CORPORATE GUIDE TO
GREEN POWER MARKETS

WORLD RESOURCES INSTITUTE

Diversifying Corporate Energy Purchasing with Wind Power

INSTALLMENT 9

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BACKGROUND

Wind power generates more than electricity: it occupies center stage in the debate on how to reduce dependence on fossil fuels in the electric sector. Wind power is the fastest growing renewable electricity technology in the United States; installed generating capacity has increased 15 percent annually since 1990 and 30 percent per year since 2000.[1] In 2006, wind was the second largest source of new electric-generating capacity in the United States (just after natural gas), and in 2007, wind power constituted approximately 30 percent of all new electric-generating capacity in the United States.[2] However, siting issues have divided some communities; opposition to wind projects has received significant press coverage; and the industry has been stymied by on-again, off-again policy support from the U.S. Congress.

This installment of the World Resources Institute's Corporate Guide to Green Power Markets focuses on wind power as an important component of an energy portfolio. It answers some key questions. How are U.S. wind markets developing? How do interested energy buyers find good wind power products? What barriers exist to purchasing power from new wind developments in the United States? It reviews wind project development in the U.S. and debunks some of the myths associated with the use of this technology. It describes WRI's Green Power Market Development Group's efforts to bring new, cost-competitive wind power to corporate markets. Finally, case studies of wind project purchases show how corporate America can support and participate in this growing, renewable energy industry.

Summary

Wind power is the fastest-growing form of renewable electricity and constitutes a substantial portion of green power products in the United States. Corporate energy buyers can incorporate wind into energy portfolios in a variety of ways: through utility-offered green pricing programs, renewable energy certificates (RECs), long-term power contracts, or on-site generation. In addition, corporate investment in wind projects provides other ancillary benefits, such as providing companies with a clean energy source that does not have any fuel costs. Wind power is here now, is proven, and is supported by many energy consumers across the United States.

Wind power faces a number of challenges, both perceived and real. In addition to concerns over the technical challenges of wind power, many corporations may not yet know how to integrate wind power into their energy purchasing strategies. Corporations may worry that visible debates and public support for some projects could be tempered by concerns about aesthetic values or potential effects on bird and bat populations. High up-front capital costs of these projects, combined with the challenge of transmission and integration of wind power into existing power grids, have dissuaded energy consumers from making direct investments in wind power. The market has been facing rising development costs due to increasing demand for wind turbines that has far exceeded supply, unfavorable exchange rates, and price increases in key commodities such as steel. Despite these cost trends, the market for wind power continues to grow, and there is certainly potential for further growth with expanding opportunities for corporate participation.

For corporate wind power purchases, one of the remaining critical issues is that existing policy does not fully account for the environmental benefits of wind power. Wind power has the potential to help corporations and the United States diversify into cost-competitive, clean energy technologies that address negative impacts from climate change, enhance energy security, and provide local employment.

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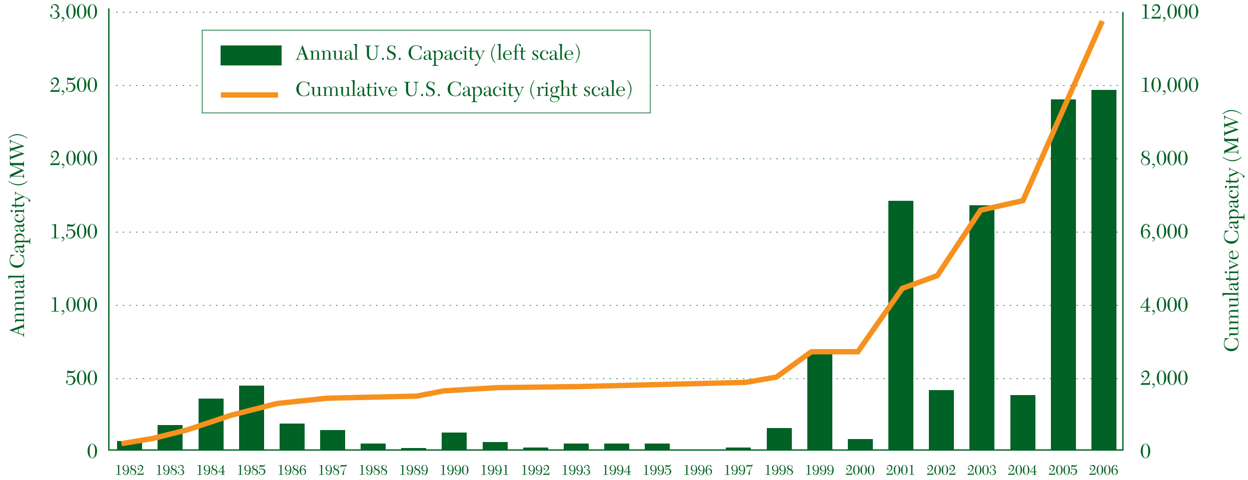
FIGURE 1 Cumulative U.S. Wind Power Capacity



Source: AWEA, GEA database

The Status of U.S. Wind Power Development

In the United States, installed wind power capacity has grown tremendously, particularly since 2000. In 2007, the United States overtook Spain to become the second-largest wind power producer (behind Germany). By the end of 2007, wind capacity in the United States totaled 16,818 MW and is expected to generate more than 48 billion kWh of electricity in 2008 (approximately 1.2 percent of total U.S. electricity), according to the American Wind Energy Association (AWEA).[3]

Growth in the U.S. market has been driven by the increasing economic competitiveness of wind power and increasing demand for renewable energy. In addition, a growing number of states now have renewable portfolio standards. In several states, this support and favorable wind resources have combined to make wind energy cost-competitive with fossil fuel electricity. Seven of these states encompass nearly 75 percent of installed wind power capacity in the United States. Texas passed California in 2006 to become the state with the largest amount of installed wind power. The other states (in order of installed wind capacity) are Minnesota, Iowa, Washington, Colorado, and Oregon.[4]

Behind the Growth: Public Policy Drives Wind Development

The development of wind power has been driven by several key policy factors. First, deregulation has encouraged wind developers to enter into both the emerging voluntary and mandatory markets for green power in a number of states. Second, development has been driven by the federal production tax credit (PTC), which amounts to 1.5 cents per kWh (indexed to the rate of inflation) for wind electricity produced and sold into the electrical grid. Wind farms built in 2006 receive 1.9 cents for each kWh generated over a 10-year period. This federal production tax credit has helped many otherwise marginal wind power projects become economically viable and has spurred investment in associated technologies. Unfortunately, Congress has failed to send clear signals about the credit's future. This policy uncertainty has discouraged companies from investing in wind turbine and component manufacturing facilities, producing a boom-bust cycle in wind development and aggravating supply shortages (see Figure 1). In December 2006, Congress extended the production tax credit through 2008, which is expected to stimulate the construction of an additional 4,000 MW of wind capacity in 2007.[5] There are several emerging cap-and-trade programs that are being evaluated at the state, regional, and federal levels. If properly designed, these programs could provide additional support for renewables.

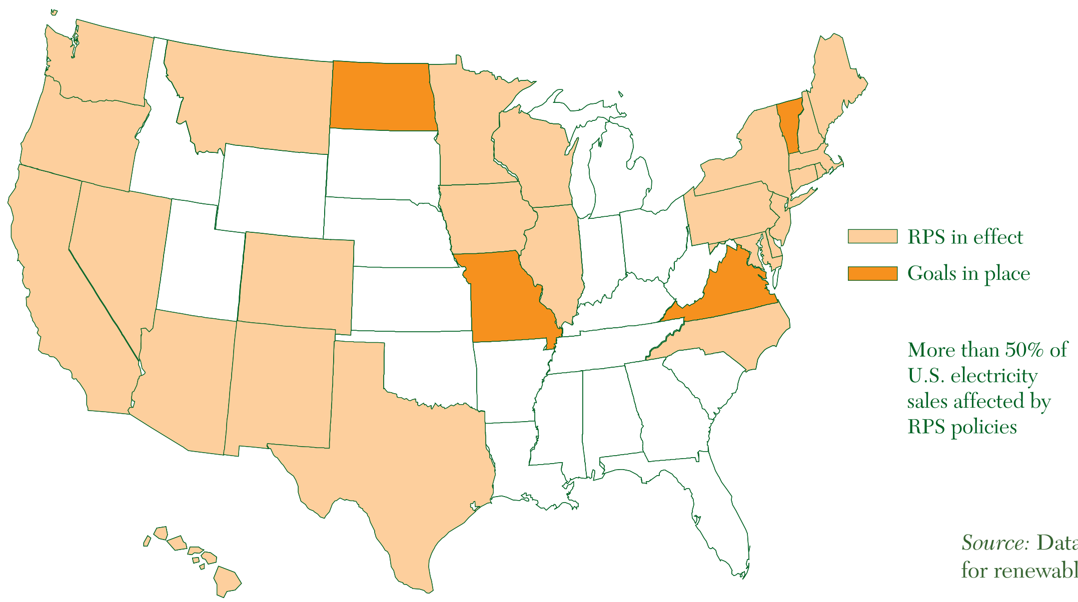
Equally important to the wind industry is a second policy that complements the production tax credit—a renewable portfolio standard (RPS). The emergence of new or expanding state RPS policies in the past five years has also spurred wind development. RPS laws require electricity providers to purchase a certain percentage of their electricity from renewable sources. Twenty-five states and the District of Columbia have enacted RPS legislation, with most states opting to support a 10-to-20 percent renewable requirement phased in over 10 to 15 years. RPS legislation has been particularly good to wind power in states like Texas, where it represents the lowest cost renewable alternative.[6] RPS policies work best when they have solid enforcement mechanisms, policy certainty, and address financing of new projects.[7] A recent report by the U.S. Department of Energy found that state RPS policies were responsible for about half of the wind energy added in the United States between 2001 and 2006, with the share increasing to 60 percent in 2006.[8] Congress has considered enacting a federal renewable electricity standard that may include both renewable power and energy efficiency and place an obligation on utilities across the United States. Passage of such a policy would further develop national markets for wind power.

