

Two Major HVDC Projects

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1. Introduction

This paper's title describes what it is about. These are two very important projects. The first, briefly described below, is also an important part of a major wind power project. This transmission project is currently planned to be completed by 2026.

The largest renewable energy infrastructure project in U.S. history, an \$8 billion wind farm and transmission line-is set to begin construction in 2023. San Francisco-based Pattern Energy took over the projects, called SunZia Wind and SunZia Transmission, from Southwestern Power Group in July 2022. The wind part of the project consists of a total of 3,000 megawatts from wind farms to be built in three counties in New Mexico. An 885-kilometer bidirectional high-voltage direct-current transmission line will run from New Mexico and south-central Arizona. The transmission line will sidestep the growing difficulties of connecting renewable energy sources to the power grid.¹

The Second Project is currently in the development phase, and has just started, but appears to be well along in planning, and may be completed by 2028.

The North Plains Connector is an approximately 385 mile and up to 600 kilovolt high voltage direct current (HVDC) transmission line connecting the U.S. eastern and western electric grids in, respectively, North Dakota and Montana. The North Plains Connector will be open to all sources of electrical power generation. In response to demand, the project will be able to transport power in either direction along the line.²

The North Plains Connector will extend from an existing substation in Colstrip, Montana, to an existing substation in Center, North Dakota, and a new substation in Morton County, North Dakota.

HVDC Transmission lines are very different for AC lines in a number of ways. I explored this issue in an earlier series of two posts over a year ago. These posts are described and linked below.

HVDC Transmission - Part 1, Technology: *In general, an HVDC line tends to be used for specific critical and/or long-distance applications whereas an HVAC line tends to be part of a large AC network composed of many synchronized AC lines that operate at various voltages.*

Part 1 of this series will look at specific applications where HVDC Transmission excels, other applications that may not be as suitable, and the geographic area in the U.S. Grid where they have and will continue to be used extensively. Part 1 will also look at the technology used to implement an HVDC line.

<https://energycentral.com/c/gr/hvdc-transmission-part-1-technology>

¹ January 2013 IEEE Spectrum (hardcopy), "United States Wind on the Wire,"

² North Plains Connector Website, <https://northplainsconnector.com/>

HVDC Transmission - Part 2, Major Projects: This is a two part series on HVDC Transmission. This part will look at major HVDC Transmission projects that are currently being implemented in the U.S.

<https://energycentral.com/c/tr/hvdc-transmission-part-2-major-projects>

Part 1 of the above described and linked series also looked at a major utility consortium: Western Energy Imbalance Market. The North Plains Connector will link this market (at Colstrip, Montana) to utilities further east.

This Post will review various aspects of both projects, starting with the North Plains Connector, including their management, participating utilities and schedule.

2. North Plains Connector

The North Plains Connector is important for a number of reasons. This section will explore these reasons and other details about this project.

2.1. Management & Organization

ALLETE & Grid United join forces to develop key transmission link to enhance reliability of the nation's electric grid. "Additional investment in transmission is critically important to achieve a clean-energy future and is a key part of our 'Sustainability-in-Action' growth strategy as our national footprint expands," said ALLETE Chair, President and CEO Bethany Owen. "This innovative project is an important step toward a resilient and reliable energy grid across a wide area of the country and ties into important transmission projects being developed in the Upper Midwest and the Western Interconnection. We commend Grid United's efforts on this much-needed project to enhance the nation's grid and are thrilled to join forces as together we advance the North Plains Connector to completion."

