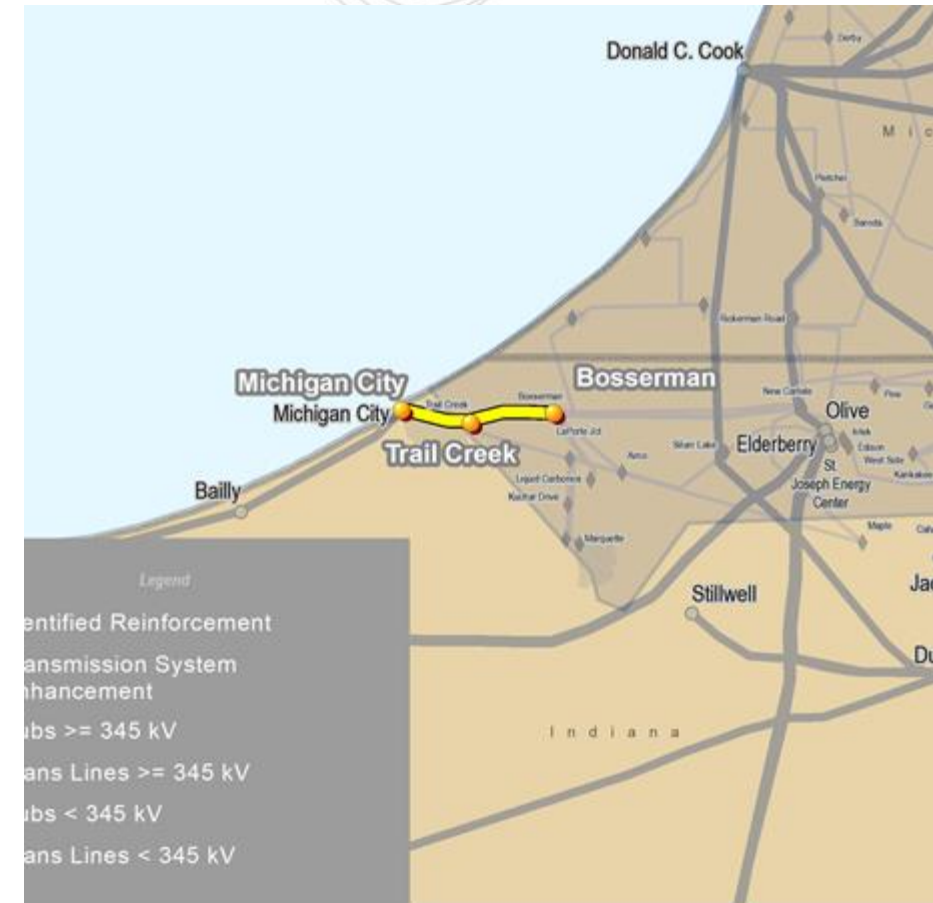
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Transmission Expansion Advisory Committee
November 14, 2019

2018/19 Market Efficiency Window

2018/19 Market Efficiency Window Interregional Analysis

- Analysis is complete, concluding 2019 PJM-MISO Coordinated System Plan
- Three drivers identified:
 - Marblehead N 161/138kV Transformer
 - No proposed project met B/C criteria in either region
 - Monroe – Wayne 345kV
 - No proposed project effectively resolved congestion
 - Bosserman – Trail Creek 138kV
 - Rebuilding Michigan City to Trail Creek to Bosserman 138kV to be recommended in both regional processes

- PJM selected BT_481, rebuilding Michigan City to Trail Creek to Bosserman 138 kV lines
- Results presented at Oct 2019 TEAC:
 - Highest B/C ratio
 - Robustly addresses congestion on identified issue
 - Passed reliability no-harm test
 - Passed all PROMOD sensitivity scenarios
- Recommended as Interregional Market Efficiency project in both PJM and MISO regional processes
- Interregional Cost allocation
 - PJM 89.1% MISO 10.9%





