September 3, 2025

RE: Opposition to Gore-Doubs-Goose Creek (500kV0 Valley Link (765kV) and the CPAM to Identify Transmission Line Corridors

Dear Mr. Kershner,

At the August 6, Between The Hills Community Meeting in Neersville, I heard that the developers of the proposed Valley Link 765kV transmission line were / had been meeting with County officials and state representatives to discuss the siting location of that line. You assured me that was not the case. If meetings were to occur, property owners in the vicinity being considered ***must be*** notified in advance of any discussions between Loudoun County elected officials and/or staff and Valley Link representatives or sub-contractors siting the line.

We were pleased to hear of your opposition to the proposed 765kV line. However, it must be noted, you wrote a letter to PJM to oppose the route of the MARL 500kV transmission line and supported a Loudoun County resolution to re-route it into our neighborhood, but you did not write a letter in opposition to the proposed 765kV project, nor is there any press release or content on your webpage indicating you are opposed to the 765kV Valley Link project. We expect that you will be writing a press release or editorial opposing the Valley Link project and will be supportive of a Loudoun County resolution against the 765kV transmission line? There is no place in Loudoun County where a 765kV line should be sited - especially not one on V-structs with guyed wires. Valley Link should be told not to site their 765kV lines anywhere in the County and that there needs to be a better solution. First Energy now has two proposed HVAC transmission projects through western Loudoun - the 500kV Gore-Doubs-Goose Creek (FirstEnergy's MARL segment) and Valley Link 765kV.

Further, we were happy to hear that you support under-grounding of transmission lines, including the use of underground High Voltage Direct Current (HVDC) . As you know HVDC is the only technology that can be used to underground longer transmission lines such as these two interstate proposals. I believe you have the handout my daughter prepared on the Black & Veatch Underground HVDC study that they did in 2009 for the PATH 765kV transmission line proved HVDC underground was a feasible solution through the Lovettsville and Neersville areas. I've attached her handout to this letter.

Some key facts:

- The full title of that study was : Black & Veatch, "PJM Interconnection Potomac-Appalachian Transmission Highline (PATH) Project, HVDC Conceptual Study, B&V Project No.164996, B&V File 42.2004 , FINAL November 17, 2009 This was entered into the record as part of the Virginia SCC Case PUE 2009-00043 Application of PATH Allegheny Virginia Transmission Corporation

- Concept 2 was to use HVDC Underground From a substation in Frederick County, VA, along the existing lines the Mt Storm - Doubs transmission lines on through Jefferson County, WV through Loudoun County segment and into Frederick, MD

- This is the same location PJM has proposed to locate MARL (500kV) and Valley Link (765kV) through Frederick County, VA, Jefferson County, West VA and western Loudoun County , VA and into Frederick , MD

- The HVDC with underground Concept 2 (~25 miles underground) would have cost 2x the overhead HVAC 765kV option ($1, 767M vs $3,595M) The additional $1,828M amounts to an extra $73.12M per mile

- Recent studies by NextGen Highways indicate the price has come down significantly and thespace required for installation is smaller now.

- The Aspen/Golden Underground alternative proposed by Loudoun County to put 3 miles underground would be an additional $480M over the cost of the overhead line. $160M extra per mile!

The HVDC underground solution proposed in 2009 costs less per mile than the alternative underground solution the county proposed for the Aspen/Golden HVAC transmission line.

Accordingly, we hope you will support a resolution for a pilot underground HVDC project in place of these two overhead HVAC lines.

The topic of revisions to the comprehensive plan also came up and there was a brief mention of Loudoun County establishing transmission corridors. We interpreted your remarks at the meeting as an admission that the County does not have the authority to site transmission lines *but also* that all new transmission lines must be within existing easements. The County cannot dictate that lines be within existing easements, these solutions are proposed at a regional level and the County has no say at all. I see nothing to negotiate in view of the Board's public and repeated position on the siting of new transmission lines - that it can create "transmission corridors" and work with energy companies to site transmission lines - the County lacks the authority to do so. The question then becomes: Why is the County pursuing identification of transmission corridors if it lacks the authority to site transmission lines?

To be clear, we strongly oppose the designation of transmission corridors anywhere in the County.

Establishing transmission corridors is telling the companies where to site their lines and where not to site the lines. After establishing transmission corridors, the County intends to "collaborate" with the utility, behind the backs of those property owners and to their detriment but to the benefit of other property owners, to propose new easements on private property in areas determined by the county. Such a designation / specification would immediately devalue property both within and adjacent to the specified "corridor". In doing so, the County would be liable for a taking in advance. This would create two classes of property owners ones subject to ongoing and continuous takings for electrical infrastructure to support the County's data center build-out, *at the direction of Loudoun County* and properties *protected by Loudoun County using tax payer monies* to oppose the transmission line routing.

By establishing transmission corridors, the Loudoun BOS would be telling energy companies and every other transmission company to site the line in the area where Loudoun County wants it located or Loudoun County will oppose the project at the Virginia SCC. To claim the Board would not be doing so insults our intelligence. For example, from the April 16, 2024, Loudoun County Resolution Opposing the Proposed Western Loudoun Route for New 500kV Electrical Transmission Lines:

> **"FISCAL IMPACT:** There are no fiscal impacts associated with adopting the Resolution. ***In the event there is no change to the proposed Western Loudoun Route, then Loudoun County may need to participate in proceedings to oppose approval of the Western Loudoun Route.*** The County will likely incur significant expenses retaining outside counsel and experts."

