This document is one of a series of reports and guides that are all part of the NYSERDA Wind Energy Tool Kit (complete kit will be available in Summer 2005). Other components of the kit are listed below. Interested parties can find all the components of the kit at: www.powernaturally.org. All sections are free and downloadable, and we encourage their production in hard copy for distribution to interested parties, for use in public meetings on wind, etc.

Any questions about the tool kit, its use and availability should be directed to: Vicki Colello; vac@nyserda.org; 518-862-1090, ext. 3273.

In addition, other reports and information about Wind Energy can be found at www.powernaturally.org in the on-line library under "Large Wind."

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Sample Ordinance Standards

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    Other Potential Environmental Impacts

Electrical Grid and Wind Generation: Reliable but Intermittent

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Technology

How large are today's wind turbines?

Most wind turbines in New York today are about 300 ft (91 m) to 400 ft (122 m) to the maximum tip height of the blade. Tower heights range from 213 ft (65 m) to 262 ft (80 m).

How much electricity does a wind turbine produce?

Most wind turbines in New York are rated at about 1.5 megawatts. Each turbine of this size produces enough electricity to serve about 740 homes.

Given the current wind energy technology, how reliable is their operation?

Reliability of wind turbines is typically defined as the quantity of time they are on-line and ready to produce electricity divided by the total time in the year (also called "availability"). Whether or not they produce electricity is a function of the wind. Ignoring external influences on turbine availability such as grid outages or forced curtailments by the utilities, wind turbines have demonstrated very high reliability, meaning they are available to produce energy approximately 97% of the time. However, due to intermittency of the wind resource, the turbines do not always produce the maximum power output possible. When averaged over a year, wind projects typically operate at levels equivalent to 30 to 40% of their full capacity (aka capacity factor).

Can energy production by the wind project be reasonably predicted in advance? If so, how is this being done with today's technology and how might this be done a few years from now?

While the wind doesn't blow all the time, reliable patterns (on a daily and seasonal basis) exist. These patterns are used to project long-term energy production from wind projects, as well as to forecast short-term energy delivery.

As part of project development, long-term wind measurements are compiled from nearby monitoring stations (such as airports and government environmental monitoring stations). These long-term data are correlated to the on-site wind measurements, which are then adjusted up or down depending on the correlation to reflect the long-term resource. Although it is expected that the wind resource will vary from this estimate in any given year, the intention is to predict the long-term average output from a wind project over its estimated design life.

Short-term forecasts serve a different purpose. Utilities use short-term forecasts (i.e., up to 48 hours in advance) to plan the dispatch of their generation resources. In the past few years, sophisticated wind prediction computer models have been developed to predict the hourly output from a wind project for several days into the future. Continued improvement in these models is expected to result in increasingly accurate forecasts.

Socioeconomic Impacts

How does the local town, county, or municipality benefit from wind energy development?

Wind energy development benefits the local community in several ways. First, wind projects help to increase the tax base (or revenue in cases where payments-in-lieu of taxes are used). Wind power projects place very low demands on the existing town and county public services (such as water, sewer, fire, and road maintenance) in comparison to other forms of residential and commercial development activities. This low demand on services means that money from the wind projects are applied directly to existing community needs. For example, the 30 MW wind energy project in Fenner, New York, is providing the town of Fenner approximately $150,000 per year from payments-in-lieu-of-taxes and the 11.6 MW Madison wind energy project is providing approximately $30,000 per year for both the Town of Madison and the Madison Central School District.

Other direct economic impacts include the creation of new jobs for construction and ongoing operation and maintenance. Multiplier effects include new, or increased, business to support the operation of the wind project or to support the general growth of the wind industry in that area. For example, a part supplier may expand operations to that locale, keeping dollars in the local community as well as bringing in non-local dollars for projects outside the locale. Hotels, restaurants, and other service industries can also see increases in business primarily during the construction phase; however, this can extend into the operation phase at reduced levels. Tourism is another area that can experience increases in activity.

How many jobs are typically created by a new wind power project during construction and during operation? What types of jobs are created? Can local labor be used? Is union labor used?

