A Message from the Renewable Energy Policy Project

Policymakers and landowners in the Great Plains are growing increasingly enthusiastic about a European idea: distributed clusters of one to five large (100 to 500 kW), locally-owned, electricity-generating turbines. In the following REPP Issue Brief, consultant John Dunlop suggests that wind clusters should complement the large, multi-unit, professionally developed windfarms that today produce most American windpower. Mr. Dunlop asserts that in coming years, wind clusters will allow American communities, cooperatives and families to harness indigenous wind resources and thereby generate electricity, protect the environment and stimulate the local economy.

REPP welcomes this paper for the encouraging tidings it brings to the wind industry, currently bedeviled by bad news. While windpower has surged around the globe, net installed capacity in the United States has merely held steady since the early 1990s, even though the wind industry has progressively lowered costs and improved machines. One of the few recent wind stories carried by the general news media concerned the bankruptcy of Kenetech Windpower, formerly the nation's largest wind firm. We find Mr. Dunlop's report of wind cluster development in the Great Plains heartening, and are encouraged by news of a recent Department of Energy distributed wind initiative.

Mr. Dunlop's paper should interest electric utilities pondering an uncertain future. As the American electric system introduces greater retail competition, all types of electricity suppliers, including municipal utilities and consumer-owned cooperatives, will struggle to retain customers. Because most Americans do not think of electricity as a consumer product, many firms will find it difficult to establish customer loyalty to their brand of power. Some companies will compete on price alone. Others, however, will find a powerful marketing strategy in linking energy services in customers' minds with local economic development and a clean environment. We expect that these energy pioneers will search for ways to facilitate wind cluster development.

Wind clusters constitute not only a clean energy technology but an apt rural development tool. Because they can be integrated into existing land use, wind clusters provide agricultural cooperatives or farming and ranching families with an extra source of income. Wind clusters also represent a business opportunity for impoverished areas that want to grow economically without damaging the environment. By casting clean energy as a farm product, the environmental community can fashion valuable political alliances with groups endeavoring to preserve family farming and ranching.

We thank John Dunlop and REPP's Managing Editor, Susan Conbere, for their efforts in producing this paper.

Adam Serchuk and Alan Miller **November 15, 1996**

WIND CLUSTERS:
EXPANDING THE MARKET APPEAL OF WIND ENERGY SYSTEMS

John R. Dunlop[1]

Background

The United States produces more electricity from wind power than any other country in the world. The vast majority of installations are located in three large wind development regions in California. Stimulated by state and federal government policy to accelerate the development of wind energy, most projects were structured to take maximum advantage of the concentrated wind resource, the close proximity of high wind sites to major population centers, and economies of scale. The results were large, corporately-owned windfarms with many turbines in a single location -- the "California Model."

During the 1990s, the wind energy community in the United States has looked to the Great Plains region[2] for further wind development. Nearly every state in the Great Plains has many times the wind energy capacity of California, and regional, technical, community and political support for wind energy development has grown steadily in the Great Plains over the past fifteen years. For instance, at least one government or utility wind resource assessment program is being conducted in every state. Many states have installations of utility-scale wind turbines, and most states have enacted laws specifically related to wind energy development.

Aggressive government initiatives in at least two states have resulted in the "California model" leading wind development in the Great Plains. In Iowa, for instance, a state law requiring investor-owned utilities to invest heavily in renewable energy was re-affirmed by the Iowa Utilities Board in August 1996. Utilities were ordered to have at least 105 "full capacity" megawatts[3] under contract within six months. In Minnesota, Northern States Power (NSP), the largest utility in the state, was pressured by the Department of Public Service in 1991 to build a "large" wind project. NSP responded by contracting for power from a 73-turbine, 25 MW wind power plant (NSP Phase I) built by Kenetech. The plant went on line just southeast of Lake Benton, Minnesota, along the Buffalo Ridge, in May 1994. At the time, it was the largest wind power

[1]The author wishes to thank Karl Rabago, Adam Serchuk, Randy Swisher, Mike Tennis, and Carl Weinberg for their comments. The opinions expressed in this paper are those of the author and do not necessarily reflect the views of REPP's staff or Steering Committee.

