Transmission and Wind Energy:

Capturing the Prevailing Winds for the Benefit of Customers

nationalgrid

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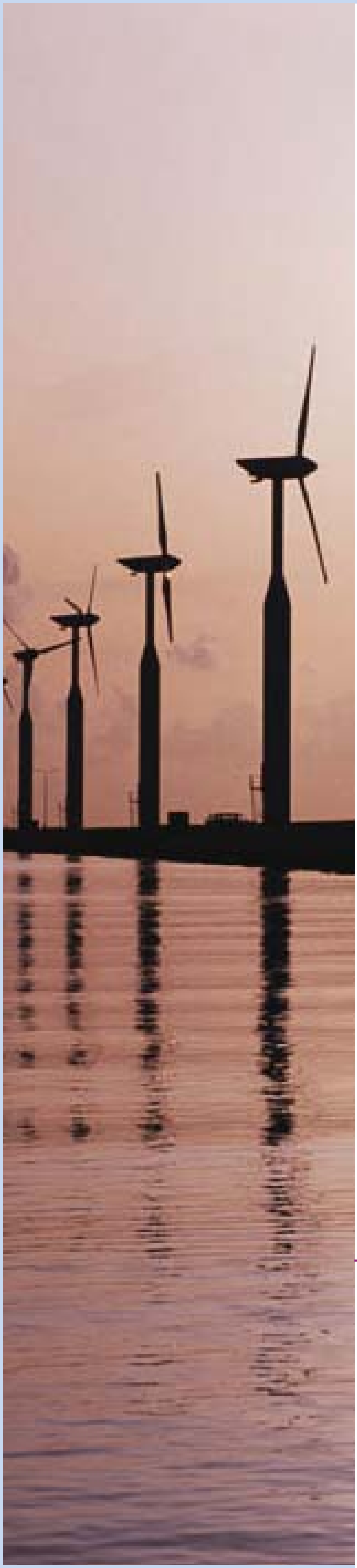


Executive Summary

The potential benefits of wind power as a clean, renewable, economic, domestically available power source have captured the attention of energy policy leaders, consumers, and the electricity industry. The United States (US) has tremendous wind energy resources. California is viewed as one of the leaders in the modern US wind industry in terms of capacity installed; however, 16 other states have even greater wind potential. Only a small portion of that potential has been tapped. The US currently derives approximately 1% of its electricity from wind power, whereas parts of Europe use wind power to meet up to 25% or more of their electricity needs.

In 2005, wind power in the US grew rapidly and became more competitive as volatile natural gas prices increased and crude oil prices reached record highs. Improved technology, federal tax credits and public policies that encourage utilities to use clean energy sources helped fuel the growth from coast to coast. Projections are that US wind capacity could reach 100 gigawatts (GW) by 2020, meeting 6% or more of national electricity needs.[1]

The objective of this paper is to examine the transmission policy issues around wind and renewable sources of generation. Reliability and commercial issues are reviewed, both in the US and abroad, and recommendations are provided for effective integration of wind sources into the US electric system. Key findings of this paper are:

- Over-reliance in the US on any one fuel type results in reliability and economic consequences, highlighting the benefits of diversified energy resources.
- Wind generation is becoming an economic power source, and has the further benefit of mitigating environmental climate change concerns.
- In order to tap the vast potential of new generation sources such as wind power in the US, we must address the existing challenges in generator interconnection and transmission cost and planning policies.
- The current US transmission system was not built to support competitive regional markets nor is it sufficient to integrate planned and potential new generation sources; additional transmission infrastructure will be required.
- Operating techniques for intermittent generation resources, properly structured market rules, and effective transmission policies for regional planning, cost allocation, and cost recovery and incentives will help to facilitate wind power as well as other new sources of generation.
- Transcos (for-profit independent transmission companies) focus on delivering low-cost reliable energy to consumers by facilitating robust electricity markets and providing transmission access to new generation sources including renewable energy. Because of their for-profit structure, a further advantage is that Transcos can be held firmly accountable by regulators for system performance and operating costs.

1 See http://www.awea.org/newsroom/Wind_Energy_Basics.pdf. Also, in his visit to National Renewable Energy Laboratory (NREL) on February 21, 2006 President Bush described the possibility of generating 20% of US electricity needs from wind.

- Robust transmission infrastructure policies in countries outside the US have helped them progress toward achieving their goals for renewable sources of energy while maintaining system reliability. The challenges to effective integration of wind power in the US are not insurmountable; they can be addressed with industry, public, and regulatory commitment.
- Several countries, including Denmark, Germany, Spain and the UK have had coordinated government efforts and policies to facilitate wind power, and these are proving very effective. Some areas of North America, such as Alberta and Texas, are also employing planning and cost allocation policies that are helpful to new generation sources.

Specific recommendations for changes needed to take advantage of US renewable resources to the benefit of electricity market users and customers are:

- *Employ greater use of available operational techniques, such as wind forecasting tools, for reliable operation of wind resources;*
- *Properly structure market rules to address imbalance and capacity value in a manner that reliably and economically facilitates renewable generation sources;*
- *Engage industry and stakeholders in long-term, robust, and comprehensive regional planning for transmission infrastructure, including infrastructure needed for new sources of generation;*
- *Incorporate economic and customer cost metrics, in addition to reliability, into regional planning processes;*
- *Implement workable cost-allocation and recovery mechanisms to recoup the costs of transmission infrastructure improvements;*
- *Provide regulatory incentives for transmission infrastructure investment and independent ownership/operation of the nation's transmission system.*

Several countries, including Denmark, Germany, Spain, and the UK, have had coordinated government efforts and effective regulatory policies to help facilitate wind power development.

Driving Trends

Regulatory and Public Policy

Due to load growth and generation retirements, coupled with an increasing interest in replacing old, inefficient and dirty generators, US energy policymakers are looking to facilitate new generation sources. Over-reliance on any one fuel type (such as natural gas in the Northeast markets) has resulted in reliability and economic challenges highlighting the benefits of a diversified energy mix.[2]

The global community's increased focus on clean and renewable sources of energy is due to its concerns about the negative environmental effects of burning fossil fuels. The growing consensus among scientists is that the burning of fossil fuels and the associated release of carbon dioxide and other greenhouse gases stoke global climate change, intensify droughts in some parts of the world, floods and storms in others, and add to the deterioration of air quality, among other negative health and environmental consequences.[3] As a result, there is heightened public policy attention on wind energy, which produces no harmful air emissions, no greenhouse gases, and does not consume nor pollute water sources.[4]

Federal initiatives promoting cleaner sources of generation include the Advanced Energy Initiative announced in President Bush's January 2006 State of the Union Address – a 22% increase in energy research in zero-emission technologies such as clean coal, solar, and wind power. The Energy Policy Act of 2005 included an extension of a federal Production Tax Credit (PTC) providing tax credits for electricity generation with wind turbines and other renewables.[5] Also, the Federal Energy Regulatory Commission (FERC) has begun to put in place policy changes to facilitate the interconnection of new wind plants.[6]

Individual states have taken the lead in promoting the development of renewable energy including wind power. Many states have established Renewable Portfolio Standards (RPS) programs, which require a percentage of electricity supply to come from renewable sources. By the end of 2005, 22 states had an RPS program or similar goal. Examples include New York with a goal of meeting 24% of its power supply needs from renewable sources by the year 2013, California with a goal of 20% by year 2010,[7] Colorado and Minnesota each with a goal of 10% by 2015, and Vermont with a 10% goal by 2012.

In the international arena, the US is focusing on a six-nation multilateral agreement to promote near-term deployment of clean energy technologies, the Asia-Pacific Partnership on Clean Development and Climate, authorized by the Energy Policy Act of 2005. Other countries have also made an aggressive commitment to environmental energy policies, such as the Kyoto Protocol climate change pact.[8] A European Commission position that 21% of total electricity generation in 2010 come from renewable resources was established in 2004.[9] Several countries, including Denmark, Germany, Spain, and the UK, have had coordinated government efforts and policies to facilitate wind power, and these are proving very effective; Figure 1 illustrates domestic and international levels of wind capacity as a percentage of peak load.

2 The Northeast markets have recently faced risks of power shortages during severe cold weather events that taxed the availability of natural gas to fuel the high percentage of generation resources that run on natural gas while serving domestic heating demand. Also, recent run-ups in fossil fuel costs have occurred in international markets and as a result of severe domestic hurricane activity in the US gulf coast region.

3 See http://www.pewclimate.org/global-warming-basics/basic_science/

4 Although wind power has many advantages, environmentalists continue to voice their concerns about the direct and indirect impacts of siting new wind plants. Their main concerns relate to avian mortality, visual/noise impacts and interference with natural habitats.

5 The PTC provides a tax credit of 1.9¢/kWh for a 10-year period for qualified renewable energy facilities on-line by December 31, 2007. The PTC can be key for financing wind projects; for instance, in the case of FPL Energy Wind, PTC payments make up 38% of its annual revenues. "Pre-sale, FPL Energy National Wind LLC," Feb. 10, 2005, Standard and Poors.

6 FERC's Order 661 adopts technical requirements for new wind plants to ensure reliable system operation. "Interconnection for Wind Energy," Docket No. RM05-4-001.

7 As of the end of 2005, 10.7% of electricity in California is from renewable sources. California State Energy Commission Report CEC-300-2006-009-F, April 2006.

