ENERKNOL RESEARCH

North America

Power and Utilities | Smart Grid

Transmission Investments Critical To Accommodate Changing Resource Mix

Shifts In Power Flow And Renewable Energy Utilization To Meet Environmental Objectives Require Transmission Enhancements

January 4, 2016

Policy Brief

Author

Erin Carson
Chief Policy Strategist

Janis Kreilis
Analyst

Contact

(212) 537.4797
info@enerknol.com
www.enerknol.com

Key Takeaways:

- Transmission investments are expected to increase significantly to replace aging infrastructure, maintain reliability, and meet environmental obligations and state renewable energy goals
- Transmission is critical for connecting high-quality renewables and other lower-carbon resources far from load centers to the grid
- The Federal Energy Regulatory Commission has issued a decision reducing the base return on equity for transmission investments in the Midcontinent Independent System Operator region
- The New York State Public Service Commission will proceed with improvements proposed for 156 miles of high-voltage transmission lines to reduce congestion and transmit renewable electricity

Entities Mentioned:

- California Independent System Operator
- Department of Energy
- Environmental Protection Agency
- Federal Energy Regulatory Commission
- Midcontinent Independent System Operator
- New York Independent System Operator

Related Research

Wind Generators To Provide Reactive Power Under Revised Interconnection Agreements

States Seek New Net Metering Models To Address Balance In Distributed Generation

Insight for Industry – Transmission Expansions Critical to Utilize Remotely-Located Renewable Resources and Address Shifts in Power Flow

Transmission investments are becoming increasingly important to deliver electricity from new renewable generators, as the most productive areas for wind, solar, and geothermal locations are often located far from population centers. Retirement of coal plants and nuclear plants also contribute to shifts in power flows across the transmission system. However, lengthy, complicated, and costly siting and permitting processes continue to hinder installation of new transmission lines and upgrading existing ones. Since multiple federal, state, and local government agencies are involved in right-of-way authorizations and environmental permitting, inter-agency coordination is critical. Utility decisions to make long-term investments and investors' decisions to commit capital to facilitate such investments rely on stable and predictable regulations.

The location of large-scale wind farms in remote areas creates a need for additional transmission capacity, which has been difficult to achieve due to planning and permitting hurdles that can cause delays and cost increases for new transmission projects. As solar plants increase in size, they, too, will face increasing transmission challenges. While regulatory efforts allow for inter-agency and inter-regional coordination to encourage transmission development, increased regulatory certainty to ensure adequate returns and timeliness of reviews will facilitate implementation of planned investments.

The location of large-scale wind farms in remote areas creates a need for additional transmission capacity, which has been difficult to achieve due to planning and permitting hurdles that can cause delays and cost increases for new transmission projects

An upgraded, reliable and efficient transmission system is critical to maximize the use of lower-emitting sources and renewable resources to meet the emissions reduction goals under the Environmental Protection Agency's (EPA) Clean Power Plan (CPP). The United States has approximately 642,000 miles of high-voltage (34 kV and greater) transmission lines, running from generating plants to step-down substations, which reduce the voltage and connect the transmission network to the distribution grid serving retail customers. Transmission upgrades will support the growing use of distributed resources to improve the flexibility and resilience of the system. These grid upgrades will also facilitate wholesale market competition and include advanced monitoring systems and technologies to ensure grid resiliency and flexibility.

Aging Infrastructure and Shifting Generation Mix Necessitate Transmission Expansions