Bosserman-Trail Creek Proposal Final Results

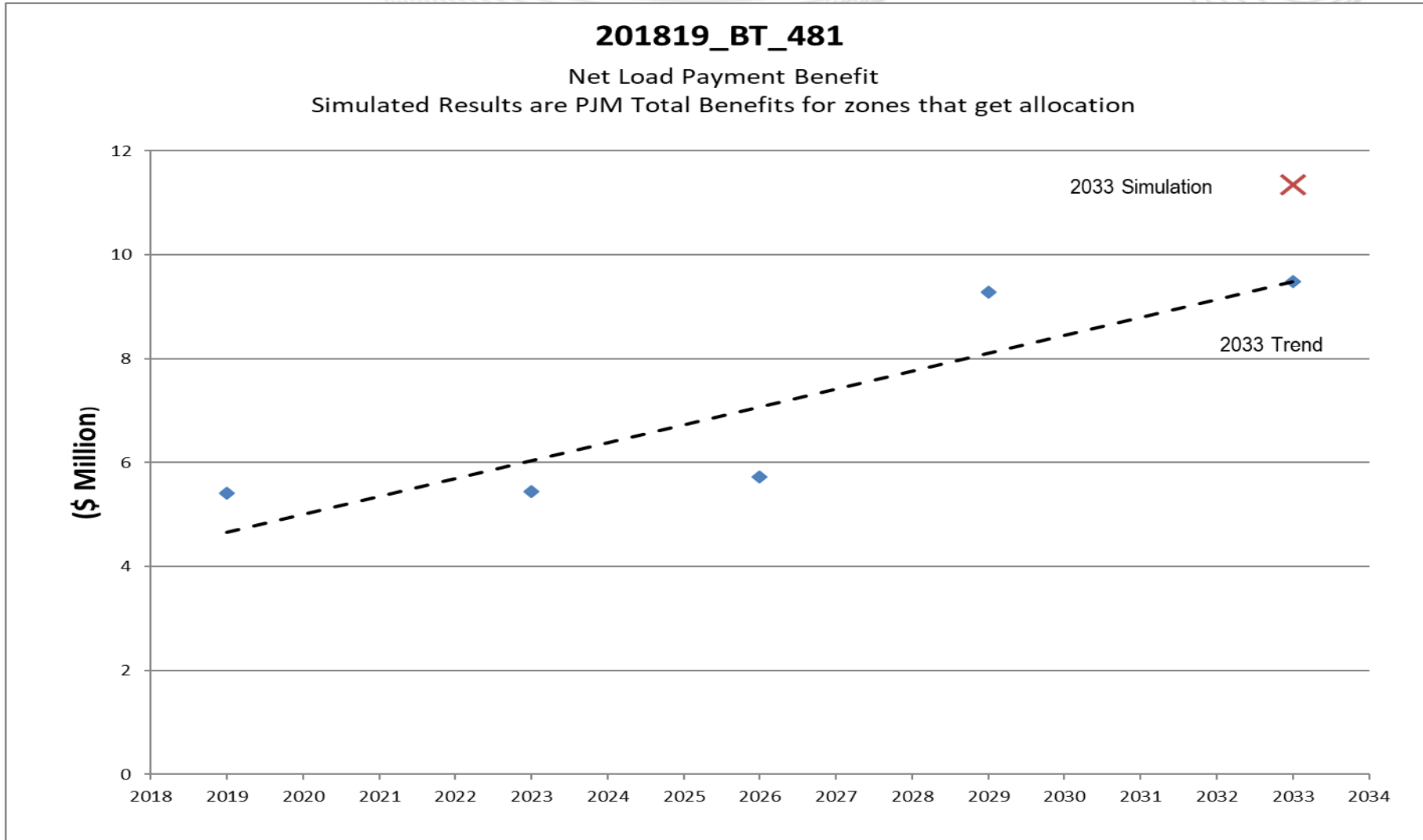
Proposal ID	BT_481
Proposal Description	Rebuild Michigan City-Trail Creek-Bosserman 138 kV (10.7mi)
Project Type	Upgrade
B/C Ratio Metric	Lower Voltage
In-Service Cost (\$MM)*	\$24.69
Cost Containment	No
In-Service Month	Jan 2023
% Cong Driver Mitigated	100%
2023 Shifted Cong (\$MM)	\$0.04
PJM Benefit Metric (\$MM)	69.16
PJM Base Case B/C Ratio	2.63
PJM Interregional Cost Allocation %**	89.1 %

* Costs based on PJM's Independent Cost/Constructability Review

** Cost split based on September 20 IPSAC Presentation :

<https://www.pjm.com/-/media/committees-groups/stakeholder-meetings/ipsac/20190920/20190920-ipsac-presentation.ashx>