[2]With regard to wind energy resource and development opportunities, the Great Plains states are considered to include Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin.

[3]A "full capacity megawatt" would produce electricity at the rated capacity of the project every hour of the year. However, the winds do not blow at the rated wind speed all the time. In Iowa, in a wind regime which could provide a 30% capacity factor, the 105 full capacity megawatts would be achieved by 350 MW of wind power.

plant in the U.S. outside the state of California.[4]

Many in the state were thrilled that major wind power development had begun in Minnesota. While local residents, public officials and community development specialists agreed that wind development is good for the environment, many questioned whether it benefitted local economic development. In evaluating the large-scale project, they observed that

- siting was conducted by out-of-state specialists;
- turbines and blades were manufactured on the West Coast;
- towers were built in Texas;
- the construction crew from Texas hired few local workers;
- the plant was operated remotely from a control center near San Francisco;
- investment capital came from outside the state; and
- local units of government received no tax revenue to cover the additional administrative and road maintenance costs incurred by the local government. (The state exempted wind energy from local property taxes in 1992 to stimulate wind energy development.)

In response to their experience with the NSP Phase I project, and expecting similar experiences with even larger NSP projects, local officials and others called for an examination of other wind energy development models that would provide more benefits to the local community.

A Complementary Development Model

In Europe, government regulations have internalized the energy and environmental benefits of wind energy by taxing electricity use heavily and, in turn, passing on the tax revenues in the form of incentives to wind energy producers. Consequently, individuals, local farmers and businesspeople have found it financially attractive to invest in small, local wind energy projects. A robust, sustained market for wind energy has emerged. With a stable market, manufacturers have chosen to establish local branches or manufacturing facilities to support the market, and many of the jobs stimulated by the market are in the local community. The majority of wind-produced electricity in Europe is now generated by single turbines or small clusters of wind turbines. The development pattern has come to be known as the "European Model."

[4]This project became the first phase of a larger, ongoing project. As the NSP Phase I project was being completed, NSP also sought permission to build temporary nuclear waste storage facilities near their nuclear power plant on Prairie Island in the Mississippi River. The 1994 Minnesota legislature granted permission, but also required that NSP must have 425 MW of wind power operating on their system by the year 2002. Under specified financial conditions, that capacity requirement may even increase to 825 MW of wind power. NSP quickly began planning for their next wind power project (NSP Phase II), selecting the winning bidder for a 100 MW plant in May 1995. When completed, this will be the largest single wind power plant in the world.

Many wind energy advocates in the Great Plains recommended exploring the local benefits of the European Model. Interest in this model has spurred a flurry of studies, legislative measures, public forums and utility initiatives in cluster wind energy development in the Great Plains states. In addition, several utility-scale single turbines and clusters of turbines have been installed. These turbines have helped establish familiarity with smaller, dispersed wind energy projects.

Cluster Development Studies

In contrast to large wind energy projects, cluster wind development is potentially attractive to local communities because it appears to have positive economic effects on them. Consequently, much of the research and analysis of cluster development has focused on local land owners, government officials, financial institutions, businesses, etc. One of the most valuable results of these studies occurs before the study is even published. By asking probing questions, the researcher is both informing the subject in the interview about issues relevant to wind cluster development, and causing the subject to consider the potential impact of such a model seriously. The research process itself becomes part of the community education effort.

Some of the studies completed in the past year have helped show that wind cluster development can complement large-scale wind development (S1, S7) and overall energy planning (S15). Brakken (S1) conducted dozens of interviews across the northern Great Plains, summarizing the advantages of cluster development and the barriers to implementation. In addition to local ownership, economic activity, and jobs, Brakken reports, farmers see cluster development as a "cash crop" that gives new life to the farming lifestyle. One developer suggested that wind turbines are harvesting a new crop fifty meters up in the sky. Haley (S7) documents some of the same advantages of cluster development within the state of North Dakota. Appel Consultants (S15) conducted their broad analysis for the Minnesota Legislative Energy Task Force, created by the same legislation that mandated NSP to install 425 MW of wind energy by 2002. They conclude that all forms of wind energy development will be important to the energy mix in the state.