WRI's Green Power Market Development Group's Experience with Wind Power

The Green Power Market Development Group brings together companies that voluntarily want to diversify their energy use, support more environmentally sound energy production, or meet corporate emission reduction targets. When the group was established in 2000, such companies had no cost-competitive green power options; green power and wind power electricity products offered by utilities and marketers had largely been developed with the individual household consumer in mind.

Developed in association with the World Resources Institute, the group was founded on the premise that increased corporate demand for renewable energy would accelerate cost-competitiveness and help create a clean energy future in the United States. Corporate participants are able to aggregate their demand, develop strategies, and explore opportunities at a larger scale than any one company acting alone.

State Renewable Portfolio Standards



Source: Database of state incentives for renewable energy (2007)

The group has supported wind power through three different types of purchases: retail green power products (such as Community Energy's Pennsylvania wind projects), purchase agreements that act as a hedge against fuel price changes (such as Austin Energy's Green Choice program, which offers a wind/landfill gas electric power blend), and renewable energy certificates (RECs). In December 2007, the total amount of wind power supported by Green Power Group purchases was more than 500 MW, enough to power more than 125,000 households. The National Renewable Energy Lab estimates that voluntary purchases such as these—through utility green pricing programs or from green power marketers—have stimulated demand for over 2,000 MW of wind power in the United States.[9]

WIND POWER PRODUCTS FOR CORPORATE BUYERS

Corporations interested in purchasing wind power should review their approaches and opportunities in order to develop a purchasing strategy that offers the highest level of environmental and economic benefits at the lowest cost. There are a number of factors that influence the cost of wind power, and corporate buyers may shift strategies in order to take advantage of better wind locations, the ease of transactions, or local community interest near a specific corporate facility. As with any renewable energy purchase, reasons for buying wind power can vary. Assessing wind power with specific corporate goals in mind will help determine what type of wind power product is most attractive.

For companies seeking to develop a wind power strategy, six main approaches have emerged from the Green Power Market Development Group's work:

1) **Renewable Energy Certificates**: Companies can find a provider of renewable energy certificates (RECs) to supply wind certificates from regional resources, or anywhere in the country, by accessing http://www.eere.energy.gov/greenpower/markets.[10]
2) **Green Pricing Programs**: Working in partnership with their utility, companies can purchase green power directly or develop other "greening" options.
3) **Reducing fluctuating energy cost risk by purchasing wind**: Companies can purchase wind power to hedge against fluctuations in fossil fuel prices reflected in the cost of purchased electricity. This can potentially be achieved through green pricing programs with a companies' electric utility, or potentially through an on-site wind facility or power supply agreement with a power marketer selling a fixed price wind-based project or even potentially through direct off-take agreement with a wind project.[11]
4) **Aggregation**: Companies can enter into partnerships with suppliers, state agencies, and utilities that can bridge the corporate need for short-term flexibility with suppliers' need to ensure long-term revenue streams.
5) **Investing in wind projects**: Equity investments in new wind farms can be an attractive alternative for companies with tax appetite to monetize the federal production tax credit and accelerated depreciation treatment applied to wind projects.
6) **On-site wind projects**: On-site wind installations are increasingly attractive as energy costs rise and companies seek to reduce electricity purchases and realize the public relations benefits of going green.

Each of these strategies carries its own potential costs, risks, and rewards, as outlined below.

Renewable Energy Certificates

Renewable power facilities generate two discrete products: commodity electricity and environmental benefits. Each megawatt-hour (MWh) of electricity generated by renewable energy displaces generation by fossil fuels, and results in environmental benefits in the form of avoided emissions. A renewable energy certificate (REC) represents one MWh of zero emissions electricity and can be purchased by customers interested in "greening" their power purchases.[12]

There are a number of reasons why buyers may favor renewable energy certificates (RECs) as a means of "greening" their energy consumption. First, the availability and cost-effectiveness of wind power products depends highly on location. For example, corporate buyers in the southern U.S. face a shortage of cost-effective wind resources. By purchasing RECs, these buyers may choose to support wind projects anywhere in the U.S. where the economics and wind resources are most favorable. This is especially attractive to national corporations with operations in several states and regions. RECs also create national markets for renewable energy suppliers, reducing their dependence on local demand for renewables and enabling them to develop high-quality power installations where wind resources and transmission infrastructure allow.

REC purchases eliminate concerns about the costs associated with transmission, distribution, and other services required to transmit electricity from the wind farm to the end user. RECs can be purchased in regulated and in deregulated markets and are sold separately from a customer's utility bill.

Many GPMDG companies have used RECs as part of their overall strategy to meet their renewable energy goals and have been active in developing the REC market. Green-e® certified RECs are recognized as a credible tool for buying green power by state, regional, and federal authorities.[13] The market for RECs has played—and will continue to play—a critical role in encouraging the development of new renewable energy projects by:

- Providing renewable energy project developers with a much-needed source of revenue that can shift the balance in favor of securing project financing;
- Providing an additional revenue source that improves investor confidence in the renewable energy sector and leads to further investment; and
- Allowing companies to support renewable energy, even when on-site options are not feasible or when the local utility does not provide green power.

REC purchases have increased dramatically in recent years. As of December 2007, REC purchases by the EPA's Green Power Partners, an organization of 850 green power purchasers (including several Green Power Market Development Group members), amounted to more than 11 million MWh.[14] Recent data from Green-e, the leading certifier of RECs, indicate that residential users account for 81 percent of REC customers, but wholesale and non-residential customers account for more than 99 percent of the volume of RECs purchased, indicating the importance of the corporate market. Wind energy is the dominant source of renewable electric generation for RECs, accounting for 83 percent of the total supply, with other renewable energy generation technologies making up the balance.[15]

Prices for wind RECs in the voluntary market vary considerably. These prices are affected by a variety of factors, including location and vintage of generation, contract term, and volume of purchase. Evolution Markets (http://www.evomarkets.com), a leading REC brokerage, offers monthly reports on renewable energy RECs. Table 1 shows pricing of RECs published by Evolution Markets in December 2007 (RECs generated by other technologies included for comparison).

Large-scale wind developments, such as the Stateline Project in Oregon developed by PacifiCorp Power Marketing (PPM Energy Services) and the Aquila wind farm in Kansas, sell RECs either directly or through RECs suppliers such as Bonneville Environmental Foundation, Sterling Planet, and others. Brokers such as Natsource and Evolution

TABLE 1 Voluntary REC Market, December 2007

Generation Technology	Region	Term	Volume (MWh)	Offer (per MWh)
Wind	National	2007	50,000	$5.50
Wind	WECC	2010–12	25,000	$10.00
Any Tech	National	2007–08	100,000	$4.50
Wind	CA	2008–11	150,000	$15.00
LFG	National	2007	25,000	$4.00
Solar	National	2007–09	5,000	$14.00

Source: Evolution Markets (see http://new.evomarkets.com/index.php?page=Renewable_Energy).

Voluntary markets refer to markets in states that do not have RPS standards. REC prices in these markets are generally lower than in mandatory markets.

BOX 1

The Role of RECs in Development of New Wind Power

Community Energy Inc. (CEI), a marketer and developer of local wind power projects, is using the sale of RECs to help finance new projects. For example, in 2003, the University of Pennsylvania signed a 10-year contract to purchase local wind renewable energy credits (RECs) equivalent to 40,000 MWh per year from CEI. This large, long-term REC purchase is leading to the development of at least 15 MW of new wind supply in Pennsylvania. Given the strong credit of the buyer, CEI can bank on the long-term income from the RECs to sufficiently complement the revenue stream from the facility's electricity on the wholesale market. This makes the project financially viable and, therefore, attractive to project investors.

Source: reprinted from North American Wind Power Monthly, May 2004 issue, with permission from Brent Beerley, Community Energy Inc. and North American Wind Power Monthly.