8 Under the Kyoto Protocol, 34 industrialized countries and the Energy Environment Council (EEC) are required to reduce greenhouse gas emissions by at least 5% below 1990 levels between 2008 and 2012. A total of 161 parties to the protocol have ratified the treaty.

Figure 1: Penetration of Wind Resources 2005[10]

	Peak Load	Installed Wind	Penetration
Denmark (west)	4 GW	2.4 GW	60%
Germany	81 GW	18.5 GW	23%
Spain	41 GW	10.0 GW	24%
California	45 GW	2.3 GW	5.1%
Texas	60 GW	2.0 GW	3.3%

Wind generation is becoming an economic power source, and has the further benefit of mitigating environmental climate change concerns.

Industry Developments

The wind power industry is young by electricity industry standards, but in the last 20 years it has made great strides. Single wind turbine capacity has grown from 50 kilowatt (kW) production machines to 2 to 3 megawatts (MW) and more. Over the last two decades, the cost of wind energy at the bus bar has dropped by more than 80%, from 15 - 20 cents per kilowatt hour (¢/kWh) to approximately 4 - 6 ¢/kWh today due to technology advances.[11] Increasing reliability has accompanied the cost decline, with availability of modern machines reaching rates of 97 to 99%. Additional contributing factors to increased reliability include economies of scale associated with larger rotors, improved energy capture with customized airfoils and variable speed controls, taller towers reaching higher wind speeds and improved forecasting technologies.

These technical advances have helped wind power to become a competitive alternative generation source. While the wind industry is highly capital-intensive, there are negligible operating costs compared to thermal units. The economics of wind are also aided by its relative price stability in that it is not dependent on a source of supply with volatile prices, as is the case with most fossil fuel sources. In addition, wind appears to compare favorably to fossil fuels when environmental and health effects and costs are taken into account.[12]

There are a number of studies that support the improving economics of wind power relative to other sources of generation.[13] A current comparison focused on natural gas at various prices is shown in Figure 2. With the recent price of gas around $8.85 MMBTU,[14] wind power is gaining a competitive advantage over energy supply from gas. A recent report by the Electric Power Research Institute (EPRI) reached similar conclusions about the competitiveness of wind power relative to coal, as well as gas generation.[15]

Figure 2: Natural-Gas Plant Fuel Cost Compared to Wind Power[16]

	Gas			Wind
$ / MMBTU (Gas cost)	5	6	8	
¢ / kWh	3.5 - 5	4.2 – 6	5.6 - 8	3.5 4.5 (without PTC)

9 "Commission Report in Accordance with Article 3 of Directive 2001/77/EC," Commission of the European Communities communication to the Council and the European Parliament Brussels, May 26, 2004.

10 Most industry analyses express wind penetration rates as rated capacity of wind plant relative to system peak load, however, there is no single uniform definition of wind penetration.

11 "Winds of Change – Issues in Utility Wind Integration," IEEE Power & Energy Magazine, November/December, 2005; and "Renewable Electricity: Poised to Make a Difference," Power Engineering Magazine, Dan Arvizu, Director, National Renewable Energy Laboratory, May 2006.

12 "Wind Energy the Facts", Volume 4, European Wind Energy Association, December 2003.

13 A 1996 California Energy Commission report presents a comparison of the cost of wind compared to the cost of energy from other types of fuels. The report found that the levelized cost of energy for wind is 3.3 - 5.3 ¢/kWh (with PTC) and 4 - 6 ¢/kWh (without PTC), compared to coal at 4.8 - 5.5 ¢/kWh and gas at 3.9 - 4.4 ¢/kWh. Although this comparison is 10 years old, it is still useful; the cost of natural gas has increased since 1996, so the levelized cost of gas-fired plants is now expected to be higher. Energy Technology Status Report, California Energy Commission, 1996.

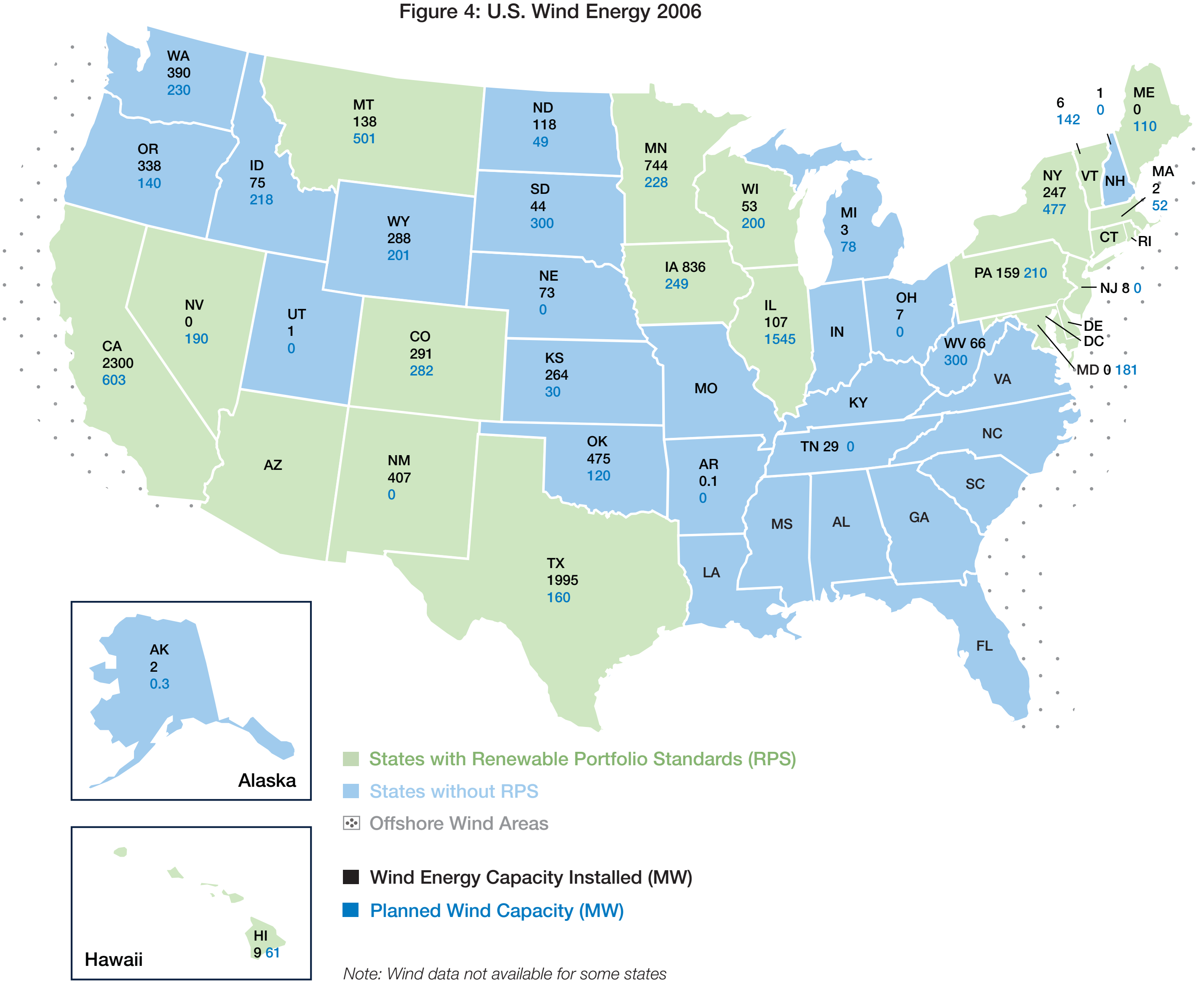
14 Energy Information Administration, Henry Hub price, January 19, 2006.

15 "Making Billion Dollar Advanced Generation Investments in an Emissions-Limited World," EPRI Summer Seminar, August 8 & 9, 2005, pp. 24-25.

16 "Integrating Wind Power into the Electric Power System," Ed DeMeo, Renewable Energy Consulting Services, Inc., NARUC Energy Resources and Environment Committee meeting, November 15, 2005.

Figure 4 shows the current installed and planned wind capacity for the US. Installed wind capacity in the US as of May 2006 was nearly 9,500 MW, and there are plans for nearly 7,000 MW more in the next few years. These numbers are still a fraction of the theoretical wind energy potential in the US.[17] In addition to the more than 1,200 GW of on-shore wind potential, off-shore areas of coastal states could provide almost as much again.[18] Off-shore wind projects are currently being pursued in Texas and Massachusetts.[19] While the full technical potential of wind is not likely to be tapped, if even a fraction of it is developed, wind power would contribute significantly to meeting US electricity needs.

Figure 4: U.S. Wind Energy 2006



Note: Wind data not available for some states

17 Wind Energy Potential-An Assessment of the Available WIndy Land Area and Wind Energy Potential in the United States, Pacific Northwest Laboratory, 1991. Installed and planned MW are from AWEA website as of May 2006. www.awea.org/projects/

18 The US Department of Energy estimates there are more than 900,000 MW of potential wind energy off the coasts of the United States. Much of the potential offshore wind resources exist near major urban load centers. US DOE, Massachusetts Technology Collaborative and GE, "A Framework for Offshore Wind Energy Development in the US," September 2005.

19 In Texas, plans are moving forward for a 500 MW off-shore wind farm, the largest currently in the US (Superior Renewable Energy, LLC), and a 150 MW off-shore project (Galveston-Offshore Wind, LLC). In Massachusetts, plans are being considered for a 420 MW wind farm (Cape Wind) and a 300 MW offshore wind farm (Patriot Renewables, LLC) in Buzzards Bay.