Furthermore, the one and only local with an existing 500kV transmission line is Lovettsville and Neersville areas, hosts to the Mt. Storm - Doubs 500kV and 138kV transmission lines. Declaring this local a "transmission corridor" per Loudoun County would necessitate matching "corridors" in adjacent counties and even adjacent states! **Talk about an overreaching land grab**!

While claiming not to site lines, the County would be doing indirectly what it lacks the authority to do directly. Also, establishing transmission corridors preempts the transmission company from looking at less costly and less impactful alternatives - such as along roadways. It is quite clear that the end result of the "review process" with respect to the transmission lines has been pre-determined: the Lovettsville and Neersville areas in western Loudoun gets the infrastructure corridor to support the data centers. Property owners in this area could wind up with two 500 kV lines, a 138 kV line and a 765 kV line on V-structs with guyed wires.

A 765kV will not fit within the existing easements it will require the taking and destruction of 200' of property linear feet covering several miles of forested lands on Short Hill Mountain - it will take approximately 325 acres of private property - rendering it "unusable" for all intents and purposes due to the 185' - 200' V-structures with guyed wires. Additionally, it would negatively impact Virginia Perpetual Open-space conservation easements held by the County as well as state and national parks.

The 500kV proposed to be "within the existing easement" through the Lovettsville and Neersville areas in western Loudoun, at this point, requires mono-poles of an average height of 185' to accommodate the 500kV plus the existing 138kV under built. While the AVERAGE height of the towers will be about 185 feet, many will be more than that due to the added lines. To place this in perspective, the current height of the Dominion tower is about130 feet, and except for high points in the terrain is mostly shielded from view buy trees, the existing 138kV H-frames is not visible at all - the Statute of Liberty is only 151'. This monstrosity will dominate view-shed for miles! Are we looking at 190 to 200 foot towers? Will they be visible half-way to Route 9?

All of these steel “scenic” wonders will be brought to the communities due to LOUDOUN COUNTY'S UNCONSTRAINED approval of data center re-zoning and at NO COST TO THE DATA CENTERS. Property owners will bear the brunt of this cost followed closely by the Ratepayers. Will Neersville and Lovettsville private property owners be forced to “host” the widest total transmission easement with the tallest towers , highest total voltage transmission and the largest Electro-Magnetic Field in the Commonwealth and in fact the entire east coast? Only time will tell.

In the meantime, to whom do I send my thank you note, for putting ourselves and other private property owners in Neersville and Lovettsville under threat of losing their property, destroying the generational value of their properties, the aesthetic degradation of their environment, the negative effects on the natural environment and the health risks of the EMFs?!!!

The County intervened in the Aspen proceeding and hired a firm to develop a concept and testify on an under-ground HVAC alternative. As well as hiring a real-estate expert to evaluate the degradation in property values due to the 180' towers for that transmission line being in the view shed of homes up to 1/4 to 3/4 of a mile away. No 180' towers are actually sited on these private properties for the Aspen/Golden line, this was an assessment of the degradation in value per the view-shed only. See the Direct Testimony of Direct Testimony Of William C. Harvey On Behalf Of Loudoun County, Virginia VA SCC Case Nos. Pur-2024-00032 And Pur-2024-00044. Lines 51 - 58 of which are below:

> "The mass appraisal was to reflect the unimpaired and impaired value, if any impairment was found, of residential properties located along the approximate 4.5-mile long Route 7 segment of Harry Byrd

Highway (Route 7) near Loudoun County Parkway to Belmont Ridge Road and the approximate 2.0-mile-long segment of Harry Byrd Highway (Route 7) near Ashburn Village Boulevard to Belmont Ridge Road in Loudoun County, Virginia that are expected to be affected by Class 5 (External Conditions) Detrimental Conditions caused by the planned 500/230 kV lines included in the Consolidated Cases as "overhead aerial lines and towers."

The County is obligated to treat its citizens/property owners equally. It seems to us in light of the County's actions in the Aspen/Golden case, and their actions in "collaborating" with the utilities to re-route the 500kV line to existing easements, the County must support under-grounding these transmission lines by hiring a firm, nationally recognized as competent to develop an HVDC underground alternative, such as Black & Vetch, as well as a real-estate professional to do a "mass appraisal" to evaluate the degradation in property values of properties subjected to a 185' tower with a 500kV and 138kV line as well as prosperities which will have the 185' tower and lines in their view shed.

We would appreciate a clarification of the County's position on the following questions:
(1) Will the Board oppose First Energy's proposed 765 kV line no matter where the transmission developer proposes to site it?

(2) Will the Board contract with Black & Veatch, to update the 2009 underground HVDC concept, evaluate and propose an under-ground alternative using HVDC technology from the proposed new Frederick County , Virginia substation through Loudoun to the Potomac River?

(3) Will the Board set aside Data Center tax revenue or institute impact fees for the data centers to pay for the cost difference between the overhead HVAC and under-ground HVDC solutions ?

We would appreciate a written response to these questions.

Sincerely,

Alfred and Irene Ghiorzi

Visit website stopmarlvirginia.com

Subscribe for updates check back for news and actions you can take

No one in Western Loudoun should be forced to host an overhead HVAC Infrastructure corridor to plug

Is HVDC underground feasible for the MARL/ Gore-Doubs Goose Creek 500kV and valley link transmission 765kV lines?

