Fifteen Case Studies:

Public Power Investments in Wind

Prepared for
American Public Power Association
Demonstration of Energy-Efficient Developments Program

Sponsored by
Western Area Power Administration
U.S. DOE Wind Powering America Program

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** The case studies in this collection reflect the leadership and innovation of public power utilities nationwide in wind development and wind power purchasing. Each one takes a detailed look at project drivers, technical approaches, financing and marketing aspects. Each also offers lessons learned and prospects for program expansion. Nine of these case studies were completed in spring 2005, while three, indicated above by an asterisk (*), were completed in fall 2006. The final three case studies in this collection were written in 2008 and 2009. The local utilities and joint action agencies featured have generously shared their experiences and insights in hopes of advancing more wind projects among public power utilities nationwide.*

Public Power Harvests the Wind

Sample case studies reveal trends and unique solutions

	PROJECT ATTRIBUTES	Austin	AMP Ohio/ Bowling Green	ARPA/Lamar	Platte River/ Fort Collins	MEAN/Aspen	Missouri River/ Moorhead/ Worthington	Sacramento (SMUD)	Seattle	Waverly	Nebraska Public Power District	Delaware Municipal Energy Corporation	Princeton Municipal Light Department
General	Size of Joint action agency/utility	361,000 customers	JAA with 90 members; lead utility– 13,400 customers	JAA with 7 members; lead utility– 5,900 customers	JAA with 4 members; lead utility– 58,000 customers	JAA with 59 members; lead utility– 2,500 customers	JAA with 58 members; lead utilities–14,000 and 5,200 customers	548,000 customers	365,000 customers	4,400 customers	88,000 customers	1,500 customers	JAA with 9 members; lead utilities-- 22,000 and 12,000 customers
General	Direct ownership												
General	Outside project developer/marketer												
General	Distributed generation system												
General	JAA wind farm with >6 turbines												
Key Drivers	Portfolio diversification												
Key Drivers	Environmental hedge												
Key Drivers	Economic development												
Key Drivers	Regulatory drivers	Local			Local		Minnesota REO	Voluntary, ahead of state RPS	Voluntary	Local and IA green power option	Voluntary	State RPS	State RPS
Key Drivers	Community pride												
Business Strategies	Rate-based (all or some costs)		Joint-venture financing							Widely sold			
Business Strategies	Green power program (own RECs)									Anticipated			
Business Strategies	Green power program (purchased RECs)		Sold and remarketed through GME, AMP-Ohio										
Business Strategies	Innovative project financing/design												
	Highlights	Large wind project; highgreen power sales	Agency members opt in;partnership with GME	Economy of scale by locating near large windfarm	Diverse wind portfolio; local green power pioneer	Diverse wind portfolio; innovative local program	Partnership to develop community wind	Direct ownership of large windfarm	Innovative purchasing to meet high goal	Wind pioneer; local green tag program	Innovative ownership structure to promote community development and minimize costs	Direct ownership of small community-based wind farm	Early action to support offshore wind development

SAMPLE CASE STUDY: AUSTIN

Austin Energy Green Power Marketing

Austin Energy's GreenChoice program is one of the most successful green power marketing efforts in the nation. In 2004, it sold more than 334,000 MWh of green power, 80 percent of which was generated by wind. How does Austin Energy do it? The GreenChoice staff believes these five strategies help.

1. **Marketing strategy treats GreenChoice as a product.**
2. **Pricing reflects the long-term price stability of renewables.**
3. **A product manager runs the program, with an inter-departmental team.**
4. **The program has executive support and city council support.**
5. **Marketing emphasizes the business customer recognition package.**

What's unique about public power wind?

Each case study in this collection takes a detailed look at project drivers, technical approaches, financing, marketing approaches and outcomes, lessons learned and program outlooks for public power wind development. The chart above summarizes the variety of projects covered. Yet, taken together, the case studies suggest instructive trends in public power wind development.

- The economics must work, but they are not the main drivers of the wind investment decision.
- Self-reliance and community pride are especially powerful drivers.
- Community wind projects tend to evolve into partnerships among utilities, in order to achieve economy of scale.
- Significant opportunities exist for distributed, lower wind-speed systems that sidestep transmission problems. Successful projects often require joint action agency involvement in engineering planning and review of local utilities' all-requirements contracts.
- Regulations affect public power differently. Usually exempt from RPS requirements, they must set voluntary goals. Successful efforts usually include IRP planning and public involvement.
- Public power utilities are developing increasingly diverse portfolios, including wind power obtained through project ownership, co-ownership, and innovative wind purchase contracts.

WIND POWERING AMERICA
APPA American Public Power Association
Western Area Power Administration

Public Power Harvests the Wind

Partners in southeastern Colorado jump on a big wind opportunity

Arkansas River Power Authority - Lamar Light and Power

Highlights

When the Arkansas River Power Authority and one of its member cities added five wind turbines to the massive Colorado Green Wind Farm, it made a big difference for all of ARPA's members in southeastern Colorado and northern New Mexico. Today, ARPA supplies affordable wind power to Holly, La Junta, Lamar, Las Animas, Springfield, and Trinidad, Colorado, as well as to Raton, New Mexico. The joint action agency owns two of the turbines, and the City of Lamar owns three of them. According to Lamar Light and Power electric superintendent Rick Rigel, "Colorado Green gave us the economy of scale we needed to make our own project feasible." The ARPA/Lamar project demonstrates how smaller public power entities can get the greatest possible benefit from their local wind resources.

The five 1.5 MW turbines that provide wind energy to the ARPA system are a great source of pride for the surrounding communities, and together with the entire 162 MW wind farm they have brought measurable economic development benefits. Construction brought many workers to these communities and revitalized all kinds of local businesses. Some of these benefits lingered, especially through a large increase in property tax revenues on wind lease-holders' lands.

Wind has not been a panacea for ARPA. The wind generation so far has not helped with summer peaking, and Lamar has chosen to refurbish a natural gas plant into a coal-fired generator. Transmission constraints have prevented the immediate expansion of an excellent wind site near Springfield. ARPA communities have become advocates for wind and for finding solutions to wind's related challenges.

Building the wind farm near Lamar, Colorado

History

The project began with a false start in the late 1990s, when Enron Wind began prospecting for a commercial wind farm in the area. This would become the Colorado Green Wind Farm. Enron's interest inspired Lamar's now-retired utility manager, Leon Sparks, to see if the community could get into the game. Working with ARPA and using anemometers from the Western Area Power Administration, Lamar began collecting wind data in February 2001. Subsequently it selected a site and began lease negotiations. Lamar planned to ride on the coattails of Enron's economy of scale by installing four or five of the same turbines that Enron planned to use.

By 2001 Enron had a solid proposal for the Colorado Green Wind Farm, a 162 MW, 108-turbine wind project south of Lamar,

including a promise that Xcel Energy would buy the output for at least 15 years. Selling a few extra wind machines in the area only made the deal sweeter for Enron. However, Enron's bankruptcy derailed the plan.

Patience became part of Lamar's winning strategy. GE Energy eventually bought Enron Wind and established GE Wind. But GE Wind was interested in technology, not project development. Finally, two developers, Shell Wind Energy and PPM Energy stepped forward. Colorado Green was back on track, and so was the ARPA/Lamar project. During the interim, Lamar had also taken the chance to gather more wind data and to secure a site that struck the best compromise between wind production and access to the Lamar system. The team added another wind site, too, near Springfield. The availability of volume discounts thanks to the nearby Colorado Green Wind Farm would save 15 to 20 percent off the total cost of the project.

How ARPA and Lamar measure up to the Colorado Green Wind Farm

Colorado Green Wind Farm

- 162 MW total rated capacity
- 108 GE 1.5 MW turbines
- Developed and owned by Shell Wind Energy and PPM Energy
- Xcel Energy to purchase output via long-term contract

ARPA and Lamar Wind Project

- 7.5 MW total rated capacity
- 5 GE 1.5 MW turbines
- Three turbines owned by Lamar Light and Power
- Two turbines owned by Arkansas River Power Authority
- All output sold by ARPA to its members

The project, including three turbines that are owned by Lamar and two that are owned by ARPA, are financed by tax-exempt revenue bonds. Both bond issues were financed over 20 years, on similar terms.

Rigel succeeded Leon Sparks as electric superintendent in Lamar. As the Springfield site began to take shape, the electric superintendent there, Darwin Hansen, became a leader, too. Throughout the design and construction process, California-based Sea West Windpower, a California firm, provided specialized engineering expertise. Jim Henderson, general manager of ARPA, brought all the project partners together. The four 1.5 MW GE turbines at Lamar were commissioned in late February 2004, with a fifth following shortly thereafter in Springfield. With groundwork already laid, turbine construction and commissioning took less than three months.

The first six months of reported data are impressive. The capacity factor for turbines at the Lamar site is estimated at more than 30 percent. The capacity factor at the Springfield site is averaging above 40 percent, with an astounding 66 percent reported in September 2004. GE Wind is responsible for turbine maintenance. Other than typical early-stage adjustments, the turbines have been trouble-free so far.

The Lamar utility operates all five ARPA/Lamar turbines from its power plant control room. For control, both wireless and telephone cable communications are used. ARPA purchases the output of the turbines that are owned by Lamar Light and Power and blends it with generation from its own wind turbines, as well as with the overall supply mix. The wind energy is rate-based, so the costs and benefits are shared among all ARPA members. Rigel says that the people of Lamar are proud to know that their utility owns wind turbines capable of meeting about 14 percent of their total energy needs (a net generation of about 14,000 MWh per year). In actuality, the wind energy is dispersed through the grid.

Strategic drivers

Resource diversification. One driver for the project was the rising cost of operation for a natural gas plant at Lamar. Lamar, which owned the plant and sold its output to ARPA, finally shut it down in 2003. ARPA's supply portfolio included some other natural gas and federal hydropower, but it primarily relied on coal-fired generation. Wind generation has added diversity to the system's portfolio, thus lowering ARPA's gas-price risk. However, according to Henderson, the joint action agency is still not completely satisfied with its portfolio. Wind generation's intermittency remains an unresolved issue. ARPA remains concerned that rising natural gas prices and increasing use of wind power throughout the West may put upward pressure on wholesale demand charges.

To be on the safe side, ARPA is supporting development of more firm capacity on its system. Lamar's natural gas plant is being recommissioned as a 38.5 MW coal-fired plant, with completion expected in 2008. According to Henderson, the region needs firm capacity, and while coal carries some risk, it is less risky right now than natural gas. At the same time, wind energy will complement the coal generation. New demand charges aside, wind will remain a clean, low-cost resource long into the future. And if the wind project generates more energy than ARPA needs at any given time, the wind power will always find a market.

Environmental concerns. Environmental concerns were a strong driver behind another large wind project in the region called the Colorado Green Wind Farm. In 2001, the Colorado Public Utilities Commission ordered Xcel Energy to include purchases from that 162-MW project in its "preferred portfolio." This occurred under pressure from a number of Colorado environmental groups, including the Land and Water Fund of the Rockies (now Western Resource Advocates). They reasoned that Xcel needed to begin a shift from its nearly exclusive dependence on coal, in order to reap clean-air benefits and to save water in the drought-prone region. Regulators also liked the proposed project's cost-effectiveness.

According to Leon Sparks, former electric superintendent of Lamar Light and Power, the community took pride in its role, building on the Colorado Green project and its environmental benefits. Lamar Light and Power also likes the environmental balance that wind development gives its portfolio. The new wind generation will help to mitigate emissions from the coal-fired project that it recently began.

The impact on ARPA and its member cities of a renewable portfolio standard (RPS) ballot measure that passed in Colorado in 2004 will not be known for a year or more. But ARPA and its members believe they will benefit because they are already a step ahead of RPS regulation.

Economic development. The economic development benefits of the ARPA/Lamar project are outstanding. The region is relatively remote and dependent on relatively unstable agriculture-based industries. Currently the region is in a severe drought, which has hurt both farming and ranching. Prowers County, where Lamar is located, has one of the lowest per capita incomes in the state.

Wind development brings a steady income for landowners who hold wind leases, and it adds some permanent employment in wind system maintenance and operation. More important, it increases the local tax base. Typically, wind projects under 10 MW would bring these benefits in small doses. But in the Lamar area, the benefits have been dramatic, due to the combined impacts of the ARPA/Lamar project with the 162-MW Colorado Green project.

The Prowers County assessor has estimated that the Colorado Green project alone will generate more than $2 million in tax

revenues per year. More than half of that total will accrue to area schools. About $765,000 per year will accrue to county government, and about $190,000 per year will go to the county medical center. This local tax windfall is likely to add nearly $23 million to the local economy over the 30-year life of the wind farm. Actual tax data will not be available until 2005. The assessor told the *Lamar Daily News* that the county has not decided yet exactly how it will distribute these benefits over the long term.

According to Lamar Light and Power electric superintendent Rigel, the project also has had a revitalization effect. Colorado Green wind farm construction created 200 to 300 jobs. Once construction was completed, about a dozen directly wind related jobs remained. In addition, some local businesses have been able to retain workers, as the community begins, for the first time in years, to grow. Tourist traffic is up, too. Rigel expects that someday wind farms will become a common sight, but for now they draw bus loads of visitors from near and far.

The ARPA/Lamar project adds just 4.6 percent to the size of the Colorado Green wind farm, but the added benefits are not lost on the people of Lamar and Springfield. According to Darwin Hansen, electric superintendent of the Springfield municipal utility, when people found out that the Springfield wind site was delivering the best performance in the region, they became overwhelmingly interested "in getting the big wind in here." That will take an investment in new transmission, which community leaders are actively supporting.

Technical details

A full reporting of technical details, though not current, is available on the Lamar Light and Power Web site, www.ci.lamar.co.us/lightpower/info.htm. In summary, the project utilizes five 1.5 MW turbines from GE Wind Energy, for a total rated output of 7.5 MW. Each turbine is about 260 feet tall and has blades that are about 111 feet long. The three blades on each turbine are designed to operate between 11 and 22 revolutions per minute. Each blade has its own independent adjustment mechanism that allows it to change pitch depending on the wind speed. Actual performance during the first nine months of operation has exceeded engineering expectations, especially at the Springfield site. It is also important to note that O&M personnel report no problems with bird nesting or bird loss.

The turbines generate power at 575 volts. Transformers at each turbine site step this up to match the distribution voltage of 24.9 kV. The turbines are connected to each other with fiber optic cable. Communications and control from the Lamar control room are accomplished through wireless communication (to the Lamar site) and telephone-cable (to the Springfield site).

Financing and contractual details

Each turbine in the ARPA/Lamar project cost about $1.6 million, installed. For its three turbines, the City of Lamar issued $6 million of revenue bonds, taking advantage of a 40-year low in municipal bond interest rates. The term is 20 years, with annual payments of more than $400,000. ARPA used similar financing for its two turbines.

The total cost of wind energy is estimated at less than 4.5 cents per kWh. Project sponsors note that they do not include federal Renewal Energy Production Incentive (REPI) payments in their cost calculations. REPI is subject to annual budget allocations and has not always been adequate for all program applicants.

Because ARPA has all-requirements contracts with its members, Lamar sells wind power from its turbines to ARPA. Thus, the entire output of the ARPA/Lamar project is shared among ARPA members. The cost of electricity from the project is

rate-based. There has been no rate impact. However, ARPA anticipates introducing a new rate structure, including demand charges. This could affect the overall cost of keeping wind in the system portfolio. Early data suggest that the wind resource will not be available during ARPA's peak-demand times, which occur in midsummer. The utility plans to utilize new coal-fired generation to ensure that it meets system demand at all times.

Conclusions and outlook

The ARPA/Lamar project is exceptionally popular among customers in the drought-prone region of southeastern Colorado. The local economy has benefited from both the Colorado Green project and from the ARPA/Lamar turbines.

ARPA's concerns about the intermittent nature of wind are relatively common among utility systems. The significant fact is that ARPA's concerns did not prevent it from moving ahead with the project. Local partners agree that the project owes a lot to Leon Sparks, now-retired electric superintendent of Lamar Light and Power, who was a knowledgeable advocate. Partners also cite the importance of working with an experienced engineering contractor (in this case, Sea West Windpower). Together, the ARPA/Lamar team succeeded in securing excellent wind sites and in capturing the economy of scale that GE Wind and others brought to the Colorado Green project.

ARPA has rate-based the wind power without impacting rates to date. ARPA's total wind resource represents significantly less than 10 percent of the system's supply portfolio, and utility experience nationwide indicates that intermittency should not be an issue until it represents more (some say significantly more) than 10 percent of the system portfolio.

Darwin Hansen, electric superintendent of the Springfield municipal utility notes that people in his community want to see more wind developed. The Springfield site could accommodate a 40 to 50 MW wind farm. Transmission constraints are an immediate barrier. However, Hansen believes the site can be developed eventually, and that it could benefit the ARPA system. The ARPA/Lamar team is also aware of other wind developers prospecting in the region, adding a competitive aspect to the decision-making process.

Some economic development benefits accrue to the community no matter who is the developer or the purchasing utility. In fact, planned wind expansion to meet Xcel Energy's future needs is likely to benefit more ARPA towns. However, to reap the greatest benefits, public power utilities must stake their claim to the wind. ARPA/Lamar partners enjoy the equivalent of free fuel for their five wind turbines. Wise project planning lowered their capital costs. The current construction of new coal capacity at Lamar may dull the appeal of the overall project to some green power advocates, but from another viewpoint, the wind power helps to mitigate coal plant emissions. And the coal plant does not preclude the development of more ARPA wind power in the future.

When asked to name the drivers behind the local wind project, Henderson named three reasons, which summarize the project well:

1. The project provided the opportunity to get involved with wind, to gain experience with this increasingly important technology.
2. The absence of regulatory problems made the project even more attractive. Wind is very popular, and it reflects well on the utility.
3. The opportunity to work with big wind suppliers and developers significantly cut costs. This long-term cost-effectiveness will be further enhanced by the fact that the project is locally owned.

Public Power Harvests the Wind

Strong commitment and smart marketing pay off

Austin Energy

Highlights

In December 2003, Austin Energy announced its new energy plan, including goals that put it at the forefront of utility energy efficiency and renewable energy development nationwide. Austin plans to meet 20 percent of its energy needs with renewables, and 15 percent with energy efficiency, by 2020. At the time of this announcement, the utility was already engaged in negotiations to more than double its existing wind generation. It will purchase the output from a 91.5 MW wind farm near Sweetwater, Texas, scheduled for completion in early 2005. It has other agreements in place to purchase the output from a wind farm at King Mountain, near Midland (representing 76 MW), and a 10 MW share of a wind farm owned by the Lower Colorado River Authority. That brings Austin's wind resource to more than 177 MW by 2005. Together with generation from landfill gas and solar PV, renewable energy will add up to more than 5 percent of Austin Energy's total resource portfolio in 2005.

Austin Energy's commitment to renewable energy stems from its tradition of innovative problem solving. It offers useful lessons for public power systems that face fuel cost risks, growing customer demand for green power, and a constant need for economic development. It has demonstrated savvy in its power-contract negotiations. And its green power marketing program merits special attention. Austin's GreenChoice program is the number one green power marketing program in the U.S., in terms of total kWh sold. In 2003, GreenChoice sales surpassed those of the next largest green power program, Portland General Electric, by more than 30 percent.

King Mountain Wind Ranch near Odessa, Texas. Photo: Cielo Wind Power

Yet Austin Energy faces many of the same challenges that other public power systems do, in securing transmission access and in balancing immediate concerns against long-term interests. Austin Energy is a pacesetter with a practical bent.

History

Austin Energy has been a leader in wind energy for a decade. In the mid-1990s, it became a partner in one of the nation's first wind farms, a 35 MW project utilizing 112 Kenetech turbines owned by the Lower Colorado River Authority. Austin agreed to purchase output representing 10 MW. This wind power is still in its portfolio.

In 1999, Austin Energy committed to meeting 5 percent of its energy needs with renewables by 2005. This commitment spurred a number of new renewable energy projects and negotiations, including an agreement to purchase 76 MW from a wind farm at King Mountain, near Midland. The King Mountain wind farm, commissioned in 2001, has a total of 278 MW of wind generation. It utilizes Bonus 1.3 MW turbines, from the Danish manufacturer Danregn Vindkraft (soon to become part of Siemens Power Generation). Cielo Wind Power developed the site, and FPL Energy subsequently acquired it.

Originally, Austin Energy's wind power from LCRA was rate-based, with costs and benefits spread among all customers. But the Austin project team decided that wind generation from King Mountain could be sold as a green power product. It made this decision based on customer surveys and local support for other renewable energy programs. (Later, LCRA wind power was also added to the green power program.)

According to Roger Duncan, Austin Energy assistant general manager, the GreenChoice program has succeeded largely because it shows customers the economic benefits of investing in renewables. Customers pay for the program through a special GreenChoice Charge, which replaces the fuel-adjustment charge. The GreenChoice Charge is set to pay off the capital investment and operating costs required to tap the renewable energy. As such, it is relatively stable, compared to highly volatile prices for natural gas. Shortly after Austin Energy initially rolled out the GreenChoice program in 2000, natural gas prices skyrocketed. The utility had to raise the fuel adjustment charge for the conventional fuel mix—but it did not raise the GreenChoice Charge. Customers quickly picked up the benefit of renewable energy's price stability; it became one of the main drivers behind the program's success.

As of December 2004, the charge for GreenChoice customers is 3.3 cents per kWh. Subscribers who signed up at 3.3 cents will continue to pay 3.3 cents until December 2013, no matter how the standard fuel adjustment charge, reflecting gas prices, may change.

Austin Energy planners and the GreenChoice marketing team have worked

Austin Energy
Green Power Marketing

Austin Energy's GreenChoice program is one of the most successful green power marketing efforts in the nation. At year-end 2004, the program had subscriptions for 382,988 MWh per year, 80 percent of which was generated by wind. How does Austin Energy do it? The GreenChoice staff believes these five strategies help.

1. Marketing strategy treats GreenChoice as a product.

2. Pricing reflects the long-term price stability of renewables.

3. A product manager runs the program, with a cross-departmental team.

4. The program has executive support and city council support.

5. Marketing emphasizes the business customer recognition package.

hard to set the right prices for subsequent groups of GreenChoice subscribers. Their objective is to cover all the costs of green power (80 percent of which is wind power). Some component costs of wind power are harder to predict than the team had expected. Transmission congestion has affected the total amount of wind power that is available and the amount of green power the utility must buy on the market. With each subscription group, however, the team believes it is getting closer to reflecting actual, still very competitive, costs.

Large customers have been more receptive to the GreenChoice program than any other customer class. This may be because they are savvier at estimating the value of what amounts to a 10-year contract price for green power. Business customers also appreciate the marketing support and recognition that Austin Energy provides. The program has become an economic development tool, because it portrays the Austin business community as progressive and concerned. GreenChoice has won numerous awards from environmental, green marketing, and consumer-service marketing organizations.

The new Sweetwater wind acquisition will be marketed through the GreenChoice program, too. Eventually, Duncan predicts that more renewables will be rate-based or marketed through a different channel all together. Meanwhile, GreenChoice continues to grow at an average of 41 percent per year.

The new Sweetwater wind farm is being developed by Renewable Energy Systems (RES). The site utilizes 61 1.5 MW GE turbines. One advantage to this new wind farm is that it has access to a 345 kV transmission line.

Power purchase agreements, like the ones Austin Energy has with FPL Energy and RES, can ease the burden of project risk. They also provide an exit strategy at the end of the contract term, so the utility can eventually partner up with a different wind farm or build its own. Austin is seriously considering owning its own wind generation in the near future, Duncan says. This would allow the utility to drive more of the key development and operations decisions associated with the resource.

Strategic drivers

Resource diversification. Austin Energy's conventional fuel mix is approximately one-third coal, one-third natural gas, and one-third nuclear energy. Recently, natural gas prices have become extremely volatile, with a tendency to skyrocket. Austin Energy believes that all fossil fuel prices are going to rise in response to geopolitical, environmental, and technical pressures. The utility's wind program has saved money on natural gas costs over the past few years. According to Duncan, the utility is seriously exploring a variety of strategies in addition to wind development, to increase resource diversification.