Challenges of Wind Power

In order to realize the tremendous potential of new generation sources such as wind power in the US, we must address the existing challenges of interconnecting these new renewable resources. Many of these interconnection challenges are rooted in current transmission system planning policies, system operation, and electricity market policies and practices. However, some of these challenges are beginning to be addressed and based on international and domestic experience, none appear to be insurmountable.

Reliable and Sustainable Wind Operation

The FERC has addressed some operational issues associated with wind generation in Order 661. In the order, FERC adopted a joint recommendation by the North American Electric Reliability Council (NERC) and the American Wind Energy Association (AWEA) requiring wind generators to be able to remain in service during and following system fault conditions. FERC requires a wind plant to maintain adequate reactive power and meet voltage support requirements if necessary to ensure system safety and reliability. The wind plant must also provide supervisory control and data acquisition (SCADA), or communications capability, to transmit data and receive instructions from the transmission provider to protect system reliability. Industry concerns remain, however, regarding the intermittency of wind power.

Intermittency

As with some other renewable sources, intermittency is a characteristic of wind generation; wind plants only generate when the wind is blowing within a particular range of speed. Historically, grid operators have relied primarily on dispatchable generation that can be adjusted by system operators to increase or decrease output on demand. Fossil and nuclear generation can be scheduled well in advance, but it can be difficult for wind generators to provide firm schedules far in advance because of their dependence on the weather.

Due to their intermittency, a major concern is whether wind plants need to be backed up with a significant amount of dispatchable generation, adding costs and complexity to system operation. Several studies have analyzed the intermittency issues around wind power and have concluded that the additional amounts of dispatchable generation needed in association with wind power are modest, that the additional costs associated with dispatchable generation do not destroy the economics of wind power, and that system operation need not be compromised. In fact, the interconnectedness of the US transmission system compared to the European system can aid in rounding out variances in wind production across regions, suggesting that the US may be able to accommodate an even greater percentage of wind power than Europe:

- A report prepared for New York State analyzed a 10% penetration of wind on its 33,000 MW system.[20] It covered the impacts of the cost of wind generation itself, reductions in conventional plant operating costs from their displacement by wind energy, and conventional plant operating cost increases attributable to wind intermittency. The report concluded that with 10% penetration of wind, the net New York system load variability will increase by approximately 6%. According to the report, at this level of penetration any rapid drop in production from the wind farms is not expected to affect the existing operating reserve requirement for the state. In terms of cost, the report showed an annual net reduction of $350 M on total variable cost to the New York Independent System Operator (NYISO). This represents the displacement value of variable operating expenses, such as fuel and plant startup costs for fossil fuel plants. The report found that the $350 M reduction may be higher with improved wind forecasting ability.

20 "The Effects of Integrating Wind Power on Transmission System Planning, Reliability, and Operations," GE Power Systems Energy Consulting, Phase I and II, February 2004 and March 2005.

There are many successful examples, internationally and in the US, of reliable and cost-effective integration of wind power.

- Several studies from the UK, including the March 2006 UK Energy Research Center study, assessed wind penetration levels of 10 to 20%, and concluded that wind energy is neither prohibitively expensive nor limited by intermittency.[21]
- A recent study released by the European Wind Energy Association concluded that 20% of demand on a large electricity network can be met by wind energy without posing any serious technical or practical problems today.[22] The report also noted that chief among the barriers to wind generation is the lack of adequate cross-border transmission.

Wind Forecasting

Forecasting plays a major role in minimizing the impacts of the intermittency of wind on the electricity system. Wind is not random. It can be forecasted, with greater accuracy on shorter timescales. Such forecasting becomes essential with a higher penetration of wind resources on a system. Forecasting abilities improve day-ahead scheduling of intermittent resources, allowing a decrease in spinning reserve requirements and subsequent savings to customers.[23]

The industry's forecasting ability has been improving, and efforts continue to develop better tools and strategies to deal with forecast error and wind volatility in the day-ahead, hour-ahead and intra-hour time frames. Using current forecasting tools, the error for a 36-hour forecast for a single wind farm has decreased by 13 to18% of the total installed wind power capacity and slightly less for day-ahead.[24] Aggregation of wind power over a wider area increases forecasting accuracy.[25]

State-of-the-art wind forecasting technology is being used in other countries including Denmark, Germany, and Spain, and parts of the US, bringing increased certainty for advance scheduling. California has led the US in adopting state-of-the-art forecasting. Its new forecasting capability went into operation in August 2004 under a FERC-approved tariff amendment called the Participating Intermittent Resource Program (PIRP).[26] The PIRP reduces the risks of incurring 10-minute imbalance charges for wind generators from bidding into the forward energy markets.

In Denmark, wind forecasting is required of each wind developer interested in joining the market. Most of the wind power participates in the day-ahead market. Energinet, the system operator and transmission owner, continues to conduct research and development projects to further develop state-of-the-art forecasting methodologies and tools to minimize imbalance deviations.

Electricity Storage

Technological advances in electricity storage may also hold promise for mitigating many of the effects of wind's intermittency. Storage can assist in overcoming intermittency by storing energy and then providing that energy when needed. Electricity storage can reduce the need for increased balancing generation to counter the effects of wind intermittency, and reduce associated balancing costs and resulting penalties on the generators. There are ongoing worldwide industry research and development efforts directed at the commercialization of energy storage technologies.[27] Developers are beginning to couple wind generators with non-intermittent generator sources or with storage capacity. As these storage technologies become more commercially viable, the effects of intermittency can be reduced even further.[28]

21 "The Costs and Impacts of Intermittency," UK Energy Research Center, March 2006; "Total cost estimates for large-scale wind scenarios in the UK," Lewis Dale, David Milborrow, Richard Slark and Goran Strbac, 2004; "Renewable Energy: Practicalities," House of Lords Science and Technology Committee 4th Report of Session 2003-04, July 15, 2004.

22 "Large Scale Integration of Wind Energy in the European Power Supply: Analysis, Issues and Recommendations," The European Wind Energy Association, December 15, 2005.

23 "The Effects of Integrating Wind Power on Transmission System Planning, Reliability, and Operations," GE Power Systems Energy Consulting, February 2004 and March 2005. The report indicated that there are large savings in operating costs of the New York system from using wind energy forecasts for day-ahead unit commitment amounting to $95 M of cost reductions a year.

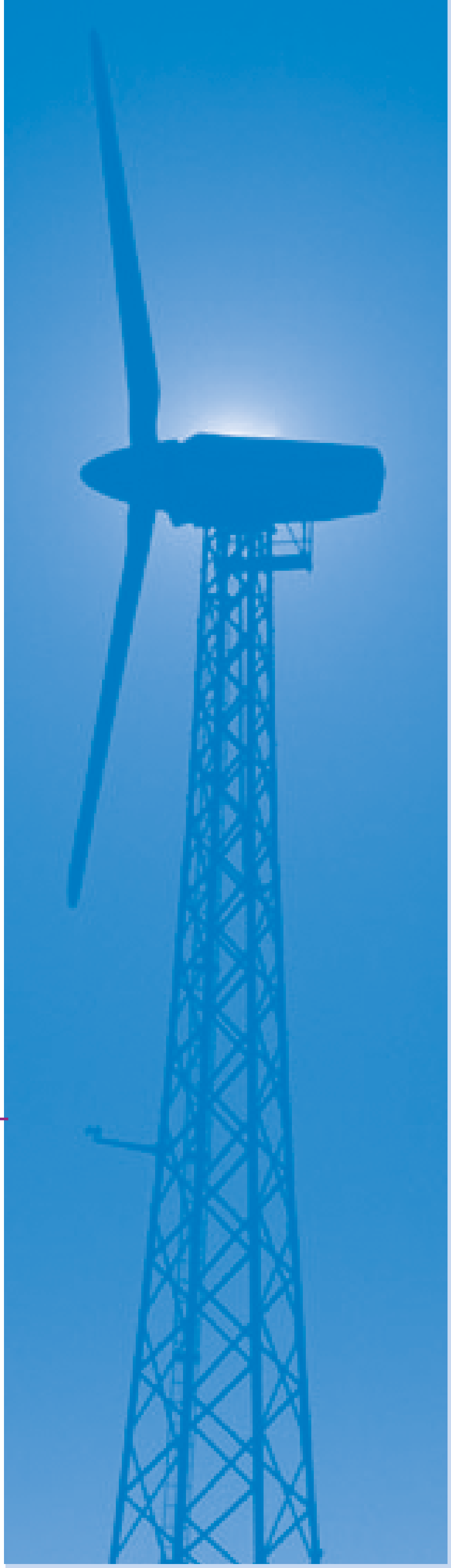
24 "Overview of Wind Energy Generation Forecasting," TrueWind Solutions, LLC & AWS Scientific, Inc, for the New York State Energy Research and Development Authority and New York State Independent System Operator, December 17, 2003.

25 System wide forecasting errors for multiple dispersed wind plants may be reduced by 30-50% compared to errors of individual wind plants due to the smoothing effect of geographic dispersion. "The Future of Wind Forecasting and Utility Operations," Ahlstrom, Jones, Zavadil, and Grant, IEEE Power & Energy Magazine, November/December 2005.

26 AWS Truewind was selected to be the California ISO's forecast provider.

27 In 2004, a UK House of Lords report urged the British government to promote research and provide incentives to encourage the commercialization of promising storage technologies. "Renewable Energy: Practicalities", House of Lords, Science and Technology Committee, 4th Report of Session 2003-04, July 15, 2004 p. 63.