The short answer is yes!

For the PATH 765kV transmission line Black & Veatch did a study that proved HVDC underground was a feasible solution through our area. Although it was more expensive (at that time)

- The full title of that study was : Black & Veatch, "PJM Interconnection Potomac-Appalachian Transmission Highline (PATH) Project, HVDC Conceptual Study, B&V Project No.164996, B&V File 42.2004 , FINAL November 17, 2009 This was entered into the record as part of the Virginia SCC Case PUE 2009-00043 Application of PATH Allegheny Virginia Transmission Corporation

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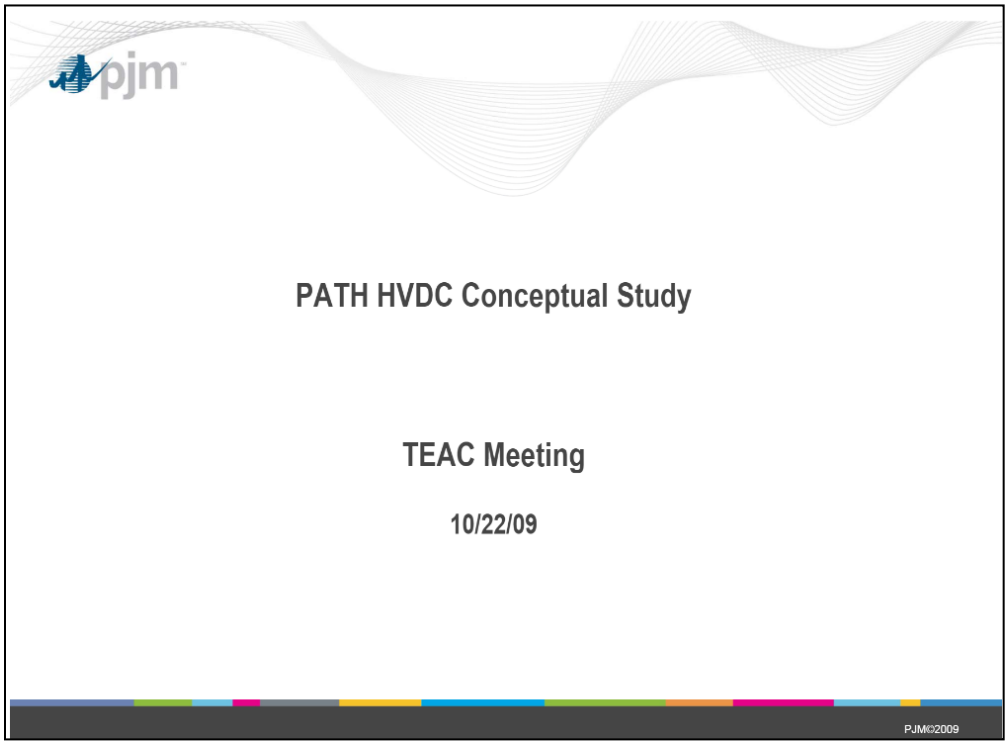
=> The HVDC underground solution proposed in 2009 costs less per mile than the alternative underground solution the county proposed for the Aspen/Golden HVAC transmission line.

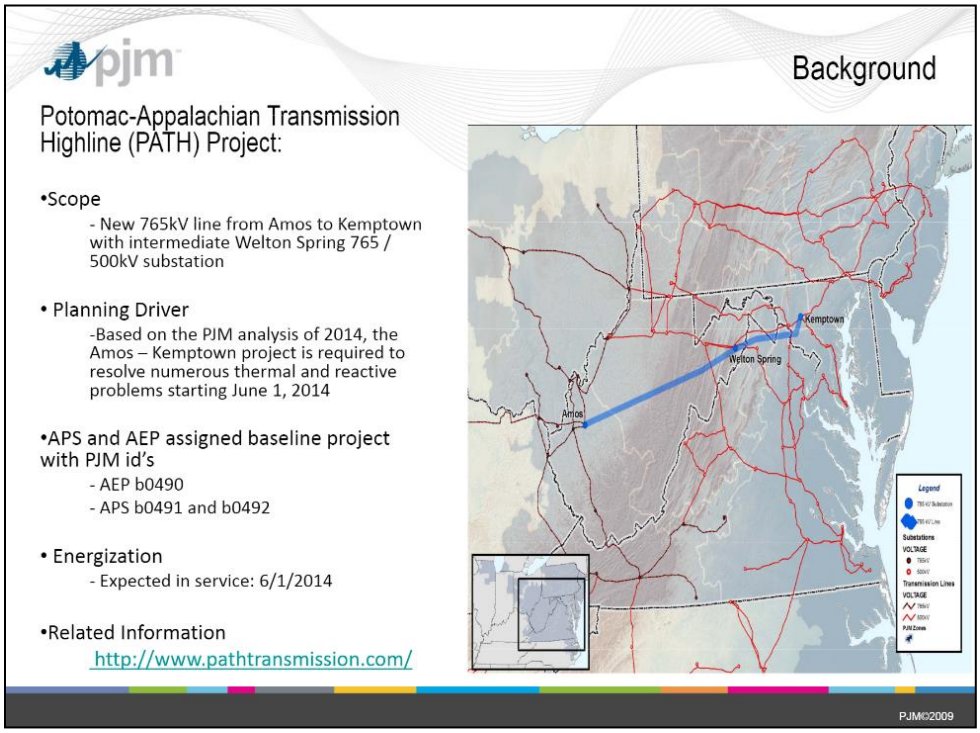
=> Data Center impact fees and taxes can be used fund the additional cost of under grounding Loudoun County must set aside funds for this purpose . At this point many of these companies are worth hundreds of billions to trillions in market caps (Amazon reached a $2 Trillion Stock Value on June 27, 2024) . Their executives and boards are paid 100's of billions of dollars . There is more than enough money to cover the cost of using HVDC and undergrounding these lines

