Town of Bethany Wind Turbine Study Committee Report

Ramon J. Cipriano, editor
January 8, 2007

Introduction

Although this report is the "final" report as necessitated by the urgency of the impending moratorium expiration in July, readers are reminded that due to the extremely fluid nature of the issue, the committee and in particular this editor will continue to provide new information to town officials as it becomes available in the form of addenda, newsletters, or whatever means required.

As seen below, the previous introduction is retained as a point of reference in time. In the roughly five months since it was written, the development pressure, itself a function of factors both local and international in scope, has continued to increase relentlessly. Middle East cognoscienti believe that Israel is now preparing to use both conventional and nuclear warheads to attempt to destroy Iran's blossoming nuclear capability. Such could easily ignite a conflagration of uncertain scope, since the United States and Russia back opposite sides, and both countries have enough warheads to retard civilization. Even without a doomsday scenario, or an attack on Iran by whomever, instability in the region could cause the price of oil to skyrocket with minimal provocation. At a more local level, the state of New York has committed itself to the development of alternative energy sources including wind. In a recent position paper distributed by County Planning Board Executive Jim Duval on Sept. 7, 2006 to town supervisors, the law firm of Thomson/West of Rochester spells out in no uncertain terms what is going to happen (New York Zoning Law and Practice Report, July/August 2006). They cite numerous instances in case law to show that wind turbine farms meet the three essential criteria required to have them enjoy the relaxed zoning laws applicable to public utilities. Translation: wind farms are coming to New York State regardless of the opposition of individual towns. Any town not recognizing this is in for a rude awakening.

In the opinion of this editor and most of the members of this committee, this extremely complicated issue can be boiled down to two main factors: money, and location. The wind development companies are interested primarily in making as much money as possible, not the welfare of the towns. The fraction of the revenue that they do release is going to be fought over by towns, school districts, and counties, and if a town isn't careful they could end up with so little that the project is not worth doing (specifically, less that $8,000/MW/turbine/year directly into the town coiffers, according to Eagle Town Supervisor Joseph Kushner....see PILOT section below). These are industrial machines and will have significant impact wherever they are sited for decades. Few people would object to siting them on the shores of Patagonia (where the wind is fearsome), whereas in a bedroom community such as Bethany the situation is different. If the setbacks are "adequate" to mitigate local concerns people do not object. The definition of "adequate" is key here. Some members of this committee have recommended a setback of one mile. The company approaching Bethany, UPC, would probably consider that to be cost prohibitive. One can show that increased line loss (power loss from the turbine to the grid) is not the major problem. Charles Pfaff, an electrical engineer and contractor who is not affiliated with any wind development company, notes that such line losses are deliberately engineered to be less that about two percent, by appropriate choice of conductor size, insulation, and

distribution voltage. Simple arithmetic shows that the revenue generated, compared to the revenue offered to towns or landowners, can easily absorb this two percent. Their main concern would likely be the initial cost of installation....and that could probably be absorbed by extending the term of operation by a year or so. On the other hand, a one mile setback is overly restrictive if ice throw is the determinant issue (see comments in that section).

Original Introduction (August, 2006)

As I write this in the early hours of August 2, 2006, the country is sweltering under a massive heat wave, and the world, particularly that part which produces most of the global oil supply, is in turmoil. Recently the Town of Bethany has been approached by a major wind developer, keenly interested in installing here a wind farm of truly industrial scale. Such a project could generate revenue for the town the likes of which it has never seen. Improperly executed, it could also have devastating effects on the pastoral quality of this rural area, and far more importantly, quite negative effects on the health and safety of our residents. As pointed out in our town's Comprehensive Plan, we the town residents are willing to encourage some responsible industrial development in this largely agricultural region, so long as the aforementioned negative effects do not ensue. The members of this truly democratic committee have a broad spectrum of opinions as to the advisability of this highly controversial proposal. Charged with finding out the facts, which are buried in a massive amount of information both pro and con, as is always the case when the situation is not simple (and this particular issue is extremely complicated), we have worked long and hard to ferret out those facts, and in this report will focus on them. Anecdotal information, misinformation, innuendo, and just plain falsehoods will be pointed out as necessary. We will concentrate as much as possible on that which can be substantiated with references to peer-reviewed articles in scientific, engineering, medical, and other relevant, reputable journals, and will include those references. We have worked long and hard on this, uncompensated, and have traveled many miles to see for ourselves what is going on. During the course of the past several months, some of our opinions have shifted, in either direction. This report will reflect the diverse nature of such and consequently will itself prove to be controversial. The relationship between wind and other forms of alternate energy, the word's energy sources, current focus on oil, and consequent threats to global security, are far beyond the scope of this report. We will point out that our mandate is to gather facts to determine the advisability of such a project in general, and not necessarily with respect to the particular company, UPC, which is now approaching us. The situation is fluid, dynamic, changing by the day, and this must be forefront in our thinking and recommendations.

Issues

ENVIRONMENTAL - HEALTH & SAFETY

- **Hazards to aviation**

  This topic is still under investigation by the editor. Information solicited from the Federal Aviation Administration and the Department of Defense has so far not been made available.

There are two main concerns: (1) possible collision hazards of approaching (landing) aircraft at major airports, especially in bad weather, and (2) possible interference with military aircraft operations. As for the first concern, we note that there are no major airports in Bethany, although there is at least one uncontrolled airstrip. As for the second, inhabitants of our town are aware of large military aircraft from the Niagara Falls Air Reserve Station occasionally passing low overhead (< 1000 feet AGL). One would assume they are aware of what is going on, and will not hesitate to contact UPC or any other development company if necessary (if they haven't already).

Note: there is the rare but still possible chance that a piece of ice, or turbine blade, could become detached while the turbine is spinning, and impact a low-flying aircraft. The maximum height such could possibly achieve, which could be significantly higher that the ground-to-blade-tip height, can be calculated using the same physical analysis discussed by the editor in the section on Ice Throw.

- ## Lightning protection and fire department equipment needs

Lightning occurs when the electrical potential between the ground and a storm cloud becomes great enough to exceed the breakdown potential of the air between ground and cloud. The mechanisms responsible for the charge separation, after decades of study, are still not well understood. Nonetheless the potential difference can exceed several million volts, and the current flow can reach over two hundred thousand amperes. The heat energy released in a large flash, if converted to mechanical energy, is adequate to lift a railroad freight car from the ground to the base of the cloud. The conducting path will follow that of least resistance, although the potential difference is so great that current will flow even in "non-conductors" such as fiberglass and wood turbine blades. The Joule heating is so great that unless conductors are built into the turbine blades, they will catch fire and/or explode, with obvious potential for fatal injury to anyone in or very near (5 or 10 meters) the tower. There is no way to prevent the turbine from being hit by lightning. The best one can do is provide a good and robust conducting path to ground. If a tower did catch fire, there would be no way to put it out save for very special equipment not normally available to most rural fire departments. Such departments could of course keep the fire from spreading, so if turbines are sited well away from residential structures, the latter would be safe.