Austin Energy has one of the strongest solar energy programs in the country. It recently committed to developing as much as 100 MW of distributed solar by 2020. It has tapped landfill gas, but the supply is limited. It is investigating other sources of biomass energy, including using switchgrass as a fuel. Yet wind will be Austin's major renewable resource for the foreseeable future. Austin Energy recognizes intermittency as a problem with wind, but its wind resource is still small relative to the utility's overall portfolio. Eventually, energy storage systems, like compressed air storage, or in the longer term hydrogen, may solve some intermittency problems. For now, Austin Energy believes that the more diverse its portfolio, the less trouble it will have with intermittency and a host of other risk issues.

Environmental concerns. Austin is widely recognized as a community that values the environment. The utility has implemented programs that promote clean energy and

energy efficiency since the 1980s. Recently it has taken a leadership position on climate risk. In 2003, the World Wildlife Fund named Austin Energy one of five utilities in the U.S. that was at the forefront of addressing climate risk through its commitment to renewable energy and energy efficiency. Austin's city and utility leaders are beginning to recognize climate risk in their long-range plans. They believe that the city will benefit in the future if it becomes a national center for green industries, fueled by clean energy.

This belief is supported by research. In 2003 the Texas State Energy Conservation Office, the City of Austin, and the U.S. DOE funded a study under a program called the Community of the Future Initiative. This study drew on technical advisors and citizen groups to envision an achievable sustainable energy future for Austin. It resulted in the publication of a book called *Silver in the Mine*, by Michael Osborne (who now works for the utility). The book, with recommendations for policy consideration, is available on Austin Energy's Web site, www.austinenergy.com.

Consumer demand. Austin energy has long been aware of consumer demand for renewables, including wind energy. The utility completed surveys and market research before it launched the GreenChoice program, and its assessment of the demand for green power has been proven. According to the U.S. DOE National Renewable Energy Laboratory (NREL), GreenChoice ranks as the number one green power program in the U.S., measured by the amount of energy sold each year.

As of fall 2004, GreenChoice program statistics included:

- 383,000 MWh of renewable energy annually, purchased through program subscriptions.
- 7,440 residential subscriptions, or 23 percent of the total kWh purchased.
- 309 commercial subscriptions, or 77 percent of the total kWh purchased.
- Of the commercial subscriptions, 48 companies are Corporate Champions, purchasing >700,000 kWh per year.
- The Austin Independent School District purchases 45,000,000 kWh annually from GreenChoice, accounting for 30 percent of its electricity.

In October 2003, when the school district announced its purchase, Austin Mayor Will Wynn applauded district officials for helping to make Austin "the clean energy capital of the world."

Economic development. The economic development benefits of Austin Energy's wind program are less apparent than the economic development benefits of its distributed energy initiatives, only because the wind farms are far away. It would be hard to attribute any job development in Austin *directly* to wind power. However, companies that support the GreenChoice program benefit from the utility's multifaceted recognition program. And the city has benefited from its image as a clean-energy destination. According to Carol Harwell, who leads the GreenChoice program, that program, along with Austin Energy's other progressive programs, has helped the to secure convention business for green-energy and environmental gatherings, including the World Energy Engineering Congress. City leaders believe that within the next few years, a number of companies with businesses directly related to clean energy will locate or expand in Austin.

Technical details

Austin energy is not directly involved in the technical operations of its wind suppliers. Technical details are summarized in the History section, above.

Transmission issues have greatly influenced the success and growth of the Austin wind program. According to Duncan, supplies from the King Mountain wind farm in West Texas have been curtailed due to transmission constraints "since day one."

Because of this, the utility has had to buy some wind power on the spot market at a much higher cost.

Duncan is optimistic that ERCOT, the regional transmission agency, will resolve some of its wind-related transmission problems. However, transmission is a source of frustration and added cost. For this reason, Austin Energy carefully considered transmission access in its contract with the Sweetwater wind farm. That site has good transmission access. Duncan says he also expects to see coastal wind farms in Texas, which will have better transmission access. He is optimistic about the development of small wind machines (about 5 kW) that can be mounted unobtrusively on city buildings and operated as part of a diverse distributed energy system. The solutions to future energy problems require "thinking outside the box," he says.

Financing and contractual details

Austin is currently utilizing power purchase agreements with LCRA, FPL Energy (for King Mountain), and RES (for Sweetwater).

Mark Kapner, who spearheaded contractual negotiations for Austin Energy, offers advice for other public power utilities that are working with wind suppliers for the first time. Most important, he advises utilities to make sure the supply agreement is absolutely clear on who is responsible for costs in the case of technical problems and transmission problems. Who will pay for energy that is not produced or not delivered? This question is more complex than it seems, because the reasons for failed production and delivery are numerous and complex. Kapner advises a process of asking "what if" questions.

He also notes the value of "real energy" versus renewable energy certificates (also known as green tags). Austin has found that customers appreciate knowing where their wind power is coming from. It is important in negotiations to be sure the utility is buying both the energy and the "green tag" environmental attributes. So far, Austin has not participated in the green tag market.

Like other public power utilities, Austin supports development of a tradable production tax credit, which would make it more cost-effective for public power utilities to own their own wind generation. However, Austin has found that the costs of waiting for the perfect financial conditions are higher than the costs of moving ahead in the wind arena. When construction at the Sweetwater site was at risk because renewal of the production tax credit was delayed, Austin Energy engaged the wind farm developer to move ahead anyway. The utility agreed to pay a higher price for wind generation in any months when the supplier could not benefit from the production tax credit. Austin Energy does not like to call this a gamble, but nevertheless, it won. Construction continued, Congress renewed the tax credit, and Austin will get wind power deliveries on time without having to pay any premiums.

Conclusions and outlook

Austin Energy has become exceptionally savvy about emerging clean energy markets by encouraging staff development and by tapping expert advice. This has helped the utility to make bold but well-reasoned decisions as it builds one of the largest renewable energy programs in the U.S.

The utility has embraced change in ways that other utilities might find difficult at first. It has listened to its customers' concerns about the environment and even about climate change. It has asked "what if" questions about the risks of continuing down a conventional energy path, and it has asked the same kinds of questions about the risks of investing significantly in renewables.

According to Roger Duncan, assistant general manager, transmission is a major challenge to large wind development in

Texas and elsewhere. Wind resources are seldom rich where transmission capacity is abundant. Austin believes utilities must work with policymakers to resolve transmission issues. At the same time, Austin has started to consider new wind options, including owning wind generation and seeking out new wind sites that do not pose such major constraints.

Duncan also stresses the importance of creativity in designing green power programs. Austin's GreenChoice Charge (which replaces the fuel adjustment charge) sends a clear and positive message to consumers. It has proven more effective than most other options, which ask customers to buy blocks of green power, in addition to their regular electric bill. Austin acknowledges that many utilities do not have fuel adjustment charges, or they are prohibited by regulators from using any similar per-kWh adder for green power. However, Duncan and members of his staff advise other public power utilities to look for solutions. Ideally, pricing mechanisms should reflect the relative stability of renewable energy costs over time. "The utility uses wind as a price hedge, and so can the consumer," Duncan says.

Austin is also ready to embrace new clean energy technologies as they are proven. The costs of dealing with wind's intermittency are eased when wind is part of a more diverse mix of viable clean energy options.

Public Power Harvests the Wind

Delivering strong benefits from modest wind power resources

Bowling Green Electric Utilities

Highlights

In recent years, wind power has begun to make its mark on the American landscape, beginning for the most part on windy plains west of the Mississippi. Now, a four-turbine wind farm in Bowling Green, owned by ten Ohio municipal utilities, proves that wind power also works for communities far from the Western plains. The Bowling Green site has modest wind resources—Class 2 on a scale of one to seven. But Daryl Stockburger, director of Bowling Green Electric Utilities, has worked with other partner cities, American Municipal Power-Ohio (AMP-Ohio), Green Mountain Energy, and project consultants to get the most out of this local wind resource.

Bowling Green is clearly the project's leading sponsor. Stockburger initiated the idea and pursued a leading ownership role for Bowling Green. But the project won strong support from nine other AMP-Ohio cities, which together with Bowling Green formed the Ohio Municipal Electric Generating Agency Joint Venture 6 (OMEGA-JV6). AMP-Ohio and Green Mountain Energy served as project developers, and OMEGA-JV6 purchased the completed project. Construction took place in two phases. The first was completed in November 2003, and the second in November of 2004. Each phase involved construction of two 1.8 MW Vestas wind turbines. Total rated output for the wind farm is 7.2 MW.

The wind farm provides cost-competitive green power, generated from a local resource. It has boosted community pride and economic development. And it helps AMP-Ohio to market its green power program. This in turn helps AMP-Ohio to balance its resource portfolio. The project partners see this relatively small wind venture as a strong beginning, which will be followed by more renewable energy development in Bowling Green and throughout Ohio.

Dedication ceremony for Ohio's first wind project Bowling Green. Photo: Aaron Godwin

History

Like several other leading wind power cities, Bowling Green is home to a university. Discussions about environmental sustainability and energy options have been ongoing at Bowling Green University for decades, and over time,

interest in energy efficiency, load management, and renewable energy grew city-wide. Prior to the wind acquisition, Bowling Green Electric Utilities had already invested in some renewable energy — notably hydropower, landfill gas, and to a lesser extent solar photovoltaics.

Daryl Stockburger, Bowling Green's longtime utilities director, says he has been watching developments in wind power for many years, as part of his interest in building a diverse, sustainable energy portfolio. In the late 1990s wind costs began to come down. At the same time wind technologies improved, especially in their ability to harvest energy from low-speed wind resources. Stockburger worked with SEED Ohio (now Green Energy Ohio), a nonprofit energy agency, to lay the technical groundwork for a wind demonstration. He worked with volunteers to monitor wind resources around Bowling Green and to outline a project plan.

Local support for renewable energy was evident because the utility had been running a successful green power marketing program since 2000. The program supported developments of landfill gas, small hydro, and solar photovoltaic projects. In 2000 and 2001, Bowling Green Electric ranked among the top ten green power marketing programs in the U.S., based on the percentage (up to 3.4 percent) of customers that subscribed. Recently the utility opted to participate in the AMP-Ohio green power program. It is part of the APPA Hometown Connections suite of programs. Green Mountain Energy provides the green power, but its product offerings in Ohio all rely on in-state generation, now including the Bowling Green wind project. In fact, the power marketing partnership between AMP-Ohio and Green Mountain was an important part of project financing.

Bowling Green looked to its joint action agency to help develop the project, which it configured as one or two wind turbines. But as neighboring utilities learned about the proposed project, it began to grow. First, Cuyahoga Falls, expressed an interest in sponsoring one 1.8 MW turbine. Soon about a half-dozen cities voiced an interest in ownership. Green Mountain Energy, a large green power developer and marketer, also offered support. The partners decided that AMP-Ohio and Green Mountain would own the project during its development and then sell it to a joint venture representing the participating local utilities. The venture was called the Ohio Municipal Electric Generating Agency Joint Venture 6 (OMEGA-JV6).

According to Pam Sullivan, marketing director for AMP-Ohio, this kind of arrangement was not new to AMP-Ohio; it often develops projects and services for members, who then choose whether they want to sign on. Eventually, a total of ten AMP-Ohio cities became partners in OMEGA-JV6. Each chose how much of the total four-turbine project it would support, and each decided the details of how it would finance its portion.

When the first two Vestas 1.8 MW turbines went up in 2003, this was the first utility-scale wind project in Ohio, and one of the first east of the Mississippi. By fall of 2004, when the second two turbines were completed, utilities in six eastern states had built or proposed wind farms many times larger than the Bowling Green project. OMEGA-JV6 partners truly broke ground for wind power in the eastern U.S. They also showed that relatively small, distribution-side wind projects could provide value for their utility sponsors.

Strategic drivers

Resource diversification. Bowling Green Electric has a long-standing commitment to resource diversification. Prior to the wind power acquisition, its energy portfolio included coal, nuclear, hydropower, landfill gas, and a slight contribution from solar photovoltaics. To meet demand requirements, it also uses load control,

equivalent to 1 MW of capacity. Since completion of the wind farm, the utility has added wind resources representing a 1.5 percent share in its portfolio.

AMP-Ohio/Bowling Green Project at a Glance

Project Development: AMP-Ohio and Green Mountain Energy

Project Ownership: Ohio Municipal Electric Generating Agency Joint Venture 6 (OMEGA-JV6), including 10 AMP-Ohio member cities. Lead partners: Bowling Green (4.1 MW) and Cuyahoga Falls (1.8 MW)

Total Size of Project: 7.2 MW

Turbine Manufacturer/Size: Vestas 1.8 MW (4)

Commissioning:
Phase 1, November 2003
Phase 2, November 2004

Estimated Capacity Factor: 30%*

* Based on one year of performance data

Wind Resource: Class 2

Marketing details:
Project cost is rate-based. Green Mountain Energy purchases all environmental attributes.

AMP-Ohio sponsors the Nature's Energy green power program for its members, which is provided by Green Mountain Energy.

Bowling Green and other AMP-Ohio cities receive network service from First Energy, an Ohio investor-owned utility. This means that the project could be built on Bowling Green's distribution system, while the energy produced is shared among the ten partners. AMP-Ohio dispatches the wind generation. According to Stockburger, the wind project's intermittency has about the same modest impact on First Energy's network as any changing industrial load would.

Environmental concerns. Bowling Green is a community with strong environmental values. Stockburger reflects those values, and has been a leader statewide and nationally in developing load management programs and utility renewable-energy solutions. In 2003 a statewide renewable energy advocacy group, Green Energy Ohio (GEO), named him Energy Pioneer of the Year. He was honored not only for his role in developing the wind farm, but also for promoting a variety of renewables through integrated resource planning. His mutually respectful relationship with the environmental community has paid off for the utility. It received technical assistance with wind resource monitoring and project design. The relationship has also drawn energy and environmental conferences to Bowling Green, with spillover benefits for the local economy. GEO also honored AMP-Ohio in 2003 for its leadership on the wind development program.

At the same time, Ohio is in a region where coal-fired generation is the low-cost option for almost every utility. AMP-Ohio provides coal-fired generation, but it is also sensitive to environmental concerns. Active local support for renewable energy has translated into a new voluntary green power program. AMP-Ohio's experience with the wind farm in Bowling Green has prompted the joint action agency to seek other cost-effective wind opportunities, too. Wind plays a tiny but growing role in AMP-Ohio's balanced-energy strategy.

Economic development. The biggest economic impacts from the AMP-Ohio/Bowling Green wind project are the result of an increase in community pride. The windmills draw tourists, and local people are proud to share details about the project with them. A local newspaper noted

that because the wind farm shares a site with the county landfill, this might be the first time that a landfill is frequently crowded with tourists! There also have been benefits for Bowling Green in identifying itself as a clean energy leader. Environmental conferences have come to town. AMP-Ohio has begun to promote the region as a logical place to site all kinds of clean-energy companies.

Technical details

After monitoring the Bowling Green wind site for at least a year, project planners faced the fact that this was most likely a Class 2 wind site, on a scale of one to seven. The good news was that new wind technology can harvest considerable energy from low wind-resource sites.

Project partners decided to use 1.8 MW Vestas wind turbines, mounted quite high. The wind towers are about 260 feet tall. The blades are 132 feet long, giving the wind machines a reach of more than 390 feet into the air. This compares to the monitoring tower, which was just 164 feet tall. Stockburger suggests that the monitoring tower must have missed the stronger winds that passed above. He also credits new Vestas turbine technology. Whatever the reason, the Bowling Green project is actually performing about like a Class 3 wind project. The turbines have generated about 23 percent more electricity than expected. Performance reflects a load factor of about 30 percent, though Stockburger warns that this is based on only one year of data. The bottom line is that the project is more cost-effective than expected.

One important cost-saving factor is the location of the wind farm. The developers leased land from Wood County, which has a landfill nearby. Gaining community approval for the project was relatively easy because of its established public use. Siting near Bowling Green's distribution lines also was key to the project's success. Distribution upgrades were modest, including a recloser for the site, which boosts system protection. Bowling Green and many other AMP-Ohio cities receive network service from First Energy, an Ohio investor-owned utility. Thus, energy generated at the wind site actually blends with other resources on the grid and is shared among utilities on the network. AMP-Ohio transfers the environmental attributes (similar to renewable energy credits) to Green Mountain Energy, and these benefits are marketed separately.

Financing and contractual details

The partnership between AMP-Ohio and Green Mountain Energy provided distinct advantages in financing the project. Green Mountain agreed to purchase all the environmental attributes of the project. The utilities would receive the energy produced, plus separate payments from Green Mountain for these attributes. The revenue from Green Mountain is more than enough to cover the O&M costs of the project. Net revenue is unrelated to other aspects of the project's capital financing, but as it accumulates, it will help to fund future wind project development.

Partners in the joint venture are paying for debt service through a wind power demand charge on their wholesale bills. Financing terms were very favorable, according to Sullivan. The partners used private-issue bonding through Fidelity. Besides a low interest rate, the terms included flexibility in the length of term. At this time, partners are expecting to pay off the debt in 13 years from date of issue. This relatively short-term financing increases the cost per kWh of wind energy produced, but it offers the benefit of paying off the capital project costs sooner. Once debt is paid off, the only costs for the wind power will be O&M costs. So long as the relationship with Green Mountain persists, the wind project will be a wholesale revenue producer.

Stockburger says he realizes that utilities elsewhere have chosen to finance wind

projects over longer terms, in order to lower short-term costs. He is satisfied with the higher cost of Bowling Green's wind power, citing an acceptable range as anything between 1.5 cents and 6.5 cents per kWh. He notes that this project has not received Renewable Energy Production Incentives (REPI) to date, and that if REPI payments become available, project economics will improve. Bowling Green's total cost to obtain wind power is reportedly about 20 percent higher than the cost of its conventional mix

Conclusions and outlook

The AMP-Ohio wind project at Bowling Green is an innovative and successful partnership. It was developed by AMP-Ohio and Green Mountain Energy, then sold to a joint venture of ten AMP-Ohio member utilities. Like many other public power wind partnerships, it owes its success largely to leadership from one system—in this case, Bowling Green Electric Utilities.

Daryl Stockburger initially saw the wind project as a logical extension of his portfolio diversification plan. His utility already relied on renewables and load control to meet about 18 percent of its needs. A local wind project could boost that percentage and further promote the utility's successful green power program. He also believed the project could benefit neighboring municipal utilities, if they cared to join in. Working with AMP-Ohio, he built support for a joint venture by developing strong data on the wind resource and identifying technology options that could make the relatively modest resource into a cost-effective one.

Today the project includes four Vestas 1.8 MW turbines. Ten AMP-Ohio member cities have signed on as partners in the venture, known as the Ohio Municipal Electric Generating Agency Joint Venture 6 (OMEGA-JV6). Leading partners include Bowling Green (4.1 MW) and Cuyahoga Falls (1.8 MW). Financing included a deal with Green Mountain Energy to sell environmental attributes, which are similar to renewable energy credits. This creates revenue from the project for every kWh produced. Notably, Green Mountain is the supplier for AMP-Ohio's green power program.

The Bowling Green project is noteworthy for several reasons. First, it is one of the first public power wind projects east of the Mississippi. Limitations in wind resources and project acreage did not deter project partners. Further, AMP-Ohio showed a willingness to innovate by offering the program as a choice instead of a requirement for its members. This put a viable project in the field where all members can evaluate it, even as a small set of leaders reap the direct benefits.

This is technically a "distributed generation" project, since it interconnected through the Bowling Green distribution system. The approach minimizes interconnection costs and avoids transmission hassles. Network service from First Energy provides integration with the grid.

Wind power still cannot compete on cost or dispatch ability with AMP-Ohio's conventional resources. Yet wind works well as a small but growing part of a balanced portfolio. Bowling Green considers it to be cost-effective. AMP-Ohio has been encouraged by this first experience with wind to grow its interest in renewables, looking for other wind development opportunities statewide.

Public Power Harvests the Wind

Savvy financing supports large-scale wind development

Energy Northwest

Highlights

Development of the Nine Canyon Wind Project, near Kennewick, Washington, is central in the Energy Northwest plan to be the region's preferred source for energy solutions in the 21st century. While Energy Northwest has been engaged in electricity generation since 1964 and maintains a broad portfolio of generating projects, this project was the agency's first wind development. Phase 1 was completed in 2002, paving the way for additional clean energy projects, including more wind, biomass, solar energy, and coal using new integrated gasification combined cycle (IGCC) technology.

Energy Northwest is a joint operating agency that serves the generation and energy service needs of 20 public power utilities in Washington. The Nine Canyon Wind Project involves ten of these as participants in one or more phases of development. The two completed phases comprise 49 turbines and nearly 64 MW in wind capacity. Planned Phase 3 development would bring total project size to 63 turbines and 96 MW of capacity.

Among technical highlights is the project's approach to managing wind variability. Phase 1 integration services, provided by Bonneville Power Administration (BPA), have used hydropower as a cost-effective back up energy source that effectively firms the wind resource. This approach holds promise wherever hydropower is available. It has been limited, however, by regulations affecting river management and salmon conservation in the Northwest.

On the business side, the project demonstrates a strategy to sell green tags, or renewable energy certificates (RECs), from the wind power. One REC represents the environmental attributes of 1 MWh of wind power. RECs have value because businesses and individuals (as well as utilities) will buy them to support renewable energy and meet renewable energy goals. In six months, Energy Northwest sold more than 40,000 RECs, worth about $120,000, on behalf of its wind project participants. REC sales help to offset wind project costs and raise public awareness of the environmental benefits of wind power.

Photo: Energy Northwest

In addition, Energy Northwest has helped to pave the way for other public power agencies to finance wind projects, using municipal bonds and a new federal incentive, the Clean Renewable Energy Bond (CREB) program. Financing with CREBs offers benefits similar to those of the production tax credit[t1]. This approach is slated to help finance Phase 3 of the Nine Canyon Wind Project and another Energy Northwest wind project.

History

The Nine Canyon Wind Project was Energy Northwest's first generation project financed through the municipal bond market in 25 years. The agency, formerly known as the Washington Public Power Supply System, had avoided municipal bond financing after its involvement in a failed nuclear power plant. Thanks to detail-oriented planning and a savvy business strategy for the Nine Canyon Wind Project, Energy Northwest was able to return to the municipal bond market and to win favorable terms.

First, Energy Northwest worked to secure the confidence of its own members. The agency develops energy projects on a subscription basis, so only those members who choose to support a project share the related costs and benefits. The Nine Canyon Wind Project ultimately won the support of member and non-member utilities, including Benton County PUD, Chelan County PUD, Cowlitz County PUD, Douglas County PUD, Franklin County PUD, Grant County PUD, Grays Harbor County PUD, Lewis County PUD, Mason County PUD (#3), and Okanogan County PUD. Since the first phase of the project was announced, some utilities who had left Energy Northwest have rejoined, in part due to its commitment to renewable energy projects[t2].

A thorough assessment of the prospective project site suggested that it could support nearly 100 MW of wind development. The wind resource was about average for this type of development, with an estimated 30 percent annual capacity factor. Yet the site had good transmission access, and it presented no major environmental concerns. Project manager Dave Kobus credits support from the environmental community, including the Audubon Society, as very important to the project's overall success.

The project was developed in phases. Phase 1 was initially expected to include only 28 turbines, providing a total capacity of about 36 MW. Subsequently, Energy Northwest's nuclear generating station signed on as a temporary member, to improve economies of scale, including a price break for a larger turbine order[t3]. Phase 1 grew to include 37 turbines, delivering 48.1 MW of wind capacity. Energy Northwest chose a leading wind developer, Renewable Energy Systems, Inc. (RES), as its general contractor for the project.

Financing for Phase 1 was completed in November 2001, and construction began in February 2002. That fall, the project began commercial operation.

Phase 2 of the Nine Canyon Wind Project followed quickly on the heels of Phase 1. Five of the original participating utilities signed on, triggering a new round of planning, financing, and construction. This phase, including construction of 12 more wind turbines, representing 15.6 MW of capacity, proceeded quickly. The Energy Northwest board approved the project in April 2003. It secured financing in May, and the project began commercial operation in December[t4].