=> FirstEnergy is now responsible for two massive transmission lines targeted through our communities (Valley Link and Gore-Doubs-Goose Creek). Its time to re-evaluate and look at ONE single solution - figure out how much

power can be reasonable imported from est Virginia and build A SINGLE INCLUSIVE HVDC Underground solution to solve it.

=> PJM TEAC Charts on the concept are attached, the full engineering study (B&V Project No.164996, B&V File 42.2004 , FINAL November 17, 2009) was filed during the Virginia SCC Case PUE 2009-00043 Application of PATH Allegheny Virginia Transmission Corporation





Study Process

- Develop Scope of work for study
- Solicit proposals from vendors
- Black & Veatch (w/ ABB) awarded PO
- PJM identified project requirements
- Study completed in two steps:
  - Welton Spring – Kemptown
  - Amos – Welton Spring

Study Scope

PATH Current Design

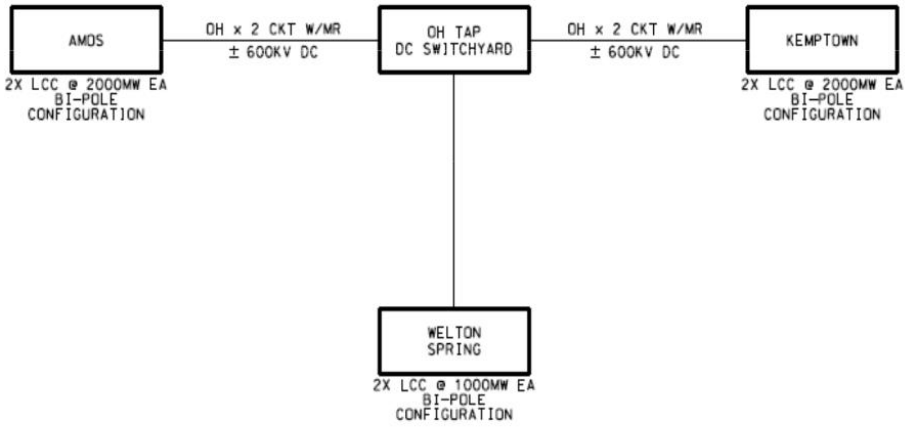
Single circuit 765kV AC overhead transmission line from Amos - Kemptown

PATH HVDC Study

Concept 1: HVDC overhead transmission from Amos-Welton Spring-Kemptown

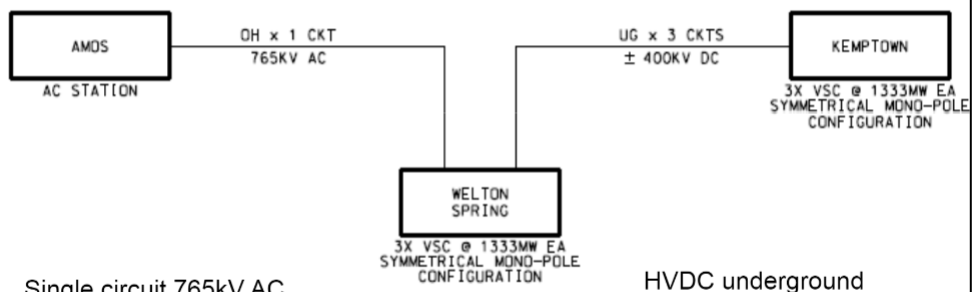
Concept 2: Single circuit 765kV AC overhead transmission from Amos-Welton Spring; HVDC underground transmission from Welton Spring-Kemptown

Concept 1



HVDC overhead transmission from Amos - Welton Spring - Kemptown

Concept 2



Single circuit 765kV AC overhead transmission from Amos - Welton Spring

HVDC underground transmission from Welton Spring - Kemptown

Key Physical Features Comparison Summary

	Current Design	Concept 1	Concept 2
Structures			
Max Structure Height	130 ft	150 ft	N/A
Max Structure Width	150 ft	80 ft	N/A
Right-of-Way			
Amos – Welton Spring	200 ft	150 ft	200 ft
Welton Spring - Kemptown	200 ft	150 ft	110 ft