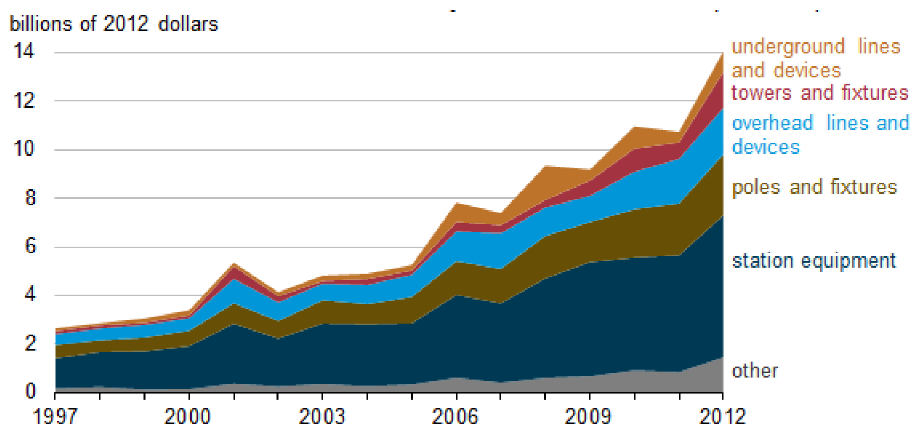
Since 1998, electricity wholesale and retail market restructuring has led regional transmission organizations to upgrade and add new transmission infrastructure, primarily seeking to prevent outages, such as the 2003 blackout that affected an estimated 50 million people in the Midwest, Northeast, and Ontario. More recently, on December 17, the New York State Public Service Commission (NY PSC) voted to proceed with improvements proposed for 156 miles of high-voltage transmission lines to reduce grid congestion and allowing lower-cost electricity and renewable electricity produced in upstate New York to flow to downstate customers. The action requires the New York

Independent System Operator (NYISO) to conduct a competitive process to select cost-effective alternatives. The proposal involves replacing and upgrading current lines within existing rights-of-way and new substation facilities, all estimated to provide $1.20 in benefits for every dollar spent. The NY PSC made available more than $2.3 million to municipalities, community groups and environmental advocates to foster broader public participation. Upgrading the state's transmission system is part of the Energy Highway Blueprint initiative and an important building block under Reforming the Energy Vision (REV), a long-term strategy towards a clean and resilient energy system.

According to the Energy Information Administration (EIA), U.S. electricity transmission investment during 1997-2012 increased fivefold, from $2.7 billion to $14.1 billion, reversing a three-decade decline (Figure 1). A March 2015 report from the Edison Electric Institute (EEI) highlights that total transmission investment by its members reached $16.9 billion (nominal $) in 2013 and expects year-over-year total transmission investment to peak in 2014 at approximately $20.2 billion (nominal $).

U.S. electricity transmission investment during 1997-2012 increased fivefold, from $2.7 billion to $14.1 billion, reversing a three-decade decline

Figure 1- Investment in Transmission Infrastructure by Investor-Owned Utilities, 1997-2012



Source: EIA

Despite limited growth in overall electricity retail sales—less than one percent annually from 1997-2012—the location of demand has changed due to population shifts. Areas with greater growth in the South and West require new investments to meet higher demand. The growth rate of total U.S. end-use electricity consumption has been on the decline. New technologies, policies that promote energy efficiency, and increases in distributed generation (particularly rooftop solar) have contributed to decline in demand growth.

In addition to relieving congestion and replacing aging equipment, transmission upgrades and new transmission projects are becoming increasingly important to deliver electricity from new renewable generators, often located far from population centers; as well as facilitate wholesale market competition and advanced monitoring technologies to ensure grid resiliency and flexibility. The electricity market restructuring thus provided utilities with increased flexibility to purchase less expensive power from non-utility generators and suppliers outside their service territories.

Regionally, differences in transmission investment reflect local circumstances. From 2008-2012, the California and New England ISOs have had the most investment per megawatt of demand (Table 1). In Southern California, investor-owned utilities spent almost $13 billion from 2003-2012 to expand transfer capability to address transmission constraints and connect to renewable resources that help meet California's renewable portfolio standard (RPS). In the New England region, 475 transmission projects were placed into service from 2002 through June 2013 to strengthen system reliability, wholesale electricity market competition, reduce congestion, and decrease the added cost of must-run generating units during peak times. More recently, major transmission expansions are occurring in the Midcontinent Independent System Operator (MISO) and Southwest Power Pool (SPP) regions. The Western Electricity Coordinating Council’s 10-year transmission plan shows that adequate transmission is being developed in the Western electricity interconnection to meet projected needs through 2024, including state RPS requirements. In Texas, the state legislature passed renewable energy standard (RES) in 1999, and subsequently, in 2005, the legislature strengthened the RES and added a transmission policy that led to the creation of the Competitive Renewable Energy Zones (CREZ) program, which facilitated wind-generated electricity transmission from west Texas to the heavy load centers in the east and south.