<u>During Construction</u>: Employment during construction varies by project size and by specific construction activities. Generally wind energy project construction work is performed over a 6- to 9-month period. All forms of conventional construction labor are employed to build wind energy projects. The wind turbine supplier is typically responsible for transport, delivery and installation of the tower sections, nacelle and rotor. Existing teams of personnel trained by the manufacturers are utilized for these tasks; however, local labor is also used. Local or regional construction companies are commonly retained for “balance-of-plant” construction work (roads, foundations, electrical collection system, O&M building, etc). As an example, about 78 jobs were created during the construction of the Fenner, NY wind plant (30 MW in size with 20 turbines.)

During Operation: Project staffing levels can vary depending on the project size, location, equipment type, and O&M approach. Maintenance personnel generally need to be proficient mechanics or electrical/electronic technicians. With these skills, they can be readily trained in wind power mechanical and electrical systems and maintenance equipment. Approximately one O&M job is created for every 10 to 20 turbines.

How does the landowner benefit?

The landowners benefit directly from annual lease payments throughout the project's operating life while being able to maintain existing land uses over approximately 95% of the land. For land that is already in production (i.e., farming or ranching), the landowner receives two revenue streams – one from the existing use and one from the wind project.

How does a wind power project affect property values?

A study was recently completed to evaluate the impact of wind projects of at least 10 MW on nearby property values. The study evaluated approximately 25,000 land transactions within 5 miles (the view shed) of 10 wind projects. Of all the wind projects built in the U.S. between 1998 and 2001, 27 projects fit the criteria of having 3 years of land transaction data before and after the wind project. Of those 27, only 10 had statistically good data. The report concludes "statistical evidence does not support the contention that property values within the viewshed of wind developments suffer or perform poorer than in a comparable region. For the great majority of projects in all three of the cases studied, the property values in the view shed actually go up faster than values in the comparable region." The report is available on-line at http://www.crest.org/articles/static/1/binaries/wind_online_final.pdf.

Data on property value impacts is limited, and additional studies will be needed in the future to confirm these results.

Do wind power projects affect TV, radio, or cell phone reception?

Utility-scale wind power projects do not affect cell phone reception. In fact cell phones are often the main means of communication used on wind energy projects. Turbines could potentially interfere with radio or TV signals if the turbine is in the "line of sight" between a receiver and the signal source. This problem can usually be handled by improving the receiver's antenna, installing relays to transmit the signal around the wind energy project, or making slight adjustments to particular turbine locations. Use of satellite or cable television is also an option as wind projects will not affect these systems.

For communities and people in close proximity to a wind power project, what were the reactions before the wind power project was built? How did reactions change after construction?

Based on polling conducted in Texas, Vermont, Canada, the United Kingdom, and other locations, support for wind projects generally increases after installation. Many people are still relatively unfamiliar with wind energy and its actual visual and sound impacts before a project, and discover after the project is built that the impacts are not as significant as first believed. In areas where pre-construction support was high, it remained high after construction. In areas where pre-construction support was low or medium, it increased following project completion. Some examples demonstrating the magnitude of opinion changes and additional references are included in an article prepared by the American Wind Energy Association (http://www.awea.org/faq/survpub.html).

Given the current wind energy technology, how much sound, measured in decibels (dBA) can be heard at various distances from the base of a turbine? At what frequency(s) do wind turbines emit sound?

Sound from wind power projects varies by specific site depending on wind direction and atmospheric conditions. Wind projects typically emit two types of sounds: a swooshing sound from the blades and a mechanical sound from the gearbox and generator. During periods of high winds, the natural sound of the wind itself often drowns out any sound from the wind turbines. Sounds from wind turbines are most noticeable under low wind conditions.

Wind turbine manufacturers have implemented a number of modifications to reduce turbine sounds to their current low levels. Modifications include limiting rotor tip speeds, modifying the airfoil shape, and utilizing helical mesh gears within the gearbox. Sound levels from turbines are approximately 43-45 decibels as measured at 250-350 m (820-1,150 ft) from the turbine. Putting this sound level in perspective, the threshold of hearing is 0-10 decibels, a soft whisper is 30 decibels, ambient sounds in a quiet suburban residential area are 48-52 decibels, ambient sounds in an urban residential area are 58-62 decibels. Additional information on sound from wind turbines can be found in the following documents:
Wind Energy and Noise, http://www.awea.org/pubs/factsheets/WE_Noise.pdf .
Noise from Wind Turbines: The Facts, http://www.bwea.com/ref/noise.html .

