



Market Efficiency Update

Nick Dumitriu

Principal Engineer, PJM Market Simulation

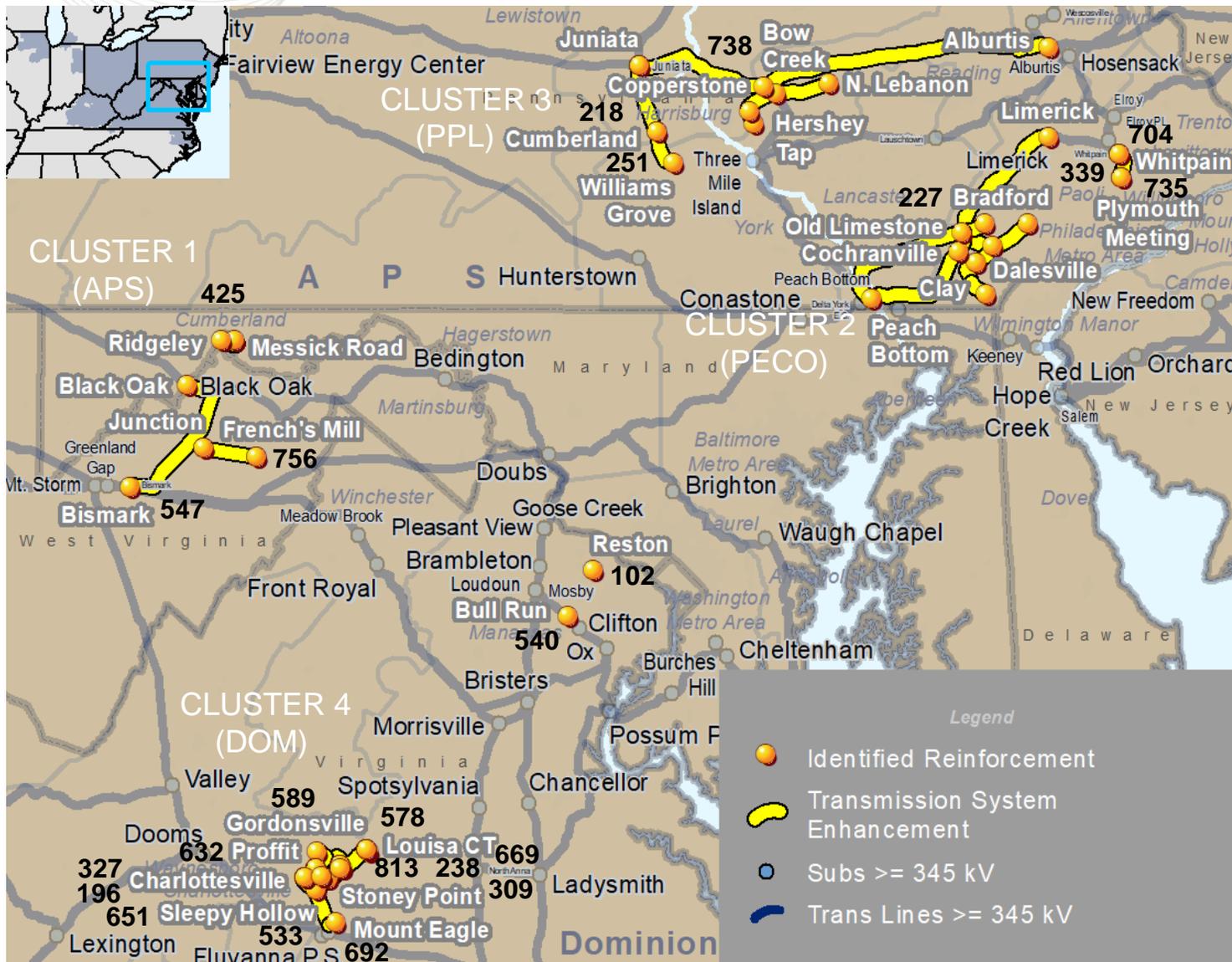
Transmission Expansion Advisory Committee

October 5th, 2021

2020/21 Long-Term Window 1

- 24 proposals received from 7 submitting entities (10 greenfield proposals, 14 upgrades).
- Grouped in 4 clusters
 - Cluster No. 1 (APS) - French's Mill to Junction 138 kV
 - Cluster No. 2 (PECO) - Plymouth Meeting to Whitpain 230 kV
 - Cluster No. 3 (PPL) - Juniata to Cumberland 230 kV
 - Cluster No. 4 (DOM) - Charlottesville to Proffit 230 kV
- Preliminary B/C ratios for Clusters 1, 2, and 3 posted at the [08/31/2021 TEAC](#)
 - Preliminary B/C ratios were computed using the submitted in-service cost of components.
- Cluster 4, Charlottesville to Proffit 230 kV (DOM)
 - Constraint was posted as a reliability violation but eliminated after the re-tool.
 - A review of the reliability proposals in relation to the Market Efficiency window will continue.

2020/21 Long-Term Window 1 – Map Clusters 1, 2, 3, 4



Initial Review and Screening Market Efficiency Proposals – Cluster 4 (DOM)

- Initial reviews performed for the proposals submitted to the Long-Term Window 1
 - Performance Review – PJM evaluated whether or not the project proposal satisfied the benefit to cost ratio threshold of 1.25 and solved the required congestion driver.
 - Planning Level Cost Review – PJM reviewed the estimated project cost submitted by the project sponsor and any relevant cost containment mechanisms submitted.
 - Feasibility Review – PJM reviewed the overall proposed implementation plan to determine if the project, as proposed, can feasibly be constructed.

- Individual descriptions of submitted market efficiency proposals included in [Appendix A](#)

- Redacted public market efficiency proposals posted on the Competitive Planning page.
 - [Redacted Public Proposals for 2020/2021 RTEP Proposal Window 1](#)

Initial Review and Screening Market Efficiency Proposals – Cluster 4 (DOM)

- Performed preliminary N-1 thermal violation screening on all proposals.
 - Also used to determine list of flowgates to monitor.

- Calculated PJM benefits and determined preliminary B/C ratios.
 - Preliminary B/C ratios were computed using the submitted in-service cost of components.

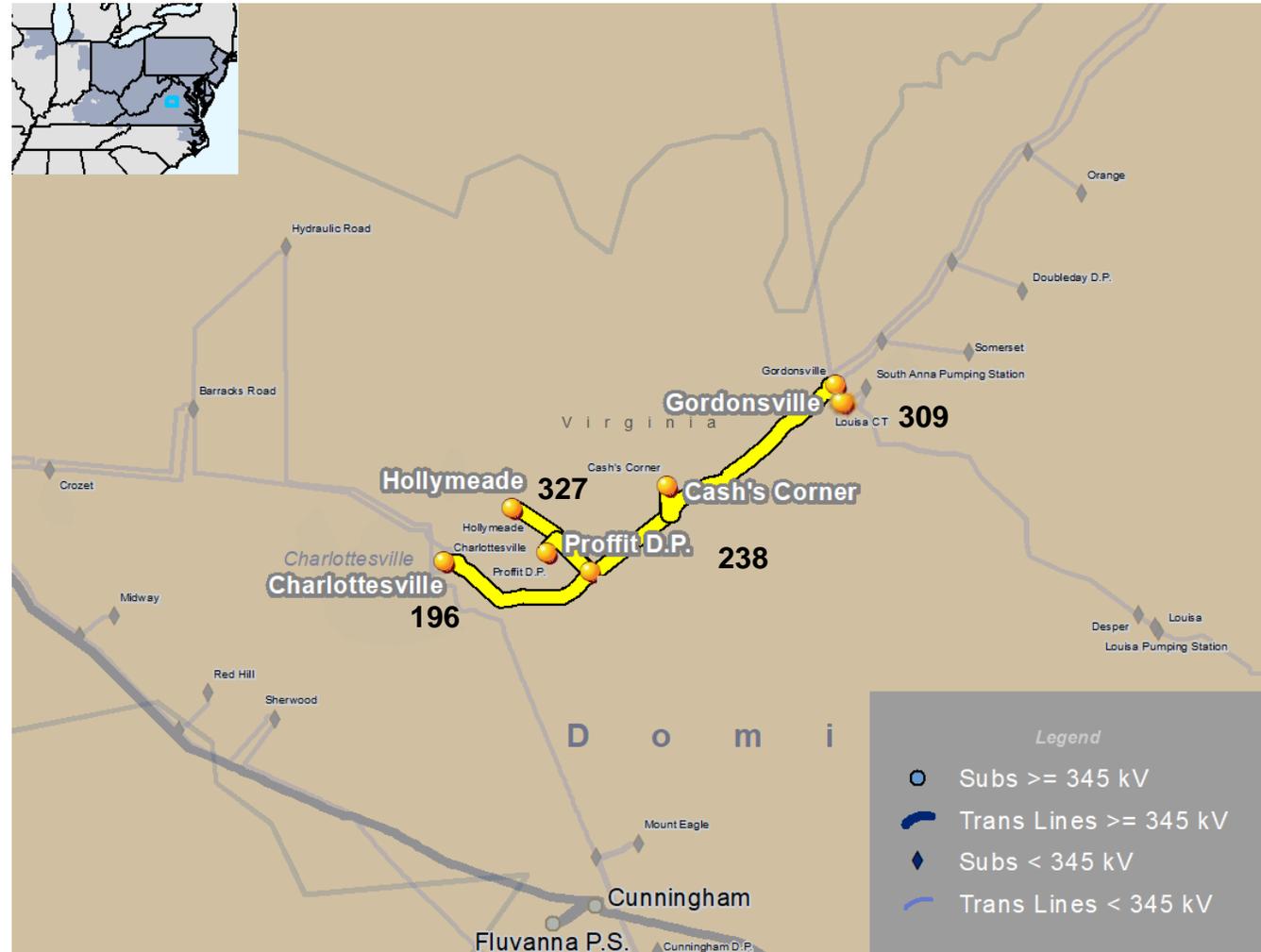
- A high level review of the plans identified in each of the proposals did not reveal any other concerns at this stage of PJM's review.