Table 1- Transmission Investment per Megawatt of Peak Demand from 2009 to 2013

Region	2009	2010	2011	2012	2013	Average
PJM	$16,457	$18,776	$28,952	$22,191	$29,238	**$23,100**
MISO	$20,162	$15,871	$13,788	$20,292	$31,734	**$20,400**
SPP	$13,926	$20,344	$13,810	$28,062	$19,707	**$19,200**
CAISO	$50,713	$35,766	$29,350	$106,322	$100,514	**$64,500**
ERCOT	$10,243	$12,144	$15,560	$17,141	$34,867	**$18,000**
ISO-NE	$32,419	$23,757	$30,213	$76,475	$71,242	**$46,800**
NYISO	$11,199	$22,295	$28,595	$14,399	$12,093	**$17,700**
TOTAL US	$16,607	$17,513	$18,543	$24,339	$28,526	**$21,100**

Source: DOE

In Texas, the elimination of transmission constraints, largely attributed to the state's CREZ program, has helped wind generation reach new heights in recent years, such as the March 2014 peak output of more than 10,000 MW

The elimination of transmission constraints in Texas, largely attributed to the state's CREZ program, has helped wind generation reach new heights in recent years, such as the March 2014 peak output of more than 10,000 MW. The CREZ includes almost 3,600 circuit miles of transmission lines and will accommodate up to 18,500 MW of wind power. As CREZ transmission expansions have allowed wind power to flow to more electricity demand areas, curtailments of wind generation on the Texas electric grid have steadily dropped since 2011 and occurrences of wind-related negative real-time electricity prices have declined.

Complexity and Pace of Permitting and Review Processes Identified as Key Challenge to Evolving Transmission Needs

Transmission projects can take several years to become operational and have high upfront capital costs. Lengthy, complicated, and costly siting and permitting processes continue to challenge the installation of new transmission lines and upgrading existing lines. Since multiple federal, state, and local government agencies are involved in right-of-way authorizations and environmental permitting, inter-agency coordination is critical.

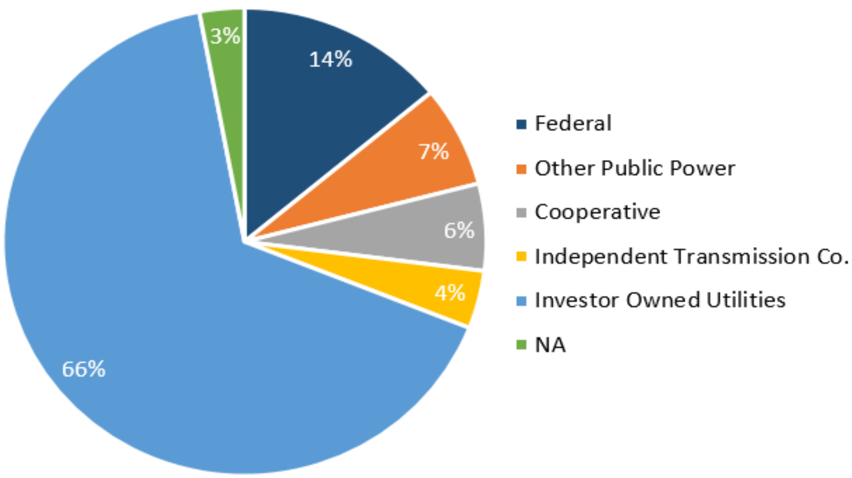
Moreover, construction costs increase with rerouting and underground requirements, and projects that pass the federal evaluation process are still subject to additional evaluations as part of state commission reviews and siting processes, which vary by project. While states have jurisdiction over siting of transmission lines on private or state-owned land, in most cases, local governing boards oversee distribution for publicly or cooperatively owned electric utility. Such differences in oversight jurisdictions create challenges as changing the grid in one location can alter electricity dynamics over a larger area. Disparity in planning processes to evaluate benefits of transmission and additional reviews in subsequent planning processes of some jurisdictions increase risks and may cause projects to be delayed, scaled back, or cancelled.