Can setbacks be effective in insulating the public from turbine/project sounds and visual impacts?

Distance is a very effective tool for sound attenuation. For this reason, wind turbines are generally located approximately 1,000 ft (305 m) away from residences.

While wind turbines can be visible from greater distances, local topography and vegetation can block it from view. Visual aesthetics is a subjective topic; some people like the turbines, others feel they ruin the natural scenery. The wind industry tries to be sensitive to these issues while ensuring that projects are developed in a manner that is economically viable in the long term.

Are setbacks sufficient to minimize the chance that turbines will cast shadows on nearby dwellings?

Yes. As part of project layout analysis, computer models can calculate the shadow zones around wind turbines during different times of the day and during different seasons to calculate the affected areas. The position and direction of windows in a structure are input and the chance of a cast shadow or shadow flicker from moving blades can be determined. These calculations provide a worst case analysis since the models do not account for the blocking effects of trees and structures. The distances calculated in the models, along with an understanding of any potential blocking effects, can be used in determining appropriate setbacks.

Are turbines required to have lights? If so, are specific colors preferred and do they need to blink on and off?

Yes. The Federal Aviation Administration (FAA) requires any structure over 200 ft (61 m) to have aviation warning beacons. Rules for structures near airports are more stringent. The local or regional FAA office decides the light color, number of lights per project, flash pattern, etc. For wind turbines, the beacon is typically placed on top of the nacelle. The blades are not lit.

Environmental Impacts

Have birds been killed by wind turbine blades? How are flight paths of migratory birds affected?

Birds have been killed by flying into wind turbine blades and the support structure. The most publicized examples are in Altamont Pass, California. Since that time, equipment designs have changed (horizontal-bar lattice towers have been replaced by tubular towers or angled-bar lattice towers which reduces perching space), blade speeds have been reduced, and environmental considerations during the siting process have become much more rigorous. The wind industry is working with environmental groups, federal regulators, and other interested parties to develop methods of measuring and mitigating wind energy's effect on birds. Migratory birds are less of a concern than raptors, but flight paths of migratory birds should also be considered in a site assessment. The wind energy industry has taken significant steps toward quantifying and supporting research on avian mortality.

How does mortality of birds at wind power projects compare to mortality associated with other commonly accepted human activities?

Even at Altamont Pass, only 1-2 birds per turbine are killed each year in the U.S. With approximately 26,600 turbine towers (both large- and small-scale), that equates to approximately 26,600-53,200 bird deaths per year. Tall communication towers kill approximately 4 million birds a year. Approximately 60 million die in collisions with vehicles, another 98 million with buildings and windows, and another 100+ million due to housecats and feral cats.

Additional information is available in the following reports:
Comparative Impacts of Wind and Other Energy Sources on Wildlife, http://www.awea.org/pubs/factsheets/wildlife.pdf
Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States, http://www.nationalwind.org/pubs/default.htm

How do wind power projects affect the habitat of ground animals?

Increased traffic and noise, particularly during construction, can temporarily disrupt wildlife use of the immediate area. During operation, the increased presence of human activity may alter animal behavior; however, these effects would be minor compared to other forms of development. A detailed study at a wind project in Vermont indicated that the installation of a wind project did not affect the bear populations in the area. Another study of elk conducted at a project in Wyoming did not discover displacement effects and noted that use of the area had not declined.

Do the turbines produce hazardous wastes?

Turbines require lubricating oils, grease, and hydraulic and insulating fluids (within electrical transformers). When spent, these materials are handled and managed in accordance with state and federal hazardous materials and solid waste regulations. Lubrication oils are returned to the suppliers for recycling. Otherwise, wind projects do not produce hazardous waste nor emit radiation, particulate matter, or greenhouse gases.

How much pollution is displaced by the operation of a 1,000 kW (1 MW) wind turbine over a typical turbine life span of 20 years?

Assuming that a 1 MW turbine operates at a 35% capacity factor over its 20-year life span, the turbine would produce 3,066,000 kWh/year or a total of 61,320,000 kWh in 20 years. Using the average fuel mix in New York State for coal, natural gas, and oil for the year ending 2002 to quantify emissions, 0.892 pounds of CO_2, 0.003 pounds of SO_2, and 0.0012 pounds of NOx were produced for 1 kWh of electricity.