A decorative graphic of thin, overlapping grey lines forming a wavy, abstract shape is positioned at the top of the slide, above the main title.

2020/21 Long-Term Window Preliminary Results Cluster No. 4 (DOM)

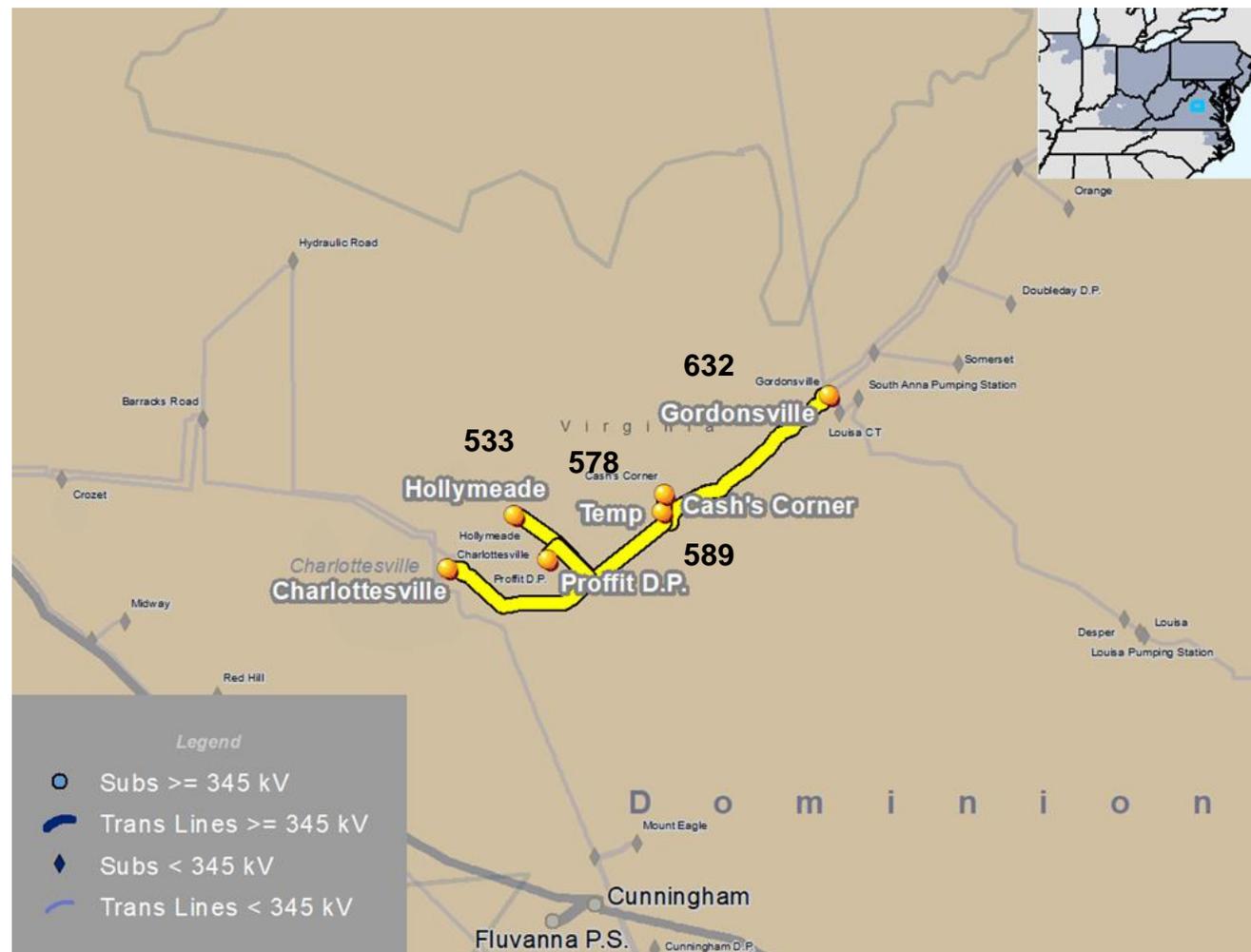
Cluster No. 4 (DOM) - Proposals Received

- [196](#): Charlottesville-Proffit 230kV Line Rebuild.
- [238](#): Charlottesville-Gordonsville 230kV Greenfield Line.
- [309](#): 5 MW Battery Energy Storage System at Louisa CT substation.
- [327](#): New Hollymeade Tap 230kV Substation. Charlottesville-Hollymeade Tap-Cash's Corner-Gordonsville 230kV Line Rebuild.



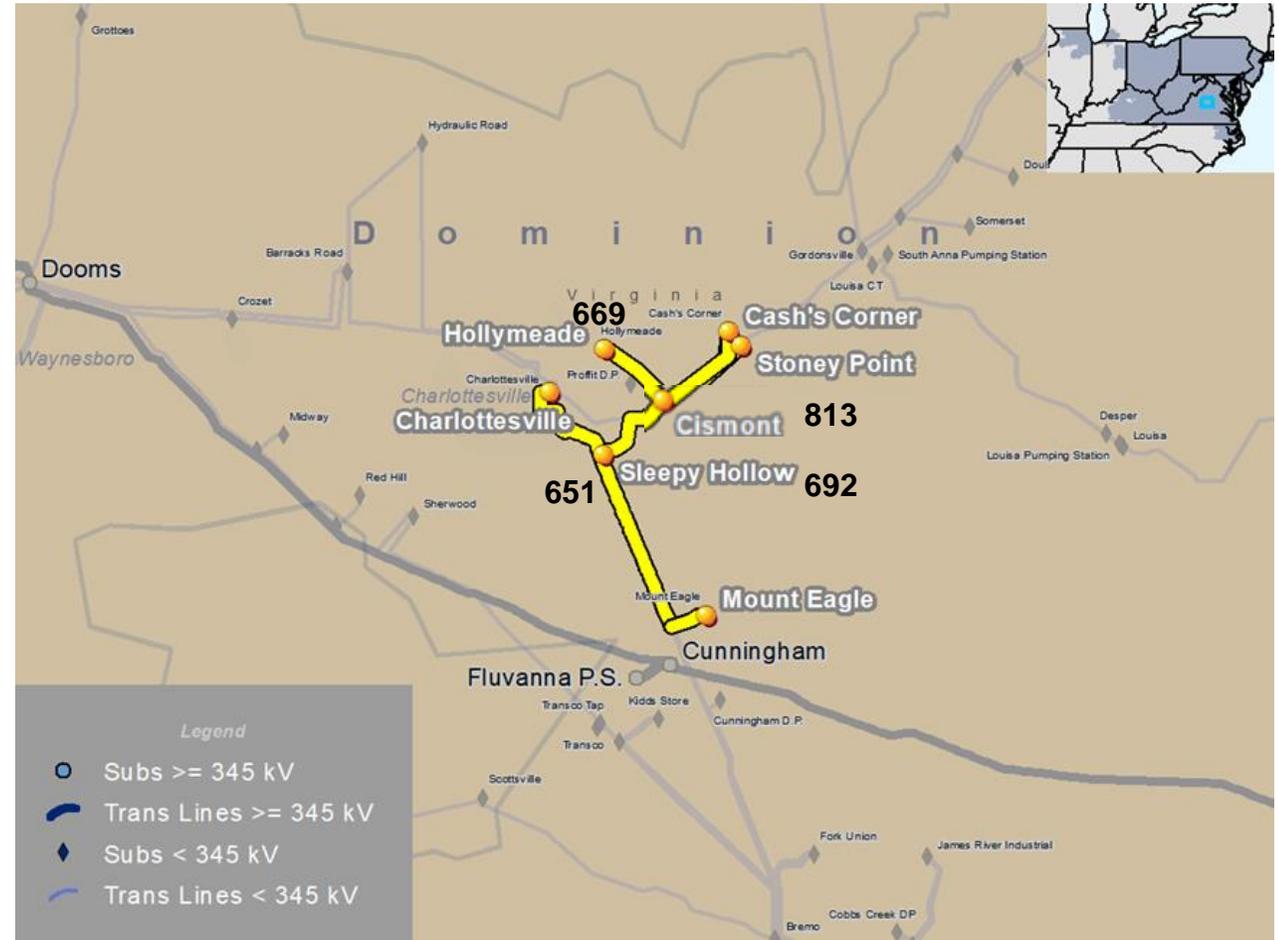
Cluster No. 4 (DOM) - Proposals Received (cont.)