Comparison Aspects HVDC vs. AC

- Permitting
- Future Expansion
- Operations and Reliability
- Maintenance

Estimated Cost Comparison

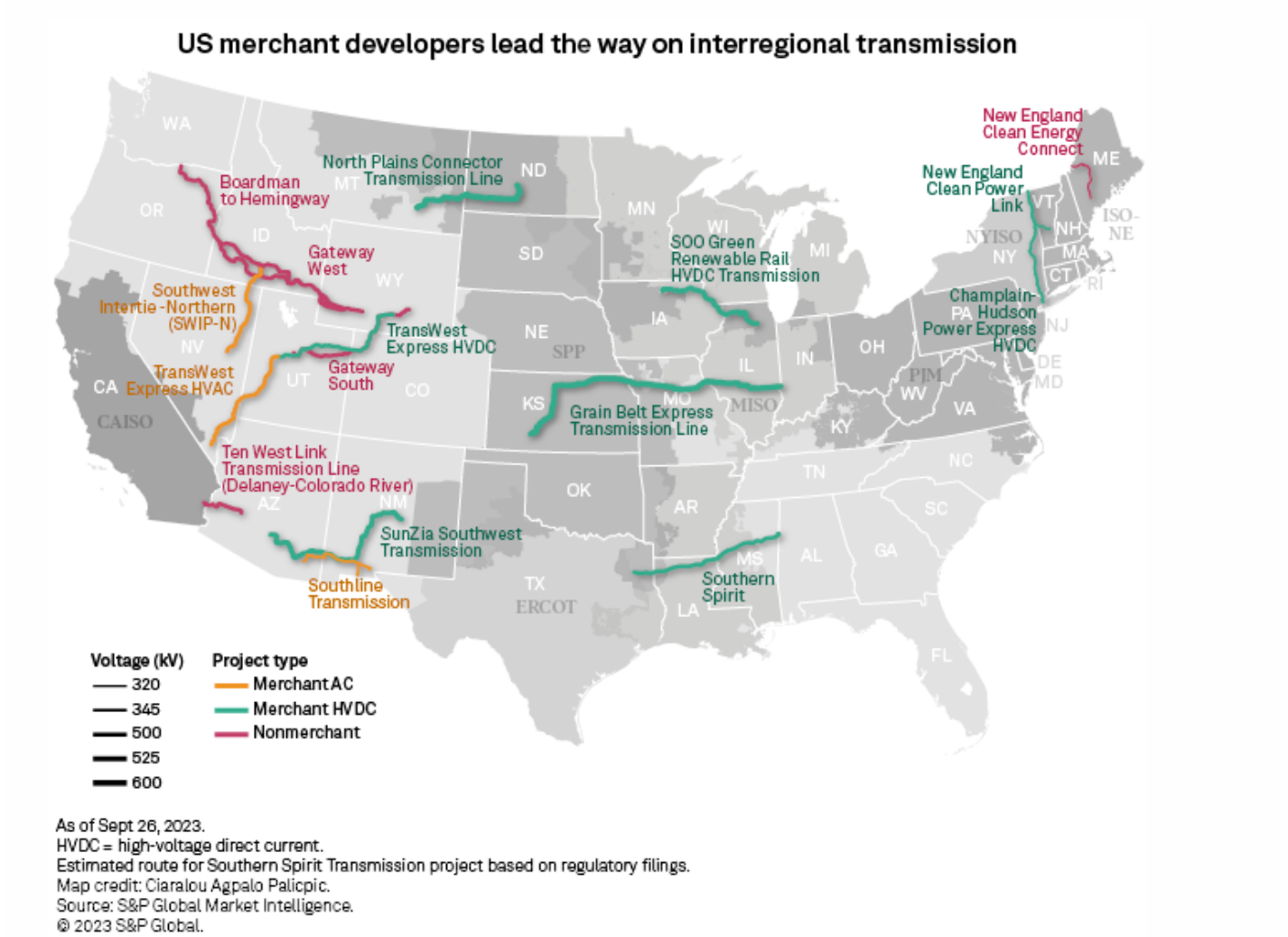
	Current Design	Concept 1	Concept 2
AC Overhead Line	$1,204 M	--	$756 M
AC Interconnection Substations	$563 M	$563 M	$563 M
HVDC Overhead Line	--	$1,002 M	--
Overhead Tap Switchyard	--	$8 M	--
HVDC Underground Line	--	--	$884 M
HVDC Convertor Stations (LCC)	--	$838 M	--
HVDC Convertor Station (VSC)	--	--	$1,392 M
TOTALS	**$1,767 M**	**$2,411 M**	**$3,595 M**

Next Steps

- Complete final edits to report
- Post report by mid November

HVDC Transmission Lines & Links:

https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/merchant-developers-fill-void-in-us-interregional-grid-build-out-76447354



As of Sept 26, 2023.
HVDC = high-voltage direct current.
Estimated route for Southern Spirit Transmission project based on regulatory filings.
Map credit: Ciaralou Agpalo Palicpic.
Source: S&P Global Market Intelligence.

Region	Project Name		Company	Voltage (kV)	AC/DC	Miles	Expected year in service	Cost ($B)	Merchant (Y/N)
New England	New England Clean Power Link	●	Transmission Developers	320	DC	154	2029	1.60	Y
	New England Clean Energy Connect	●	Avangrid Inc.	320	DC	145	2025	1.40	N
New York	Champlain-Hudson Power Express	●	Transmission Developers	320	DC	339	2026	6.00	Y
Texas-Southeast	Southern Spirit Transmission	●	Pattern Energy Group LP	500	DC	400	2027	2.50	Y
Midwest	Grain Belt Express	●	Invenergy Transmission LLC	600	DC	800	2028	7.00	Y
	SOO Green Renewable Rail HVDC Transmission	●	Soo Green Renewable Rail LLC	525	DC	350	2029	2.50	Y
Southwest	SunZia Southwest Transmission	●	Pattern Energy Group LP	525	DC	550	2026	2.00	Y
	Southwest Intertie Project	●	LS Power Group	500	AC	285	2025	0.71	N
West	TransWest Express	●	TransWest Express LLC	500	AC/DC	732	2027	3.00	Y
	Boardman to Hemingway	●	PacifiCorp Idaho Power	500	AC	290	2026	1.20	N
	Southline Transmission	●	Grid United LLC Black Forest Partners LP	345	AC	280	2027	0.80	Y
	Gateway South	●	PacifiCorp	500	AC	416	2024	2.07	N
	Gateway West	●	PacifiCorp Idaho Power	230-500	AC	1000	2024-2030	NA	N
	Ten West Link	●	Lotus Infrastructure Partners	500	AC	125	2024	0.39	N
	North Plains Connector	●	Grid United LLC ALLETE Inc.	500	DC	395	2029	2.50	Y

