HVDC Transmission, Part 2 - Major Projects

By John Benson

February 2022

1. Introduction

This is a two part series on HVDC Transmission. Part 1 of this series looked 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 also looked at the technology used to implement HVDC lines. There is a link to Part 1 below.

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

This part will look at major HVDC Transmission projects that are currently being implemented in the U.S.

Each section below will review a single project or a set of coordinated projects.

2. TransWest / Gateway South

These are actually two coordinated projects, as described below:

2.1. TransWest Express Project

The TransWest Express (TWE) project is a 732 miles of high-voltage transmission infrastructure consisting of two systems: a 500kV direct current (DC) system with terminals near Sinclair, Wyo., and Delta, Utah; and a 500kV alternating current (AC) system from the Utah terminal to southern Nevada.

The estimated cost of this project will be $3 billion.

The DC system terminals to be phased over time from 1,500 MW to 3,000 MW of transmission capacity.

TransWest Express LLC is a wholly owned affiliate of The Anschutz Corporation, a privately held company based in Denver. Through its affiliates, The Anschutz Corporation has been actively involved in the West for more than 75 years in the fields of ranching, agriculture, energy development and transmission, and more. The Anschutz Corporation's activity and investments in the energy field reflect a strong commitment to responsibly developing and managing natural resources.[1] TransWest could begin construction in 2022.

The TransWest Express project also demonstrates the extent to which HVDC can mitigate non-dispatchable generation impacts. Without the TWE project, it will not be feasible to develop and interconnect 1,500 to 3,000 MW of wind generation to the weak Wyoming transmission grid. Without significant transmission system upgrades, only a

[1] TransWest Express LLC, http://www.transwestexpress.net/index.shtml

small fraction of the wind generation will likely be able to operate. In addition, the reliability of the grid will be compromised.[2]

2.2. Gateway South

As part of our Energy Gateway Transmission Expansion, we are planning to build a high-voltage transmission line, known as Gateway, extending approximately 400 miles from the planned Aeolus Substation in southeastern Wyoming to the Clover Substation near Mona, Utah. Gateway South could begin construction in 2023.[3]

See the map below for the proximity and location of these projects.[4]

/ TransWest Express / Gateway South

Gateway South will use a 500 KV three-phase AC line.

3. Grain Belt Express

The projects described in the prior section have a major advantage in acquiring right-of-ways. They are in the western part of the U.S. where most of a path is either public land or private range-land. However, once a project starts moving further east into prime

[2] U.S. Energy Information Administration, "Assessing HVDC Transmission for Impacts of Non-Dispatchable Generation," June 2018, https://www.eia.gov/analysis/studies/electricity/hvdctransmission/pdf/transmission.pdf