- [533](#): 10 MW Battery Energy Storage System at Hollymeade substation.
- [578](#): New Hollymeade Tap 230kV Substation.
- [589](#): Build Second Charlottesville-Gordonsville 230kV Line. Upgrade terminal equipment from Hollymeade to Gordonsville 230 kV.
- [632](#): 5 MW Battery Energy Storage System at Gordonsville Substation.



Cluster No. 4 (DOM) - Proposals Received (cont.)

- [651](#): Charlottesville-Proffit 230kV Line Series Reactor.
- [669](#): 5 MW Battery Energy Storage System at Hollymeade Substation.
- [692](#): Sleepy Hollow-Stoney Point 230kV Greenfield Project.
- [813](#): New Cismont 230kV Substation. Charlottesville-Hollymeade Tap-Cash's Corner-Gordonsville 230kV Line Rebuild.



Cluster No. 4 (DOM) - Preliminary B/C Ratios (cont.)

Proposal ID	<u>196</u>	<u>238</u>	<u>309</u>	<u>327</u>
Proposal Description	Charlottesville-Proffit 230kV Line Rebuild	Charlottesville-Gordonsville 230kV Greenfield Line	5 MW Battery Energy Storage System at Louisa CT substation	New Hollymeade Tap 230kV Substation. Charlottesville-Hollymeade Tap-Cash's Corner-Gordonsville 230kV Line Rebuild.
Project Type	Upgrade	Greenfield	Upgrade	Greenfield
B/C Ratio Metric	Lower Voltage	Lower Voltage	Lower Voltage	Lower Voltage
In-Service Cost (\$MM) ¹⁾	\$19.49	\$45.83	\$25.98 ²⁾	\$35.93
Cost Containment	No	Yes	No	No
In-Service Year	2024	2025	2023	2025
% Cong Driver Mitigated	100%	100%	4%	99.36%
2025 Shifted Cong (\$MM)	Hollymeade-Cash's Corner ³⁾	No significant shift	N/A	No significant shift
Base Case B/C Ratio	N/A	3.95	N/A	5.28
FSA Sens. B/C Ratio	N/A	3.18	N/A	3.57
Low Load B/C Ratio	N/A	3.28	N/A	4.77
High Load B/C Ratio	N/A	2.89	N/A	3.09
Low Gas B/C Ratio	N/A	1.95	N/A	2.93
High Gas B/C Ratio	N/A	3.50	N/A	4.28

Notes: 1) Costs under review by PJM.

2) Corrected BESS cost includes augmentation, replacement and recycling (disposal) expenses.

3) Rebuilding only the Charlottesville-Proffit segment shifts congestion to the next segment, Hollymeade-Cash's Corner.

Cluster No. 4 (DOM) - Preliminary B/C Ratios (cont.)

Proposal ID	533	578	589	632
Proposal Description	10 MW Battery Energy Storage System at Hollymeade substation	New Hollymeade Tap 230kV Substation	Build Second Charlottesville-Gordonsville 230kV Line. Upgrade terminal equipment from Hollymeade to Gordonsville 230 kV.	5 MW Battery Energy Storage System at Gordonsville Substation
Project Type	Upgrade	Greenfield	Greenfield	Greenfield
B/C Ratio Metric	Lower Voltage	Lower Voltage	Lower Voltage	Lower Voltage
In-Service Cost (\$MM) ¹⁾	\$40.45 ²⁾	\$10.02	\$25.97	\$29.15 ²⁾
Cost Containment	No	No	Yes	No
In-Service Year	2023	2023	2025	2023
% Cong Driver Mitigated	5%	0%	100%	2%
2025 Shifted Cong (\$MM)	N/A	N/A	Hollymeade-Cash's Corner-Gordonsville ³⁾	N/A
Base Case B/C Ratio	N/A	N/A	N/A	N/A
FSA Sens. B/C Ratio	N/A	N/A	N/A	N/A
Low Load B/C Ratio	N/A	N/A	N/A	N/A
High Load B/C Ratio	N/A	N/A	N/A	N/A
Low Gas B/C Ratio	N/A	N/A	N/A	N/A
High Gas B/C Ratio	N/A	N/A	N/A	N/A

Notes: 1) Costs under review by PJM.

2) Corrected BESS cost includes augmentation, replacement and recycling (disposal) expenses.

3) Proposed terminal equipment upgrades not enough to achieve proposed ratings on Hollymeade-Cash's Corner-Gordonsville.

Cluster No. 4 (DOM) - Preliminary B/C Ratios (cont.)

Proposal ID	651	669	692	813
Proposal Description	Charlottesville-Proffit 230kV Line Series Reactor	5 MW Battery Energy Storage System at Hollymeade Substation	Sleepy Hollow-Stoney Point 230kV Greenfield Project	New Cismont 230kV Substation. Charlottesville-Hollymeade Tap-Cash's Corner-Gordonsville 230kV Line Rebuild.
Project Type	Upgrade	Upgrade	Greenfield	Greenfield
B/C Ratio Metric	Lower Voltage	Lower Voltage	Lower Voltage	Lower Voltage
In-Service Cost (\$MM) ¹⁾	\$11.38	\$25.95 ²⁾	\$36.07	\$73.64
Cost Containment	No	No	Yes	No
In-Service Year	2023	2023	2025	2025
% Cong Driver Mitigated	99.62%	4%	100%	100%
2025 Shifted Cong (\$MM)	No significant shift	N/A	Stoney Point – Cash's Corner ³⁾	No significant shift
Base Case B/C Ratio	17.20	N/A	N/A	2.53
FSA Sens. B/C Ratio	16.00	N/A	N/A	1.61
Low Load B/C Ratio	13.80	N/A	N/A	2.45
High Load B/C Ratio	10.75	N/A	N/A	1.98
Low Gas B/C Ratio	9.08	N/A	N/A	1.31
High Gas B/C Ratio	14.45	N/A	N/A	2.00

Notes: 1) Costs under review by PJM.

2) Corrected BESS cost includes augmentation, replacement and recycling (disposal) expenses.

3) Proposed greenfield shifts congestion to the next segment, Stoney Point – Cash's Corner.

- Finalize and post the retooled Market Efficiency Base Case that will be used to conduct the final review of all proposals.
 - The significant changes include deactivations, withdrawal of deactivations, and suspension or execution of Interconnection Service Agreements.

- Cost / Constructability Analysis as needed

- PJM intends to share the results of the final review with stakeholders at the December TEAC after which a final recommendation will be made to the PJM Board for review and approval.

2021 Acceleration Analysis

Acceleration Analysis of Reliability Upgrades

- Scope
 - Determine which Reliability upgrades, if any, have an economic benefit if accelerated or modified
- Study Years
 - 2022 and 2026 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

- Finalized PROMOD modeling work for 2022 and 2026 (AS-IS topology) cases
- Completed PROMOD simulations
 - 2022 and 2026 study years with 2022 Topology (AS-IS Topology)
 - 2022 and 2026 study years with 2026 Topology (RTEP Topology)
- Compared the board approved reliability upgrades with the congestion reductions between the AS-IS and the RTEP Base cases

Acceleration Analysis: 2022 Load, Generation and Economic Assumptions

Congestion Decreases Associated With Approved Reliability Projects - 2022 Study Year			2022 Study Year			Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD
			2022 Topology	2026 Topology	Year 2022 Congestion (\$ Millions)			
Constraint Name	AREA	TYPE	Year 2022 Congestion (\$ Millions)	Year 2022 Congestion (\$ Millions)	Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD	
MORGAN - CHERRY RUN 138kV	APS	LINE	\$2.6	\$0.0	\$2.6	B3240: Upgrade Cherry Run and Morgan terminals	2025	
GORE - STONEWALL 138kV	APS	LINE	\$50.0	\$0.0	\$50.0	B3242: Reconfigure Stonewall 138 kV substation	2025	

Note: For a particular flowgate, the congestion savings for the 2022 study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.

Acceleration Analysis: 2026 Load, Generation and Economic Assumptions

Congestion Decreases Associated With Approved Reliability Projects - 2026 Study Year			2026 Study year			Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD
			2022 Topology	2026 Topology	Year 2026 Congestion (\$ Millions)			
Constraint Name	AREA	TYPE	Year 2026 Congestion (\$ Millions)	Year 2026 Congestion (\$ Millions)	Congestion Savings (\$ Millions)	Upgrade Associated with Congestion Reduction	ISD	
MORGAN - CHERRY RUN 138kV	APS	LINE	\$6.6	\$0.0	\$6.6	B3240: Upgrade Cherry Run and Morgan terminals	2025	
GORE - STONEWALL 138kV	APS	LINE	\$51.3	\$0.0	\$51.3	B3242: Reconfigure Stonewall 138 kV substation	2025	

Note: For a particular flowgate, the congestion savings for the 2026 study year are calculated as the difference in simulated congestion between the PROMOD case with AS-IS topology and the PROMOD case with the RTEP topology.

Acceleration Analysis Result

- Acceleration analysis has been completed;
 - Project B3240, a \$0.23 million upgrade of terminal equipment on Morgan – Cherry Run 138 kV will be accelerated to June 2024 at no additional cost.
 - Project B3242, a \$13.3 million reconfiguration of the Stonewall 138 kV substation cannot be accelerated at this time.