The US may be able to accommodate an even greater percentage of wind power than European countries.



Imbalance Charges

Many transmission tariffs include imbalance penalties in their rules. These apply to the differences, or imbalances, between the day-ahead scheduled energy and actual real-time production. The intent of such penalties has historically been to promote good scheduling practices, including prevention of gaming, and thus ensure system operators that sufficient generation will be available to serve the load. These penalties are often not based on cost, but structured to motivate market participants to keep to their schedules.

Wind generators face challenges with predicting wind output as they do not have the same control over their fuel source (wind) as traditional generation sources. As wind generators are not generally subject to the same gaming concerns as traditional generation sources, a wind imbalance penalty does not encourage efficient scheduling. Such traditional penalties do not make sense for wind; they can be unfairly punitive and can render wind plant financing uneconomical. In some cases, the penalties for deviation can exceed the value of the wind energy provided. Many regions have made attempts to modify their imbalance penalty policies for intermittent resources;[29] however wind developers continue to describe imbalance charges as a major impediment to wind generation.[30]

One appropriate method of designing imbalance charges for intermittent resources, as well as all resources, may be to structure the charges to recoup the true costs of such imbalances.[31] The proper allocation of actual imbalance costs should provide the necessary incentives for suppliers to remain in balance without resulting in unfairly punitive measures. Such imbalance charges should reflect all applicable categories of costs created by a deviation from forward schedules, including regulation costs and other costs such as start-up and no-load costs, and the costs for reserves that the system operator would not have obtained but for the imbalance. Together with a robust transmission infrastructure, as described later, gaming potential for traditional generators would be mitigated without penalizing intermittent sources of energy such as wind.

The ability to aggregate balancing responsibilities among wind developments may also help resolve imbalance concerns. Aggregation in the same geographic location and time period should be explored; however, aggregation may not work well and could threaten reliability if the wind generators are located in separate reliability zones or control areas. Options for aggregation, combined with a cost-based imbalance charge regime and the implementation of state-of-the-art wind forecasting, will contribute to making US electricity markets more conducive to wind generation.

Capacity Value

The industry is debating at what level, if any, should wind generators receive capacity credits or payments given that wind generation is intermittent. Although a wind generator has high mechanical reliability, unavailability of the wind source can lead to effective forced outage rates of 50-80%.[32] Wind patterns are not correlated well with demand or load patterns.

Many studies have been done concerning capacity credits and the value of wind for reliability and capacity. In general, studies have shown that there is some appropriate capacity credit for wind resources. In the US, capacity credits vary by region:

28 One example is the EPOD EMT Power Storage System technology that has been developed specifically to store commercial volumes of solar electric power for later use or resale. Pilot testing for wind power usage is underway. By storing some or all of the wind power generated during off-peak periods when power prices are at their lowest, users are able to time the sale of this stored power to peak periods when power prices may be 10 times that of off-peak. The storage of wind power in the EMT also allows wind power developers to offer guaranteed volumes of power at fixed times, known as “firm capacity.”

29 Several regions have modified their transmission tariffs in an attempt to accommodate intermittent resources such as wind. The Western Area Power Administration’s Rocky Mountain Region has waived the penalty bandwidth for intermittent resources and simply requires a financial settlement at market prices, netted at the end of the month. Both PacifiCorp and the Bonneville Power Administration have modified their tariffs to allow intermittent generators to change their day-ahead schedule up to 20 minutes before the operating hour waiving the $100/MWh penalty (but applying a lesser cost-based charge). NYISO’s present market rules relieve up to approximately 500 MW of new wind power of the obligation of balancing charges or penalties. PJM does not assess imbalance penalties on any generators; all imbalances in PJM are resolved financially using the real-time energy market. California uses a wind forecasting approach and allows wind generators to “net out” energy imbalances and potentially avoid penalties for deviations. ERCOT permits 50% deviation from schedules without subjecting renewable resources to penalties.

30 Testimony of Mr. Robert Sims, Senior Vice President of SeaWest Wind Power, FERC Technical Conference “Assessing the State of Wind Energy in Wholesale Electricity Markets,” December 1, 2004.

31 See “Preventing Undue Discrimination and Preferences in Transmission Service,” FERC Notice of Proposed Rulemaking Docket Nos. RM05-17-000 and RM05-25-000, May 19, 2006, pp. 42, 53, and National Grid comments in these dockets filed August 7, 2006.

32 “Wind Project Evaluation Webcast,” Barbara Y. Coley, New Energy Associates, December 2005.

- PJM has a 20% capacity credit in its standards based on wind generators' historical capacity factors during peak hours.
- NYISO and ISO-NE allow wind projects to submit a request for capacity payment on terms similar to thermal generators. These regions are currently reviewing the appropriateness of arrangements for intermittent resources.
- In the Southwest Power Pool, 3 to 8% of the rated wind capacity can be considered for capacity credits.
- In ERCOT, 16.8% of wind actual capacity can qualify as firm capacity credit.

The industry needs to continue to work toward a consistent and appropriate approach to recognize the capacity value of wind resources both to ensure reliability and fairly credit the contribution of wind power.

Getting Interconnected

Although there is sufficient evidence showing that wind generation can be reliably integrated into the electricity system, and efforts are underway to explore appropriate market mechanisms to address imbalance and capacity value for wind generation, obstacles to new generation sources continue to exist due to the lack of adequate transmission system access. The remoteness of wind sources, an underinvested transmission infrastructure, and lack of workable transmission investment policies all hinder the development of wind power in the US.

Wind Source Remoteness

Many windy areas are geographically remote from load centers. On average, strong wind sites are located a far distance from major metropolitan centers. For example, the Dakota states, often called the "Saudi Arabia of Wind" for their significant wind resources, are far from the heavy population and commercial centers of the Twin Cities of Minneapolis and St. Paul, Milwaukee, Chicago and Denver. In many cases, there are no transmission lines between the wind resources and the markets. And even where transmission lines are available, they often do not have enough regional capacity to move new sources of power to where they are needed.[33]

The current US transmission system was built primarily to ensure reliable and generally local electric service on a utility-by-utility footprint basis. It was not built to support competitive regional wholesale markets that require moving large quantities of power across long distances, nor is it currently sufficient to integrate planned and potential wind generation. Additional transmission infrastructure will be needed.

At present, there are several barriers to needed transmission investment. These include lack of comprehensive regional planning criteria that effectively capture the benefits of wind power and other new generation sources, unworkable cost allocation rules for transmission investment, inadequate financial incentives for transmission developers, siting challenges, and uncertainties over when and how costs are recoverable in wholesale and retail rates. These issues can become more challenging when transmission upgrades are needed to move renewable power from a wind-rich state into another state that has an RPS requirement or green market opportunities.[34] Some regional planning processes do exist, but their ability to overcome these barriers is limited in their current form. More needs to be done to improve regional planning and reduce regulatory barriers to needed transmission infrastructure improvements necessary to facilitate the delivery of new remote generation sources to load centers.

33 "Transmission investment simply hasn't kept up with the pace of network resource additions and network load additions over the last 20 years. The result has been particularly problematic for wind resources. They are located in remote areas with little load," remarks of John Krajewski on behalf of Transmission Access Policy Group, FERC Technical Conference Transcript, December 1, 2004 p.113.

34 Green market opportunities exist for load-serving entities that are interested in adding clean sources of power to their generation portfolio, regardless of whether their states have an RPS or not, and can result in the trading of Renewable Energy Certificates (RECs). Consumers in a number of states have the option of purchasing RECs, which offset less clean energy use in one location with cleaner energy generated elsewhere.

35 "Wind Transmission, Innovations in State Policy," Matthew H. Brown, director, National Conference of State Legislatures Energy Project, July 2005.

Micrositing

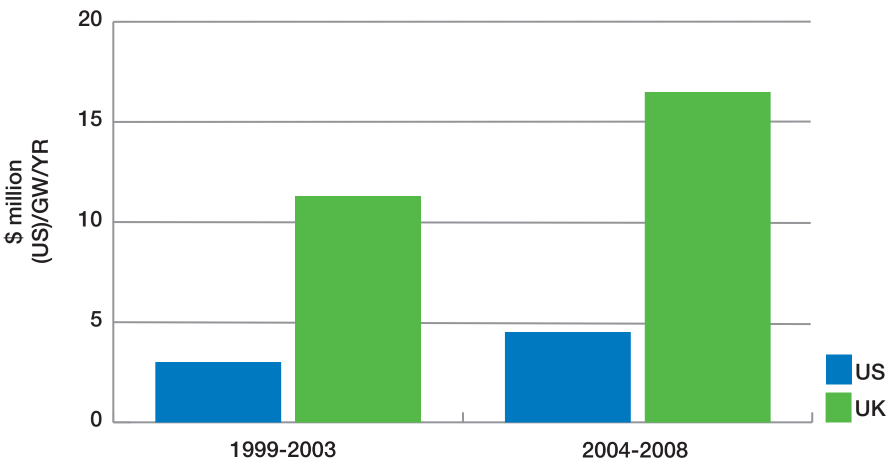
The problems associated with wind development may be amplified by the issue of "micrositing." Micrositing refers to the particular placement of turbines within a wind farm site to optimize electricity production. The particular location of the wind turbine is critical because the energy output of a wind turbine increases exponentially with the increase in wind speed; a 20% increase in average wind speed from 10 mph to 12 mph increases the electrical output of a wind turbine by around 80%.[35] Thus, it is imperative that a wind turbine be placed at exactly the right place on a site for wind. Developers measure wind resources at highly specific locations; moving a turbine a few hundred feet or less may significantly affect the wind speed. Micrositing issues can put additional constraints on siting transmission to interconnect wind generation.

