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Construction of a 330-kilovolt high-voltage direct current power transmission line in Ukraine



PHOTO BY SERGEI MALGAKOV/TASS VIA GETTY IMAGES

Siemens estimates a worldwide market of approximately **40 new line projects** in the next 10 years.

Plugged In

As a cleaner energy future emerges, a major hurdle remains: the ability to efficiently move power, particularly from far-flung wind farms, solar facilities and hydroelectric dams to urban and remote customers. High-voltage direct current (HVDC) lines can bridge the gap and spur renewable energy growth. Siemens, which is executing several HVDC projects, estimates a worldwide market of approximately 40 new line projects and 20 refurbishment projects in the next 10 years.

Projects to build lines are often major undertakings. State Grid Corp. of China is expected to bring online the CNY18.6 billion second phase of its HVDC line later this year in Brazil, spanning more than 2,500 kilometers (1,550 miles) and 78 cities. Last year, the company also began a project to build a more than 2,000-mile (3,200-kilometer) line in China that will transmit enough power to supply an estimated 26.5 million people when it's completed later this year. "We have a lot of renewable energy sources around the world that are not utilized today, which we should utilize more," Markus Pettersson, ABB global product manager of HVDC transformers, told *Future Power Technology*.

China, which has most of its coal plants and hydroelectric facilities located in remote areas, is leading the way in building HVDC lines within its borders and beyond. Projects are also popping up across Europe. In December, a joint venture from Elia and National Grid, with installation from Siemens, built a £560 million, 140-kilometer (87-mile) HVDC line that connects Herdersbrug, Belgium and Richborough, England. National Grid is now pursuing other projects in France, Norway and Denmark.

Two key challenges often face teams when executing these vast systems: costs and permitting. HVDC projects are expensive.

Because most of the world is outfitted for alternating currents (AC), DC lines require a converter station at each end to transform the incoming energy into DC and back into AC for delivery. It's an endeavor so costly that, in the United States for instance, billionaires have begun funding projects in the absence of public backing. Meanwhile, stakeholder challenges are common because of the length of the lines, which can mean that many municipal and provincial authorities need to approve projects.

Charging Forward

An inability to woo public and local government stakeholders has stalled many projects in the U.S. A 730-mile (1,175-kilometer) transmission line that could deliver wind power from rural Wyoming to an area near Las Vegas, Nevada has faced years of delays due to permitting. Other projects have stalled because states that the lines would pass through see them as disruptive without providing value to local residents.

"If a state doesn't get any benefit, it doesn't have to give a right of way to build a line to go through their jurisdictions," says Ram Adapa, technical

executive in the power delivery and utilization sector at the Electric Power Research Institute, which conducts research and development within the electric power sector including on HVDC projects. He is based in Palo Alto, California, USA.

Anticipating delays can help. Project teams can work around these setbacks by extending early parts of project schedules in order to secure permitting from all jurisdictions, says Rajendra Iyer, global business leader of grid integration solutions at PMI Global Executive Council member GE Renewable Energy, Paris, France. Last year, his team completed a six-year, US\$1.5 billion HVDC project to carry offshore energy from the North Sea to northwest Germany.

“The key is planning and executing well ahead of the HVDC link coming in,” Mr. Iyer says. “Your initial pain in the capital expenditures can be easily mitigated by proper planning.”

Old Meets New

Another way project teams can sidestep permitting delays is to convert existing AC lines to DC lines, eliminating the need to get a new right of way. But refurbishments present their own challenges, particularly when systems need to be taken offline, says Jörgen Krömeke, head of tender and projects department HVDC, Siemens Gas and Power, Nuremberg, Germany.

Siemens is upgrading India’s oldest HVDC link, with the project expected to close in 2021. Live installations, such as with this project, require

Back Track

The future of energy might require a solution from the past. More than a century ago, Thomas Edison tried—and failed—to make direct current (DC) lines the mainstream method for transporting electrical energy. Alternating currents (AC) won out. But recent technological advances have made high-voltage direct current (HVDC) lines a promising option to tackle the distribution of renewable energy.

“One big advantage to HVDC is the efficiency of power transmission over long distances,” George Culbertson, vice president of power delivery markets for HDR, told *POWER*. “If the transmission line route is longer

than about 300 miles [483 kilometers], DC is a better option because AC lines have more line losses than DC for bulk power transfer.”

Over long distances, such as when transporting energy from remote wind farms to urban areas, those losses can be substantial. In the United States, for instance, DC lines could be a way to harness the massive amount of wind energy from northern states to fulfill energy needs far across the country. DC lines also provide control over the flow of power, which can help manage the unpredictable nature of energy generated from renewables such as solar and wind.

expediency to minimize outage times, he says. Having a strong local presence helps.

“You try to address that by getting close to the customer and involving the local entities,” says Mr. Krömeke. “Being close to the client for continued contact can help you understand what the client really wants and adjust the scope to what the client really needs.”

That proximity also allows the team to respond quickly to changes. “A truly agile project management approach is only viable with a strong presence on the ground, allowing us to quickly adapt our plans when the need arises.” —*Ambreen Ali*

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