Markets are also conducting REC transactions matching up purchasers with RECs from projects in the United States or elsewhere. (For a list of certified providers, visit http://www.green-e.org/).

Green Pricing Programs

Many utilities and marketers in both regulated and deregulated states offer green power pricing programs. These programs generally deliver a block of power from a wind project for an added charge on the utility bill and often have the additional advantage of supporting local wind power development with local environmental benefits. Austin Energy offers a wind energy electricity product that, for some customers, exempts participants from fossil fuel price adders; at times, it has been cheaper than their conventional fossil fuel electricity product (see next section). Some programs also offer customers the opportunity to purchase a percentage of their total electricity from wind or other renewables. Price premiums ranged from $0.01 to $0.088/kWh in 2006 (see http://www.eere.energy.gov/greenpower/ for a list of green power providers).[16] More than 750 utilities, about 25 percent of utilities nationally, now offer green pricing programs. The National Renewable Energy Laboratory estimates that retail sales of renewable energy in voluntary green power markets amounted to 12 million MWh in 2006, or about 0.3 percent of total U.S. electricity sales. Wind power was the leading renewable energy technology in green power sales with 62 percent, followed by biomass energy sources, including landfill gas (23 percent), geothermal (7 percent), hydropower (6 percent), and solar (1 percent).[17]

New REC-based projects are becoming available for customers who would like to support wind power while remaining with their existing energy supplier on the lowest cost "standard offer" contract. The buyer company works with the energy provider to find a source of RECs that are added on to the utility bill. This keeps transaction costs low and ensures that the energy is "greened" by the utility.

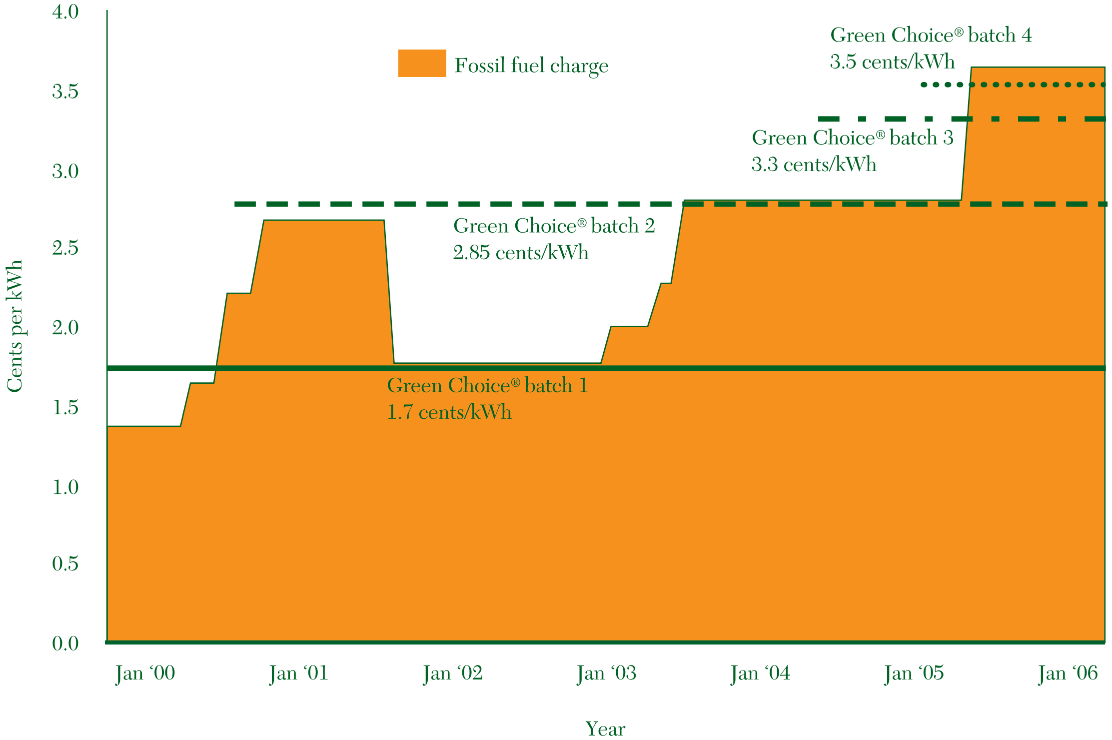
PECO Energy of Pennsylvania, for example, is partnering with Community Energy to offer its customers RECs from wind projects. Niagara Mohawk of New York offers customers multiple green power options, differentiated by price and renewable energy technology, and allows them to pick the option they prefer. Collaboration between utilities and REC providers may result in lower prices for green power products and result in a greater variety of product options for commercial buyers. Purchasing Green-e certified RECs affiliated with a utility may also enhance REC credibility with managers and other stakeholders.

Reducing Fluctuating Energy Cost Risk by Purchasing Wind

Because it requires no fuel inputs, wind power can act as a hedge against price volatility in fossil fuels. Where fuel charges fluctuate and high natural gas prices can create spikes in electricity bills, customers may benefit from having wind to help stabilize their fuel price surcharges.

Austin Energy, a utility in natural gas-dependent Texas, has been particularly successful in offering green power products to customers as hedges against fuel price volatility. To date, Austin Energy has purchased more than 90 MW of wind and landfill gas generation capacity, and has passed the benefits on to customers as fixed-price power. Surcharges for the "Green Choice" program are set at levels that make it attractive both to Austin Energy and its customers to hold long-term contracts for the renewable electricity. As gas prices rise, many "Green Choice" customers are actually saving money on their electricity bills relative to the standard rate. "Green Choice" is the most successful green power product in the United States. The first batch of

FIGURE 2 **Austin Energy's fossil fuel charge vs. GreenChoice® charge**



Source: Austin Energy, 2005

renewable energy, which was sold at a subsidized price, and the unsubsidized second batch have both sold out. The third batch of power is already 70 percent subscribed because of clear indications that fuel charges will rise in the future.

There are additional opportunities for corporate buyers to contract directly with a renewable energy project and benefit from the price stability of wind. In addition to purchasing traditional RECs, several developers are offering long-term fixed price REC contracts for new wind projects. Long-term "Project REC" contracts could allow for developers to secure financing for new projects and could help drive new investment in wind development. Another mechanism for supporting renewable energy projects would be to enter into a contract for differences ("CFD") agreement with a developer. A CFD is a financial tool that acts as a hedge against rising electricity prices. The payment from the large buyer to the developer drops if electricity rates increase, and if electricity rates increase beyond an agreed upon level, the developer would pay the difference. Southern New Hampshire University recently entered into a 15-year contract for differences with PPM energy. Corporate buyers should consider any accounting issues associated with financial hedges when evaluating this option.

In terms of macro-scale impacts, many studies have shown that achieving significant renewable energy market penetration can reduce consumer energy costs. For example, a Wood Mackenzie study found that a 15 percent national RPS would result in 3 bcf lower gas demand, a projected drop in natural gas prices to $5/MMBtu from the base case of $6/MMBtu by 2026, and lower variable electricity costs of $240 billion.[18]

Aggregation

Like most other renewable energy technologies, wind power relies on a freely available natural resource for "fuel." With no fuel costs and relatively small and predictable operations and maintenance costs compared with other generation technologies, wind power can provide power at very predictable pricing. However, wind turbines are capital-intensive, requiring large initial investments before they can generate a single watt of electricity. In order to secure financing, wind generators typically need to lock in contracts as long as 15 or 20 years with electricity buyers. While these terms are suitable for investor-owned utilities that must provide energy and in return are allowed to recoup costs, most commercial and industrial energy consumers prefer to contract for shorter periods, in the range of one to three years.

There are opportunities for energy consumers, marketers, and suppliers to partner in ways that provide developers with the long-term certainty they need to secure financing for new projects while preserving the flexibility offered to buyers by short-term contracts. For example, as RPS mandates become more widely implemented across the U.S., many developers have adopted early entry strategies to capture economically sound projects before these mandates come into effect, selling RECs to generate revenue in the interim. Exelon entered into 20-year contracts with 175 MW of wind projects in Pennsylvania and West Virginia in anticipation of RPS implementation. In turn, Community Energy markets the RECs from those wind projects to other buyers, generally on a short-term basis. Companies in RPS states can buy short-term RECs from developers before the RPS ramps up.

In another case, the state of Massachusetts has started a program to spur the development of new wind projects by developing financial instruments that help to ensure their long-term viability. The Massachusetts Renewable Energy Trust (MRET) has used part of its public benefits fund monies to finance 10-year put and call options for RECs, in essence guaranteeing the long-term revenue stream necessary for a wind or other renewable energy project to move forward. MRET sells all the RECs it purchases to raise funds for other activities. In 2003, MRET awarded six companies $33 million in REC purchase commitments, representing 100 MW. Massachusetts issued a second solicitation in 2005 with $15 million in public benefit funds and $13 million in RPS alternative compliance payments. Seven projects representing 106 MW received awards.[19]

Such examples are relevant to corporate buyers of green power who may enter into partnerships with utilities or, if available, state public benefit funds. Utilities and/or state public benefit funds can more easily enter into long-term contracts, provide critical pricing support to green power projects, and therefore allow corporate buyers to take shorter-term positions. Such partnerships can help support the more rapid development of new wind projects and meet corporate green power purchasing goals.

