NEXTGEN HIGHWAYS

FACT SHEET

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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.

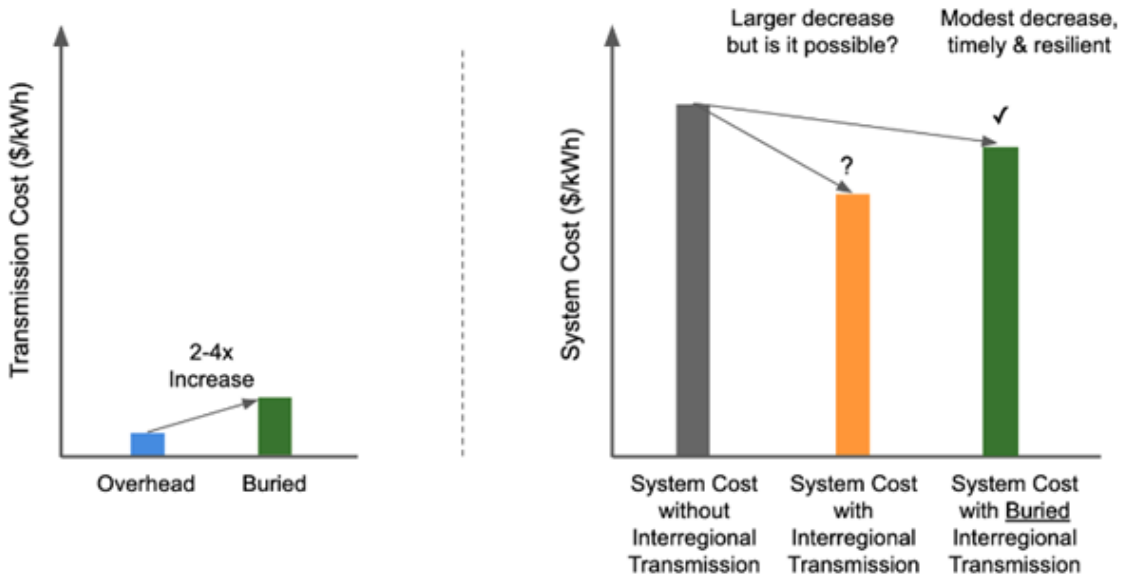
The figure below illustrates how the cost of buried HVDC transmission can appear unaffordable as a standalone project but affordable when taking system benefits into account, from a system cost perspective.

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