Development status ● Advanced development ● Construction begun

As of Sept. 26, 2023.
NA = not available.
Cost estimates confirmed with developers or based on latest available regulatory filings.
Data set limited to projects and line segments in advanced development or under construction.
Source: S&P Global Commodity Insights.

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Source: S&P Global Commodity Insights.

Unites States:

1) New York HVDC Underground (September 2023) : **Champlain Hudson Power Express**, "About the Project," https://chpexpress.com/project-overview/

- HVDC
- 400kV (https://chpexpress.com/news/champlain-hudson-power-express-announces-contractor-selection-process-complete/)
- 1250MV of power
- 339 miles with 60% in waterways and 40% buried underground
- $4.5 Billion

Another source: https://waterfrontalliance.org/2022/04/27/canadian-renewable-energy-transmission-line-is-approved-nyc-residents-cant-wait-for-peaker-plants-to-close/

2) New York , New Jersey (2013, 2007) : HVDC entirely Underground and undersea.

- **The Hudson Project**: 660MW between NY & PJM **completed 2013** entirely underground and underwater HVDC.

  https://hudsonproject.com/project/

  - "The Hudson cable is entirely underground and underwater, using high voltage direct current ("HVDC") technology. The route begins in Ridgefield, New Jersey, the site of the Hudson converter station, where it interconnects with the PJM system at a PSE&G substation. The line follows existing railroad rights-of-way, through an inactive railroad tunnel to the edge of the Hudson River in Edgewater. It is then buried beneath the Hudson for approximately three-and-a-half miles to a landfall point near Pier 92 in Manhattan. The final stretch of cable is routed beneath the West Side Highway and ultimately into the ConEdison W. 49th Street Substation."

- 345kV
  - https://hudsonproject.wpengine.com/wp-content/uploads/2010/09/NYPSC-Press-Release-09.08.10.pdf

- **NeptuneTransmission**: 660MW, 65 mile HVDC underground and undersea cable - New Jersey to Long Island NY, **completed 2007** - ahead of budget and ahead of schedule.
- https://boundlessenergyllc.com/project-development/neptune-regional-transmission-system/

  https://neptunerts.com/

  - "Neptune Regional Transmission System, LLC (Neptune RTS) developed, permitted, financed, built, and now owns and operates the Neptune Project, a 65 mile undersea and underground high voltage direct current (HVDC) transmission line that extends under water and underground from Sayreville, New Jersey to Nassau County on Long Island. Neptune provides up to 660 MW of power to Long Island electricity consumers – enough for 600,000 homes — and supplies more than 20 percent of Long Island's typical electricity demand. Neptune began construction in June 2005 and was completed in June 2007, on budget and ahead of schedule."

3) Vermont (2023) : HVDC Underwater & Underground: **New England Clean Power Link**
https://electricityforum.com/news/NEW-ENGLAND-CLEAN-POWER-

"The New England Clean Power Link is a proposed 1,000 MW High Voltage direct current (HVdc) underwater and underground transmission cable that will bring clean, low-cost energy from the U.S.-Canadian border to Vermont and the New England marketplace. Once completed, the project will lower costs for consumers, reduce environmental emissions, create jobs, increase tax revenues, and diversify fuel supply in New England, all while respecting Vermont's natural beauty by burying the cable.

4) New Hampshire (2015 -2023 was ultimately rejected) : **Northern Pass**

https://www.nhpr.org/environment/2015-09-03/meet-the-cable-that-made-burying-52-miles-of-northern-pass-possible
"Eversource took the money that it saved by switching to HVDC Light, and plowed it into burying the line through the White Mountain National Forest."

- 192 Miles

- 1.6 Billion
- HVDC at least 52 miles proposed to be underground
- (I believe this Northern Pass was rejected in June of 2023. The technology is still relevant)

5) New Hampshire (2023) : HVDC Underground & Along existing Easements : **Twin States Clean Energy Link**
https://www.wbur.org/news/2023/10/31/vermont-new-hampshire-national-grid-twin-states-canada-hydropower

The Twin States Clean Energy Link project is utilizing roadway burial and existing transmission corridors in Vermont and New Hampshire. Where new corridors are being placed, the project will bury about 75 miles of underground HVDC line.
HVDC

@75 miles underground

(I believe the Twin States Clean Energy Link was withdrawn recently)

6) **SOO Green underground transmission line between MISO, PJM**

https://soogreen.com/

"The SOO Green HVDC Link is a first-of-its-kind electricity transmission project that will install state-of-the-art high-voltage direct current (HVDC) transmission cable underground along existing railroad corridors. SOO Green is pioneering an innovative model for developing transmission infrastructure to deliver renewable energy long distances to customers across the Eastern U.S. that virtually eliminates the visual, land and environmental impact of above-ground transmission lines. SOO Green will enable the development of new, low-cost renewable energy resources while enhancing the power grid's reliability and resilience."