Investing in Wind Power

Opportunities also exist to support wind power through direct investment in new wind farms. Up until 2002, ownership of wind farms in the U.S. wind industry was dominated by large utility subsidiaries with experience in the electric industry and large federal tax liabilities that could be used to monetize the federal production tax credit. More recently, a wide range of financial firms have begun purchasing and owning wind projects using carefully engineered financial structures. To date, few nonfinancial corporations have invested directly in wind projects.

Beyond the financial structuring issues, evaluating an investment in a wind project requires a range of unique knowledge and skill sets, including sophisticated analysis of wind studies, environmental impact assessments, community acceptance, tax credits, terms of state grants or loans, power purchase agreement details, and the potential financial value of the RECs that the project may generate. For most companies, investing in a wind project is likely an undertaking that will require the assistance or participation of a competent third party.

Various multinational corporations are seriously contemplating an investment in a wind project and will retire the RECs to meet their environmental commitments. Typical unleveraged equity returns can range from 7.5 percent for late-stage investors to 11 to 15 percent for early-stage investors. Wind projects also generate substantial state and federal tax credits, so developers are often looking for "tax investors" or companies that can take full advantage of all associated tax credits. These investments could act as a natural hedge on electricity costs. As electricity and REC prices rise, so do the equity returns from a direct investment.

It is important to note that investing in a wind project does not necessarily equate to owning the environmental benefits. Without ownership of the renewable energy or the RECs generated by a wind project, an investor can claim to provide financial support for a renewable energy project, but cannot claim they own the green power. In voluntary green power markets, the end buyer of produced green energy—through RECs or a green pricing program—purchases the environmental benefits of the project, and these cannot be double-counted.[20]

On-Site Wind Projects

Developing on-site wind projects is an emerging strategy for firms looking to green their energy use and simultaneously realize significant public relations benefits. One model is to host turbines and to integrate the power directly into new or existing facilities. Because wind is a variable resource, and in some areas of the country is more abundant at off-peak hours, on-site development is typically accomplished through the net metering rules in a given state or utility territory. These programs typically cap the total size of a project, but a facility is still connected to the utility that seamlessly integrates the wind power into the facility, or buys the power back at retail electricity rates if the wind facility generates more than the facility's load.

While the size of such projects is typically limited to smaller installations, more states are increasing the cap on net-metered projects, making utility scale wind turbines feasible. In addition, such pricing is typically based on retail rates rather than wholesale rates, and despite the relatively small size of projects, project economics can be competitive or even attractive in good wind resource areas. However, for manufacturing facilities that run 24/7 in areas with high average wind speed, on-site wind turbines can help offset electricity purchases and secure some of the benefits of having on-site power options.

Another potential on-site model is for companies with large landholdings, such as companies with timber or mineral resources, to lease attractive wind project sites for development by a third-party. Wind farms typically only utilize 2 to 3 percent of the lands they have, and typically do not preclude using the remaining lands for other productive purposes. In addition to earning lease royalties, a company may have opportunities to co-invest in the development phase of a project and to potentially integrate a large wind project to supply existing facilities through a negotiated agreement with the interconnection utility. Hosting wind turbines through either of these models provides a strong, highly visible statement about a firm's commitment to utilizing renewable energy and reducing fossil fuel emissions that can pay off in stronger relationships with customers, employees, shareholders, and local communities.

BOX 2

Examples of Community-Based Wind Power Development

Corporations in communities across the country can be part of a move to support local, clean energy sources.

Although a number of large wind projects have been contested by surrounding communities, there are very different community perspectives on this power source. A recent market trend is the emergence of community wind projects, loosely defined as wind projects owned by towns, schools, commercial customers, and farmers. Such projects have grown from 0.2 percent of total wind capacity in 2001 to 2.2 percent in 2006, or 258 MW.

Community wind projects can consist of several approaches. One is simply landowners raising the money and developing the wind project. Another is known as the Minnesota Flip, where a PTC-eligible partner owns the project for the first 10 years, then passes along ownership to farmers. Finally, the 100.5 MW Trimont project in Minnesota features a combination of PPM Energy, a large wind developer, and 43 landowners. PPM and the landowners share the gross projects, and farmers receive about 5 percent of project revenues.

Community wind projects can be difficult to develop; obstacles include securing wind turbines in a supply-constrained environment and interconnection delays. Yet more market development with community wind is on the way. Minnesota expects to add 300 MW of community wind projects in 2007, and a total of 800 MW is expected by 2010, with Xcel Energy responsible for 500 MW. Oregon may see four community wind projects in 2007 for a total of 26 MW. Community wind feasibility studies are under way in Massachusetts and New York, and Vermont, Montana, Nebraska, and North and South Dakota all may see community wind projects in the future.

BOX 3

On-site Wind Power at Harbec Plastics, Inc.

Harbec Plastics uses 1,500–2,000 MWh annually to power its plant in northern New York. For two years, the 250 kW Fuhrlaender wind turbine installed on-site has generated roughly 25 percent of the company's electricity load. For wind facilities, New York's net metering law is limited to farm-based systems of under 125 kW, which means that the company is unable to sell power back to the electrical grid. Without net metering in New York, the economics of on-site wind projects are far less attractive. Nevertheless, Harbec decided to make on-site wind power a component of a more diversified energy portfolio that included energy reduction strategies, such as new manufacturing equipment and combined heat and power, which improve the overall energy costs of the company and help offset the longer payback for wind power.

The two most elusive components of the project were predictable: project financing and permitting. Owner Bob Bechtold approached more than 30 banks to fund Harbec's energy plan, which required $400,000 to cover purchase and installation of the wind turbine. He heard the same basic concern from each lender: without an example of a similar wind project demonstrating success, the investment was too risky. Bechtold finally secured financing by bringing four banks together on the deal, decreasing each lender's risk exposure.

Local officials and the community were concerned about the project's possible impact on bird populations and noise levels. Bechtold presented data available through organizations such as the American Wind Energy Association (AWEA) to address these issues, but it was 13 months before the county manager of economic development publicly supported the project. Following that approval, the wind turbine was installed and running in a year.

Harbec Plastics now has two years of experience with on-site wind power. The wind turbine typically provides 300,000 to 350,000 kWh per year. Based upon the current level of electricity production and utility rates for purchased power, the turbine will pay for itself in less than 10 years. The project could be paid off sooner if Harbec had been able to take advantage of net metering or grants from the state benefit fund.

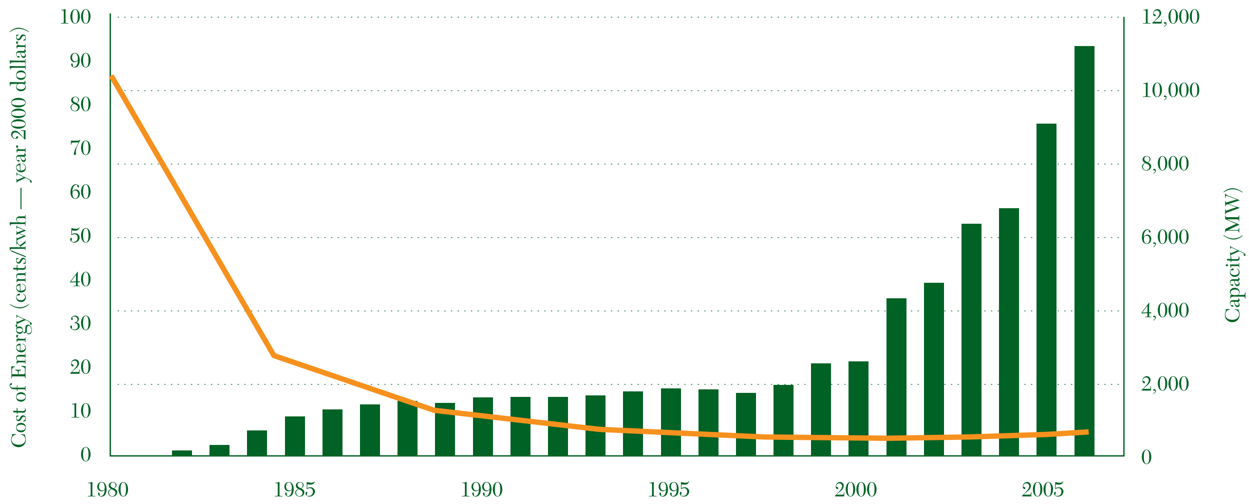
Two key considerations for companies interested in on-site wind are:

- Financing: Contact trade associations, such as AWEA and turbine manufacturers, to identify financial institutions that specialize in funding wind energy projects. In addition, the U.S. Department of Agriculture provides grants and/or loan guarantees to agricultural producers and rural small business (See Section 9006 of the 2002 Farm Bill at **http://www.rurdev.usda.gov/rbs/farmbill/**).
- Community Outreach: Before filing permit applications, organize informational meetings for the surrounding community and identify possible aesthetic, noise, or wildlife issues. If possible, find a respected community member who supports the project and who is willing to act as an advocate.