Enabling the creation of wind energy cooperatives can contribute to the development of locally financed, operated and owned cluster wind projects. DeBoer (S4) examined the feasibility of the cooperative model in counties along the Buffalo Ridge in Minnesota. While local ownership does not have the same impact in the U.S. as it might in Europe due to the much lower cost of energy here, DeBoer identifies scenarios in which cluster development can be attractive. For instance, direct participation of the co-op members in a wind project may give them confidence to accept a rate of return that makes a project feasible.

Regardless of the ownership model, wind energy has an impact on the owners of windy land. The Izaak Walton League developed an excellent guide for land owners (S11) that not only gives advice on owning a wind system, but counsels the land owner on how to avoid potential pitfalls of

leasing land to others for wind development.

The economics of locally-owned wind cluster development continues to be widely debated. While conventional wisdom holds that larger projects can be built at lower costs than clusters of wind turbines, smaller projects avoid many of the legal and permitting problems that seem to plague mega-scale wind farms. Gipe (S5) reports that in the Netherlands, many farms or agriculture cooperatives already have in place much of the infrastructure -- roads and distribution lines in particular -- to support a cluster wind project. This actually results in a lower installed cost for wind clusters than larger projects. Gipe contends that the same conditions may exist in many areas of the Great Plains.

Conover (S3) qualitatively summarizes many of the impacts on the local economy in her 1996 report to the National Wind Coordinating Committee, including indirect economic impacts. Economic impacts will be further analyzed in two additional studies underway. The Southwest Regional Development Commission has contracted for an analysis of the impact of wind development in southwestern Minnesota (S14), due to be released this year. The Izaak Walton League also anticipates investigating this issue, focusing on combined utility and community financing (S9).

Clusters of wind projects appear to have an advantage over large, centrally-located wind power plants because they are dispersed throughout a utility's power transmission and distribution system. Some utility and transmission reliability planners contend that small cluster wind projects may actually relieve strain on a transmission or distribution line near its capacity. Gosselin (S6) reports that supporting or refuting this contention is difficult since transmission capacity and load data is considered proprietary by utilities. He also reports that assumptions in the capacity analysis can dramatically impact results, such as using worst case scenarios -- hottest day of the year and no wind -- to estimate the maximum capacity of a line. Obviously, a transmission line will not be driven over capacity by a wind power plant on a still day. Other technical issues, such as voltage flicker, harmonics and power quality, will be handled no differently than in larger wind power plants.

One of the finest analyses of utility-owned cluster windfarms was conducted by utility consultant Tom Wind (S16). Wind addresses many of the issues of particular importance (or concern) to municipally-owned utilities and analyzes the economics of a small wind power project. He estimates that the net cost of energy from a cluster wind project for a locally owned and controlled municipal utility, with their low cost of financing, could be as low as 3.2¢/kWh. The bottom line, according to Wind, is that while a wind project is not going to save the utility a lot of money, it is not going to cost a lot of money either. Also, there is relatively little risk. He concludes that municipal utilities should build small cluster projects for one major reason -- customers <u>want</u> them.

Brakken (S2) conducted a survey of consumer-owned utilities (COUs)[5] and attitudes about wind energy. In some cases, these attitudes are greatly influenced by existing contractual power purchase agreements, such as agreements between distribution cooperatives and generation and transmission cooperatives. However, he also discovered that COUs tend to be more sensitive to local opinions than investor-owned utilities, since COUs are managed by utility owners.