- ## Stray voltage

The following report was submitted by Steve Breckenridge in September 2006 and is reproduced here unedited.

Stray Voltage - Apprehension ?

Apprehension over stray voltage has been expressed by committee members and other concerned members of the community.

Extraneous voltage appears on grounded surfaces in buildings, barns, and other structures. It is classified as a low frequency form of conductive electromagnetic interference.

In most buildings stray voltage is *not* a problem, because the levels are generally below the perception level of humans. Usually, there is *no* sensitive electronic equipment, which can be affected by it.

Concern in the agricultural field - However, in the 1970's, stray voltage became a concern in the agricultural field with dairy farmers. Cattle are ten times more sensitive to electricity and electronic interference than humans, as they are constantly standing in water or on moist areas of the barn.

Proper Installation/Grounding - if equipment is properly installed and properly grounded...evidence *does not* lead to wind projects as being a major source of stray voltage.
Unsubstantiated problems - Concerns in the Midwest with *stray voltage* on farms and their connection to wind farms are non-conclusive at this time. Supposed documentation, concerning herd and health and reproductive problems, is *unsubstantiated* at this time.

Conclusion - people should be concerned about *stray voltage*, however, if equipment is properly installed and maintained according to proper engineering standards, the wind turbines should not themselves dictate a major concern in the community.

- **Earthquake - Fault line - seismic effects - hydrology**

The following report was submitted by Geoffrey A. Briggs on August 26, 2006 and is reproduced here unedited.

Report summary, hydrology, seismology, conclusions
Attached are Fig. 1 - Map of Proposed Wind Turbine Project - Bethany (NY) obtained, with much difficulty, from C. Swartley, UPC Project Director.

Fig. 2, New York Faults (1989, 2002) provided by the geology department of the State University of New York at Buffalo, a map showing faults, fractures and the main traces of the Clarendon - Linden Fault System.

Fig. 3, Black Creek Watershed

Figure 1, the proposed wind turbine project map shows that close to one-quarter of the town of Bethany would be under the control of UPC leases. Of significance is the fact that these leased areas are in or surround the Black Creek drainage system. To date, the project developer (UPC) has provided no field-based studies on the effects of excavation for tower bases, roads, staging areas, buried or surface cables or subsequent removal of vegetation. Again, due to lack of information from UPC, it is necessary to interpolate within the wind turbine areas. Regardless of wind turbine density or distribution there is major potential for disruption of both surface and groundwater flow due to the proximity of project excavation to Black Creek. Aquifer recharge, perched water tables and wildlife would be severely affected, especially if a north-south configuration is utilized as this would effect a continuous, parallel disruption of flow to and from recharge areas.

Figure 2, the map of New York Faults shows that the areal extent of the wind turbine project proposed by UPC is directly on the main traces of the Clarendon-Linden in western New York. Historical seismic data shows that in the 1920's and 1930's major structural damage was recorded in Genesee and Wyoming counties, including the area proposed for the wind turbine project. Significant structural damage was observed in buildings and masonry from Attica to the hamlet of Little Canada, a damage trajectory which cuts directly through the proposed wind turbine project area.

Conclusions:

In my review of hydrological and seismological concerns regarding the proposed UPC wind energy project in the Town of Bethany (NY) I have presented data and factors, both current and historical. Surficial features in the town are a complex mix of fluvioglacial and ice contact features which yield a great variety of soil types and drainage patterns. From what I have seen - or been allowed to see by the project developer UPC, the developer has made, literally, a superficial review of existing geological information on the town. Major field investigation of the proposed project area is essential if seismic hazards and risks and hydrologic impacts are to be addressed.

Editor's comment: *It is certainly true that it has been difficult to obtain specific engineering or scientific information from UPC. Purportedly we were told this was because the project director for our area, Mr. Swartley,*

did not himself possess such knowledge. Eventually Mr. Swartley did organize a teleconference at which town officials were able to ask technical questions from a UPC engineer. At that conference it became obvious that the issue raised above by Mr. Briggs pertaining to possible seismic activity in the area proposed for turbine installation had not been adequately addressed by UPC. Mr. Briggs specifically attempted to get some quantitative assessment of the probability of tower failure in the event of a local earthquake, to no avail. It is apparent to the editor that such assessment would in any event be extremely difficult to get meaningfully in view of the many unknown variables. For example, if the frequency of the seismic activity happened to match the natural resonant frequency of the tower, the tower would likely collapse in spite of otherwise robust construction, as was observed to happen to the Tacoma Narrows Bridge in November of 1940.

- **Storm water runoff - erosion - sedimentation**
- **Construction disruption - road upkeep & repair**
- **Security - vandalism - terrorism**
  To be addressed by the editor forthwith.
- **Noise - infrasonic (below 20 Hz)**
  To be addressed by the editor forthwith.
- **Shadow and flicker effects**

The following report was submitted by Loy Ellen Gross and is reproduced here unedited.

Shadow Flicker and Blade Glint

Flicker: Definition

Flicker (also called the Disco Effect of Strobe Effect) is caused when the rotating wind turbine blades cast moving shadows that cause a flickering effect, or when glossy blades reflect light in a moving pattern, causing a reverse flicker (also called Blade Glint).

Shadow flicker occurs under a combination of conditions at particular times of the day or year. It happens when the sun shines behind a turbine rotor. This can cause the shadow of the turbine blades to be cast onto roadways, buildings and other objects; which appears to flick the sun on and off as the turbine rotates. Reverse flicker occurs, likewise, under certain conditions. It happens when the sun reflects off turning rotor blades, reflecting a bright light back to the sun ward side of the turbine (5).

The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of the flickering. Shadows cast close to a turbine will be more intense, distinct and 'focused'. This is because a greater proportion of the sun's disc is intermittently blocked.

Sources of Flicker, for Comparison

Fluorescent Lights:	120 Hz
Computer Screens :	75 Hz
Televisions:	60 Hz interlaced
Vehicle Turn Signal:	13 Hz
Wind Turbine Shadow	1.25 - 5 Hz

Most people notice flicker up to about 50 Hz, after which the brain's response to the flash lasts longer that the flash itself. Epileptic responses to flicker typically run from 12 Hz and up, but can be as low as 3 Hz.

Effects of Flicker

Shadow flicker is one of the "annoyance' or 'nuisance' effects of wind turbines, similar to noise and view complaints, however it is unique among these. While all are somewhat subjective and tolerated by different percentages of nearby residents, shadow flicker is the least well tolerated. Residents impacted by flicker complained of headaches, migraines, nausea, vertigo and disorientation after only 10 minutes of exposure (2,3).

