

Supporting Invenergy's Transmission Development



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Background

The electric grid is an immensely valuable asset, and a complex system to operate. Long-distance, high-voltage direct current (HVDC) transmission is essential for meeting U.S. decarbonization goals and improving the electric grid. With 20+ years of experience as a renewable energy developer, Invenergy has the experience and resources to be a leader in the electric transmission development space, as well. However, transmission development is a complex industry, with cumbersome permitting processes and expensive overhead costs. There is a lot to learn for private companies in this field, as until now, utilities served as the primary transmission developers, not private companies. Our work with Invenergy this summer focused on supporting their extensive efforts to successfully build out four key HVDC transmission projects across the country by developing resources and reference guides for Invenergy Transmission developers.

Purpose

Interregional transmission projects remain difficult, slow, and expensive to build because of these key barriers:

- **Planning:** A lack of comprehensive, interregional transmission planning that leads to successfully approved projects that are ready for construction
- **Permitting:** Slow and cumbersome permitting processes for new transmission lines
- **Paying:** Difficulties in acquiring capital for transmission projects and allocating costs to customers that reflect the multiple benefits they provide

With these challenges comes a necessity to build new systems and methods that streamline and expedite the transmission development process, and to help new and current employees understand the complex history and context of the electric grid. The transmission industry is novel for non-utilities, and Invenergy transmission teams are grappling with establishing best practices to streamline a project. Coordination between teams can often be difficult, complicated, and redundant, leading to increasingly inefficient practices and potentially delaying the project. Our team's purpose is to help Invenergy address these barriers through the creation of a company-wide reference document and analysis of current best practices.





Methods

Phase 1: Background Research

Conducted a literature review and preliminary research on the history and current state of the U.S. electric grid and high-voltage direct-current (HVDC) transmission. Interviewed Invenergy Transmission employees to understand Invenergy's unique role in this development space and the essentials of developing a transmission project as a non-utility.

Phase 2: Subject-Specific Research

Developed an outline for a 20-page report and assigned report sections to individually research and write about. Interviewed industry experts, including former FERC Chairman Richard Glick, national transmission expert Rob Gramlich, and more.

Phase 3: Creation of Report

In early June, began writing an initial rough draft of the report. Conducted an extensive peer review process, involving our Capstone advisor and Invenergy partners as editors for clarity and content. In early July, finalized the 20-page final report.

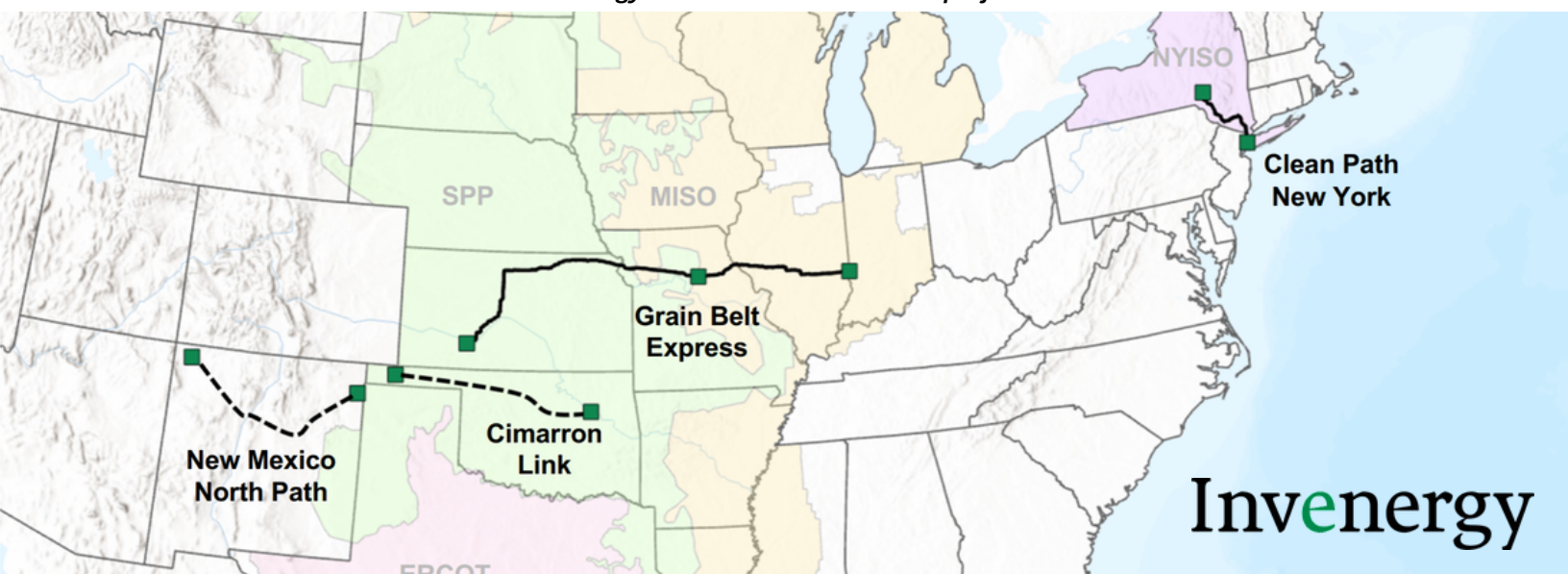
Phase 4: Presentation of Report

Presented the report's contents in a slideshow presentation to Invenergy Transmission leadership (in-person and virtually) in early July to share our work and receive feedback.

Phase 5: Analysis of Four Current Projects

For deliverable two, divided our four team members among the four current Invenergy Transmission projects. Carried out an extensive interview process with the projects' team members to understand each one's processes and strategies for every step of the development process. Recorded information and synthesized findings into a spreadsheet with all four projects for easy comparison and analysis.

Invenergy's four HVDC transmission projects





Outcomes

The outcome of our project is two distinct deliverables. The first is a report on the current state of HVDC transmission in the U.S. The report is intended to serve as an internal resource for current developers, and new hires, so it was written to be a readable, short (20-page) report for Invenergy transmission developers to establish or bolster a thorough understanding of this complex industry. The main topics of the report include: The history of the U.S. electric grid, issues with the current grid, government actors and recent updates in transmission regulation, technological factors of HVDC transmission, economic factors of merchant (privately-developed) transmission lines, barriers to transmission buildout, and a conclusion highlighting potential pathways forward for the industry.

The second deliverable is an Excel spreadsheet meant to serve as a resource guide for transmission developers to have easy access to the strategies, processes, tools, documentation, tracking techniques, lessons learned, and other fundamental information on the processes established in existing projects. These projects include Invenergy's current four HVDC transmission projects: Clean Path, Cimarron Link, North Path, and Grain Belt Express. The research was primarily performed through in-depth interviews with individuals in focal roles across Invenergy's transmission development teams and focused on gaining key insights on each team's development process. Finally, our team performed a cross-analysis of Invenergy's four current projects to streamline potential approaches and methods for future ones.

Conducting in-depth research on HVDC transmission has been a meaningful learning experience for our team, and our report and analysis will be a valuable resource for Invenergy's current and future transmission developers.

Acknowledgements

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