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Transmission Considerations For A 20% Scenario

NREL's Wind Deployment System model found that it would be cost-effective to build more than 12,000 miles of additional transmission at a cost of $20 billion.

BY SANDY SMITH

In May, the U.S. Department of Energy (DOE), in partnership with its National Renewable Energy Laboratory (NREL), the American Wind Energy Association, and others from the electric power and wind industries, released the report "20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electric Supply." This technical report explores one scenario for reaching a 20% contribution of wind power to the nation's supply of electricity by 2030 and contrasts it to a scenario in which no new U.S. wind power capacity is installed.

The report examined costs, major impacts and challenges associated with the 20% scenario. It investigated requirements and outcomes in the areas of turbine technology, manufacturing, transmission and grid integration, markets, environmental aspects and wind plant siting.

In its conclusion, the report found that the U.S. possesses affordable wind energy resources far in excess of those needed to enable 20% electricity from wind. To reach the 20% scenario of a projected 293 GW of new capacity, new wind power installations would need to increase to more than 16,000 MW per year by 2018 and continue at that rate through 2030. The report projects that wind plant costs and performance will improve modestly over the next two decades, but no technological breakthroughs are needed. In the 20% wind scenario, 46 states would experience significant development of wind plant capacity.

The report found that costs incurred by the 20% scenario exceed those of the no-new-wind scenario by about 2%. Although there would be higher capital costs on the front end, those costs would be offset by lower expenditures of fuel for generation. The estimated incremental cost would be $43 billion, or about $0.06 per kWh of total generation.

The report's authors identified a number of major challenges to realizing the scenario, including:

■ investment in transmission to move electricity generated by wind to load centers,

■ developing larger electric load balancing areas in tandem with expanded regional planning processes, facilitating integration of wind,

■ significant expansion of the manufacturing supply chain,

■ continued reduction in capital costs and improvements in turbine performance, and

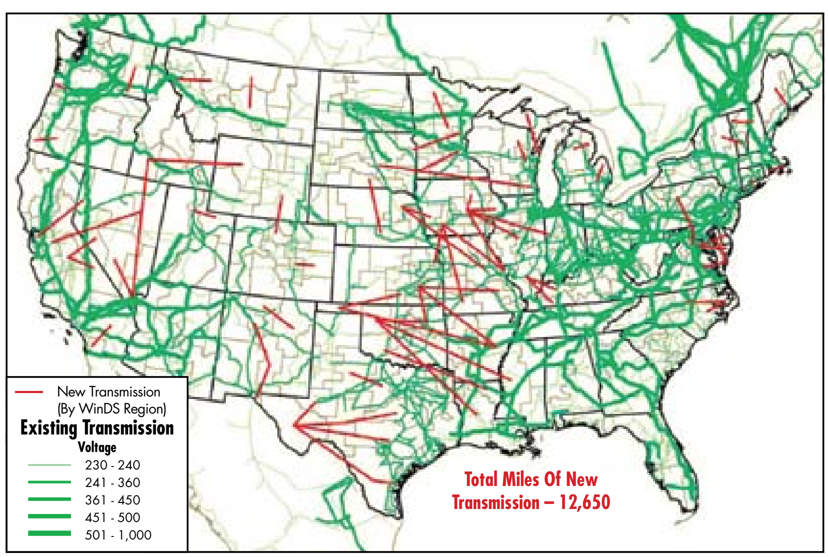
■ addressing concerns about local siting, wildlife and environmental issues.

The key barrier

That the report lists expansion of transmission as a critical need to realize the 20% scenario is no surprise. Simply put, lines have to be put up to move wind-generated electricity from the areas with the best resources – which tend to

Figure 1

2030 – New Transmission Lines – WinDS Region Level – Simplified Corridors >= 100 MW



Source: U.S. Department of Energy

be remote – to the areas with the highest demand for power. The report noted a number of activities related to expansion and development of transmission infrastructure, including:

- planning by the Western Governors' Association's Clean and Diversified Energy Advisory Committee (CDEAC),
- collaboration of Minnesota utilities in the CapX2020 transmission development effort,
- creation of competitive renewable energy zones (CREZs) in Texas and Colorado,
- creation of state transmission or infrastructure authorities in a number of Western and Midwestern states,
- large, multistate transmission construction projects, such as TransWest Express,
- the Southwest Power Pool extra-high-voltage initiative and X Plan, and
- the Midwest ISO Transmission Expansion Plan for 2006, 2007 and 2008.

For the report, an analysis of how much transmission would be needed for the 20% scenario was conducted. NREL's Wind Deployment System (WinDS) model was used to determine distances from point of electric production to point of consumption, as well as the cost-effectiveness of building plants close to load or in remote areas and paying the transmission cost.