Other sources:
https://www.utilitydive.com/news/soo-green-transmission-miso-pjm-interregional-big-wires-act-hickenlooper/693916/
https://www.utilitydive.com/news/soo-green-pjm-grid-operators-helping-or-hurting-energy-transition/616966/

7) Minnesota : **The NextGen Highways Feasibility study for the Minnesota Department of Transportation**

https://nextgenhighways.org/resources/ngh-resources/

Other sources:
https://www.utilitydive.com/spons/why-hvdc-cables-are-poised-to-provide-valuable-alternatives/651800/
https://www.powermag.com/the-vital-link-how-hvdc-is-modernizing-the-grid/

8) California 2023 - 2028:
a)**Power By the South Bay Project**: https://www.lspgridcalifornia.com/newark/

"The Power the South Bay Project (also known as the Newark – Northern Receiving Station HVDC Project) is a reliability-driven project that will strengthen the electrical grid in the South Bay area by providing a strong, new source to the area. The project will support economic development and provide better access to cost effective, renewable energy to meet the needs of residents and businesses. The project is located in Alameda and Santa Clara Counties, California and is anticipated to enter into service in 2028.

The project includes two new 320 kV high voltage direct current (HVDC) terminals, which provide the ability to control power flows. Each terminal also includes a 230 kV alternating current (AC) gas-insulated switchgear (GIS) switchyard. The Albrea terminal will interconnect to the existing Newark substation via a new 230 kV AC transmission line. The Baylands terminal will be located near the existing Los Esteros substation and will

interconnect to the existing Northern Receiving Station via a new approximately four miles 230 kV AC underground and overhead transmission line. A new approximately eight mile ±320 kV HVDC underground and overhead transmission line will connect the two terminals."

b) **Power Santa Clara Valley Project**: https://www.lspgridcalifornia.com/metcalf/

"The Power Santa Clara Valley Project (also known as the Metcalf – San Jose B HVDC Project) is a reliability-driven project that will strengthen the electrical grid in central San José by providing a strong, new source to the area. The project will support economic development and provide better access to cost effective, renewable energy to meet the needs of residents and businesses. The project is located in Santa Clara County, California and is anticipated to enter into service in 2028.

The project includes two new high voltage direct current (HVDC) terminals, which provide the ability to control power flows. The Skyline terminal will include a 115 kV alternating current (AC) gas-insulated switchgear (GIS) switchyard and will interconnect to the existing San Jose B substation. The Grove terminal will include a 500 kV AC GIS switchyard and will interconnect to the existing Metcalf substation via a new approximately one mile 500 kV underground transmission line. A new approximately 13 mile ±320 kV HVDC underground transmission line will connect the two terminals.

Construction is planned to begin in early-2026 after necessary permits, agreements and land rights are received. The construction phase of the project is anticipated to be approximately 2 years in duration, concluding with the energization and testing of the new project facilities."

NEXTGEN HIGHWAYS

FACT SHEET

November 2022

Buried High-Voltage Direct Current (HVDC) Transmission is Cost Competitive

The NextGen Highways vision builds on a growing body of evidence that underground high-voltage direct current (HVDC) provides a cost-effective, efficient solution to the nation's transmission needs, and in so doing, advances our renewable energy and carbon reduction goals.

What is HVDC transmission?

High-voltage direct current (HVDC) transmission lines are more efficient and effective for transmitting large amounts of power over long distances than high-voltage alternating current (HVAC) lines. Because most of the electric transmission in the United States (U.S.) is overhead HVAC, AC power must be converted to DC for the long-haul transfer and then converted back to AC for delivery to consumers. While the high cost of converter stations has been a barrier to HVDC projects, that cost is now declining.

Comparing the costs of overhead vs buried transmission

Very few HVAC transmission lines run underground since the cost of burying high-voltage AC cables has historically been prohibitive. Conventional wisdom among transmission professionals is that buried HVAC costs seven to ten times more than overhead HVAC.

Comparing buried to overhead HVDC transmission is difficult since, in recent years, HVDC transmission development has been limited in the U.S. Current estimated costs, however, suggest buried HVDC transmission is roughly two to four times more expensive than overhead HVDC.

What is buried HVDC transmission?

Buried HVDC is the practice of burying the HVDC cables below ground rather than stringing them between poles overhead. While this burying cables can be more expensive than stringing lines overhead, this method can improve resilience and avoid viewshed and other land impacts. The technology is maturing as the industry gains experience designing and building buried HVDC projects around the world. There are three underground HVDC projects in active development in the U.S.-- SOO Green, Champlain Hudson and Clean Path New York–as well as three others in Europe–SuedOstLink, SuedLink and Italy/France Interconnector.

A review of these projects suggests the cost of underground HVDC is on par with overhead HVAC when the point of comparison is the cost per Gigawatt-mile.

Furthermore, for a few reasons, the projected costs of buried HVDC transmission lines is declining:

- Converter station costs –which are required to convert DC power to AC– have fallen from $300 million per GW per converter down to a conservatively estimated $200 million per GW per converter.
- Installed cable costs have fallen from over $3 million per GW-mile to $1-2 million per GW-mile.

The fact that these HVDC projects are in active development suggests a level of project value and cost acceptance from the developers, customers, regulators, and other stakeholders.

