Briefing File
Wind Concerns Ontario
Meeting with Minister of Energy and Infrastructure
Hon. George Smitherman
January 24, 2009

Contents:

MAIN LEVELS OF CONCERN

1. The adverse effects of industrial wind on the public's health, well being and safety and environmental impacts on birds, wetlands, conservation areas and shorelines. (Noting the absence of a full environmental assessment for any project to date.)
2. Proper land use regulations such as used for hydroelectric in order to protect rural economies, historic landscapes, quality of life and remove disruptive change from rural to industrial.
3. Economic sustainability. Financial burden on Ontario taxpayers, municipalities, manufacturers and businesses through high costs of wind generated power.
4. How do these developments fit in with Ontario's economic and industrial strategy?

WHAT DOES WIND CONCERNS ONTARIO WANT?

1. That the Province of Ontario immediately put in place a moratorium on further industrial wind turbine development to stay in effect until the completion and public review of a comprehensive and scientifically robust health/noise study of the effects of wind turbines.
2. To establish clear province wide standards and consistent guidelines which thoroughly address the issues of public health and safety, and the impact on the natural, physical, and social environment.
3. To make a commitment to expeditiously correct problems caused by wind turbine installations already put in place without adequate standards, and that you bring together the people who are affected by this new industrial development and the people responsible for it in rural Ontario to help facilitate a transparent process going forward.

1. An Introduction to Wind Concerns Ontario

Formed October 25, 2008 by representatives from a number of Ontario community groups and individuals. This province-wide coalition promotes awareness of the true impacts of industrial wind power facilities on our health, environment, economy and quality of life.

Twenty- Nine Groups and Individuals currently constitute Wind Concerns Ontario:

- Alliance to Protect Prince Edward County
- Amaranth Melancthon (Dufferin County)
- Beckwith Responsible Wind Action Group (Lanark County)
- Blue Highlands Citizen's Coalition
- Chatham Kent Wind Action Group
- Citizens Against Lake Erie Turbines (off shore turbines)
- Coalition of Residents of Tiny Township (Simcoe County)
- Coalition to Protect Amhurst Island (Lennox and Addington County)
- East Garafraxa Group (Dufferin County)
- Essex County Wind Action Group (On shore turbines)
- Friends of Arran Lake (Bruce County)
- Grand Valley (Dufferin County)
- Innisfil Windwatchers (Simcoe County)
- Keep Whitney Wild (Nipissing County)
- Kincardine Windfarm Action Group (Bruce County)
- Lorrie Gillis (Grey County)
- Madawaska Valley Wind Forum (Renfrew County)
- Middlesex Wind Action Group County
- Ontarians for Responsible Wind- Parry Sound (ORW – Georgian Bay Chapter)
- Oxford County Wind Action Group
- Preserve Grey Highlands (Grey County)
- Save the Bluffs (Greater Toronto Region)
- Save our Skyline Renfrew County
- Sydenham Wind Group (Dawn/Euphemia - Lambton County)
- Vestige (Grey County)
- Wainfleet Group (Niagara Region)
- William Palmer (Bruce County)
- Wilno Wind Power Coalition SOS (Renfrew County)
- Wolfe Island Residents (WIRE) (Frontenac County)

Executive Officers:

- Bill Anderson – Chairman
- Colette McLean – Treasurer
- Ann Adams – Secretary
- Beth Harrington – Media Relations
- John Adams – Legal
- Maureen Anderson – Webmaster
- Bill Palmer – Research

2. <u>An Introduction to Spokespersons for Wind Concerns Ontario for this Meeting</u>:

<u>Beth Harrington</u> B. Mus.
Beth Harrington graduated from Berklee College of Music Boston with a Degree in composition. As host writer broadcaster for CBC television for 14 years Beth has interviewed hundreds or personalities, politicians, writers and others. After leaving the CBC Beth moved into production working as producer for The Pamela Wallin show for several years and hosting and co-creating Chatelaine & Company for the Women's' Television Network.

Beth Harrington has worked successfully and tirelessly managing promoting and in some cases hosting large fundraisers and benefit concerts. In her career Beth has run her own music production company, and starred in several music variety shows as well as being an award winning song writer.

<u>Dr. Robert McMurtry</u> M.D. , F.R.C.S. (C), F.A.C.S.

Dr. McMurtry graduated from the University of Toronto in Medicine, and is a Fellow of the Royal College of Physicians and Surgeons of Canada. He has worked in orthopedic surgery in South Africa, Uganda, and Toronto's former Sunnybrook Hospital, where he founded and directed Canada's first Trauma Unit and multi-disciplinary Hand Unit. In 1987 he was appointed Professor and Chair of Surgery at the University of Calgary and Chief of Surgery at Foothills Hospital in Calgary. In 1992 he became Dean of Medicine at the University of Western Ontario. In 1999, as the first Cameron Visiting Chair at Health Canada, he provided policy advice to the Deputy Minister and Minister of Health. Dr. McMurtry is the founding Assistant Deputy Minister of the Population and Public Health Branch of Health Canada. In 2002 he was appointed as a Special Advisor to the Roy Romanow's Commission on the Future of Health Care in Canada, and in 2003 to the Health Council of Canada. In 2003, he received the Presidential Award of Excellence from the Canadian Orthopedic Association. The Royal College of Physicians and Surgeons of Canada gave him the 2009 James H, Graham Award for individuals "whose outstanding achievements reflect the aims and objectives of the Royal College."

Presently Dr. McMurtry is Professor Emeritus of Surgery at the University of Western Ontario and Orthopedic Consultant at St. Josephs Health Care in London, Ontario.

<u>William K.G. Palmer</u> B.A.Sc. P. Eng.

Mr. Palmer has applied experience gained in protecting the environment, and serving public and employee safety in industry (Noranda Mines) and the operation of generating stations (Ontario Hydro / OPG / Bruce Power) to the study of industrial wind turbines. Using background in engineering and risk assessment gained from the University of Toronto and Massachusetts Institute of Technology, and experience in power station operations, environmental assessment and safety risk assessment, he has assessed the risk posed to the public by wind turbines using peer reviewed engineering methods.