Trend for Net Load Benefits of Proposal BT_481



- Recommend BT_481 for provisional* approval at the December Board meeting
- Continue to coordinate with MISO

**Dependent on MISO Board approval of same project*

2018/19 Market Efficiency Window Hunterstown – Lincoln Proposals

- Preliminary results first presented at [July 2019 TEAC](#)
 - Calculated preliminary benefits and determined preliminary B/C ratios for all 22 proposals
- Top 5 proposals analysis completed
 - Cost/Constructability review completed
 - PROMOD base and sensitivity runs completed (see Appendix B)
- Three lower cost proposals fully relieve congestion on the driver with minimal shift in congestion
 - HL_622: Rebuild the Hunterstown-Lincoln 115 kV line
 - HL_469: Install SmartValve* power flow control series devices
 - HL_960: Build new Hunterstown-Lincoln 115 kV line

**SmartValve is a Trademark of Smart Wires Inc.*



Hunterstown-Lincoln Proposal Top5 Results

Proposal ID	HL_622	HL_469**	HL_007	BT_293	HL_960
Proposal Description	Rebuild the Hunterstown-Lincoln 115 kV line.	Install SmartValve™** power flow control 5% series reactance device in series with the Lincoln Tap-Hunterstown 115 kV line.	Build a 115 kV ring bus at the Lincoln tap.	Build Meade 115 kV substation.	Build new Hunterstown-Lincoln 115 kV line.
Project Type	Upgrade	Greenfield	Greenfield	Greenfield	Greenfield
Proposer Cost (\$MM)	\$7.21	\$4.65	\$7.58	\$8.95	\$10.13
PJM/Independent Cost (\$MM)*	\$6.20	\$7.15	\$8.26	\$8.40	\$11.92
Cost Containment	No	No	No	No	Yes
In-Service Year	2023	2022	2023	2023	2021
% Cong Driver Mitigated	100%	100%	86%	86%	100%
2023 Shifted Cong (\$MM)	\$1.77	\$2.03	\$1.35	\$1.35	\$1.89
15-Yr NPV NLP Benefit (\$MM)	\$586	\$552	\$428	\$428	\$563
PJM Cost Used (\$MM)	\$7.21	\$7.15	\$8.26	\$8.40	\$11.92
B/C Ratio	76.41	72.61	48.78	47.97	44.39