Finally, in April 2006, the Energy Northwest board approved Phase 3 development of the Nine Canyon site. This phase would build out the site, with the addition of 14 large turbines, delivering 32.2 MW of wind capacity. Six participants have signed on to participate in Phase 3. This project was designed to tap CREB financing, a federally subsidized bonding instrument introduced in 2006 to support renewable energy development by non-profit utilities and local governments. Phase 3 should be completed in 2007.

Strategic drivers

Indigenous resource development. Energy Northwest operates as a highly responsive, member-driven agency. It is governed by a board of directors representing member utilities and by an executive board, which includes a broader range of stakeholders. The agency's stated vision is "to be the

region's preferred source for energy solutions." Member utilities subscribe voluntarily to the projects and services of their choosing.

Energy Northwest's resource portfolio currently includes a nuclear power plant, a hydroelectric project, the Nine Canyon Wind Project and White Bluffs Solar Station. In addition, the agency provides operations and maintenance services for other generating projects, including a landfill gas project. This diverse portfolio reflects member concerns for risk management, local economic benefits, and environmental protection.

The Nine Canyon Wind Project gives participating members the chance to tap the region's rich wind resource. Project Manager Dave Kobus reports that private wind developers have approached the joint operating agency, but that Energy Northwest members prefer the agency to develop, own, and operate wind generation in line with a basic tenet of public power: local control. Advantages include long-term cost savings and the ability to fine-tune system integration and performance. It is also important for public power utilities in the region to have a secure source of wind energy. Washington is likely to enact a renewable portfolio standard soon, making access to wind resources highly competitive. With this in mind, Energy Northwest has continued to secure wind sites in the region, including a site near Reardan, southwest of Spokane, where it plans a new 50-megawatt wind project.

Economic development. Energy Northwest members are well aware of the economic development benefits of renewable energy projects. The Nine Canyon Wind Project brought a range of construction jobs to the Kennewick area. Project operations and maintenance requirements have created several good permanent jobs, but Energy Northwest characterizes the project as needing relatively little staff support. More important, land lease payments bring regular income to the farm[t5] families who own the Nine Canyon site, and project revenues raise tax receipts.

Technical details

Including both Phase 1 and Phase 2 construction, the Nine Canyon Wind Project includes 49 1.3-MW wind turbines, with a total capacity of 63.7 MW. The Siemens brand turbines are mounted on tubular steel towers, each about 200 feet tall.

The turbines line the windy ridgetops in dryland wheat farming country near Kennewick. Although the project lease covers more than 5,000 acres, less than 50 acres are actually taken out of production for the turbines, access roads, and other infrastructure. As part of the overall construction plan, Benton Country PUD built a substation and high-voltage line needed to deliver wind power to the BPA transmission system. Capacity was based on the anticipated full size of the project.

The turbines generate electricity under a range of wind conditions, from eight miles per hour to 56 m.p.h. When winds reach a sustained 56 m.p.h., the turbines shut down, starting again automatically in 42 m.p.h. wind conditions. Full power is achieved when winds blow at about 30 m.p.h. The site is typically most productive in winter. While the project's average capacity factor (referring to the percent of time that it is generating electricity) is about 30 percent, it achieved a capacity factor of 56.3 percent in January 2006. Participants are generally satisfied with project performance.

Wind integration has been technically successful, despite some logistical challenges. Grant County PUD initially provided integration services for Phase 1 of the wind project. Then BPA was selected to provide the service. BPA used hydropower storage to compensate for the variability of the wind resource. This approach proved very economical. However, environmental regulations related to salmon conservation

have restricted river storage of hydropower. This in turn may prevent new wind customers, including participants in Phase 3 of the Nine Canyon Wind Project, from receiving BPA wind integration services. In that case, Energy Northwest would arrange[t6] for alternative integration services for these participants.

Despite changing cost structures, wind power from the Nine Canyon Wind Project continues to be cost-competitive. According to Kobus, the definition of cost-competitive electricity changes over time, because construction and operational cost increases tend to affect all kinds of generation projects. While the Nine Canyon Wind Project initially delivered electricity for about 3.5 cents per kWh, first-year project costs have escalated. Phase 3 expansion of the Nine Canyon Wind Project and new wind projects nationwide are considered economical at 6 to 8 cents[t7] per kWh.

Financing and contractual details

Energy Northwest financed Phase 1 of the Nine Canyon Wind Project through the sale of $70,675,000 of investment-grade tax-exempt municipal bonds. Phase 2 used a similar bond sale, raising $21,960,000. Refinancing of Phase 1 resulted in significant overall project savings. The overall project is financed at 5.85% net interest over 22 years.

Not only did this project mark Energy Northwest's return to the municipal bond market; this also was the first time that the leading Wall Street firms considered financing a large public power wind project. Energy Northwest met repeatedly with finance agencies, educating them about the benefits of wind power and about the reliability of wind technology today.

Key aspects of the financing plan were geared to lower project risk. Participants in Phase 1 signed 22-year power purchase agreements. Participants in Phase 2 signed 20-year agreements. Participants essentially have "take or pay" contracts, and they have agreed to rates that reflect actual operations and maintenance costs. If one participant should default on its agreement, the other participants will make sure that all project costs are still covered. Project contractors also provided assurances that the work would be completed on time and on budget. They have met or exceeded all expectations.

Another contingency plan involved covering the risk that federal Renewable Energy Production Incentive (REPI) payments might not be fully available every year, even though REPI is ideally available for ten years. Unlike the Production Tax Incentive, REPI is subject to annual Congressional appropriations, which have tended to fall short of applicants' needs. In fact, Energy Northwest received only about two-thirds of the REPI incentives that the project was qualified to receive 2005. To protect against this eventuality, the agency has planned on receiving only half of its REPI incentives.

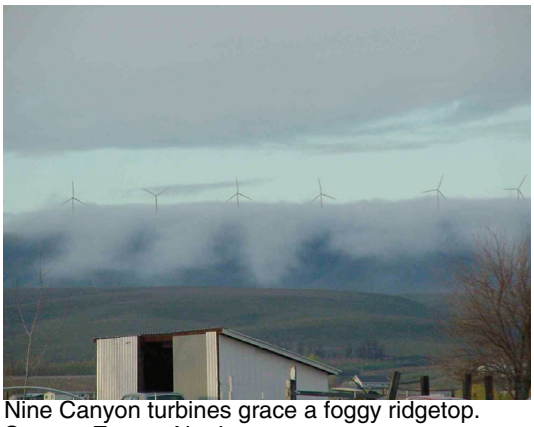
The sale of RECs or green tags has been a small but useful bonus from the project. One REC represents the environmental attributes of 1 MWh of wind power. RECs have value because businesses and individuals (as well as utilities) will buy them as a way of supporting renewable energy and meeting renewable energy goals. For example, Safeway gas stations in the region have agreed to buy RECs from Energy Northwest to offset all the electricity they use. In six months, Energy Northwest sold a total of more than 40,000 RECs, worth about $120,000, on behalf of project participants. REC sales help offset project costs and raise public awareness of the environmental benefits of wind power.

Conclusions and outlook

One sign that Energy Northwest has been successful in wind development is that its members continue to support project expansion. Construction for Phase 3, totaling 32.2 MW, is expected to begin in the summer of 2007. Another wind project,

planned for Reardan, in east-central Washington, is also planned. It will deliver approximately 50 MW of wind capacity when it is completed.

Both of these new projects are planned to use CREB financing. This financing mechanism was introduced as a result of the Energy Policy Act of 2005. The CREB program is targeted for local governments, public power utilities, electric cooperatives, and tribal utilities that cannot use the production tax credit (PTC). In effect, CREBs offer zero-interest financing for a term of up to 14 years. The net benefits are expected to be about the same as the PTC. Energy Northwest applied for CREB financing during the first funding cycle in 2006 and is awaiting the allocation decision.



Nine Canyon turbines grace a foggy ridgetop.
Source: Energy Northwest

Energy Northwest remains committed to future wind development. Besides preparing to advance current projects, the agency continues to invest in wind prospecting on behalf of its customers.

The early success of the Nine Canyon Wind Project also has enhanced Energy Northwest's efforts to pursue other innovative generation projects. The largest of these is an IGCC coal project, which will serve two 300-MW turbines. This plant, called the Pacific Mountain Energy Center, is one of the first projects of its kind nationwide. As Energy Northwest looks to the future, it expects to continue to offer diverse, clean energy resource options to its members. Wind is an important part of this portfolio.

Public Power Harvests the Wind

Municipal utilities support wind projects at local schools

Forest City, Iowa
Hull, Massachusetts

Highlights

According to the U.S. Department of Energy Wind Powering America Program, dozens of communities in some 20 states host school-based wind projects. These range in size from one kilowatt to a half-megawatt or more. In most cases, the participating school district owns the wind system. In a few cases, the local utility owns the system, but it is sited to also benefit a local school. This brief report summarizes two case studies, which demonstrate how public power utilities have supported wind development in partnership with schools. With utility participation, these projects can deliver strong energy benefits as well as educational benefits.

In *Forest City, Iowa*, the school district has taken the lead, with the municipal utility's support. Here, the utility participated in project planning for a 600-kW Nordex turbine, installed at the local elementary school in 1999. The utility provided interconnection services, and it meters the project, providing full credit for any wind-generated electricity that the district does not immediately use.

The result has been well received by the entire community. Wind energy has offset the school district's energy bills. Students have benefit directly through hands-on experience with renewable energy and through a proud association with the project. The utility benefits by supporting wind power while shouldering minimal risk. Due to technical difficulties, the school district will not recover project costs as quickly as it had predicted. Still, the turbine produced more than 6.3 million kWh of electricity through mid-2006. On balance, the project is a success.

One of two large wind turbines in *Hull, Massachusetts,* illustrates a different approach—utility ownership and control of a school-sited wind project. Hull is a community of about 11,000 residents, located on Boston Harbor. Prior to its current project, the Hull school district owned a 40-kW wind turbine that operated from 1985 through 1996. That project was a partial success, but it used relatively early wind technology that was difficult for the district to manage. Counting high repair bills, the small turbine returned just more than half of its cost in energy savings before it was retired.

Local interest in wind power remained high, however, and within a few years, the municipal utility had stepped forward to lead a new wind development plan. Hull Wind 1 is the result of that plan.

Hull Wind 1, just outside the high school fence.

The Hull Municipal Light Plant (HMLP) purchased Hull 1, a 660-kW Vestas wind turbine, outright in 2001. The University of Massachusetts Renewable Energy Research Laboratory and the Massachusetts Division of Energy Resources supported project development. Vestas provided turnkey installation services, and HMLP provided the interconnection. A site very near the original 40-kW turbine site on Boston Harbor provided an excellent wind resource, just outside the high school fence.

The Hull 1 project produces about three percent of Hull's electricity on a yearly basis. The high school continues to use the wind turbine as a real-world demonstration of renewable energy. This is a more limited role than the role it played when the district owned and operated a turbine, but the partnership with HMLP has worked out well. The success of Hull Wind 1 led HMLP to invest in a second, 1.8-MW wind project, which was completed in May 2006.

Forest City in Detail

History. The Forest City Community Schools Wind Project began in the classroom. In 1997, a high school physics student asked whether Forest City might have a strong enough wind resource to support a local wind project. His question led to a class wind-monitoring project, which showed promising results. Dwight Pierson, Forest City Schools superintendent, also took an interest in wind power. His preliminary figures showed that a turbine on Forest City school grounds could pay for itself through energy savings. This led the district to take a more detailed look at the proposal. It formed a task force on wind development, including representatives from the school board, the student body, the city, and the municipal utility.

The utility agreed to provide the interconnection with the distribution system. It agreed to meter the turbine and credit the school district for every kWh that the turbine produces, whether the district uses that electricity immediately or not. This improved project economics. Fortunately, the school is located on a feeder line, which also serves a Winnebago RV manufacturing plant. The season when the wind turbine is most likely to produce excess electricity often matches the peak season at the plant.

The district compared economics for a 250-kW turbine and a 600-kW turbine. It chose a Nordex 600-kW wind turbine, which at that time cost about $673,000 installed. It financed the purchase and installation with the help of a $250,000 interest-free loan from the Iowa Energy Center Alternative Energy Revolving Loan Program. The district obtained additional financing at 4.1 percent from a local bank.

The district also applied for and won a federal Renewable Energy Production Incentive (REPI) credit of 1.5 cents (inflation-adjusted) per kWh produced. Depending on annual budget allocations, applicants may receive the REPI for 10 years. On this basis, the Forest City project was slated to pay for itself through energy savings in 12 to 14 years. When the turbine went online in January 1999, it was one of the first utility-scale wind projects in the Midwest, and it was the second school wind project in Iowa, after Spirit Lake.

Forest City includes information about the turbine's construction and performance on its schools' Web site, www.forestcity.k12.ia.us

Results. The Forest City wind project's performance has varied with changing wind conditions and due to some technical problems. Yet it has made a significant contribution to the school district's energy needs. Through July 2006, it produced about 6.5 million kWh of electricity, valued

at more than $400,000, including $98,000 in federal REPI incentives.

Considering the vast improvements in wind technologies in the just the past five years, the problems that Forest City has experienced with this 1998-vintage turbine are not so unusual. Over time, the turbine shaft warped. The district had the generator repaired and rewound in 2005. Pierson reports that this repair was not covered by warranty.

Before generator-related problems cropped up, the project was returning about enough value each year to pay for itself on schedule. Now that the technical problems are fixed, the turbine is once again productive. However, changing weather patterns have at least temporarily reduced the available wind resource. Over the life of the project, the turbine has produced about 50 to 75 percent as much electricity as it was originally expected to produce. This amounts to about 60 percent of the district's overall electricity needs. The Forest City school district expects that the project will still pay for itself, but over a longer term than the 12 to 14 years that was originally projected.

Markers for success include the educational value of the project. Students were involved from the beginning, and some classes still study turbine performance as part of their science and math curricula.

The municipal utility has managed wind integration without significant problems. Its participation in the project includes some additional staff time and equipment. The investment has paid back to the utility through stronger community relations.

As a result of the project, the school district became more aware of all its energy needs. It took many energy-saving measures as a result of a district-wide energy audit. It recently installed a geothermal heat pump system for heating and cooling. Instead of being discouraged by the technical problems that they have encountered, school district officials feel ready to apply their experience to a new wind project. Pierson reports that the district has been approached by a wind developer that would like to partner on a new 800-kW wind project. The school project also contributed to greater interest in wind energy throughout the region. Winnebago County is involved in negotiations with a developer for a multi-turbine wind project nearby.

Hull in Detail

Hull, Massachusetts, is a community of about 11,000 full-time residents, located on Boston Harbor. A municipal utility, the Hull Municipal Light Plant (HMLP), serves the community's electricity needs. Before it began to support wind development, HMLP relied on purchases from the New England Power Pool for all of its electricity needs. Today, with the school-based project and a new project in operation, Hull relies on wind energy to meet about 10 percent of its annual needs.

History. By some measures, Hull's communitywide interest in wind energy dates back to the 1820s, when townspeople erected a traditional "Old Dutch" windmill on the harbor. More recently, wind advocates in the early 1980s recognized that the high school was located near the site of the old windmill. They gathered supporters from the school district and worked with the Massachusetts Department of Energy Resources to acquire a 40-kW wind turbine. The school district took ownership of this turbine, installed in 1985.

Despite voluntary support from HMLP, the school district found it hard to give the system the regular maintenance and repairs that it needed. Performance fell off, until a storm-related breakdown let to irreparable failure in 1997. Advocates point out that even as turbine performance began to degrade, it continued to produce wind power and energy savings until its final breakdown. In its last three years of operation, it reduced

the school district's electricity bills by more than 28 percent.

Wind advocates, led by Anne Marcks from the high school and Malcolm Brown from the community, met within a few months of the small turbine's failure, to discuss how to revive the program. As in Forest City, Iowa, a high school physics class investigated technical options. A community-wide planning committee considered different ways that the school district might support a new wind purchase—from asking for public donations to selling electricity to the local utility. Ultimately, planners decided that the utility would be better prepared to own and run the turbine, in partnership with the schools. HMLP agreed, thanks in part to support from operations manager John MacLeod, who had worked with the school district on the earlier wind project. After MacLeod became HMLP general manager, he continued to be a wind supporter.

The University of Massachusetts Renewable Energy Research Laboratory joined the project, with support from the Massachusetts Department of Energy Resources and the U.S. Department of Energy. It completed wind resource assessments and detailed development plans, with an eye to replicate the project in other Massachusetts communities. Since Hull was interested in a relatively large (one-half MW or greater) turbine, public acceptance would be a primary concern.

According to Brown, continuous press reports and a well-publicized public meeting to present the project plan were crucial in gaining community support. Local residents wanted to know about noise levels, environmental impacts, and visual impacts. They also wanted to know about project economics, electricity cost savings, and the project's long-term economic outlook. An open discussion of these and other concerns helped to build support for the project.

The Hull 1 turbine blade was hoisted into place.

Results. HMLP chose a site on city-owned land near the site of the previous turbine. This site was in close proximity to the high school. HMLP issued a request for proposals in January 2001 and selected a vendor in April. It contracted with Vestas for turnkey installation of a 660-kW turbine, priced at about $698,700. HMLP agreed to provide utility interconnection services, valued at about $54,000. By December, construction on Hull 1 was completed.

The turbine has performed well, with a capacity factor of about 26.5 percent. By late 2006, it had produced more than 7 million kWh.

Hull purchased the wind turbine, including a maintenance and warranty package and insurance, outright. While this is a relatively unusual approach to financing, it offers significant savings on interest. The project is expected to save the community about $2 million over the 20-year project life. It produces wind energy for the equivalent of 3.4 cents per kWh.

Hull receives federal Renewable Energy Production Incentive (REPI) payments (originally valued at 1.5 cents, but currently adjusted to 1.9 cents per kWh produced). The REPI is usually considered to be available for 10 years, at most. Hull's analysis is optimistic in that it assumes REPI availability for the life of the project. In addition, Hull has sold Massachusetts renewable energy certificates (RECs) from

the project, and expects to continue to do so. RECs, also known as green tags, represent the environmental attributes of the wind power. The Massachusetts Renewable Portfolio Standard set up a market for these attributes.

Unlike the earlier school-owned turbine, this utility-owned turbine was configured to directly benefit the community as a whole. The electricity produced offsets the amount of electricity that HMLP must purchase through the New England Power Pool. To make the savings more visible, Hull uses some of the savings to offset the municipal street lighting bill.

Outlook. This project, which began as a 40-kW school-based demonstration, has taken HMLP from a backstage role to that of a leader in national wind development. The 660-kW Hull 1 project has very high visibility, and it has attracted visitors from all over the world. The project's economic success and strong public support led the community to invest in a second utility-scale project, a 1.8 MW turbine, installed with a unique supporting structure at the landfill. Construction for that project was completed in May 2006. Wind now accounts for about 10 percent of Hull's overall resource portfolio.

Hull 1 and the new turbine, Hull 2, engage local high school students in hands-on learning about renewable energy resources and basic engineering. Moreover, students have had a close-up civics lesson, as a debate rages about more wind development on the Massachusetts coast. Opposition to a large offshore wind development called Cape Wind is often countered by the Hull project. Here wind energy has become part of the local culture, and many citizens have become outspoken wind advocates. More information on wind development for Hull and neighboring communities is now easy to find on the Web at www.hullwind.org.

Lessons for School Wind

Both Forest City and Hull have pursued relatively large wind projects—more than half a megawatt in capacity. At this scale, involvement from the local utility is crucial. Whether the utility plays a supportive role, as it does in Forest City, or whether it takes the lead, it offers necessary support with grid-interconnection and maintenance oversight. A municipal utility also may provide financing support, including access to municipal bonds, incentives, or simply a pool of local capital that is needed to make a project go. As both of these projects show, the responsibility for a relatively large wind project may challenge a school district. Whether or not the school district owns a wind project, it can play a crucial role as the local champion for wind.

In both of these cases, a local wind project helped to draw regional attention, to spur other developments locally or in communities nearby. In this way, the lessons of community wind development are multiplied. Students not only see how the science of wind energy works, but they also get a glimpse of the political leadership needed to move wind development into the mainstream.

For both scientific and social-studies related education, the Kid Wind Project (www.kidwind.org), initiated by teachers, students, and representatives of the wind industry, is one good starting point.

The U.S. Department of Energy National Renewable Energy Laboratory (NREL) and Wind Powering America Program offer support for school-based wind development. This includes information available at www.windpoweringamerica.gov. Resources available include technical and financing information, model presentations, more case studies, and additional teaching materials. The school wind projects featured range from very small classroom-scale turbines to large wind projects like those in Forest City and Hull.

Diversifying the wind portfolio as member needs grow

Municipal Energy Agency of Nebraska - City of Aspen Electric Utilities

Highlights

Wind development among public power utilities often starts at the grass roots. A distribution utility manager will pick up on a growing local interest in renewable energy and begin to build a business strategy in response. If that local utility is part of a joint action agency—and especially if it has an all-requirements supply contract—its response cannot be unilateral. Energy planning for these utilities must engage the joint action agency and other member cities. The challenges and the benefits of this approach are demonstrated by the case of Aspen, Colorado and the Municipal Energy Agency of Nebraska (MEAN).

The city of Aspen has a small municipal utility, serving about 2,500 customers in the city's business district. It is one of the 59 utilities from Nebraska, Colorado, Kansas, Iowa, and Wyoming that are members of MEAN. The joint action agency is an all-requirements supplier, but Aspen has worked with MEAN over the years to incorporate local hydropower projects into its portfolio. Aspen is proud of its historic commitment to renewable hydropower. It is also a community with a high level of environmental awareness. A citizen group, partly funded by the city, worked with utility manager Phil Overeynder as he developed the wind power plan.

Aspen's first strategy with MEAN to acquire wind power involved a third party—the Colorado-based Platte River Power Authority. Platte River expanded its wind farm near Medicine Bow, Wyoming in 1999, and it agreed to sell the output of one of its ten turbines to MEAN. The deal turned out to be only the first of several wind endeavors for MEAN. But one benefit for small utilities in working through a joint action agency is that good projects tend to grow. Within a few years, other MEAN cities were getting excited about wind. The demand for wind power to serve Aspen and Platte River's member cities was growing, too. It was time to bring more wind power to the region.

Two 1.5 MW wind turbines and an old water pumping windmill near Kimball, Nebraska
Photo: NMPP Energy

For MEAN, the decision to buy or build required careful deliberation. Ultimately, MEAN decided to build seven wind turbines in Kimball County, Nebraska. The turbines have a total rated capacity of 10.5 MW. Twenty-six MEAN members signed up to share the output, and the wind farm went on line in October 2002.

Aspen continues to have a dynamic local wind program, supported in part by a novel tax on new buildings that have disproportionate energy needs. The utility works with a separate agency, created by city council, to implement this program. Other MEAN cities take more traditional approaches, including green power marketing or ratebasing wind power. They contract with MEAN for 1 to 10 percent of their total resource needs. The City of Kimball, which lies in the shadow of the wind farm, has bought the largest share, at 10 percent.

Today, interest in wind power continues to grow among MEAN members. The agency is involved in a new wind acquisition. This time, careful deliberations resulted in the decision not to build but to buy—from a Nebraska Public Power District (NPPD) wind farm on the opposite side of the state from the Kimball wind site.

History

Aspen, Colorado has a long-standing commitment to renewable energy, beginning with a small hydroelectric plant that was built to serve mining interests in the 1880s. The municipal utility, Aspen Electric, has added more hydropower over the years. Local hydro represents a total of one-third of its resource portfolio today. But another renewable resource—wind power—is also becoming significant. It accounts for more than 5 percent of Aspen Electric's portfolio today. Counting large hydropower from the Western Area Power Administration, Aspen can claim that its energy is more than 50 percent renewable. And Aspen's city council would like to see that share grow even larger. Its reasons include a strong local commitment to environmental protection and a strong sense of local self-reliance. The city is engaged in a multifaceted sustainable energy plan, which covers everything from promoting renewable energy to developing an energy-efficient vehicle fleet to charging a tax on new buildings that are energy hogs.

However, the City of Aspen has not accomplished this all on its own. Its all-requirements electricity supplier, MEAN, has been a partner every step of the way. MEAN has worked out special pass-through agreements with Aspen to facilitate its hydro development. When Aspen expressed an interest in acquiring wind power, MEAN again responded.