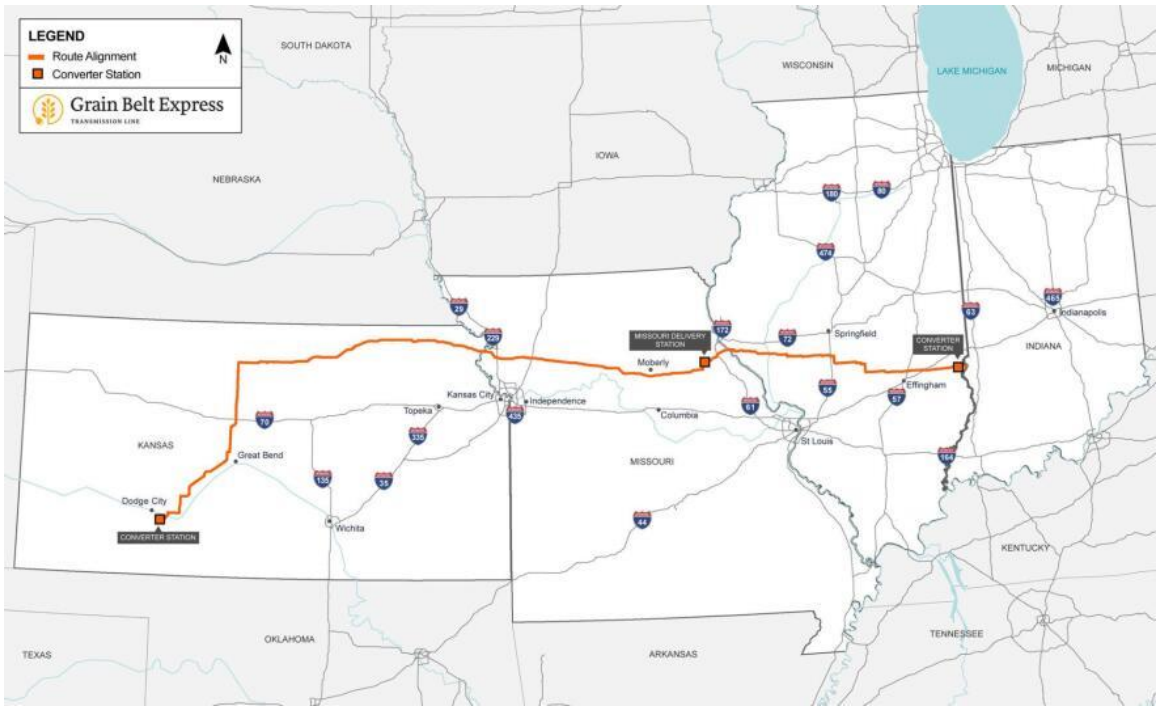
[3] PacifiCorp, Transmission, "Gateway South," https://www.pacificorp.com/transmission/transmission-projects/energy-gateway/gateway-south.html

[4] Naureen S Malik & Dave Merrill, Bloomberg Quint, "Buffett-, Anschutz-Backed Power Lines Get Deal to Move Forward," https://www.bloombergquint.com/business/buffett-anschutz-backed-power-lines-get-deal-to-move-forward

farmland, land-owners are frequently reluctant to negotiate agreements for transmission to pass across their lands, even though HVDC transmission lines require less land than HVAC lines with similar capacity would. By the name of this project, you can probably guess that the Grain Belt Express is one of these more difficult projects.

Grain Belt Express is an approximately 800-mile high-voltage direct current (HVDC) electric transmission line. When built, it will deliver up to 4,000 megawatts of low-cost, homegrown clean energy from western Kansas, tapping into one of America's strongest renewable energy resources.[5]

The proposed route of the project is shown in the map below.



Although this project continues to make slow, steady progress, its developer (Invenergy Transmission LLC) has been fighting battles in three states since it acquired this project. In 2014 Clean Line Energy Partners (CLEP) proposed construction of the Grain Belt Express (GBE) HVDC transmission line to transmit wind power from Kansas to Indiana. In November 2018 Invenergy and GBE jointly requested the Missouri PSC's approval of Invenergy's planned acquisition of GBE.

The Missouri Public Service Commission rejected it in 2018 but a year later designated Invenergy a public utility, which allowed it to use eminent domain to get easements for the project.[6]

[5] Grain Belt Express, https://grainbeltexpress.com/

[6] Peter Key, Energy Central, "Grain Belt Express not out of Missouri's legislative woods yet," June 14, 2021, https://energycentral.com/c/tr/grain-belt-express-not-out-missouris-legislative-woods-yet

Invenergy also has gotten the Grain Belt Express approved in Kansas but is still considering its options for the project in Illinois, where work is already under way to make those options harder.

An energy bill being considered in Illinois would allow developers of transmission projects such as the Grain Belt Express to be able to use eminent domain to secure land for rights-of-way, reversing a 2017 Illinois Supreme Court decision…

Invenergy has purchased nearly half of the land it needs in northern Missouri for the construction project that will begin in earnest in 2023. All of those deals have been the product of voluntary negotiations with landowners willing to sell, according to the company, although Invenergy could have used eminent domain to acquire the land.[7]

"Eminent domain would only be a last resort. We are continuing to pursue voluntary negotiations with landowners," said Nicole Luckey, vice president of regulatory affairs for Invenergy.