No matter what wind product an energy buyer chooses, there are several purchasing strategies that may help find the most economical wind power options available:[21]

1. **Aggregate**: Aggregate corporate loads across locations to find-high volume opportunities, either for grid-connected wind power or RECs.
2. **Bid competitively**:
   a. In states that have restructured their electric sector, conduct an RFP for power needs, including a request for pricing for a range of predetermined power volumes (e.g., 25,000 kWh, 50,000 kWh and 150,000 kWh) or at various percentages of corporate energy load.
   b. In restructured or regulated markets, conduct an RFP for RECs to offset the emissions from conventional power purchases, thereby "greening" conventional power.
3. **Consider switching providers (if electric sector is restructured)**: Use lower rates offered by a different electricity provider to finance the purchase of wind or other renewable power options.
4. **Finance with energy efficiency**: Reduce power demand with energy efficiency projects and purchase green power with the savings.
5. **Evaluate new procurement models**: Investigate on-site, equity positions in nearby wind projects, hedging energy price risk using renewable energy.

FIGURE 3 **U.S. Wind Power Capacity and Cost Trends**



Source: NREL's "Wind Energy Update." Available at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/wpa_update.pdf

THE UNDERLYING ECONOMICS OF WIND POWER

Wind's growth has been driven by a combination of environmental benefits (as an electricity generating technology with no emissions) and increased cost-competitiveness. The cost of wind-generated electricity at good wind sites has dropped from 35 cents/kWh in 1980 to as low as 2–5 cents/kWh today.[22] While unfavorable exchange rates and increased demand for raw materials and wind turbines have recently increased wind generating costs somewhat in the U.S.—issues that also affect fossil fuel generation costs—several economic factors have resulted in a substantial long-term decrease in the cost of wind power over the previous three decades.

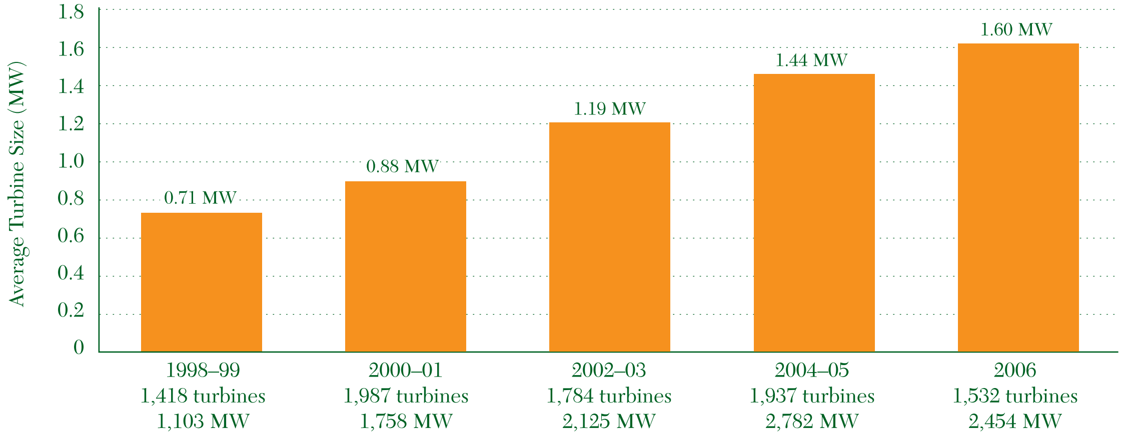
The long downward trend in the price of wind-generated electricity can be attributed to technological advances and increased economies of scale. Turbine manufacturers are producing larger and higher capacity turbines. Since 1998–99, average wind turbine size has increased by 124 percent. Nearly 17 percent of all wind turbines installed in 2006 were rated at over 2 MW, as opposed to 0.1 percent in 2002–03 and 2004–05. A number of manufacturers—including Gamesa, Mitsubishi, Suzlon, and Clipper—currently sell 2 MW or larger turbines in the United States, and some of Vestas' 3 MW turbines are showing up in recent wind installations as well. General Electric will start selling their 2 MW class turbine in North American markets starting in 2008, and is currently producing a 3.6 MW model for offshore applications. Given constraints to transporting and installing the current 2 to 3 MW class of wind turbines, the overall size of machines and capacity per turbine may not increase significantly for some time for onshore applications, but continued improvements in design and electronics are expected to continue to improve efficiency and drive down the delivered cost of energy from this technology.

Figures 4 and 5 present the characteristics of wind generating plants in 1998–2006 and the costs. Wind generating projects in 2006 generated approximately 140 times more energy than wind projects installed in 1998–99 and prices declined with increasing capacity through 2005. The recent increase in price can be seen in 2006.

The most economical wind projects in the United States are scaled at approximately 50 to 150 MW to achieve economies of scale in materials, construction and operation.[23] At an average capacity factor of 30 percent and with wind turbines at a capacity "rating" of 1.5 MW each (the maximum power they can put out assuming they are operating 100 percent

FIGURE 4

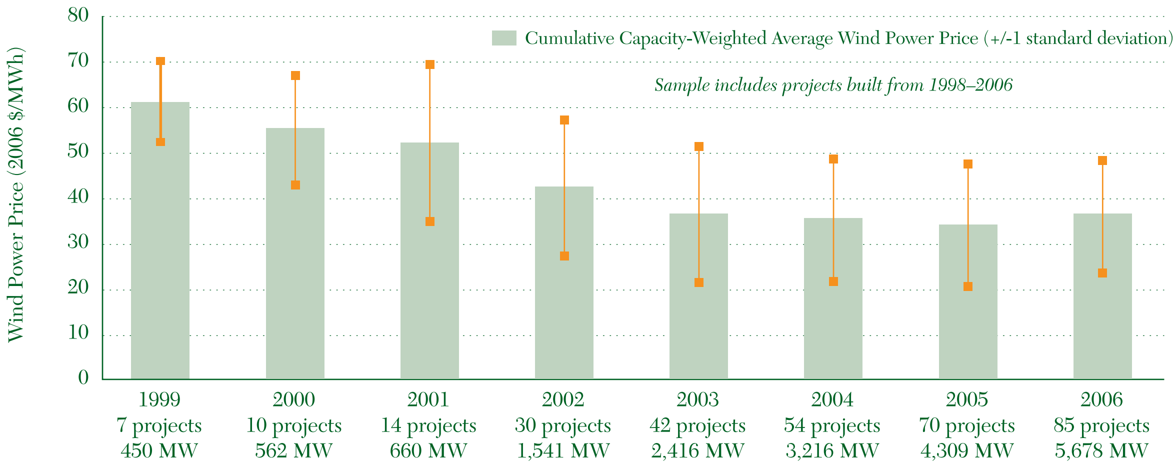
Characteristics of Wind Turbines Installed in 1998–2006



Source: AWEA/GEC project database.

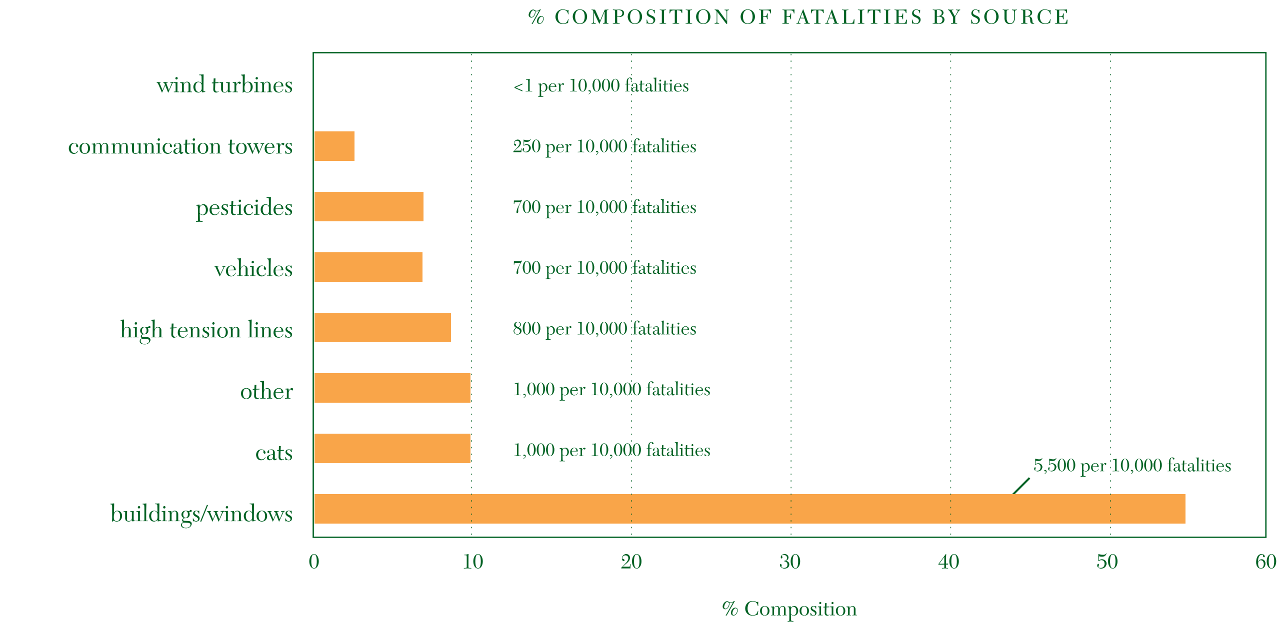
FIGURE 5

Cost of Wind Turbines Installed in 1999–2006



Source: AWEA and U.S. Department of Energy. Annual Report on US Wind Power Installation, Cost and Performance Trends: 2006. Available at: http://www.nrel.gov/docs/fy07osti/41435.pdf