In 2007 Mr. Palmer presented a scientific paper to the Second International Conference on Wind Turbine Noise confirming changes in wind profile at night in Ontario that was resulting in increased annoyance from wind turbines, and noise at residences above the Ontario Guidelines. Mr. Palmer has made formal presentations to Ministry of the Environment staff regarding noise from wind turbines. While Mr. Palmer advocates the safe use of renewable energy, and is using solar energy to power TRI-LEA-EM, a gathering place under development by his family, he is concerned that improper siting of wind turbines has demonstrated that it may harm the public without mitigating benefits.

3. <u>The Issue of Public Safety Risk from Wind Turbines</u>:

<u>Summary</u>:

- Hydro One has established setback standards to protect transmission lines from wind turbine accidents, but the public have no similar protection
- MOE, who approve wind turbine installation have no setback standards, nor intention to develop any
- Proponent recommended setback standards are inadequate to protect the public
- Lack of standards results in installation of turbines where posted cautions then advise public to avoid provincial highways, without providing alternatives
- Risk is not calculated the same for wind installations as other generating means

<u>Recommended Resolution</u>:

- Establish standards to protect the public based on actual Ontario experience and international recommendations
- Calculate risk for wind turbines consistent with the risk calculation for other generating systems

<u>Background</u>:

Ms. Enza Cancilla, Manager, Public Affairs of Hydro One Networks Inc. wrote on November 3, 2008[i], *"Hydro One has conducted a thorough review."* (Of issues of concern identified about potential risks to the Hydro One transmission corridors posed by wind turbines.) Ms. Cancilla's letter goes on, *"As part of this review, local and international experience was reviewed to arrive at a set of recommendations on the distances between wind turbine generators and Hydro One facilities. Mechanical risks (e.g., blade failure, tower collapse, ice throw) and wind-induced risks (e.g., Aeolian vibration, galloping, wake-induced, turbulence-induced) were examined. Of these the mechanical risk of complete blade failure (detachment) or wind tower collapse set the furthest limits of risk to transmission structures. To avoid these risks, we developed technical directives for a required wind turbine setback from our transmission assets. After due process, the technical directives will become a Hydro One standard."*

The standard from July 2008 to the present time shows *a setback of 500 metres from 500 kV assets.* These are the critical assets of Hydro One, for which failure would cause an upset. Smaller setbacks are recommended for 230 kV assets, where there is typically redundancy, or 115 kV assets for which failure would generally only pose an inconvenience. It is considered that protection of the lives of citizens should also be a critical requirement as the lives of people are neither redundant, nor is it only an inconvenience if a person is killed or seriously injured. Should not a similar setback apply to the *"sensitive land use"* defined in section 6 of the Ontario PPS[ii], as *"buildings, amenity areas, or outdoor spaces where routine or normal activities occurring at reasonably expected times would experience one or more adverse effects … examples may include, but are not limited to residences, day care centres, and educational and health facilities."* PPS advises us that public safety is of importance, so the lives of members of the public who travel along roadways, live in homes, or work fields near

wind turbines should deserve protection, as human life is surely of value comparable to the physical assets of transmission towers.

Ms. Doris Dumais, Director of the Ontario Ministry of the Environment Environmental Assessment and Audit Branch wrote on April 9, 2008, stating[iii] that she was *"pleased to rely on behalf of the Minister"* regarding risks from wind turbines. Ms. Dumais states in her letter, *"In your letter you also express your opinion that setback approvals being granted in Ontario are not protecting the public. I would like to make it clear that the ministry does not have standards for setbacks from wind turbines."* The letter goes on to discuss noise limits, and how proponents are required to address noise limits, but does not address the issue of public safety setbacks. The paragraph concludes, *"The ministry does not intend to introduce setbacks for wind turbines. As you know, municipalities may set requirements for wind turbine setbacks under the authority of the Planning Act."*

The impact of not having a provincial standard for protection is that developers are quoting CANWEA recommendations for municipal bylaws that a setback equal to the blade length of a wind turbine plus 10 metres is a perfectly safe setback[iv]. This is about 41 metres + 10 metres or 51 metres from most of today's wind turbines.

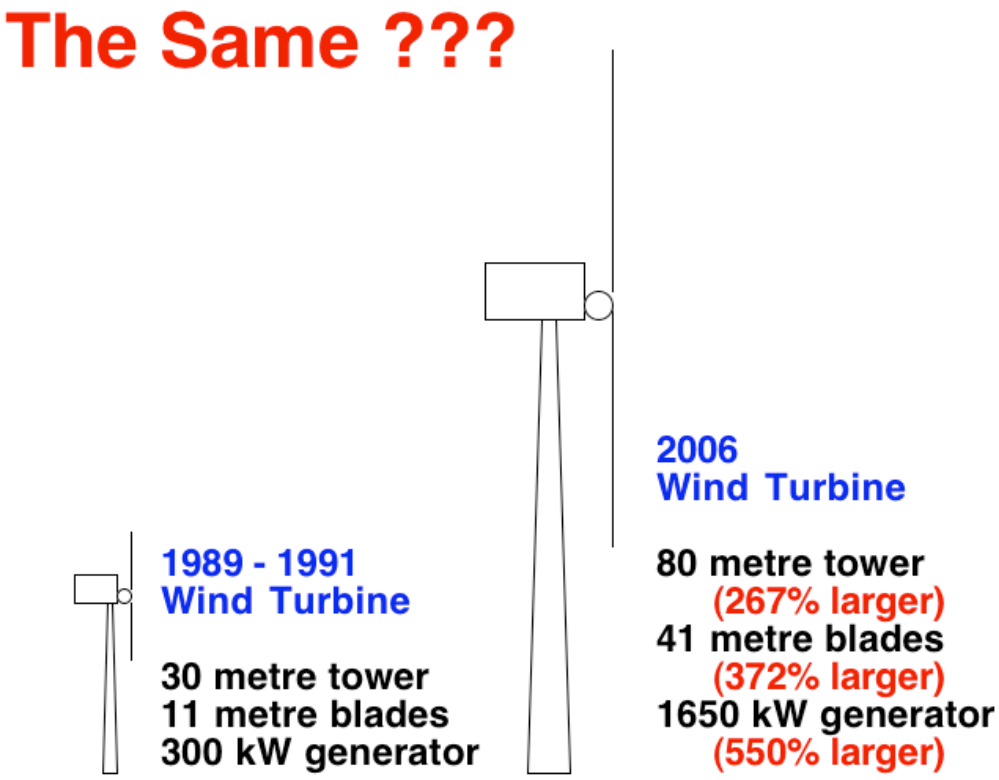
It is clear that the responsibility to deal with public safety is not being adequately addressed without having in place standards to protect the public.