Choosing an appropriate basis for cost comparison

When evaluating the cost of buried HVDC transmission, it is important to consider not only the difference in cost between overhead and buried HVDC transmission, but also benefits to the larger bulk power system. For example, a single HVDC line may reduce the need to build power plants or local transmission, however, those benefits may not be included in the initial evaluation of project value.

Conventional analysis of transmission projects considers each project as an individual financial asset – separate from the surrounding system. Considering a project as a component in a larger system, where transmission costs constitute approximately 20

percent of the total system cost, changes the calculations. As such, a project affecting a larger system is likely to result in broader benefits including other avoided costs, resulting in the project having a greater impact than just the actual transmission project cost.

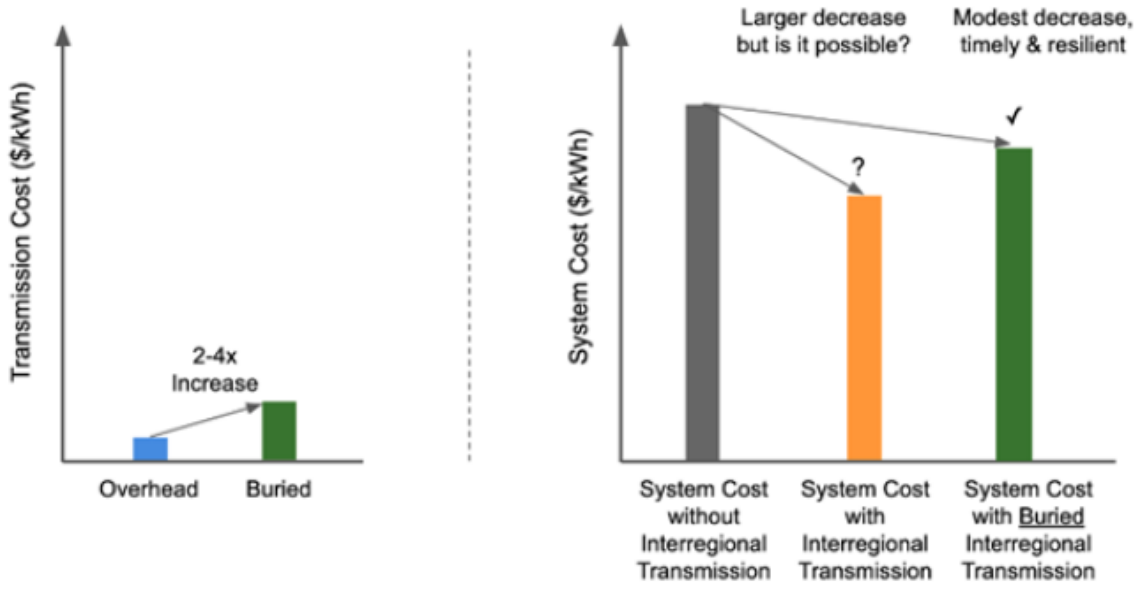
The figure below illustrates how the cost of buried HVDC transmission can appear unaffordable as a standalone project but affordable when taking system benefits into account, from a system cost perspective.

System benefits are especially relevant in the case of interregional transmission, which multiple studies have shown would significantly reduce the total system cost by moving low-cost power from where it's generated to regions of high demand. More interregional transmission reduces the need to build new power generation resources. The important questions then become:

1) Whether the cost of a buried HVDC transmission project can be offset by the reduction in system costs it will produce, and

2) Whether burying the HVDC line would provide greater project certainty and faster permitting and siting timeline than a corresponding overhead HVDC project.

Figure 1: System Benefits of Buried HVDC Transmission Change in Cost Analysis



Benefits of buried HVDC transmission

Buried HVDC transmission provides a number of important benefits not provided by overhead HVDC transmission. These benefits include:

- Facilitating public acceptance and reducing public opposition, since burying this infrastructure in the publicly-owned ROW means that people do not lose a portion of their private land for energy development and viewsheds are not disrupted
- Accelerating permitting and land acquisition timelines
- Improving project certainty
- Enhancing grid resilience by
    - mitigating the risks posed by severe weather events (e.g., hurricanes, ice storms, wildfires), for example, in Louisiana Hurricane Laura knocked out all nine transmission lines delivering power into the Lake Charles area of Entergy's service territory. Hurricane Ida knocked out all eight transmission lines delivering power into New Orleans, leaving the city without power for half a month.
    - protecting the system from geomagnetic disturbances (e.g., solar flares or an electromagnetic pulse attack).
- Significantly reducing land use impacts. Buried HVDC requires approximately one-fifth of the ROW space that traditional overhead HVAC requires.
- Removing the electrocution risk for birds and the collision risk for small aircraft

Key Takeaways

- While current projected project costs for buried HVDC transmission are greater than overhead HVAC transmission, buried HVDC has the potential to be a better investment for consumers, when the full set of costs and benefits are considered.
- As the underground HVDC projects referenced above are placed in-service, NextGen Highways will conduct additional costs analysis in comparison with HVAC projects.

Sources

- NextGen Highways Feasibility Study for the Minnesota Department of Transportation
- Transmission Planning for 100% Clean Energy

About NextGen Highways

The NextGen Highways is a collaborative initiative promoting the use of highways and other existing rights-of-way as infrastructure corridors where electric and communications infrastructure are strategically and safely co-located in existing highway right-of-way. Learn more at http://www.NextGenHighways.org