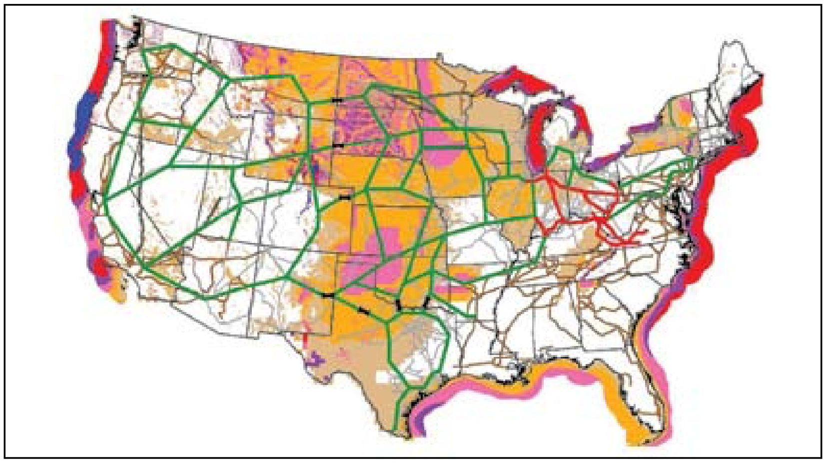
The model also took into consideration transmission needs for coal and other generation sources. The WinDS model found that it was often more efficient to site projects remotely in the area with the best resources and, in fact, the model found that it would be cost-effective to build more than 12,000 miles of additional transmission at a cost of $20 billion.

Most of the transmission would be needed in the longer term after generation coming online uses the available capacity on the existing grid. Indicative transmission corridors for the 20% scenario can be seen in Figure 1. The red lines show general areas in which new transmission capacity would be needed in addition to the existing grid (represented by green lines).

This approach is consistent with analyses conducted by the CDEAC, Midwest ISO, Electric Reliability Council of Texas (ERCOT) and American Electric Power (AEP), which produced a conceptual transmission plan to integrate 20% electricity from wind. The AEP plan provides for 19,000 miles of new 765 kV transmission lines at a discounted or net present value of $26 billion – an estimate close to that of the NREL WinDS model. (See Figure 2.)

Figure 2

Composite Wind Resource Map



Existing 765 kV
New 765 kV
AC-DC-AC Link

Transmission Lines
Voltage (kV)
345-499
500-699
700-799
1,000 (DC)

Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density At 50 m W/m^2	Wind Speed At 50 m m/s	Wind Speed At 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1,600	8.8 - 11.1	19.7 - 24.8

Source: U.S. Department of Energy

The report notes that investment in transmission infrastructure will accommodate not only the 20% scenario, but also other generation resources needed to meet growing demand.

Barriers to investing

The report notes that there are a number of barriers to investing in enough transmission to accommodate the 20% scenario, including transmission planning, allocation of the costs of new transmission investments, assurance of cost recovery and siting of new transmission facilities.

Transmission planning has been separated from generation planning at utilities since the 1990s, when federal open access rules required the separation of transmission and generation businesses. As it stands, generation developers will be reluctant to move forward on a project unless it is clear that there is transmission available to move power from the plant.

Transmission developers are reluctant to move forward on expansion until interconnection requests are filed and existing capacity filled. This scenario has stymied transmission development until recently. A significant amount of far-reaching transmission planning activity has been taking place, spurred in part by the Federal Energy Regulatory Commission's (FERC) Order No. 890, which mandates open transmission planning processes be enacted by transmission system operators under FERC jurisdiction.

These plans include activities in the Pacific Northwest, California's renewable energy transmission initiative, proposed western renewable energy zones, and the joint coordinated system plan being undertaken by the Midwest ISO, Southwest Power Pool, and PJM Interconnection in partnership with the Tennessee Valley Authority. Exercises such as these can help achieve better coordination to interconnect generation resources as well as achieve economies of scale. In addition, the Texas CREZ implementation will serve as a model for transmission system planning to accommodate expansion of wind generation.

Cost allocation and cost recovery (i.e., who pays for transmission development) continues to be a thorny issue. The question always arises as to whether the costs for development and expansion of transmission infrastructure should be paid up front by wind plant developers or passed to ratepayers. California has addressed this question to a large extent with its third path for financing transmission, where the initial costs for building transmission would be borne by utilities that will be reimbursed at a later date after the renewable projects are online and generating revenue.

Other transmission system operators and merchant transmission developers are working on financing and cost-recovery mechanisms that invariably must be approved by FERC. The exception to this is the Texas CREZ mechanism, where the ratepayers pay the costs for transmission expansion. ERCOT, the primary system operator for Texas, operates within the borders of that state and is not under FERC jurisdiction.

Transmission siting also will continue to be a challenge – local and state opposition to transmission construction and expansion will always arise with specific projects. Concerns about aesthetics, property values and impacts on the environment exist with every project.

In addition, state agencies may reject a project if it appears that an interstate line will not present significant benefits for its residents. The provision in the 2005 Energy Policy Act giving the U.S. government the authority to establish National Interest Electric Transmission Corridors may prove instrumental in facilitating construction of transmission to realize the 20% scenario.

Moving forward

The DOE report hints at the need for an initiative to develop a national interstate transmission superhighway, reflecting the booms in transmission investment that came with development of the federal hydropower system and the emergence of other generation technologies, such as nuclear and gas.

As the authors of the report note, the 20% electricity from wind scenario will require a major national commitment to clean, domestic energy sources and the will to do what it takes to make it happen. NWP

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