FIGURE 6 **Human-Caused Bird Fatalities**



Source: Erickson, W.P., et al. 2002. Summary of Anthropogenic Causes of Bird Mortality. Washington, DC: USDA Forest Service.

of the time at maximum speeds), a 100 MW wind farm will generate 262,800 MWh each year—enough to meet the needs of approximately 25,000 homes.

The purchase, construction, and installation of wind turbines themselves make up around 70 percent of a wind project's costs, while maintenance contributes another 20 percent. Taxes, land leases, and insurance account for the remaining 10 percent. Wind speed is a critical element in wind project development; a one mph difference in wind speed can affect wind energy costs by about 0.5 cents per kWh.[24]

More recently, it appears that the cost of wind power is increasing. A U.S. Department of Energy report determined that the capacity-weighted average 2006 sales price was about $49/MWh, as compared to $35/MWh in 2004 and 2005 and $31/MWh in 2002 and 2003. Because the 2006 wind projects may reflect turbine prices that were locked in as much as two years in advance, the costs of wind power projects installed in 2007 and later may be somewhat higher. The increases in wind power costs track closely with increases in the cost of wind turbines. Wind turbine costs have risen by more than $400/kW (60 percent) since the 2000–02 period. Higher wind turbine costs have been attributed to the decreasing value of the U.S. dollar to the Euro, higher material and energy input prices, shortages in turbine components, and perhaps greater profit-taking by U.S. wind turbine manufacturers.[25]

DE-BUNKING MYTHS ABOUT WIND POWER

Despite the great strides that have been made in wind power over the past 20 years, there are a number of issues that make wind power controversial. This section explores two of the most common: that wind production results in unacceptable levels of bird and bat deaths, and that wind's variable output renders it "unreliable" as a source of electric power.

Bird and Bat Fatalities

One of the most persistent myths about wind power is the effect of wind turbines on bird and bat populations. An April 2005 article in the Chicago Tribune serves as an example of this public concern, warning that "wind farms can be installed in places where they border on the murderous" and that "bird deaths can approach the catastrophic."[26] Numerous studies and congressional hearings, however, reveal such perceptions to be inaccurate.

Wind turbines account for only a minor fraction of anthropogenic bird fatalities. Recent research estimates that only 20,000 to 37,000 birds die each year due to wind turbine collisions (only 3 of every 100,000 human-caused bird deaths).[27] There are an average of 2.3 fatalities/turbine/year, or 3.1 fatalities/MW capacity/year.[28] In fact, researchers have concluded that even if 100 percent of U.S. generation was wind-powered, turbines would account for only 1 of every 250 human-related bird deaths.[29]

Concern about wind power and bird deaths began in large part due to problems in California's Altamont Pass. Constructed in the 1980s, Altamont is one of the largest and oldest wind farms in the world, and is the only wind farm in the U.S. at which bird fatality is a significant issue.[30] Here the concern centers not on the *number* of avian deaths caused by the wind farm (which is actually below the national average),[31] but rather on the impact on a specific bird type.[32] In 2007, various wind energy companies, Alameda County, and certain environmental organizations reached a settlement that called on wind companies to reduce raptor mortality by 50 percent within three years through such actions as blade painting, stopping operation of wind turbines during the winter months, shutting down various wind turbines identified as high risk, and removing some wind turbines and replacing them with fewer wind turbines with a higher capacity.

The industry is now much more aware and sophisticated regarding bird migratory patterns and has improved its avian research and studies. Newer turbines operate at slower speed, reducing the risk to birds. In addition, adjustments made to turbine height, tower placement, and operation schedules (such as shutdowns during migratory periods) may significantly reduce mortality rates for problematic sites.

A recent issue concerns the impact of wind turbines on bats. In particular, researchers are concerned about the large number of bat fatalities observed in 2003 and 2004 at the Mountaineer Wind Energy Center in West Virginia, and in 2004 at the Meyersdale wind plant in Pennsylvania.[33] Unanticipated bat fatalities have also occurred at the Summerview wind project in Alberta, in contrast to the other wind projects in Alberta, which have zero or low bat fatalities.[34] At the moment, knowledge on this topic is extremely limited, and estimates of bat fatalities per turbine per year range between 2 and 50. Several explanations have been advanced, such as that bats are following linear corridors; failing to detect turbines when echolocating; experiencing decompression near blades; or being brought into blade range by thermal inversions. It has also been hypothesized that bats may be attracted to wind turbines by inserts, turbine sounds, or turbines for roosting.[35]

A research initiative, known as the Bats and Wind Energy Cooperative, began to study the issue in 2003. Participating organizations include Bat Conservation International, the American Wind Energy Association, the National Renewable Energy Laboratory, and the U.S. Fish and Wildlife Service. Although no endangered species of bat has been found killed at a U.S. wind farm, the number of bat kills could push certain bat species toward endangered status, particularly given the scale of projected wind development in some regions.[36] Some potential solutions include limiting the operation of wind turbines during times of peak bat migration. As bats tend to fly during periods of low winds when wind power production may be relatively low, this may not adversely impact the economics of wind energy generation. Another potential option involves acoustic or visual bat deterrent strategies that are under research and development currently.

The wind industry is also collaborating with government and university researchers to study the potential impacts of wind turbine development on the population of greater prairie chickens that is found in Kansas, Oklahoma, and other parts of the Great Plains. Greater prairie chickens shy away from tall structures because of fears that they may host predators such as raptors, and it is thought that greater prairie chickens may avoid wind turbines for this reason. Kansas State University is conducting the research in Kansas where wind projects are proposed. Funding has been provided by various wind companies, the Nature Conservancy, the Kansas Department of Wildlife and Parks, the National Renewable Energy Laboratory, and the U.S. Fish and Wildlife Service.[37]

Variability

Another issue commonly cited by wind critics is that the electric output of the resource is variable. Because power can only be generated when the wind blows above a certain threshold speed, it is often discounted as a "reliable" electricity source. However, wind energy constitutes a small proportion of the electricity generation on the grid, and the impact is often overstated.

Critics worry that reliance on wind power would increase the required amount of backup generation or reserve capacity needed to fill in when wind is unavailable, and that overall grid costs will increase because of these gaps in wind generation. Numerous studies have been conducted on the potential costs to integrate wind and other variable renewable energy sources onto the utility grid.[38] All have found that the costs to integrate wind are modest at moderate penetration levels, typically less than $5/MWh at wind energy penetrations of 20–25 percent. The study results also determined that the amount of additional backup generation required to offset gaps in wind production is significantly less than one-to-one and is small relative to the amount of wind power capacity on the grid.[39]

In a number of areas around the country, wind energy output can be forecast with an acceptable level of certainty within a 24-hour period. Further advances in the field of "wind forecasting" are being developed and will result in tools and processes that will enable wind energy output to be predicted with reasonable accuracy to factor into decisions made by electricity dispatchers on a day-ahead basis. In some areas of the country, there is even hour-by-hour scheduling of which power plants will be operating. Grid operators are increasingly familiar with how to integrate wind into electricity systems. And policymakers, such as the Federal Energy Regulatory Commission, are revisiting rules to allow more flexibility for wind resources.[40]

Renewable energy technologies such as wind can also be a vital part of least-cost capital planning for utility transmission and distribution systems. A Lawrence Berkeley National Laboratory study shows that western utilities are increasingly looking at renewable energy technologies as part of their integrated resource plans and have become increasingly comfortable with renewable energy technologies.[41]

Xcel Energy expects to have 2,800 MW of wind capacity on its system by the end of 2007 and 6,000 MW by 2020.[42] PacifiCorp's 2007 IRP plan calls for 2,000 MW of renewable energy (including wind) by 2013.[43] Utilities are also exhibiting greater interest in owning wind projects, with 25 percent of new capacity added in 2006 from electric utilities.[44]