Other studies have presented the cluster development model to utilities (S13) and raised issues which may be important during the utility restructuring debate (S10). For example, cluster projects can be added in smaller increments than large windfarms, reducing the impact of each project on the host utility. The dispersed nature of cluster projects also may benefit the existing transmission grid, since new transmission lines may be more difficult to build in a more competitive industry. The Minnesota Department of Public Service will examine the benefits of cluster wind development for utilities (S12) under a new grant from the Department of Energy.

Legislative and Regulatory Initiatives

Minnesota and Iowa lead the region in legislative action supporting cluster development. Minnesota has defined wind energy as an agricultural crop, enabling the establishment of cooperatives to harvest wind and making cooperatives eligible for low interest loans. Small cluster wind power projects (up to 2 MW in size) will become eligible for a 1.5¢/kWh incentive payment in July 1997. These projects can be owned by individuals or a wind energy cooperative. The state also has exempted small cluster development (up to 2 MW) from property tax. (Larger projects are no longer exempt.) Projects up to 5 MW are exempt from the power plant siting requirements, simplifying the permitting process.

Iowa has had a unique net energy billing law for several years. Most states with net billing laws limit the maximum size of the qualifying facility.[6] Iowa, however, has no capacity limit. Consequently, large, utility-scale wind turbines can be installed at facilities with high electric loads. If the entire wind energy production is used by the facility, it only has to pay for excess consumption. The net effect is that the electricity produced by the wind turbine has retail rate value. If the turbine produces more electricity in a month than the facility uses, on the other hand, the utility is only required to pay the avoided cost rate for that energy. This cost is frequently just a quarter of the retail rate. While net billed wind turbines are not usually considered cluster wind projects, which sell their electricity to the utility, issues such as dispersed locations, siting and technical interconnections are much the same.

Responding to interest generated by the municipal utility in Waverly, Iowa, the state legislature created in 1996 an exemption to a state law that now allows multiple municipal utilities to co-fund

[5]COUs include municipal utilities, distribution cooperatives, and generation and transmission cooperatives.

[6]Limits for other Great Plains states are 100 kW (North Dakota), 40 kW (Minnesota), and 20 kW (Wisconsin)

a cluster wind power project. The federal government recently recognized the viability of cluster development as well. The Clinton Administration has earmarked $6.5 million in its 1997 budget for a "Wind Cluster Program," to be conducted through the U.S. Department of Energy.

Information Dissemination

The success of a community-based cluster wind energy program depends on providing the public with information. Local residents are directly involved in the decision process and need to know the advantages and disadvantages of the cluster development model. Cluster development has been a major element in numerous public forums across the Great Plains in the past year.

The Minnesota Sustainable Energy for Economic Development Project hosted three community conferences on wind energy in three corners of the state. Glen Cannon of Waverly Light and Power brought his municipal wind power project message to the annual meeting of the Minnesota Municipal Utilities Association in June 1996. Michael Noble of Minnesotans for an Energy-Efficient Economy presented the "Ten Top Reasons" that Cooperative Power (a Minnesota generation and transmission cooperative) should invest in wind energy at the cooperative's annual meeting. The Northwest Area Foundation hosted a forum in February 1996 to help identify the research and information needed to support cluster development. The Dakota Resources Council has held at least two forums in North Dakota communities to discuss small cluster wind energy projects. Cluster development also has been discussed at wind energy meetings and conferences in South Dakota, Nebraska, Kansas and Iowa. Finally, the Sustainable Resources Center in Minneapolis is coordinating the development of a curriculum on wind energy. This curriculum, to be fully implemented by July 1997, will be used by schools and extension services to hold workshops in windy areas of Minnesota.