The issue could come up again next year, but Luckey said the company isn't concerned with that, as Invenergy is open to talking with lawmakers.

"It's about coming to the table and letting them know we respect their point of view and the constituents they represent," Luckey said. "We want to be a partner with them, and we are going to continue education and outreach with citizens and lawmakers."

The Grain Belt Express will run power from wind turbines in Kansas, through Missouri and Illinois and into Indiana, where it will connect with other… lines. That means while most of the power will be sold to customers in the Midwest and east coast, it will also be part of the larger power grid nationwide.

Luckey said linking the Grain Belt Express to the power grid could have helped avoid the massive power outage Texas experienced in February…

A $2 billion wind energy project spanning the length of northern Missouri is for the first time asking a judge to force a resistant landowner to sell the company an easement on their land. [8]

Grain Belt Express, a proposed high-voltage transmission line that would carry 4,000 megawatts of renewable energy from Western Kansas to Indiana, has faced fierce criticism from some Missouri landowners and elected officials.

In September, it filed a petition for condemnation against a farmer from Gower named Bradley Horn. A hearing in the case was originally scheduled last week in the Circuit Court of Buchanan County but was delayed until Feb. 2.

---

[7] Jonathan Ahl, St Louis Public Radio, "Grain Belt Express Moving Forward With Land Purchases," June 28, 2021, https://news.stlpublicradio.org/government-politics-issues/2021-06-28/grain-belt-express-moving-forward-with-land-purchases

[8] Lukas Vanacker, Missouri Independent, "Grain Belt Express takes first resistant Missouri landowner to court," Dec 21, 2021, https://missouriindependent.com/2021/12/21/grain-belt-express-takes-first-resistant-missouri-landowner-to-court/

The company is arguing that Horn "did not accept the written offer for the property interests," and later "negotiations were unsuccessful." It marks the first time Grain Belt Express has taken a resistant landowner to court.

The judge can appoint three disinterested residents of the county, who have to assess the just compensation for Horn.

Authors comment: Although this project should be completed by around 2025, all of the contentious legal moves could delay this further. However Invenergy seems to be really determined to make this happen, and I believe it will, eventually.

4. Square Butte Repurposing

I found one case study from the source referenced at the end of this paragraph where an existing HVDC line was being reconfigured for renewable integration. *The Square Butte HVDC line was commissioned in 1977 to connect the Milton R. Young Power Plant (a coal unit) in Center, North Dakota, with the Arrowhead Converter Station in Hermantown, Minnesota. The 465-mile, 250-kV transmission line was initially dedicated for transferring electricity generated at the coal plant, however the coal-fired generating unit in North Dakota is slowly being retired, opening room for renewable energy transmission. In 2009, the HVDC line and its associated facilities were acquired by ALLETE Inc. (d/b/a Minnesota Power)… for $71.5 million. This is part of ALLETE 's plan to comply with Minnesota's RPS requirements, which set a minimum of 20% renewable energy generation or procurement by 2020 and 25% by 2025. ALLETE has indicated that there are plans to use the HVDC line to transport increasing amounts of wind energy while gradually phasing out coal-based electricity. This wind energy will be supplied by ALLETE's Bison Wind Energy Center, which provides 496 MW.*[2]

5. The SOO Green HVDC Link

In section 3 above, the Grain Belt Express project, we saw how a range of local and state entities could obstruct a major project. But what if grid entities seek to derail a major project (pun intended)?

The SOO Green HVDC Link is a 350-mile 2,100 MW, 525KV underground high-voltage direct current (HVDC) transmission line running along existing rail corridors from Iowa to Illinois.[9]

The SOO Green HVDC Link will utilize modern grid technology to build the first link of a national HVDC clean energy power grid.

By connecting the nation's two largest power markets – MISO in the Midwest, and PJM in the east – the SOO Green HVDC Link will help meet America's growing demand for affordable, zero-carbon electricity.