OBSTACLES TO GREATER WIND DEVELOPMENT

The improving economics of wind, the escalating costs of fossil fuels (particularly natural gas), and concerns over environmental issues such as air emissions and global warming all point to a bright future for wind energy in the United States. However, several obstacles to greater use of wind energy remain:

- *Policy Uncertainty.* As mentioned earlier, the on-again, off-again nature of the production tax credit has made the wind industry a boom-and-bust business. The wind industry booms when the PTC is available, but craters when the PTC is unavailable. Similarly, proposals for a national renewable portfolio standard have come before several sessions of Congress, but have ultimately been voted down. Uncertainty over the availability of the PTC and a national renewable portfolio standard has made it difficult for manufacturers to make long-term investments in renewable energy. Most conventional policy support is not subject to similar uncertainty.
- *Equipment Shortages*. Demand for wind turbines has far exceeded supply, and wind turbines and related equipment in the United States are expected to be unavailable until 2009. The American Wind Energy Association is lobbying for a five-year extension of the PTC to at least in part help alleviate supply issues and provide some policy stability.
- *Transmission*. Good wind resources are generally (although not always) located in remote areas, with inadequate transmission capacity to reach urban load centers. Moreover, it is widely acknowledged that the national grid is in serious need of upgrades. One report suggested that as much as $56 billion may be needed this decade to preserve transmission adequacy at its present level.[45] As new transmission improvements are planned, available wind resources should be factored into the planning process. One example is in Texas, where the state has

created Competitive Renewable Energy Zones (CREZ). This program guarantees utilities the ability to recover transmission project costs in areas with high-quality wind resources, even if the wind projects have not yet been built.[46]

- *New Transmission Products.* Aside from building new transmission, opportunities exist to more fully utilize existing lines. In some regions, transmission may be fully reserved on a contract basis, but not fully utilized. The Rocky Mountain Area Transmission Study, for example, found that some major transmission paths in the West operate at full capacity for only 20 to 50 hours per year.[47] Because of this, some have called for a "conditional firm" transmission service that would provide firm transmission service subject to curtailment for a definable number of hours per year to allow transmission systems to be more efficiently utilized.[48] In May 2007, the Federal Energy Regulatory Commission (FERC) adopted Order 890 that updates FERC's open access transmission rule that was issued in 1996 (Order 888). As part of Order 890, FERC incorporated conditional firm transmission service as an accepted transmission product, although FERC limited the maximum contract term to two years. Such a limitation may restrict the impact of conditional firm service for energy companies who desire a longer term of service.
- *Market Rules.* One of the biggest barriers facing wind has been a lack of fair treatment in energy markets. Wind providers operating in regulated markets have been hard-hit by energy imbalance penalties imposed under FERC Order 888. Under Order 888, FERC allowed transmission providers to apply a penalty, at their discretion, if energy deliveries varied 1.5 percent or more (either higher or lower) from advance energy schedules. The purpose of these imbalance penalties was to support the system operator's need to keep systemwide generation and load balance in real time.[49] These penalty provisions, however, allowed utilities the discretion to impose penalties of up to $100 per MWh, sometimes increasing wind costs by more than 50 percent.[50] In May 2007, FERC addressed this issue in Order 890 by adopting the Bonneville Power Administration's tiered set of energy imbalances, which increase as the amount of the deviation increases, and applies the tiered formula to both energy imbalances and generator imbalances.
- *Siting.* Despite its environmental benefits, wind farms face siting challenges that rival those of any other generation or transmission projects. Perhaps the best-known example is the 420 MW offshore Cape Wind project in Massachusetts, which faces a well-financed and determined opposition. Numerous wind projects in other states have encountered similar resistance from local communities. Along with concerns about potential bat and avian mortality, opponents cite construction impacts, noise, damage to view corridors, and the potential for reduced property values. Some developers have also reported siting issues related to impacts on military and navigational radar. Successful siting of wind projects involves educating the public early in the siting process, communicating early and often with stakeholders and landowners, and being flexible in addressing potential concerns.

Wind Power and Air Pollution: Emerging Policy Frameworks

Most sources of air pollution in the United States are regulated under the Clean Air Act. In the Clean Air Act, an overall level of pollution (a "cap") was established, and pollution allowances (rights to pollute) were given to electricity generators based on their amount of fuel input. The cap and number of awarded allowances are reduced over time, resulting in improved environmental conditions. When regulators put in place cap-and-trade programs, such as the NO_x and SO_2 trading programs, there were a predetermined number of pollution allowances given out in the market. Because wind power does not require fossil fuel, it does not emit pollution. As such, wind power was not allocated allowances under the NO_x and SO_2 emissions trading programs, nor has it received any revenue from the sale of allowances, which many other power sources have benefited from if the source cut emissions lower than the required target. This has several implications for wind power projects:

- *Wind power projects have not financially benefited by providing clean energy free of NO_x and SO_2.* Because pollution allowances (NO_x and SO_2 allowances today, possibly CO_2 allowances in the future) have financial value, an allocation of revenues from the sale of allowances would represent a marketable asset for wind owners and make wind power more economical.

- *Wind power could, however, benefit indirectly under a cap-and-trade program for CO_2 if it were designed to send a strong market signal*. Because wind power offers a non-polluting method of generating electricity, wind and other renewable energy resources will be more favorable for utilities seeking to minimize their overall pollution levels. Because utilities will be seeking cleaner sources of electricity, wind power has an advantage. Further, as demand for allowances increases and the cost of compliance rises, wind will benefit from higher market costs for energy.

Polluting sources must purchase allowances to cover their emissions—and clean sources are therefore preferable because they require no allowances. This should benefit renewable energy sources such as wind power. Over time, renewable energy resources do have a significant positive impact on air quality. Market-based cap-and-trade programs can provide several options for wind power developers to gain extra value and increase returns on wind power projects. There are four different program structures available or under consideration. These are: output-based allowance allocations, allowance set-asides, offsets, and recognition of voluntary purchases in mandatory programs.

Output-based allocations. Policymakers do not have to allocate carbon allowances based on fossil fuel use. Allowances can also be allocated based on the output of a generation source. Every megawatt hour of generation could receive a value. Clean sources such as wind power and nuclear energy or hydropower would then be able to sell their pollution allowances, providing these clean sources with an advantage and creating a higher cost for polluters who would need to purchase the rights to pollute from the clean generators. This "output-based" allowance allocation approach is supported by a number of utilities that have made investments in clean technology in advance of any regulation.

Set-aside allowances to support public interests. The NO_x Budget Trading Program is an EPA-administered interstate cap-and-trade program covering large industrial sources and electric generation in 22 eastern states and the District of Columbia. It includes an optional set-aside provisionl; six states included it in their implementation plans.[51] The provision sets aside a predetermined percentage of allowances specifically for energy efficiency and renewable energy projects, including wind power (see Montgomery County case study below). This essentially lowers the total amount of NO_x that can be emitted by a small amount that is taken from the program and reserved for clean energy projects. Projects can qualify for these allowances if they meet certain state specifications; the most important is how many tons of NO_x emissions are expected to be displaced by the project. Qualifying projects receive allowances from the program, which then may be retired or sold in the emissions market for monetary value, thus increasing returns for wind power developers. Current NO_x allowance prices range between $2,000 and $3,000/ton. State set-asides range from 1 to 5 percent of total state allowances.[52]

Offsets under the Clean Air Interstate Rule (CAIR). CAIR is a federal program to reduce SO_2 and NO_x in 28 eastern states and the District of Columbia. States may choose to participate in the program through a cap-and-trade pollution market; in so doing, they may incorporate allowance set-asides as well as an output-based allocation framework for new sources where all electric generators in a state, including wind generators, are allocated allowances based on generation regardless of emissions. These allowances are allocated for free, enabling wind power developers in participating states to use their sale as an added revenue stream. Each state must adopt the EPA promulgated model rule and in the process may include a set-aside. The model rule adoption process is currently under way; CAIR regulations become effective in 2009 for NO_x and 2010 for SO_2.[53]

Recognition of voluntary set-asides under the Regional Greenhouse Gas Initiative. The Regional Greenhouse Gas Initiative (RGGI) is a coordinated, mandatory effort among Northeast and Mid-Atlantic states to cap and reduce CO_2 emissions from power plants in the region.[54] RGGI contains several provisions that are relevant for wind developers. First, each RGGI state must provide a set-aside of at least 25 percent of all state allowances for consumer benefit or strategic energy purpose. Wind generation is likely to qualify for some portion of the set-aside, though each state's rules will differ. Like the NO_x Budget program and CAIR, these allowances can be sold to increase wind project revenue. Second, each state may allocate remaining allowances in any way they see fit.