*Costs based on PJM's Independent Cost/Constructability Review

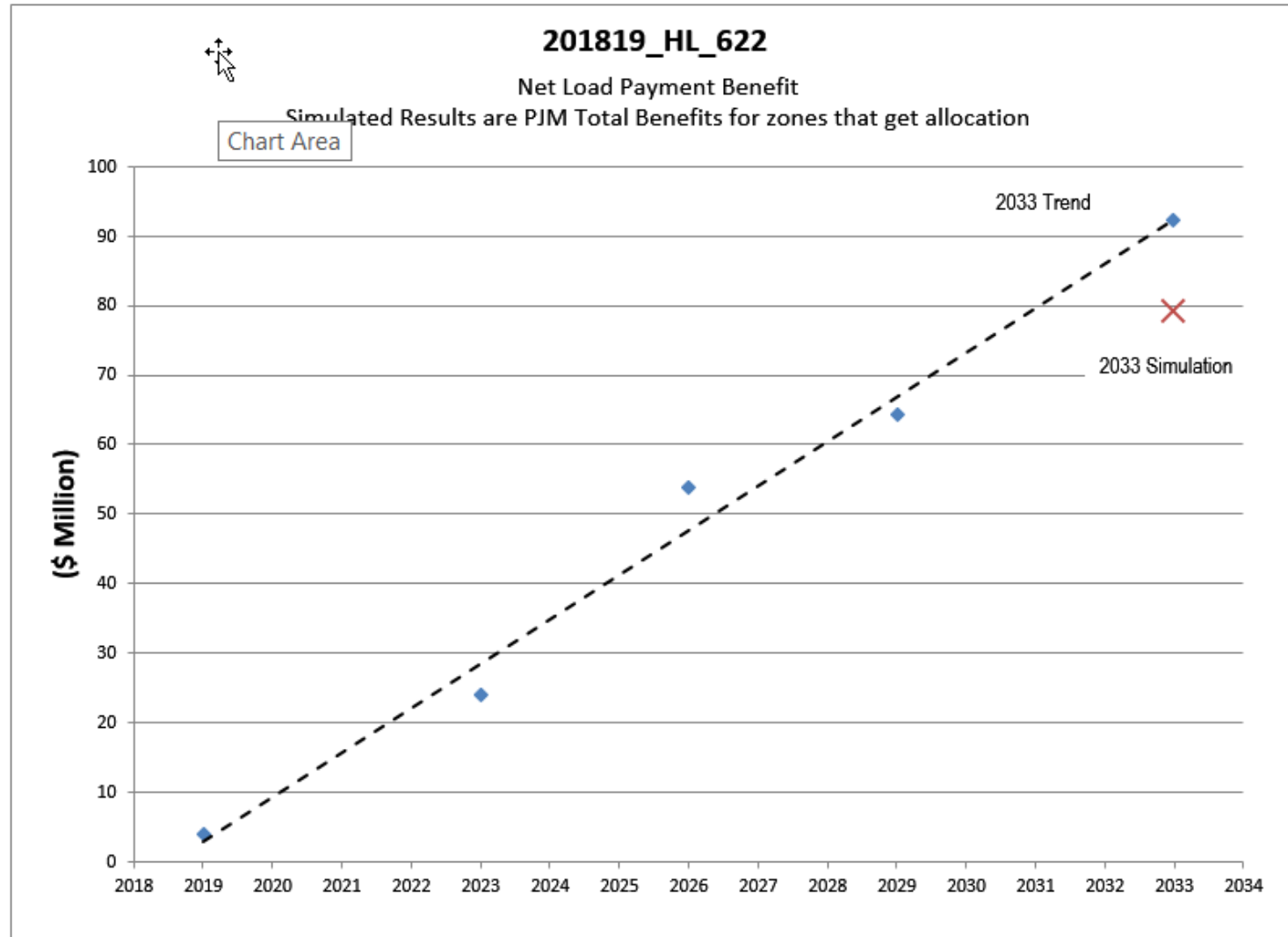
**SmartValve is a Trademark of Smart Wires Inc.

Criteria	HL_622 Upgrade Solution	HL_469 SmartValve™* Solution
Constructability Risk	Upgrade, no additional property needed	Greenfield, permitting risk related to new property for substation due to location near historically sensitive area
PJM Operations and Markets	No changes needed to real-time operations procedures and practices	At this time, real-time operations would not be able to fully utilize the dynamic capabilities of this device without additional changes
Additional Integration Cost with Operations and Markets	No additional costs	May require updating Day-Ahead, Real-Time, SCADA systems to support full operational range of this type of device
Industry experience	Established well known solution	Limited experience with SmartValve™ device
Additional System Capability/Flexibility**	Yes/No	No/Yes

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**Capability in terms of line ratings increase / Flexibility in terms of dynamic flow control

- Completed comprehensive analysis considering both economic benefits and operational challenges of proposals
- HL_622, rebuild the Hunterstown-Lincoln 115 kV line, will be recommended to the PJM Board for RTEP inclusion
 - High B/C Ratio: 76.41
 - Low Cost: \$7.21 million
 - Fully addresses target congestion driver Hunterstown – Lincoln 115 kV
 - Passes all PROMOD sensitivity scenarios
 - Reliability Analysis has been completed and no reliability violation identified
- PJM staff will recommend proposal HL_622 to the PJM Board
 - Proposal will be presented at the December Board meeting
 - Timeline supports RTEP model build