Disparity in planning processes to evaluate benefits of transmission and additional reviews in some jurisdictions increase risks and may cause projects to be delayed, scaled back, or cancelled

The DOE's Quadrennial Energy Review released in April 2015 identifies the emergence of transactive energy, which refers to demand response, storage, and customer-owned generation, creating bidirectional flows. While electricity traditionally flows unidirectionally from generation, through transmission and distribution, to end-users, new and emerging distribution and customer-sited technologies may not align with the existing oversight jurisdictions and grid operations. Planning and operations of the transmission system could be affected if flows from customers are substantial.

New transmission construction also requires extensive technical and environmental planning, which partly depends on the ownership structure. Currently, investor-owned utilities (IOUs) own 66 percent of high-voltage transmission lines while the federal government owns 14 percent (Figure 2). The federal government can develop and own transmission projects through the Bonneville Power Administration, Western Area Power Administration, Tennessee Valley Authority, and Southwestern Power Administration. While transmission lines are primarily owned by IOUs, public power utilities, and cooperative entities, new transmission-focused ownership forms are emerging. Transmission-focused entities, including independent transmission companies and merchant transmission firms, deal with acquiring, developing, building, and operating transmission to earn profits. These entities seek to build long-distance transmission lines that cross more than one state and are subject to regulatory approval processes. Ownership has a direct effect on the regulatory regime applied to transmission projects. For instance, publicly owned electric utilities and almost all rural electric cooperatives generally are not subject to the Federal Energy Regulatory Commission (FERC) jurisdiction over transmission planning and cost-allocation rules, as long as they act alone.

Figure 2 - High Voltage Transmission Ownership Structures



Source: DOE

Utilities Seek Predictable Returns and Cost-Recovery to Access Capital for Projects with Long Lead Times

Utility decisions to make long-term investments and investors' decisions to commit capital to facilitate such investments rely on stable and predictable regulations. Given the long lead times and risks, utilities seek stable, long-term returns for transmission investments to ensure capital access and timely development of projects. According to EEI, transmission developers are frequently faced with low or negative free cash flows for long durations due to heavy development costs and long lead times involved in pre-construction activities and siting approvals. The potential increase in a utility's borrowing costs affects customers, who ultimately bear the cost of accessing capital. While transmission accounts for about 11 percent of an electric customer's total bill, the EEI emphasizes that returns on equity (ROEs) need to be predictable and sustainable over the long-term to produce savings and support policy benefits.

Utility decisions to make long-term investments and investors' decisions to commit capital to facilitate such investments rely on stable and predictable regulations

Consumer groups have advocated for reductions to existing ROEs on transmission investments. Most recently, on December 22, 2015, FERC issued an initial decision (Docket No. EL14-12-002) reducing the Base ROE for transmission investments in the MISO region to 10.32 percent from the current 12.38 percent rate. The decision addresses a portion of a complaint filed by a group of large industrial customers, finding that transmission line owners in the MISO region have been receiving an "unjust and unreasonable" ROE of more than 12 percent. The ruling also requires MISO to refund, with interest, the difference between the revenues they collected during the period from November 12, 2013 through February 11, 2015, and what they would have collected had they implemented the base ROE of 10.32 percent.

Regulatory Efforts Facilitate Inter-Agency Coordination for Transmission Planning and Cost Allocation

As transmission planning often involves decisions by more than one jurisdictional authority to agree on cost allocation and assess benefits, federal efforts seek to enhance coordination. In June 2014, FERC issued its Opinion No. 531 adopting a new two-step methodology to calculate the return on equity and providing guidance on the treatment of rates of return for transmission investment.