Utility Initiatives

Waverly Light and Power has operated its own wind turbine for two years. Residents of the city have been highly supportive of the utility's efforts to use renewable resources, such as its wind turbine. The utility explored the possibility of expanding its use of wind energy but the city is not located in a very windy part of Iowa and the projects appeared marginal. The utility manager, Glen Cannon, began to explore other options. With the help of the utility's consultant, Tom Wind, they determined that it would be more viable to install a wind turbine in the north-central part of the state and wheel the power back to Waverly than to install the turbine in their small service territory. Furthermore, they concluded that energy from a small cluster of machines would be even more viable. Waverly invited other municipal utilities to participate in a joint venture to evaluate the cluster wind project model more thoroughly. Due to the interest of multiple members, the Iowa Municipal Utilities Association agreed to fund the study. With the enabling legislation passed in 1996 (see above), many expect a joint municipal utility wind cluster project to be proposed in the near future.

Numerous utilities from across the region are expressing interest in the new cluster wind energy initiative being coordinated by the Electric Power Research Institute (EPRI) for the U.S. Department of Energy. Small utilities are encouraged to collaborate with private sector partners to propose modest (up to 5 MW) cluster wind power plants. Proposals were due in October 1996. The winning bid is to be selected before the end of the year, and the project is to be installed before the end of 1997.

Under a directive of the Minnesota Department of Public Service, Otter Tail Power in Fergus Falls, Minnesota, evaluated a 10 MW wind power plant in their service territory. Though they did not select the project for installation, they have conducted a wind resource assessment of the region and modeled a cluster wind project in their utility system. Since they made their decision regarding the power plant, they have made their wind data publicly available. Northern States Power also facilitates small, cluster wind energy projects by exempting projects less than 12 MW from the competitive bidding requirement that they have set for larger projects.

Installations

While cluster wind energy activity has increased dramatically since mid-1995, many single utility-scale wind turbine and cluster wind projects have been operational in the Great Plains states for years. The earliest is a three-turbine cluster installed by NSP in 1986. Even by the utility's admission, it was not the shining example of wind power plant operation. However, it did give NSP a wealth of operating experience with utility-scale wind turbines (Bonus 65 kW machines).

Marshall Public Utilities has been buying electricity from a cluster of five wind turbines since 1992. The 120 kW Wind World machines are in a poor site within the city limits, but they are a highly visible example of the cluster wind energy concept.

In Iowa, a few clusters of 65 kW Windmatic turbines were installed in the early 1990s. Three were installed on Monty Miller's farm in north central Iowa in 1992; five were installed on George Braaksma's farm near Sibley. In May 1996, the largest wind turbine in the Great Plains was installed by Northern Alternative Energy next to the earlier project on the Braaksma farm. The 600 kW Micon M1500 turbine was the first turbine Micon assembled at its facility in Hutchinson, Minnesota. The turbine had to travel some distance to get to the site, however. It was displayed at *Windpower '95*, the annual meeting of the American Wind Energy Association in Washington, DC, and provided a hands-on large turbine example for the students in the wind technology training program at Southwest Technical College (Jackson, Minnesota).

Vestas American has several single turbines in Iowa. One V-27, 225 kW turbine was supplied to the municipal hospital in Nevada, Iowa; another was purchased by Shafer Systems in Adair, Iowa, just west of Des Moines. The turbine in Nevada joins two 250 kW Wind World turbines in town

(installed in 1993 and 1994). One observer suggested that the view of the three dispersed turbines reminded them of installations in Denmark.

In the summer of 1996, two reconditioned Micon turbines were installed at two American Indian communities in North Dakota -- the Spirit Lake Nation of Sioux in eastern North Dakota, and the Turtle Mountain Chippewa in the northern part of the state. Power from the 108 kW turbines will be used to offset the load at a water plant and a casino. Members of the tribes have received training that will lead to a community-based business to operate and maintain the turbines.

Additional clusters of wind turbines are expected to be installed in the Great Plains in the near future. Permits are being issued to Northern Alternative Energy, Minneapolis, for an 11.25 MW wind power plant in far western Minnesota along the Buffalo Ridge**.** The company plans to use 15 Micon 750 kW turbines. Other utility and university projects are in the planning stages.