Therefore, in one year a 1 MW turbine displaces:

- 2,734,872 pounds of CO_2,
- 9,918 pounds of SO_2, and
- 3,679 pounds of NOx

Over the 20-year life of the turbine, the amount of pollution displaced is:

- 55 MILLION pounds of CO_2,
- 198,360 pounds of SO_2, and
- 73,580 pounds of NOx.

Safety

Are there industry standards for setbacks from housing, roads, property lines, and power lines?

In general, setbacks used in wind power projects vary from 500 to 1,350 ft from homes, structures, sensitive environmental areas, etc. Setbacks from roads and non-participating property lines differ, depending on the ordinance or conditional use permit, but are often equal to the maximum tip height, maximum tip height plus some extra distance such as 100 ft, or a multiple of maximum tip height.

Are such setback distances sufficient to minimize the chance of public injury and loss of private and public property value?

Yes, long-term operation experience in California has demonstrated that properly sited projects that employ adequate setbacks significantly reduce the risk of public injury and loss of private and public property. No member of the public has been injured or killed from an operating wind energy project. Other forms of energy generation pose higher levels of risk, particularly when factoring in exposure to air pollution.

Can turbine blades become coated with ice? If the potential for icing and ice throws exists, are there ways to protect the public or reduce the risk of injury to the public from ice being thrown from turbine blades?

Icing conditions can occur in areas of New York and these conditions are typically evaluated as part of the project development process. Risk of injury from potential ice throws is managed in several ways including the following practices:

- Blade Design – Manufacturers and blade designers continue to research materials and methods that could be employed to reduce the possibility of ice accumulation and subsequent throws. Design features such as the use of black blades and the applications of special coatings have been used at some cold weather sites.
- Turbine Controls – If ice accumulates on turbine blades, it also affects the wind speed and direction sensors. If the sensors become iced up, the control computer stops turbine operation automatically. Icing on the blades also results in reduced performance, unusual loads, or vibrations that are detected by the control system and trigger an automatic stop. If the turbine is not operating, ice from the blades, nacelle, and tower falls to the ground in the immediate vicinity of the machine.
- Operator Intervention – Project operators can halt operation of certain turbines (or the entire project) during icing events. Provided there is some wind available, site operators can manually ‘bump’ the rotor for a few slow rotations to make the blades flex and relieve some of the ice build-up.
- Safety Zones – Establishing adequate setback areas from inhabited buildings, roads, and power lines significantly reduces the risk of injury or damage in the event of ice throws. There is a limited body of research into quantifying ice throws probably due to the fact that there have been no reported injuries associated with these events.

The people most at risk from falling ice are the site personnel, as most ice falls from the blades, nacelle, and rotor near the base of the tower. Most project developers have strict rules established for personnel and operations during an icing event to prevent worker injury and to protect the public.

Have blades or pieces of blades ever broken off? If so how far do pieces travel?

Although there are a few reported instances of blade throws during the early years of the wind industry with old technology, these occurrences are now rare, due in large part to better testing, design, and engineering of commercial wind turbines. The distance ice may travel from a blade is difficult to document since icing events are rare (in comparison to the total time in a year), it is difficult to document/witness a true ice throw, and the size of the ice will influence the distance. Project operators note that large pieces of ice (that are considered potentially hazardous) tend to fall within the 1-2 rotor diameters of the turbines (approximately 250 to 500 feet).

Have turbine towers ever collapsed and if so, how have they failed and how far have they fallen?

Although turbine tower collapses are rare, there are reported instances of tower collapse due to a number of unique circumstances. The reasons for collapses vary depending on conditions and tower type, but have included blade strikes, rotor overspeed, cyclonic winds, and poor or improper maintenance (torque bolts). In cases where information is available, the majority of the rotor, tower and nacelle have fallen to within 1 to 2 hub-height distances from the base.

What safety provisions are used to keep the public safe?

Wind turbines have locked doors at the tower base and on all transformers precluding the ability of a non-authorized person to access the operating equipment. Substations and interconnection points are always fenced. A fence may be used around the O&M building, depending on its location.

Some communities have established information kiosks along roadsides to channel curious sightseers out of road traffic and into an area that is a safe distance from the turbines.

Have any wind turbines ever caught fire? If so, what is the typical response protocol? How is public safety maintained?