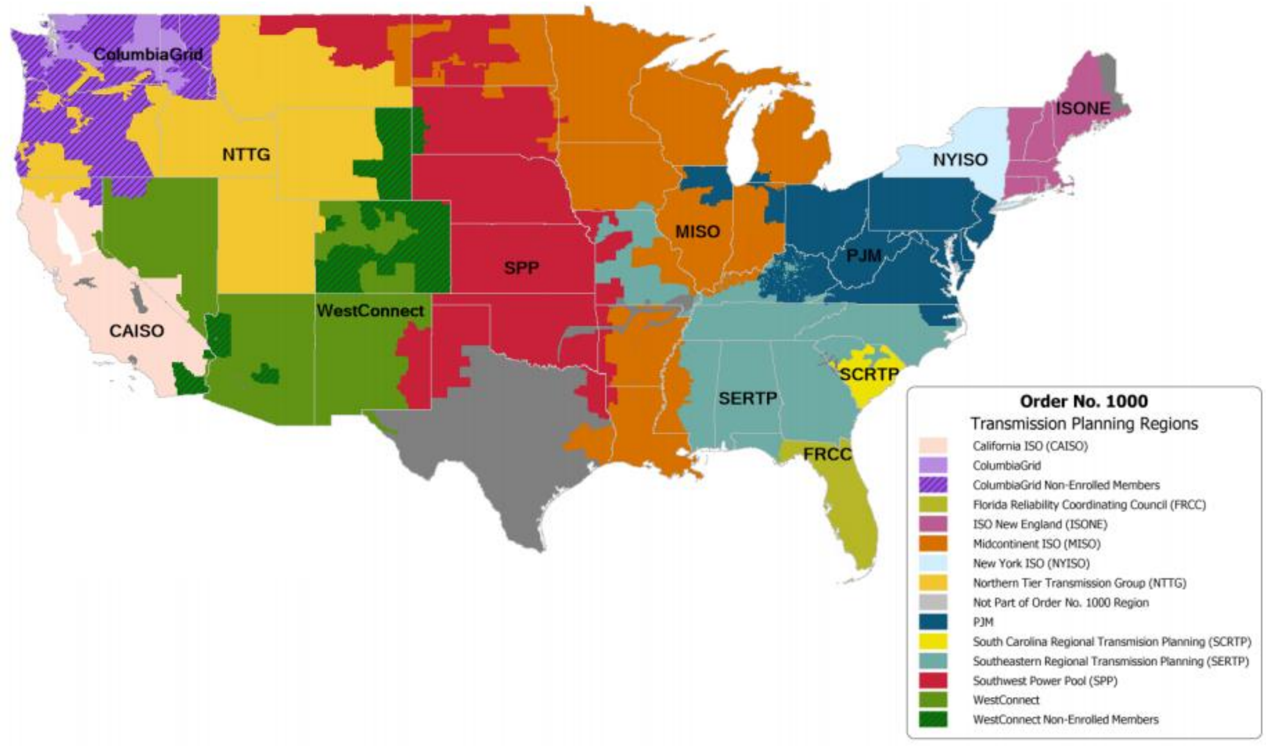
In 2011, FERC issued Order No. 1000 establishing the key regional planning and cost-allocation requirements for transmission projects, with a goal to promote coordinated regional planning and inter-regional planning processes (Figure 3). Under the rule, local and regional planning processes must consider transmission needs driven by public policy requirements and transmission providers in neighboring planning regions must collectively determine efficient or cost-effective solution to mutual transmission needs. Each planning process must follow regional cost allocation principles for new facilities among beneficiaries, and neighboring planning regions must follow a common interregional cost allocation method for new interregional facilities. Public policy requirements include state policies for cost-effective integration of renewable resources required under state RPS and voluntary guidelines. Currently, 29 states and the District of Columbia have RPS goals.

FERC Order 1000 recognizes the need for additional transmission facilities driven largely by changes in generation mix and the need for potentially significant, investment in new transmission facilities to meet reliability needs and integrate new sources of generation

FERC Order 1000 recognizes the need for additional transmission facilities driven largely by changes in generation mix and the need for potentially significant investment in new transmission facilities to meet reliability needs and integrate new sources of generation. Increased adoption of RPS measures has contributed to rapid growth of renewable energy resources that are often remote from load centers, thereby increasing the need for transmission to access them.

