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THIS WEEKEND

What Can Wind Energy Contribute to New York?

Gary A. Abraham

This is the first in a two-part article on the benefits and impacts of New York's effort to rely for a portion of its electricity needs on wind energy. The first article focuses on the contribution industrial wind plants can make to New York's electricity needs, and the land resources that will be needed. The second article looks at the impacts wind plants can have on host communities that host them.

In 2004, New York adopted the goal of achieving 25% of the state's energy needs from renewable sources by the year 2013. In 2004 New York was already generating over 19% of its electricity from renewable sources, mostly from hydroelectric plants on the St. Lawrence River and Niagara River.

The Alliance for Clean Energy New York, Inc., a booster for wind plant development, says 1,088 megawatts (MW) of electricity capacity is expected from newly sited wind turbines in New York by the end of 2008. However, the first phase of New York's largest operating wind plant, the Maple Ridge Wind Farm in Lewis County, with 120 1.65 MW turbines, each over 400 feet high, required approximately 21,000 acres. The Maple Ridge project has elicited noise complaints by many people within a mile of

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that area. It is therefore worth asking how much electricity the host community and the state can expect from these plants, and whether the land resources and impacts are worth the benefit.

Unfortunately, the track record so far does not show that wind has the ability to generate much electricity. No industrial wind plant in New York has contributed to the local host community's electricity needs. Instead, wind plants connect to the state electricity grid, where what they generate is distributed throughout the state.

The capacity of wind to generate electricity is limited by both technology and nature.

The capacity of wind power is limited

The utility industry uses the term "capacity factor" to determine a power plant's ability to generate electricity. The capacity factor for a power plant reflects the amount of energy actually generated over the course of a year as a proportion of the energy the plant would have produced at full capacity, operating 24/7 every day of the year. Only some power plants operate near full capacity, also called "nameplate," "rated" or "installed" capacity. Conventional power plants that burn coal typically operate at around 70-90% of their full capacity (e.g., 70% capacity factor), nuclear power plants operate at 90% to 100%. Wind power plants in New York typically operate at a capacity factor of 20%.

There are two important reasons for the low capacity factor of industrial wind turbines. The first has to do with the amount of wind resources an area offers. Large commercial wind turbines begin to generate electricity at about 9 mph and reach their rated capacity when winds reach about 27 mph. Below 9 mph, no electricity will be generated, and between 9 and 27 mph less than full capacity will be generated.

Wind resource areas are classified from 1 to 7, with Class 4 winds (average winds ranging from 15.7 to 16.8 miles per hour) considered the minimum necessary to make industrial-scale wind plant development viable. However, most Class 4 wind resource areas in New York are off-shore in Lake Ontario and Lake Erie. There are few land areas in New York that possess Class 4 winds. The Tug Hill Plateau, where the Maple Ridge project is located, is one such area, but that project is currently operating at a 20% average capacity.

Energy output from the wind is proportional to the cube of the wind speed. That is, as mean wind speeds decrease, the capacity factor for wind turbines decreases exponentially. Accordingly, wind power plants in New York proposed for locations with less an Class 4 winds will experience an exponential decrease in capacity factors. In our area, the Bliss Windpark in Wyoming County is about to come on line, with 67 turbines, each rated at 1.5 megawatt (MW) each, or a total capacity of 100.5 MW. The same company is advancing another "windpark" in adjacent Centerville and Rushford (Allegany Co.) about the same size, and a third "windpark" is being discussed in adjacent Farmersville (Cattaraugus Co.). The combined wind plant would have a rated capacity of about 300 MW, but can hope to generate 20% at best, or 60 MW.

If Maple Ridge is any guide, these three interconnected wind power plants will require about 50,000 acres.

In addition to wind resources, a second reason for the low capacity factor of industrial wind turbines is the seasonally intermittent nature of wind. The New York System Independent Operator (NYISO), a non-profit company that manages the electricity grid for the state, assigns a "capacity credit" to each power plant in the state, representing the amount of electricity that the grid operator can rely on to meet peak demand. NYISO assigns to wind power plants a 10% capacity credit in the summer and a 30% capacity credit in winter. This is because late summer days, when electric consumers are using air conditioners (especially downstate), are times when we have the least wind but the highest peak electricity demand. When wind blows the most, during winter nights, is when New York needs the least electricity and when wind contributes the most.

This means, to meet our peak demand needs we need to continue to build new more dependable capacity or continue to delay retiring old, polluting but dependable power plants.

The assigned capacity credit is based on an expected average over a season. Wind's contribution diminishes even further when we look at how daily fluctuations in electricity demand and electricity generation are managed. Most power plants can provide steady generation of electricity around-the-clock at a large fraction of their rated capacity. These plants provide "baseload capacity," that is, a minimum amount of electric power required over a given period of time at a steady rate. Fluctuations, peaks or spikes in customer power demand are handled by baseload power plants.

