



## PJM Interconnection and Wind Energy

### **Q: *What is PJM Interconnection?***

PJM is a regional transmission organization (“RTO”) coordinating the transmission of electricity and managing a wholesale power market across all or parts of 13 states and the District of Columbia. Over 60 million people reside within the PJM region, which encompasses all of Pennsylvania, West Virginia and Maryland, as well as most of the state of Virginia. The organization was formed as a power pool by three electric utilities in 1927. In 1956, with the addition of two other members, it became the Pennsylvania-New Jersey-Maryland Interconnection, or PJM. Its present role as an RTO was enabled by the federal Energy Policy Act of 1992 and several orders issued afterward by the Federal Energy Regulatory Commission, or “FERC.” For more information regarding FERC’s role in the regulation of the transmission and sale of electricity, please see AHA’s Wind Energy and Government Regulation fact sheet.

### **Q: *Who are the members of PJM?***

PJM is comprised of:

- **Transmission Owners** – entities (usually electric utilities or their parent affiliates) that own or control electric transmission lines (operating at over 100 kilovolts). TOs retain ownership of their lines, but PJM has “functional control” of the lines and has primary oversight in day-to-day operations.
- End-use customers, such as **Load Serving Entities** – LSEs are typically the conventional electric utilities, such as Mon Power and Potomac Edison (under the FirstEnergy umbrella).
- **Generation Owners** – entities that own power plants (“generating units”), including wind energy facilities
- Electric Distributors
- Other Suppliers, such as power marketing entities

### **Q: *How does PJM coordinate the transmission of electricity throughout its region?***

On a minute-by-minute basis, employees in PJM’s control room attempt to balance the output of electricity from generating units connected to its grid with the demand for electricity of customers within its territory (the latter often referred to as “load”). If generator output exceeds or falls short of load, PJM operators employ measures, such as requesting an increase or decrease in output from a generating unit, to bring the grid back into balance.

***Q: What kind of power markets does PJM oversee?***

PJM administers several markets, all concerning the sale of electricity at wholesale, as opposed to the retail sales from electric utilities to residential customers over distribution lines. In an effort to ensure an adequate supply of electricity on any given day, PJM coordinates transactions in two markets:

- **Day-Ahead**: relies on a forecast of the next day's **peak load** (the maximum amount of electricity expected to be consumed at any point in time during the day). Bids to provide or consume energy the next day are submitted prior to a scheduled cutoff.
- **Real Time**: relies on short-term forecasts of load for the next hour. Bids are submitted and accepted within very brief timeframes.

PJM also operates two ancillary services markets, which facilitate keeping the grid in balance:

- **Regulation**: Generators or other facilities are compensated for injecting or absorbing brief bursts of electricity to or from the grid within 30 seconds of PJM's signal to do so, in an effort to keep the **frequency** of the electric grid at 60 hertz (Hz).
- **Synchronous Reserves**: Generators increase their output or large electric users go off the grid to reduce load (part of what is termed **demand response**), in an effort to bring generation and load into balance. Facilities participating in this market must be able to increase output or drop load within 10 minutes.

***Q: What planning processes does PJM undertake?***

PJM engages in two main planning processes: the **Reliability Pricing Model** ("RPM") auctions and the **Regional Transmission Expansion Plan** ("RTEP").

The RPM auctions are designed to send price signals to the market to ensure the availability of sufficient generating resources in PJM, in an amount necessary to satisfy an Installed Reserve Margin requirement (for the 2014-15 "Delivery Year," this figure is 15.3% extra generating capacity beyond that needed to meet the forecasted peak load).

The RTEP process utilizes computer modeling to assess the ability of the transmission network to accommodate generators placing energy on the grid and Load-Serving Entities or other users to obtain energy at the point on the grid at which it is needed. The results of the RTEP dictate which Transmission Owners will be directed to construct new lines or enhance existing facilities, and where on the grid those projects will be carried out.

***Q: How do wind energy facilities operate in the PJM region?***

Upon reaching the appropriate point in the process of interconnecting with the PJM grid, a wind facility (to use a hypothetical, the "Rumbling Blades Wind Project") may participate in the RPM auctions and the Day-Ahead and Real Time markets, and that

project is included as in-service for the purposes of the RTEP. The owner or operator of Rumbling Blades can then submit bids to supply capacity in the RPM auctions and energy in the daily markets. However, such participation is limited by the highly variable nature of wind generators, which makes prediction of their operation very difficult.