From the ALLETE Web Site: ALLETE is a provider of competitively-priced energy in the Upper Midwest, and invests in transmission infrastructure and other energy-centric businesses. ALLETE's Minnesota Power electric utility serves 145,000 residents, 15 municipalities and some of the nation's largest industrial customers. Other businesses include ALLETE Clean Energy, a developer of clean generation projects; BNI Energy in North Dakota; Superior Water, Light and Power in Superior, Wisconsin; ALLETE Renewable Resources, which operates and maintains wind generation facilities in North Dakota; and New Energy Equity, a developer of solar energy projects.³

From the Grid United Website: Grid United has a mission to do just what our name implies – unite the U.S. electric grid by building new long-distance, interregional transmission lines to ensure that Americans have access to low-cost power when and where it is needed. We are focused solely on accelerating the much needed expansion and modernization of America's electric power infrastructure to build a more reliable grid, create good-paying jobs, and deliver low-cost, clean, domestically-produced energy to businesses and homeowners across the country. Direct current (DC) is the preferred technology for moving large amounts of power across long distances. DC results in higher overall efficiency and reliability than an equivalently-sized alternating current (AC) system moving the same amount of power.⁴

³ ALLETE, Our Businesses, <https://www.allete.com/OurBusinesses>

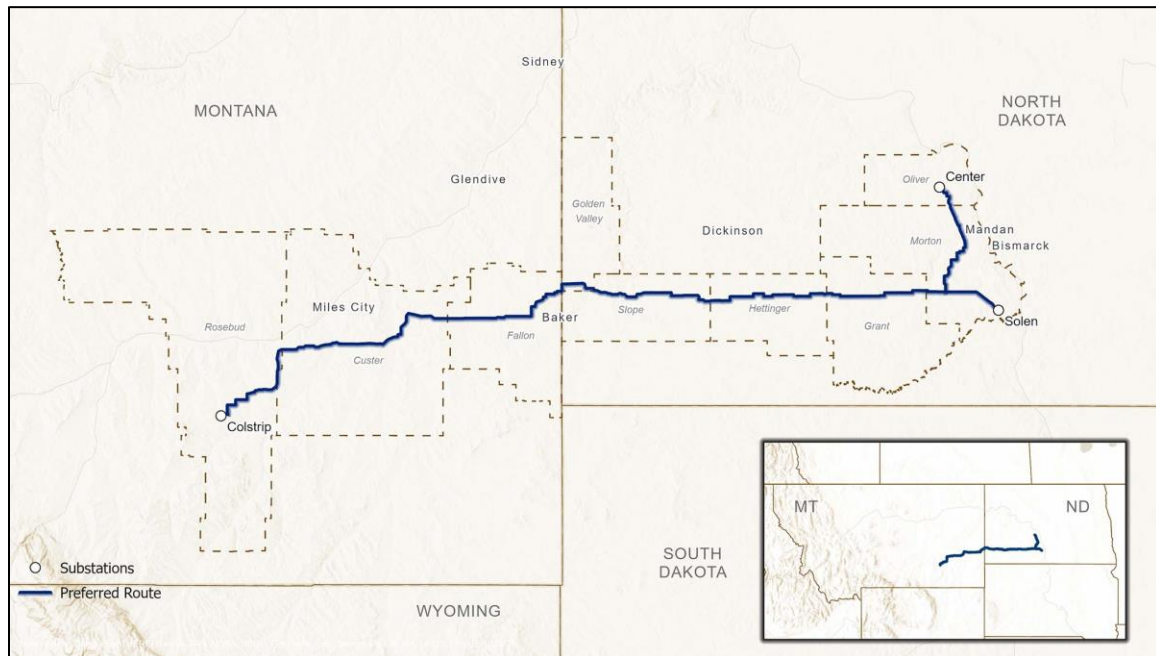
⁴ Grid United, About Us, <https://www.gridunited.com/about/>

ALLETE and Grid United have signed a memorandum of understanding to explore transmission opportunities, with plans to execute a North Plains Connector development agreement in the first half of the year. The project represents an approximately \$2.5 billion investment in Montana and North Dakota and will be a long-term asset for those states. Connecting the North Dakota and Montana grids will help mitigate the impact of extreme weather events and accommodate the growing demand for electricity. ALLETE expects to pursue at least 35% ownership and would oversee the line's operation.

"We are delighted to work with ALLETE on the North Plains Connector. ALLETE's superior track record of energy development in the Upper Midwest makes them the ideal partner to support this project through development into operations," said Grid United CEO Michael Skelly. "It is no secret that the U.S. is in desperate need of new electric transmission capacity, and the North Plains Connector will provide resiliency and reliability benefits for decades to come."