MEAN's search for wind power to meet member needs began in 1999. It looked to a neighboring joint action agency, Colorado-based Platte River Power Authority, which had a 6 MW, ten-turbine wind farm near Medicine Bow, Wyoming. This was one of the earliest wind farms in the country. MEAN arranged to buy the output of one turbine from Platte River.

The catch was that Platte River wanted to retain the environmental benefits of the resource. These environmental benefits are accounted for as green tags or Renewable Energy Certificates (RECs). These benefits may be sold separately from the electricity that wind turbines generate, usually to show that the buyer supports specific environmental goals. RECs may also be used to account for utility investments toward Renewable Portfolio Standard (RPS) requirements in states that have RPS laws or regulations.

According to MEAN manager of operations Kevin Gaden, his agency was wary of buying the output of wind generation that did not include RECs. Without the RECs attached, power generated by wind is stripped of its environmental value in power markets. At the time of this deal, Platte River had no intent to market its RECs, nor did MEAN. But MEAN recognized that RECs were an essential component of wind power, which would be increasingly important in coming years. MEAN made a power purchase agreement from Platte River's wind farm as an interim solution. The deal demonstrated that MEAN supported wind development, even though it

could not claim to have purchased the environmental benefits of wind power.

Circumstances changed just a few years later. Platte River members wanted more wind energy, and interest throughout the MEAN system was rising, too. With growing demand for wind power, both joint action agencies realized they needed new solutions. MEAN could have found a new wind supplier, but it also wanted to gain direct experience with wind technology. Moreover, Nebraska has some of the best wind resources in the country. MEAN began to review wind data and found a good site in Kimball County.

When MEAN offered subscriptions to the wind farm, member systems looked carefully at the projected costs and benefits, and then considered how the project would sell to their local customers. Aspen and Kimball signed on first, and a few other cities joined in. Notably, Aspen is relatively small, and Kimball serves about 1,700 customers. Leadership from these two small cities triggered regionwide interest, since larger cities seemed to respond, "If they can do this, we can, too." A snowball effect kicked in, and soon the Kimball County wind farm had 26 sponsors. Together, they signed up for 80 percent of the wind farm's output over the life of the project. According to Gaden, this was significantly greater sponsorship than MEAN expected. The project is considered fully subscribed because MEAN wants a cushion of 20 percent of the project's rated output to hedge against possible breakdowns or other contingencies. The wind farm was commissioned in October of 2002.

MEAN's next wind power investment will be a partnership in a 60 MW wind farm that is being developed by the Nebraska Public Power District near Ainsworth. MEAN is contracting for a 7 MW share of the project output. The project will rely on 36 1.65 MW turbines. Considering the high Class 4 wind resource that characterizes the site, engineers expect that the Ainsworth wind farm will have a capacity factor of about 40 percent. In addition, the site has the advantage of good transmission access. This complements the Kimball wind farm well, since Kimball is on the western side of the state, on a separate transmission system. The NPPD project should be completed in 2005.

Strategic drivers

Resource diversification. MEAN has interests in several renewable energy technologies, principally wind and farm-related biomass. These are logical choices because they use resources indigenous to Nebraska. The wind resource at Kimball is rated Class 4, on a scale of 1 to 7. This makes it potentially valuable to the region's future economy. Public power presents a good model for sharing most of the benefits from indigenous resources within the region, instead of allowing national or international companies to control most of the profits and environmental benefits.

Still, the bulk of MEAN's portfolio is conventional generation. Wind power provides a hedge against rising fossil fuel prices and against the risk of increasing environmental regulation. Wind has not delivered well on peak, but it has provided low-cost energy at other times. Wind power currently represents about 2.2 percent of MEAN system production.

For Aspen, resource diversification means adding other renewables to the utility's hydropower resources. Besides wind power, Aspen has investigated developing waste methane from mining sites. This has been a complicated venture, with a still uncertain future. Aspen also considers energy efficiency to be a resource. A local nonprofit, the Community Office for Resource Efficiency (CORE), receives utility funding to support both energy efficiency and renewable energy development, including wind purchases.

Environmental concerns. Environmental concern was a key driver for MEAN's wind development program. MEAN was aware of a growing interest in green power among several of its member cities. Market research reflected this interest even in relatively conservative communities. Electric customers like knowing that the utility is developing renewable energy.

In Aspen, the environment was a particularly strong driver. A nearby electric co-op, Holy Cross Electric, demonstrated in the late 1990s that customers in the Aspen area wanted green power. The co-op's green power marketing program was one of the strongest in the country at that time, based on the percentage of customers participating. Aspen quickly followed the co-op's lead, but its program does not sell wind power by retail subscription. Wind energy is blended into Aspen's resource portfolio so all customers support it. Today, the city subsidizes wind acquisitions through a unique local program called REMP—the Renewable Energy Mitigation Program. REMP requires builders to meet strict energy codes or to pay a mitigation fee for excessive energy use. Since Aspen has many luxury homes, some builders don't mind paying a fee of $5,000 to $10,000 for the freedom to install heated driveways, spas, and swimming pools. REMP raised $2 million during its first three years of operation. This funding has supported energy-efficient public building and renovation projects, and it partly subsidizes Aspen Electric's wind purchases.

Other MEAN cities have not gone to such lengths to support renewables and energy efficiency. Yet the 26 Kimball wind farm sponsors include strong wind proponents. Some cities now have green power marketing programs. Hastings, Nebraska offers 100 KWh blocks of wind power for $4.75 per month. Gillette, Wyoming came up with the popular "Got Wind?" advertising campaign as part of its green power marketing program. Western State College, in Gunnison, Colorado, has supported green power through student fees. Each student pays an additional $5 per year to support green power for the school.

How do the environmental benefits add up?

MEAN's 10.5 MW Kimball County wind farm produced a total of 29,260 MWh of energy during its first year of operation.

This represents low-cost energy and an opportunity to mitigate the impacts of conventional electricity generation. During that first year, MEAN's project displaced

Carbon Dioxide	20,484 tons
Sulfur dioxide	117 tons
Nitrous oxide	58.5 tons

Economic development. Kimball County, Nebraska has benefited from the MEAN wind farm there. MEAN leases land from a local rancher. Throughout rural America, ranchers have found that such lease payments are a good hedge against changing livestock markets. Each of the seven MEAN turbines takes up about one-quarter acre of land, and livestock reportedly graze right up to the bases of the towers.

MEAN's wind farm is not large enough to create many directly wind-related jobs. More important is the strong sense of community pride that the wind farm has created. Also, the wind farm has drawn tourists, who often stop in town for a meal or to shop. Kimball and other communities are advocating more wind development in the region, since they recognize that economic development benefits can add up.

Technical details

The Kimball County wind farm consists of seven 1.5 MW turbines made by NEG Micon. The total rated capacity of the

project is 10.5 MW.The turbines are mounted on towers 230 feet high, and each blade is 115 feet long. Total cost for each of the seven turbines was about $2 million, though Gaden notes that additional turbines that may be installed someday would cost less per unit now that infrastructure is established.

Drawing on a strong Class 4 wind resource, the turbines had an estimated capacity factor of 32 percent during their first year of operation. It is too soon to predict their long term performance, but the outlook is good. The wind farm delivered 29,260 MWh of wind energy during its first year, about 2.2 percent of overall MEAN system production.

NEG Micon1.5 MW wind turbines at the Kimball wind farm

According to Gaden, there have been technical hurdles, but they have been managed. Transmission is often a problem for wind farms because of physical access or because of system congestion. MEAN faced challenges in working out a good agreement to cover wind-related ancillary-service costs on the transmission system. As transmission owners, generators, and regulators gain experience with wind, some of these problems probably will not seem so daunting.

Gaden notes that his background in customer service has helped him to motivate his technical staff. "From a traditional engineering perspective, some of what we are doing would not make sense, but we are responding to a new customer need. Knowing that this is a worthy challenge makes it easier for the engineers to solve problems," he says.

Financing and contractual details

The initial acquisition from Platte River Power Authority hinged on Platte River's insistence upon retaining the environmental benefits. Since MEAN was making the purchase on behalf of Aspen Electric, it followed Aspen's willingness to accept that deal. Today, the deal might be considered unacceptable, since wind power without its associated environmental benefits is viewed as generic electricity. Gaden warns utilities to consider the long-term value of RECs. He considers it fortunate that MEAN and Platte River both had growing needs for wind power, so that they could each develop new wind generation and retain the environmental benefits.

The total cost of the seven-turbine Kimball wind farm was about $14 million. While MEAN could not detail financing, the cost of wind power under its financing regime is very competitive. Most sponsor utilities rate-base their wind energy. The impact on rates for a MEAN utility that uses wind for 2 percent of its resource needs comes to about 75 cents per customer per month.

Originally, MEAN figured that members would support about 50 percent of the project, and that it could sell the rest. However, members subscribed for about 80 percent of the project's output. MEAN

considers this fully subscribed, though it does sell excess power, as it is available.

Conclusions and outlook

MEAN's experience demonstrates a practical way for joint action agencies to grow into wind development. One member utility, Aspen Electric, brought the wind option to the attention of the joint action agency and its other member cities. MEAN's first wind acquisition was centered on Aspen's needs and utilized a pass-through agreement that minimized the risk to other members. But in short order, other MEAN members began to see the benefits of wind power, and the MEAN program began to grow.

MEAN recognized early that the environmental benefits of wind are valuable in themselves. RECs represent the environmental attributes of the wind energy and allow utilities to account for their green power investments. Strictly speaking, a utility that buys wind power stripped of RECs cannot claim to have purchased wind power. On a practical level, though, some utilities may *facilitate* wind development by supporting wind generation, whether or not they hold ownership of the environmental benefits. This was the case with MEAN's first wind investment.

The project in Kimball County gave MEAN full control of its wind program, including RECs. It also gave the agency useful experience with wind technology and marketing. Yet recently, when the agency needed more wind power, it looked at all of its options again.

For its next wind project, it will work with NPPD, purchasing 7 MW of a new 60 MW wind farm near Ainsworth. MEAN members deliberated over joining the NPPD effort or adding more turbines to the Kimball project. The benefits of ownership were still attractive. However, the NPPD site offered an excellent wind resource adjacent to an existing 115 kV transmission line. MEAN members liked the balance that this gave their wind portfolio, it is on the opposite side of the state from the Kimball project. With completion of the new project, MEAN will have wind linked to transmission on both sides of its system.

MEAN may increase its wind portfolio again through ownership or purchase agreements. According to Gaden, each acquisition must be considered on its merits. The current market is especially favorable to joining big wind projects if they have excellent resources and good transmission access.

Public Power Harvests the Wind

Working with public power utilities and their customers

Nebraska Public Power District

Highlights

Nebraska Public Power District (NPPD) serves 52 publicly owned municipalities and 24 public power districts and electric cooperatives. Altogether, it provides wholesale and retail electricity to nearly one million Nebraskans. The 60-megawatt wind project at Ainsworth serves this broad customer base. It also benefits other project partners, including the Nebraska-based Grand Island Utilities, Omaha Public Power District, and Municipal Energy Agency of Nebraska, and one out-of-state municipal utility, JEA, in Jacksonville, Florida.

As facility owner, NPPD spearheaded this project, secured financing, and retains more than half of the output. NPPD also provided construction oversight and currently operates and maintains the project. Ainsworth-based KBR Rural Public Power District has provided local technical support. Yet all partners played a role in the success of this large-scale effort—the largest wind project in the state of Nebraska.

The Ainsworth Wind Energy Facility includes 36 1.65-MW Vestas wind turbines. The overall site is expansive, spreading across approximately 11,000 acres of land south of Ainsworth in north-central Nebraska. Yet only about 50 acres were taken out of agricultural production for wind towers, roads, and related infrastructure.

One unique aspect of this project is the planning process that led to NPPD's decision to build. Unlike many states, Nebraska does not have a state renewable portfolio standard. Decisions to invest in renewable energy must come directly from utility management and policymakers.

The decision-making process also reflected informed customer viewpoints. NPPD used a unique survey process called deliberative polling, involving more than 100 randomly selected customers. This process, which required a review of background materials and participation in an all-day workshop, showed that customer support for wind development was very strong. Customers who participated in the process favored wind development, even if it might result in a slight increase in electric rates. The participants expressed a preference for spreading the cost of wind development across the entire rate base, instead of asking individual customers to pay a voluntary green power premium.

Ultimately, NPPD developed the Ainsworth Wind Energy Facility with only negligible rate impact. Especially valuable aspects of the development plan included pinpointing a site that had both a strong wind resource and excellent transmission access. In addition, the project benefits from partnership strategies to market excess wind power and to sell the environmental attributes of the project through renewable energy certificates (RECs).

History

In cooperation with the National Renewable Energy Laboratory, NPPD began to monitor wind resources in the mid-1990s. In 1998, the utility worked with the NREL Turbine Verification Program to install two 750-kW turbines at Springview. This project gave

NPPD direct experience with turbine technology and system integration. It also provided experience in wind project partnership. NPPD owns 61 percent of the Springview project; Lincoln Electric System owns 29 percent, and four other public power utilities hold 5 percent or less. KBR Rural Public Power District owns a small share and operates the Springview turbines at the local level. With headquarters in Ainsworth, KBR proved early on that a distribution utility can provide the technical and community support that a wind project needs in order to succeed.

NPPD's decision to expand its wind program came gradually, as an outgrowth of its Springview experience and as a result of board decisions in support of portfolio diversification. Nebraska does not have a Renewable Portfolio Standard; the drive to add renewables came from within the utility and at the strategic direction of the board. Customer sentiment and economical impact were also among their considerations.

A unique survey process called deliberative polling helped the NPPD to understand how customers would prefer the utility meet future energy needs. In 2003, with funding assistance from the Nebraska State Energy Office and Western Area Power Administration, NPPD engaged James Fishkin of the University of Texas at Austin (now of Stanford University) to lead this process. It involved more than 100 randomly selected NPPD customers in preparing for and participating in an intensive one-day meeting. Since more than half of the participants had to travel more than 100 miles to take part, NPPD offered to pay expenses. NPPD planners viewed the enthusiastic and open-minded participation of so many customers as a benefit worth the investment.

The process addressed the question of whether NPPD should continue, decrease, or expand its commitment to renewable resources. Specific renewable energy options included the addition of 200 MW of wind power by 2010 (5 percent of NPPD's yearly electricity needs) and 5 MW of methane generation produced from animal manure.

NPPD Ainsworth Wind Energy Facility

The Ainsworth Wind Energy Facility demonstrates successful partnership among public power utilities.

Project Partners: Nebraska Public Power District, Omaha Public Power District, Municipal Energy Agency of Nebraska, Jacksonville Electric Authority (JEA), and Grand Island Utilities. KBR Rural Public Power District is also a participant.

Total Size of Project: 60 MW

Turbine Manufacturer/Size: NEG Micon 1.65 MW (36)

Project commissioned: Fall 2005

Capacity Factor: 40 – 44%, based on engineering data

Keys to project success:

- Excellent wind resource
- Partners boost economy of scale
- Access to NPPD transmission
- Local (KBR) utility support
- Economics based on use or marketability of wind energy
- Innovative REC strategy

Participants received detailed information to compare these options with a combined cycle gas alternative and a new coal plant that would use advanced pollution control technology. The relatively in-depth education that participants received was the biggest difference between this approach and typical customer surveys.

Participants came to understand that any choice about their energy future represents

trade-offs, and that there is no silver-bullet solution to today's energy problems.

Strategic Drivers

Resource diversification. NPPD relies on coal for approximately 60 percent of its energy needs. In addition, nuclear energy comprises 24 percent of the NPPD resource portfolio. Ten percent is purchased power, while hydropower, oil, gas, and renewable resources each contribute five percent or less. Since the completion of the Ainsworth project, wind power supplies about 1.7 percent of the NPPD portfolio. Wind resource variability is not a major concern, because the Ainsworth project is aimed at generating low-cost energy for use in the off-peak season or for sale on the wholesale electricity market.

NPPD's board of directors has outlined considerations that guide the utility's wind acquisitions. For example, new energy resources should benefit Nebraska economically and environmentally. Also, new resources should not degrade the utility's outstanding service, and they must be generally cost-competitive with other, readily available resource options. So far, wind energy has met these requirements. Wind energy is a promising resource, which can benefit Nebraska and its rural communities, if it is carefully developed.

Environmental concerns. The deliberative poll of NPPD customers, completed in 2003, showed that environmental protection is important to NPPD customers. Among five choices, top-ranked customer concerns were (1) adequately meeting future electricity needs, (2) keeping electricity costs affordable, and (3) protecting public health and the environment. Concerns for economic development and service reliability ranked lower in this poll. NPPD is highly committed to environmental protection. Studies and ongoing programs that protect soil, air and endangered species are included in projects associated with NPPD's generation facilities, including the Ainsworth Wind Energy Facility.

Economic development. As noted above, NPPD's board of directors has expressed a specific interest in considering the economic development impacts of new energy options. In this light, wind development is very attractive. Wind is an abundant, indigenous resource for Nebraskans. Development provides jobs during construction and for ongoing operations. Land-lease payments and increased revenues to local businesses help the rural economy, directly and by raising tax revenues. The community of Ainsworth has welcomed this development, based largely on an understanding of its economic benefits.

Technical details

The Ainsworth wind project taps exceptional natural and technical resources. The site, in north-central Nebraska, offers a Class 5 (on a scale of 1 to 7) wind resource, with an average wind speed of nearly 20 miles per hour. This supports wind farm operations with a projected annual capacity factor of 40 percent or more.

The 60-MW project consists of 36 towers, each supporting a 1.65-MW turbine. Each tower is 230 feet tall. NEG Micon, a company that subsequently merged with Vestas Wind Systems, supplied the turbines. NPPD secured engineering, procurement, and construction support from Austin-based Renewable Energy Systems, Inc., which was, at that time, one of the nation's leading wind-development firms.

The project's proximity to transmission is key to its value. NPPD owns the 115,000-kilovolt transmission line with which the project interconnects, and it operates the project through its own dispatch center. NPPD continues to improve its wind forecasting capabilities, while reports from staff indicate that project performance has been practically trouble-free.

Financing and contractual details

The total cost of the Ainsworth wind project was about $81.3 million. NPPD financed the entire project, using fixed-rate municipal bonds over a 20-year term. The utility received a favorable interest rate of 4.25 percent.

The Omaha Public Power District (OPPD), Municipal Energy Agency of Nebraska (MEAN), and the City of Grand Island signed participation agreements for various portions of the facility's output. OPPD will take the output of 10 MW of the facility, MEAN will take the output from 7 MW, and Grand Island will take the output from 1 MW. JEA, the Jacksonville, Florida, municipal utility, has contracted for the output of a 10 MW share, but through an unusual 20-year purchase agreement. JEA never physically receives the wind power. It sells the power back to NPPD, but retains the RECs, which represent the environmental attributes of the wind generation. This arrangement helps JEA to meet its renewable energy goals, without requiring JEA to actually wheel the energy over such a great distance. In turn, NPPD uses the energy to displace higher cost generation or to sell into the market. The partnership with JEA came in part from both utilities' participation in The Energy Authority (TEA), a power marketing service based in Jacksonville. TEA facilitates off-system sales of wind energy for the project.

NPPD customers have expressed a willingness to pay more for wind power, but this project has a negligible rate impact. Smart project planning and favorable financing have kept costs affordable. In addition, NPPD has benefited by selling some wind-related RECs. It has worked with several green power brokers to sell RECs to buyers in at least three states so far. By working with a broker, the utility can be a part of the emerging national market for RECs without having to build internal staff expertise. Revenues from wind-related RECs are modest today, but NPPD expects the REC market to grow.

The utility currently does not use voluntary subscriptions or green power premiums to support its wind development program. NPPD customers prefer to see wind project costs shared among all customers, making support for renewable energy a universal cause in Nebraska.

Schoolchildren visit the wind site at Ainsworth.

Conclusion and outlook

The 60-MW wind project at Ainsworth is a significant step toward NPPD's long-term renewable energy portfolio goal. It builds directly upon the utility's earlier experience in wind development at Springview. In fact, both projects involve the same local host utility, KBR Rural Public Power District. Other partners for the Ainsworth project, including Omaha Public Power District, Municipal Energy Agency of Nebraska, Grand Island Utilities, and Florida-based JEA, bring their own experience in developing renewable energy for public

power utilities. Financed with municipal bonds and without access to the federal production tax credit, this project relies on a strong wind resource, solid engineering, good transmission access, and economies of scale to achieve cost-effectiveness. While the results of a deliberative poll indicated customer willingness to pay more for wind power, this project did not have to test that willingness; its rate impact is negligible.

Project sponsors say their experience verified the importance of access to transmission in increasing project cost-effectiveness and ease of operation. Economy of scale is also important. This was achieved by gathering partners from the public power community. Each partner benefits not only from participation in a larger, more cost-effective project, but also from collaboration on technical and marketing aspects.

Finally, community relations are key. In partnership with NPPD, KBR Rural Public Power District helped to build and nourish community support for the Ainsworth project. It serves as a local contact for tours and general questions about both earlier Springview wind project and the new, expansive wind facilities. In an era when local opposition could stop a wind project, the community of Ainsworth has embraced the wind farm as a local landmark and as part of its culture. As just one example, the local high school recently heralded a new slogan for its homecoming football game: "Let's Blow 'Em Away."

Public Power Harvests the Wind

Testing new wind power acquisition strategies

Platte River Power Authority - Fort Collins Utilities

Highlights

The municipal utility of Fort Collins, Colorado has long been recognized as a leader in wind energy development. It won the American Public Power Association Energy Innovator Award in 1997 for its efforts to launch the second green power program in the U.S. (after Traverse City, Michigan). Working with its power supplier, the Platte River Power Authority, Fort Collins has continued to advance its commitment to wind and other renewable resources. In 2003, it adopted an updated Energy Supply Policy, including a commitment to meet 15 percent of the city's electricity needs with renewables by 2017. In 2004, Fort Collins won recognition as a Wind Power Pioneer from the U.S. Department of Energy Wind Powering America Program.

In important ways, Platte River Power Authority shares Fort Collins' reputation for leadership in wind power development. Working to serve Fort Collins and three other member cities (Longmont, Loveland, and Estes Park), this relatively small joint action agency has tested several wind-acquisition strategies, including project ownership, power purchase agreements, and green tag purchases. Currently, Platte River owns ten wind turbines at a Medicine Bow, Wyoming wind farm, with a total rated capacity of 6 MW. In addition, it buys renewable energy certificates (RECs), also known as green tags, primarily from the Pleasant Valley Wind Farm in southwest Wyoming. Platte River is evaluating this new strategy, as well new construction options, as it looks to secure more wind power in the future. Its goal has been to provide green power that is as reliable and as affordable as possible.

History

Platte River Power Authority's earliest experience with wind power came in the early 1990s, as a participant in the planning of the Foote Creek Rim Wind Farm near Arlington, Wyoming. The wind farm used turbines from an early leader in wind technology development, Kennetech. Platte River planned to use the project to gain experience with wind power. According to the initial plan, the cost would be rate-based.

600-kW Vestas turbine at Medicine Bow, Wyoming. Photo: Tom Hall

That project was short-lived. Kennetech closed due to bankruptcy in 1996, and the project fell apart. But Platte River continued to be interested in wind. One of its member cities, Fort Collins, had surveyed its customers and found strong support for a green power program. The city asked Platte River, its all-requirements supplier, to contract with a wind developer that could meet its program needs. Platte River subsequently contracted to buy the output of two wind turbines that were being developed near Medicine Bow, Wyoming.

Meanwhile, Fort Collins launched its green power program. Even before turbine construction began, it attracted 700 program subscribers—about two percent of the utility's customers. They agreed to pay a two cent per kWh premium for wind power as soon as deliveries began. It is fairly common for a utility green power project to be well-subscribed in advance; the approach supports efforts to attract developers or to secure financing. However, long construction delays created challenges for the Fort Collins utility staff. They maintained support from customers through savvy communications and cooperative efforts with community leaders. Commissioning at Medicine Bow was finally completed in spring 1998, and Fort Collins began billing green power customers that summer.