A decorative graphic of thin, overlapping wavy lines in a light grey color is positioned at the top of the slide, extending from the left side towards the center.

Appendix A

2020/21 Long Term Window 1

Individual Proposal Descriptions

Cluster 4 (DOM)

Proposal No. 196 (Rebuild Charlottesville-Proffit Rd)

Project ID: 202021_196

Proposed Solution:
Rebuild a section of the Charlottesville to Proffit 230 kV line.

Project Type: Upgrade

kV Level: 230 kV

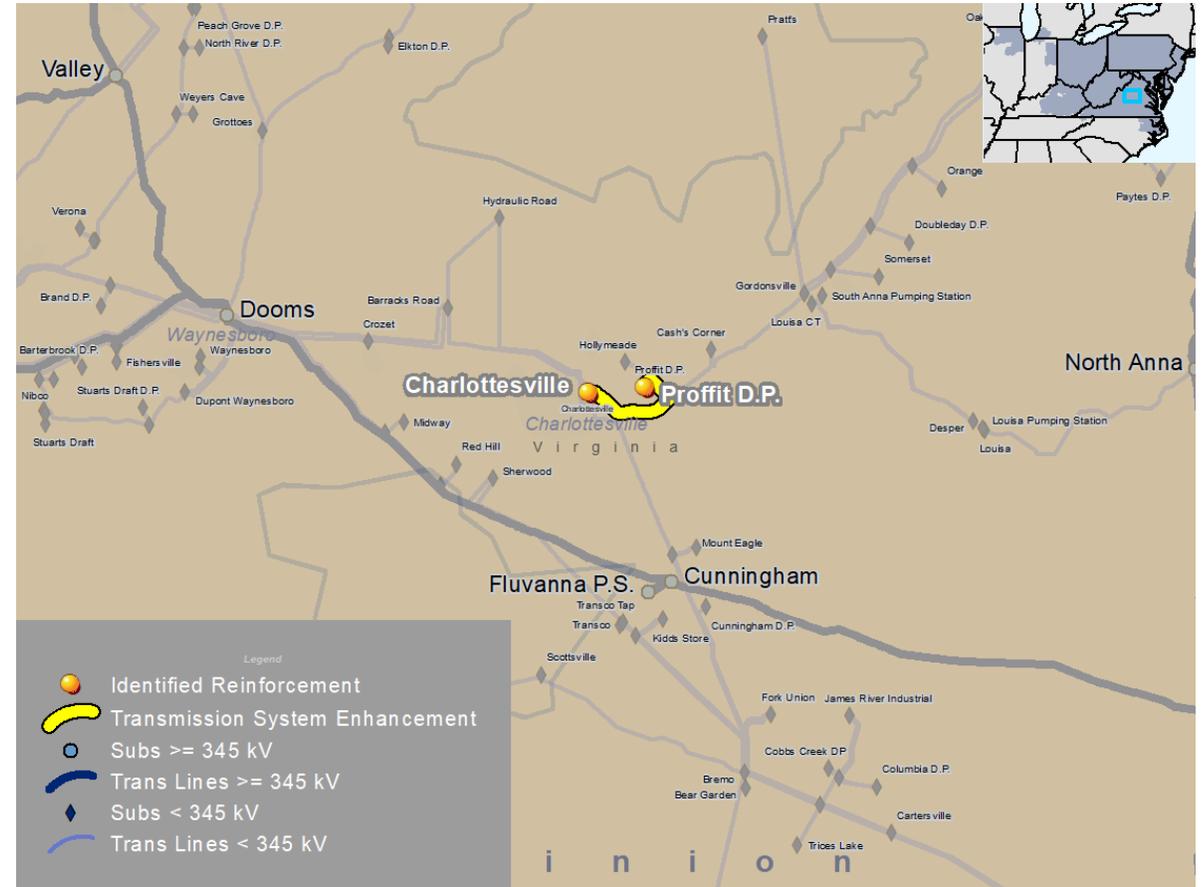
In-Service Cost (\$M): \$19.49

In-Service Year: 2024

Target Zone: DOM

ME Constraints:
Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 196](#)



Proposal No. 238 (Charlottesville to Gordonsville 230 kV)

Project ID: 202021_238

Proposed Solution:
Build a new 230 kV line between Charlottesville and Gordonsville 230 kV stations.

Project Type: Greenfield

kV Level: 230 kV

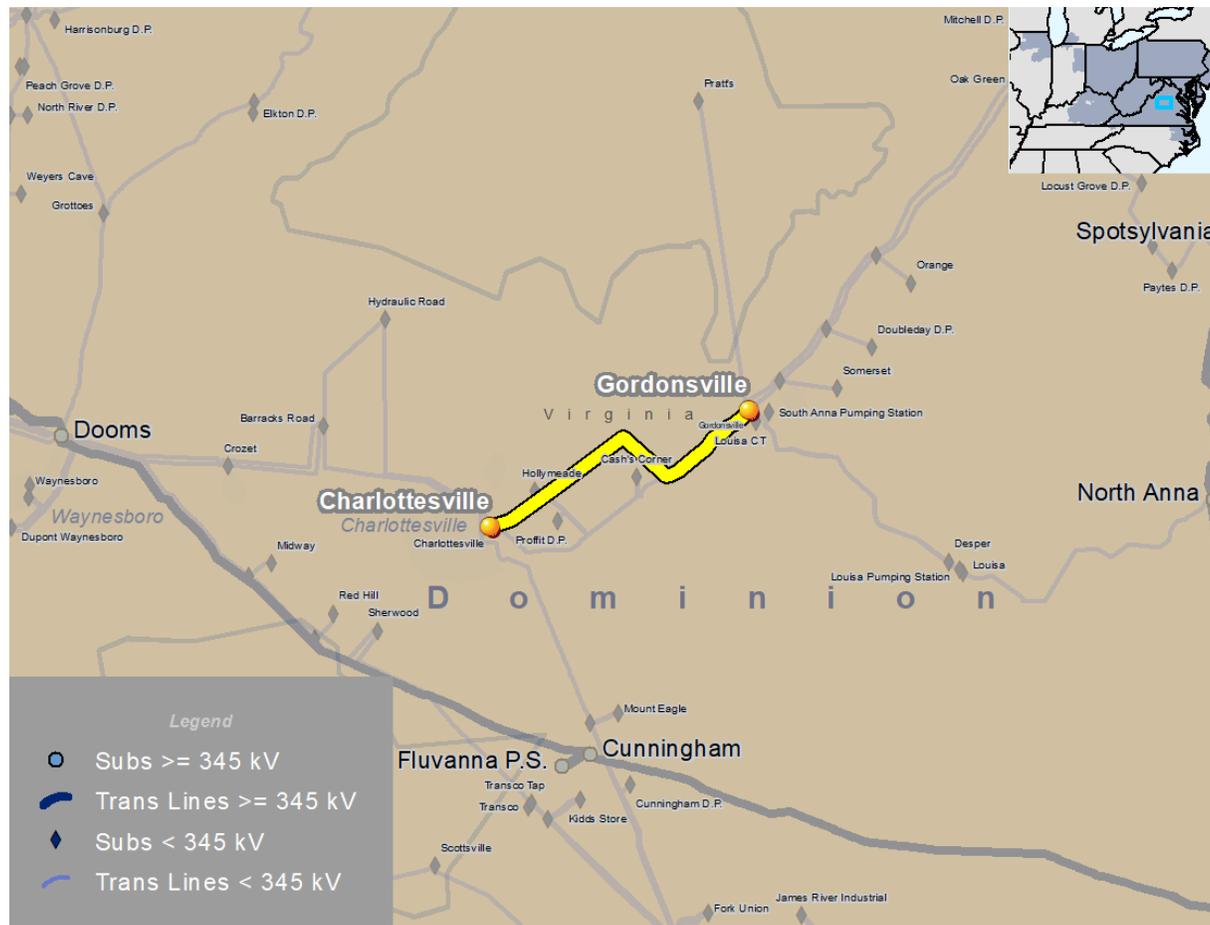
In-Service Cost (\$M): \$45.83

In-Service Year: 2025

Target Zone: DOM

ME Constraints:
Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 238](#)



Proposal No. 309 (Louisa CT Switching Station 5 MW Battery)

Project ID: 202021_309

Proposed Solution:
Install a 5 MW battery energy storage device at Louisa 230 kV switching station.