The SOO Green HVDC Link will utilize a unique development approach to avoid the siting and permitting challenges that have historically hindered development of new overhead power transmission. The project seeks to replicate the model used to

[9] SOO Green HVDC Link, https://www.soogreenrr.com/about/

successfully build America's fiber optic network by placing an underground HVDC transmission line along an existing railroad from North Central Iowa to Northern Illinois.

This innovative, minimally invasive and environmentally superior way to build transmission avoids the visual impact of overhead transmission lines, minimizes tree clearing, avoids sensitive wildlife habitat and limits impacts to neighboring landowners.

SOO Green will create new value for renewable energy suppliers, power marketers and consumers by linking generation produced in the Midwest electricity market (operated by MISO, the Mid-Continent Independent System Operator) to consumers in the Eastern electricity market (operated by PJM Interconnection). SOO Green will supply residential, municipal and commercial customers in PJM with reliable, affordable and clean energy.

5.1. Stake-Holders

The following are major stake-holders in SOO Green HVDC Link:

Direct Connect Development Company *is the Minneapolis–based transmission development company responsible for advancing the SOO Green HVDC Link. Direct Connect is pioneering a new model for transmission development that utilizes underground installation along existing transportation corridors, providing unmatched reliability and resiliency benefits. This enables future development and delivery of untapped high-quality renewable energy generation to new customers. Direct Connect is building "Transmission 2.0" – the energy grid of the future while significantly avoiding environmental, visual and land use impacts.*[10]

SOO Green HVDC Link today announced the selection of ***Prysmian Group*** *– the worldwide leader in the energy and telecom cable system industry – as its preferred supplier of high-voltage direct current cable systems for this first-of-its-kind transmission project to be installed underground along existing railroad rights of way. The 2,100-megawatt interregional project, considered the first link in a national clean energy grid, will connect two of the largest energy markets in the US. By linking the Midwest Independent System Operator (MISO) serving the central US, to the eastern PJM Interconnection, SOO Green will deliver abundant, low-cost renewable energy to population centers from Chicago to the mid-Atlantic region.*[11]

Other Major Partners:

https://www.soogreenrr.com/partners/

As part of the ***Iowa Utilities Board*** *(IUB) franchise process, public informational meetings were hosted in each of the eight Iowa counties to provide an overview of the project to landowners. The meetings included presentations by representatives of the Iowa Utilities Board and SOO Green. Copies of the presentations from the IUB and*

[10] Direct Connect Development Company, https://www.soogreenrr.com/direct-connect-development-company/
[11] Prysmian Group Press Release, "Prysmian Group Awarded $900M SOO Green HVDC Link Project, a Key Milestone in Building a US Clean Energy Grid," June 21, 2021, https://www.prysmiangroup.com/en/press-releases/prysmian-group-awarded-900m-dollars-soo-green-hvdc-link-project-a-key-milestone-in-building-a-us-clean-energy-grid

Project, as well as handouts from the IUB and Office of Consumer Advocate (OCA) are available for download.[12]

5.2. Route

See the map below:

5.3. The Conflict

The $2.5 billion SOO Green transmission project ticks many boxes for being an ideal proposal to help advance the energy transition, a key Biden administration priority.[13]

The innovative transmission line would run underground along railroad rights of way, delivering 2,100 MW of wind power from the Midcontinent Independent System Operator (MISO) into the PJM Interconnection, the regional transmission organization (RTO) that runs the grid and wholesale electricity markets in 13 Mid-Atlantic and Midwest states, plus the District of Columbia.

Electricity on the high-voltage direct current (HVDC) project would be able to flow in two directions, bolstering grid reliability if generating plants in MISO's footprint unexpectedly go offline during a deep winter freeze or other event.

Direct Connect Development Co., the project's developer, says its biggest hurdle isn't landowner objections, environmental concerns or permitting disputes — typical snags for major infrastructure projects that are avoided by burying the line. It is PJM and its rules that don't accommodate a new type of project.