2019 Annual Reevaluation of Market Efficiency Projects

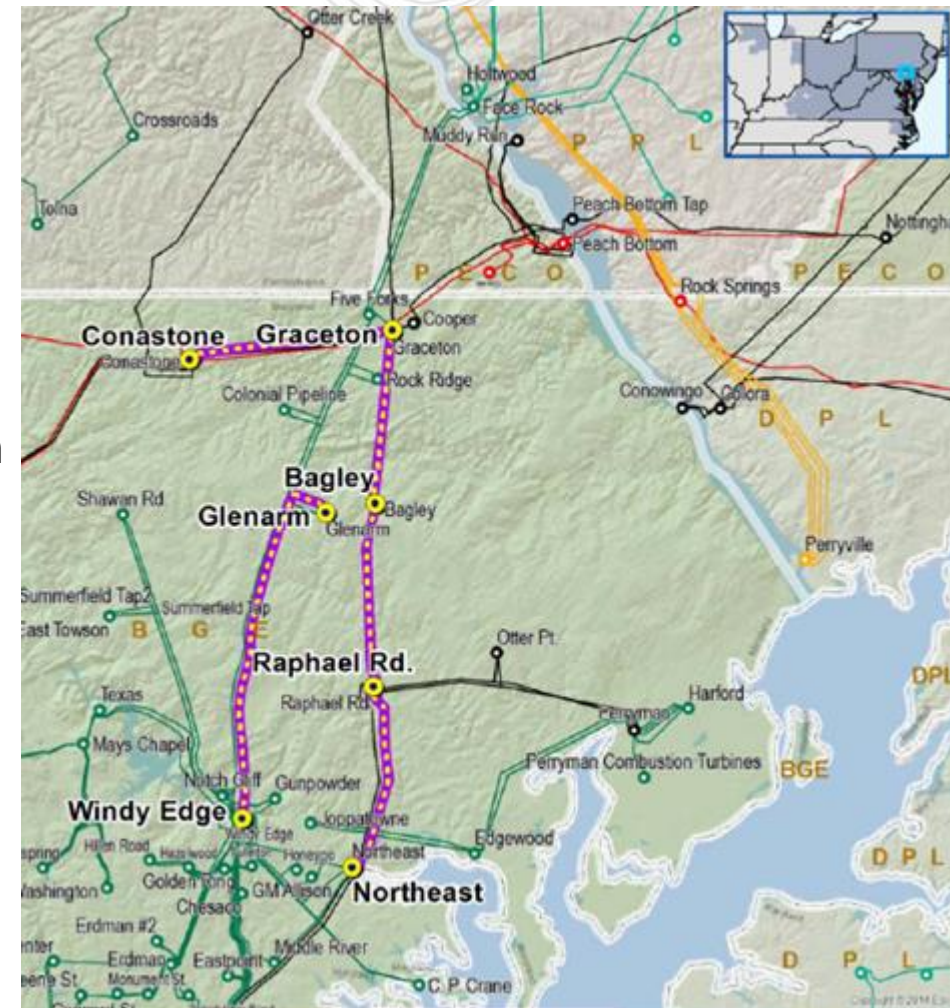
- Applies to Market Efficiency projects approved during the 2014/15 and 2016/17 RTEP Windows
- Using the most recent Market Efficiency case available:
 - Base case version 2019-07-26 (posted on 08/02/2019)
 - With First Energy generator deactivations withdrawn
- Projects already in-service, under construction or cancelled are no longer required to be reevaluated.
- Projects must continue to meet the B/C criterion of 1.25
- Reevaluation Process to be completed by December 2019