2.2. Route

See the map below.



2.3. Schedule & Permitting

Brant Johnson, who leads the project for Grid United, an independent transmission company, told WDEA members that it represents a \$1.5 to-2 billion investment in the two states. Johnson said the company hopes to have a final route by the second quarter of 2023, after which permit applications would be filed leading to development of an environmental impact statement which is expected to take at least two years to complete. He said construction would begin after approvals in 2025 or 2026, and could be in operation as early as 2028.⁵

⁵ Western Dakota Energy Association, Meeting Review, Oct 14, 2022, <https://www.ndenergy.org/Newsletter/Rough-Rider-Review>

In Montana, the North Plains Connector will be seeking a Major Facility Siting Act (MFSA) certificate from the Montana Department of Environmental Quality (DEQ). In North Dakota, the project will be seeking a Corridor Certificate and Route Permit from the Public Service Commission (PSC).²

The Montana MFSA regulates electric transmission lines over 69kV and provides for a comprehensive review of the siting and construction of applicable transmission facilities. Through the MFSA process, the Montana DEQ serves to (1) ensure the protection of the state's environmental resources, (2) ensure the consideration of socio-economic impacts, (3) provide citizens with an opportunity to participate in facility siting decisions, and (4) establish a coordinated and efficient method for the processing of all authorizations required for regulated facilities.

The North Dakota PSC oversees the siting of transmission facilities under the North Dakota Siting Act. The purpose of the Siting Act is to ensure that the location, construction, and operation of new transmission facilities will produce minimal adverse effects on the environment and upon the welfare of the citizens of North Dakota.

2.4. Current Status

First of all, as I write this paper (Early February) this project is very new, but it seems to be very well developed at this point in the project.

Grid United started preliminary work on the project in the summer of 2021, looking at constraints such as biological, land use, existing infrastructure, and archeological/cultural sites, according to documents it created for stakeholder meetings.⁶

On January 30, Grid United announced that it would team up with ALLETE, an energy company headquartered in Duluth, Minnesota that owns electric utilities, Minnesota Power and Superior Water, Light & Power of Wisconsin, in addition to other companies.

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"Additional investment in transmission is critically important to achieve a clean-energy future and is a key part of our 'Sustainability-in-Action' growth strategy as our national footprint expands," said ALLETE Chair, President and CEO Bethany Owen. "This innovative project is an important step toward a resilient and reliable energy grid across a wide area of the country and ties into important transmission projects being developed in the Upper Midwest and the Western Interconnection."

The North Plains Connector project is in the development phase, with Grid United engaging with landowners and stakeholders to determine the best route for the line. The companies expect project permitting to start this year as they work toward an in-service date of 2029, pending regulatory approvals.

⁶ Jennifer Runyon, Power-grid International, "North Plains Connector transmission line will tie eastern and western US grid," Jan 31, 2023, <https://www.power-grid.com/td/north-plains-connector-transmission-line-will-tie-eastern-and-western-us-grid/#:~:text=Grid%20United%20started%20preliminary%20work%20on%20the%20project,according%20to%20documents%20it%20created%20for%20stakeholder%20meetings>

2.5. Potential to Participate in Western Energy Market

There are two opportunities here. The first is the Western Energy Imbalance Market, which is described in the first subsection below. The second is the replacement of a major coal generation plant (that is the midst of being retired) with transmitted power.

2.5.1. Western Energy Imbalance Market

Note that the following text is from the earlier “HVDC Transmission - Part 1, Technology” post described and linked in the Introduction to this paper.

CAISO defines Imbalance Energy as the "... difference between supply and demand in the Real-Time versus the Energy and Demand scheduled in the Day-Ahead Market." Also one of the main functions of the Real-Time Market was to minimize Imbalance Energy by using existing bids, and accepting new bids for the Real-Time. The CAISO Western Energy Imbalance Market is an extension of the CAISO Real-Time Market, and supports imports and exports from/to other Balancing Authority Areas.