A 2009 Memorandum of Understanding (MOU) brought together nine federal agencies to coordinate efforts on transmission on federal lands and expedite actions to address challenges. Participating agencies are the Department of Agriculture, Department of Commerce, Department of Defense, Department of the Interior, Advisory Council on Historic Preservation, White House Council on Environmental Quality, DOE, EPA, and FERC.

Figure 3 – FERC Order No. 1000 Transmission Planning Regions



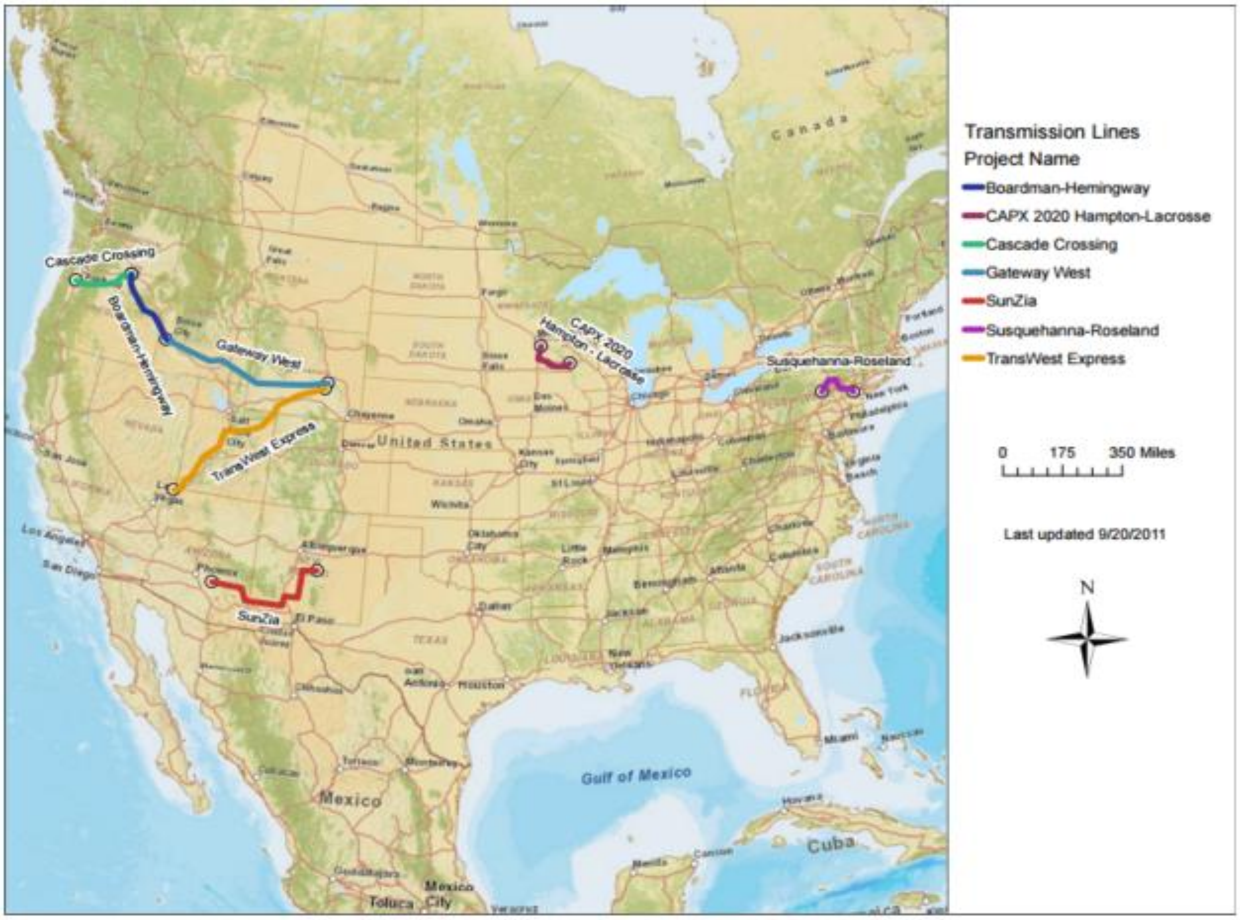
Source: FERC

The Rapid Response Team for Transmission (RRTT), established in response to a 2011 Presidential Memorandum, builds on cooperation developed through the MOU to improve the overall quality and timeliness of electric transmission infrastructure permitting, review, and consultation on federal and nonfederal lands. The RRTT ensures coordination through Integrated Federal Planning; applies a uniform and consistent approach to consultations with tribal governments; resolves interagency conflicts, and ensues that agencies involved are fully engaged and meet timelines.

The Rapid Response Team for Transmission (RRTT), established in response to a 2011 Presidential Memorandum ensures coordination to improve the overall quality and timeliness of electric transmission infrastructure permitting, review, and consultation on federal and nonfederal lands

The RRTT began operations with seven pilot project transmission lines across 12 states – Arizona, Colorado, Idaho, Minnesota, New Mexico, Nevada, Wyoming, Utah, New Jersey, Pennsylvania, Oregon, and Wisconsin – aimed to increase electric reliability, integrate new renewable energy into the grid, and save consumers' costs (Figure 4).

Figure 4 – Rapid Response Team Pilot Projects



Source: DOE

Renewable Generation Growth Depends on Transmission Access

Utilization of renewable energy resources located in remote areas could be stifled if transmission is inadequate. The most common issues pertain to line congestion and lack of service to the most productive areas for wind, solar, and geothermal locations, which are often far from load centers.

Renewable utilization is challenged by line congestion and lack of service to the most productive areas for wind, solar, and geothermal locations, which are often far from load centers