5E (b2992) Reevaluation Analysis Overview

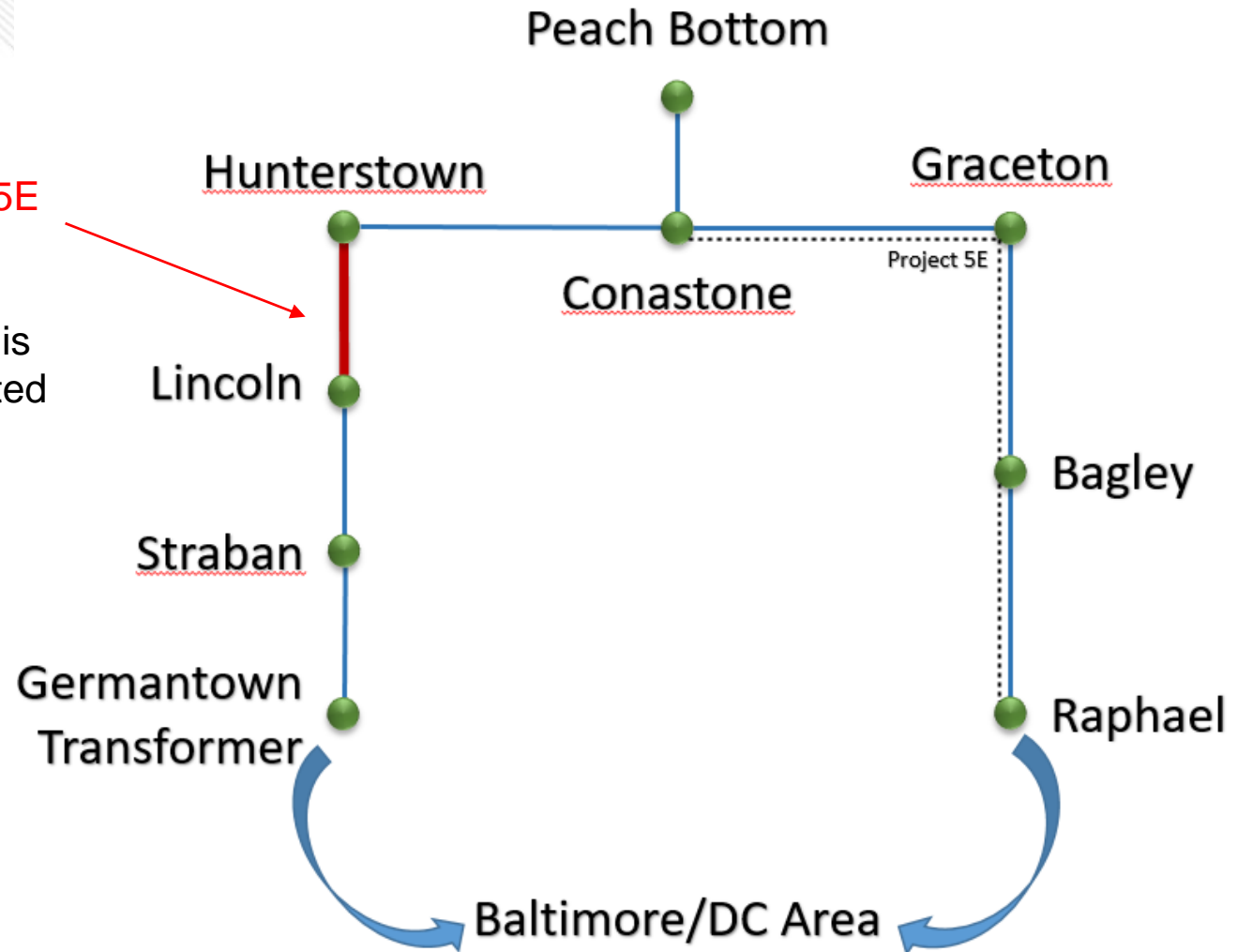
- History
 - Project 5E (B2992) approved during 2016/17 Window:
 - B/C Ratio: 5.93 (Cost: \$39.65 mill)
 - Reevaluation Nov 2019
 - Updated Cost: \$48.3 mill
 - B/C Ratio: **1.11**
 - B/C Ratio: **1.80** (with Hunterstown – Lincoln congestion relieved)

- In the current Market Efficiency Base Case, benefits of 5E (b2992) are decreased because of Hunterstown – Lincoln 115 kV congestion
 - Once Hunterstown – Lincoln 115 kV congestion relieved, 5E (b2992) delivers expected benefits



Hunterstown – Lincoln congestion prevents 5E (b2992) benefits to be realized.

If Hunterstown – Lincoln 115 kV congestion is relieved, then 5E (b2992) delivers the expected benefits.



- **Construction Status**
 - Design and engineering - 95% complete
 - Construction scheduled to begin March 2020, with an expected 6/1/2021 in-service date

- **Cost Update**

Baseline #	Costs (Direct & Indirect)*	
b2992.1	Reconductor Conastone-Graceton 2323/2324 Circuits	\$18,487,474
b2992.2	Bundle Conductor Graceton-Bagley-Raphael Road 2305/2313 Circuits	\$20,306,088
b2992.3	Remove Windy Edge - Glenarm 110512 Substation Limitations	\$237,592
b2992.4	Reconductor Raphael Road - Northeast 2315/2337 Circuits	\$9,264,714
	Total In-Service Cost	\$48,295,868