Project Type: Upgrade

kV Level: 230 kV

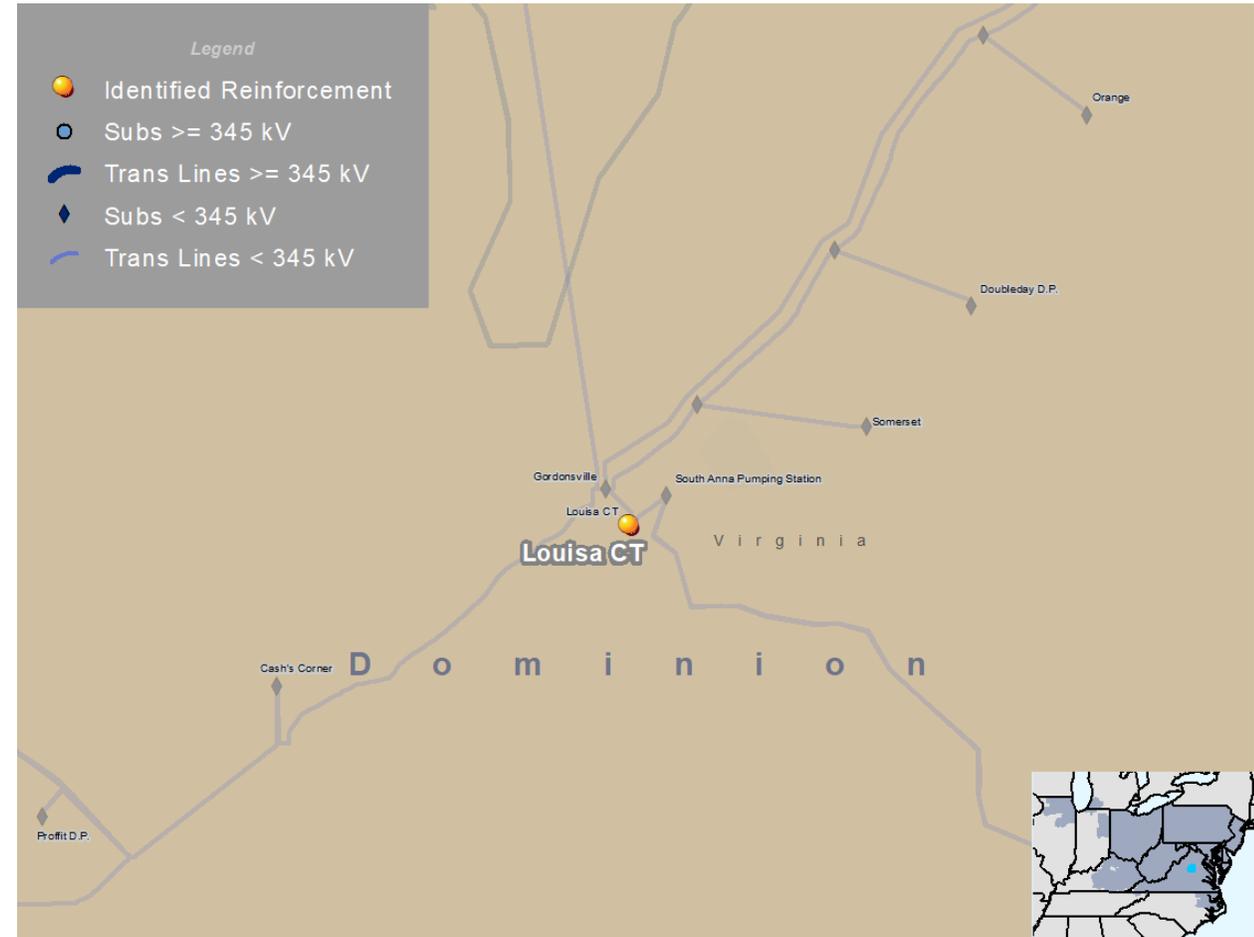
In-Service Cost (\$M): \$25.98

In-Service Year: 2023

Target Zone: DOM

ME Constraints:
Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 309](#)



Proposal No. 327 (Hollymeade Tap Sub and Rebuilds)

Project ID: 202021_327

Proposed Solution:

Interconnect the Charlottesville – Proffit 230 kV line and the Hollymeade - Cash’s Corner 230 kV line via a new 230 kV substation at the Hollymeade Tap. Rebuild the 230 kV corridor from Charlottesville-Hollymeade Tap-Cash’s Corner-Gordonsville.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$35.93

In-Service Year: 2025

Target Zone: DOM

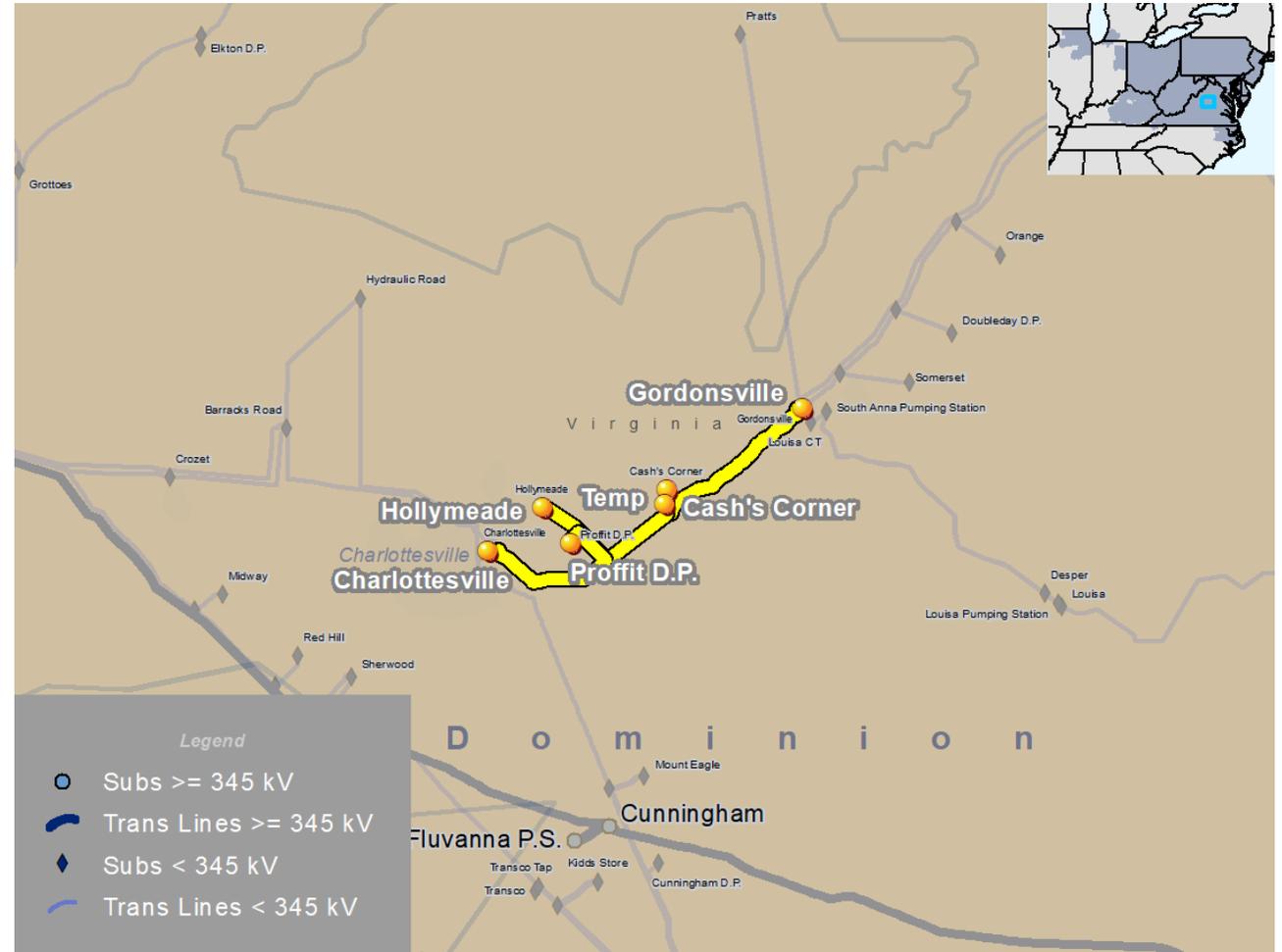
ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Cumberland to Juniata 230 kV

Junction to French's Mill 138 kV

Notes: [Redacted Public Proposal 327](#)



Proposal No. 533 (Hollymeade Substation 10 MW Battery)

Project ID: 202021_533

Proposed Solution:
Install a 10 MW battery energy storage device at Hollymeade 230 kV substation.