In extremely rare circumstances, wind turbines have caught fire. Since the public typically does not have access to the private land on which the turbines are positioned, the safety of the general public is not compromised. If a wind turbine catches fire, staff personnel and fire personnel maintain a safety area around the turbine and protect against the potential for spot ground fires until the fire is out. Power to the section of the project with the turbine fire is also disconnected.

Site Exploration

What criteria are used in determining the location of a wind power project?

The key criteria include an adequate wind resource, sufficient quantity of land, appropriate terrain features and orientation to prevailing winds, close proximity to transmission lines (with capacity to receive the power), limited or manageable environmental issues (i.e., sensitive habitats or species), manageable historic and cultural issues (i.e., preservation areas or artifacts), the presence of an energy purchaser, conducive state or federal policies to encourage development, and a supportive community and landowners.

What is the first task the developer performs when scouting out or exploring a location for a wind energy project?

There are a number of 'first tasks' that developers and prospectors conduct when considering new areas for a wind energy project. The key activities include a review of existing wind resource information (existing measurements, wind atlases, meteorological knowledge, etc.); an evaluation of land, elevation and topographic features on maps; and an assessment of energy market conditions, rules, and policies. Site surveys are then performed to identify properties of interest, determine the proximity to transmission lines, inspect existing wind measurement equipment, evaluate area vegetation and land forms for signs of wind-influenced growth patterns or erosion, and assess compatibility with existing land uses.

If the information indicates the site is promising for wind development, developers then begin talking to landowners about their interest in hosting wind turbines and pursue installing wind monitoring equipment. Other tasks include discussions with the local utilities and/or transmission line owners to determine if there is capacity on the transmission lines in the vicinity and to identify where wind generation could be added to the system.

Can wind power projects be built in stands of trees?

Yes; however, tree removal will be required for the access roads, turbine assembly areas, the power collection system, and the substation. Wind projects in wooded areas exist in Vermont, West Virginia, Pennsylvania, and Tennessee (to name a few). The wind resource will be impacted by the trees. Project developers might use taller towers to reduce the impact of the trees on the wind speeds experienced by the turbines. Tree removal for the express purpose of improving the wind resource is not a common practice.

Land Control and Landowner Information

It is often said that wind project development can coexist with pre-project land uses, thereby preserving the multiple uses of the land by the landowner (i.e., farming and ranching). How much space does a typical wind energy project utilize during construction and during operation? If a project were sited on forested land, how

much land would be cleared for construction work areas? How much could be reclaimed?

In open, flat terrain, utility-scale plants require approximately 50 acres/MW for spacing, setbacks, etc., but only about 5% of the land is used for construction and 2-3% of the land is used for the turbine structures, facilities, and access roads during operation. A wind project located on a ridgeline in hilly terrain may require less space, approximately 20 to 40 acres/MW depending on the terrain features. Upon project decommissioning, the entire area can be reclaimed.

Other than loss of land for construction work areas and long-term operation and maintenance, does a wind power project have any other affect on crop yield?

No. Any land not directly used for turbine structures, facilities, and access roads is available for other uses, as long as it does not significantly decrease the wind resource at the project. Testimonials from farmers with wind turbines on their land can be found at www.windustry.com.

What information resources are available for landowners considering leasing their land to a wind power project?

On-line resources include the following:

- U.S. DOE's Wind Powering America web site contains a detailed compilation of reference materials for landowners to become better educated about the development process. http://www.eere.energy.gov/windandhydro/windpoweringamerica/.
- Green Energy Ohio has assembled a "Tool Kit for Wind Energy" document on wind energy development. Specifically "Section 10: Wind Power for Farms" contains a collection of FAQs and links to other information about land leases written specifically for the landowner either wanting to bring wind to their property or facing negotiations with a wind developer. http://www.greenenergyohio.org/page.cfm?pageId=100
- Windustry, a non-profit organization, provides landowner testimonials discussing all aspects of wind energy project impacts at www.windustry.com. A specific section under 'easements' includes a bullet list of questions for landowners to ask developers and an explanation of easement agreement clauses. Another document, *Harvest the Wind: A Wind Energy Handbook for Illinois,* produced by Windustry is available at http://www.iira.org/pubsnew/publications/IVARDC_Reports_614.pdf. This document contains both generic and Illinois-specific information on wind energy development. Chapter 3 focuses on the land acquisition process.