- To show some examples of the need to consider the public safety risk of wind turbine accidents, consider that Ontario has had two blade failures in the last 2 years, one at the Port Burwell wind development in April 2007 following a lightening strike[v], and one at the Prince wind development in January 2008 in a winter storm[vi], both on GE turbines. Not shown is a third failure reported of a smaller industrial type turbine on a farm near Belwood Ontario when a blade nearly hit the farm home after traveling some 100 metres from the tower. (As reported on CKCO Television[vii]). Not shown is the fact that the 5 Vestas turbines at the Huron Wind development had 5 blade failures due to lightening strikes in their first year of operation[viii]. None of those resulted in blade pieces on the ground, but demonstrate the sort of risk turbines face.
- The most comprehensive database available to date was published on behalf of the Netherlands Agency for Energy and the Environment[ix]. This was a study that looked at the experience of 43,000 turbine-years of experience in Germany, Denmark and the Netherlands up to 2002. In that time, they analysed "over 200 severe accidents and incidents" (their words) and found that 62 of these appeared to be relevant for the safety of nearby objects (or persons, should they be nearby). They found the following "recommended values" for failure rates: (Statistically risk analysis increases the values found slightly when the data of failures is not large to be statistically significant.)
    - Loss of blade 8.4 x 10-4 (failures per year per turbine)
    - Collapse of entire tower 3.2 x 10-4
    - Collapse of rotor or nacelle 1.3 x 10-4

- This means for a single turbine, the severe accidents that could cause loss of life (loss of blade that can travel up to 500 metres), collapse of the tower (limited to pretty well the total height of the tower plus a bit for impact bits - say about 150 to 200 metres), or collapse of the nacelle or rotor (generally limited to about 50 metres) would have a total failure rate of about 1.3 x 10-3, which means that if one had 1000 turbines one might expect 1.3 of these failures per year.
- That body of data was based on turbines up to 2002, and a lot of those turbines were smaller than installed in Ontario today.
- Considering ONLY the two blade failures of large industrial turbines that put blade pieces on the ground at a distance from the tower, Ontario has a blade failure rate of 2 in 615 years, or 32 x 10-4 failures per year (4 times higher than reported in the survey published in the Netherlands!).
- Looking at relevant differences, we find looking at information from the US Department of Energy Renewable Energy Laboratory, who reported in a paper published in 2002 by N. Kelley and B. Smith "Evaluation of Wind Shear Patterns at Midwest Wind Energy Facilities"[x] (NEL/CP-500-32492) that new taller wind turbines might be subject to a new failure rate because of the difference in wind speeds across the rotor (wind speeds at the top of the rotor are higher than wind speeds at the bottom resulting in the blade flexing as it goes around the circle.)
- A second report filed by the National Renewable Energy Laboratory in the USA, concurred that tall wind turbines (as in Ontario) would be subject to a higher blade failure rate because of the higher wind shear on tall turbines[xi].

  - This photo shows the physical size of a wind turbine blade[xii]. When seen up close, and one looks at the size of the men in the picture, one recognizes that if one of these blades, or a part of a blade falls from a turbine, the consequences are severe.

- A graphic model of the size of wind turbines in 1989 and today is used to show that the new turbines are considerably larger. Yet, the references quoted by a proponent[xiii] to justify a 50 metre setback for the larger turbine were written in 1988 and 1991 when turbines were the size of the left drawing, yet these were used to justify the same setback for the turbine shown in the right drawing.[xiv]



A further result of not having standards in place to protect the public can be seen in the example of the Enbridge Ontario Wind Farm in Kincardine. The wind farm layout permitted turbines to be installed within 121 metres of the municipal roads, and 150 metres of provincial highways. Then, the company installed caution signs on the approach roads to the turbines stating "Caution – During Potential Icing Conditions Stay Back 305 Meters from Turbines." This means that during winter conditions, the public cannot travel on provincial and municipal highways without ignoring the posted safety cautions, as the 305-metre radius crosses completely across the roadways.

Pieces of ice 12 inch x 12 inch x 2 inch thick have been found up to 100 metres away from the 50 metre hub height "Tacke" wind turbine which has a 21 metre blade length at the Bruce Information Centre[xv]. Simple calculation shows that having a piece of 12 inch x 12 inch x 2 inch thick ice fall from the larger turbines installed today is equivalent to dropping a solid concrete block 18 inches x 8 inches x 8 inches out of a 6 storey window. The effect is serious. Ice can drop from a turbine even when shutdown as it melts since it can be carried by the wind. Ice does not have to be "flung" from moving blades to travel appreciable distances[xvi].

It is important to recognize a significant difference between the ways "public safety risk" is calculated by wind proponents, compared to the method used by other electrical generators. "Risk" the product of the accident probability and consequences at a location normally is calculated assuming that a person is physically present at the location in question. "Risk" is a condition that is location dependent. For example, the calculation of individual risk carried out under the licence conditions for a nuclear generator assumes that a person is continuously at the location at which they will be most impacted when the accident occurs (at the boundary fence). The risk assessment posted by the CANWEA[xvii] for Ice Throw and Blade Failures, calculates the risk for ice throw assuming a person can only stand in a 1 square metre area in the "donut" between 50 metres from a turbine and 300 metres from the turbine. This assumes that all ice falls in only 1 square metre area up to 300 metres from a turbine, that somehow (unspecified) the public is precluded from approaching within 50 metres of the turbine, and that the person chooses to stand in the same square metre. By doing this, the calculation by Garrad Hassan as supported by CANWEA reduces the risk by a factor of 1 / 275,000 (or 0.000004) since the calculation claims that ice could fall with equal probability into any 1 square metre area.