Wind power is unable to respond to fluctuations, peaks or spikes in customer power demand and therefore provides no baseload capacity. Baseload plants must be kept on line even if substantial wind-generated electricity is added to the grid.

In fact, substantial amounts of wind-generated electricity increase the fluctuation in the grid as wind power comes on and off, and may increase the demand for responsive baseload plants. Fluctuations caused by integrating wind power into the regional electricity grid also require additional management from the grid operator, potentially increasing the cost of electricity.

Baseload plants may also be operated at reduced capacity when electricity from wind plants is added to the grid. If operated at reduced capacity (for example in the winter, when substantial wind-generated electricity might be added to the grid), power plants that burn fossil fuels operate less efficiently, emitting more pollution per unit of energy produced than if they were allowed to run continuously at maximum capacity. In other words, substantial additions of wind-generated power to New York's electricity grid will have the perverse outcome that air quality will not improve very much.

<u>The land wind power plants require</u>

A central consideration in any policy to increase the role of commercial wind power in achieving renewable portfolio standards in New York should be the amount of land required to reach such a goal. Most other power plants require 10 acres or less.

In 2005 New York consumed 154 million MWh of electricity. NYSERDA has said that New York has enough land based wind potential to generate 10 percent of the State's electricity consumption. If a typical 60-turbine wind plant in New York requires about 10,000 acres (a conservative assumption), to generate 15.4 million MWh with wind plants that achieve a 20% capacity factor will require about 146 wind plants and 1,460,000 acres, or 2,281 square miles.

When coupled with the need to maintain existing baseload power plants and the inability of wind to replace the need for future baseload capacity, this much land may be too high a price to pay for a technology with the lowest energy output of any current alternative. For example, enhanced geothermal energy, using existing oil drilling technology to tap heat over 200 degrees about three miles below the earth's surface, was recently assessed by MIT in a study that concludes known deep geothermal resources can provide 57,000 times the current energy needs of the nation.

The finances of wind energy

Industrial wind energy developers make as much or more from public subsidies, grants and tax credits as from the sale of electricity they generate. In fact, the primary reason for the growth of large-scale wind projects is the public money available to investors.

Wind power companies get about two-thirds of the $1-2 million each turbine costs from a federal tax credit. The federal Production Tax Credit pays wind companies 2 cents per kilowatt hour for a ten-year period, or over $750,000.00 for each modern turbine constructed.

In New York, wind energy companies get similar state tax credits and a guaranteed price for electricity generated, since state law requires the local power company in control of the grid to pay wind power plants connected to the grid the same wholesale price other power plants charge. Wind power companies therefore have no market competition. New York State Energy Research and Development Authority (NYSERDA) provides grants to many utility scale wind farms. The state Public Service Commission levies $150 million per year in charges taken from our utility bills to subsidize alternative energy projects including wind.

New York law also deprives local municipalities of tax revenue from a wind plant for the first 15 years of operation. Unless the municipality enacts a local law opting out, for 15 years state law makes wind power plants exempt from local taxes. Where a municipality has not opted out, the wind power company must negotiate a payment-in-lieu-of-taxes agreement (or PILOT) with the local municipalities. Typically these agreements provide about a half-million dollars per year, divided among the town, school, county and IDA. This is a small fraction of the taxes that would have been assessed on a project worth well over $100 million.

And, as the next article will discuss, reduced benefits to the host community come at the expense of property values and quality of life near the wind plant. This can have an adverse impact on the local tax base.

Conclusion

The large land resources wind power requires and the potential adverse impacts of wind plants on rural communities (such as changes to nighttime noise and viewscapes, habitat fragmentation, bird and bat mortality) should be weighed against the small potential contribution commercial wind power can make to New York's electricity generation needs. Wind power has the lowest energy output of any current alternative and avoids little if any building of new fossil fuel capacity. As a result, renewable energy capital investments by the public (electricity ratepayers and taxpayers) may be squandered on a feel good solution to the energy and climate crisis at the expense of rural land and environmental values.

Special E-Ffects (Ellicottville, NY), May 23, 2008

Is Wind Energy Good for Your Town?

by: Gary A. Abraham

This is the second in a three-part article on the benefits and impacts of New York's effort to rely for a portion of its electricity needs on wind energy. The first article focused on the unappreciated poor contribution industrial wind plants can make to New York's electricity needs, and the enormous land resources that will be needed. The second & third articles look at the impacts wind plants can have on the communities that host them.

Over 60 utility-scale wind power projects are proposed in upstate New York communities, including the western New York towns of Ashford, Machias, Yorkshire, Rushford, Centerville, Farmersville, Carrollton, Allegany, Hartsville, Albion, Wethersfield, Ripley, Fredonia and Arkwright. These are dramatically different than home or small business wind power projects, which involve turbines about 45 feet high that run very quietly. (For details visit www.realgoods.com and look for "Wind Turbines".)