How does the landowner ensure that the land can be returned to farming or other uses?

Decommissioning clauses in lease agreements typically require all visible traces to be removed, and concrete removed to a depth of 3 ft or covered with like soil material to a height of 3 ft. Provisions for returning the land to its original state may also be included and defined in the land lease agreement. Complete foundation removal is not viable since some foundations can extend 30 ft into the ground. As long at the top ‘working layer’ of soil is returned, farming or other uses can be restored.

How do landowners protect themselves from a wind project that becomes abandoned by the developer or owner/operator?

Due to sizable investments, outstanding loans, contractual energy delivery requirements, and public policy, wind energy projects are not facilities that can easily become ‘abandoned.’ The value of the known wind resource, equipment, a power sale contract, and an interconnect agreement would attract new owners. At a minimum, the lending banks would be highly motivated to see the project continue operation if for no other reason than to receive repayment of their loan.

A landowner’s main form of protection against an ‘abandoned’ project is the decommissioning clauses and requirements in the land lease agreement. In areas where local permitting authorities establish decommissioning requirements, landowners are additionally protected since the government has a legal obligation to intervene.

Additionally, local governments or lending banks often require projects to establish decommissioning escrow accounts or post a letter of credit to pay for decommissioning. At a minimum the equipment will have scrap value that (depending on the cost paid for scrap steel) could be sufficient to pay for the entire decommissioning process.

What obligations does a wind power project developer have in advising landowners to seek their own counsel?

The developer has no specific obligation to advise landowners to seek their own counsel. As with any contract negotiation, it makes good sense to have a lawyer knowledgeable in the particular field review the contract. Legal costs may seem prohibitive and some project developers may be willing to help offset some of the legal costs; however, the landowner should select counsel that can provide independent, objective advice.

What is the relationship between the wind power project developer, project owner, and landowner?

The relationship between the developer/owner and landowner is contractually defined through legal agreements including documents such as a Met Tower Agreement, Option Agreement, or Land Lease Agreement. The wind resource above a property is treated similarly to minerals or gas resources in the ground and lease agreements define the legal rules, rights and compensation associated with the resource and land to which both parties agree. Local governments are not a party in these agreements and have no oversight jurisdiction. The first two agreements noted above define the relationship during the initial wind testing/assessment phase and may have a shorter duration (in the range of 2 to 5 years). These are typically exclusive agreements (i.e., preventing the landowner from leasing land to more than one developer) and can place limits on the type of information the landowner is allowed to transfer to others. The Land Lease defines the relationship during construction, operation, and decommissioning of the actual project and typically has a term of 20 years with options for extensions. The Met Tower and Option agreements are usually between the developer and the landowner while the lease may be between the project owner and landowner.

Land leases may also be necessary for other project components such as access roads, power lines, met towers, and operations and maintenance ("O&M") facilities. The costs developers/owners are willing to pay for land required for these purposes may be different than for the wind turbines. Finally, project developers/owners may be interested in leasing neighboring land to help control the types of tall structures that can be built on land surrounding the wind project. This type of 'wind easement' lease helps ensure that the project is adequately exposed to a good wind resource for the project's operating life.

Permitting

See "Permitting and Approvals" Section of the Tool Kit

What types of studies are typically required by permitting authorities during their review of wind power project development?

The types of studies required by permitting authorities vary depending on the local land use regulations, state regulations, type of land impacted (state, federal, etc.), and sources of project funding. Depending on the specific conditions, permitting approval and study requirements can range from a building permit to a detailed Environmental Impact Statement. Typically, project developers prepare project documentation or assessments that examine the potential impacts on air, water, visual resources, wildlife, land use, sound levels, and health. Other studies may be required as indicated by the regulating authority and specific site conditions. Based on the content and completeness of the project documentation, local authorities may decide that they have sufficient information to make a ruling on the project.

Construction

Vehicles from heavy construction operations, such as a wind power project, could potentially damage local and county roads. Have wind power projects ever helped the locality maintain roads during construction?

If road damage is a potential problem, the owner/developer works with the locality to address those concerns and mitigate impacts. Wind power projects have been required to make road upgrades where the existing infrastructure has not been adequate for the truck transport requirements. Payment of the costs is negotiated with the local governments.