Policies and incentives such as state RPS and renewable energy tax credits, combined with a substantial decrease in the cost to build large-scale wind turbines, have led to significant growth in wind generation. Significant wind additions began in 2006, spurred by state RPS requirements, high natural gas prices at the time, production tax credit, and wind technology cost reductions. Installed wind power capacity grew at a rate of eight percent in 2014 in the U.S., bringing the total to approximately 66 GW and 4.9 percent of the U.S. end-use electricity demand. While renewable capacity growth through 2014 was largely driven by wind capacity, reduction of solar costs and growing interest in third-party installers has contributed to substantial increase in solar capacity growth over the past 2-3 years. The U.S. installed 1,361 MW of solar photovoltaics (PV) in Q2 2015 to reach 24.1 GW of total installed capacity.

As large-scale wind farms are often located remote areas that are far from population centers, transmission difficulties pose a significant barrier for wind development. Transmission involves crossing multiple states with different regulatory requirements and public lands subject to several environmental restrictions. The challenge of locating lines across states and federal lands, and opposition from public interest groups, make the process even more difficult. For example, in July 2015, the Missouri Public Service Commission denied Houston-based Clean Line Energy's 780-mile-long Grain Belt Express power line to carry wind power from the Kansas high plains across Missouri to eastern power grids, due partly to opposition from local landowners.

The Texas CREZ program stands as an example where wind investments followed transmission capacity expansions. However, securing long-term electricity supply contracts is a prerequisite to obtain transmission investments required to access remote renewable energy resources. Several transmission line proposals in the South and West are challenged by the inability to secure power purchase agreements for the wind they would deliver.

Increasing Transmission Investments Key to Meet CPP Obligations and Address Shift in Power Flows

The CPP and other environmental regulations at the local, state, and regional levels encourage switching to lower-emitting fuels, including natural gas and renewables. The North American Electric Reliability Corporation's (NERC) 2015 long-term reliability assessment report finds that environmental regulations contribute significantly to the change in resource mix, driving the shift from coal and toward natural gas and renewables. Electricity generation from natural gas increased by 85 percent from 2000-2013, with natural gas-fired power plants accounting for more than 50 percent of new utility-scale generating capacity in 2013. Growing share of natural gas in the nation's electric generation mix increasingly requires the electricity and natural gas systems to function together.