As with car of seasickness, this is because the three organs of position perception (the inner ear, eyes, and stretch receptors in muscles and joints) are not agreeing with each other: the eyes say there is movement, while the ears and stretch receptors do not. People with a personal or family history of migraine or migraine-associated phenomena such as car sickness or vertigo are more susceptible to these effects.

The most well-known response to flicker was the Pokemon cartoon incident. Episode #38, originally broadcast in 1997, included red and blue flashes at 12 Hz for about 5 seconds. This caused convulsive epileptic seizures violent enough to create emergency services calls in 685 children, most of whom had no previous seizure episodes. The Japanese government responded by setting new guidelines with maximums of 3 Hz and 2 second duration for any flashing images on screen (8).

While the annoyance factors are obvious, yet subjective, other medical factors are measurable. Photosensitive epilepsy is triggered when the visual disturbance is within certain frequency ranges. Older model turbines generate flicker at about 1.1 Hz, which is outside the boundaries of photosensitive epilepsy (although is still may cause nausea and migraines). Newer turbines, however, can generate disturbances of 2.5 Hz, which can cause epileptic seizures and neural dysfunction in people who are susceptible.

Calculating Flicker Areas

While some wind developers tout a flat distance (usually 10 rotor diameters) as a radius, the best calculation of seasonal timing and duration of flicker effects uses computer software to accurately calculate amount of shadow per year in the area around the tower. The relevant data points are the latitude and longitude of the site, used to create a shadow map. This map will clearly outline affected areas by distance and direction from the turbine. Any properties which may potentially be affected can be identified and the risk calculated.

For purposes of zoning, it may be sufficient to create one shadow geometry for the center of the Town of Bethany and use it as a guideline for all areas. A map generated online showed a maximum distance of about 1,8000 ft for noticeable flicker . (9)

Reducing Flicker

Wind turbines can be painted by the manufacturer so that they blend with the natural environment. In most cases turbines are painted gray so that they will blend well with the skyline, but some are also painted green or are two-toned. Other turbines are manufactured with a galvanized metal so that the metal will weather and turn gray naturally. Zoning can require the turbine to be painted with a blending color that is non-reflective in nature, removing Reverse Flicker effects altogether.

One of the simplest and most controversial ways to reduce shadow flicker on an existing turbine is to plant tall vegetation in the shadow path. This overrides the flickering shadow and provides relief from its effects. However, many property owners object to this strategy as they desire sunlight on their home and/or yard.

Installing special controllers on the turbine which automatically turn it off during peak times is a common and reasonably inexpensive solution, but one that must be pressed by the town and/or landowner to be implemented (1).

Moving the turbine is the most expensive option and one that is nearly impossible to effect without strict zoning laws. Proving the annoyance factor of flicker is difficult as it is often viewed as a subjective determination and property owners are typically asked to sign "hold harmless" clauses with the wind developer, preventing many suites from coming to court.

Zoning Precedents

The most effective way to reduce flicker effects is to zone them away from residences, schools, churches, libraries and places of business prior to construction, via materials requirements and setback requirements. Some communities also take care to prevent flicker from distracting drivers on the road. Irish guidelines state that due to the height and movement of wind turbines, the towers should be set back from the road by up to 300 m (990 feet) depending on circumstances (6). A report by the Michigan State University Extension suggests that a shadow flicker study be commissioned and included with each tower permit application (6). In any case, it is recommended that turbines be limited to a flicker frequency of 3 Hz or less, regardless of whether a residence is affected (4).

References

(1) Berkshire Today, PowerGen Renewables vs Cumbria residents, 2004.

(2) Western Morning News, Plymouth GB, January 6, 2004.

(3) Health, hazard, and quality of life near wind power installations: How close is too close? by Nina Pierpont, MD,PhD March 1, 2005
http://www.responsiblewind.org/docs/wind_turbines_and_health.pdf

(4) Photosensitive epilepsy - other possible triggers by Professors g Harding (Aston University, England) and S Seri, 28 October 2005
http://www.epilepsy.org.uk/info/photo_other.html

(5) Good animated image at http://www.windpower.org.en/tour/env/shadow/index.htm

(6) Land Use and Zoning Issues Related to Site Development for Utility Scale Wind Turbine Generators, Michigan State University Extension, January 2004
http://web1.msue.msu.edu/cdnr/otsegowindflicker.pdf

(7)http://www.brucecountry.on.ca/download/Wind-Farm-Requirements-ZBA.pdf

(8) http://faculty.washington.edu/chudler/pokemon.html

(9) http://www.windpower.org/en/tour/env/shadow/shadowc.htm

Editor's comment: *Flicker vertigo and vertigo are two different phenomena. The latter is variously defined as* "an illusion of movement, a sensation as if the external world were revolving around the patient (objective vertigo) or as if he himself were revolving in space"(subjective vertigo)...see On-Line Medical Dictionary, University of Newcastle upon Tyne), *and is fairly well understood, it's etiology having a*

variety of factors chief of which are pathologies in the middle ear, or actual lesions in the Vestibulocochlear nerve or Medulla Oblongata (Clinical Neuroanatomy for Medical Students, ISBN 0-7817-2831-2, p213, p361). *Flicker vertigo is so rare it's difficult to find a good reference in the standard medical literature (neither the above references nor Medline's On-Line Medical Dictionary, nor Mosby's Medical, Nursing, and Allied Health Dictionary, have it). Nonetheless it is well documented and has been experimentally studied in the psychology laboratory. It is relatively well-known by experienced helicopter pilots. One definition is* "A steady light flicker, at a frequency between approximately 4 to 20 Hz can produce unpleasant and dangerous reactions in normal subjects, including nausea, vertigo, convulsions, or unconsciousness. The exact physiological mechanisms are unknown" (United States Naval Flight Surgeon's Manual: Third Edition, 1991: Chapter 9: Ophthalmology). *The key here is the frequency of the light source, with a lower bound of 4 cycles per second. An industrial turbine turns at about 20 revolutions per minute, and since there are three blades the frequency is 60 cycles per minute, or one cycle per second, i.e. a factor of four lower even than the lower bound said to induce flicker vertigo. Ms. Gross states above that "Newer turbines, however, can generate disturbances of 2.5 Hz, which can cause epileptic seizures and neural dysfunction in people who are susceptible".* ***There is absolutely no credible reference in the medical, scientific, legal, or other peer-reviewed literature that wind turbines have ever caused anyone to have an epileptic seizure.*** *One notes that VFR helicopter pilots flying into the sun really have no choice as to whether they look out the window or not. Someone near a wind turbine isn't under a gun to keep staring at it...if looking at it is unpleasant, they will simply turn away. Same goes for shadow flicker.*

- **Interference with any form of electronic or electromagnetic communication**
  To be addressed by the editor forthwith.