Project Type: Upgrade

kV Level: 230 kV

In-Service Cost (\$M): \$40.45

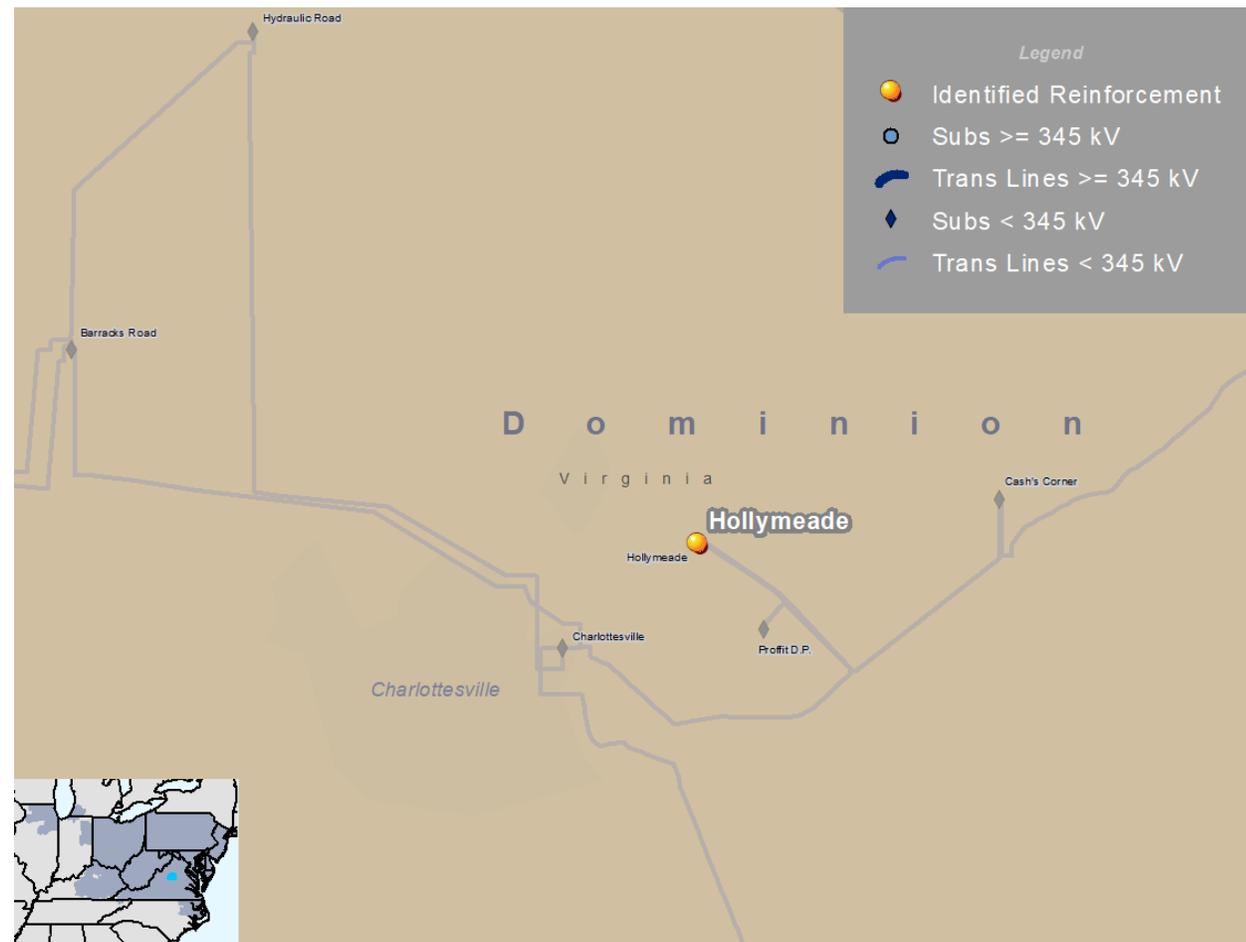
In-Service Year: 2023

Target Zone: DOM

ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 533](#)



Proposal No. 578 (Hollymeade Tap Substation)

Project ID: 202021_578

Proposed Solution:
Interconnect the Charlottesville – Proffit 230 kV line and the Hollymeade - Cash’s Corner 230 kV line via a new 230 kV substation at the Hollymeade Tap.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$10.02

In-Service Year: 2023

Target Zone: DOM

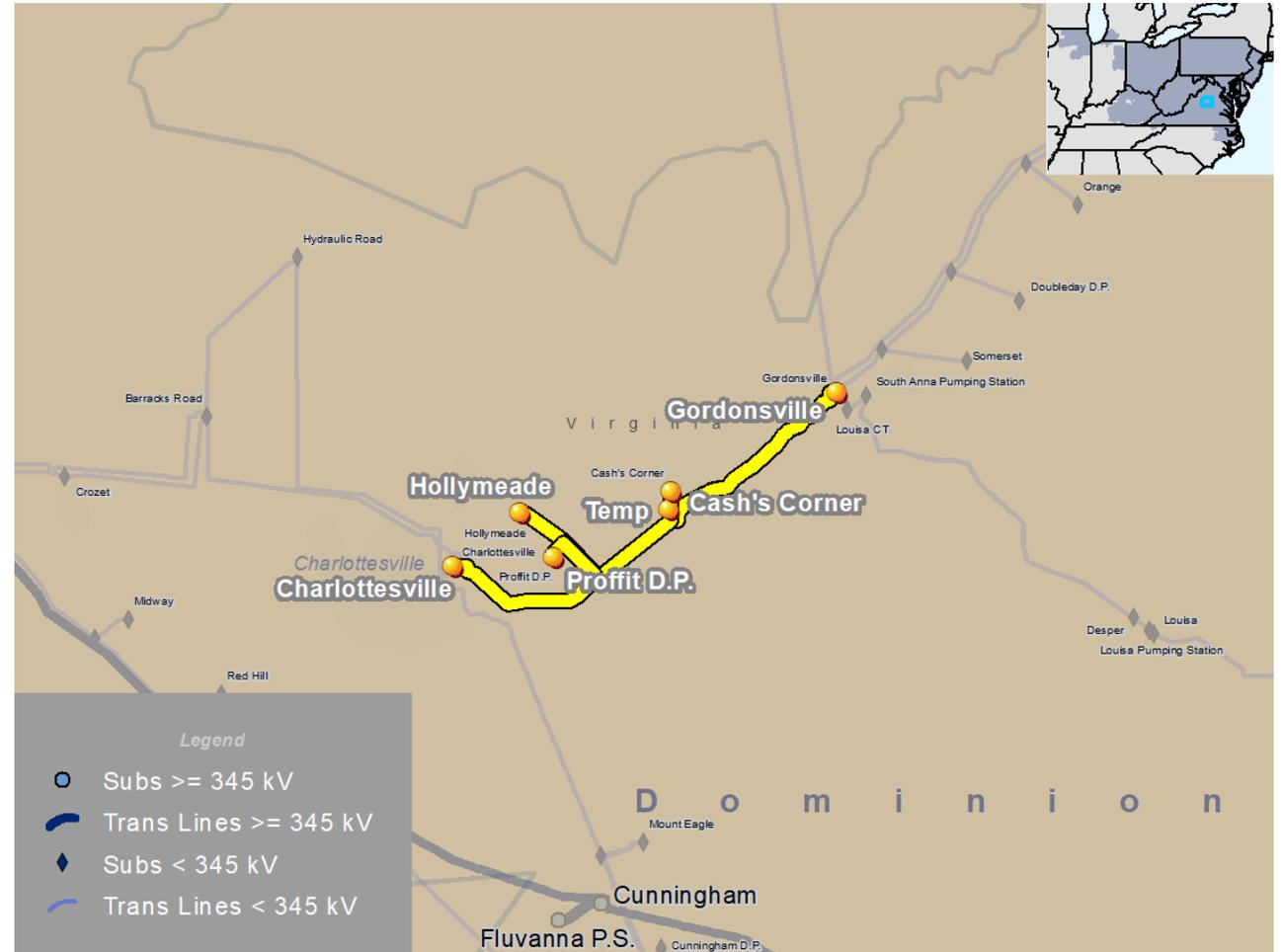
ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Cumberland to Juniata 230 kV

Junction to French's Mill 138 kV

Notes: [Redacted Public Proposal 578](#)



Proposal No. 589 (Charlottesville to Proffit 230 kV 2nd CKT)

Project ID: 202021_589

Proposed Solution:

Build a new 230 kV line between Charlottesville and Proffit Rd. DP 230 kV stations. Upgrade terminal equipment from Hollymeade to Gordonsville 230 kV.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$25.97