Thus, instead of assuming a person is at the location where the accident occurs as assumed by other energy generators, the method used by the CANWEA paper reduces the risk by a huge factor so it is hardly comparable! In particular, even if one was trying to calculate the number of people killed (a different calculation than "risk") one could not assume that the chance of ice falling is equal anywhere in the "donut" from 50 to 300 metres as done by the Garrad Hassan report for CANWEA, since the threatened area will vary depending on the wind direction as shown in current papers for calculating ice drop risk[xviii]. written by some of the same authors (Henry Sieffert) as quoted by the Garrad Hassan report. They only quote from a 1997 report of Mr. Sieffert, and not from his more current material. To do the calculation in a comparable manner as to other generating means, the calculation would have to consider the distribution of ice throw, and assume the person was standing in the most impacted area. It is important that "risk" is calculated in the same fashion for wind generators as for other technologies, as reducing the risk by a factor of 0.000004 before doing the comparison hardly makes for a representative comparison.

It is also of interest to note that the Garrad Hassan paper states, of turbine blade failures, "GH considers that the failure rate values recommended by the Dutch Handbook [6.3] are particularly conservative in the context of current-day commercial wind turbines as the various root-causes of blade failure have been continuously addressed through developments in best practice in design, testing, manufacture and operation. …. Use of the Handbook values for present day turbines can therefore be considered as inappropriate."
"The reduction in blade failures referred to in the above reports coincides with the widespread introduction of turbine design certification and type approval."

Yet, as shown in this paper, the actual blade failure rate in Ontario to September 2008 is more than 4 times higher than the blade failure rates identified in the "Dutch Handbook." The Garrad Hassan report conclusions are not consistent with actual Ontario experience.

4. The Impact of Noise From Wind Turbines

Summary:

- False expectations of the impact of wind turbine noise are raised by government and industry publications and web sites
- Wind profile changes at night have been clearly proven from data monitoring over 2 years in Ontario showing that at night ground wind speed falls, while wind speed at hub level rises, resulting in increased noise at night, yet MOE guidelines still support false claims that wind turbine output only goes up when ground speed wind rises
- MOE standards to penalize cyclic noise are not being applied for wind turbines
- MOE are issuing Certificate of Approval AIR documents for wind turbines in contravention of their own standards for how to calculate wind turbine noise
- MOE Officers are quoting incorrect information to citizens with concerns about wind turbine noise

Recommended Resolution:

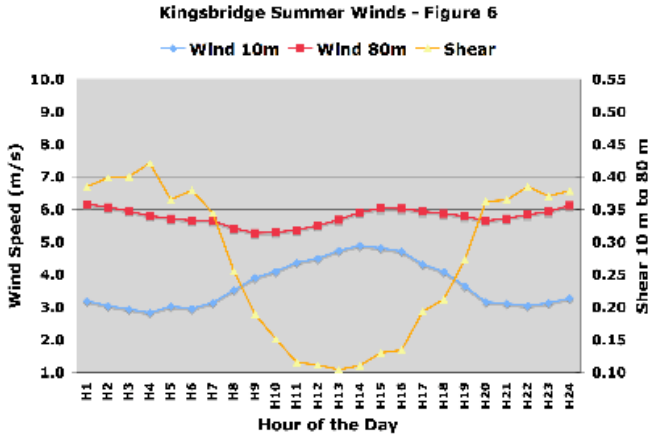
- Revise MOE Wind Turbine Noise Guidelines to remove increase in wind turbine noise based on false expectations of a constant wind shear profile
- Revise MOE Wind Turbine Noise Guidelines to be consistent with MOE standards to penalize cyclic noise.
- Properly apply MOE standards that are in effect, and correct Certificate of Approval documents that were issued in error resulting in situations above the MOE standard

Background:

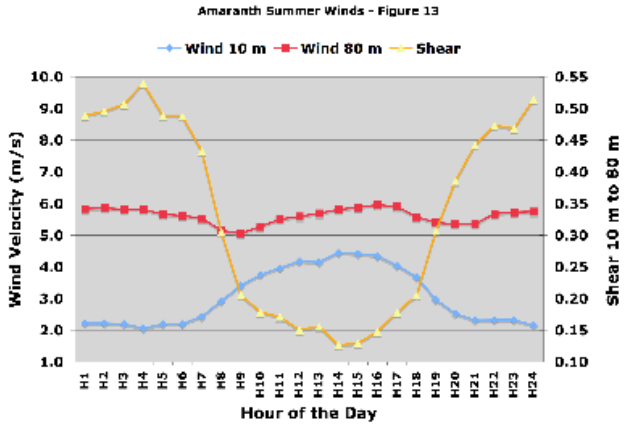
- Information on the CANWEA web site[xix], the Ontario Ministry of Energy web site[xx], and the Ontario Power Authority[xxi] all discuss sound from wind turbines in the terms of a "quiet whisper" or "rustling leaves" which are characterized as about 15 to 20 dBA in intensity at a receiver[xxii], in practice, the Ministry of the Environment allows the sound from wind turbines to be as loud as 51 dBA[xxiii].
- The difference between a sound at 20 dBA and a sound at 51 dBA is a factor of more than 2^{10}, or 1024.
- In the daytime while the sun heats the earth, the atmosphere becomes turbulent, or "unstable" and the wind speed at the turbine hub is linked to the wind speed at the 10-metre level by a logarithmic relationship. However, after the sun sets, particularly if the atmosphere is clear of clouds, the earth cools, and the atmosphere changes from an "unstable condition" to a "stable condition." In this case, the wind speed at the turbine hub level is no longer tied tightly to the ground wind speeds[xxiv]. The wind speed at the hub level can rise, while the wind speed at the ground level falls. This is mathematically expressed as an increase in wind shear. The unstable atmosphere has a wind spear of about 0.14, while a stable atmosphere may have a wind shear of 0.4 to 0.5[xxv]. In practice what this means is that on clear nights, after the sun sets the wind speed at the hub level increases and the turbine makes more noise, while the wind speed at ground level falls, and the "masking noise" falls. Both of these make a wind turbine more annoying after

the sun sets. These conditions were reviewed in the Ontario Municipal Board Hearing PL 060986 in the Presentation "Analysis of Boundary Layer Winds Near Goderich and Their Application to Wind Farms Along the East Coast of Lake Huron."[xxvi]