The western EIM is a real-time bulk power trading market, the first of its kind in the western United States. EIM's advanced market systems automatically find the lowest-cost energy to serve real-time customer demand across a wide geographic area. Utilities will maintain control over their assets and remain responsible for balancing requirements

while sharing in the cost benefits the market produces for participants. The map below shows current EIM participants, and those utilities that plan to join in the next few years.⁷

Since launching in 2014, the western EIM has enhanced grid reliability and generated cost savings in the \$millions for its participants. EIM improves integration of renewable energy, which leads to a cleaner, greener grid. As of 2019, there have been \$650 Million in benefits. See the map on the left for the membership of the western EIM.



⁷ Western Energy Imbalance Market (EIM), About, <https://www.westerneim.com/Pages/About/default.aspx>

Note that Northwestern Energy is part of the western EIM. Furthermore they are part-owner of a 500 kV transmission line that terminates in Colstrip:

NorthWestern Energy is a 31% owner in the 500-kilovolt transmission line that runs 250 miles from Colstrip to markets in Montana and further west. This line is critical for delivering reliable energy to industrial, retail and residential customers.⁸

2.5.2. Colstrip Steam Electric Station Decommissioning

The Colstrip steam electric station (CSES) was a 2,094MW coal-fired power plant located near Colstrip, Rosebud County, Montana, US.⁹

It is operated by Talen Montana, a subsidiary of Talen Energy, which is a privately-owned independent power producer based in Pennsylvania.

The Colstrip units one and two were owned by Talen Energy (50%) and the Washington state energy utility, Puget Sound Energy (PSE, 50%).

Unit three is owned by Talen Energy (30%), PSE (25%), Avista Corporation (15%), Portland General Electric (PGE, 20%), and PacifiCorp (10%).

Talen Energy doesn't have any ownership interest in the Colstrip unit four, which is owned by the South Dakota-based utility NorthWestern Energy (30%), PSE (25%), PGE (20%), Avista (15%), and PacifiCorp (10%).

The six co-owners of the Colstrip power plant were sued by Sierra Club and the Montana Environmental Information Centre for the violation of the US Clean Air Act in 2013.

The plant owners agreed to retire the two older units by 2022 as part of a settlement reached in July 2016.

In June 2019, operator Talen Energy, however, announced its plan to close units one and two by the end of 2019, citing poor economics to operate the units as the reason.

Changing environmental laws and increasing operating costs have also led other co-owners to plan for exiting units four and five as early as 2025, approximately nine years ahead of previous estimates.

Author's comment: The North Plains Connector Project could bring in power to supplement supplies, and /or provide lower-cost energy. Per information in section 2.3 above, this transmission project is currently scheduled to be completed in 2028.

3. SunZia Project

New Mexico boasts some of the most abundant, constant wind resources in the United States. SunZia Transmission will carry this energy resource to areas with high demand for power, delivering fuel-free, affordable energy to Arizona and the Western United States.¹⁰

⁸ NorthWestern Energy, Our Electric Transmission and Distribution System, <https://www.northwesternenergy.com/clean-energy/where-does-your-energy-come-from/electric-transmission>

⁹ NS ENERGY, Colstrip Power Plant, Montana, <https://www.nsenegybusiness.com/projects/colstrip-power-plant-montana/>

¹⁰ Pattern New Mexico, "SunZia Transmission," <https://patternenergynewmexico.com/projects/sunzia-transmission/>

3.1. Organization

Pattern Energy announced plans Monday to invest \$8 billion in New Mexico-based wind generation and new transmission infrastructure after acquiring partial ownership over the SunZia Southwest Transmission Project.¹¹

The Southwestern Power Group has been working since 2008 to develop SunZia, a massive transmission project that would carry wind-generated electricity from Central New Mexico to Arizona for export to western markets. Pattern has now purchased the rights to build one of two 550-mile transmission lines contemplated in the SunZia project for an undisclosed price.