---

[12] https://www.soogreenrr.com/iubmeetings/

[13] Ethan Howland, Utility Dive, "SOO Green transmission project faces PJM obstacles: Are grid operators hindering the energy transition?" Jan 13, 2022, https://www.utilitydive.com/news/soo-green-pjm-grid-operators-helping-or-hurting-energy-transition/616966/

"The only significant challenge we're facing is outdated regulations and market rules imposed on us by unaccountable grid operators that are protecting the narrow interests of their members and preventing innovative infrastructure solutions like the controllable HVDC transmission line from accessing the market," Steve Frenkel, Direct Connect vice president, said.

The SOO Green project faces two major hurdles at PJM. First, the grid operator is studying the project's potential effects on the grid through its interconnection process, which is used for generating facilities and is backlogged. Also, SOO Green's market entry is being blocked by capacity import requirements Direct Connect argues shouldn't apply to controllable HVDC transmission lines.

Direct Connect contends SOO Green could be a model for taking advantage of the rail system that crisscrosses the United States. It would run about 350 miles underground next to a railroad between Mason City, Iowa, and Yorkville, Illinois, avoiding visual complaints and siting disputes with landowners, according to Frenkel.

The SOO Green project would use innovative technology that helps meet several needs, including delivering low-cost wind power into PJM. It would also improve grid reliability amid growing concerns about extreme weather and, as a merchant project, investors would bear the transmission line's financial risks, not utility ratepayers, Frenkel said.

The project would include voltage source converter stations built by Siemens Energy at each end of the line to convert alternating current (AC) power to DC power and vice versa. The grid is AC, but DC power lines are more efficient than AC lines. For the transmission line, Direct Connect plans to use cross-link polyethylene cables, which have little line loss compared with AC power lines.

The converter stations can respond to a grid operator's dispatch orders almost instantaneously, according to Frenkel. They could provide reactive power, dynamic voltage support, black start and other grid services typically offered by power plants, according to Direct Connect.

As part of an open season to find customers for its project, Direct Connect is in talks with renewable energy developers in MISO and with potential customers in PJM, according to Frenkel. "Despite the challenges that are not unexpected with an innovative project that's groundbreaking, we have very strong positive reception from the marketplace, both in terms of the energy developers we're talking to on the sell-side and large energy buyers on the buy-side," he said.

While it faces challenges at PJM, SOO Green has the support of most of Iowa's congressional delegation and four Illinois House members.

"The SOO Green project is exactly the kind of interregional transmission project our country needs to build a reliable and resilient clean energy grid," Rep. Sean Casten, D-Ill., and three other Illinois House members said in a Dec. 16 letter to the Federal Energy Regulatory Commission.

The lawmakers urged FERC to fully consider SOO Green's arguments in two complaints against PJM pending at the agency. Most of Iowa's congressional delegation wrote a similar letter in October.

"When existing rules slow or block the development of such projects, the public is denied the economic, environmental, and grid infrastructure benefits that such projects can

reliably deliver," they said. "Similar economic, environmental and reliability benefits can be realized nationwide if projects like SOO Green can proceed expeditiously without undue barrier."

Last year, Direct Connect filed two complaints at FERC… Direct Connect said PJM's process for considering merchant transmission lines was flawed and was delaying the power line by years. PJM studies proposed merchant transmission projects through its generation interconnection process, which Direct Connect argued is unfair…

Direct Connect filed a second complaint in September, arguing that PJM's rules for importing capacity from outside its footprint block market entry without providing significant reliability benefits…

Author's Note: The above referenced article is very good with a balanced viewpoint, but was too long for me to include much of it. I would suggest that interested readers click through reference 13, read, and consider the full article.

I worked closely with PJM on a project shortly after Y2K (when I worked for Siemens). I respect them greatly, but I'm not sure they are in a good place to fairly consider innovative concepts like the SOO Green HVDC Link.