Platte River's involvement in wind development was complicated by the constantly changing wind industry of the 1990s. The technical profile of the Medicine Bow project changed during development, from Micon turbines to Vestas. And instead of merely assisting with project financing, Platte River eventually opted to buy the project—now three turbines—outright. In 1999, it acquired five more turbines at the site, selling power from one to Tri-State G&T and from another to the Municipal Energy Agency of Nebraska. It retained the power from three for its own customers. Platte River then bought two more turbines at Medicine Bow in 2000. This brought its total ownership to 10 turbines (nine Vestas and one Nordtank unit).

In recent years, Fort Collins' demand for green power has continued to grow, and other member cities have launched green power marketing programs, too. Platte River expects to add capacity at the Medicine Bow Wind Project, but it has also begun to work with wind power marketers to meet growing needs. Several factors influenced this shift. These include:

- Uncertainty about the availability of the federal Renewable Energy Production Incentive (REPI). Because the REPI relies on annual budget allocations, planners do not figure this benefit into project cost-benefit calculations. The renewable energy production tax credit, which is available to private developers, is subject to congressional renewals. Yet project planners have viewed it as relatively more certain than the REPI.
- Transmission charges for putting wind onto the system have gone up, as transmission congestion and wind integration are regionwide concerns.
- Technical challenges persist, primarily related to equipment failures (gearboxes and generators). This may be due in part to the age and relatively small size of the turbines. Regardless, it is evident that maintenance and repairs can be a burden for a small player.
- The scale of turbines and wind farms nationwide has increased. Larger companies now use their access to multiple wind sites and markets to alleviate intermittency concerns. Many of these companies sell wholesale wind power through contracts that virtually "firm" their wind deliveries. Platte River is currently assessing the value of these so-called shaping contracts to meet its needs.

Platte River took a bold step in 2004, becoming one of the first joint action agencies to provide a significant amount of

green power through Renewable Energy Certificates (RECs). On behalf of Fort Collins, it purchased RECs representing 20,000 MWh of green power from the Pleasant Valley wind farm at Evanston, Wyoming. This project is owned primarily by FPL Energy, and its output is being marketed by PPM Energy. Altogether, it comprises 80 Vestas 1.8 MW turbines, with a total rated capacity of 144 MW. Platte River is one of several buyers from the site.

Platte River wind sources for Fort Collins

Medicine Bow (Platte River)

Total Rated Output: 6 MW

Projected Annual Production: 17,500 MWh

Number of Turbines: 10

In-Service Date: May 1998

Amount purchased by Fort Collins Utilities in 2004: 10,000 MWh

Pleasant Valley (RECs)

Total Rated Output: 144 MW

Projected Annual Production: 396,000MWh

Number of Turbines: 80

In-Service Date: December 2003

Amount purchased by Fort Collins Utilities in 2004: 20,000 MWh

One REC represents the environmental attributes of one MWh of renewable electricity, including the air emissions that are avoided. Platte River buys the RECs and combines them with its own conventional generation, reconstituting a product called "equivalent wind energy." The generator (or in this case a marketer) sells the energy derived from this wind generation into the grid as undifferentiated energy, stripped of its green benefits. This is because environmental benefits can only be purchased once, and Platte River is buying them in the form of RECs. By using RECs, utilities can support renewable energy without having to deal with intermittency and transmission access issues, and they can tap larger, more cost-effective projects. All told, Platte River's equivalent wind energy is cheaper than its self-generated wind.

Since it began to sell equivalent wind energy, the Fort Collins utility has been able to cut the cost per kWh of participating in its wind power program by 60 percent. In 2003, the premium for subscribers was up to 2.5 cents per kWh, but the new premium price, available through 2005, is just a penny. Fort Collins' standard residential rate is about 6.5 cents per kWh.

Lori Clements-Grote, senior communications and marketing specialist for Fort Collins notes that customers can support more wind development per dollar since Platte River began to buy RECs. This should make it more attractive for customers to buy all of their power on the premium wind power rate. Other customers may choose to buy a "block" of wind power. Since the cost per kWh of wind power has gone down, the $5 and $10 blocks effectively represent a bigger wind power buy. As of late 2004, no data were available to reflect how well customers were receiving these relatively new options.

Over the years, Fort Collins wind power program has been very successful. It has maintained a subscription rate of about 2 percent of all Fort Collins customers. This is about twice the subscription rate for the average utility green power program. Currently, the program has about 1,200 subscribers, including 70 commercial customers and 1,130 residential subscribers. (In addition, a small amount of wind power

is still rate-based.) Subscribers must renew their agreements every year.

Fort Collins' energy services engineer John Phelan expects that customers will see another advantage to buying RECs. That is, the RECs are associated with power at a new wind site. Phelan says that companies involved in selling RECs are typically at the forefront of wind development, applying the best technologies and state-of-the-art marketing strategies. It helps the green power marketing effort to have news to share about new wind projects. In the future, the utility's wind portfolio will include Platte River's existing turbines, RECs-supported wind projects, and new construction with Platte River's new development partners at Medicine Bow.

Strategic drivers

Resource diversification. Both Platte River Power Authority and Fort Collins follow an integrated resource planning model for assessing their current and future energy needs. In 2003, the Fort Collins city council approved a new Energy Supply Policy, aimed "to provide strategic objectives regarding system reliability, rates and the environment to guide the electric utility to the future…in partnership with PRPA." This policy specifically recognizes the value of a diverse energy portfolio, with an emphasis on increasing the renewables component. Fort Collins expects to meet 15 percent of its needs with renewables by 2017.

Platte River's current portfolio comprises about 72 percent coal, 25 percent hydro, 2.3 percent wind, and less than 1 percent natural gas. Because it does not rely on natural gas, it has not been greatly affected by gas price volatility.

Platte River has directly felt the loss of federal hydro power availability since the region has been in a drought. John Bleem, Platte River wind program manager, notes that hydro would be a good match for wind power, since hydro is generally dispatchable while wind is not. For now, however, the hydropower is limited.

When Platte River considers diversification, it considers a variety of products within each supply category, too. For example, it has applied a variety of clean-coal technologies within its coal portfolio, and it has worked with a variety of wind energy strategies. It obtains wind power from Medicine Bow, Pleasant Valley, and (to supply other Platte River cities besides Fort Collins) two other wind farms. It recently announced plans to add an additional turbine at Medicine Bow in 2005, working with a large-wind developer. The agency's objective is to find the most reliable and cost-effective mix of conventional and renewable energy resources.

Environmental concerns. Fort Collins has a growing reputation as a city that is committed to sustainable development. This is due in part to its environmentally sensitive location on the Front Range of the Rockies and to the influence of Colorado State University, located there. In 1997 Fort Collins joined an international network called Cities for Climate Protection. It adopted a "no regrets" policy toward climate change—supporting changes in energy use and city planning that lower local carbon emissions while reducing pollution, saving money, and potentially creating jobs. In 2004 the city became a charter member of the Rocky Mountain Climate Organization. Its interests in reducing climate risks are naturally compatible with its interest in developing wind resources.

There is also a practical benefit in acting ahead of environmental regulation. The utility's renewable energy goal was announced well before the passage of Colorado's Amendment 37, Renewable Portfolio Standard (RPS) proposition in fall, 2004. Under Amendment 37, Fort Collins most likely can self-certify its compliance with the statewide RPS without suffering all

the expense and red tape of standard regulatory compliance.

Consumer demand. A high level of consumer demand was reflected in early surveys and in the utility's ability to sign up 700 wind power subscribers long before the program actually began. A 1998 report, *The Fort Collins Wind Power Pilot Program: Who Subscribed and Why*, by Q4 Associates and TechMKKT Works, explored customer expectations and loyalty issues as well as straightforward environmental concerns. At the time, deregulation was a looming concern. The survey found that green power subscribers were significantly less likely to switch suppliers than other customers. Almost 70 percent of green power customers surveyed said they would not switch suppliers even if they could save on their bills. This was notable because these customers were predominantly characterized as "no-frills greens," who did not put a lot of importance on many of the other utility products and services (such as reliability and energy-efficiency programs). The report speculated that the wind program might enhance loyalty with this customer group.

Recently, Fort Collins tested acceptance of green power goals across its entire customer base when it proposed a rate increase to finance the renewable energy and efficiency mandates of its 2003 Energy Supply Policy. The increase would be relatively small—two percent divided equally between renewables and efficiency. Still, the proposal was well publicized, and the utility braced for complaints. According to John Phalen, energy services engineer, the complete lack of protest was a quiet indication of support.

Technical details

Technical details are summarized in the History section, above. Because of its long involvement, Platte River has had first-hand experience at every step along the evolutionary path of the wind industry.

Bleem advises other utilities to recognize that new wind technology is far superior to what was common less than a decade ago. Platte River's Vestas turbines have been good performers, but Bleem notes that today's larger wind machines are even better. He advises any utility that is interested in owning or buying from dedicated turbines to get the best maintenance contract possible. He looks to Europe as a model for better long-term maintenance and consequently for better long-term system performance.

Platte River's greatest disappointment has been that the wind resource has not performed on peak. When it is available, wind is one of its least expensive resources, but the utility has to look to other resources to meet its summer peaking needs. Platte River is currently reviewing wind contract options that would help address this intermittency problem.

Financing and contractual details

Platte River's wind turbines at Medicine Bow were cash-financed. Financing benefited somewhat from the fact that the site was originally a U.S. Department of Energy test site, with good roads and access to test equipment and technical support. Like other public power utilities, Platte River has concluded that the federal Renewable Energy Production Incentive (REPI) is important but currently too uncertain to be counted on in financing wind projects.

The utility characterizes its experience with RECs as positive so far. In 2004, it purchased the environmental attributes of 20,000 MWh of wind power from PPM Energy. PPM is the power marketer for the Pleasant Valley wind project in southwestern Wyoming. By combining these environmental attributes (reflected as RECs) with actual generation from its conventional system, Platte River can provide a wind power equivalent on a steady basis to its wholesale customers. This

approach is subject to some controversy. In some states, if a utility is required to meet an RPS, it cannot use out-of-state RECs toward this goal. Some public power utilities also report that their customers want to know that their green power purchase includes both the REC and the actual generated wind energy. Yet an obvious benefit in Platte River's use of RECs is that the resulting equivalent wind resource is 60 percent cheaper to end-use customers than the previous wind-resource mix was. The partners are watching to see if this advantage outweighs any drawbacks.

In addition, Platte River is assessing shaping services from major wind power marketers. Through this type of service, the supplier resolves intermittency problems, using traditional resources to shape wind output. It trues up the contract, accounting for the green-power and conventional-power components, every month or two. In this way, the buyer gets energy off peak, and over the course of time, it meets its specific green power goals.

Conclusions and Outlook

The relationship between Fort Collins Utilities and its joint action agency, Platte River Power Authority, has been very cooperative in the area of wind resource development. Both Fort Collins and Platte River were interested early on in learning how to use wind technology and how to bring this resource to customers most cost-effectively. So far the partners have not found a silver-bullet solution to all of wind's challenges, but they have increased their commitment to adding green power to the system. Fort Collins also has provided leadership for the other three municipal utilities that are members of Platte River Power Authority. All Platte River member utilities receive wind energy today.

The Fort Collins wind power program offers two options for customers. They may subscribe by paying one cent per kWh more for all their electricity or they may purchase a $5 or $10 block of green power each month. Since Platte River began to purchase and use RECs, the cost per kWh has dropped and the amount of wind supported per $5 or $10 block has increased. It is too soon to know how this change will affect participation rates in one purchase option or the other.

Fort Collins has begun to rate-base more wind power since the passage of its 2003 Energy Supply Plan. That plan sets a renewable energy supply target of 15 percent by 2017—a target that is probably too high to meet through voluntary subscriptions alone. The fact that customers did not protest a rate increase related to rate-basing more renewables has been taken cautiously as a show of support.

Platte River believes strongly in resource diversity, including working with different wind supply strategies. It was an early leader in developing its own wind farm at Medicine Bow, Wyoming. It has purchased RECs, RECs and shaped energy, and it may purchase a load-shaping green power package by 2006. Recently, it announced plans to work with a wind developer to add a new 2.5 MW turbine to the Medicine Bow site, probably in 2005. This partnership will bring financing advantages and technical resources that Platte River would not have if it were working alone. With their diverse and steadily evolving strategy, Platte River and its member cities foresee a growing commitment to wind resources.

Public Power Harvests the Wind

Embracing the benefits of ownership

Sacramento Municipal Utility District

Highlights

The Sacramento Municipal Utility District (SMUD) is one of the nation's largest municipal utilities, serving about half a million electric customers in a community of more than 1.5 million. It also is one of a handful of utilities that lead the nation in renewable energy development. SMUD's leadership in solar energy has sometimes left the other parts of its renewable energy portfolio in shadow. But wind power is truly the workhorse among SMUD's renewables. By 2008, wind will make up about 45 percent of the utility's renewables portfolio, followed by geothermal (26 percent), biomass (22 percent), small hydro (6 percent) and finally, solar (about 1 percent).

SMUD has set a substantial goal for renewable energy development. Its voluntary renewable portfolio standard (RPS) calls for meeting 10 percent of its needs with renewables by 2006 and 20 percent by 2011. This far exceeds California's current RPS goal and about matches Governor Swarzenegger's proposed accelerated statewide goal of 20 percent by 2010. In 2004, the SMUD board of directors embraced renewables as a way to help the utility support its core values. These include

- competitive rates, especially for the mid- to long-term
- system reliability
- customer service excellence
- environmental protection.

SMUD has two distinct wind development strategies. One is a robust green power program and the other is rate-based procurement from SMUD-owned wind generation. The green power program, called Greenergy, has been a national leader since the late 1990s. In 2004, it ranked fourth among U.S. green power programs, by number of subscribers and by total amount sold. It reported sales of nearly 177,000 MWh, from landfill gas, wind, small hydro power and solar resources. The wind portion was obtained through agreements with the Stateline Wind Project, FPL Energy Highlands Project, PPM Energy, and from its own resources.

SMUD Vestas 660 kW turbine

Yet the most unique aspect of SMUD's involvement in wind is its ownership of a wind farm in the nearby Montezuma Hills, called the Solano Wind Project. The utility had some pioneering experience with wind technology in the early 1990s, but it initiated this large and growing project in 1999. By 2003, the project included a total of 23 660-kW Vestas wind turbines, for a total rated capacity of 15 MW. In 2005, construction will begin on an additional 85 MW of wind generation at the Solano site.

This will be one of the largest wind projects to be directly owned by a public power utility. SMUD's decision to pursue this project is testimony to the specific economic and strategic benefits that ownership can bring. Some of these benefits are easy to see on paper, such as the cost comparison of site ownership to leasing. Other benefits—such as the risk management advantages of owning a project instead of relying only on green power markets—are less obvious, but perhaps more important. If the Solano Wind Project builds out successfully, as planned, SMUD is likely to pursue more utility-owned wind generation.

History

SMUD's commitment to renewable energy began in the 1980s, driven by a landmark decision by customers to close the Rancho Seco nuclear plant and to meet a growing portion of the utility's needs with energy conservation and renewables.

The utility's first major opportunity to work with wind power came in 1993. Wind surveys had identified a good resource in Solano County, near Sacramento. SMUD purchased 3,300 acres and initiated plans to build a 50 MW wind project using 180 relatively small Kennetech wind turbines. However, an initial effort, totaling less than 5 MW, was fraught with technical difficulties. In 1999, two of these turbines were replaced with one state-of-the art demonstration turbine (a Vestas V47), with an installed capacity of 660 kW.

The utility then continued to collect wind and production data, confirming that both the resource and the technology were strong. Other wind developers also moved into the area. SMUD decided the time was right to expand its demonstration project. By 2004, the utility had a total of 23 Vestas 660-kW turbines at the site, representing a rated capacity of 15 MW. And it had plans once again for development. In summer 2004, SMUD released a request for proposals to supply 85 MW of additional wind power at the Solano Wind Project site.

Sacramento Municipal Utility District Solano Wind Project

In 2005, SMUD plans to initiate an 85 MW expansion of its Solano Wind Project. Here is a summary of the project to date (2004).

Project Ownership: SMUD

Total Size of Project: 15 MW

Turbine Manufacturer/Size: Vestas 0.66 MW (23)

Commissioning: 1994-2004

Estimated Capacity Factor: 37%*
* Based on operating data

Marketing summary:
Project cost is rate-based, except for the output of 3 turbines, which are dedicated to the SMUD Greenergy green power marketing program.

The Solano Wind project will be used primarily to meet portfolio goals. The Greenergy program utilizes contractual agreements, to supply more than 143,000 MWh of green power to its subscribers.

According to SMUD director of business planning and budget, Jim Tracy, the utility learned plenty of lessons from its early experience. For example, SMUD learned never to underestimate the importance of technical assurances. When staff wrote the new RFP, it specified a 10-year minimum warranty with a matching operations and maintenance (O&M) contract. According to Tracy, technical assurances relate directly to the success of project financing. "If you know your O&M costs in advance, you can start to pencil out the long term cost of power," he says.

SMUD issued general revenue bonds to finance the new project. SMUD policy-makers have pushed for congressional passage of a tradable tax credit, so public power utilities could enjoy some of the benefits that the federal production tax credit offers to private developers. However, SMUD also recognizes that this is prime time for wind development, especially for a utility with an aggressive RPS policy. Other companies in the wind industry recognize this too, and that puts upward pressure on the market price for wind energy. The savings that are available to utilities that are willing to "do it themselves" are significant.

SMUD is also making significant purchases of wind power. This is the main strategy for the Greenergy green power marketing program. The rationale is that the green power program is completely reliant on customer subscriptions and therefore is relatively unpredictable. At the same time, Greenergy must deliver exactly what it promises, since customers agree in advance to pay for a set amount of green power. A power purchase agreement, in this case with PPM Energy, offers this assurance. Currently, Greenergy has a contract with PPM Energy for the output of 50 MW of wind power from the Stateline Wind Project on the Oregon-Washington line. In addition, three turbines with a total rated capacity of 1.8 MW from the Solano Wind Project have been dedicated to serving the Greenergy program since April 2004. Greenergy may buy additional power out of the Solano Wind Project, as it is available.

Strategic drivers

Resource diversification. Resource diversification is one of SMUD's primary energy supply goals. The California energy crisis of 2001 is still fresh in the memory of policymakers and customers. They share a strong sense that too much reliance on the power market is not in the utility's long-term best interest. Thus, adding demand-side and renewable energy resources, with a preference for utility-owned or -controlled resources, is important to SMUD.

Projecting needs to fulfill both its 20-percent RPS and a growing green power program, SMUD expects to need 2,250 GWh per year of renewables by 2011. Wind power will be the primary resource, along with geothermal, biomass, small hydropower, solar, and hybrid renewable systems. SMUD is one of the few utilities in the country that has its own strong energy research and development (R&D) program, to help prepare it to meet future energy needs. SMUD's R&D program, called the Advanced, Renewable and Distributed Generation Technologies Program, is funded in part by the California Energy Commission.

Environmental concerns. Concern for the environment is one of SMUD's six core values. This concern is driven by long-standing customer interest and by utility leadership. In 2003, the World Wildlife Fund named SMUD as one of a handful of utilities in the U.S. that are at the forefront of addressing climate risk through commitments to renewable energy and energy efficiency. In 2004 SMUD became the first company to certify a greenhouse gas emissions inventory with the voluntary California Climate Action Registry. According to Bud Beebe, SMUD regulatory affairs coordinator, the reporting exercise provides feedback for utility planning to further reduce emissions of carbon dioxide

and other greenhouse gasses. Increasing generation from wind power will be directly reflected in registry reporting. SMUD notes that wind power has the advantage of being a low-cost energy resource at the same time as it delivers environmental benefits.

Consumer demand. As utilities like SMUD add large amounts of rate-based green power to their systems, consumer demand might seem to be a less important driver than it once was. According to Jim Burke, Greenergy program manager, this is not the case. As a voluntary program, Greenergy remains a constant indicator of growing interest in green power. This, in turn, drives the utility's willingness to invest directly in rate-based renewables.

The Greenergy program ranks high by every measure that the U.S. DOE National Renewable Energy Laboratory tracks. In 2004, SMUD ranked third among utilities nationwide for overall green power sales (177,000 MWh/year, or 20.2 average MW). It ranked fourth for total number of participating customers, with 28,500 participating in either Greenergy or SMUD's PV Pioneers Phase I project. It ranked fourth in customer participation, too. And the premium charged for Greenergy was among the lowest charged by green power programs nationwide, at 1 cent per kWh. According to Burke, participation in Greenergy continues to increase. However, customer demand depends on strong and carefully coordinated communications. Greenergy provides training and incentives to win cooperation from call center employees, and it uses a variety of bill inserts, direct mail, and retail partnerships to keep communication with customers flowing.

Economic development. The SMUD board has directed program planners to favor local benefits over global benefits in resource planning. This has influenced SMUD's decision to invest directly in wind power instead of relying on wind power purchased from out of state. In addition, SMUD supports the local economy by keeping rate impacts to a minimum. The utility's decision to build at the Solano Wind Project rather than to buy wind power will save as much as a half-cent per kWh, according to Tracy. This includes sizable benefits from owning the land where the wind project is sited. Tracy suggests that municipal utilities nationwide might want to acquire good wind sites before the rush to develop them becomes any more intense. In some areas, good wind sites have already been purchased or leased by the large wind developers.

Technical details

Responses to SMUD's wind development RFP were under review at the time of this report. Thus the technical details of the Solano project expansion are not yet determined. The expansion that brought capacity of the site to 15 MW in 2004 relied on 660 kW Vestas wind turbines. They are mounted on tubular towers 240 feet above the ground. This was important in addressing concerns for bird safety. Earlier lattice-design wind towers with faster spinning blades that were previously common in California resulted in high rates of bird mortality. At the time SMUD was planning the next wind expansion, data was still not sufficient to prove that the new turbine designs would be safer for birds. The best strategy in such a case, according to Solano Wind Project Manager Dick Wallace, is to assure the public that the utility will monitor bird mortality carefully and mitigate problems if they arise. SMUD had already invested in careful research to gain confidence in its position, but advises against asking customers to support a project on trust alone.

Aesthetic concerns are also becoming a factor in California wind development. It is important to be honest with customers and area landowners about the visual impact of large wind farms. SMUD's project environmental impact reports use extra-large photos of the turbines instead of photos on

standard letter-sized paper, so that aesthetic issues are out front and can be resolved before construction begins.

SMUD's experience with wind has been encouraging. Utilities that are beginning their wind programs today can be relatively sure that wind technology will perform much better and more reliably than it did a decade ago. The new Solano turbines are available more than 95 percent of the time and perform with a capacity factor of about 37 percent. The practical benefits of improving wind technology include the ability to deliver more low-cost wind energy and the ability to finance a project over a longer period of time, which significantly reduces the cost per kWh.

Financing and contractual details

SMUD utilized low-interest revenue bonds to finance the 2004 Solano project expansion, and it is using similar financing for its slated 2005 project expansion. Financing details for the new project were not available, but the 2004 request for bids suggested some parameters, For example, the request for bids included a requirement that the new wind generation (up to 85 MW) must provide a minimum 10-year warranty and operations and maintenance (O&M) contract. SMUD's experience leads it to value this technical assurance, despite some additional cost.

As SMUD works to achieve its RPS goal of 20 percent renewable energy by 2011, it may continue to purchase a significant amount of wind through power purchase contracts. Currently it contracts with PPM Energy to buy wind energy from the Stateline Wind Project. It has had other contracts, too, in past years. SMUD is not engaged in buying or selling green tags, though Tracy says the utility is continuing to watch developments in the developing green tags market.

Conclusions and outlook

SMUD is one of the strongest voices among municipal utilities in favor of direct ownership of wind generation. The utility looks at wind ownership in much the same way as it looks at owning conventional generation, including a new 500 MW natural gas plant. Utility-owned generation is a hedge against market volatility and the market abuses that California experienced in the energy crisis of 2001. SMUD is also in favor of owning its wind site instead of leasing it because this reduces operating costs and enhances long-term price stability.

When the current expansion of SMUD's Solano Wind Project is complete (by 2008), the utility will own a 100 MW wind plant. The cost will be rate-based, as part of the utility's overall commitment to meet a growing renewable-resource goal.