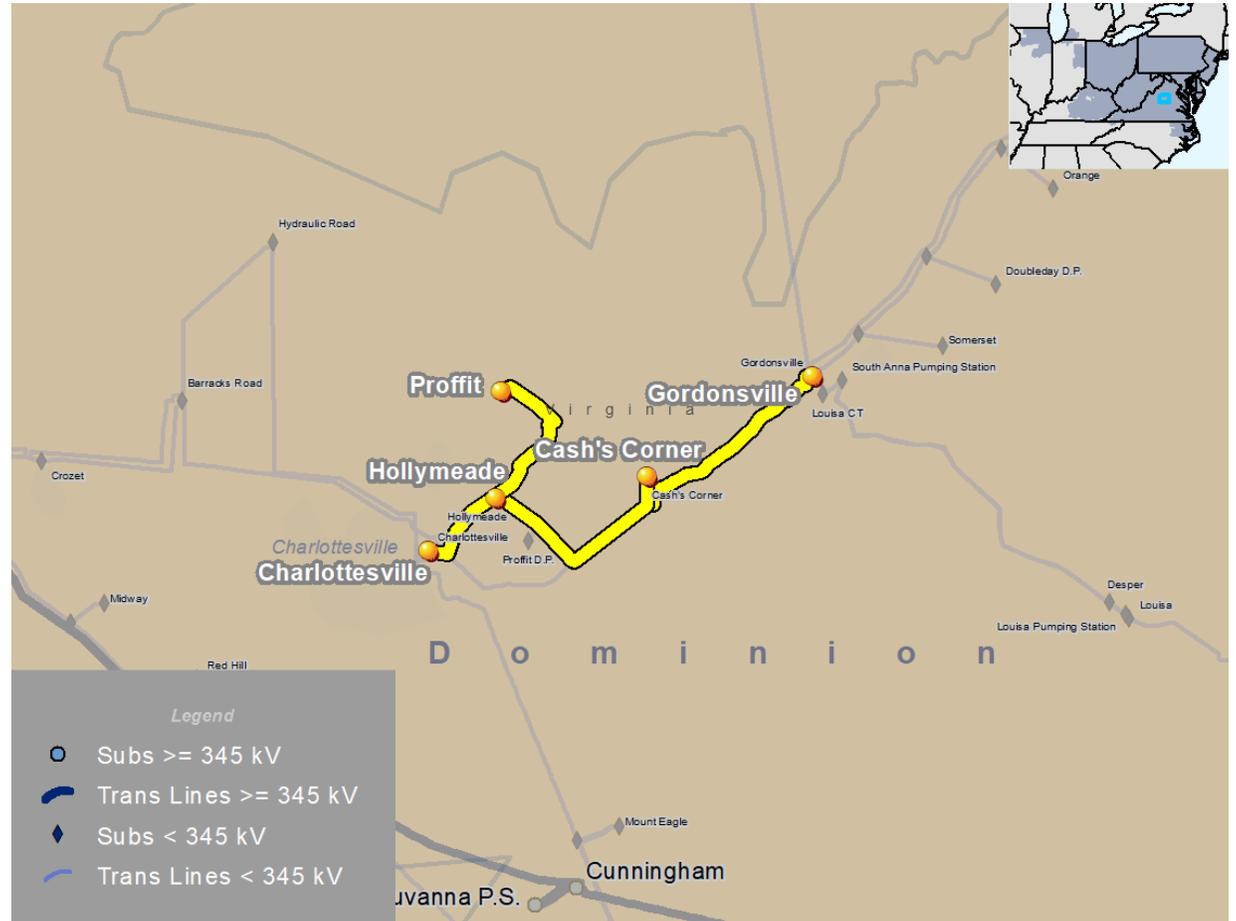
In-Service Year: 2025

Target Zone: DOM

ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 589](#)



Proposal No. 632 (Gordonsville Substation 5 MW Battery)

Project ID: 202021_632

Proposed Solution:
Install a 5MW battery energy storage system at Gordonsville 230 kV substation.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$29.15

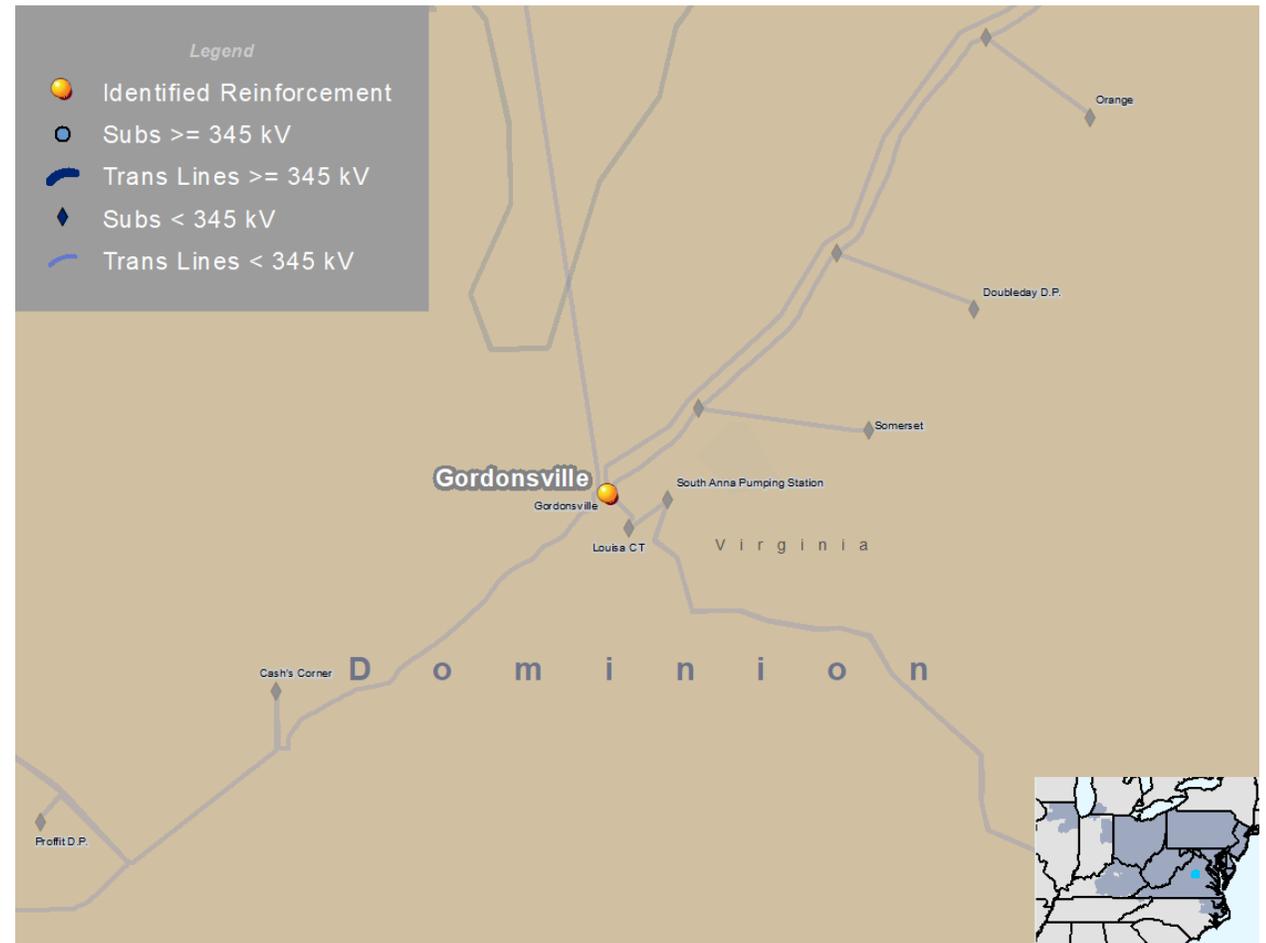
In-Service Year: 2023

Target Zone: DOM

ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 632](#)



Proposal No. 651 (Series Reactor Charl-Proffit)

Project ID: 202021_651

Proposed Solution:
Install series reactor on the Charlottesville – Proffit Rd. 230 kV line.

Project Type: Upgrade

kV Level: 230 kV

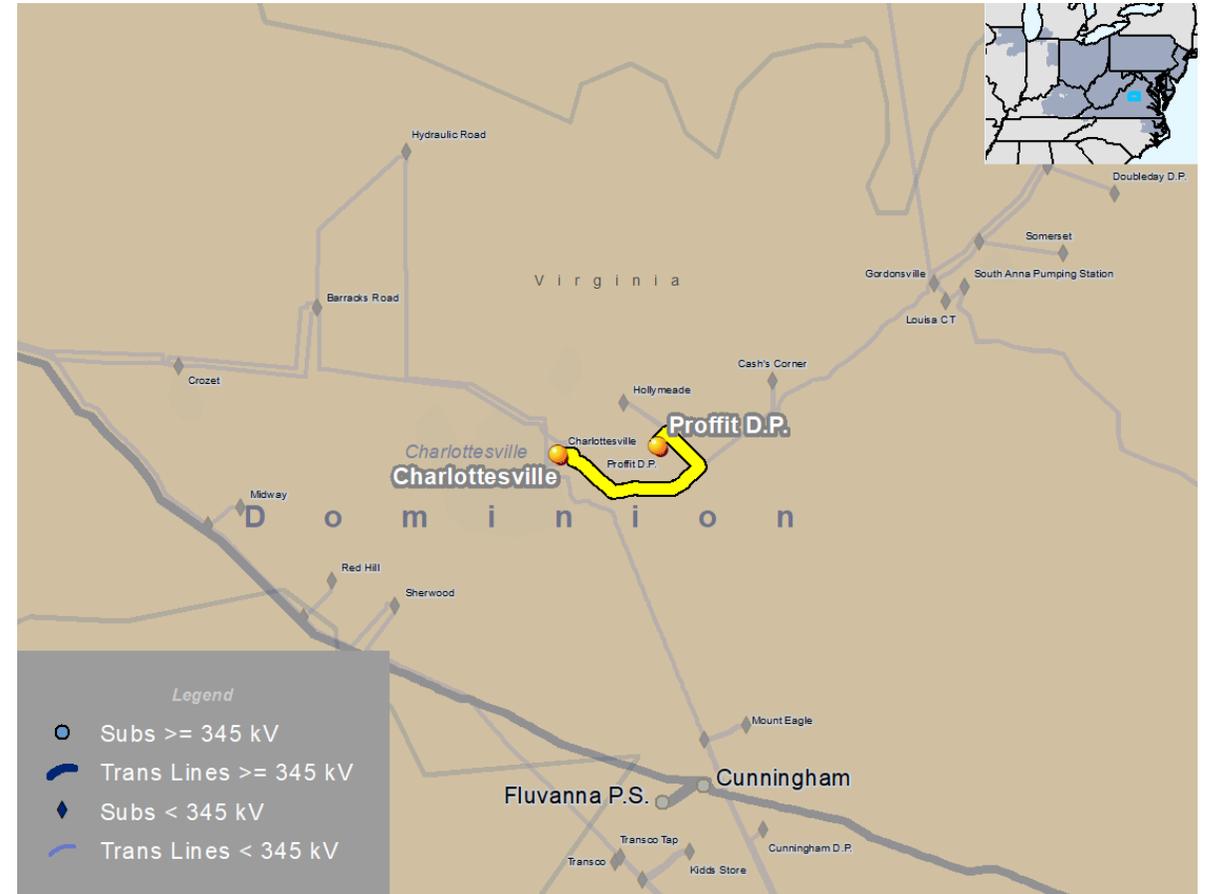
In-Service Cost (\$M): \$11.38

In-Service Year: 2023

Target Zone: DOM

ME Constraints:
Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 651](#)



Proposal No. 669 (Hollymeade Substation 5 MW Battery)

Project ID: 202021_669

Proposed Solution:
Install a 5 MW battery energy storage system at Hollymeade 230 kV substation.

