

# How Does Wind Generation Impact Competitive Power Markets?

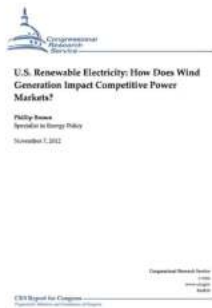


As the world increasingly seeks sustainable and clean energy alternatives, wind generation has emerged as a prominent player in the power industry. Wind power offers numerous advantages, including environmental benefits and reduced reliance on fossil fuels. However, its integration into competitive power markets brings about several unique challenges and opportunities.

## **Understanding the Basics of Wind Generation**

Wind generation involves harnessing the natural power of wind to produce electricity. Wind turbines are strategically placed in areas with consistent wind flow, such as open fields or coastal regions. As wind hits the turbine blades, it

spins a rotor connected to a generator, converting kinetic energy into electrical energy.



## U.S. Renewable Electricity: How Does Wind Generation Impact Competitive Power Markets?

by Alexis Stephens (Kindle Edition)

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Wind generation has seen significant growth over the years, with substantial investments in wind farms and technological advancements in turbine design. It has become a cornerstone of renewable energy production, reducing greenhouse gas emissions and contributing to the global effort against climate change.

### The Impact of Wind Generation on Competitive Power Markets

#### 1. Integration Challenges:

While wind generation brings many benefits, it also poses challenges when integrated into competitive power markets. The intermittent nature of wind power, dependent on wind availability, creates logistical issues for grid operators. They must balance supply and demand in real-time to ensure grid stability.

#### 2. Price Dynamics:

Wind generation alters the pricing dynamics of power markets. During periods of high wind availability, wind farms generate excess electricity, leading to a decrease in wholesale electricity prices. Conversely, during low wind periods, reliance on alternative power sources may increase electricity prices.

### 3. Grid Flexibility:

Wind generation encourages the development of a more flexible and adaptable power grid. To accommodate the intermittent nature of wind power, grid operators need to invest in advanced monitoring systems, energy storage technologies, and demand-response mechanisms. This transition can positively impact the overall efficiency and resilience of power infrastructures.

## **Opportunities Arising from Wind Generation**

### 1. Green Energy Market:

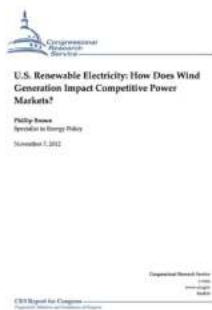
Wind generation stimulates the growth of the green energy market. Many consumers are willing to pay a premium for electricity sourced from renewable sources. As wind power becomes more accessible and cost-effective, competitive power markets can tap into this market segment, expanding their customer base and diversifying revenue streams.

### 2. Job Creation and Economic Growth:

The development and maintenance of wind farms and associated infrastructure create employment opportunities. Wind generation projects require a skilled workforce, providing jobs and boosting local economies. This investment in renewable energy can contribute to regional development and reduce dependency on fossil fuel industries.

Wind generation has a profound impact on competitive power markets. While it presents integration challenges and alters pricing dynamics, it also brings opportunities for grid flexibility and the development of green energy markets. With its environmental benefits and potential for economic growth, wind power continues to shape the future of sustainable energy production.

So, as we move towards a greener future, let us harness the power of the wind to create a more sustainable and competitive power market.



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U.S. wind power generation has experienced rapid growth in the last 20 years as total installed capacity has increased from 1,500 megawatts (MW) in 1992 to more than 50,000 MW in August of 2012. According to the Energy Information Administration (EIA), wind power provided approximately 3% of total U.S. electricity generation in 2011. Two primary policies provide market and financial incentives that support the wind industry and have contributed to U.S. wind power growth: (1) production tax credit (PTC)—a federal tax incentive of 2.2 cents for

each kilowatt-hour (kWh) of electricity produced by a qualified wind project (set to expire for new projects at the end of 2012), and (2) renewable portfolio standards (RPS)—state-level policies that encourage renewable power by requiring that either a certain percentage of electricity be generated by renewable energy sources or a certain amount of qualified renewable electricity capacity be installed.