The relationship between this large wind acquisition and the ongoing Greenergy green power marketing program is subtle but important. Green power supported by the Greenergy program will not be directly counted toward the RPS requirement, but it lowers the amount of additional green energy needed to satisfy the RPS. This is beneficial. Greenergy also gives the utility a way to engage customers directly in supporting renewable energy development. It keeps the topic of renewables and environmental responsibility out front. Drawbacks only arise if wind power comes into short supply or if customers misunderstand the differing goals of the two wind programs. Communications is key.

SMUD's growing commitment to renewable energy development, demonstrates a high level of confidence that renewable energy is the wave of the future. The utility believes that carefully planned investments in renewables also have strategic benefits for utilities today.

Acquiring wind in an uncertain climate

Seattle City Light

Highlights

Seattle is a city of more than half a million people, located on Puget Sound in Washington State. The municipal utility, Seattle City Light, has been a national leader in energy resource management since the 1980s. Over the years, conservation, customer service, energy cost containment, risk management, and other concerns have influenced utility planning. And since 2000, a new concern has come into play—climate risk.

The city is committed to using energy conservation, investments in renewables, and non-utility emissions reductions to make Seattle "greenhouse gas neutral" by 2005. Utility load growth will be held in check by conservation programs, or it must be served by renewables. Emissions from power plants, city vehicles, and other sources will be offset by investments in reducing greenhouse gas emissions elsewhere. Through this plan, Seattle has pledged to meet or beat the greenhouse gas reduction goals set by the Kyoto Protocol. Its aim is to act locally and to catalyze more action by the range of climate stakeholders.

City Light relies largely on hydropower, so it is beginning with lower greenhouse gas emissions than most electric utilities have. But carbon-free hydropower presents other challenges. It has availability constraints, based on weather conditions and salmon protection regulations. While the utility must supplement its hydropower, it is now wary of the short-term power market. City Light suffered shortages and price spikes during the California energy crisis of 2001.

For these reasons and more, wind power is becoming a strong part of Seattle's energy resource portfolio.

In particular, the city is buying wind power from a wind farm on the Washington-Oregon state line. The Stateline Wind Project is an enormous complex, developed by FPL Energy and Vansycle. It includes 180 MW of capacity built on the Washington side in 2001 and more than 83 MW built on the Oregon side at the same time. Since then, the complex has been expanded by FPL and by other companies that have built adjacent wind farms. Seattle City Light has worked with power marketer PPM Energy to contract for a share of Stateline, up to 175 MW of capacity, through 2021. This is essentially all the output of the Washington side of the project.

Stateline's Vestas 660 kW wind turbines

Seattle started receiving some wind from the project in 2002, and has now fully ramped up its program. It has used this period, while the utility has more than enough energy resources, to learn how the wind project performs and to explore specific contract options with PPM Energy. The

challenge that City Light faces is to balance its purchases of wind power to take advantage of this resource when other low-cost resources, principally hydropower, are not fully available. City Light is also working in an uncertain environment with regard to transmission regulations. The Pacific Northwest region may form a regional transmission organization, or Bonneville Power Administration may continue to dominate in regional transmission. City Light must be ready with a wind resource that meets its needs, however the market develops.

History

City Light's wind acquisition resulted from policies and processes that have been evolving for a long time. The utility has done long-term resource planning since the 1980s. As in other progressive utilities, its resource planning now takes an integrated resource planning (IRP) approach. This includes an assessment of future needs and options, incorporating technical and market research and public input. City Light reviews both demand and supply side resources to meet customer load for the lowest reasonable cost, risk, and environmental impacts. The utility is currently working on its 2005 IRP. Seattle also has an Office of Sustainability and Environment, which coordinates efforts with the utility on an ongoing basis to address all clean energy issues.

In 2000, the Seattle city council passed two guiding resolutions on climate risk. One adopted the Kyoto goal of a 7 percent reduction in greenhouse gas emissions and called for research to find out if Seattle could do even better—perhaps tripling that reduction, to more than 20 percent by 2010. The second resolution outlined City Light's commitment to achieve zero net greenhouse gas emissions. This included funding to purchase emissions offsets, such as financing energy improvements by regional industries. It also suggested utilizing energy efficiency, conservation, and non-hydropower renewables to help meet climate goals. The city's decision to act ahead of regulations was based in part on its experience anticipating salmon regulations. According to environmental director Lynn Best, City Light developed salmon protection policies before it was required to. This created good relations with regulators and saved money for the utility once mandatory salmon regulations materialized.

In part, Seattle's bold climate policy is simply based on the belief that this is the right thing to do. Seattle is at risk from climate change—rising sea levels, unpredictable swings in the snows and rains that feed the hydro reservoirs, and an economy that includes forestry, fishing, and outdoor recreation. Even if local actions alone cannot stop impacts, city leaders believe the city must act as a catalyst and support efforts to mitigate climate change.

The programs that resulted from these climate resolutions include a large wind acquisition plan. The utility decided to work with PPM Energy, which was marketing power from the Stateline Wind Project.

The Stateline Wind Farm was completed in late 2001. City Light began to test the resource. By late 2004, it was taking generation equivalent to 100 MW. The utility was long on energy resources in 2004, but leaders believed it was a good time to work out interconnection issues and to review contractual options for the future. The costs of the large wind acquisition are rate-based. City Light has a separate voluntary green power marketing program, which focuses on local projects in solar energy, small wind power, biomass, and emerging technologies.

Strategic drivers

Resource diversification. According to City Light planners, resource diversification is not an explicit driver, except as it supports risk mitigation.

City Light reports that it has sufficient resources to meet average monthly demand, even in a dry year, but that there may be temporary shortages. In addition, the utility will need to add resources over the long run, as customer demand increases. One of City Light's goals is to create a hedge against drought-induced hydropower shortages, substituting conservation and non-polluting resources.

The utility also wants to mitigate risk by minimizing its exposure to power market volatility. The California energy crisis in 2001 demonstrated the value of long term contracts.

When City Light began seeking a wind supplier, it favored the Stateline Wind Project partly because it could obtain a 20-year agreement from the power marketer, PPM Energy. It also liked the fact that the resource was in Washington State.

Environmental concerns. The City of Seattle's commitment to sustainable development is reflected in every department, from public transportation to utility operations. Following passage of a city council resolution that directed City Light to achieve a "no net emissions" goal for greenhouse gases, the Office of Sustainability and Environment began to inventory Seattle's greenhouse gas emissions. The report, released in 2002, found

- The city had already cut greenhouse gas emissions from its operations by 48 percent from 1990 to 2000, and the trend appeared to be continuing.
- Transportation accounted for more than half of the community's emissions. Emissions reductions over the previous decade were largely due to energy conservation and recycling.
- Based on progress that the city had already made, it should be able to reduce greenhouse gas emissions beyond goals equivalent to those in the Kyoto protocol, with net positive impacts on the local economy.

Seattle won recognition from national and international organizations for its leadership on the climate issue. It is a leading member of the international Cities for Climate Protection (CCP) program, and in 2002 it hosted a conference of more than 250 CCP program cities.

Economic development. Seattle has integrated its environmental stand into its economic development strategy. According to Steve Nicholas, director of the Office of Sustainability and Environment, the city has done market research, confirming its belief that Seattle is seen worldwide as a good place for environmentally conscious companies to do business. A healthy environment is healthy for business, he notes.

Conversely, the cost of not acting on climate issues could be enormous. At its current pace, global warming is likely to reduce the region's snowpack by 50 percent over the next 50 years, threatening the water supply for drinking, irrigation, and hydropower generation. Seattle's actions alone cannot prevent these costly developments, but its leadership may induce other cities and countries to act. Seattle leaders believe that a strong widespread response can slow climate change to some degree.

Technical details

The Stateline Wind Project is one of the largest wind farms in the U.S. It was developed by FPL Energy and Vansycle. The first phase of the project was commissioned in 2001, with turbines in both Washington and Oregon. Seattle City Light has contracted for the output of the turbines on the Washington side of the project, equivalent to 175 MW. The rated total capacity commissioned in Washington in 2001 was 180 MW. The project utilizes 273 Vestas V-47 wind turbines.

The Oregon portion of the Stateline project includes 127 Vestas turbines, totaling more than 86 MW of rated capacity. Later additions to the Stateline project include those developed by FPL Energy and those by other developers who secured sites nearby. The region has one of the best wind resources in the country.

In 2002-03, City Light purchased 140,850 MWh from the Stateline Wind Project. Its acquisition is expected to increase with the utility's overall energy needs.

Contractual details

It was a challenge for City Light to find large renewable energy resources that were immediately available to meet its needs. The utility wants to promote new renewable energy technologies. However, it has set aggressive targets, which dictate a large, reliable acquisition.

City Light worked out a long-term supply contract with PPM Energy for resources from the Stateline Wind Project. It has contracted for wind generation "not to exceed 175 MW" for a period of 20 years. The contract allows flexibility in working out shorter-term specifics.

So far, wind generation has not been well matched to Seattle's demand profile. As a result, utility leaders opted for a new contract instrument, called an integration exchange, which addresses wind's intermittency. This requires PPM Energy to deliver the amount generated at Stateline each month as a flat supply that does not reflect intermittent fluctuations. To achieve this, PPM delivers on a schedule that is delayed by two months.

City Light reports that it chose this service because it had no experience in dealing with the characteristics of wind generation and because the service facilitates matching between resources and customer demand. The cost of these shaping services varies, depending on the amount and variability of the wind energy generated each month. On the average, City Light's current integration exchange contract adds about 1.5 mils per kWh to the cost of wind power.

The utility also believes it is important to purchase the environmental benefits with the wind energy. Some wind power suppliers separate the environmental benefits as renewable energy certificates (RECs), so they can be sold separately from the energy. Trading markets for RECs are just developing nationwide, but City Light anticipates that RECs will increase in value over time. This is true because utilities in some states may use RECs to satisfy state renewable portfolio requirements. Eventually, RECs also may be used to satisfy voluntary or mandatory greenhouse-gas reduction targets.

Like most other utilities that have purchased wind power, City Light has found transmission access to be a challenge. Utility planners recommend working closely with transmission providers from the start, to assure access and to minimize extra charges that transmission providers will want, in compensation for dealing with intermittency issues. Transmission-related planning is especially difficult for City Light because stakeholders in the Pacific Northwest have not yet determined the long-term structure of the wholesale market. The region may form a regional transmission organization, but this is not yet determined. In the face of uncertainty utilities like City Light must ask what-if questions before they make long-term commitments.

Conclusions and outlook

Seattle City Light has one of the largest public-power wind acquisition programs in the country. Seattle City Light has one of the largest public-power wind acquisition programs in the country. Its 2000 commitment to achieving a "no net greenhouse gas emissions" goal, as well as its goal to meet all load growth with

conservation and renewable resources, put the wind program on a fast track.

City Light is working effectively with PPM Energy to assure that it meets its green power goals, even though the profile of wind generation is not exactly matched to the utility's resource needs. City Light believes it made a good decision in starting wind deliveries at a time when it still had adequate energy resources. This gives the utility a chance to see how the wind resource performs and to adjust contract terms before the wind power must play a greater role in meeting specific needs. Since 2002 the portion of Seattle's needs that are met by wind have increased from about 1 percent to 3 percent. This portion will continue to grow, as Seattle taps up to 175 MW of wind capacity from the Stateline Wind Project.

Utility leaders expect renewable resources to play a greater role in Seattle's future. They see a continuing role for energy conservation, too.

The utility is a pioneer in responding to climate risk. Research from Seattle's Office of Sustainability and Environment indicates that its climate strategy is good for the local economy. So far, it is also good for the utility. The higher cost of wind power can still be less than the cost of energy from a natural gas combustion turbine. Wind is a good hedge against fluctuations in hydropower availability and against volatility in the power market. These practical considerations represent the kind of thinking that Seattle leaders believe other utilities can and must apply in their own resource decision making, to move the industry and the environment toward greater sustainability.

Public Power Harvests the Wind

Leadership rooted in small-town values

Waverly Light and Power

Highlights

Waverly Light and Power serves a farm-based community of about 9,000 in northeastern Iowa. The system peak is less than 30 MW and the utility employs fewer than 30 people. Yet Waverly is a world-recognized leader in renewable energy and energy efficiency. In 1993 it installed the first utility-scale wind turbine in Iowa. Later it became the first electric utility in the U.S. to offer green tags, a form of renewable energy certificates that allows investors to support wind power development. The utility is part of a tradition of progressive city-owned systems that accomplish more than utilities many times their size, through efforts that are both highly innovative and practical.

The Waverly wind program was initially driven by a desire to control purchased power costs and to meet needs locally. Policymakers shared the belief that producing renewable energy locally would strengthen the economy and build community spirit. These simple drivers grew to include a strong commitment to the environment. Waverly became one of the first utilities in the nation to track its greenhouse gas footprint as it works to reduce climate risk.

The output of Waverly's three wind turbines currently represents about 5 percent of the utility's resource portfolio. Waverly plans to add more wind in the near term, aiming for about 10 percent of the portfolio.

The utility also has a new green power marketing program. This is in addition to an ongoing green tag marketing program. Waverly initiated the Iowa Green Tags program in 2001, offering buyers worldwide the chance to support its local renewables program.

While Waverly is often cited for its achievements in wind development, the utility is always reviewing its progress and making adjustments. Waverly's team of utility policymakers, staff, consultants, and industry partners has faced its share of problems and challenges, but it has always found practical solutions. It remains a good case study for municipal utilities that are now entering the field.

Installing Waverley's Skeets 4 turbine

History

In the early 1990s, Waverly Light and Power launched several strategies to slow an increasing appetite for purchased power. Demand had been growing at a rate of 4.2 percent per year—almost twice the national average. And looking ahead, Waverly faced the end of a favorable long-term power contract in 1999. Utility leaders followed a basic integrated resource planning (IRP) process, which set them on course with cost-effective demand-side management and energy-efficiency efforts. The IRP process also gave them an appetite for wind.

The program evolved through three stages. Waverly's first experience with wind was limited to an 80 kW turbine. It was named Skeets 1, in honor of Russell "Skeets" Walther, the farmer who owned the wind site. In 1993 this site hosted the first utility-scale wind turbine in Iowa, and one of the first in the nation.

The advent of wind power in Waverly coincided with the arrival of a new general manager, Glenn Cannon, from a large East-Coast public power utility. But the decision to develop wind power came under leadership of a strong board of trustees and a community advisory group. This broadly collaborative process was one key to the wind program's success.

The first wind site was just outside Waverly, but given the limitations of early-90s small-turbine technology, the site did not merit more development. When Waverly looked to expand its wind program, it looked for a stronger wind resource. It chose to buy two turbines at the Storm Lake Wind Farm, near Alta. Today this wind farm has a total rated capacity of nearly 200 MW. Waverly opted to build two 750 kW Zond Z-50 turbines there. Although they are technically identified as Storm Lake Turbines 210 and 211, the utility dubbed them Skeets 2 and Skeets 3. Transmission from the site was achievable because Waverly had an adequate contract in place for transmission through the region.

Skeets 2 and 3 went on-line in the summer of 1999. The utility outsourced operations and maintenance. Meanwhile it began to develop a program called Iowa Energy Tags, which it launched in 2001. This program offers buyers anywhere the chance to own the environmental attributes of Waverly's green power. Iowa Energy Tags are marketable because not every utility or energy user that wants to support renewables has direct access to renewable energy generation. Increasingly, businesses and individuals want to offset their conventional energy use with a contribution to renewable energy development. Green tags also reflect the early development of greenhouse emissions trading markets. The Iowa Energy Tags have generated about $20,000 so far. Yet, however modest, the program helps to finance new wind and to build support for developing renewables on a grander scale.

In 2001, the utility took down the original Skeets 1 wind tower. It replaced this local landmark with a new 900 kW NEG Micon turbine. Community support for the local site was strong, but the decision to build in town was not merely promotional. It was based on technical and economic considerations. For instance, improvements in wind technology since the construction of Skeets 1 promised strong performance even in an area that had only a moderate wind resource (Class 3, compared to a maximum Class 7). The site had already been prepared for wind generation, presenting savings even considering the cost of upgrades. And this site, with close access to the distribution system, offered a considerable advantage by avoiding transmission costs and hassles.

The Micon turbine's record of operation for 2002 through 2004 has been impressive. By most measures, it has exceeded expectations.

Waverly Light and Power
Wind Projects at a Glance

Project Ownership: Waverly Light and Power

Total Wind Capacity: 2.4 MW (2004)

Turbine Manufacturer/Size:

Skeets 2 and 3: Zond Z-50, 750 kW
Located at Storm Lake Wind Farm

Skeets 4: NEG Micon 900 kW
Located at Waverly, Iowa

Commissioning:
June-July 1999 (Skeets 2 and 3)
December 2001 (Skeets 4)

Estimated Capacity Factor:
31% estimated (Skeets 2 and 3)
36% to date, 28% estimated (Skeets 4)

Marketing Details:

Project costs are rate-based. Effective financing resulted in costs for wind power of less than 3 cents per kWh, before REPI consideration. Customers and non-customers may buy Iowa Energy Tags to support Waverly Light and Power wind development.

In addition, WLP has launched a local green power program, partly in response to a statewide regulation requiring Iowa utilities to offer green power to their customers.

And Waverly Light and Power's interest in wind development has continued to grow. According to Cannon, the utility is in the early stages of development for a 1.65 MW turbine, which it hopes to build in 2007.

Strategic drivers

Resource diversification. During its resource planning process in the early 1990s, Waverly recognized the value of decreasing its reliance on outside suppliers. The utility was growing fast, and a long-term supply contract was running out. Waverly's strategy was two-fold: First, it would slow load growth by focusing on demand-side management and energy efficiency. Second, it would begin to acquire capacity from a variety of sources, including both conventional generation and renewable energy resources. Waverly's leaders recognized that the utility's first wind machine, at 80 kW, could not make a big dent in the community's power-supply needs, but they liked the fact that the wind resource was local and that it was clean. Over time, Waverly has increased the role of renewables in its portfolio. Wind represents more than 5 percent of that portfolio today, and it is likely to grow to 10 percent before long. Waverly's demand-side programs have also been very effective at keeping load growth in check.

Environmental concerns. Waverly Light and Power is one of a handful of utilities in the U.S. that has made a bold commitment to reduce its impact on climate change. In 2003, the World Wildlife Fund recognized its contribution by naming it as a WWF *PowerSwitch!* climate partner. It was named primarily because if its commitment to increase energy efficiency by 15 percent by 2020. Yet the utility sees its energy-efficiency programs and its support for renewable energy development as closely related. It tracks its greenhouse gas emissions and savings, and reports this to its customers. For example, in 2003, Waverly's wind generation offset 6,850 tons of carbon dioxide emissions. Cannon credits the community's close ties with agriculture as one reason why it is so receptive to environmentally responsible policies and programs. He believes successful utilities must learn new ways to integrate environmental concerns into their business plans.

Consumer demand. Waverly's wind program began with strong leadership from its board of trustees and from a citizens advisory group. More important, support for

the wind program has grown over the last decade. Before it built Skeets 4, a relatively large project, near town, the utility contacted neighboring landowners to be sure it addressed their concerns. One novel indication of community support is reflected in Waverly Light and Power's new logo, which suggests a spinning wind turbine.

Economic development. The state of Iowa imports 95 percent of its fuel, at a cost of about $5 billion per year. By relying less on outside suppliers, Waverly keeps dollars circulating closer to home. Through the Iowa Energy Tags program, it has also brought in thousands of dollars from as far away as Europe.

Technical details

Skeets 2 and 3 are 750-kW Zond Z-50 turbines, located at the Storm Lake Wind Farm, near Alta. The towers are more than 210 feet tall, and the rotors have a 164-foot span. Operations and maintenance has been outsourced to GE Wind. Its quarterly reports through 2004 are posted on the Waverly Light and Power Web site, at www.wlp.waverlyia.com. The turbines have achieved availability of more than 97 percent. Production in 2003 was about 4,100 MWh, representing a capacity factor of 31.3 percent. Production in 2002 was slightly greater, with a capacity factor of 33.7 percent.

Skeets 4 is a 900 kW NEG Micon turbine, with a span of about 171 feet, mounted on a tower 230 feet tall. It generates an estimated 2.2 million kWh per year. A prime consideration in choosing this turbine was its sensitivity to lower wind speeds. It operates in winds from 7.8 mph to about 56 mph. This is important because the Waverly site is only a Class 3 wind resource (on a scale of 1 to 7). The blades turn slowly. The result is a machine that is relatively quiet. Skeets 4 has also been free of bird mortality problems, partly due to the technology and partly due to its location relative to migration paths.

The new turbine has exceeded expectations. Through the summer of 2004 its capacity factor averaged 36 percent, compared to an engineering estimate of 28 percent annually. Cannon reports that intermittency has not been a significant problem on the system. He advises utility managers to think of wind generators in the same way as they think of large customer loads. "Large customer loads actually swing more than our turbines do," he adds. It works much like "negative load". As wind becomes a greater part of Waverly's resource portfolio, intermittency may become more of a concern. However, Cannon expects the availability of more load leveling and storage techniques before that time.

Maintenance requirements are less troublesome than those of diesel generators, Cannon reports. Waverly has lightened its load by outsourcing O&M for all three of its turbines. The yearly cost of about $7,500 covers supervision, monitoring costs, insurance, and routine and unscheduled maintenance.

Financing and contractual details

Waverly has financed wind development much as it would finance other generation investments. New wind machines currently cost about $1 million per MW and have a life of 25 to 30 years. "If you use a 25-year amortization, wind costs less than new base load coal," Cannon says.

A fact sheet from the Iowa Department of Natural Resources summarized Waverly's costs for wind. Including all capital, land lease, and O&M costs, the cost of wind power from Waverly's three turbines averaged $0.0282 per kWh in 2002, and slightly more in 2003. Counting the impact of the federal Renewable Energy Production Incentive, the cost came to $0.0107 per kWh. Including the cost of money, this cost increased to $0.0148 in 2002, and slightly less in 2003. Note that different utility's reported costs for wind differ based on

different calculation methods. The bottom line is that most utility wind projects are cost-competitive with conventional options, although financing and incentive structures make a significant difference. Waverly assumes 25 year amortization.

Iowa Energy Tags have relatively little impact on Waverly's project economics, though they are useful in promoting wind development. Each green tag sells for $50 and represents the benefits of 2.5 MWh of wind generation. Buyers enjoy an added benefit because their payments are tax deductible. To date, Waverly has generated about $20,000 in revenue from Iowa Energy Tag sales.

Conclusions and outlook

Waverly Light and Power has demonstrated that wind development is within the reach of even small communities. In the early 1990s, local policymakers reviewed their demand growth and supply options and decided that wind development could be one in a set of cost-effective strategies. Waverly's determination in pioneering wind development before many other utilities has paid off. Today wind serves as a low-cost energy source and as a source of tremendous community pride.

The decision to build Skeets 4 in town was a bold yet careful decision. The 900 kW wind machine looms over Waverly. The utility made assurances that aesthetics, bird mortality, and noise would not be problems. The community welcomed the project. Moreover, the site allowed Waverly Light and Power to interconnect directly into the distribution system, avoiding transmission issues all together. The fact that Waverly does not have an all-requirements supplier made the decision easier. However, some joint action agencies have cooperated in building "distributed" wind generation, and the results can be very cost-effective.

Waverly is also a leader in taking a strong environmental stance, including addressing climate risk. The fact that the community has embraced energy efficiency, renewable energy, and other carbon-reduction policies is testimony that "green" policies and programs can work in America's heartland.

Public Power Harvests the Wind

Responding to market drivers and regulatory trends

Missouri River Energy Services - Moorhead Public Service – Worthington Public Utilities

Highlights

Like other wind power pioneers, the leaders of Moorhead Public Service in Moorhead, Minnesota didn't wait for large companies to bring wind power to their community. They completed their first wind tower locally in 1999 and launched a green power marketing program that became recognized nationwide. Subsequently, Moorhead's joint action agency, Missouri River Energy Services, recognized rising interest in green power and began to plan a wind program for member utilities in all four of the states that it serves. Today, its RiverWinds program brings regionally produced wind power to more than two-thirds of its 58 member utilities, while Moorhead continues to operate its own local wind power program.

