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# PJM on wind

Wind power is growing rapidly in the United States and in Pennsylvania where 8 wind farms that total 259 megawatts now operate. Those wind farms already generate enough power for about 80,000 homes. Another 4,714 megawatts are in various stages of development within Pennsylvania, which would create enough power for an additional 1.4 million homes.

Just in the Keystone state, wind power is creating thousands of jobs. Across the nation, wind power provides hundreds of millions of dollars of tax payments and rental fees to landowners, and displaces more and more electricity that would otherwise be made by burning coal, oil, or natural gas.

Wind farms create zero air pollution; require no destructive mining to obtain fuel to make electricity; and use no water, unlike coal and nuclear plants that must have massive amounts of water to cool them. They also diversify how electricity is made and reduce the price volatility of energy, providing another substantial economic benefit.

While wind energy is not perfect, wind's impact on the environment is minor, unlike burning fossil fuels to make electricity. In fact, for global warming, the top threat to biodiversity and our environment, wind power is also medicine for a fevered planet. Every new wind turbine produces more electricity with no global warming pollution and reduces the amount of electricity that would otherwise be produced from coal and other fossil fuels that are dangerously heating the earth.

Given all these environmental and economic benefits of wind power, it is especially good news that wind is growing rapidly. Yet, not everyone supports wind.

Organized opposition to wind power has emerged and opponents of wind power and wind farms have actively spread substantial misinformation about the nature of wind power and its role on the electric grid. Some opponents have said things like wind power is phony and does not provide real electricity; wind power does not reduce the need to burn fossil fuels to make electricity; and new coal plants must be built to back up wind farms.

To get the real story about wind farms and their role on the electric grid, PennFuture interviewed **Karl Pfirrmann, Interim President and CEO of PJM Interconnection** (PJM). PJM is the organization that operates the grid for the entire PJM region that includes nearly all of Pennsylvania and much of 14 other states. The PJM region runs from Delaware in the East to Illinois in the West and New Jersey in the North to Kentucky in the South.

PJM is independent of all utilities, generators, and consumers. Its legal responsibility is to make sure that the grid is reliable and the wholesale electric market is competitive. PJM plays a role much like an air traffic controller who cannot favor one airline over another and must insure safety of the skies.

**PennFuture:** For the benefit of our readers, please briefly describe how the grid is kept in balance in real time, tracking demand and ensuring generation is available to meet that demand?

**Pfirrmann:** All power supply systems must balance demand (use of electricity) and generation in real time. Either having too much or too little energy on the system causes problems. Maintaining the balance between electricity demand and production actually begins one or more days ahead of "real time" with the analysis of planned and unplanned equipment outages, bids by suppliers, schedules of generation resources, and energy transactions (imports or exports) between PJM and PJM's neighbors. Based on this analysis, PJM establishes a least-cost mix of generation for each hour of the day to meet forecasted demand, scheduled transactions and system reserve requirements. On a real-time basis, PJM adjusts the mix of generation to ensure that variations in demand and imports/exports are met while providing adequate reserves to meet established performance criteria. This real-time adjustment also accommodates energy supply which becomes available but was not scheduled, such as wind energy. Because wind generators have very low operating costs and thus can accept virtually any market price, if wind generation is available, it is invariably included in the supply mix.

**PennFuture:** How does the system accommodate wind generation when it comes onto the system as you have described?

**Pfirrmann:** When wind generation is available, in order to keep the system in balance, supplies from other sources are either reduced or are not brought on line. Almost always, it is the most expensive power which is "backed down" or "avoided". In 2006, about 70 percent of the time coal-fired generation is the most expensive generation on the system and is displaced when wind becomes available. The other 25 percent of the time natural gas-fired generation is the most expensive.

Because PJM is an extremely large system, with approximately 1,270 sources of generation interconnected to an extensive transmission grid, we have a great deal of flexibility in identifying the appropriate sources to back down as wind generation – even unscheduled wind generation – comes onto the system.

**PennFuture:** Are there significant costs associated with this process of identifying and backing down generators when wind generation becomes available?

**Pfirrmann:** No. Wind generation does not pose significant costs as a result of its variable nature. The transmission system is sufficiently flexible that it can readily accommodate the change in power flows. And, most generators are sufficiently flexible that they can be backed down with minimal effects on their operating efficiency.

**PennFuture:** We hear questions about whether wind energy, because of its variable nature, needs to be "backed up" by conventional generation resources. For example, does having wind on the system increase the need for operating reserves?

**Pfirrmann:** The costs of managing wind as a variable resource are modest, and the owners of wind generators bear their allocated portion of that cost.

The principle reserve we maintain is synchronized reserve. It's comprised of generation units which are synchronized to the grid and ready to deliver energy on extremely short notice. They serve as protection against a sudden loss of the single largest generating unit on the entire system, and the amount we maintain is based solely on the size of that largest generating unit. We also maintain a "regulation reserve" to manage the short-term variability in demand. Although demand, or usage, varies in predictable ways which we manage by scheduling resources we can reasonably anticipate needing, demand also varies in less-predictable ways. To match these moment to moment variations in usage, we pay generators to be ready to deliver additional energy on a near-term basis if needed. The costs for maintaining this state of readiness are allocated to power users.

The one form of reserve for which wind can create a need is the "supplemental reserve". Supplemental reserve protects the system from falling below the amount of generation needed to serve demand and to maintain the synchronized reserve I discussed earlier. If a generator goes off line suddenly, some of the synchronized reserve may actually be required to serve load pushing the synchronized reserve below its required level. This in turn requires the activation of supplemental reserve in order to replenish the synchronized reserve that has been converted to energy. PJM pays generators to be available to provide this supplemental reserve. Because the need for this reserve is based partially on supply-side considerations, we allocate a portion of the costs to the generators in instances when their actual production deviates from their scheduled production. Its cost is deducted from the payments they otherwise receive for their energy deliveries. The cost is nominal, however, ranging from about 75 cents to $2 per megawatt-hour.

**PennFuture:** Do you see this changing as more wind generation comes onto the system?

**Pfirrmann:** That will depend. The PJM system is so large that we will be able to integrate a good deal of wind into the system without operational difficulties, and the wind generators themselves are carrying costs associated with their variable nature. Smaller transmission systems have studied this issue and found that, at levels below 20 percent penetration, the costs of integrating wind generation are a small fraction of the value of that generation.

**PennFuture:** You now have several years' experience with wind generation. How variable is wind in reality?

**Pfirrmann:** Wind is not as variable as people may think. Our experience shows that, if a wind generator is operating at a certain level at present, there is an 80 percent probability that it will be operating within ±10 percent of that level one hour from now. And, there is a 60 percent probability that it will be operating within ±10 percent of that level five hours from now. We're also encouraged that better forecasting will enable us to better predict the output from the wind generators on our system.

**PennFuture:** What has been your experience with wind's capacity value?

**Pfirrmann:** Development-stage wind projects are analyzed on the basis of having a capacity value of 20 percent of their nameplate value. Although electricity demand on the PJM system reach a relative peak during winter when wind generation is greatest, the highest peak demand occurs in summer when wind generation is not as great. As we study the feasibility of interconnecting a proposed wind project with the grid, we anticipate that, during the summer peak demand periods, we will receive from that project an average of 20 percent of its maximum output. Experience is telling us that the amount is somewhat less than that, but wind does definitely have a capacity value. As the amount of installed wind capacity becomes more substantial, it will displace the need for some conventional, typically fossil-fuel-based, generation capacity.

*PennFuture thanks Mr. Pfirrmann for this interview and information.*