A typical utility-scale project is the "Allegany Windpark" proposed by Noble Environmental Power in Rushford and Centerville, a 67-turbine project about 80 yards wide (most of the length of a football field) and 450 feet high. The Allegany Windpark's 67 turbines will require about 25 square miles of project area. The town of Centerville (which gets 55 of the turbines) has a total area of 35.4 square miles. So most of the land area of a town hosting such a project will be dominated by the presence of 500-foot-high wind turbines.

Each turbine weighs about 1,000 tons and requires a 400-600 ton crane to assemble. Up to forty concrete piles about 70 feet deep on top of which a concrete pad is installed require a total of about 40,000 cubic feet of concrete and 150 tons of steel for each turbine. Sixty-seven turbines will require 2.68 million cubic feet of concrete, over

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Sixty-seven turbines will require 2.68 million cubic feet of concrete, over 10,000 tons of steel, and enough heavy equipment to transport these and the turbine parts.

The Allegany Windpark requires 14 miles of new access roads to the turbines, each 32 feet wide, and another 24.5 miles of transmission lines, mostly excavated underground. The access roads would be rebuilt to a width of 12 feet after the turbine construction is completed, but over half of the transmission corridor would 100 feet wide. In addition, crane paths will often be constructed from one turbine site to the next because the cost of breaking down and reassembling the crane at the next site is too expensive. (For more details *see* www.rmtinc.com/public/pdf/Wind_Farm_Infrastructure_article.pdf)

Combining the Allegany Windpark with Noble's adjacent Bliss Windpark and another the company wants in Farmersville triples all these specifications. Each project has an expected lifespan of 20 years.

The impacts such projects have are complex and incompletely discussed in the applications submitted to local town boards. To simplify matters I will divide these into environmental impacts and direct impacts on people. But first a note on how these projects are regulated: Because there is no comprehensive state regulation of wind power plants (they are not considered utilities, for example), the burden of trying to understand, avoid and reduce adverse impacts falls on town boards. This has proven an impossible situation because, by the time the town board receives an application the wind developer has usually purchased easements from enough property owners in town to control the project area. Rural towns in New York are generally so pressed for revenue that they cannot say no to development, and those in town who have sold easements are often the first to lobby their town board.

Environmental impacts

Development of a wind power plant can change drainage patterns and harm water quality by silting up creeks, ponds and wetlands. Muddying up waterways reduces the oxygen available for fish and other aquatic species. Diverting the flow of waterways reduces nutrients in downstream waters. Aquatic species will decline as a result.

Criss-crossing the countryside with access roads and transmission lines can fragment habitat adjacent to turbine sites and divert non-avian wildlife populations away from the area. Large tracts of forest and grasslands are commonly broken up by wind projects. To determine the extent of such impacts requires intensive field studies in and around the project area for each of the four seasons, but few wind developers do such studies prior to seeking local approval.

Bird and bat mortality from industrial wind turbines is an increasing concern. Isolated wetlands and meadows are prime breeding grounds for birds. For example, the Allegany Windpark project includes 184 wetlands. (Acre for acre, restoring a wetland takes more carbon out of the atmosphere than anything else we know how to do.) Breeding birds are especially sensitive to land disturbance and will be driven away by tall structures. However, most attention has been focused on migratory birds, including raptors such as hawks and owls. These species commonly winter in western New York. Raptors are attracted to other birds and bats killed by wind turbines and then they get hit.

Migrating bird kills from wind turbines are higher under conditions of bad weather and low cloud cover, which often force migrant paths closer to the ground surface, within the height of wind turbines. All migrating birds fly much lower in elevation during adverse weather conditions, especially on foggy, rainy nights in the autumn. It is under these conditions when most birds hit turbine towers (as well as windows, windmill blades, and other high structures). The 120-turbine Maple Ridge Wind Farm in Lewis County is required to conduct an ongoing avian mortality survey. That survey has found that the project kills 10 migratory birds per turbine every six months. At Allegany Windpark site migrant passage rates were found to be significantly higher than at Maple Ridge.

However, bats are killed by wind turbines in much greater numbers than birds, and there are no generally accepted explanations. Significantly greater bat fatalities are occurring at wind power projects in the eastern U.S. than elsewhere, so many that the cumulative impact of all wind projects on populations could be significant. Most fatalities occur on nights with low wind speed. Because little energy is generated on such nights, U.S. Fish & Wildlife Service recommended that turbines for the Allegany Windpark be shut down after sunset when low wind speeds are low between July 15 and September 15, the bat migration season. (For more, visit www.fws.gov/northeast/nyfo/es/section7.htm)

Wind farms are also sources of pollution. Oil leaks, spills and turbine fires, however infrequent, are an expected occurrence. More importantly, emissions and waste are generated by the manufacture of wind turbines and the production of enormous volumes of cement, truck traffic emissions and land clearing required to install industrial wind turbines. Such pollution might be worth it if utility-scale wind farms could generate enough electricity to make a significant dent in greenhouse gases or our need for greater energy independence, but as the first part of this article showed, they don't.