Another Missouri River member city, Worthington, Minnesota, also has played a key role in this wind power development story. Like Moorhead, Worthington was interested in owning its own wind farm. However, state regulatory developments and project economics steered Worthington to let Missouri River take the lead role. The joint action agency became the owner of two turbines constructed in Worthington in 2002, and subsequently of two more turbines built at the same site. The wind power generated in Worthington supplies the RiverWinds program and helps Missouri River to meet its renewable energy objective. Two more turbines may be constructed at the site, and Worthington still holds the option to own that generation.

The Missouri River experience demonstrates how a joint action agency may address widely differing needs for wind power development. The agency serves utility members in South Dakota, North Dakota, Minnesota, and Iowa. It faces regulated renewable energy targets in Minnesota, and it is mandated to offer green power for customers in Minnesota and Iowa. Some member communities would support aggressive wind development. Moorhead and Worthington needed Missouri River to work with them, and the agency responded. But other member utilities are more wary. They are reluctant to pay for wind generation when coal-fired generation and hydropower have been affordable and abundant for so many years. This issue is exacerbated because transmission in the region is constrained. The Missouri River wind power program demonstrates strategies to gradually overcome a range of marketing and technical challenges.

Moorhead Public Service's second 750-kilowatt wind turbine spins in sync with Zephyr, the utility's first wind turbine (far left).

History

According to Kevin Bengtson, energy services coordinator for Moorhead Public Service, interest in wind has been high in this northwest Minnesota community, going back at least 15 years. Agricultural windmills have long been common, and farmers were anxious to see today's wind technology. Local educational institutions, including Minnesota State University, Concordia College, and Minnesota Technical Institute, also fostered an interest in renewable energy technologies.

Assessments of the wind resource began in 1997. The utility hired consultants to help monitor the wind, and a Moorhead Public Service staff engineer prepared specifications for the first wind machine. The utility selected a 750 kW turbine from NEG Micon (now Vestas).

Moorhead commissioned the first turbine in May 1999. Siting on city-owned land offered a less than ideal wind resource, but it cut costs for land leasing and system interconnection. The local site also boosted community pride in the project. Bengtson believes local siting has helped Moorhead to win exceptionally high subscriber support for its green power marketing program.

The utility launched its Capture the Wind green power program even before it built its first turbine. It signed up 425 subscribers in a community of about 12,500. That fully subscribed generation from the first turbine. When an additional 85 customers put their names on a waiting list, the utility began to plan a second turbine. The excellent performance of the first turbine confirmed the city's resolve to expand the program. The second turbine was subscribed within a month. Moorhead commissioned its second 750 kW turbine in 2001.

Missouri River, which is Moorhead's energy supplier, supported the local utility on the project. While it holds "all requirements" contracts with its members, Missouri River allows local utilities to generate up to 10 percent of their power locally. Through a mutual agreement, the agency buys the wind generation and sells it back to Moorhead with no markup on the price.

The Worthington wind farm began with the same kind of local support that the Moorhead project had. Worthington formed a citizens task force to review wind power options. It worked with a Minnesota wind advocacy group, Windustry, and hired a regionally known wind planning engineer named Tom Wind. The task force recommended that the local utility should own its own turbines and use the wind energy locally, rate-basing it for all its customers. This proved difficult when new state legislation mandated that customers must have the option to buy green power. It would be difficult for a small utility to run a green power marketing program in addition to rate-basing wind generation. According to Worthington Public Utilities electric utility manager Scott Hain, Missouri River was reviewing the new legislation, too. It would have to offer green power to all its Minnesota customers and to meet a new statewide voluntary Renewable Energy Objective (REO). By 2005, 1 percent of its supply to Minnesota utilities would have to come from renewables, increasing to 10 percent by 2015. The agency offered to invest in the wind farm, in support of the Worthington project.

The first phase of the project included four 900 kW NEG Micon turbines. Missouri River worked with its sister agency, the Western Minnesota Municipal Power Agency, to finance two of these. A Wisconsin joint-action agency, Wisconsin Public Power Inc. (WPPI), purchased the other two turbines.

In 2003, Missouri River announced that it would add two more turbines—using an improved 950-kW NEG Micon design—to the Worthington site. The City of Worthington still wanted to own its own wind generation, but financing and green

power marketing opportunities favored working through the joint action agency.

Today, Missouri River uses the output approximately equal to that of one turbine to supply its regionwide green power program, called RiverWinds. The output of the other three wind machines provides electricity to meet the Minnesota REO. Only about 2 percent of Worthington customers participate in RiverWinds. But Worthington customers take particular pride in their utility's direct investment in the wind project: They financed one-third of the cost of a new interconnection line that ties the wind farm to a local substation.

Turbines at Worthington serve the region.

Strategic drivers

The drivers for wind power development in Moorhead and Worthington reflect the same values that have driven wind development in other midwestern agricultural towns. Many customers share an interest in self-reliance, stewardship, and distributed energy technology. They want to see firsthand how wind technology works. When the opportunity came before them, they were willing to support a wind project.

Moorhead looked to wind pioneers in other public power cities, including Fort Collins, Colorado and Traverse City, Michigan as models for acquiring and marketing wind power. Moorhead opted to finance its wind power through the assurance of green power subscriptions. Worthington wanted to spread the cost of wind development over the local rate base. Ultimately, Missouri River financed nearly all of the Worthington project cost, and developed a green power program for Worthington and other Missouri River member cities.

According to Jeff Peters, Missouri River marketing director, community-based wind in Moorhead and Worthington has real value as a way to boost interest in public power. "As a result of these wind projects, we see that people are interested in how their community utility is run, and more people want to get involved," he says.

Yet wind development represents a big commitment, in terms of cost and technical support. Given the fact that Missouri River had adequate energy supplies, including Western hydropower, coal, natural gas, and fuel oil generation, the joint action agency might not have pursued wind power so aggressively had it not been for state mandates. The State of Minnesota enacted its REO in 2001, requiring good faith efforts from all Minnesota utilities to provide at least 1 percent of retail energy from renewable resources by 2005, increasing to 10 percent by 2015. Both Minnesota and Iowa also require utilities to offer voluntary green power marketing programs. Both a powerful base of local support and the demands of state regulation drive Missouri River's wind development efforts.

Technical details

The Moorhead and Worthington projects have utilized wind machines from NEG Micon, now Vestas.

The wind resource at Moorhead is estimated between Class 3 and Class 4, with an average wind speed of about 14 miles per hour. The 750 kW turbines have proved good performers. They generate about 1.5 million kWh per year, with a capacity factor

of about 24 percent. While better wind sites existed in the region, the utility is satisfied. Savings from using city-owned land and from avoided transmission costs more than make up for the project's modest performance.

The technology proved itself early on, according to Bengtson. High winds—nearly 100 miles per hour—hit Moorhead just two days after the first turbine was installed. The windstorm took down distribution lines serving the turbine. When the utility finished system repairs two days later, the turbine operator nervously hit the "reset" button, and the turbine went back to work without a problem.

The NEG Micon turbines at Worthington also have been relatively trouble-free. The newer machines at the site are essentially the same as the original 900 kW turbines, but they deliver about 50 kW more, thanks to adjustable-pitch blades and a rotor sweep that is two meters wider. The 950 kW machines were expected to perform with a capacity factor of about 31 percent, but they have performed at about 34 percent. The average wind speed in Worthington is estimated at 16.8 miles per hour.

When Worthington initiated its plan to build a wind farm, it called for a dedicated line between the wind towers and a nearby Worthington substation. Eventually, the approximate $1.5 million cost for the interconnection—including underground line and enough capacity for future turbines—was split among Worthington, Missouri River, and WPPI. Some wind developers view this as a highly cautious design approach, but sponsors report that it provides unbeatable protection against possible power quality problems. Missouri River reports that it has never experienced a voltage surge due to the wind's intermittency. The wind generation is actually utilized entirely by Worthington, since maximum wind capacity at the site is about 5.5 MW, and the local end-use load is about 40 MW. (This is despite the fact that Missouri River owns the environmental benefits and sells only a small portion of those back to Worthington.) The total cost of the wind project, including turbines and interconnection, is about $1000 per kW installed.

Missouri River has documented project construction on its Web site, www.riverwinds.biz/watch_us_grow. This annotated slide collection provides a close-up view of the process, from assessing the wind resource through placing the rotor blades on the hub assembly.

Financing and contractual details

The wind project at Moorhead was cash financed out of utility reserves. The utility expects a 10 to 11 year payback on the project. The decision to self-finance was simplified because Moorhead secured more than enough green power customers to support the project, before construction began. Moorhead's Capture the Wind program has been cited repeatedly by the U.S. Department of Energy's National Renewable Energy Laboratory as one of the top green pricing programs in the country, as measured by percentage of customers participating. At peak participation, the small utility counted more than 7 percent of its customers as green power subscribers. Moorhead still has about 5 percent participation, even with a growing customer base and minimal promotion.

Customers pay a $5 per month premium for each block of 1000 kWh of green power, or a premium of one-half cent per kWh on total consumption. The green power product is not pure wind power, but rather a blend of two-thirds federal hydropower with one-third wind. If it were pure wind power, the premium would be about 1.5 cents per kWh. According to Bengtson, the utility decided that it was more important to keep the premium low than it was to sell pure wind power. Subscribers sign up for a three-year contract, after which they have the chance to opt out or to be automatically resubscribed.

The local program has been a source of community pride. Customers competed to name the two turbines (the winners being Zephyr and Freedom), and schools and civic groups frequently tour the wind site. Yet, once Moorhead has repaid its investment in the two wind machines, the utility may disband the Capture the Wind program and rate-base the wind generation. In this way, everyone in the community will share the costs and benefits of wind power. Under this scenario, customers wishing to buy additional green power could continue to support the Missouri River RiverWinds program. A final decision about how to manage the Moorhead program over the long term is still pending.

Missouri River's approach to financing its wind plants has been straightforward. It worked with the Western Minnesota Municipal Power Authority (WMMPA), the agency that typically finances Missouri River's generation. WMMPA used tax-exempt bonds over a 25-year term. Currently, only 70 percent of the project cost is receiving the Renewable Energy Production Incentive (REPI). This federal program is funded through annual budget appropriations and tends to fall short of demand. If the project were fully incentivized, the cost of electricity generation would average 2.85 cents per kWh. Peters stresses the importance of incentives like REPI in triggering more public power wind development.

Missouri River sells some of its wind energy through the RiverWinds green power marketing program. About two thirds of Missouri River's 58 member cities are currently participating. In addition, three non-member municipal utilities have signed on to obtain green power for their customers. According to Peters, participation rates differ widely from one participating city to the next. In most cities, less than 1.5 percent of customers subscribe. A few communities have much higher subscription rates, however. Moorhead and Worthington continue to lead.

Peters notes that a few of the cities with good subscription rates are not near any wind sites. While Moorhead may be one exception, green power marketing success usually does not hinge on having wind turbines nearby, he says. It has more to do with local leadership and culture.

Missouri River considers green power sales helpful in boosting the Worthington project, but it has not relied on RiverWinds program subscriptions to make the project viable.

Conclusions and outlook

Currently, Missouri River obtains about 5.2 MW of its energy supply from wind power, not counting nearly 1.5 MW that is passed directly back to Moorhead. Missouri River counts wind power as 0.5 percent of its overall energy supply, but 1 percent of its supply for member cities in Minnesota. Clearly, Minnesota's requirement that all its utilities make a good faith effort to meet REO requirements has influenced the agency's energy plans. Missouri River also has been influenced by requirements in Minnesota and Iowa that it must provide a green power option to its customers.

Missouri River's experience with wind so far has been positive, encouraging it to move ahead of regulations and offer green power throughout its four-state territory. According to Peters, wind is the agency's lowest cost non-hydro resource, and wind offers environmental benefits that many customers appreciate. The agency believes it is easier to secure economic and environmental benefits as the owner and operator of wind generation than it would be to secure these benefits as a customer of a large green power marketer. The wind project at Worthington provided first-hand experience with wind technology and interconnection. Now, Missouri River is considering expanding its wind development efforts.

It may develop a large wind farm near Watertown, South Dakota. This site could

support 40 to 80 MW of wind generation. It is also a supporter for the innovative Iowa Stored Energy Plant, headed by the Iowa Association of Municipal Utilities. This project will use wind energy, combustion turbines, and aquifer storage of compressed gases to provide a reliable energy supply, maximizing the use of low-cost wind and off-peak generation. When completed, this will be only the third compressed air energy storage project in the world, after one in Germany and one in Louisiana. The project is especially interesting to Missouri River because transmission is so constrained in the upper Midwest. The energy storage project would allow wind generation to be used as though it were a firm resource, available on demand. In this way, it could compete favorably for transmission access.

Immediate concerns for Missouri River include working with the new Midwest Independent System Operator (MISO) on regional transmission issues. It is still not certain how MISO will accommodate wind development. According to Peters, regulations currently favor large wind projects of 40 to 80 MW or more, and this discourages direct involvement from most local utilities. Since Moorhead's pioneering wind effort in the late 1990s, only a handful of other Missouri River members have expressed an interest in locally owning wind generation. So far, none of their plans have reached fruition.

Some wind advocates wish for more local ownership of projects in Worthington and throughout the region. According to Worthington's Hain, the region has a strong and valuable wind resource, but wind development is a complicated business these days. A transmission feasibility study can easily cost $25,000, and legal costs for anticipating all kinds of contract contingencies add up fast. The uncertain nature of incentives, including the REPI, also leads small potential project sponsors to hesitate. In addition, the state's well-intentioned mandate that utilities must offer green power options deters small utilities from rate-basing the cost of wind power. It is too complicated for most small utilities to offer both a rate-based wind program and a voluntary option, Hain says.

He suggests that partnerships, such as Worthington's partnership with Missouri River, are vital for community wind projects today. He favors choosing partners that share a public power philosophy, believing that this approach preserves as many benefits as possible for the local people for whom wind is an indigenous renewable resource.

Public Power Harvests the Wind

Wind Power in Nebraska: Addressing Historical Challenges in the Public Power Sector to Become a Leader in 21st Century Wind Power Development

Nebraska Public Power District

Highlights

Nebraska has tremendous wind power potential. The American Wind Energy Association (AWEA) places Nebraska sixth among all U.S. states for potential wind capacity, yet Nebraska ranks 23rd for installed wind capacity.[1] Nebraska is also unique in that all of its electric utilities are nonprofit, public power entities. Consequently, Nebraska's public power utilities confront a big hurdle since they do not qualify for federal tax credits or accelerated depreciation incentives offered to private sector renewable energy development. This case study sheds light on how Nebraska electric utilities and private wind developers—including community-based energy developers—are working together to develop new wind generation in Nebraska.

Due to limited federal renewable generation incentives for public power utilities, the Nebraska Public Power District (NPPD) decided to partner with private sector developers in order to access the benefits of federal tax incentives. Historically, however, Nebraska's eminent domain law has discouraged private wind developers due to the risk of having the plant acquired by public power. Under Nebraska law, any generation facility built by private corporations, and selling electricity to others, is subject to acquisition by public power.[2]

To encourage private wind power development in Nebraska, the state created a mechanism to protect developers and allow public power utilities to purchase the output of a privately developed electricity generation project. The state enacted Community-Based Energy

Nebraska Community-Based Energy Development: Highlights of Legislative Bill 629

- C-BED projects must be owned by qualified owners for the first 10 years of operation.
- For projects of more than two wind turbines, these qualified owners can be Nebraska residents, limited liability companies whose members are Nebraska residents, Nebraska non-profit companies, electric suppliers that sell electricity on the wholesale or retail markets, or tribal councils.
- Property owners whose land the turbines are located on must be offered, in writing, the opportunity to own a part of the project.
- Each qualified owner can own no more than 15 percent of the project and the maximum amount two or more electric suppliers may own is 25 percent combined.
- Qualified owners can partner with non-qualified owners as equity partners in project development.
- Over the 20-year power purchase agreement, at least 33 percent of electric generation revenue must go to qualified owners or the local community with no more than 67 percent of the revenues going to non-qualified owners.
- Electric suppliers may contract away their right to acquire the wind farm through eminent domain.
- Electric utilities in the process of incorporating renewable energy into their electricity supply portfolio must seek out technically, economically, and operationally feasible C-BED projects.

Development (C-BED) legislation to allow public power utilities to give up the right of eminent domain over the span of a 20-year power purchase agreement (PPA) and offer other incentives for private developers.[3] C-BED decreases the financial risk for private wind developers in Nebraska by allowing the eminent domain law to be contracted away. In return, it requires these privately held companies to partner with Nebraska investors to develop wind projects. C-BED also ensures that a portion of the wind power development revenue remains in Nebraska.

NPPD is partnering with private C-BED companies to develop two wind generation projects: Elkhorn Ridge and Crofton Hills. Elkhorn Ridge was developed by Chicago-based Midwest Wind Energy, LLC and is owned and operated by equity partner Edison Mission Energy of Irvine, Cali. Crofton Hills will be developed by equity partner Community Wind Energy Transmission.[4] These two sites—located in northeastern Nebraska—are the first wind projects to be built in Nebraska by private companies. Elkhorn Ridge, the first site developed under C-BED, was completed in early 2009 and more than doubled Nebraska's wind generation capacity from roughly 73 megawatts (MW) to 153 MW.[5,6] Crofton Hills, expected to be complete by the end of 2009, will add an additional 40 MW of capacity. The electricity generated at these two sites, which will be eligible for the federal renewable energy production tax credit (PTC), will reduce the price NPPD pays for wind-generated electricity by about 25 percent.[7]

History

Nebraska began wind power development in 1998 at the 1.5-MW NPPD-owned Springview wind facility.[8] Through 2001, small installations were continually added to existing generation sites, bringing the state's capacity to 3.5 MW in 2002. That year the Municipal Energy Agency of Nebraska (MEAN) added Nebraska's first large installation, an 11-MW project in Kimball, located in western Nebraska. This was followed by a 59-MW project near the northern Nebraska town of Ainsworth in 2005, owned by NPPD in partnership with utilities in Nebraska and Florida. All of these sites were developed solely by public entities.[9]

Unfortunately, public power does not have access to the same financial benefits provided to private entities through tax incentives. Despite the availability of federal Renewable Energy Production Incentive (REPI) and Clean Renewable Energy Bonds (CREBs) to public power utilities, renewable energy development has far outstripped the available funds from these programs. REPI is subject to annual appropriations and CREBs have been subject to a volume cap on the number of available bonds, giving private companies, which have access to the federal renewable energy production tax credit (PTC), a competitive advantage over public power utilities.

The history of the PTC begins with the Energy Tax Act of 1978, in which its predecessor, the investment tax credit (ITC), was included. The ITC provided a 10 percent federal tax credit on new capital investments for wind and solar electricity generation. The ITC, however, did not provide incentives for the ongoing operation of renewable energy facilities. The PTC was created in 1992 to address this shortcoming.[10] The PTC gives the wind generation owner a per-kWh income tax credit; in 1992 this credit was 1.5 cents per kWh and has been indexed to 2.1 cents per kWh in 2008, reflecting inflation.[11]

Although REPI offers a stated, inflation-adjusted rebate of 2.1 cents per kilowatt-hour (kWh) in 2008 dollars,[12,13] it effectively pays less than 20 percent of the PTC during the first year and may pay nothing for years two through 10;[14] on the other hand, PTC payments are guaranteed for 10 years. CREBs allow public power utilities to finance renewable energy projects through tax credit bonds that give the bondholders federal income tax credits in lieu of interest payments.[15] Based on NPPD's experience with CREB applications, funding has been available only for projects with

wind turbines of less than 1 megawatt; small projects get priority over larger ones for CREB financing.[16]

Profitable private developers that are subject to federal income taxes have access to the PTC, which reduces the cost of renewable energy generation. Combining the PTC and accelerated depreciation effectively reduces the developer's project cost by about one-third. Public power utilities partner with private developers on wind projects to capture most of the value of the PTC. Most of the PTC is passed through to the public power utility in the wholesale energy price. This pass-through of the PTC allows NPPD to purchase wind generated electricity at a lower cost than if NPPD owned the wind power facility itself.[17]

The PTC expired in 1992, but was re-enacted multiple times. Allowing the PTC to expire has created an inconsistent pace for wind development. Years when the PTC was set to expire saw far less wind capacity development than years when the PTC was guaranteed for future availability. Strong growth in wind power generation is clearly linked to the existence of the PTC.[18] The wind generation portion of the PTC is set to expire at the end of 2009. Elkhorn Ridge came online in early 2009 and the completion of Crofton Hills is slated for the end of 2009.[19] Both sites qualify for the current PTC and will receive PTC benefits for the first 10 years of operation.

The state of Nebraska tax code has provisions that discourage private development. The tax code allows certain properties, including wind farms, to be fully depreciated over five years.[20,21] This allows a wind farm owner to be released from personal property tax obligation after five years, and, consequently, wind power development provides no long-term revenue for Nebraska's counties. In effect, a developer could set up its operation in Nebraska and after five years would have little financial commitment to the local community or the state other than paying landowners lease fees for access to their land. Among other benefits, C-BED helps to mitigate the loss of property tax revenue and keeps a significant portion of the wind development revenue in the local community. Over the 20-year PPA, C-BED requires that at least 33 percent of the revenue for electricity generation from a C-BED wind farm not leave Nebraska.[22]

To promote partnerships between developers and Nebraska communities, two significant incentives were created for developers. The first, and arguably most important, is the contracting away of eminent domain rights from public power utilities for wind projects, thus removing the utility's ability to acquire the wind power project. Second, the project owners do not have to pay state and local sales tax on project capital delivered to the development site, which can add up to millions of dollars.[23,24]

Strategic Drivers

Resource Diversification. Although Nebraska has not yet adopted a renewable energy portfolio standard,[25] NPPD has established its own renewable energy goal of 10 percent by 2020. This goal will require development of an additional 345 MW of wind capacity by 2020, or roughly 40 MW per year after 2009. Because this goal is self-imposed, NPPD can ramp up or scale back its target depending on federal or state legislative changes that may emerge.

Another significant driver for the expansion of renewable generation is that wind energy can act as a hedge for electricity prices. Because the fuel cost of wind is zero in this case the other variable costs are relatively low and constant from year to year, wind-generated electricity does not suffer from the larger price volatility that surrounds electricity generators using fossil fuels. Removing the volatility of plant generation is a significant factor in considering wind.[26]

Environmental and Regulatory Concerns. In addition to hedging electricity prices, wind power also hedges the effects of potential climate change legislation. Incentives for electricity generators to reduce carbon emissions drive the adoption of environmentally friendly practices and technologies in the power industry. With climate change legislation pending in the U.S. Congress,[27] along with an increasing number of local, state and regional climate change initiatives,[28] many electricity generators anticipate an electricity market that will soon include regulation to minimize carbon emissions. Preparing for a carbon-constrained economy is another significant driver behind NPPD's focus on renewable generation.

NPPD can acquire carbon credits through the PPA and then use carbon credits from its wind generation to offset emissions from its fossil plants, or could sell excess credits on the market to create another revenue stream. NPPD has the option to buy each of these sites from the developers after 10 years.[29] In the meantime, NPPD is buying renewable energy credits (RECs) throughout the life of the PPA. These RECs can be sold into a national REC market or used for binding state or federal RPS goals that may be implemented in the future.

Nationwide, there are a number of lucrative REC markets. RECs enable utilities in other states to meet renewable portfolio standard (RPS) goals. Even though Nebraska does not have an RPS, RECs can be sold to utilities in other states that do have an RPS.[30] NPPD has seen wholesale REC prices that range from$1.50 to $5.00 per REC,[31] which is equivalent to 0.15 to 0.50 cents per kWh, or up to one-quarter of the PTC value.

Economic Development. Wind energy is often promoted as an excellent way to boost local economic development. Landowners hosting wind turbines receive revenue from the turbine owners. In Nebraska, these landowners are commonly farmers or ranchers who have to give up only a small portion of their acreage to diversify their income. C-BED further ensures that Nebraska businesses will continue to receive a portion of the revenue stream so long as the wind farm is operational.