Once construction is complete, will the construction areas, including construction roads, be restored to their original condition?

Those portions of lay down areas not needed for plant operation are usually restored to the original condition. Roads built for construction are typically left in place and used as access roads to the project site and turbine locations. The ‘balance-of-plant’ construction contractor is responsible for this work. Typically this activity is included in the scope of work in the construction contract, and is incorporated as a part of the construction loan.

Electricity

If I purchase wind power, do the electrons actually flow to me? If not, where do they flow to and how can I claim that I am getting the environmental benefits that I paid for?

Electrons flow along the path of least resistance, which means they will flow to the closest load. Electrons created by wind power that are delivered onto a local transmission line will be drawn to high loads such as cities and large manufacturing facilities. But a portion of the electrons are also drawn into the local distribution system to serve smaller loads like street lights, homes, and shopping centers. There is no physical way to force electrons generated by a certain energy source to be delivered to specific locations via the power grid. The only way to guarantee that you receive electrons from a renewable energy source is to have a system installed on your side of the utility meter.

Accounting of wind power generation is based on meter readings at the project and at the customer’s location. Certification programs such as Green-e (www.green-e.org) and the Green Pricing Accreditation Initiative (www.resource-solutions.org/greenpricing.htm) have been created to audit and verify that accounting practices of green product suppliers truly deliver the green energy purchased by customers.

What are the real markets for electricity generated from wind energy?

Markets for wind energy are driven by a number of different factors including the following:

1) Natural increases in electricity consumption – Electricity consumption increases continually as population increases and the use of electrical consumer goods expands. In general, the rate of electricity demand slows when economic activity slows and increases when economic conditions improve. The retirement of older generation plants also results in an increased need for new electricity sources. Utilities must meet this growing demand by adding new generation or by energy conservation. Wind energy competes for these additions with conventional generating technologies such as coal, hydroelectric, and natural gas. Adding wind and other renewables to the generation mix has value because it diversifies the generating technology utilized (thereby reducing risk), reduces the impact of fuel price volatility, does not add to air pollution or have waste disposal concerns, helps improve public perceptions, and can be installed relatively quickly to meet unexpected needs.
2) Response to public policy – Policy initiatives in over 20 states across the country and within the Federal government have created new markets for wind energy by

requiring utilities, and other electricity suppliers, to include renewable energy in their generation portfolios. These changes have primarily occurred as part of the utility deregulation process as policy makers have recognized that renewable energy sources have system benefits and that existing market rules are biased toward conventional generating options. New market rules are helping to expand the existing market for wind power. Additional information on state renewable energy incentives can be found at www.dsireusa.org.

3) Customer demand for green power – Customer polls repeatedly show a preference for green power. As a result, many utilities are offering green energy products to build customer loyalty, increase their expertise with new generation sources, and expand their business lines. Wind power provides one response to a growing market for green energy products. Green pricing is an optional utility service that allows customers to support a utility company's investment in renewable energy technologies. Customers typically pay a premium on their electric bill to cover the extra cost of the renewable energy. More than 300 utilities are now offering a green pricing option. Green power can also be purchased from organizations other than utilities.

A number of large companies have chosen to purchase green power in the U.S. for reasons such as expanding an existing policy of environmental stewardship and obtaining power at long-term, fixed prices. Some of the large corporations that have recognized the benefits of purchasing green power include Alcoa, Toyota, Lowe's, Kinko's, Pitney Bowes, Lockheed Martin, and Staples. Additional information can be found at http://www.eere.energy.gov/greenpower.

Economics

Aside from the benefits of reduced pollution, does wind power have other benefits (economic or otherwise)?

Wind power projects reduce pollution through the reduction of fuel consumption necessary for electricity production from other generating options. Expansion of wind energy will reduce our dependence on foreign sources of fuel, as well as reduce the consumption of native, finite sources of fuel such as coal and natural gas. In hydro-electric dominated utility systems, wind energy helps conserve water or can make up for water deliberately released to improve water quality for fish and other water dependent species.