Conclusion

Large-scale wind projects have established the United States as a world leader in wind energy development. However, as EPRI states in its Turbine Verification Program Phase III (TVP-III) solicitation,

> The role and interest of U.S. utility companies in owning and operating large wind turbine facilities have changed, due to a combination of low-cost surplus power availability, uncertainty about impacts of electricity industry restructuring, and increasing competition in the electricity industry. As a result, a new market for wind power may be developing, which is characterized by smaller dispersed [clusters of] wind turbine generation facilities . . . .

Dispersed clusters of wind turbines appear to have many advantages over large-scale developments in some regions, especially for local communities. This is particularly true in the Great Plains, where small communities are broadly distributed throughout the windy regions. These communities create a dispersed electricity load well served by local wind power.

Cluster wind projects will not displace large wind development where the latter is appropriate. However, cluster projects are expected to create opportunities for parallel development: a near-term, community-based market that is robust for wind energy in the United States.

Appendix 1
Measures Supporting Cluster Development in the Great Plains

Cluster Development Studies

S1) Brakken, William A., Brakken Executive Associates, St. Paul, MN, *Harnessing the Wind: Opportunities and Impediments for Developing Dispersed Wind Generated Electricity in Minnesota, the Dakotas and Montana*, Northwest Area Foundation, St. Paul, Minnesota, 31 May 1995.

S2) Brakken, William A., Brakken Executive Associates, St. Paul, MN, *Minnesota's Cooperative and Municipal Electric Utilities: Opportunities for Energy Efficiency and Renewable Energy*, Environmental Law and Policy Center, Minnesota Sustainable Energy for Economic Development Project, January 1996. An assessment of attitudes expressed by utility administrators regarding investments in renewable energy and energy efficiency (REEE); documentation of contractual arrangements between consumer-owned utilities (COUs) and their power suppliers; and recommendations for action supporting increased investment in REEE, including cluster wind energy projects.

S3) Conover, Karen, Global Energy Concepts, Bothell, WA, *Impact of Wind Energy Development on State and Local Economies*, National Wind Coordinating Committee, Denver, CO, 16-17 January 1996.

S4) DeBoer, Bob, St. Paul, MN, *Preliminary Survey of the Market Feasibility of Farmer-Owned Cooperatives in Lincoln and Pipestone Counties*, draft graduate paper, Humphrey Institute of Public Affairs, University of Minnesota, Minneapolis, MN, January 1996, unpublished.

S5) Gipe, Paul, Tehachapi, CA, personal communication, 30 October 1994, related that NOVEM, the Netherlands environmental and energy agency, had determined that clusters are less expensive to build than large-scale projects.

S6) Gosselin, Journey, *Utility-Scale Wind-Generated Electricity: Overcoming Technical Barriers to Distributed Generation*, Minnesotans for an Energy-Efficient Economy, St. Paul, Minnesota, May 1996.

S7) Haley, Jay, *Harnessing Prairie Wind for Electricity: An Inventory of the Vision, the Technology and the Economic Realities*, Energy and Efficiency Research Center, University of North Dakota, Grand Forks, ND, 1995. A compilation of concept, technical and economic information directed at individual farmers in North Dakota; presented at *Marketplace '95*, the annual state economic development fair in Bismarck.

S8) Haller, Mark, Hudson, WI, *Wind Energy Development: What is Best for Minnesota?* A proposed state strategy for supporting cluster development. Unpublished.

S9) Izaak Walton League of America, Minneapolis, MN, *Utility/Community Financing and Capacity*

Firming Options for a Municipally-owned Cluster Wind Power Project; subject of grant application submitted August 1996; application pending.

S10) Jacobson, Ralph, Innovative Power Systems, *Distributed Generation in a Deregulated Utility Business*, briefing paper written for Minnesotans for an Energy-Efficient Economy Board of Directors planning retreat, 11 July 1996.

S11) Lange, N., and W. Grant, *Landowner's Guide to Wind Energy in the Upper Midwest*, Izaak Walton League of America, Minneapolis, MN, June 1995. Provides guidance to land owners in windy areas on investment, ownership and leasing wind rights for cluster and large-scale wind development.