- The cyclic nature of wind turbine noise with a "whoosh" every second or so[xxvii], is more annoying than a steady noise, just as a jack hammer is more noticeable at a distance than a comparable sound level that is steady[xxviii].
- Wind turbines tend to have more sound energy at low frequencies than at high frequencies. It is recognized by the World Health Organization that low frequency noise is more noticeable than higher frequency noise[xxix]. Sound measurement by the dBA scale tends to "correct" the sound received to be equivalent to what an average ear hears. It does this by reducing the measured value for the low frequencies.
- Since October 2008, the MOE Noise Guidelines for Wind Turbines require that calculations must be done for the average nighttime wind shear.
- Summer wind shear calculations for two Ontario wind farms, Kingsbridge and Amaranth show that while the daytime hour wind shear is in the order of 0.10 to 0.15m the nighttime wind shear is in the order of 0.40 to 0.50[xxx]. Using a wind shear of 0.40 instead of 0.22 (for a "neutral" atmosphere) will mean that the allowable distance from wind turbines to receptors will be doubled.



Similar results have been seen from local wind monitoring towers at the Enbridge Wind site, and Bruce Power



These graphs showing summertime data for Kingsbridge and Amaranth wind farms show that summer night wind shear is much higher than in the daytime

- Even where the MOE have standards, for example the Interpretation Document for Applying MOE Technical Publications to Wind Turbine Generators, Wind

Turbine Noise Guidelines in place during the application for the Enbridge Ontario Wind Project, they issued the Certificate of Authorization Air in violation of their own standards.

- The MOE's Wind Turbine Interpretation Document, which required calculations in accordance with International Standard ISO 9613.
- Memo from Al Lightstone to John Kowalewski dated April 26th, filed as OMB PL060986 exhibit 118 shows that Valcoustics recalculated the sound levels for 21 receptors who were above the MOE 40 dBA guideline, at the suggestion of the MOE by not considering all turbine sound sources in accordance with ISO 9613 so as to reduce the sound levels in order to bring the receptors into compliance
- The Valcoustics revised Environmental Noise Assessment dated May 17, 2007 (filed as OMB PL 060986 Exhibit 92) was neither conservative (it considered the sound from the nearest turbine as dominant or upwind, and reduced the contribution for others on the side or back, even for cases where 2 or more turbines - which combined had a greater contribution, at only slightly greater distance in the dominant upwind wind rose direction existed) nor in compliance with modern models for the reduction of sound from a downwind turbine (it reduced all downwind turbines at any distance by 8 dBA (stated in sworn testimony to be at the suggestion of John Kowalewski of the MOE.) Modern models (NORD 2000 for example) show a reduction of 8 dBA would only apply for turbines at a distance of greater than 3000 metres. The reduction at 1000 metres is negligible (less than 1 dBA).
- The MOE Certificate of Approval Air 4355-747LHM dated July 4, 2007 refers to the Valcoustics Environmental Noise Assessment dated May 17, 2007 was thus not prepared in accordance with MOE Guidelines.
- On January 21, 2009, MOE Senior Environmental Officer stated[xxxi], "As we discussed late yesterday afternoon, the effective noise level guideline according to MOE Publication NPC-232 for your area would be 40 dBA between 7:00 pm and 7:00 am, (and 45 dBA between 7:00 am and 7:00 pm)." He goes on to state, "The "limit" will change depending upon wind speed. The "limit" can be as much as 60 dBA in high winds, (a 60 dBA "limit" would involve wind speeds in excess of 12 meters per second), (40 kph). The MOE document Noise Guidelines for Wind Farms identifies the relationship between wind speed and sound level limits for wind turbines. The document "Noise Guidelines for Wind Farms" is located at: http://www.ene.gov.on.ca/publications/4709e.pdf." The MOE Officer is not responding in accordance with the current MOE "Noise Guidelines for Wind Farms" dated October 2008, which states that the maximum limit for noise from wind turbines is 51 dBA, not 60 dBA, and this applies only when the wind velocity at the 10 metre elevation exceeds 10 metres per second (36 km/hr) at a 10 metre height – which was not the case when the readings at the home were taken in December 2008. Even the older MOE Noise Guidelines" had an absolute limit of 53 dBA at a 10 metre wind speed of greater than11 metres per second. When the MOE do not apply their own guidelines to noise in excess of their limits, the public is not protected.

5. The Issue of Health Effects From Wind Turbines

Summary:

- Adverse health effects are being noted by people in Ontario after the installation of wind turbines
- Medical evidence has been published of physiological adverse effects of the noise from wind turbines

Recommended Resolution:

- We request that the Province of Ontario immediately put in place a moratorium on further industrial wind turbine installations to stay in effect until the completion and public review of a comprehensive and scientifically robust health study of the effects of wind turbines.
- We ask you make a commitment to expeditiously correct problems caused by already established wind turbine installations.