Other benefits include:

- Adding wind energy to the generation mix reduces the impact of rising fuel prices, which in turn lessens the potential for increases to your electric bill.
- Wind projects, through land lease agreements, increase the financial security of local landowners through lease and royalty payments. In many cases, wind turbines on working farms and ranches have helped to provide a stable source of income allowing maintenance of existing operations or expansion into new areas.
- Wind projects expand the local tax base and keep dollars in the community. Payments to local governments (in lieu of taxes) can be hundreds of thousands of

dollars or more per year depending on the project size, wind resource, and other factors. For small communities and towns, this can represent a significant increase to funds available for schools, civil works, maintenance of existing services, or addition of new services.

How much capital do current wind projects typically require and what are the sources?

Capital investment varies based on turbine size and project size. Large turbines (like those used in utility-scale projects) can cost between $1,200/kW and $1,500/kW installed, while small-scale turbines cost approximately $3,000/kW installed. A 100 MW project using 67 1.5 MW turbines could cost from $120 to $150 million. Sources of funding include bank loans, bonds, and equity investors. The split between debt and equity can range from 70% debt/30% equity to 50% debt/50% equity. Private companies and individuals are typically the source of equity while large financial institutions are typically the source of debt.

Can we help to pay for the development and maintenance of wind generated electricity in ways other than through government funding and tax incentives?

Alternative methods for the public to support and pay for wind include:

- Purchasing green energy from local utilities or other suppliers.
- Investment into stock of wind industry companies that are publicly traded.
- Formation of cooperatives that are whole or part owners in a wind energy project (a common economic model in Germany and Denmark).
- Support of companies that purchase sizeable quantities of renewable energy.

Incentives

Are utility-scale wind power projects eligible for tax incentives?

At the federal level, wind projects may be eligible for a Federal production tax credit (PTC). This credit has expired and been reinstated several times over the past decade. The availability of the PTC is expected to remain critical to the development of wind power. The owners of utility-scale wind projects are eligible to receive the federal PTC, assuming that they have a large enough tax base to be able to utilize the credit.

Where can I find information on state and federal incentives for wind-generated power?

The Database of State Incentives for Renewable Energy (DSIRE) maintains a comprehensive website, www.dsireusa.org, which contains detailed information on renewable energy incentives. Other information is available through the U.S. Department of Energy, state energy offices, and local government agencies. NYSERDA maintains information on incentives available in New York.

How do these types of incentives affect the cost of energy?

Most economic incentives are designed to impact either the capital investment (dollars or financing terms) or tax basis. These incentives can lower the principal and interest payment or lower taxes paid by the project, which directly lowers the cost of energy. Most legislative incentives do not directly impact the cost of energy. Their goal is to help establish and/or strengthen the market for renewable energy.

How do the tax incentives for wind energy compare to incentives for other forms of energy generation?

All energy technologies receive some form of support from the federal and/or state government but the type of incentive and its impact on the cost of energy from generation technologies varies widely. Subsidies come in various forms, including payment for production, tax deductions, guarantees, and leasing of public lands at below-market prices. Incentives can also be provided indirectly, for example, through federal research and development programs, or provisions in federal legislation and regulations. The Renewable Energy Policy Project has written several papers on federal energy policy, including a paper that compares incentives for wind, solar, and nuclear power. Links to these documents can be found at www.repp.org.

Additional Sources of Information

American Wind Energy Association – *Frequently Asked Questions*
http://www.awea.org/faq/index.html

Grassroots Campaign for Wind power – *Wind Energy FAQ*
http://www.cogreenpower.org/landowner.htm

Green-e – Renewable Electricity Certification Program
http://www.green-e.org

Green Energy Ohio – "Section 10: Wind Power for Farms" – *Tool Kit for Wind Energy*
http://www.greenenergyohio.org/page.cfm?pageId=100

International Electrotechnical Commission – *IEC Wind Turbine Standards*
http://www.awea.org/standards/iec_stds.html

Windustry
http://www.windustry.com

National Wind Coordinating Committee
www.nationalwind.org

New York State Public Service Commission
http://www.dps.state.ny.us/articlex.htm

NYSERDA
www.powernaturally.org

Renewable Energy Policy Project
http://www.crest.org/articles/static/1/binaries/wind_online_final.pdf

The British Wind Energy Association – *Wind Energy FAQs*
http://www.bwea.com/ref/faq.html

U.S. Department of Energy – Energy Efficiency and Renewable Energy Website
http://www.eere.energy.gov/greenpower

U.S. Department of Energy – Wind Powering America web site
http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/34600_landowners_faq.pdf