Status of the US Transmission Infrastructure

There is ample evidence that the nation's transmission system is significantly underinvested, with associated troubling reliability and economic effects. Although there has been a recent upturn in US planned transmission investment,[36] transmission investment has not kept up with load growth or generation investment, nor has transmission been sufficiently expanded to accommodate the advent of regional power markets. Transmission investment declined in real dollar terms during the 23-year period from 1975 to 1998, and over the same time period transmission capacity relative to load declined in every NERC region.[37] The Edison Electric Institute (EEI) estimates that capital spending must increase by 25%, from $4 billion to $5 billion annually, to assure system reliability and to accommodate wholesale electric markets, and describes the current growth rate in transmission mileage as insufficient to meet the expected 50% growth in consumer demand for electricity over the next two decades.[38]

The US has a long way to go to catch up with international investment levels. Figure 5 shows high-voltage transmission (>230 kV) investment levels in the US versus the UK. New Zealand, Spain, the Netherlands and Poland also have significantly higher transmission investment levels than the US on a historical and future basis.[39]

Figure 5: Normalized Transmission Capital Investment[40]



The current US transmission system was not built to support competitive regional markets; additional infrastructure will be required to bring customer savings.

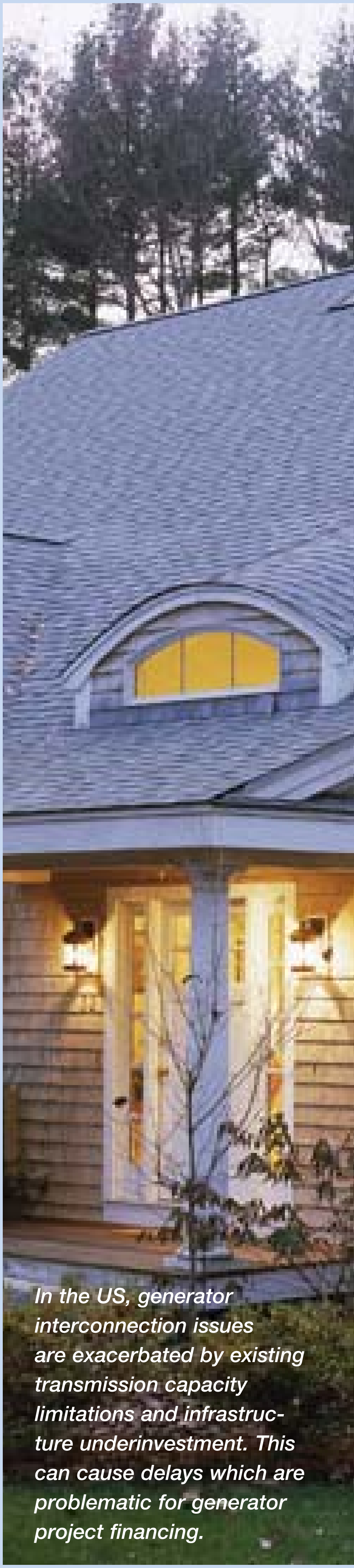
36 Some recently announced major planned projects include: American Transmission Company's Arrowhead-Weston 220-mile 345 KV line from Wisconsin to Minnesota, Allegheny's 210-mile 500 KV transmission expansion project from Pennsylvania to Virginia, and AEP's 550-mile 765 KV transmission line from West Virginia to New Jersey. National Grid's US investment levels are expected to increase, from $85M in 2004 to $294M in 2009, and will include high voltage reinforcements to southeastern New England.

37 Brendan Kirby, U.S. Department of Energy, Oak Ridge National Laboratory, FERC Technical Conference, "Transmission Independence and Investment," Docket No. AD05-5-00, April 22, 2005.

38 Thomas R. Kuhn, Testimony on Behalf of the Edison Electric Institute before the House Subcommittee on Energy and Air Quality Committee on Energy and Commerce, February 10, 2005.

39 Based on a National Grid analysis of planned investment in high voltage transmission through 2008. Investments were adjusted for market size. "Transmission: The Critical Link" June 2005, p.19. (http://www.nationalgridus.com/non_html/transmission_critical_link.pdf). Also see "Transmission Independence and Investment Pricing Policy for Efficient Operation and Expansion of the Transmission Grid," testimony of Nick Winser at FERC Technical Conference, "Transmission Independence and Investment," Docket No. AD05-5-00, April 22, 2005.

40 National Grid analysis on investment levels >230 kV normalized for market size. US investment data derived from Edison Electric Institute Survey of Transmission Investment, May 2005, and National Grid UK investment figures.



In the US, generator interconnection issues are exacerbated by existing transmission capacity limitations and infrastructure underinvestment. This can cause delays which are problematic for generator project financing.

The Energy Policy Act of 2005 puts the issue of needed transmission infrastructure squarely before FERC, the US Department of Energy, and states through provisions for incentives for new investment and independent industry business models (e.g., RTOs and Transcos). The provisions are meant to foster non-discriminatory and adequate access to transmission.

Interconnection Process and Queue Issues

The challenge facing a wind developer, and indeed any new generation resource, of whether it can interconnect to the grid in a timely and economic manner can be critical for project financing. FERC Order 2003 outlines the interconnection process for all generators greater than 20 MW and Orders 661 and 661-A provide specific interconnection requirements for reliable operation of wind generation. These orders represent action by FERC to establish interconnection standards that facilitate generation development, including wind development. However, a number of issues remain that can result in delays in timely interconnection for new projects. As explained below, the current interconnection processes can be an obstacle. However, facilitating improved transmission access and adequacy, including implementing more robust regional planning, can help to mitigate many of the problems seen in current interconnection processes.

In the current interconnection process, the generator developer applies to the transmission provider for an interconnection after identifying a proposed site. The transmission provider must then perform a system impact study to determine what interconnection facilities and system upgrades would be necessary to connect that generator to the electric system. To manage requests for interconnection, a transmission provider has an intake process referred to as a queue. The interconnection queue provides for orderly management of requests under a first-come first-served approach, and serves as the basis for assigning cost responsibility to generation developers for transmission upgrades.

Ideally, all generator applications would be processed in a timely manner. However, the queue process can become burdensome particularly if significant transmission upgrades are required for a project. Queue position can have real commercial significance; a long wait in the interconnection queue can have serious consequences for the financial viability of projects, particularly renewable projects if they are dependent on the recently extended federal PTC.

Project-by-Project Approach

Under the current standard US approach, a proposed generation project is held responsible for the reliability effects and costs of all transmission upgrades associated with its particular interconnection. These effects are determined by the transmission provider's studies of each project, based on assumptions made with regard to the timing of the projects ahead of it in the queue. However, final reliability requirements and cost responsibility depend on which projects are ultimately built. As these often may not be the same projects assumed in the study, further uncertainty and possible delays exist for siting, financing, equipment procurement, and meeting deadlines for eligibility for the PTC in the case of wind and other renewable projects.[41]

Uncertainty with respect to ultimate cost responsibility and timing delays can prevent a project from proceeding. Some queuing management improvements, such as clustering, class-year studies, and subordination processes[42] aim to mitigate the problems caused by the project-by-project queue approach, but have only achieved a certain degree of success. Developers continue to indicate that the current interconnection processes are problematic.[43]

The current interconnection process approach can also be cost-prohibitive to a developer

41 For instance, in PJM almost 50% of generator interconnections were withdrawn from the queue since 1997 (www.pjm.com/planning/project-queues).

42 Clustering or Class Year approach refers to generator interconnections grouped with other proposed generating projects into a periodic open season, which is six months in PJM and one year in New York. The projects are studied collectively to determine the necessary transmission upgrades, the costs of which may be shared by multiple new generation projects. The subordinate process, such as offered in New England, allows a developer the option to accelerate the construction and operation of its facilities ahead of other projects in the queue if the developer assumes the risks associated with building their facilities in a sequence different from the study order of the queue. These risks include additional uncertainties for ultimate reliability requirements and cost responsibility for transmission upgrades, including the continuing obligation to update studies as relevant projects with higher standing in the queue advance through the process.

43 "Comments of the American Wind Energy Association, the Renewable Northwest Project, the Center for Energy Efficiency and Renewable Technologies, Wind on the Wires, and West Wind Wires," FERC Docket No. RM06-4, "Promoting Transmission Investment through Pricing Reform," January 11, 2006.

because interconnection and transmission upgrade costs can be very large, particularly when regions are starting with an underinvested transmission system. Furthermore, the practice of assigning cost responsibility for transmission upgrades to the next project or projects in the queue fails to take into account what may be broad benefits to system users from such upgrades. Consequently, when these costs are assigned to only one or a few generators, they can present a significant obstacle to needed transmission expansion.

Lack of deliverability can also prohibit remote generation sources from being utilized to serve load throughout a region.