** A 2.5% inflation rate was used to escalate costs to in-service date*

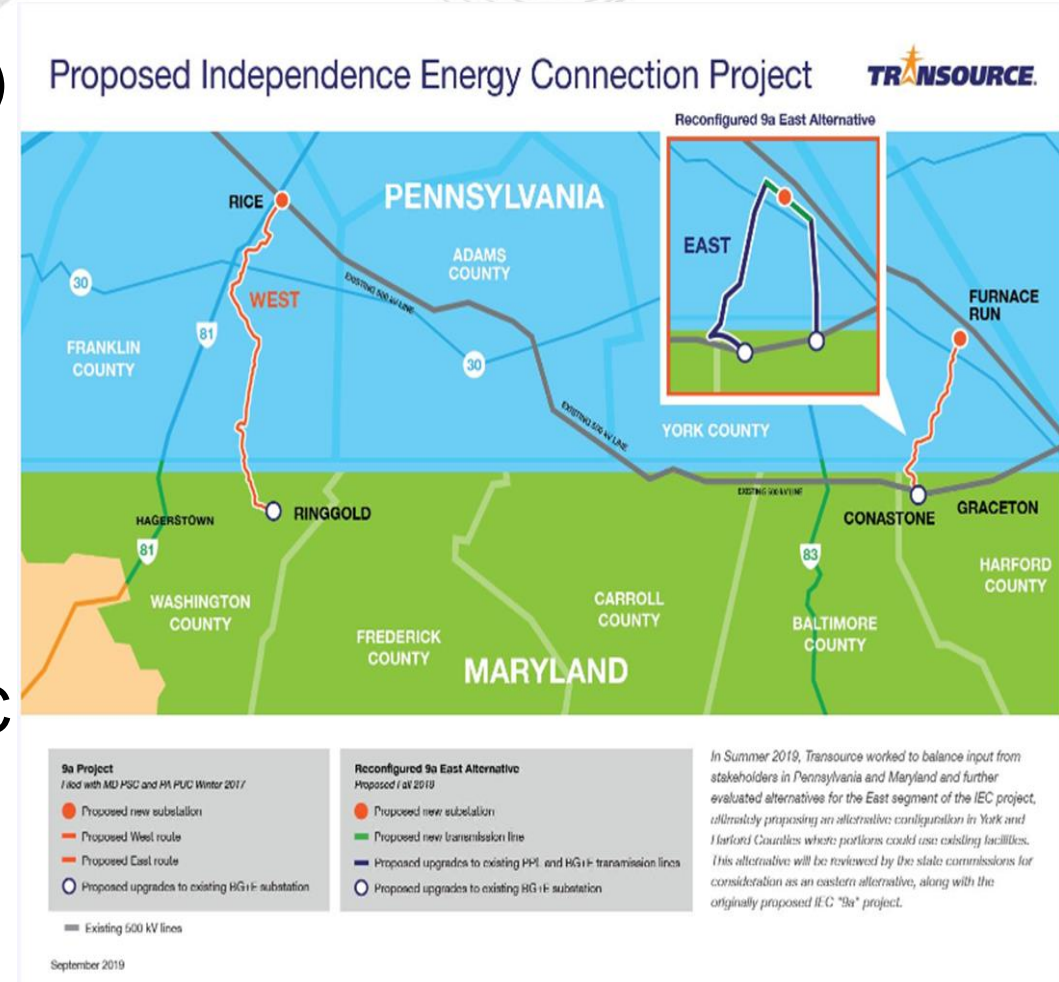
- Reevaluation of 201617_1-5E (b2992.1-4) project completed
 - PJM Staff will recommend keeping 5E (b2992) in the RTEP pending approval by the PJM Board of HL_622, reconductoring of Hunterstown – Lincoln 115 kV.
- Reevaluation of projects b2697, b2976, b2931 completed
 - All projects pass the 1.25 threshold
 - Results included in Appendix C
- This concludes the 2019 Reevaluation process



Alternative IEC East Portion of the IEC Project (Transource 9A)

- IEC Project (Transource 9A) Details
 - <https://www.transourceenergyprojects.com/IndependenceEnergyConnection/>
 - PJM Baseline # b2743, b2752
- Original application
 - In December 2017, Transource filed CPCN applications to build the IEC Project (Transource 9A) before the Maryland Public Service Commission (MD Commission) and Pennsylvania Public Utility Commission (PA Commission).
- Proposed Alternatives
 - In the course of the regulatory proceedings, alternative reconfigurations of the IEC Project (Transource 9A) were introduced by various parties.
 - PJM analyzed these alternative routes to assess reliability and market efficiency impacts.
 - In addition to the IEC Project (Transource 9A), an Alternative IEC East Portion of the IEC Project has been filed as part of a proposed settlement in the pending proceedings before the MD and PA Commissions