- **Esthetic impact - quality of life**

Submitted by Paul Lewis, reproduced unedited

Loss of Property Use and Esthetic Impact - Quality of Life

One of the controversies over wind turbines is the massive size and placement of these structures and how they may change your lifestyle. How would you like to go out of your front of back door and have a 450 tower staring you in the face or have numerous people stopping by questioning the wind turbines? This would be part of the lifestyle change you would have to make. The placement of these towers in Bethany is proposed to be as close as 1000 ft from property lines and other residences. When you look over the rolling hills of Bethany you may see a farmers silo or two, which in most cases are less than 100 feet tall and are part of the agricultural district we live in. What if you looked over the rolling hills of Bethany and now you see up to eighty 450 foot towers. This would definitely take away from the esthetics of the countryside. In many cases the people who live in the agricultural/residential sections of these towns moved there to get away from the city hustle and bustle. After my trip to Wethersfield and the committee's trip to Tug Hill it became very apparent these things will never blend into the rural country setting like farm buildings/silos do.

When wind towers are placed in line with residences then you start to lose your quality of life. Some of these issues are the low frequency noise, flicker effect, loss of TV (antenna), cell phone and satellite cable reception. Low frequency noise is generated while at various speeds. The noise is not always present but there is definitely times when the noise is very noticeable. As you will see when you read the attached article, if the proper precautions are not taken during the planning stages then the land owner may pay the price by having to keep their doors and windows shut and also by not going out of doors for a peaceful evening due to the noise. See noise article in the attached article by Nina Pierpont, MD, PhD dated March 1, 2005.

Another problem is the flicker effect. When the turbines are placed so that the wind turbine is between the sun and the residence at some period of time during the day or night; there will be a strobe effect at the residence on the opposite side of the turbine as the suns rays pass through the rotating turbine blades.

Again, when there is poor planning this flicker may cause health hazards to people who are epileptic or who have a very low tolerance to shadows. Again, please see Flicker in the attached article by Nina Pierpont, MD, PhD dated March 1, 2005.

It has been noted in several cases that there is a loss of TV and Cell phone reception due to interference from the rotating turbine blades and also the tower itself. During our trip to Tug Hill it was noted during my video taping that when the camera was pointed in the right direction there was interference on the video tape. This is the same type of low frequency noise that causes interference with cell phones, TV antennas and satellite TV reception.

The other issue is the continuous traffic that is brought in with people questioning the wind turbines, just like we and every other towns people have done at Wethersfield and Tug Hill. I know several people are getting tired of people always coming around asking questions.

- **Wildlife effects**
- **Ice throw**

The following report was submitted by Loy Ellen Gross and is reproduced here unedited.

Ice Throws

Definition

Ice throw occurs when condensation from the air or naturally occurring precipitation collect on the turbine blades and freeze. Thin sheets of ice form along the length of the blade, with larger "ball-like" chunks created at the tips.

Effects of Ice Throws

In Minnesota, 2002, a maintenance worker preparing to ascend the turbine was cut in half by a falling sheet of ice. There are reports too numerous to count of automobile damage due to falling lumps of ice - usually described as about the size of tennis balls.

Damage has occurred as far away as 80m (264ft), including smashed windshields and windows; dented cars and roofs; and accidents on roadways (cars hitting large chunks of ice lying in the road, not ice hitting cars).

These incidents are pulled from a fairly complete list of wind turbine accidents from the late 1990's to present, compiled by Caithness Wind Farms in the UK. This list is available online (5). It is 17 pages long and includes at least 20 accidents per year since 1999.

Mitigation

Wind turbines can be equipped with ice-resistant mechanics - both in terms of the materials used to construct the turbine and additional electronics added to prevent spin-up in the event that ice forms. However, independent tests have not been completed on either of theses solutions. Given the liability issues, it is desirable to use tested or guaranteed mitigation. The only known guaranteed mitigation is setback.

My first finding is that zoning ordinances vary widely in which physical (property) setbacks are required or even mentioned. Most (if not all) ordinances include distances from residences and property lines, while others include these plus roadway, right-of-way, livestock barns and pastures, and others listed below. Obviously, not all communities measure the same types of setbacks and some clearly place more value on livestock and outbuildings than others. I have grouped together definitions that appear to be set for the same or similar reasons.

1) Roadways / Right of Ways / Utility Elements / Buildings / Storage Barns: this setback is typically based on the belief that ice throws or high-voltage electric fields may interfere with traffic or the activities of persons not related to the project; or damage property. A team of German scientists have put together a simplified equation for calculating that risk (1), d = (D + H)*1.5, meaning add the diameter of the rotors to the hub height (tower height), then multiply that number by one and a half. With the proposed 3.0mW turbines, that means (240' + 330') *1.5 or 855 feet. Because the German scientists designate this as a rough calculation and recommend further local studies to determine the exact conditions in a given area, some communities are adding a 10% margin of error (which would make our calculation 951ft.)(8).

This setback is normally not applied to the access roads built by the wind company for the purpose of erecting, maintaining and decommissioning the turbine itself. In reading various town and county ordinances available online, it is not clear whether the setback applies to established public trails or snowmobiling paths (most likely this information is found in the communities' base zoning definitions, which are not included in the turbine document). In only one Minnesota document was i able to find a direct reference that snowmobile and walking trails were specifically included (that was a proposal from a wind turbine company, not a zoning paper). Given that, in New York, snowmobiling paths are created, mapped and maintained with public money, they might be something the town would like to consider including in any right-of-way setbacks.

Zoning Precedents

References

(1) Michigan State University Extension: Community Development and Natural Resources Studies (German study regarding risk from ice throws)
http://web1.msue.msu.edu/cdnr/icethrowseifertb.pdf

(2)National Wind Energy Association Siting Guidelines
http://www.nationalwind.org/publications/permit/permitting2002.pdf

(3)American Wind Energy Association Small Wind Turbine Siting Guidelines (This is a small turbine document; I have seen it applied to larger turbines, but could not find the reference again when I looked)
http://www.awea.org/smallwind/documents//permitting.pdf

(5)Caithness Wind Farms Accident Report
http://www.caithnesswindfarms.co.uk/Downloads/Accidents%20-%20June%2030%202005.pdf

(8)Michigan State University Extension: Community Development and Natural Resources Studies (Application of German Study to zoning)
http://web1.msue.msu.edu/cdnr/otsegowindicethrow.pdf

Editor's comment:

The spectre of ice throw is one of those "hot button" issues relating to wind turbine installation. There are plenty of anecdotal reports. I personally find the report of someone being cut in half by a falling sheet of ice hard to swallow, and can find no reliable reference. At the scene of fatal accidents involving high speed collisions, one rarely encounters severed bodies. The kinetic energy per unit mass is usually insufficient, unlike the case for airline crashes, where the impact velocity is several times greater, and the kinetic energy greater by the square of that.