Background:

- People whose homes were near wind farms in Ontario at the Kingsbridge I Wind Farm, the Ripley South Wind Farm, and the Amaranth Wind Farm have reported adverse health effects. More than one family is impacted at each location. Wind Concerns Ontario members have personally met all of these people.
- In other locations, citizens living near wind farms in Nova Scotia, Great Britain, Portugal, and the United States have reported adverse health effects. Wind Concerns Ontario members have personally met all of these people, or medical team staff who have met these persons. Written personal testimony (not third hand accounts) of people in other locations identifying adverse health effects since the erection of wind turbines near their homes have been reviewed.
- A common theme flows from all of the cases reviewed. The individuals seemed to be sincere in expressing their concerns. They expressed dismay that authorities that they felt would protect them from adverse effects had not taken action.
- At the Second Wind Turbine International Noise Conference n Lyon France in 2007, Professor Mariana Alves-Periera of ERISA-Lusofona University, Lisbon, Portugal presented a paper "In Home Wind Turbine Noise is Conducive to Vibro Acoustic Disease". Professor Alves-Periera reported:
    - The multidisciplinary medical, engineering, and scientific study team has systematically studied the effects of infrasound and low frequency noise (ILFN, <500 Hz) in human and animal models since 1980.
    - She noted that wind turbines (WT) had been identified as yet another source of ILFN. Like many other ILFN- generating devices, she stated WT can greatly benefit humankind if, *and only if*, responsible measures are taken for their implementation.
    - Vibroacoustic disease (VAD) is the pathology that is acquired with repeated exposures to ILFN environments (occupational, residential *or* recreational). She noted that numerous scientific articles on the subject had been published in peer-reviewed academic journals over 27 years[xxxii].

- Her paper noted that ILFN levels in a home within 321m to 648 m of wind turbines are sufficient to cause VAD. This family has already received standard diagnostic tests to monitor clinical evolution of VAD.
- Mr. R (the father if the family) has deep concerns about his memory loss, increased irritability and progressive intolerance toward audible noise, all of which he complained about at the very first meeting with this team, in March 2007. Both Mr. and Mrs. R. have developed great difficulty in sleeping continuously throughout the night, as well as non-specific body pain. Upon visiting a general physician at the local State Health Center, Mr. R was prescribed 2 analgesics (anti-inflammatory and spasmolytic) and 2 tranquilizers (diazepam-based and short-term sleep-inducer).
- Echocardiograms (routine, non-invasive VAD diagnostic test) of Mr. and Mrs. R. disclosed slight to moderate pericardial thickening (between 1.7mm and 2.0mm, normal for the equipment in use: <1.2mm). Respiratory drive was below normalized values in both adults (46%-53%, normal: >60%), suggesting the existence of brain lesions in the areas responsible for the neurological control of breathing.
- In mid-March, Mr. and Mrs. R received a letter from their 12-year-old son's school, expressing concern for the growing difficulties of an otherwise outstanding student …
- The paper asserted that safe distances between WT and residences have not yet been scientifically established, despite statements by other authors claiming to possess this knowledge. It noted that widespread statements claiming no harm is caused by in-home ILFN produced by WT rotating blades are fallacies that cannot, in good conscience, continue to be perpetuated. In-home ILFN generated by WT blades can lead to severe health problems, specifically, VAD. Real and efficient zoning for WT must be *scientifically* determined, and quickly adopted, in order to competently and responsibly protect Public Health.

- Other Medical Doctors have reported clinical results of patients impacted by wind turbines, including:
  - Dr. Amanda Harry, MD, UK in a paper "Wind Turbines, Noise and Health" (February 2007) concluded, "I think it is clearly evident from these cases that there are people living near turbines who are genuinely suffering from health effects form the noise produced by wind turbines."
  - Dr. Nina Pierpont M.D., PhD USA in a book titled "Wind Turbine Syndrome" (in print 2008) states, "This report documents a consistent, often debilitating complex of symptoms experienced by adults and children while living near large (1.5 – 3 MW) industrial wind turbines." She notes, "To those of you living near turbines who recognize your own symptoms within these pages, you are not crazy and fabricating them. They are clinically valid and unnecessary."
- In March 2006, the National Academy of Medicine of France passed a resolution stating, "The construction of wind turbines grater than 2.5 MW at distances of less than 1500 metres from dwellings should be suspended until development of a procedure to record the noise from wind turbines in buildings for a long period of

time, to allow completion of an epidemiological investigation into the possible medical effects of these machines."

- The lack of a standard for visual "blade flicker" from wind turbines has resulted in proposals ranging from no limitation, to a limitation based on "average weather" which permits considerable periods of flicker on clear sunny days, to limitation on an annual basis only, to a limitation based on a maximum limit considering an astrologically possible maximum – which actually is what occurs on a clear sunny day. Similarly the lack of a standard results in different interpretations on the distance of impact of a turbine from a receptor. The lack of standards has resulted in significant impact on sensitive people. A short period of flicker can act as a trigger for onset of migraine headaches that last for a considerable period after the flicker has ceased.

6. The Effect on Municipal and Provincial Economies

Summary:

- Wind turbines have a special tax assessment status and pay little municipal taxes
- A demonstrated impact on real estate sales in their area within 3 nautical miles of wind turbines has been shown to exist
- Increased power cost for wind turbine generated power will have an impact on Ontario's competitiveness

Recommended Resolution:

- It is the prerogative of the Ministry of Energy to select energy supply options, but the true costs of options should be clearly stated, rather than making statements about wind being a "fuel-less" generating source which are easily misinterpreted to think it means low cost.

Wind turbines have a special tax relationship. A wind turbine valued at 2.5 to 3 million dollars in replacement value, has a tax assessment of $40,000 per MW, so a 2 MW turbine has a tax assessment value of only $80,000. It will generate little to the municipal tax base. However, homes around the turbine, which will likely have a greater assessed value, may apply for a reduction in their assessment due to the impact of nearby wind turbines. In a recent case in Melancthon Township the assessed value of a home was cut in half by the Municipal Property Assessment Corporation (MPAC) because of the impact of the sound from the transformer station for the Amaranth wind farm even though that transformer station met Ministry of the Environment guidelines. A municipality might well find their tax revenues reduced after the installation of wind turbines depending on the number of wind turbines and the number of homes in the area. Typically more homes are impacted than the number of wind turbines.