S12) Minnesota Department of Public Service, Union of Concerned Scientists, National Renewable Energy Laboratory, *Utility Benefits of Distributed Wind Energy Development*; subject of grant application submitted June 1996; application pending.

S13) Nobel, Michael, *Utility-Scale Wind Energy: A Great Plains Model for Distributed Development*, Minnesotans for an Energy-Efficient Economy, St. Paul, Minnesota, presentation to Utility Wind Interest Group, 15 April 1996,El Paso, TX.

S14) Southwest [Minnesota] Regional Development Commission, Slayton, MN, *Economic Impact Study Pertaining to development of Wind Power in Southwestern Minnesota,* in process. Study awarded February 1996 to Agricultural Utilization Research Institute, Marshall, MN; study to be completed 01 September 1996. An analysis of the local economic impact of large and small (cluster) wind projects owned either by corporations or local residents.

S15) Wiltsee, George, et. al., Appel Consultants, Inc., Valencia, CA, *Emerging Generation Technologies*, Minnesota Legislative Electric Energy Task Force, St. Paul, MN, 28 June 1996.

S16) Wind, Thomas A., Utility Consultant, Jefferson, IA, *Wind Farm Feasibility Study*, Iowa Association of Municipal Utilities, April 1996. An analysis of a municipally owned, medium-sized wind power plant in northwestern Iowa. Concludes that the net cost (after REPI) could be as low as 3.2¢/kWh.

Great Plains Legislative/Regulatory Initiatives Directed Toward Cluster Development

L1) MN: The state will pay a 1.5¢/kWh incentive payment for electricity produced by a wind power plant with a capacity of up to 2 MW beginning July 1997 (1995).

L2) MN: Wind energy is defined as a commodity, allowing wind energy cooperatives to be formed to build project up to 2 MW (1995).

L3) MN: Wind energy cooperatives are now eligible for low interest agricultural loans for projects up to 1 MW (1995).

L4) MN: Wind energy projects up to 2 MW are exempt from property tax (1992, 1994).

L5) MN: Wind energy projects up to 5 MW are exempt from power plant siting permit requirements by the Environmental Quality Board (1995).

L6) IA: Net energy billing is available for wind energy projects with no limits on the installed capacity, including clusters of turbines (1983).

L7) IA: The state created an exemption to allow a wind power plant to be jointly owned by municipal utilities (1996).

L8) U.S.: The U.S. Department of Energy included $6.5 million in their proposed wind energy research budget for FY 1997 for a "Wind Cluster Program."

Information

I1) *Wind Across the Prairie: A Community Conference*, Minnesota Sustainable Energy Economic Development. A series of three conferences held in 1996 in Pipestone, St. Charles and Detroit Lakes, Minnesota.

I2) *Minnesota Community Wind Training Seminar*: Curriculum on dispersed, cluster wind projects being developed by the Sustainable Resources Center under funding from the Legislative Commission on Minnesota Resources; curriculum to be completed by the end of 1996; courses for residents in windy areas to be offered in early 1997.

I3) *Research and Information Needs for Distributed, Cluster Wind Energy Development*, Northwest Area Foundation, 09 February 1996. Summary of priorities established by participants issued 21 February 1996.

I4) Minnesota Municipal Utility Association Annual Meeting, presentation on dispersed cluster wind energy plants by Glen Cannon, Waverly Light and Power, 26 June 1996.

I5) Cooperative Power Annual Meeting, *Top Ten Reasons Why Cooperative Power Should Invest in Renewables*, presentation by Michael Noble, Minnesotans for an Energy-Efficient Economy, 06 June 1996; recommended that Cooperative Power add 1% of their capacity in renewables every year since the utility is growing at about 2% per year.

I6) *North Dakota Wind Energy Forums*: The Dakota Resources Council coordinated and hosted two community forums on locally owned wind energy projects within the past year.