In addition to revenue streams from leases and electricity generation, job creation is a key component in development of both sites. Elkhorn Ridge employed 100 construction workers over eight months, and created six long-term jobs to operate the wind farm on a permanent basis. At roughly half the size of Elkhorn Ridge, Crofton Hills will provide 50 local construction jobs and four permanent positions.[32]

Technical Details

Both the Elkhorn Ridge and Crofton Hills sites are in Knox County in northeastern Nebraska, which has abundant wind potential. Vestas V90 turbines will be installed at both sites. With a rotor diameter of over 290 feet, each V90 has a rated capacity of 3 MW.[34,35]

The Elkhorn Ridge wind farm consists of 27 V90s for a total rated capacity of about 80 MW and will generate enough electricity to supply 25,000 Nebraska homes, about 3.2 percent of total Nebraska households.[36,37] The turbines' hubs sit 260 feet in the air, giving the turbines a maximum height of 410 feet. The farm covers 8,355 acres and is located approximately five miles north of the town of Bloomfield.[38]

Crofton Hills will consist of 14 V90s for a total capacity of 40 MW and generate enough electricity to power 12,000 homes, about 1.5 percent of total Nebraska households.[39,40] The dimensions of the Crofton Hills turbines are identical to the Elkhorn Ridge turbines. The site is located on 2,400 acres just south of the town of Crofton.[41]

Financing and Contractual Details

The initial cost estimates to develop Elkhorn Ridge and Crofton Hills are $140 million and $69 million, respectively.[42] Both projects will be developed under the C-BED structure, with each project having a minimum of 33 percent of the revenue going to Nebraska owners, while 67 percent of the revenue may go to others. The PPA is specifically between qualified owner Elkhorn Ridge Wind, LLC and NPPD. As the C-BED structure dictates, the Elkhorn Ridge project owners will not pay state sales tax on project capital delivered to the development site, and will not be subject to Nebraska's eminent domain laws.[43]

In the meantime at Elkhorn Ridge, NPPD will purchase electricity from Elkhorn Ridge Wind for a price that is reduced by about one-quarter compared to what it would pay if the project were developed without the aid of the PTC.[44] The PTC is available for the first 10 years of Elkhorn Ridge operations, regardless of expiration or changes to the PTC legislation in the interim.[45] In NPPD's case, this public-private partnership is expected to work well. Elkhorn Ridge Wind is responsible for ownership, operation, and project risks, while NPPD is simply able to purchase electricity and renewable energy attributes, such as RECs and carbon credits, generated from the site, all while assuming very little risk.[46]

Conclusion

Despite shortcomings in the promotion of wind development at the federal, state, and local levels, utilities, developers, and communities are working together to create partnerships to break down barriers. Through C-BED, Nebraska has created a vehicle that encourages renewable energy development while promoting local interests. C-BED provides incentives to developers that enable public power to benefit from the PTC and reduce the price of renewable electricity. Continuing to develop mutually beneficial partnerships such as these will serve Nebraska well in harnessing its abundant wind resources. Public power organizations across the United States can view this case as an example of stakeholders working together creatively to address regulations that have the unintended consequence of obstructing development of economically viable wind resources.

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Public Power Harvests the Wind

Delaware Ventures into 'Bluewater': Installation of the First Offshore Wind Farm in the United States

Delaware Municipal Energy Corporation

Highlights

Delaware is poised to become the first state in the nation to complete an offshore wind farm installation. The Delaware Municipal Electric Corp. (DEMEC), a public power joint action agency, seized the opportunity to become the first public power utility in the nation to agree to purchase offshore-generated wind power, even before the project received the go-ahead from the state. Bluewater Wind LLC won the bid for the offshore project in May 2007. However, the contract wasn't approved by the state government until a long-sought agreement was reached with Delmarva Power, an investor-owned utility, on June 23, 2008. Given the large scale of the planned wind farm and the significant investment required by Bluewater to develop the project, DEMEC, representing nine municipal electric utility members, needed larger participants with deeper pockets to make the $1.6 billion project economically feasible. DEMEC signed a power purchase agreement with Bluewater in early 2007 because the joint action agency determined it would be a wise investment.[1] Delmarva Power, however, was reluctant to enter into a long-term power purchase agreement at the originally negotiated cost.

This case study illustrates the dependence that relatively small public power utilities can have on larger investor-owned utilities when participating in substantial wind power projects with large capital requirements. The considerations and drivers for investor-owned utilities can be quite different than those that motivate public power utilities.

History

As of late 2008, the United States has no installed offshore wind generation capacity, while Europe boasts 26 offshore installations with 1200 MW of total capacity.[2] However, there are nine proposals for offshore wind projects in the United States.[3] Considering that the 28 coastal U.S. states consume 78 percent of the electricity generated in the United States,[4] and that offshore wind has a higher capacity factor than onshore, offshore wind offers a strong case as a power supply option. Some states, like Delaware, seeking to implement renewable energy projects see wind power as their best option for providing renewable energy.[5] Not only does offshore wind energy provide a zero-emissions form of power, but it also offers the creation of "green" jobs. The Northeast region of the United States, if it grows to be a hub for offshore wind power development, could expect to see job growth in several sectors: manufacturing, installation,

"Commercialization of offshore wind energy faces many technical, regulatory, socioeconomic, and political barriers …"

- 20% Wind Energy by 2030, DOE report

environmental consultancy, electrical and civil engineering, and financial and legal services.[6]

The U.S. Department of Energy's 20 percent wind scenario would require an additional 293 GW of electricity to come from wind, with 54 GW from offshore generation.[7] But offshore wind project costs are generally higher than land-based wind generators, due to higher construction, installation and operating and maintenance costs.[8] Though often closer to demand centers, new transmission lines are required for offshore installations.[9]

A recent study shows that offshore turbines may affect air currents and ocean circulation.[10] The effect of these shifts is not yet known. Bluewater Wind, the subject of this case study, is required to complete a study of the impact of the turbines on birds before receiving its final permit approvals for the Delaware project.[11] The wind farm will be constructed roughly 11 miles off the coast of Rehoboth Beach, Del., and will initially consist of 150 turbines.[12]

Bluewater is a subsidiary of Babcock & Brown, an international investment group and one of the top five wind energy developers and operators in the world.[13] Babcock & Brown acquired Bluewater in September 2007 following its successful bid to begin negotiations with Delmarva Power.[14] Bluewater Wind has sought to work closely with local communities in the Northeastern states (Delaware, New Jersey, New York and Rhode Island) that are likely to host and benefit from offshore wind projects.[15]

The state of Delaware initiated a push for long-term power purchase agreements (PPA) from in-state energy sources to address a 59 percent increase in electricity rates in 2006. The stark increases were a result of the removal of a seven-year rate cap following the deregulation of the state's retail electricity market in 1999. Long-term, fixed PPAs are viewed as a way to hedge electricity market volatility. A further influence in the project's success was the 2007 change to Delaware law that requires 20 percent of the electricity produced in the state to come from renewable resources by 2019.[16]

Strategic Drivers

"You can let the market determine costs, or you can invest in making power supply more economical."

- Patrick E. McCullar,
President and CEO, DEMEC

DEMEC CEO Patrick E. McCullar first learned of the potential for offshore wind power through a report from the University of Delaware he received as a member of the Governor's Energy Advisory Council. When Bluewater appeared in Delaware, McCullar immediately approached them to express DEMEC's interest in the offshore project. The two entities swiftly reached a purchasing agreement. The board of directors of DEMEC had already adopted a resource planning policy that included renewable energy as a significant component of its future power mix and had been reviewing the viability of onshore wind power options. DEMEC's research found that while land-based wind struggles to reach a 15 percent capacity factor, offshore wind potentially offers a 30-35 percent capacity factor, which the utility found to be competitive with traditional carbon-fueled combined-cycle generated power. DEMEC also reviewed the history of offshore wind power use in Europe and found it to be a practical and reliable energy source. Historically, Delaware has had insufficient domestic generation capacity. DEMEC sought to develop in-state capacity to increase energy security and support the local economy by bringing wind development jobs and future DEMEC customers to the region. DEMEC's customer base overwhelmingly supported domestic renewable energy generation.

DEMEC also views energy derivatives markets, such as renewable energy credit (REC) and carbon credit markets, as good ways to reduce costs and earn revenue. Delaware is one of 10 Northeast and Mid-Atlantic states belonging to

the Regional Greenhouse Gas Initiative (RGGI). RGGI members have agreed to stabilize and cap CO_2 emissions from power plants and incrementally reduce CO_2 emissions 2.5 percent each year between 2015 and 2018 for a total reduction of 10 percent.[17] The Bluewater project will help Delaware meet these goals by providing DEMEC with RECs to be used or sold into existing markets. The project may also provide carbon credits in the future, a scenario that DEMEC considers an impending federally mandated reality. DEMEC viewed these ancillary benefits as a revenue stream that makes the project economically viable.

Bluewater's ease in obtaining a PPA with DEMEC contrasts with the lengthy negotiations that followed with the private power company, Delmarva Power.

Technical Details

Bluewater needed to contract with Delmarva to make construction of the offshore wind project financially viable. Although DEMEC long believed the private utility would sign on, Delmarva took a firm stance against the viability of the project, which resulted in a year's delay in reaching an agreement. Delmarva was concerned about increased electricity rates for its customers and did not want to lock in an agreement to purchase more power than it would need.

In November 2006, Delmarva issued a request for proposals (RFP) for 400 MW of new generation from any in-state source. Three bidders responded: NRG bid a coal integrated gasification combined-cycle (IGCC) project on a site owned by the company; Conectiv, a Delmarva subsidiary, bid a natural gas combined-cycle plant; and Bluewater bid the offshore wind farm. Delmarva initially told the Delaware Public Service Commission it would reject all three bids.

The state Legislature instructed the PSC to facilitate the Delmarva-Bluewater PPA negotiations, noting that the Bluewater project deserved special consideration in that it addressed a broad swath of the established RFP criteria, including cost-effectiveness, stability and environmental considerations. The project also offered an opportunity for Delaware to become a green energy leader while simultaneously stimulating its economy.

Near the end of 2007, Delmarva had not yet been convinced of the project's viability, noting high costs for the electricity and back-up facility. It continued to oppose moving forward with the contract. The PSC opened up the bid discussions for public comment and a broad environmental coalition mobilized in support of Bluewater's offshore wind contract.

Delmarva again continued negotiations with Bluewater, without an observer, focusing on three options for modifying the contract to make it feasible – expanding the customer base to include large "choice" customers, reducing the generating capacity, and removing pure cost from the deal. Under the original 450-MW proposal, only 20 percent of Delaware's customers would bear the rate burden of the project costs, while "choice" customers, i.e., large commercial and industrial, would continue to have the option to purchase power elsewhere. Delmarva asked the General Assembly to enact legislation to distribute the project costs among all Delaware customers. Secondly, Delmarva would commit to supporting a 200-MW project. Finally, project costs were reduced after the Legislature acted to increase the value of RECs for the project. On June 25, 2008, the Legislature approved an amendment to Delaware's RPS to allow a rate of 350 percent per REC.[18] By Sept. 2, 2008, the PPA between Delmarva and Bluewater was approved by all four concerned state agencies.[19]

Ultimately, Bluewater's winning project bid was more heavily influenced by political, environmental and external economic influences, rather than the initial concern over rate hikes.

Financing and Contractual Details

DEMEC signed its PPA in May 2007 for Bluewater to provide 17 MW of electricity supply (100,000-150,000 MWh) and 20 years of RECs. The contract is the first in the nation to provide for the purchase and delivery of energy from an offshore wind farm and is valued between $200 million and $300 million over the life of the contract.[20] The project offers DEMEC the ability to provide clean power to 100,000 Delaware residents.[21]

The final agreement between Delmarva Power and Babcock & Brown was signed more than a year later in June 2008.[22] Delmarva signed a 25-year agreement to purchase 200 MW of power from Bluewater.[23] With this purchase contract, Delmarva's customers will receive approximately 29 percent of their energy from wind power generated by approximately 66 turbines.[24] The agreement is an anchor contract, allowing for Bluewater to expand to 600 MW of installation for sale to other nearby wholesale electricity customers.[25] Delmarva does not anticipate purchasing more than the agreed 200 MW of power from the Bluewater project.

The estimated project cost is $1.6 billion, with initial power generation expected to begin in 2012; the contract guarantees the project will be operational by 2014 and complete by 2015.[26] The final step for Bluewater is attaining state and federal permits, which is anticipated to take up to two years to complete.[27]

The final hurdle may prove to be challenging given the financial difficulties stemming from turmoil in global financial markets that have hit Bluewater's parent company, sending the company's shares plummeting.[28] Analysts are further skeptical of renewable energy ventures' ability to stay cost-competitive with the falling price of oil. Per its contract with Delmarva, Bluewater maintains the ability to pull out of the project through June 2010 without penalty.[29]

Conclusion and Outlook

DEMEC was eager to meet the evolving consumer and government interests in renewables through a viable, forward-looking alternative energy option. DEMEC saw superior project economics in offshore wind versus land-based wind, and economic development benefits to the community in pursuing the Bluewater option. The joint action agency did not hesitate to sign a PPA that would provide economic long-term energy security to its customers. DEMEC, like many other public power utilities, took the lead in this emerging alternative energy technology, and set the example of a public power provider that takes a long-term view of economic, climate change and pollution issues. Bluewater recognizes that public power is playing an increasingly important role in U.S. energy security.

Though Delmarva was initially unable to visualize the same near-term benefits, it now projects that it will fully meet Delaware's new RPS requirement through the Bluewater offshore project and its additional onshore projects.

The keen interest and varying perspectives of the public power utility, private power company, citizens and government officials ensured that the needs of all stakeholders were considered under the PPA negotiations. Through a combined commitment to the process and flexibility in expectations, Delaware is poised to go forward with the country's first offshore wind energy project.

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Public Power Harvests the Wind

The Examination of a Municipal Utility's Commitment to Wind Energy Generation
Princeton Municipal Light Department Case Study

Introduction

Utilities have varying incentives for incorporating renewable energy into their electricity portfolios. For example, utilities in the Pacific Northwest generate a significant amount of electricity from hydro power generation given the large amount of capacity available in the Columbia River Basin. Its high water discharge, coupled with the elevated topography, has allowed construction of dozens of dams on the main river and its tributaries. Other utilities are required to comply with their state's Renewable Portfolio Standards (RPS), which mandate that a certain percentage of electricity delivered by a utility come from renewable resources such as solar, biomass, wind, or geothermal. Regardless of the motivation, renewable energy generation is becoming increasingly important to U.S. utilities and their customers.

Princeton Municipal Light Department (PMLD) customers approved installation of wind capacity to lessen the utility's dependence on other electricity generation sources, particularly from the Seabrook Station Nuclear Power Plant long before any RPS was established in Massachusetts. Although the initial 320-kW wind turbines are no longer active, PMLD is installing higher capacity wind turbines to replace the original units, which have been decommissioned. The new turbines are expected to provide 40 percent of the utility's energy.[1] The utility is looking forward to independently generating and delivering reliable, affordable and clean energy to its customers.

Background

PMLD has been committed to providing quality electric service to customers within the Princeton, Mass., town limits since 1914. The utility has a 36-square-mile service area and provides electricity to 1,391 residential, 99 commercial, 15 municipal, and 5 agricultural customers.[2] Each year, the utility purchases nearly 21 million kWh of energy from sources outside of its service territory, including central Massachusetts hydro stations (19 percent) and ISO New England (81 percent).[3]

In 1984, the utility decided to start generating a portion of its electricity. That year, town voters approved spending $500,000 to purchase and develop a 16-acre site as a wind farm. Although PMLD had initially planned to install 500 kW on 164-foot towers, funding constraints forced the utility to scale back the project to eight 100-foot towers capable of generating 320 kW of wind energy. This change proved costly in that the utility could meet only 2 percent of its electricity needs from the wind farm, instead of the hoped-for 10 percent.[4]

Over the years, the turbines' performance began to decline. Much of this decline has been attributed to age and lightning damage. By 2006, only two of the original eight turbines were operational, providing minimal electrical output. PMLD management opted to continue operating the turbines until they failed, at which point the utility decided it was more cost-effective to decommission the turbines instead of repairing or replacing failed components. All turbines were removed from the site in 2008.

Current Initiative

Winds of Change

PMLD recognized that the smaller turbines were not meeting the needs of the utility or its customers. In 1999, the utility evaluated several options for the wind farm's future and narrowed them down to four alternatives:

• *Stop Generating Energy*: The first option was to keep the turbines functioning for as long as possible. This involved spending money to keep them operational until all turbines were beyond repair. At that point, the utility would purchase the power from another source, then decide whether to keep or sell the wind farm.

• *Small Upgrade*: The utility would replace the turbines with newer, upgraded turbines, each capable of generating up to 250 kW. If installed, PMLD's wind generation would account for up to 7 percent of all electricity distributed to its customers.

• *Intermediate Upgrade*: TThe utility would replace the turbines with newer, upgraded turbines, each capable of generating up to 750 kW. If installed, PMLD's wind generation would account for up to 20 percent of all electricity distributed to its customers.

• *Large Upgrade*: The final option considered would enable the utility to benefit from economies of scale. These turbines would have a capacity 1.5 MW each. This option would provide approximately 40 percent of the utility's electricity from wind power. [5]

After analyzing all of the options, PMLD felt that the best, most cost-effective solution was to replace the eight 40-kW turbines with two 1.5-MW units to benefit from technology improvements that have occurred since the initial installation in 1984. At a height of 80 meters, the 1.5-MW Fuhrlander turbines will significantly reduce PMLD's needs for off-system power purchases and allow the utility to sell excess energy to other utilities. The utility's cash flow will be enhanced by marketing the resulting Renewable Energy Credits (see sidebar).

Voter Approval

The Princeton Board of Light Commissioners recommended upgrading the site and using the existing infrastructure as a base for the new equipment. In 2000, the utility mailed a survey to its customers to gauge their thoughts on the future of the wind site. The utility received a 58 percent overall response rate – 66 percent of the respondents said they would like to see ongoing investment in the wind farm, 78 percent thought purchasing larger turbines would be beneficial to the town and 68 percent said they wanted

Massachusetts Renewable Portfolio Standard

The Electric Utility Restructuring Act of 1997 establishes an RPS for investor-owned utilities (IOUs) in Massachusetts. Starting in 2003, IOUs were required to supply their customers with energy that consists of at least 1 percent renewable energy. The amount increased by 0.5 percent each year until 2009, when all IOUs are required to provide customers with at least 4 percent renewable energy. After 2009, the amount will increase 1 percent annually until the Commonwealth of Massachusetts' Division of Energy Resources decides to stop the increase.

- "Massachusetts Renewable Energy Portfolio Standard Annual RPS Compliance Report for 2007" (Commonwealth of Massachusetts' Division of Energy Resources)

As a municipal utility, PMLD is not subject to the state's RPS regulation. However, the utility and its customers believe that it is a good practice to follow. This is part of the reason why PMLD is looking to generate approximately 40 percent of its electricity from wind.

PMLD to have an electricity portfolio that contained substantial amounts of renewable energy.[6] As a result of the positive community support, the board recommended upgrading the site and using the existing infrastructure as a base for the new equipment.

During a special election in 2003, 74 percent of voters approved the new wind project, provided that it meets all of the following criteria

- Provides economical renewable energy for a minimum of 20 years
- Reduces energy costs in Princeton
- Diversifies Princeton's sources of electricity
- Lessens PMLD's dependence on a main supplier
- Increases the amount of renewable energy generation to at least 40 percent
- Reduces town reliance on fossil fuels and thus minimizes associated greenhouse gas emissions
- Meets the requirements of Massachusetts' RPS[7]

Voter support was critical to PMLD because voters needed to approve using tax dollars to finance the project. Although the utility would be eligible for loans and other incentives from private companies, it needed to be able to pay back what it would borrow for the extensive upgrade.

Project Financing

PMLD commissioners voted to form a wind energy cooperative to finance the project at a lower cost. Approved by the Secretary of the Commonwealth's Corporation Division in July 2007, the cooperative can own wind projects outright and purchase power from wind projects owned by other utilities. The cooperative's bylaws stipulate that membership can be expanded to include other municipal utilities or public entities that are developing wind resources. Formation of cooperatives by municipal utilities was authorized under the Massachusetts *Electric Industry Restructuring Law in 1997*.[8]

The total cost of the project is estimated to be $7.3 million. Short-term construction financing was provided by PeoplesBank. Long-term financing will be provided by Clean Renewable Energy Bonds (CREBs) or tax-free municipal debt amortized over 20 years. Municipal, cooperative, tribeal and other government entities can issue CREBs at no cost to the borrower. The bondholder receives a tax credit instead of an interest payment. It is possible that PMLD may also benefit from a maximum of $.021 per kWh Renewable

PMLD to Benefit from Cap and Trade System

The state of Massachusetts is one of the 10 states in the Northeast and Mid-Atlantic that have agreed to be part of a mandatory cap and trade system under the Regional Greenhouse Gas Initiative (RGGI) – a cooperative effort to reduce greenhouse gas emissions. Under this agreement, Massachusetts' power sector must reduce greenhouse gas emissions 10 percent by 2018 from the 2009 levels (the U.S. Department of Energy's Energy Information Administration estimates that the Massachusetts electric power sector emitted 85.1 million metric tons of CO_2 in 2005). Power plants that generate at least 25 MW and use fossil fuel for electricity generation are required to comply with this mandate.

Other states involved in this effort include Connecticut, Delaware, Maryland, Maine, New Hampshire, New Jersey, New York, Rhode Island and Vermont.

PMLD is in a unique position to leverage its state's commitment to RGGI. The utility is exempt from complying with RPS, but can sell Renewable Energy Credits (RECs) to those power plants that must comply. Each REC is the equivalent of 1 MWH that another utility can apply toward its renewable energy portfolio. PMLD has a five-year contract to sell 90 percent of its RECs and plans to keep the remaining RECs in-house.

Energy Production Incentive (REPI) provided by the federal government, depending on federal appropriations. The REPI incentives, however, have been historically underfunded, leaving many public power utilities without this important incentive.

Permitting, Siting and Historical and Environmental Reviews

After voter approval and project financing were secured, the utility proceeded with permitting and siting. Prior to a ballot measure in 2003, PMLD commissioned a noise study that concluded the wind farm would have a low ambient noise level. Several bird and endangered species tests were conducted at the site. Those tests all indicated that no plants, birds, or other species would be harmed by the turbines.

In 2004, the Massachusetts Environmental Policy Act Office certified that the wind project and site posed no environmental hazards. That same year, shadow flicker, solar shadow, and solar flicker analyses were performed to determine when these three conditions would occur. These analyses were performed to determine when light intensity would change and the potential impact of those changes on neighboring land uses. The analyses concluded that flicker from the rotating blades would occur for only a few minutes each year. Other studies conducted in 2004-05 examined the potential impact of the wind turbines on surrounding sites listed on the National Register of Historical Places and Massachusetts Historic Commission. Those studies showed the historic sites would not be adversely impacted by the turbines. In 2005, an archeological study concluded that the site contained no archeological resources that would be disturbed if the new wind farm were constructed.

Although all surveys and tests were necessary for the development of the project, permitting was probably the most important step for development of the wind farm. First, the utility received a construction permit in 2004 that allowed the utility to construct the two turbines at the wind farm. Next, in 2005, PMLD was granted access to use Stage Coach Trail on the site, which meant that there was no need for the city to add a separate road to enter the wind farm. Finally, zoning laws passed in 2005 specifically designated the land for wind turbines. These steps cleared the way for the utility to obtain a building permit from the town of Princeton at the end of that year.[9]

Next Steps

Although 74 percent of voters approved upgrading the turbine site, some individuals were determined to stall or prevent the wind farm from being recommissioned. After the Commonwealth of Massachusetts determined that the two individuals who filed lawsuits were not "aggrieved parties," the plaintiffs withdrew their legal challenge to the wind farm.[10] Ground for the site was officially broken in August 2007 and the turbines are scheduled to arrive in late 2009. PMLD plans to make the turbines operational shortly thereafter.

Conclusion

No matter what the motivation, many utilities are turning to wind as an alternative source of electricity. PMLD, a municipal utility in north central Massachusetts, has demonstrated a longstanding commitment to wind generation. Although the utility has since decommissioned the eight turbines it originally installed in 1984, it is replacing them with two much larger turbines. The new 1.5-MW turbines will provide approximately 40 percent of PMLD's electricity and will ensure stable electricity prices for the utility's customers. So long as the average cost of power from the wind turbines is below PMLD's purchase power cost, the project will be considered a success (given that the city will be able to further lower the cost by selling RECs to the secondary market).

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