The company expects to begin construction next year on that line – and on 3,000 megawatts of new wind generation in Lincoln, Torrance and San Miguel counties – for transport to Arizona and beyond, beginning in 2026, said Pattern Energy CEO Mike Garland.

3.2. Transmission System

SunZia Transmission is a 550-mile bi-directional ± 525 kV high-voltage direct current (HVDC) transmission line spanning central New Mexico and south-central Arizona.

SunZia Transmission uses state-of-the-art HVDC technology with better efficiency than comparable alternating current (AC) technology to transmit the same amount of power. HVDC is the most efficient and cost-effective technology to move large amounts of power over long distances.

Author's comment: Note from the above that the primary developer is Pattern Energy. I am very familiar with Pattern due to a Project that the company that I worked for (Siemens Energy) was a partner with Pattern on, The Trans Bay Cable (TBC). Pattern used Siemens' HVDC Technology on the TBC.

Pattern Energy Group has completed the Trans Bay Cable project in San Francisco, which is owned and operated by SteelRiver Transmission Co., an affiliate of SteelRiver Infrastructure Partners.¹²

Pattern Energy's transmission team conceived, developed and managed for SteelRiver the construction of the Trans Bay Cable, an innovative 53-mile, 400 MW high-voltage direct current (HVDC) submarine transmission line that can transmit up to 40% of the peak power needs for the city of San Francisco.

According to Pattern Energy, the project will enable renewable energy sources from north of San Francisco to supply power to the load.

Back to the main text (from reference 11).

¹¹ Kevin Robinson-Avila, Albuquerque Journal, "Renewable energy giant acquires SunZia transmission project," July 18, 2022, <https://www.abqjournal.com/2517316/renewable-energy-giant-acquires-sunzia-transmission-project.html>

¹² North American WINDPOWER, Pattern Energy Completes Trans Bay Cable, Nov 29, 2010 <https://nawindpower.com/pattern-energy-completes-trans-bay-cable-hvdc-project-under-san-francisco-bay#>

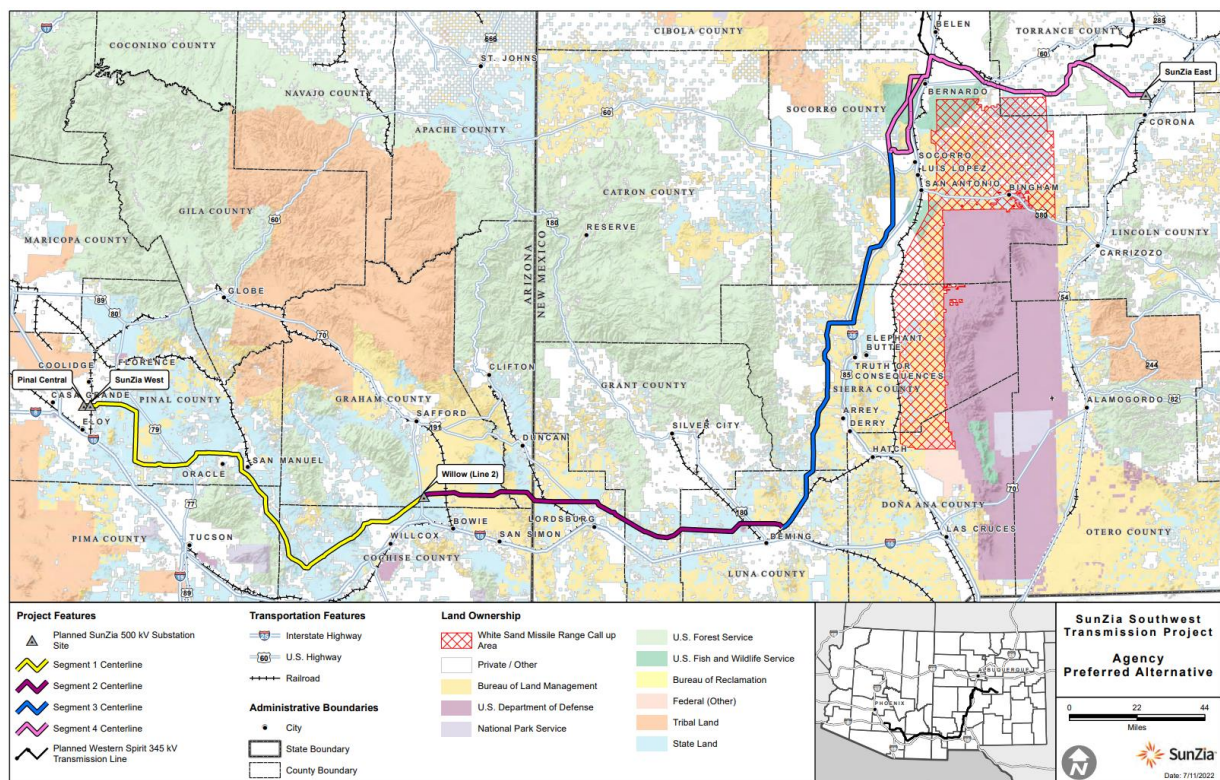
Pattern is already New Mexico's largest clean-energy developer, after inaugurating its newly built Western Spirit wind complex early this year. The company invested nearly \$2 billion in that project, including a new 155-mile transmission line and nearly 400 wind turbines scattered throughout Guadalupe, Torrance and Lincoln counties.