The meteorological conditions necessary for the formation of ice on turbine blades are rare in our location. Contrary to popular belief, water does not always freeze at zero degrees Centigrade. Absolutely pure water can be cooled far below that, until what is termed homogeneous nucleation occurs. Skipping the thermodynamics, one does often find liquid water drops at temperatures as low as -40C high up in Cirrus clouds (Heymsfield and Miloshevich, Journal of the Atmospheric Sciences, Vol 50, issue 15, August 1993). *If one of these"supercooled" droplets impacts an airplane wing, the wing metal provides a substrate for the ice crystal lattice formation, and the drop freezes*

instantly. In the lower atmosphere, ice nuclei from automobile exhaust (lead iodide) are copious and this process is rare. Ice can form during "ice fogs", when supercooled fog droplets contact anything (grass, cars, turbine blades, etc). Such fogs however form only when the air is very calm, and the turbine blades are still. If the ice has already formed and then the wind picks up, the blades will turn much slower than normal or not at all, depending on the design and built-in safeguards. The other germane meteorological situation is wind and freezing rain. That happens when raindrops in above-freezing temperatures aloft fall into a surface layer of below-freezing air. The drops do not freeze (except in extremely polluted air with copious ice nuclei, as in the Lincoln Tunnel) at first but do become chilled to less than zero degrees Centigrade, ie they become supercooled. Then they freeze on contact when they land. This is the so called "ice storm" which is uncommon here. Again, the blades will turn slower due to the greatly increased aerodynamic drag on the turbine blades, or not at all if appropriate shut-down mechanism are designed into the machine.

We next assume for the sake of argument that ice has managed to form on the turbine blades, that the aerodynamic drag of the blades is not increased (in reality not possible) and furthermore that no shut-down or slow-down mechanisms are in place, and the blades continue to turn at their maximum rotational speed. We ask, how far, theoretically, could the ice be thrown? To do that would require detailed knowledge of the shape of the ice fragments, and a supercomputer. It has never been done. However, one can obtain an idea of the ***maximum*** *distance the ice could be thrown, by calculating it's trajectory in a vacuum, where air drag can't affect it. The calculation is straightforward and requires only high-school mathematics and physics, albeit a bit lengthy. Sparing the reader that derivation, one can show that the maximum horizontal distance D from the base of a wind turbine with hub height H and blade length R (or one half the rotor diameter) that the ice would be thrown in a vacuum is given almost exactly by*

$$D = (1/2)(2*(1/2))R + (V*2)/2G +$$

$$V/(G*(1/2))[(V*2)/4G + (1 - (1/2)(2*(1/2))R + H]*(1/2)$$

*where the asterisk denotes exponentiation (3*4 means 3 multiplied by itself four times), where* V *is the speed at the blade tip, and* G *is the acceleration due to Earth's gravity. [The maximum throw obviously is from the tip, where speed is greatest. The equation is valid for any radius less of course]. Assume the same dimensions as above for the 3.0 MW machines proposed for Bethany, that is,* **H** *= 330 feet or about 100 meters, and* **R** *= 120 feet or about 36.7 meters. Assume also that the blades have no controller and are spinning at their maximum rate of about 20 revolutions per minute. That would give a tip speed* **V** *of 77 meters per second or about 172 miles per hour.* **G** is given (by God) at about 10 meters per second per second. Keeping our units and dimensions straight and putting these values into the above equation, we get

D = 743 meters = 2438 feet

So that's where the phrase "turbines can throw ice up to half a mile" probably comes from. We know that that is nonsense because we are not in a vacuum, nor would the blades turn if we were. ***However,*** *our equation is not quite completely useless. Not only does it give an upper bound, physically possible limit in a vacuum, it can also be analyzed term by term to see the relative importance of the variables determining that maximum-possible throw distance. In the first term, note that the blade length is just to the first power, that is, if the blade length were doubled , the throw distance would be doubled, all other things being equal, <u>if that were the only term in the equation...but it isn't</u> . The blade length appears in the square bracketed expression in the third term, again to the first power, but the whole square bracketed expression is raised to the one half power (square root), so the dependence is even weaker. By far the variable with the strongest influence is the tip speed, since that appears in both the second and third terms to the second power, ie the square of the tip speed. But that speed is limited to about four times the wind speed on the basis of aerodynamic considerations far beyond the scope of this note. Finally we turn to the tower height, or alternatively the hub height. Note that it also appears in the third term, in the third sub-term in the square bracketed expression, to the first power. But the bracketed expression itself is raised to the one half power, so the dependence on hub height is weak even if it were the only term in square brackets, which it is not. But it's very illuminating to see what would happen to the throw distance if, all other*

*things being equal, the hub height were **doubled** to 200 meters, or a ground-to-blade-tip height of **777 feet !** Plugging in the numbers, one is surprised to find that now*

D = 813 meters

In other words, even in a vacuum, doubling the tower height only increases the throw distance by less than 10 percent! So the dependence on height is very weak, and would be even weaker if one included aerodynamic drag in the calculations. This is mentioned because many people are frightened by the sheer size of these machines, which admittedly can be very intimidating when viewed close up for the first time by the uninitiated.

*Let's wrap this up by abandoning the theoretical stuff and having a look at what has been observed in the real world. The study most cited in this respect is **Risk Analysis of Ice Throw From Wind Turbines** by Henry Seifert, Annette Westerhellweg, and Jurgen Kroning, presented at BOREAS in Finland, April 2003 (these are the same "German scientists" responsible for the equation d= 1.5(D+H) mentioned by Ms. Gross in her analysis above, although she does not include their original paper in her list of references). They plotted the throw distance of ice pieces observed versus radius, and also included the weight of the ice pieces (page 2, figure 2). They observed only three pieces heavier than 1 KG (2.2 pounds), hardly heavy enough to sever a human body, and more importantly, the farthest throw distance they observed was less that 125 meters or 410 feet. This emphasizes the ridiculousness of calculations in a vacuum, and also the ridiculousness of requiring a one-mile setback based on fears of ice throw. Seifert et al did make a guesstimate as to the risk of a person being hit (not necessarily fatally) by ice from a turbine as follows (page 8):* "If 15,000 persons pass the road close to the wind turbine per year, there might be one accident in 300 years".

It should be noted here that the same physical principles discussed above also apply to the throw of pieces of turbine blade which might become detached (by perhaps a lightning strike), as long as they are small compared to the blade itself. In that case the relevant radius to use would be the distance from the hub at which they detach. If a blade tip detaches, obviously it's the same **R.** *If the pieces are a significant fraction of the entire blade (say, one third), the physics is more complicated, since the free-flying piece is both translating and rotating due to it's inherent angular momentum before detachment. However, in this case the throw distance would be even less: the detached piece will be rotating about it's center of mass, which itself is following a similar parabolic trajectory (in a vacuum) but smaller in amplitude, having an effective radius significantly less than that of the entire blade.*

- ## Siting and placement issues

The following report was submitted by Jim Hinkson and is reproduced here unedited.