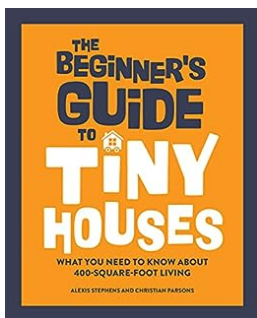
The concentration of wind power projects within competitive power markets managed by regional transmission operators (RTOs), the focus of this report, has resulted in several concerns expressed by power generators and other market participants. Three specific concerns explored in this report include: (1) How might wind power affect wholesale market clearing prices? (2) Does wind power contribute to negative wholesale power price events? and (3) Does wind power impact electric system reliability? These concerns might be considered during congressional debate about the future of wind PTC incentives.

When considering the potential impacts of wind power on electric power markets, it is important to recognize that wholesale power markets are both complex and multi-dimensional. Wholesale power markets are influenced by a number of factors, including weather, electricity demand, natural gas prices, transmission constraints, and location. Therefore, determining the direct impact of a single variable, in this case wind power, on the financial economics of power generators can be difficult. In 2012, wholesale electric power prices were down from recent highs in 2008, and lower price trends can result in financial pressure for power generators in RTO markets. Arguably, however, the two primary contributors to this decline are low natural gas prices and low electricity demand.

Wind power generation can potentially reduce wholesale electricity prices, in certain locations and during certain seasons and times of day, since wind typically

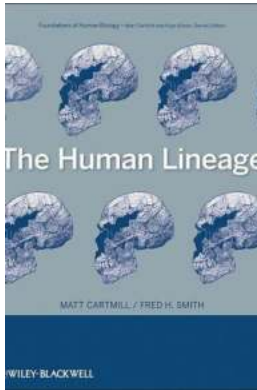
bids a zero (\$0.00) price into wholesale power markets. Additionally, independent market monitor reports for three different RTOs each indicate that wind generators will sometimes bid a negative wholesale price in order to ensure electricity dispatch. The ability of wind generators to bid negatively priced power is generally attributed to value associated with PTC incentives and the ability to sell renewable energy credits (REC). However, wholesale power price reductions and negative electricity prices associated with wind generation need to be considered in context with other dimensions of organized power markets. For example, other revenue sources (i.e., capacity markets) may be available to generators in certain RTO market areas. Also, generators oftentimes enter into bilateral power purchase agreements that can provide a hedge against power price volatility. Therefore, the absolute impact of wind electricity on the economics of power generators is difficult to determine due to the many variables and dimensions that influence wholesale power markets.

With regard to how wind power might impact electricity system reliability, two aspects of reliability are typically discussed: (1) impacts to system operations—the ability of the power system to manage the variable and sometimes unpredictable nature of wind power production, and (2) resource adequacy and capacity margins—the potential for wind power generation to either influence power plant retirements or [...]



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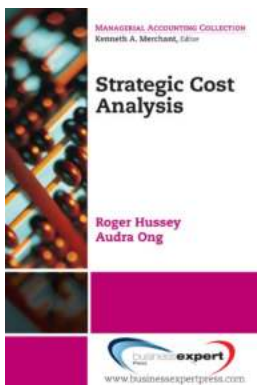
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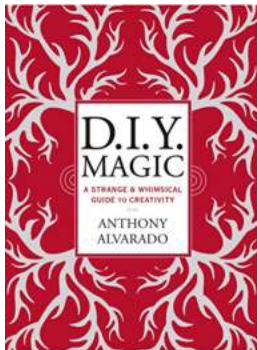
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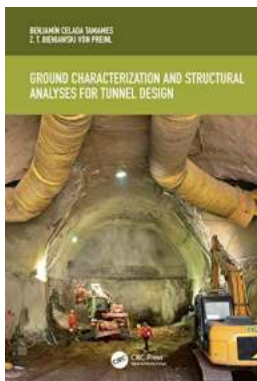
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