Deliverability

Across the US there are differences in regional approaches to requiring the deliverability of generation. Deliverability refers to the ability of generation sources to reach aggregate load in the region. New England and New York do not require that generation meet a regional deliverability standard and that can result in locked-in generation pockets. PJM has required that generators fulfill regional deliverability requirements to be eligible to receive installed capacity (ICAP) market revenues. However PJM's recently proposed modifications to its capacity market, the Reliability Pricing Model, with its creation of localized deliverability areas may lead it to re-examine its deliverability requirements. Lack of deliverability in a region can lead to the balkanization of market areas into smaller and less competitive local areas which can significantly raise costs to customers and undermine the reliability of the network. Lack of deliverability can also prohibit remote generation sources from being used to serve load throughout a region.

The current interconnection process is unlikely to work well to integrate needed new remote sources of generation into the electric system. The interconnection process alone is insufficient to provide for the robust transmission system that will meet the needs of generation developers and customers. Because the transmission system in many areas of the country is insufficient, the problems with the current interconnection and queuing processes are magnified and can become essentially "show stoppers" for new generation projects. While the queue process can provide for an orderly management of interconnection requests, robust regional planning and effective transmission policies are also needed to address the significant transmission investment required to meet growing customer load, accommodate new and diverse generation sources, and to facilitate competitive markets.

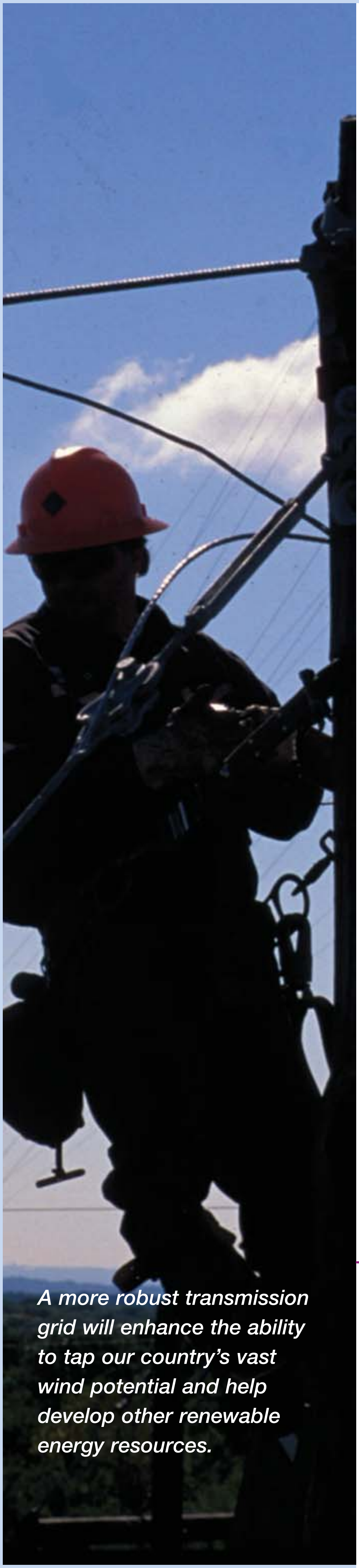
Need for Effective Regional Planning and Transmission Policies

Interconnection and queue issues are exacerbated by existing transmission capacity limitations and infrastructure underinvestment. The wind generation industry recognizes that a more robust transmission grid will enhance the ability to tap our country's vast wind potential and develop other renewable energy resources.[44] Looking abroad, we see that countries with a large wind generation sector have put into place supporting transmission planning and policies to accompany wind and other new generation development.

Currently, Denmark has the highest market penetration in the world. Subsidies granted through government policies, which since the late 1990s have helped renewable development in privately owned wind turbines (farms and industrial factories), have decreased over time due to the advances of wind technology and its growing competitiveness with conventional generation.

The majority of Danish wind plants are less than 100 MW in size and located on-shore. These are connected to the electric system mainly at voltages up to 100 kV. The wind developer is responsible only for the cost of its interconnection to the nearest 10 kV point of the electric system. Any upgrades or reinforcements resulting from a wind plant connection are paid for through transmission rates to customers. In the case of wind plants larger than 100 MW,

44 Ibid.



A more robust transmission grid will enhance the ability to tap our country's vast wind potential and help develop other renewable energy resources.

Danish system operator rules generally provide for connection at voltages above 100 kV, in which case the cost of the interconnection line along with upgrades are included in transmission rates to customers, including off-shore installations.[45]

Following the Kyoto protocol, the UK government set a target of 10% of electricity requirements in England and Wales to be sourced from renewable technologies by 2010, and 15% by 2015. An aspirational target of 20% has been set for 2020. In Great Britain, renewable generation is encouraged by additional payments to generators who supply "green energy" through the issue of Renewable Obligation Certificates (ROCs).

To date, most of the development in England and Wales has been on-shore wind plants of 50 MW or less, although this is starting to change in favor of larger projects, particularly off-shore wind farm projects. In Scotland there are naturally favorable on-shore wind resources and geographic characteristics, which have resulted in significant interest for developing on-shore sites. Wind projects in England, Wales and Scotland could result in some 14.8 GW of wind projects being connected by 2016, although it is recognized that not all of these projects are likely to materialize.[46]

National Grid in the UK operates under regulatory arrangements, including performance-based incentive programs, to provide for a reliable and economically efficient transmission system to support the electricity market. In the UK, generators enjoy firm access to the system, with the ability to be compensated by the system operator if system constraints restrict their generation output, the costs of which are usually incorporated into the incentive programs. This arrangement strengthens the incentives for the utility to plan effectively for needed transmission investment as part of providing a reliable and economically efficient transmission infrastructure.

Costs of the transmission system are generally paid for through system usage charges, and get allocated 73% to load and 27% to all interconnected generators based on the regulator's view of benefits and obligations associated with the transmission system upgrades. Under regulatory rules, National Grid requires financial security from the interconnecting generator developer(s) before proceeding with construction. This security is to provide reassurance that the transmission facilities will not be constructed only to find that the expected new generation sources never materialize. Security from generation developers is required until the new transmission construction is complete and the new sources of generation are operational. From that point on, the costs of the transmission are included in system usage charges to load and generators. The UK regulator is currently assessing the security requirements to ensure they are not prohibitive to new sources of generation.

In North America, both the ERCOT (Texas) and Alberta, Canada regions have implemented beneficial transmission policies to integrate new generation sources. These regions employ economic analysis in their planning processes to reduce congestion and integrate new generation sources. They also each employ a cost allocation methodology that broadly assigns the economic costs of transmission system improvements to system users, without attempting to assign transmission upgrades to specific generator developers.

45 Currently, two off-shore installations exist in Denmark, Horns Rev in the west (160 MW) and Nysted in the east (165 MW).

46 For more information on wind development in the UK, see Department of Trade and Industry's Final Report, The Transmission Issues Working Group, June, 2003; and "Transmission Investment for Renewable Generation, Final Proposals," OFGEM, December 2004.

Problems with Existing US Transmission Planning

Inadequacies in existing US transmission planning exacerbate the problems facing wind and other generators seeking access to the transmission system. These inadequacies include planning processes that are not geared to comprehensive regional needs, failure to accommodate long transmission lead times, and a narrow focus on minimum reliability requirements. Moreover, policymakers and planners often fail to recognize transmission as the essential infrastructure which enables competitive wholesale electricity markets and mistakenly view transmission as a market product.

National Grid described the solutions to these problems in its recent paper, *Transmission: The Critical Link*, outlining the critical components of effective regional planning. They include sufficient geographic scope, transparency, independence, comprehensive planning criteria that address both reliability and economic needs, obligation to construct, and clear cost allocation and recovery mechanisms. These problems and their solutions are summarized in greater detail in Appendix A.

Key Considerations for Renewables

Regional planning issues of particular importance to renewable energy resources such as wind include consideration of renewable trunk lines, linkage to state RPS programs, and cooperation among states.

Renewable trunk lines

The development of a robust transmission infrastructure should also include consideration of "trunk lines." Trunk lines refer to radial high-capacity transmission lines that link the interconnected transmission system to remote areas of generation resource development. A shortcoming of relying on an interconnection request-driven process, such as the generator queue, to expand the transmission system is that it creates a catch-22 situation – one in which the initiation of transmission infrastructure is driven only by a request from a new entrant, yet the absence of sufficient transmission capacity represents a significant obstacle to the participation of new entrants. Moreover, this approach can produce a sub-optimal transmission system expansion through its necessarily piecemeal study of the system. Planning studies should incorporate metrics that assess the value of building new trunk line facilities to areas of potential generation development including wind generation and other clean and/or economic generation technologies.

Moreover, cost allocation and recovery mechanisms should include provisions for addressing the costs of such projects to facilitate their development and the eventual benefits they can provide to customers. For example, trunk lines may be integrated into the system as multi-use facilities, or even become networked, non-radial facilities as the system evolves.

Recently, FERC struggled with appropriate cost treatment for Southern California Edison's proposed three-segment transmission project for potential wind development in the Tehachapi region. FERC accepted that costs for the two networked line segments should be rolled into transmission rates for all customers. However, FERC denied such treatment for the radial trunk line segment intended to facilitate wind development without evidence from Southern California Edison that the line would benefit all customers.[47] The California Public Utilities Commission is currently coordinating with the California ISO to develop a new ratemaking approach to accommodate renewable trunk lines.[48]

The development of a robust transmission infrastructure should also include consideration of renewable "trunk lines."

47 See 112 FERC ¶ 61,014, Order on Petition for Declaratory Order, (2005).

48 "Order instituting investigation to facilitate proactive development of transmission infrastructure to access renewable energy resources for California," CPUC Investigation 05-09-005, July 13, 2006.59 Resolution of the Organization of PJM States, Inc. Regarding Electric Transmission System Planning and Investment, December 15, 2005.