- PJM assessed the IEC Project (Transource 9A) inclusive of the Alternative IEC East Portion:
 - In Service Cost: \$496.17 million
 - Benefits: \$844.81 million
 - B/C Ratio: 1.60
 - Satisfies all PJM Reliability criteria
- PJM staff will present the IEC Project (Transource 9A) inclusive of the Alternative IEC East Portion at the December Board meeting
 - Request approval conditioned upon MD Commission approval and PA Commission approval



Note: Map from <https://www.transourceenergyprojects.com/IndependenceEnergyConnection/>

Appendix A

Bosserman – Trail Creek Sensitivities



B/C Ratio Sensitivities: Bosserman – Trail Creek

Sensitivity	BT_481	BT_129
Project Cost (\$MM)	24.69	29.51
Base Case	2.63	1.91
FSA Included	5.13	4.4
High Load	3.12	3.19
Low Load	3.73	2.78
High Gas	3.62	3.03
Low Gas	2.26	1.96
Outage Library 1	4.62	3.78
Outage Library 2	3.87	3.38
Outage Library 3	4.21	3.25
Outage Library 4	4.62	3.94
Outage Library 5	3.62	3.50
FE Reactivations	4.62	3.95

Note: B/C ratios computed using Independent Cost / Constructability Review

Appendix B

Hunterstown – Lincoln 115 kV Top5 Proposals Sensitivities



B/C Ratio Sensitivities: Hunterstown - Lincoln

Sensitivity	HL_622	HL_469	HL_007	HL_293	HL_960
Project Cost (\$MM)	7.21	7.15	8.26	8.4	11.92
Base Case	76.41	72.61	48.78	47.97	44.39
FSA Included	8.87	10.34	6.23	6.12	5.81
High Load	85.23	82.35	61.85	60.82	50.73
Low Load	74.61	75.94	58.09	57.12	42.63
High Gas	65.13	63.37	45.99	45.23	36.05
Low Gas	74.58	74.06	50.15	49.31	44.10
Outage Library 1	75.96	77.16	51.80	50.94	47.26
Outage Library 2	81.62	81.75	59.40	58.41	49.56
Outage Library 3	68.25	67.00	47.22	46.43	40.96
Outage Library 4	86.68	85.71	60.21	59.21	50.96
Outage Library 5	76.48	76.33	53.31	52.42	45.54
FE Reactivations	59.45	60.03	41.92	41.23	35.56

Appendix C

2019 Reevaluation Results

Proposals b2697, b2976, b2931

- Overview
 - Projects with capital cost under \$20 million are reevaluated using the original benefits* and updated capital costs.
 - Capital costs updated as of 11/13/2019
- 2019 Reevaluation B/C ratios for b2697, b2976, b2931

PJM Window Project ID	Baseline#	Type	Area	Constraint	Initial TEAC Date	Initial Capital Cost (\$ million)	Initial B/C Ratio	Current Status	Projected ISD	Updated Capital Cost	2019 Reevaluation B/C Ratio
201415_1-4I	b2697.1-2	Upgrade	AEP	Fieldale to Thornton 138 kV	9/10/2015	\$0.75	101.19	EP	1/1/2019 1:06 2: 12/31/2019	\$2.70	28.11
201617_1A_RP M_DEOK	b2976	Upgrade	DEOK	Tanners Creek to Dearborn 345 kV	11/2/2017	\$0.60	151.61	EP	6/1/2021	\$0.30	303.22
201617_1-3B	b2931	Upgrade	COMED	Pontiac to Brokaw 345 kV	8/10/2017	\$5.62	13.45	EP	6/1/2021	\$5.62	13.45

EP – Engineering Procurement

*Original benefits are the benefits that were determined when the projects were initially approved

- V1 – 11/11/2019 – Original slides posted
- V2 - 11/13/2019
 - Slide 12: Added clarifying note:
 - **Capability in terms of line ratings increase / Flexibility in terms of dynamic flow control
 - Slide 21: Added
 - Reevaluation of projects b2697, b2976, b2931 completed
 - All projects pass the 1.25 threshold
 - Results included in Appendix C
 - This concludes the 2019 Reevaluation process
 - Added slides 29,30
 - Appendix C - Reevaluation Results b2697, b2976, b2931
- V3 - 11/26/2019 – Corrected typo for MISO Cost Allocation on slide #5