BOX 4 Wind Power and Emissions Credits: A Case Study of Montgomery County's REC Purchase

In an unprecedented move to link a wind power purchase with the improvement of local air quality, Montgomery County, Maryland purchased 76,800 MWh of wind RECs over two years from Washington Gas Energy Services (WGES) and Community Energy, Inc (CEI) in May 2004. Montgomery County's wind power purchase, enough to power 3,800 households, constituted the largest wind power purchase in the nation by a local government.

The county's purchase grew out of the need to meet ground-level ozone standards set forth in the Clean Air Act. The Department of Environmental Protection examined a number of options to reduce NOx emissions (the primary precursor to ozone) and discovered that a renewable energy purchase would be cost-effective. A wind energy purchase, for example, would cost $32,000/ton/yr, while converting buses to run on natural gas would cost $103,000/ton/yr. In addition, available air quality modeling showed that during noncompliance days in the summer, elimination of all transportation-related NOx emissions would still not reduce ozone to acceptable levels in the county. To meet ozone standards, the county had to address NOx emissions transported from power production in West Virginia's Allegheny Valley.

The county assembled and aggregated energy demand from a group of county agencies, municipalities, and neighboring Prince George's county to bring down the cost of the purchase. While there was no requirement regarding the specific type of renewable energy, the size of the purchase (over 38,000 MWh/year) and the county's requirement that the energy come from a new, zero-emissions resource made a wind power purchase the most likely choice. Officials reviewed bids meeting these criteria and awarded the contract to WGES and their wind supplier, CEI.

In order to receive EPA approval of the purchase, the county had to calculate how many tons of NOx emissions would be prevented. How should the power purchase agreement be written such that the connection between the purchase and reduction in ozone levels could be made? The EPA issued guidelines to respond to these questions, including sample methods to calculate emissions reductions.

Based upon historical power generation dispatch records for the valley, an environmental consultant assumed that new power added to the valley's electricity grid would cause certain plants to reduce their output. Emissions data for those plants were then used to determine avoided NOx emissions. (At the end of the contract period, the county plans to do a "true up" to compare the estimate with the actual impact of the wind farm on emissions in the valley.)

To strengthen the connection between the purchase and air quality improvements in the Washington Metropolitan region, the county included specific terms in their REC purchase contract. The contract made clear that *all* environmental attributes of the wind power generation belonged to the buying group and transferred rights, certificates, and credits to the group. This included credits that might be developed within the contract term. (For example, if West Virginia were to change its current policy and award emissions credits to the wind farm, rights to those credits would be immediately transferred to the county.) The agreement required annual reporting of wind power delivered to the electricity grid. The contract specified that generation must occur in the contract time period and within a specific geographic area. The contract is central to the county's effort to include the purchase in the SIP for Clean Air Act compliance.

This purchase gives precedent to link renewable energy purchases to emissions reductions, provided that emissions modeling has been completed and the terms of the contract are structured appropriately. This has two important implications for the corporate energy consumer:

- Corporations may be able to receive emissions credits for renewable energy purchases in certain states and circumstances. The credits are not guaranteed, but may be obtained via an application process with state or federal regulators. Corporations might consider including local municipalities in an aggregated green power purchasing group and working to see that each purchase is counted toward regulatory compliance.
- Corporate green power activities may build local stakeholder support and enhance stakeholder relations if local health and air benefits result from green power purchases.

Finally, RGGI states have the option to hold and retire an amount of allowances equal to the avoided GHG emissions from voluntary purchases of RECs made by commercial, industrial, and residential consumers. This provision guarantees the emission reduction claims made by RECs purchasers and increases the confidence of buyers in the voluntary market, providing an indirect benefit to wind power developers. RGGI is currently in the implementation phase, where each state adopts the RGGI Model Rule. The program is set to start in January 2009.[55]

In sum, policy efforts to support wind power are now multifaceted. Production tax credits help make investments viable, renewable portfolio standards ensure there is a requirement for utilities to incorporate renewable and wind energy, and a cap-and-trade program could be designed to help capture the avoided pollution of renewable energy. Congress and the states are moving forward with all mechanisms as we seek to support local, clean energy sources. Corporate energy buyers can also diversify their purchases and support further development of wind power.

CONCLUSION

Wind power is emerging as the leading source of renewable energy in the United States. The industry has made significant technical progress and the economics of wind power now make it cost-competitive in many locations. Many of the obstacles that developers face are being overcome as renewable energy markets mature: REC products have helped quell traditional utility resistance to the technology; siting and operational guidelines continue to be refined to help ensure that wind projects are appropriately designed; and the variable output of wind power has proven to be manageable. Policy makers seeking clean, U.S. energy sources are also supporting wind power, and can play an important role in ensuring that competitive markets emerge for this important technology.

Interested corporate energy buyers have a variety of ways to support wind power. Although many purchasing strategies may require new and unfamiliar approaches to energy purchases, buyers can reap tangible economic rewards, particularly in markets where electricity prices are dependent on highly volatile natural gas prices. Additionally, companies can benefit from both the energy diversification—as well as the potential environmental values—associated with reducing the need for fossil fuels to produce electricity.

As of December 2007, 25 states and the District of Columbia support wind and other renewable energy with renewable portfolio standards[56] and several other states have implemented other policies or goals to support renewable energy development. At the federal level, wind power currently enjoys support in the form of production tax credits, and discussions about a national renewable portfolio standard are ongoing. However, wind power can play a significantly larger role in addressing the long-term challenges of energy security, climate change, and environmental quality. Emerging voluntary corporate markets can complement local, state, and national legislation to support a more rapid deployment of these technologies in the areas where they are most economical. By supporting such markets, forward-looking corporate buyers like those in WRI's Green Power Market Development Group can realize significant environmental, public health, and economic benefits, and in doing so further strengthen the business case for wind power.

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The authors alone are responsible for the views and perspectives expressed in this publication.

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23. Projects above or below this range can also be economical depending on project-specific characteristics and available incentives for development.
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31. Calculation using Altamont generating capacity (586 MW) and data in National Renewable Energy Lab. 2003. *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area.* Golden, CO: NREL. Available at: http://www.nrel.gov/docs/fy04osti/33829.pdf.

32. Mortality rates among raptors were particularly high at Alamont. For reasons not yet understood, turbine collision rates throughout the U.S. are higher among raptors than other bird species. See National Wind Coordinating Committee. 2004. *Wind Turbine Interactions with Birds and Bats: A summary of Research Results and Remaining Questions.*

33. For more detailed information on bats and wind turbines, see the presentations given at the National Wind Coordinating Committee's Wildlife Interactions Research Meeting V, held in Lansdowne, Virginia, November 3-4, 2004. Available at: http://www.nationalwind.org/events/wildlife/2004-2/default.htm; and also see presentations given at the Research Meeting VI, held in San Antonio, Texas, November 14-16, 2006. Available at: http://www.nationalwind.org/events/wildlife/2006-3/default.htm.

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36. As an illustration, the Backbone Mountain project (90 wind turbines) is right next to the ridge in Maryland where the 44 -turbine Mountaineer wind project is located.

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    Note: In May 2007, FERC addressed this issue by adopting Order 890. FERC adopted the Bonneville Power Administration's tiered set of energy imbalances that increase as the amount of the deviation increases, and apply this tiered formula for both energy imbalances and generator imbalances. Tier One imbalances of less than or equal to 1.5 percent of scheduled energy, or up to 2 MW (whichever is greater), would be netted monthly and settled at the incremental or decremental cost. Tier Two imbalances of between 1.5 and 7.5 percent of scheduled energy, or between 2 and 10 MW (whichever is larger), would be settled at 90 percent of decremental costs and 110 percent of incremental costs. Tier Three imbalances of over 7.5 percent, or greater than 10 MW (whichever is greater), would be settled at 75 percent of decremental costs or 125 percent of incremental costs. Intermittent resources are exempt from the Tier Three imbalance charges, and instead pay Tier Two charges for imbalances greater than 7.5 percent. See Federal Energy Regulatory Commission. *Preventing Undue Discrimination and Preference in Transmission Service*. Docket Nos. RM05-17-000 and RM05-25-000; Order No. 890, May 14, 2007; and Federal Energy Regulatory Commission. *Preventing Undue Discrimination and Preference in Transmission Service*. Docket Nos. RM05-17-000 and RM05-25-000; Order No. 890, May 14, 2007.

51. These states are Indiana, Maryland, Massachusetts, New Jersey, New York, and Ohio.

52. U.S. Environmental Protection Agency 2005. State Set-Aside Programs for Energy Efficiency and Renewable Energy Projects Under the NOx Budget Trading Program: A Review of Programs in Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, and Ohio. Draft report. Washington, DC: Office of Atmospheric Programs, Climate Protection Partnerships Division.

53. For more information on CAIR, see: www.epa.gov/cair/

54. Currently the RGGI states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

55. For more information on various aspects of RGGI, see: www.rggi.org.

56. See: http://www.dsireusa.org/documents/SummaryMaps/RPS_Map.ppt.

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