Gary A. Abraham resides in Allegany, New York, Gary is a public interest Environmental Attorney with a state wide practice. His website address is www.garyabraham.com.

Special E-ffects (Ellicottville, NY), May 30, 2008

Turbine fires should be expected at least once during a project's lifetime, but there is nothing to do about them. The local fire department will not have equipment that reaches to the 80-meter hub height to put out the fire, and the manufacturer's guidance says let it burn itself out. That releases lots of air pollutants that may harm those downwind of the fire.

More serious is the phenomenon of "shadow flicker," a light-strobing effect that occurs when rotating turbine blades cast shadows at sunrise and sundown. This can effect people within a half-mile of a turbine. Computer programs are available to calculate the exact dates, times and areas during the year when and where shadow flicker will be a problem, but wind developers rarely use these programs because they don't want to shut down the turbines during these times. Some people are more sensitive than others, but those with pre-existing migraine, heart or blood pressure problems, or who have high risk for these problems are likely to suffer health harms when exposed to shadow flicker. One developer advised residents to simply pull down their shades. But windows all around the house blinking on the edges will not protect a person inside reacting to shadow flicker. And this solution does nothing for those who want to be outdoors.

Perhaps the impact people complain about the most is noise. In our area, rural home sites commonly enjoy background sound levels of 35 to 40 decibels (A-weighted to mimic the human ear's range, or dBA), and 10 dBA quieter at night. The state Department of Environmental Conservation (which does not presently review wind farm applications) has issued standards for noise impacts, saying that an increase of 6 dBA is likely to elicit complaints. International health standards established by the World Health Organization identify nighttime noise levels above 42 dBA measured outdoors as a cause of sleep disturbance leading to other adverse health impacts. However, wind developers have prevailed on western New York towns adopt a 50 dBA standard for wind turbines, often measured at the walls of one's home. This much noise (50 dBA) has been measured up to one mile from an array of turbines. It's like running a refrigerator in your bedroom at night, and people who live in the country expecting peace and quiet don't like it.

The reason so much noise is generated by industrial wind turbines is not the gearbox or hub power unit. These have been engineered to be quieter than models built in years past. But as the size and height of the turbines has grown another set of problems emerged, mostly linked to the kind of sound (modulating) and the effect of wind shear. As the blades pass the turbine tower a massive amount of air is displaced, creating a "swoosh" sound that can be particularly annoying. An array of three-bladed turbines modulating at different times can create cacophony of swishing noises.

Because of their height the wind is often strong enough to spin turbine blades when there is little or no wind at the ground surface where people are. This wind shear magnifies turbine noise two ways. First, with little or no wind at the ground surface, there is nothing to mask the swishing noise of the turbines. Second, the windy layer of air at the elevation of the turbines acts as a ceiling, trapping the noise in the still layer below. Once noises are emitted into the still air below, they can bounce back from the wind shear boundary above. The people below get a reverberating, modulating sound, which, at night, can be intolerable.

Conclusion

Town boards and planning bodies considering wind farm regulations should be studying the entire land area of the town, the likely places where unacceptably annoying noise levels could be experienced, considering the latest research on how far wind turbine noise can be emitted and how weather variations affect noise levels, and create an overlay zone within which wind turbine siting is acceptable. (This may lead to the conclusion that there is not enough area in town for a wind farm.) But they aren't doing this. Instead, lured by the promise of new revenue and believing wind power has little or no down side, when approached by a wind developer most town officials have adopted local standards urged on them by the developer.

Wind farms in the Midwest and western states are sited miles away from human communities with due regard for displacement of wildlife populations. In Europe a generation of experience with wind farms has led to reluctance to site them closer than one mile from communities. In New York wind farms are a new development, placing a tremendous burden on local officials to look at potential impacts as early as possible in the development of a project. But so far, local authority has been used to accommodating the wishes of wind developers, not the people who have to live with their projects.

Gary A. Abraham resides in Allegany, New York, Gary is a public interest Environmental Attorney with a state wide practice. His email address is www.gary-abraham.com.

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Community impacts

Localized oil leaks and spills can contaminate groundwater and pollute nearby water wells. This is what happened last summer at Maple Ridge, where an intermediate transmission station overheated and blew up. This winter, months after the cleanup, residents downhill from the station found their wells contaminated with oil. The underlying problem was the lack of meaningful monitoring: once constructed, developers typically leave behind two or three low-wage inspectors who come around infrequently and are reportedly rarely responsive to residents' complaints.