***Q: How does PJM manage the integration of wind energy, given the swings in output?***

PJM would consider Rumbling Blades, as any other new wind energy facility, to be an “immature intermittent capacity resource,” and the organization’s rating of the project’s **capacity factor** and **capacity value** reflect this.

- Capacity factor is the ratio of the total energy generated by a generating unit for a specified period to the maximum possible energy it could have generated if operated at the maximum capacity rating for the same specified period, expressed as a percent.
- Capacity value is that amount of generating capacity, expressed in MW, that a generating unit can reliably contribute during summer peak hours (June 1 through August 31) and which can be offered as unforced capacity into the PJM capacity markets.

PJM will assign a Class Average Capacity Factor of **13%** to Rumbling Blades for the purposes of market participation. This figure was derived from historical operating data from wind units in PJM, and reflects the mean, or average, of all recorded capacity values for those units. Accordingly, some wind facilities operating in PJM have experienced greater capacity values, but many have experienced lower capacity values.

Applying the standards explained above, if Rumbling Blades has a peak, or “nameplate,” generating capacity of 100 megawatts (MW), PJM will assign it an Installed Capacity of only 13 MW. This figure—13 MW—represents the amount of capacity that could be cleared by Rumbling Blades in the base RPM auction. (A wind generator may request an increase in its Installed Capacity figure if it can demonstrate that the project’s operating history supports such an increase.)

Rumbling Blades would then be obligated to submit an offer in each Day-Ahead Market in the corresponding Delivery Year. The facility would not, however, be required to submit a bid to supply the entire 13 MW during Hour X if the facility’s wind data indicates lower generation capability during that time. Rumbling Blades would provide real-time wind speed and direction data from at least one meteorological tower on the project site (or an acceptable alternative source), which then would be incorporated into a Reliability Assessment prepared after the Day-Ahead Market closes. The Reliability Assessment is aimed at ensuring sufficient generating resources (including coal-fired generators) are available to respond to fluctuations in wind output.

\*\* Sources: *PJM Manual 21: Rules and Procedures for Determining Generating Capability*, Revision 9 (Effective Date: May 1, 2010), pp. 17-19, available at <http://www.pjm.com/~media/documents/manuals/m21.ashx>; *PJM Manual 35: Definitions and Acronyms*, Revision 19 (Effective Date: June 24, 2011), available at <http://www.pjm.com/~media/documents/manuals/m35.ashx>; “Wind Generation Operational Considerations,” webinar available at <http://www.pjm.com/training/course-catalog/online-courses.aspx>.

**Q: How does the total wind energy capacity in PJM compare to percentage of the total generating capacity in the region?**

The most recent annual RPM auction, the results of which were announced in May 2012, procured 164,561 MW of generating capacity for the Delivery Year covering the period of June 1, 2015 through May 31, 2016. Of this amount, wind projects comprised 796 MW, or less than one half of one percent, of the total capacity clearing the auction. This is the case despite nearly thirteen years of wind energy development in multiple states in PJM.

\*\* Source: "PJM Capacity Auction Secures Record Amounts of New Generation, Demand Response, and Energy Efficiency," press release dated May 18, 2012, available at <http://www.pjm.com/~media/about-pjm/newsroom/2012-releases/20120518-pjm-capacity-auction-secures-record-amounts-of-new-generation-demand-response-energy-efficiency.ashx>.

**Q: But I have heard references to a wind project generating enough electricity to power so many thousand homes. Is this number accurate, and how is it calculated?**

Advertising this type of figure is misleading at best. Suppose that the promoters of the Rumbling Blades Wind Project claim that the facility "will generate 219,000 megawatt-hours of electricity each year, or enough energy to power 21,900 homes!" While 219,000 megawatt-hours (MWh) of electric energy is equal to the electricity consumption of 21,900 American households (at an average of 10,000 kilowatt-hours or 10 megawatt-hours consumed annually), discussion of the ability of Rumbling Blades to provide a certain amount of reliable generating capacity throughout the year is omitted.

Based on the number cited, Rumbling Blades would have a capacity factor of 25% for the entire year (219,000 MWh generated in Year X / 876,000 MWh possible if generating at peak for the entire Year X), but its capacity value for the crucial peak summer hours in PJM would likely be right around 13%. Thus, the energy produced during that time would rarely be sufficient to meet the electricity demand of 21,900 households simultaneously. There will be many times during the summer, particularly when temperatures are high, the air is stagnant and power-hungry air conditioners are running full tilt, that Rumbling Blades will not be generating any electricity.