Project Type: Upgrade

kV Level: 230 kV

In-Service Cost (\$M): \$25.95

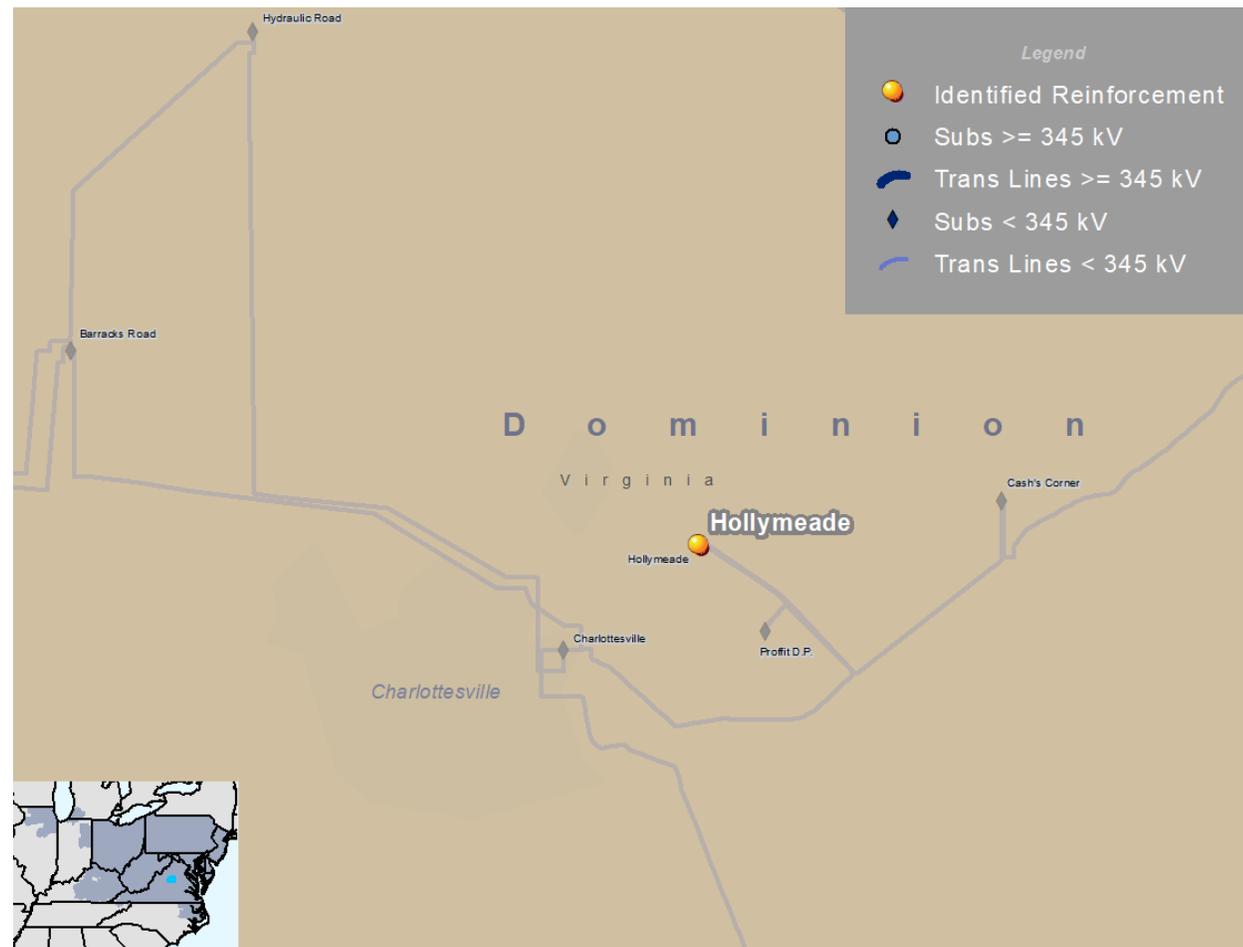
In-Service Year: 2023

Target Zone: DOM

ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 669](#)



Proposal No. 692 (Sleepy Hollow - Stony Point 230kV)

Project ID: 202021_692

Proposed Solution:

Tap the Mount Eagle - Charlottesville 230kV line with a new 230 kV Sleepy Hollow substation. Tap the Hollymead - Cash's Corner 230kV line with a new 230 kV Stony Point substation. Construct a new 230 kV line from Sleepy Hollow to Stony Point. Install a 5% series reactor on the new 230 kV line.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$36.07

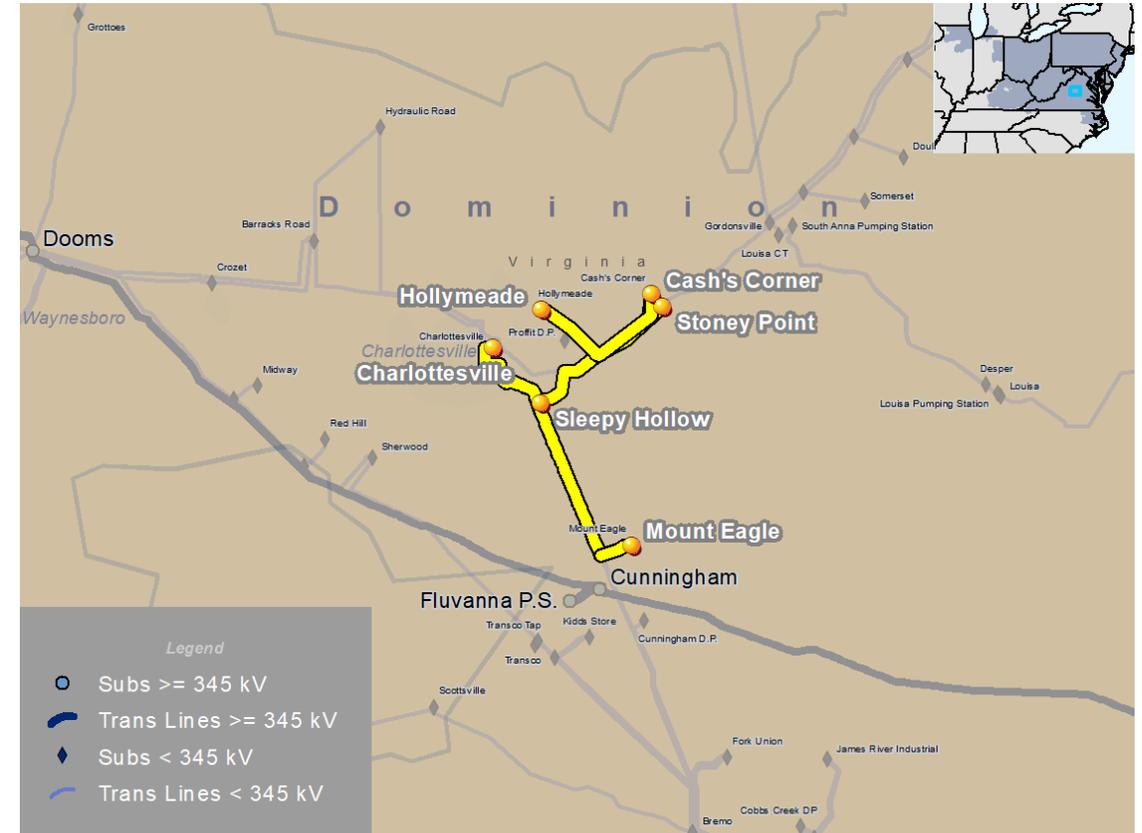
In-Service Year: 2025

Target Zone: DOM

ME Constraints:

Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 692](#)



Proposal No. 813 (Cismont Substation)

Project ID: 202021_813

Proposed Solution:
 Interconnect the Charlottesville – Proffit 230 kV line and the Hollymeade - Cash’s Corner 230 kV line via a new Cismont 230 kV substation. Rebuild the 230 kV corridor from Charlottesville-Cismont-Cash’s Corner-Gordonsville.

Project Type: Greenfield

kV Level: 230 kV

In-Service Cost (\$M): \$73.64

In-Service Year: 2025

Target Zone: DOM

ME Constraints:
 Charlottesville to Proffit Rd Del Pt 230 kV

Notes: [Redacted Public Proposal 813](#)



- V1 – 09/30/2021 – Original slides posted