Bethany Wind Turbine Committee report on turbine sites and avian concerns. Other related topics are covered by separate reports from the Committee.

Our committee was formed and research on wind turbines commenced in March, 2006. Our conclusions are based on literature, both pro and con, guest speakers and, visits to Weathersfield, Fenner, and Maple Ridge farms. Our thanks also go to the wind turbine crew that allowed us to inspect the Maple Ridge turbines from both inside and out. Thanks too, to the residents living near these wind farms that took the time to share their experiences with us.

Location...location...location...is the key to determining the best-for-all placement of wind turbines. Location or more specifically, the distance wind turbines are placed from residential areas may or may not mitigate some of the issues and/or problems reported with wind turbines.

Depending on personal opinion and lease holder status, wind turbines may have a place among current green energy options, but the placement of approximately 35 to 80, 450' towers in the residential area(s) of Bethany, NY is not recommended. Turbines do not make good neighbors (1). If the Planning Board or Town are of a different opinion, then we strongly recommend a minimum
one mile setback from all residences and, the placement of each turbine to be unanimously approved by the Town, land-owner(s), abutters, and neighbors within the view-shed, not just the lease holders and the wind

development company which in our case is UPC. As UPC reported to the citizens of Stafford, NY, when properly sited, wind-power provides an overall net benefit to the natural environment and, UPC will work with land-owners to site turbines in locations with the least impact on the landowners existing and future use(5). Again, we recommend that UPC include the Town and all other "neighbors" affected by the placement of the turbines.

The recommended one mile setback is greater that some and less than others. For example, in Pavilion, NY the set back from residences is 1,000' Perry and Cohocton, NY set 1,500'. In France, the National Acedemy of Medicine recommended that due to significant health hazards caused by turbine noise and infrasound, a moratorium be placed on all construction within a 1.5 km radius (2). The U.S. National Wind Coordinating Committee recommends 1/2 mile from any dwelling (3). German marketer RETEXO-Rise specifies turbines not be placed within 2 km (1.24 miles) of any dwelling. WOW, (We Oppose Wind farms), cites health issues as the reason they recommend 1.5 mile setbacks in any ordinance written to allow wind farms. As wind turbine sizes have grown, siting concerns have become more commonplace especially in areas of higher population (4).

With regards to turbines being considered near the Bethany Airport, the Federal Aviation Administration defines an obstruction to navigation as being 200' or taller above ground level and within three miles of a runway length > 3200' (7).

UPC reports that "siting" is the key to mitigating the disruption of migrating birds. UPC said they *(have)* extensive studies to ensure that an area does not have a high concentration of migrating birds (6). We recommend the research company be of our choice, at UPC's expense, and the study completed prior to any turbine installation. There will be bird kill. In the Maple Ridge - Tug Hill wind farm, a few local people have been hired to collect and dispose of the dead birds found near the turbines.
Wind turbines are relatively new to our area and the information provided herein is based on other people's experiences with smaller turbines. Unfortunately, the 450' turbines proposed for Bethany have never been installed anywhere before. New clean, safe and "green" technology may be right around the corner. Or a report due out in November, 2006 from the U.S. National Research Council (NRC) addressing the same concerns we have may help decide the future of turbines in Bethany (8).

In closing, the Town of Eagle, NY recently went through a process similar to our own. Their Town Supervisor, Mr. Joe Kushner met with us to share his experiences. Mr. Kushner explained how turbines will benefit his Town and expected the developer to agree to all of the Town's conditions. However, Mr. Kushner pointed out that our situation is different because the turbines for Bethany are being proposed near residential areas. Not so, or to the same degree in Eagle. Mr. Kushner recommended that either way, the committee come to a consensus and if we are not comfortable with turbines in Bethany, don't do it. At this time, we are not comfortable.

Editor's comment: *The situation in France must be considered in the context of the financial/political realities there. France leads all nations in the fraction of it's electricity generated from nuclear energy (75%!). In spite of and apart from the very significant and as yet unresolved problem of waste disposal, the nuclear industry in France is so well ensconced in the national economy that alternate forms of energy generation such as wind are not accorded the same potential future importance as they are in more forward-looking countries such as the United States. The conclusion of the French National Academy of Medicine that turbine associated health hazards mandate a 1.5 km setback is not universally accepted.*

LEGAL

- **Set backs - residential - farm - park - roads**

- **Zoning**
  To be addressed forthwith by the Town Planning Board

- **Contract control - landowners - town**
- **Owner guarantee issues**
- **De-commissioning issues**

This report was submitted by Paul Lewis and is reproduced here unedited

Windpower De-commissioning Issues

There are many issues that require investigation when a project of this magnitude is in the engineering and planning phases. One of the major issues with wind turbines is the de-commissioning of these units whether it is at the end of their service life or the unit is out of commission due to not being profitable. Should the town decide to allow wind turbines to be placed in the Town of Bethany the following issues should be addressed within the contract:

Who is responsible for the removal of these units? The committee suggests the town have a clause written into the contract that states the owner of the turbine(s) be responsible for all costs in the removal of the turbine(s) and restoration of the property where the where the wind turbines are (were) located. The wind power companies shall also be responsible for the restoration of the town, county or state property that may be affected by the de-commissioning. These issues and costs should be addressed in the contract along with a bond in the name and held by the town. This bond should also have an annual escalation clause that raises the bond by the rate of escalation for each year.

At what degree will the property be restored? The contract should read that the property is to be restored to the same condition as it was prior to the erection of the wind turbines, including the removal of the buried concrete used as the substructure. Based on another town's responses and investigation everything would be removed from the site including the concrete but only within the top two feet of the surface. This doesn't seem acceptable and the complete concrete structure should be removed due to possible future development within the town.

What will happen with the overhead and buried underground transmission lines during de-commissioning? Again we suggest a written agreement by generated and agreed to by the landowner and town which includes who will be responsible for the costs of removal and restoration of the property. Again, a bond with an annual escalation clause would be required to address this issue.

The committee asked UPC the following question about de-commissioning a unit:
If a wind turbine is placed on the landowners property and is not producing or has not produced for several months for some reason what would UPC do? Remove?

UPC's answer:

Yes, we would, and often town codes stipulate this. We would be interested in speaking further with you regarding our experience with towns that have produced wind code. The town of Cohocton is one such town. I think our ideal picture would be to work with Bethany to develop a code that works for Bethany and for the wind farm. There are quite a few precedents out there. Please take a look at the following link from NYSERDA for a start. This was especially developed for towns and communities and includes examples of wind codes from other New York towns.
http://www.powernaturally.org/Programs/Wind/toolkit.asp

Along with the above issues the town needs to develop a contract that will cover any and all ownership changes that may take place from the time that the initial contract and turbines are installed until they are de-commissioned. This would include the transfer of the bond money and the annual escalation factor.