Mr. Chris Luxemburger, a Registered Real Estate Broker, Director of the Brampton Real Estate Board, and Chairperson of the Real Estate By-Laws Committee has prepared a report based on a 3-year study of 600 real estate sales in the area of wind turbines near the Amaranth (Melancthon) Wind Power Development, showing that properties within 3 nautical miles of a wind turbine:

- were on market more than double the days of those outside 3 nautical miles
- had a sold price on average $48,000 lower (Mr. Luxemburger noted this was on properties with values of $200,000 to $250,000 – a decrease of 20 to 25%)
- the number of properties not absorbed (not sold at any price) was 11% vs. 3%

Review of the Land Title transfers in the area of the Amaranth (Melancthon) Wind Power Development shows that 5 properties have been bought by Canadian Hydro Developers, who retains title. On one of these properties, acquired at $350,000, the standing home was bulldozed. On at least two more properties, purchased at prices at or above the norm for area properties, at $500,000 and over $300,000 more than a year ago, the homes stand vacant. The status of the two remaining properties each acquired at about $300,000 over a year ago is that title is still held by Canadian Hydro Developers and has not been

transferred to other owners. This does not appear to be healthy development of a community.

In general the power purchase agreement with wind turbine developers ranging from $80 per MWh to $110 per MWh, plus a $10 per MWh federal Eco-Energy Grant means that the cost of power from wind turbines is about 2.5 times the average Ontario power cost. Actually the situation is worse than first seems, as the wind turbines have their greatest average output over the year at night, when bulk power costs are at a minimum. This increased power cost will have an impact on Ontario's industries and their competitiveness.

7. The impact of wind turbines on the ability to meet Ontario's energy needs.

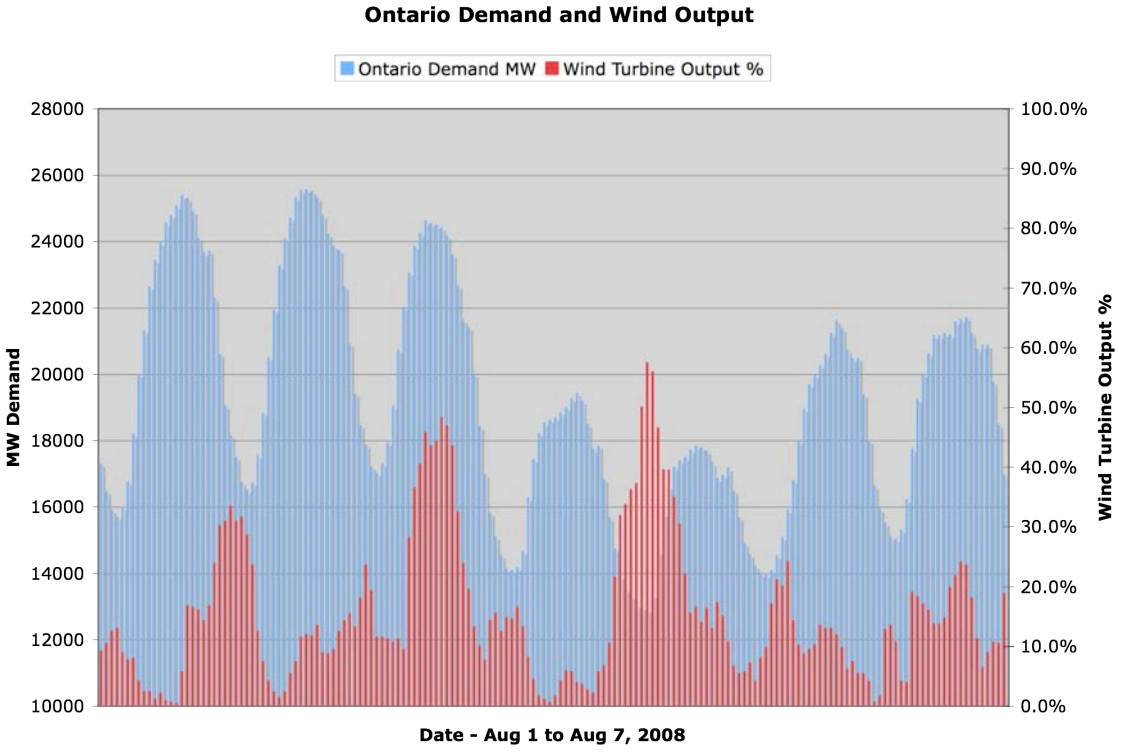
Summary:

- Wind generation demands both backup and a storage option. Natural gas backup for wind poses significant costing concerns

Recommended Resolution:

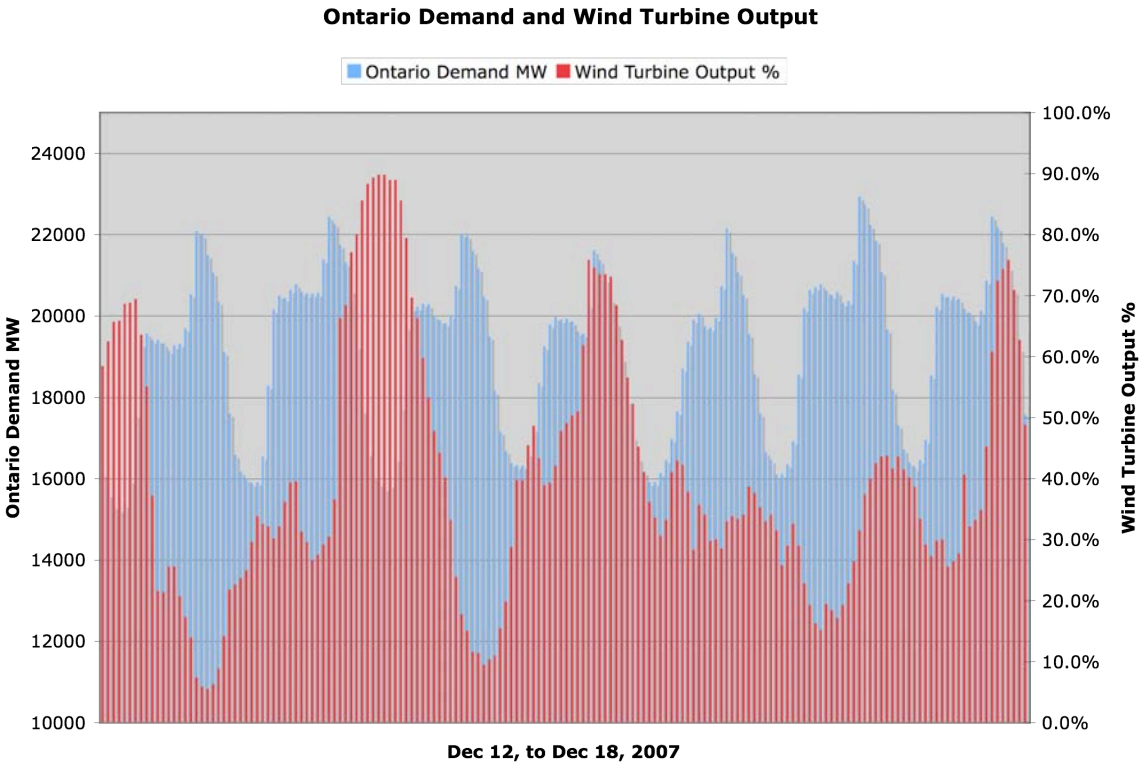
- The full costing and implications of any generating option should be revealed.