State renewables resource programs should be factored into regional planning as inputs to likely future system needs and conditions.

It may be appropriate to distinguish between trunk lines planned for and designed to serve multiple users and trunk lines that start off as sole-use interconnection facilities but evolve over time to become multi-use facilities. Where a generator seeks to interconnect through a sole-use facility, participant funding or direct assignment may be appropriate, provided that rates are structured in a manner that facilitates construction of the project and does not create a barrier to new entry. One way to bridge the gap between initially sole-use and then later multi-use facilities may be to assign costs to the generator, and credit back costs as other developers or users share in the use of the trunk line over time. It may even be appropriate to roll into transmission rates some costs of the trunk line if it can be shown to broadly benefit system users as a whole. Similar treatment could be afforded to smaller projects interconnecting to local distribution facilities.

Linking State RPS Programs with Comprehensive Transmission Planning

By the end of 2005, 22 states had RPS or similar programs. In order to optimally and efficiently expand the nation's transmission system, these RPS programs should be factored into regional planning as inputs to likely future system needs and conditions. A number of states such as Texas, Minnesota, and California have begun adopting new rules and regulations related to their state renewables initiatives that provide state legal and regulatory support for building transmission improvements for renewable power development.

- Pursuant to recently enacted Texas law, the Public Utility Commission of Texas must designate sufficient land areas as renewable energy zones throughout the state and develop transmission capacity construction plans necessary to deliver the output from renewables in the competitive renewable energy zones.
- Minnesota requires the state commission to approve energy development tariffs to promote wind projects throughout the state.
- On June 15, 2006, the California Public Utilities Commission decided to allow utilities in that state to charge ratepayers under retail rates for upfront transmission costs of building major transmission facilities in areas to support expected development of renewable energy, especially wind projects. The decision is a departure from FERC policy in which developers pay the costs to connect their projects to the grid and recover these costs over time from customers.

Cooperation Among States

The problem of aligning transmission infrastructure benefits with funding and siting reveals itself at the state level. Regulatory policies that do not allow for certain and prompt recovery of costs at the retail level for transmission investment to meet regional reliability and economic needs are a further obstacle to that investment. State cooperation for transmission cost recovery and for prompt siting approvals, along with support for robust regional planning processes, is paramount to achieving necessary levels of transmission investment. A good example is the resolution that the regional states committee in the PJM region established in December 2005. The resolution recognized the importance of regional state cooperation regarding the operation and improvement of the interconnected transmission system and encouraged investment in the electric transmission network to ensure the economic vitality of the region.[49]

49 Resolution of the Organization of PJM States, Inc. Regarding Electric Transmission System Planning and Investment, December 15,2005.

Incentives for Transmission Investment and Independence Can Help Wind Development

Transmission Incentives

FERC's recently issued transmission pricing rule offers a wide range of incentives and pricing reforms to stimulate needed investment in new transmission facilities to projects that qualify in both RTO/ISO and non-RTO/ISO regions.[50] Additionally, FERC offers incentives to encourage further independence in the operation and ownership of transmission, based on the record of investment by independent entities and the value such entities, particularly for-profit Transcos, offer consumers.

Transcos, particularly those independent of market interests and sufficiently wide in geographic scope, focus on delivering low-cost, reliable energy to consumers by facilitating robust and fuel-diverse electricity markets and providing non-discriminatory transmission access to all generation. The advantage of the Transco structure is that it can cut through thorny issues that may be associated with fragmented and vertically integrated transmission ownership, such as potential conflicting business priorities, market interests, differences in business approach, and even skill sets. Because of its for-profit structure, a further advantage is that Transcos can be held firmly accountable by the public and regulators for system performance and operating costs, particularly through performance-based rate structures.

FERC's continued encouragement of Transco formation will:

- Provide the most effective method of ensuring non-discriminatory and adequate transmission access to new, less costly, and diverse sources of generation including clean coal, renewables, and wind;
- Promote effective regional system planning processes that provide for new generation, including remote renewables, and demand-side participation in electricity markets;
- Facilitate the closure of old, dirty, and uneconomic generating sources by allowing newer, cleaner regional generation sources to be delivered to load centers.

In carrying out its transmission pricing policies, FERC ought not to lose sight of the benefits of transmission independence for achieving efficient energy markets that deliver low-cost power and environmental benefits to consumers. In particular, independent entities that own and operate the transmission system, such as Transcos, are best suited to operate, plan, and invest in the regional system ensuring that consumer benefits, not energy market interests, are the driving force. In fact, AWEA, among others, has recognized the advantages of Transcos for wind development and indicated its support for their development.[51]

50 See 116 FERC ¶61,057, Final Rule, "Promoting Transmission Investment through Pricing Reform," July 20, 2006.

51 "Comments of the American Wind Energy Association, The Renewable Northwest Project, The Center for Energy Efficiency and Renewable Technologies, Wind on the Wires, and West Wind Wires," FERC Docket No. RM06-4, "Promoting Transmission Investment through Pricing Reform", January 11, 2006.

Conclusion

Policymakers have recognized that the US has tremendous opportunities to tap wind power as a cleaner, economic, and domestically available new source of generation. Despite the challenges described in this paper, regulators, consumers and the electricity industry in the US are recognizing the environmental and economic benefits associated with wind and other clean technologies. The challenges to the effective integration of wind power into the grid are not insurmountable; they can be addressed with industry, public, and regulatory commitment.

Robust transmission infrastructure policies in countries outside the US have helped them progress toward achieving their goals of diversifying their generation sources using economical renewable sources of supply, while maintaining system reliability. We can look to these international models for transmission planning approaches, and for transmission cost allocation methods that recognize the broad benefits of a robust infrastructure.

The US has not yet fully implemented aggressive transmission policies to take advantage of additional renewable sources of power. Comprehensive, robust, long-term regional planning that includes both the reliability and economic needs of the system will help ensure adequate transmission infrastructure and non-discriminatory access that can aid renewable energy resource development. The evolution of market rules to facilitate renewable resources within the context of reliable system operation and the further use of wind forecasting tools and techniques will also help the US toward its goal of reliable, low-cost, secure and diverse electricity markets. Further, regulatory encouragement of independent transmission companies, and federal and state regulatory policies and incentives that support needed transmission investment are needed to capture the benefits of renewable generation, such as wind power, for customers.

The challenges to the effective integration of wind power into the grid are not insurmountable; they can be addressed with industry, public, and regulatory commitment.

Appendix A: Problems with Existing US Transmission Planning

There are several issues with current transmission planning in the US.

Not Geared To Comprehensive Regional Needs

The fragmentation of the nation's transmission infrastructure by hundreds of different transmission owners can make it difficult for effective expansion of the regional transmission grid. This is in stark contrast to many other countries that have a single transmission system owner and operator.[52] In much of the US, transmission owners are vertically integrated utilities and may have market interests in their own generation or supply contracts. They may face internal corporate competition for capital versus their generation interests, and the imperative to maximize overall value to shareholders can often lead to a focus on generation. Consequently, such vertically integrated utilities may not make transmission investments that provide the most benefit for the region as a whole.[53]

May Not Facilitate Long Transmission Lead Times

It can take up to five years or longer from the time a proposed transmission project is introduced to the public to the time construction begins.[54] But many regional planning processes do not look sufficiently far into the future to be able to identify needs, analyze solutions, and trigger needed transmission construction in time to meet expected system needs. In the case of new remote generation development, it is critical that transmission infrastructure is addressed ahead of the expected changes in system conditions as much as possible. For instance, wind generation development can occur quickly due the modularity of wind technology designs. In Texas more than 900 MW of wind was brought on-line in 2001, outstripping available transmission capacity.

A regional planning process that takes a long-term view of system needs, looking ahead up to 10 to 15 years, can provide opportunities to anticipate many system needs by performing planning, engineering, and even some siting functions in advance of specific project-by-project interconnection requests. This approach allows regions to monitor actual system needs to ensure that the "trigger is pulled" on transmission construction in a timely manner; neither too soon, nor too late.

Too Narrowly Focused on Minimum Reliability Requirements

Currently, most planning processes focus on the minimum reliability needs of the system without due consideration to economic efficiency, market facilitation, or other customer benefits of transmission upgrades.[55] Transmission upgrades can help reduce congestion costs, increase customers' options for new generation sources, reduce the need for regulated reliability compensation to existing inefficient generators, and lead to overall lower-cost energy and greater reliability. By focusing exclusively or primarily on minimum reliability standards,

52 New Zealand, Denmark, the UK, Spain, and Norway are among the countries that have a single transmission owner/operator.

53 "Vertically integrated utilities do not have an incentive to expand the grid to accommodate new entry or to facilitate the dispatch of more efficient competitors", FERC Notice of Proposed Rulemaking, "Preventing Undue Discrimination and Preference in Transmission Service," p. 31, May 19, 2006.

54 There are several reasons for this: engineering, procurement, analyzing route options, permitting and siting issues, coordination with public and state regulatory approvals, and solving real estate and environmental issues.

55 Some regions such as PJM, New England, and ERCOT incorporate economic needs to varying degrees into planning studies along with reliability needs.

Transmission has an inherent ability to link neighboring regions and expand existing markets that provides reliability and economic benefits to all customers in a way that generation or demand solutions cannot.

existing planning processes often miss opportunities for expansion of the transmission system to bring overall economic benefits to customers. These benefits include customers' access to new sources of generation, including wind technologies, that can reduce their overall electricity costs.