The CPP and other environmental regulations at the local, state, and regional levels encourage switching to lower-emitting fuels, including natural gas and renewables

Retirement of coal and nuclear plants could lead to a shift in power flows across the transmission system. Regions with relatively large amounts of announced coal retirements, such as the Mid-Atlantic and the Midwest are pursuing transmission upgrades to reduce costs and maintain reliability. Retirements are also affecting the nuclear power industry due largely to economic issues from low electricity prices in RTO/ISO markets and new safety regulations. Factors contributing to the decrease in wholesale electricity prices include low natural gas prices, low overall electricity demand, and, in some regions, renewable energy subsidies that produce negative prices in wholesale electricity markets. The NY PSC has approved a plan to add new transmission facilities and energy efficiency and demand-response measures to address potential issues from Indian Point nuclear unit retirements. In a similar case, the California ISO approved a new transmission line with an in-service date of 2017 to address reliability concerns and voltage problems in the San Diego region following the closure of the two San Onofre nuclear units.

Looking forward, transmission investment is expected to increase significantly to replace aging infrastructure, maintain system reliability, facilitate competitive wholesale power markets, and help meet regional policy objectives, such as emissions reduction and renewable energy goals. The DOE finds that future transmission investments will be driven by:

- future electricity demand growth trend;
- amount of transmission required to connect high-quality renewable energy resources to distant load centers;
- state and federal incentives such as the production tax credit;
- costs of competing power generation sources and demand-side resources.

Transmission investment is expected to increase significantly to replace aging infrastructure, maintain system reliability, facilitate competitive wholesale power markets, and help meet regional policy objectives, such as emissions reduction and renewable energy goals

In the case of renewable resources, the costs and time of permitting additional transmission facilities could result in the development of lower-quality resources that are closer to load centers. For new natural gas generation, transmission needs will depend on existing local and regional transmission landscape. New natural gas facilities are largely built closer to load centers where pipelines and transmission lines already exist, thereby reducing the need for new transmission. High levels of energy efficiency, demand response, and distributed generation can reduce the expected requirements for new transmission investment.

Disclosures Section

RESEARCH RISKS

Regulatory and Legislative agendas are subject to change.

AUTHOR CERTIFICATION

By issuing this research report, **Erin Carson** as author of this research report, certifies that the recommendations and opinions expressed accurately reflect her personal views discussed herein and no part of the author's compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

IMPORTANT DISCLOSURES

This report is for industry information only and we make no investment recommendations whatsoever with respect to any of the companies cited, mentioned, or discussed herein. EnerKnol Inc. is not a broker-dealer or registered investment advisor.

Information contained herein has been derived from sources believed to be reliable but is not guaranteed as to accuracy and does not purport to be a complete analysis of the company, industry or security involved in this report. This report is not to be construed as an offer to sell or a solicitation of an offer to buy any security or to engage in or refrain from engaging in any transaction. Opinions expressed are subject to change without notice. The information herein is for persons residing in the United States only and is not intended for any person in any other jurisdiction.

This report has been prepared for the general use of the wholesale clients of EnerKnol Inc. and must not be copied, either in whole or in part, or distributed to any other person. If you are not the intended recipient you must not use or disclose the information in this report in any way. If you received it in error, please tell us immediately by return e-mail to info@enerknol.com and delete the document. We do not guarantee the integrity of any e-mails or attached files and are not responsible for any changes made to them by any other person. In preparing this report, we did not take into account your investment objectives, financial situation or particular needs. Before making an investment decision on the basis of this (or any) report, you need to consider, with or without the assistance of an adviser, whether the advice is appropriate in light of your particular investment needs, objectives and financial circumstances. We accept no obligation to correct or update the information or opinions in it. No member of EnerKnol Inc. accepts any liability whatsoever for any direct, indirect, consequential or other loss arising from any use of this report and/or further communication in relation to this report. For additional information, please visit enerknol.com or contact management team at (212) 537-4797.