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# wind energy & the grid

## engineers need to solve the integration problem

RENEWABLE ENERGY IS GROWing fast, and all signs point to continued expansion. Public opinion surveys show public support for renewable energy deployment over 90%. Policy makers facing issues as diverse as energy security, water scarcity, loss of a U.S. manufacturing base, economic development, and climate change often look to renewable energy to provide part of the solution. At the same time, cost reductions and technological advances are occurring as a result of innovation caused in turn by growth and opportunity. However, the continued growth of renewable energy is threatened by the inadequacy of the nation's power grid. Overcoming this challenge will require a massive amount of engineering manpower, including both the knowledge embodied in our most experienced engineers, as well as the creativity of a new generation of engineers ready to try new solutions on new problems and break new ground to meet today's challenges.

### "If You Love Renewable Energy, You Need to at Least Like Transmission"

Statements like this one from Tucson Electric Power CEO Paul Bonavia are becoming more widely embraced. Without a renewed investment in a high-voltage grid, we will not be able to fully realize our immense potential for renewable energy production. In the parts of the United States with the best wind resources, the grid is either nonexistent or grossly inadequate. In the United States, almost 300,000 MW of proposed wind projects—about ten times the amount of wind energy that has been installed to date—are waiting to connect to the grid. Moreover, many wind projects that do get on the grid have their output curtailed, and because of the balkanization of our grid, higher wind output in one region cannot balance out lower wind output in a neighboring region. We will need more engineers to follow the lead of the outstanding transmission planners who put together the joint coordinated system plan in the eastern United States, which planned transmission lines to tap remote high-quality renewable resources.

Grid operations can be updated in a number of ways to make the grid more efficient and reliable and to facilitate the integration of renewable resources.

Policy makers need to create the conditions for investment in transmission. We still have a balkanized system of separate utility fiefdoms that tend to protect their local control rather than pursue economic and reliability improvement through better coordination and multistate transmission development. Many utilities oppose transmission development because transmission brings in low-cost competition to the generation facilities that they own. Some policy makers oppose transmission that would bring in imports because they want generation development and its associated economic development to occur only in their state. A broad coalition of entities representing consumer, environmental, business, and labor interests have been coming together to overcome this resistance. In the U.S. Senate, three bills were introduced in early 2009 by Senators Reid, Bingaman, and Dorgan that each would address the three Ps, the areas where transmission policy reform is most needed: planning, permitting, and paying for transmission. Under these bills, transmission planning would be interconnection wide with open participation. Permitting would be handled more at the federal level to ensure multistate lines do not face roadblocks. Paying, or cost allocation, would be interconnection wide to ensure all beneficiaries pay a share of the lines. Transmission development and investment, and thus renewable development and investment,

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Digital Object Identifier 10.1109/MPE.2009.934263


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**in my view** *(continued from page 128)*

awaits Congressional action to pass a bill that includes the three Ps.

## Reforms to Grid Operations

In addition to building a more robust transmission grid, grid operations can be updated in a number of ways to make the grid more efficient and reliable and to facilitate the integration of renewable resources. Many of these changes would save consumers money even without a large amount of renewable energy on the power system. These changes include the following:

- ✔ *Faster intervals for generator dispatch and scheduling:* dispatching power plants for 5- or 10-min intervals instead of the hourly intervals that are typical in much of the United States can reduce wind integration costs by half or more, as intrahour variability can be accommodated through power plant scheduling instead of relying on expensive regulation reserves.
- ✔ *Larger balancing areas:* whether through physical consolidation of balancing areas or virtual consolidation through techniques such as area control error diversity interchange (ADI), larger balancing areas facilitate the integration of renewable energy by allowing sources of variability to net out against other variability and providing a greater pool of flexible generators to accommodate variability.
- ✔ *Better integration of wind energy forecasting:* better tailoring the outputs of wind energy forecasts to provide the information that is most useful for power system operators can greatly reduce wind integration costs.
- ✔ *Dynamic line ratings, conditional firm service:* both services allow use of transmission line capacity that is physically available but that would normally be treated as unavailable under current operating guidelines.
- ✔ *Greater use of probabilistic instead of deterministic planning and operational tools:* recent advances


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in computing technology have made it possible to more accurately model what in reality are probabilistic phenomena, such as wind output profiles and demand profiles, but which are traditionally treated as deterministic phenomena by grid operators.

## What Can Engineers Do?

The European experience with wind integration includes a number of instructive lessons for the United States. A decade or so ago, when countries such as Denmark, Germany, Spain, Portugal, and Ireland were contemplating drastically increasing their renewable energy deployment, many skeptics insisted that it could not be done. Fortunately, engineers figured out that it could be done, policy makers listened to them and put the necessary policies in place, and then the engineers designed and implemented the infrastructure and operational changes that were needed. The United States can learn a lot from this experience, both from the historical view of how this change occurred as well as from the technical view of what changes we need to implement. One can similarly look back a generation to the significant changes in power system infrastructure and operations that were implemented in the United States and around the world to accommodate what was then a new and different source of electricity: nuclear power. Each new generation technology requires modification, and it is time for an update in the U.S. grid infrastructure and operations to meet the needs of the generation sources of the 21st century.

I feel some reassurance from looking at instances in which engineers put together solutions and made progress ahead of their executives and policy makers. For example, early in this decade when utilities and state regulators were fighting federal initiatives to promote regional power trading, the engineers in the southwest United States quietly developed and implemented plans for a common transmission scheduling platform, called westtrans.net. Similarly, in parts of the western United States where many political interests are opposed to balancing area consolidation, innovative ADI initiatives have allowed grid operators to capture many of the benefits of balancing area consolidation without implementing full consolidation. Engineers need not wait for policy makers to finish their endless debates; they can embrace the challenges and do what they do best—solve the problem. p&e



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