Those turbines collectively supply 1,050 MW of electricity to some 365,000 homes in California, or nearly 1 million people, making Western Spirit the largest single wind complex built to date in North America.

Now, however, Pattern's SunZia transmission and wind-farm plans will dwarf the Western Spirit achievement by far, said Pattern spokesman Matt Dallas.

3.3. Routing

See the map below.¹⁰



3.4. Schedule

The following is the basic schedule:¹⁰

- 2023: Target full construction start
- 2026: Target operations

3.5. Current Status

The SunZia Southwest Transmission Project is edging closer to a targeted 2023 start date following new state-level approvals in Arizona and New Mexico, and with a final U.S. Bureau of Land Management decision on the project expected in April.¹³

If all the regulatory stars align, renewable developer Pattern Energy could break ground next summer on potentially the largest wind development project in the Western Hemisphere, with high-voltage transmission lines spanning 550 miles from central New Mexico to south-central Arizona, and massive wind farms spread across three New Mexico counties to produce up to 3.5 gigawatts of clean power.

The project has been more than 14 years in the making, following lengthy and contentious government permitting processes at the local, state and federal levels. But, last week, the Arizona Corporation Commission gave its final approval for SunZia to move forward, ending all needed state-level regulatory processes there for the project. And, in October, the New Mexico Public Regulation Commission (PRC) approved location-control and right-of-way width permits for Pattern to connect most of its planned wind farms to the grid, the second such needed approval from the PRC since May.

The PRC must vote once more on final location and width permits to fully cover all of Pattern's SunZia-connected wind farms, likely in early 2023, said Pattern's New Mexico project development director, Jeremy Turner. A few final local permits are still needed in Arizona and New Mexico, among them special-use-district approval in Torrance County.

But, after that, the BLM's final "Decision of Record" will be the only pending regulatory hurdle, and that process, too, appears to be gliding along on schedule for completion in April.

"The BLM decision is the primary thing we're waiting on now," Turner told the Journal. "The BLM has done a fantastic job of running the process and managing the timeline. It's working through an administrative draft of its environmental impact statement now, which will hopefully result in a timely decision early next year."

Likewise, executives from New Mexico's Renewable Energy Transmission Authority, or RETA, say BLM action is "running smoothly." RETA became a partner in the SunZia project last year, turning it into a public-private co-development effort.

"It's going well," RETA Executive Director Fernando Martinez told the Journal. "RETA is really encouraged and happy about the progress with the wind farms and the transmission lines. It's getting us that much closer to construction in 2023. It's happening."

¹³ Kevin Robinson-Avila, Albuquerque Journal, "After 14 years, the SunZia transmission project is nearing the regulatory finish line," Nov 16, 2022, <https://www.abqjournal.com/2550319/sunzia.html>