If the town were to allow the development of wind turbines then we believe the contracts should be reviewed by several town land owners, not just those who have wind turbines on their property, to assure the right controls are put into the contract.

- **Potential lawsuits**

- **Legal - philosophical - view from Albany**

On June 16, 2006 a conference titled *"Siting Wind Power in New York"* was jointly presented by The Government Law Center of Albany Law School and New York State Energy Research and Development Authority. One of us (RJC) attended. There were three main take-home messages: (1) Wind energy is becoming increasingly competitive with other sources (2) Whether or not a town or local government is pro or con, New York State is committed to developing wind energy. If development lags behind state expectations, it was strongly implied that steps will be taken to ensure it. For example, declaring industrial wind farms to be public utilities. (3) Town and local governments, whether pro or con, are strongly advised to get the best lawyers they can afford when dealing with wind development companies, since the latter will surely have them.

FINANCIAL

- **Effect on property values**

The following was submitted by Francis Ashley and is reproduced unedited except for grammar.

As of the date of this report the effect on property values is far from clear, in our visits to other towns that have turbines installed. The property values in towns with turbines have increased, and conversely for property that does not have turbines in the immediate area, the picture is far from clear. We have reports of property owners trying to sell their housed and not being able to *sell because of the possibility of turbines being sited in the vicinity.*

However because of relatively little hard data on this subject, the committee believes it is much too early to make a definitive statement on this topic, regardless of what the wind development companies would like us to believe.

Editor's comment: *Mr. Kushner (personal communication) informs us that since the Town of Eagle has signed a contract with Noble Environmental to install an industrial wind farm, no town property is up for sale.*

- **PILOT - approach of other towns**

When one walks through woods and field, one observes patterns in nature that often parallel the affairs of humans. For example, when an animal dies or is killed, that carcass is a source of meat, i.e. energy, for other creatures, who will compete to get it. The smartest and/or strongest succeed. If an industrial wind farm were to be installed in Bethany, the revenue generated would be of an unprecedented magnitude. The turbine company itself of course would like to take the bulk of that money, and give back to the community as little as they can arrange for. Companies have offered two or three thousand dollars per megawatt per turbine per year. The economic situation at this time (December 2006) is such that an offer of anything less than $8,000 means the community will be shorted. But the company isn't the only entity out there which can "screw" the town. PILOT (payment in lieu of taxes) agreements are often touted as the means to a fair distribution. For example, some counties in western New York, working through their respective IDA's (industrial development agencies), have realized roughly the following distribution: The county: 40%; the school district: 30%; and finally the town: 30%. But each county is different: in

Livingston county, the county gets 30%, the town 12 to 18%, and the schools 52 to 58%. Thus the Town of Eagle posed the following question: How many new school students result from the installation of an industrial wind farm? Essentially none, of course. That being the case, they asked, "Why should the school district get the bulk of the money?" In fairness, they shouldn't. Convincing the Wyoming County IDA of the wisdom of this approach, Eagle was able to arrange a licensing agreement (between the turbine company and the town), whereby the Town, *prior to the PILOT payments kicking in,* gets 80% of the wind-generated revenue up front. The *remaining* 20% then goes into PILOT, and that portion is divided as follows: the county: 30%; the schools: 40%; and the Town: 30%. So by this method the town of Eagle receives 86% of the wind generated revenue. Needless to say this arrangement is highly satisfactory to the town fathers. This is a new, unprecedented development, and may well become a model emulated in the future by counties in New York State developing wind energy. No doubt the Bethany Town Board will take note of this situation, as well as the Genesee County Planning Board and IDA.

- **Payments to landowners**

The following was submitted by Paul Lewis and is reproduced here unedited.

The installation of wind turbines and the requirements to install high voltage transmission cables both above and below ground would require Right of Way permission from the private landowners and possibly that of the town and state for the use of their land. There is also the issue of restoring the property to its original configuration after the underground or overhead transmission lines are installed. The committee contacted UPC about this requirement and UPC stated they would pay the landowner a Right of Way payment for the use of their property. There was no mention as to how much that payment would be but it would be based on a case by case basis. We suggest the town provide payment and restoration guidance to the landowners and/or include the payment structure into the UPC/town contract. Although there are several other towns in the area that are reviewing turbine development in their own towns we were not able to get any information on this topic.

- **Depreciation and Financial Effects**

The following was submitted by Loy Ellen Gross on March 02, 2006, and is reproduced here unedited

Town of Bethany
Bethany Center Road
East Bethany, NY 14054

Re: Wind Farm Depreciation and Financial Effects

To whom it may concern:

To begin with, I would like to make it clear that I am neither a lawyer or an accountant, merely a concerned homeowner. But I have been looking into the financial operations of commercial wind farms and have learned several things that I would like to share with the town. Wind developers quickly see handsome profits, while many communities and property owners see little of nothing in the way of tax revenue - even when taxed - due to state and federal tax shelters which are provided to the industry.

Depreciation

In particular, developers can recover their capital investment very quickly, because wind energy facilities are eligible for "five-year double declining balance accelerated depreciation" for federal income tax purposes (1). In an example $500,000,000 wind farm (the approximate cost of a 480 MW farm), UPC Wind Partners can recover the entire investment through depreciation charges to offset income tax liability in just six years (1).
In order to benefit from tax shelters, the wind developer must have income. For this reason, many wind farm developments consist of two or more small companies. One company will develop the wind farm and then sell it to

the partner company, using the income for depreciation and presenting an entirely different company for the community to deal with. This is true even of UPC Wind, which typically partners with an affiliate company right from day one (3).
Due to these unique tax situations for wind farms, there is a great incentive for wind farm owners to abandon these projects one the five to six year term of tax credits have dried up, forsaking their projections and promises of twenty- to thirty-year life expectancies for the project.

Follow the Money

At the"informational meeting" in June 2005, Chris Swartley presented a few hard numbers on the proposed project. UPC Wind intends to build between 30 and 40 turbines in the Town of Bethany. Forty is about all they can fit and less than thirty would not be worth their time. For the purposes of our calculations, we will the average, or 35 turbines. They are to be GE 3.5 MW turbines, a model just barely on the market, with a quoted price tag of $2.6 million each.

Now, some numbers we must quesstimate based on current and completed wind turbine projects. Landowner payments can be as high as $10,000 per year, but are somewhat less in rural areas. The rural range is $2,500 to $5,000. We'll assume the high number of $5,000 (7) or $174,000 for the entire project.

Wind farm developers acknowledge that wind electricity costs more that traditional electricity - a cost that is ultimately passed on to the consumer. (Note that we are not talking about the SBC credit - that money is used to fund wind developer's preliminary studies). Let's take a conservative number: two cents more per KWH (8). If the Bethany wind turbines generated electricity 100% of the time, they would produce 1,073,100,000 KWH annually. However, experts acknowledge that wind turbines only produce about 30% of their rated capacity due to lack of wind and other factors, which make the annual production 321,930,000 KWH.