Transmission is Often Mistakenly Considered a Market Product

Oftentimes, transmission is mistakenly viewed as a market product, with transmission expansion to be performed by market participants in response to locational marginal pricing or other market pricing signals. However, this view of transmission has proven ineffective in furthering transmission expansion in the US. Regions that attempt to rely on such mechanisms find that market participants' proposals to expand transmission simply do not materialize.[56]

Further, some claim that transmission is a direct competitor with generation or demand side options. However, while generation or demand solutions can, in certain circumstances, mitigate the need for transmission upgrades, these non-transmission solutions cannot effectively act as substitutes for a robust transmission infrastructure. Transmission has an inherent ability to link neighboring regions and expand existing markets that provides reliability and economic benefits to all customers in a way that generation or demand solutions cannot. These mistaken views often serve as a distraction that can delay or thwart regional planning processes from advancing transmission infrastructure improvements that provide reliability and economic benefits to customers.

Achieving Effective Regional Planning

The effectiveness and scope of existing regional planning processes vary widely across the country. Regional transmission planning processes are more developed in ISO/RTO regions, where regional planning is identified as a key function for RTOs under FERC Order No. 2000 and where the FERC has held RTOs to certain standards. However, there is still considerable room for improvement. The Commission's further leadership is needed to ensure that all transmission is subject to a robust, comprehensive regional planning process in both RTO/ISO and non-RTO/ISO regions.

Critical Components of Effective Regional Planning

There are several minimum critical components that are particularly important for achieving a transmission grid capable of supporting the development of new generation sources, including remote renewable technologies such as wind. They are:

- ***Sufficient geographic scope –*** The planning process must encompass sufficient geographic and electrical scope to serve a broad market area, or area of significant prospective regional power transactions. It is desirable that all transmission owners within a region participate in the planning process. To provide the necessary infrastructure to support the development of generation, including wind and other renewable resources, the geographic and electrical scope should also include both potential generation sources (i.e., where wind resources are plentiful) and load centers.
- ***Open and transparent process –*** The planning process must be timely, well-defined, and well-documented. The process should be carried out in an open manner with the ability for meaningful input by industry and market participants including existing and potential generators, suppliers, and customers at all stages of the process. An open stakeholder process with regular meetings should review planning assumptions, criteria, and results in sufficient detail to facilitate meaningful understanding of and input into the

56 PJM has relied primarily upon participant funding to prompt economic transmission development, however congestion costs are currently around 9% of the total market, nine times that of ERCOT (scaled to market size) whose well developed transmission system has helped lower congestion costs to about 1% of its market. The absence of meaningful market response in the face of stubbornly high PJM congestion costs has prompted the region to undertake a reform initiative to further facilitate reliability and economic transmission upgrades.

planning process. With respect to wind, the planning process should provide an opportunity for consideration of the comprehensive needs of renewable resources and the needs of the system to handle resource characteristics such as intermittency.

- ***Independent entity –*** The process must be led and administered by an independent entity. In order to ensure a regional perspective, this entity should have the authority and responsibility to identify needs and proposals for consideration without being limited to simply consolidating plans submitted by incumbent utilities. This authority should be independent of market participants, and may be an ISO/RTO, an independent entity formed by participating states, or an independent transmission entity such as an ITC, Transco, or other appropriate entity as long as the planning authority and process have the requisite characteristics.

- ***Comprehensive planning criteria –*** The planning process should include explicit criteria to identify regional system needs to ensure both reliability and economic efficiency.[57] The comprehensive regional process should include:

  1) Transmission service and interconnection requests

  2) Upgrades needed for reliability standards

  3) Market facilitation and reduction to barriers to trade

  4) Access to economic power supply alternatives

  5) Reduction of need for market mitigation or generator reliability compensation

  6) Economic reduction of congestion

  7) Deliverability of resources

  8) Consideration of fuel diversity, including facilitation of renewable sources of generation

  9) Environmental performance and RPS programs

  Given the often long lead times for transmission construction, the regional planning process should have a sufficiently long time horizon (e.g., from 10 to 15 years) to ensure that transmission projects can be identified and constructed prior to the need date. The process should take a broad view of the system and include areas for potential new generation development, particularly where such development depends on location-specific resources such as wind. Specifically, the regional planning process should actively study a wide range of future scenarios in order to effectively manage uncertainty with respect to new generation, availability of generation including retirements,[58] demand growth, advanced technologies, fuel prices and availability.

- ***Authorization for construction –*** The planning process should outline roles and responsibilities for constructing all new transmission identified pursuant to the regional plan. The process should include provisions for construction of regulated transmission if merchant or market-driven projects have not addressed needs in a timely manner, for example after a predefined window for market response.[59] The regional planning authority should be able to order that transmission enhancements be undertaken to meet reliability and economic needs, and to authorize third parties to construct if incumbent utilities do not commence work in a timely fashion.

Independent entities that own and operate the transmission system, such as Transcos, are best suited to operate, plan, and invest in the regional system ensuring that consumer benefits, not energy market interests, are the driving force.

57 FERC has confirmed that, "[i]n order to fully meet the planning and expansion function for an RTO," an RTO's planning process must "identify expansions that are needed to support competition." PJM Interconnection, LLC., et al., 101 FERC ¶ 61,345 (2002), p. 24.

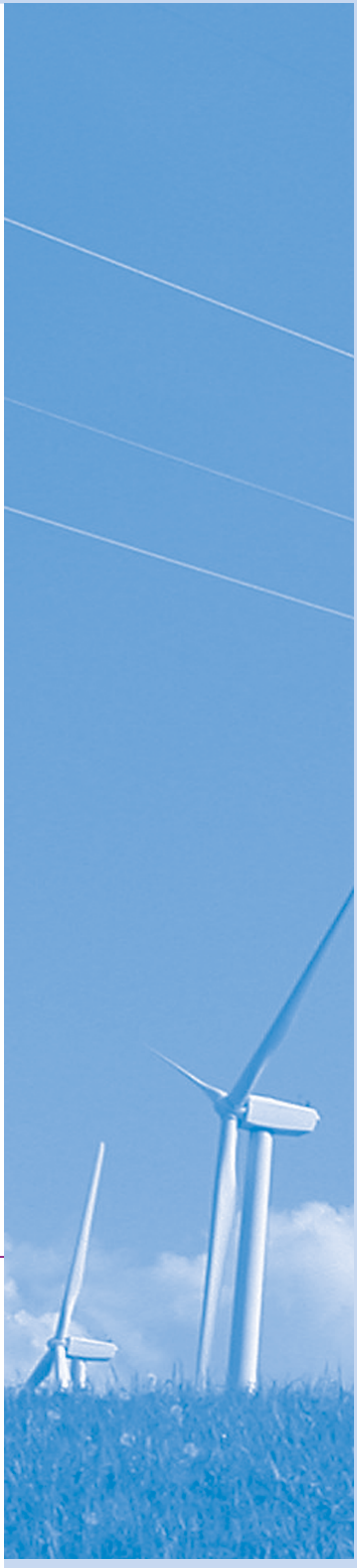
58 Reinforcing the network in anticipation of generation deactivations/retirements would avoid the need for reliability must run contracts and other forms of so-called "reliability compensation."

59 PJM provides for a one-year "market window" in its regional planning process. PJM Regional Transmission Expansion Plan, February 2006.

■ ***Cost allocation and recovery –*** No matter how compelling the case may be for a particular transmission project in the regional transmission planning process, projects are likely to face substantial resistance if the rules for how and which customers will pay for investments are not clear. The planning process should include upfront practical transmission cost allocation rules for regulated transmission built pursuant to the regional plan. Ideally, there should be a commitment and a clear path to ultimate cost recovery through wholesale and retail rates, including allowance for abandoned plant associated with the regional plan. Cost allocation rules should recognize the broad benefits that are associated with an upgrade, and could incorporate a mix of regionally spread (postage stamp), license plate, and participant funding mechanisms (for sole-use facilities). While New England has settled on a clear, easily administered cost allocation mechanism for new transmission projects,[60] cost allocation continues to be debated in other regions.[61]

60 See New England Power Pool and ISO New England, Inc.; Maine Public Utilities Commission v. New England Power Pool and ISO New England, Inc., 105 FERC ¶ 61,300 (2003), Order on Complaint.

61 PJM has been challenged by many parties regarding its current cost allocation rules. On May 26, 2006, FERC ruled that the allocations on some projects may be unjust and unreasonable and has set the matter for hearing (FERC Docket ER06-456). See also Midwest Independent Transmission System Operator, Inc., PJM Interconnection, LLC., et al,; Ameren Services Company, et al., 109 FERC ¶ 61,168 (2004) - recognizing that the Midwest ISO and PJM stakeholders were unable to agree on a long-term transmission pricing methodology for the super-region, but ordering the parties to develop a proposal for allocating to the customers in each RTO the cost of new transmission facilities that are built in one RTO but provide benefits to customers in the other RTO. See also FERC's Order on New York planning encouraging NYISO and New York stakeholders to move beyond high level cost allocation principles to a "full cost allocation methodology," FERC Docket ER04-1144, p. 29. Although the NYISO planning process is incomplete with respect to planning for economic reasons and the inclusion of a full-cost allocation methodology, it should be noted that the New York planning process does provide a cost recovery mechanism for transmission owners that must build planned projects.



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