I7) *Wind Cluster Development in the Great Plains*, presentation to AWEA board of directors by John Dunlop, regional representative, in annual meeting, 23 June 1996.

Utility Initiatives

U1) *EPRI-DOE Wind Turbine Verification Program Phase III (TVP III)*, soliciting utilities and partners

to build small (less than 5 MW) wind cluster projects; proposals due 14 October 1996; over 40 utilities had requested applications by early August.

U2) *Otter Tail Power 10 MW Wind Power Plant.* In response to a directive from the Minnesota Department of Public Service on 02 February 1996, Otter Tail Power was directed to conduct an analysis of the viability of a 10 MW wind power plant. On July 12, Otter Tail informed the department that the computer model they used "did not select" the wind project for their long-range plan. However, they will continue the wind monitoring they conduct in collaboration with the department.

U3) *Northern States Power Cluster Wind Project Contracts.* NSP will enter into contracts to purchase electricity from cluster wind projects up to 12 MW in capacity without requiring the project to be bid competitively.

U4) *Waverly Light & Power Joint Municipal Wind Power Plant*. Waverly Light and Power operates an 80 kW wind turbine located in their utility service territory. They have been interested in expanding their wind project. After conferring with their consultant, Tom Wind, they shifted their focus to building a cluster wind project in north-central Iowa and wheeling the power to Waverly in northeastern Iowa. Waverly Light and Power hosted an information meeting with other Iowa municipal utilities on 12 December 1995 to seek collaborators in an analysis of a jointly-owned municipal wind power plant. The Iowa Municipal Utilities Association later agreed to fund the complete study, which was released in April 1996.

Single Utility-Scale Turbine and Cluster Wind Energy Projects

Currently Operating

P1) Holland, MN: Three 65 kW Bonus turbines were installed in September 1986 near Holland by Northern States Power.

P2) Marshall, MN: Five Wind World 125 kW turbines were installed in May 1992 by Minnesota Windpower; electricity was sold to Marshall Public Utilities.

P3) Britt, IA: Three 65 kW Windmatic turbines were installed on the farm of Monty Miller in 1992; net energy billing was used.

P4) Spirit Lake, IA: A 250 kW Wind World turbine was installed by Spirit Lake Schools near the junior high in town in June 1993; net energy billing was used.

P5) Nevada, IA: Two 250 kW Wind World turbines were installed at the Nevada High School in town in July 1993 and June 1994; net energy billingwas used.

P6) Waverly, IA: An 80 kW Vestas turbine with new blades and controller was installed by Zond for Waverly Light and Power in 1994.

P7) Nevada, IA: A 225 kW Vestas V-29 was installed for the municipal hospital in 1995. It was located at the water treatment plant on the edge of town; net energy billing was used.

P8) Adair, IA: A 225 kW Vestas was installed in Adair by Shafer Systems in June 1995; net energy billing was used.

P9) Sibley, IA: A 600 kW Micon turbine was installed on the Braaksma farm by Northern Alternative Energy near Sibley in May 1996. This joins five 65 kW Windmatic turbines installed in May 1993 for a total capacity of 0.925MW. Electricity is sold to IES Utilities.

P10) Spirit Lake Nation, ND: One Micon 108 kW machine was installed on the reservation in August 1996. Power is sold to Otter Tail Power, Fergus Falls, MN.

P11) Turtle Mountain Chippewa, ND: One Micon 108 kW machine was installed on the reservation in 1996 August. Power is sold to North Central Electric Cooperative.

Planned

P12) Hendricks, MN: NAE 11.25 MW Buffalo Ridge Wind Farm; fifteen Micon 750 kW M1500 turbines will be installed just south of Hendricks near Lake Shaokatan. Permits are in process; construction is expected to begin in 1996.

P13) WI: PSC-mandated demonstration projects (1.3 MW, 10 MW) will be constructed by utilities. A 1.3 MW project solicitation is expected in 1996.

P14) Collegeville, MN: A single turbine (500 kW) is planned at St. Johns University. A solicitation is expected in 1997.