Electricity from wind turbines therefore cost consumers an additional $6,438,600/year - with only $175,000 of that going to the landowners, or a net $6,263,600 loss for the community.

Not only will consumers pay via higher electricity costs, but also through federal tax dollars. Wind farm developers are eligible for a federal Production Tax Credit of $0.017 per KWH produced during the first ten years of the project. If the wind turbines generate the 321,930,000 KWH listed above, wind farm owners will receive an additional $5,472,810 in tax credits.

The upshot: while Bethany landowners will receive $175,000 in payments, $11,736,410 in electric fees and tax credits will be heading to Massachusetts.

"Grassroots" Green

Many wind power producers try to sell their product on it's environmental advantage - fewer emissions for our atmosphere. Yet even a quick analysis of their profitability leads us to more likely motives for large corporations to be involved with such projects. A simple revenue vs. expenses comparison nets us these numbers for the first year:

Costs:	
35 GE 3.5MW turbines:	$91,000,000
Annual Maintenance (first ten years):	$7,000,000
35 Landowner Payments:	$175,000
Tax Credits:	
Federal Production Credit:	$5,472,810
Federal MACRS Depreciation Credit:	$18,000,000

Sales:	
321,930,000KWH x $0.05(9)	$16,096,500
Total:	-$58,605,690

Extrapolating over the six year MACRS deduction gives us:

Costs:	
35 GE 3.5MW turbines:	$91,000,000
Annual Maintenance (first ten years):	$42,000,000
35 Landowner Payments:	$1,050,000
Tax Credits:	
Federal Production Credit:	$32,836,890
Federal MACRS Depreciation Credit:	$91,000,000
Sales:	
321,930,000 KWH x $0.05 x 6 yrs.	$96,597,000
Total:	$86,365,860

Zoning Suggestions

While a community cannot zone for lost profits and tax dollars, I have located a number of suggestions made by and for communities to zone such that at least some funds remain local.

1. First, it is recommended that towns do not attempt to override state tax shelters for wind farms, as they will have limited "on the books" income. Instead, negotiate fixed annual payments to the community in lieu of taxes. The Weathersfield Project, a much smaller farm, negotiated annual payments of just over $30.000 to the community, school board and other local agencies, funding which has been used to improve roads and other institutions. The Fenner project is based on MW produced and may (or may not) add up to as much as $150,000 annually (5).

2. In relation to the lifespan of the project, it is recommended that any "annual" payments, whether made to individual property owners or community agents, be contracted for a specific number of years and placed in escrow. Most ordinances are settling on 10 years as a compromise between the 20 years the developers are promising and the five to six year term of the bank loans and tax credits. This prevents the developer from abandoning their financial responsibilities along with the project when the tax credits dry up. (4). Ten years also tends to be a common length for electricity purchasing contracts, which makes the developer comfortable with that number (6).

3. With respect to the depreciated value of the structures over time, it is recommended that insurance covering full replacement value (not actual cash value) be required for the wind turbine during its entire production cycle. Should the structure be damaged after depreciation, any insurance policy which does not cover full replacement cost will likely leave the town and residents with an eyesore.

4. With respect to the expected sale of the wind power facility to an affiliate company, it is strongly recommended that contracts are worded so that any financial and community burdens of the parent company (original developer) are passed unchanged to any and all subsequent owners of the wind facility.

All of these requirements are most effective when added directly to zoning ordinances. I hope that you find this information useful and welcome your comments and criticisms on how I could be of better help. Thank you for your time.

Sincerely,
Loy Ellen Gross

Editor's note: Mr. Kusnher informs us that he would like to address the above analysis in the near future.

- **Employment issues during and following construction**
- **Why only one company interested in Bethany?**
- **Success of wind power in other countries - trends**
  To be addressed by the editor forthwith.
- **Back-up power issues**

RECOMMENDATIONS

Note: written Aug. 02, modified only as noted by editorial comment, on 01/08/07

The following recommendations are current as of Aug. 2, 06 and subject to change, bearing in mind the dynamic nature of this issue. Although UPC is specifically mentioned, they are to be applied to any entity intending the development of industrial wind turbines in the Town of Bethany.

- For any Bethany resident whose TV, cable, cell phone, or any other form of electromagnetic or electronic communication which is in any way adversely affected by industrial wind turbine installation, we recommend the responsible entity, in this case UPC, restore such communication to pre-installation quality.
- Extant maps provided by UPC so far to the WTSC do not give confidence that turbine siting will not have significant negative impact to a number of the aforementioned issues. Therefore we recommend the Town make the decisions regarding turbine siting in Bethany.
- It concerns us that, relative to the approach taken by other wind-turbine-development companies in nearby towns, UPC has not in our considered opinion been as forthcoming as per providing information regarding relevant issues. We recommend that UPC correct that.
- We are aware that Noble Environmental, which is now developing an industrial wind farm in southern Wyoming county, has provided a pro-forma statement to town officials. According to our information, UPC has indicated such a statement would not be provided since they maintain it would compromise their competitive posture. We nonetheless recommend UPC provide a pro-forma statement.
- We recommend UPC offer Bethany *no less* monetary compensation than any other nearby town, up to and including that equal to full property assessment.

Editor's note: *Based on his experience with the contract garnered with Noble Environmental to place a turbine farm in the Town of Eagle, Mr. Kushner's opinion is that unless a town receives at least $8,000 per turbine per megawatt per year in revenue generated by the farm, the project is not worth doing. Regardless of setback, the turbine farm will have significant impact, esthetic at the least, for decades on the town.*

- Since UPC is intending to install 3.5 megawatt, 450' high turbines, and consonant with the setback requirements for such large turbines in the UK and Finland, we recommend a minimum setback of one mile.
  Editor's note: *If the etiology for this setback is concern to protect people from ice throw, it is unnecessarily restrictive. Since the greatest distance ice has been observed to be thrown is less that 125 meters, a setback of a quarter mile (402 meters) would be plenty to protect from ice.*

- We recommend any other alternate energy company approaching the Town of Bethany be required to provide information to the same extent as we have demanded from UPC, and that they be subject to the same stringent review by the WTSC and other Town officials.

- We are fortunate in that one Committee member (RJC) is a close friend of Mr. Joseph Kushner, who is the Supervisor of the Town of Eagle, where Noble Environmental is just now beginning the installation of a large wind farm. In view of the dynamic nature of wind-energy development, the potential negative impact of such development, and the fact that the Eagle project will provide us with an unparalleled opportunity to assess such development, we recommend our current moratorium be extended for six months.

Committee members as of Jan. 8, 2006:

Francis Ashley
Steven Breckenridge
Geoffery Briggs
Ramon Cipriano
Jim Hinkston
Loy Ellen Gross
Paul Lewis

Former members:

Dean Lapp
Jim Morris
Jack Woika