In planning, one has to consider if the benefits of a development can counter the drawbacks that may be generated, if the drawbacks can be shown to not be harmful. As noted above the issue of harm from wind turbines is not resolved, but if one looks at the major benefit claimed for wind turbines it is that they produce needed energy. In fact, wind turbine output usually does not match the actual load demand in Ontario. In some cases, the wind turbine output may match the load peak, but in most cases, the wind turbine output is maximum at night when the wind shear is highest, when the load is minimum. A typical curve showing the wind turbine output from all Ontario wind turbines superimposed on the Ontario electrical demand curve (but not at the same scales) is shown for a summer week below. The mismatch between the wind turbine output and demand is quite apparent. In fact for the two years of 2006 and 2008, on 50% of the days, during peak hour during 100 days of the summer from June 1 to September 8th, the output of Ontario wind turbines was 10% or less during the peak hour. On fewer than 10% of the days, was the wind turbine output 50% or higher.



In the winter time also, during cold crisp days as occurred over the last two weeks, on the coldest days, the wind turbine output was again low.

IESO records also show periods of 36 hours when the output from all wind turbines in the province is below 5% in the months of January, February, June, July, and August, when the electrical demand is greatest. These characteristics of wind turbines present difficulty for the electrical system. It requires building the generating system effectively twice, to compensate for periods when wind turbine output is low. The excess generation at night poses a problem as it requires that base load generation (or the wind turbine output) be reduced at night, but the generation from the wind turbines falls off as load increases. Consider the actual winter week shown in the curve below.



This actual data shows that on both the first and third night of the week displayed, the wind turbine output was maximum (between 70 and 90% of the maximum possible) at night, when the system load was minimum at about 16,000 MW. However, the next morning, as system load increased from 16,000 MW to about 22,000 MW, the wind turbine output fell to 10% or less. If we project to the point when we have 5000 MW of wind generation in Ontario, we can see that this might mean having 3500 to 4500 MW of wind generation at night, taking available generation above the anticipated nuclear baseload of 14,000 MW, Storage of electricity produced when not needed is a very expensive option. As Dr. Jan Carr, former CEO of OPA described the situation to CBC "The Fifth Estate" in November, 2008, *"Now, electricity is … is … is a product. It's a manmade product, it doesn't occur in nature. And it is a product which … which is very, very expensive to store. Virtually impossible to store. In large quantities – very expensive to store. Which means that the most economic way of having an electricity system is to make it on demand which therefore puts a premium on peak demand. "* Suppose Ontario decides to build a 5000 MW pumped storage capacity, to handle the excess generation at night. We have now about 7000 MW of total hydraulic generation

in Ontario. To build a 5000 MW pumped storage plant, means being able to TOTALLY reverse the flow of the St. Lawrence River, the Ottawa River, the Niagara River, all rivers flowing to the northern generating sites, and nearly every other river in Ontario that has a hydraulic plant. It would be a huge undertaking.

Similarly, advertisements on television show electric cars being a possible storage means, which everyone plugs in at night. To store 5000 MW for 8 hours at night needs a storage capacity of 40,000 MWh. For example, Toyota Prius deep cycle battery[xxxiii] has a capacity of 1.78 kWh, so we'd need about 22.5 million Toyota Prius cars each with a fully discharged battery plugged in at night to store that amount of power. Since each car battery would probably not be fully discharged and ready to take full charge, the number would likely be at least twice that. Does it seem reasonable to have 45 million Toyota Prius cars in a province with 12 million people, or about 4 for every man, woman and child? Storage of the excess generation from wind turbines at night is possible, but it will be very costly. Kermit the frog had it right, "It's not easy being green!" Storage of electricity of the magnitude required is simply not something to be lightly considered.

As a result what happens is that countries that are building wind turbines are building comparable amounts of natural gas generators. Germany and Spain, the two European nations leading in wind turbine installations, have larger "fleets" of natural gas generators than wind turbines. Ontario is headed towards the same situation as the OPA targets about 5,000 MW of wind, and 11,000 MW of natural gas generators. The difficulty is these natural gas generators that can vary output to accommodate the rapid swing in wind turbine load are simple cycle gas generators, which have an efficiency of only about 40 to 45%. They use less than half of the natural gas energy that a typical home furnace does. The United States Energy Information Agency (US EIA) stated in 2006 that Canada had an assured natural gas supply of 9 years. Similarly the National Energy Board of Canada identifies that the Canadian supply of conventional natural gas is very short in duration. The recently issued "Natural Gas-Fired Generation in the Integrated Power System Plan" prepared for the Ontario Power Authority by North Side Energy, LLC in May 2008 projects a fairly constant Canadian and US Gas Supply (and demand) through 2030 by assuming a Liquid Natural Gas (by tanker from Russian sources) of about 13.5% of the supply, and a supply of about 2% from the Mackenzie delta. This ignores the increase in demand from the new as fired generators being built in Canada and the USA, and by the tar sands oil producers which will cause more demand. Yet, the report projects that natural gas prices will remain fairly constant for the 23 years to 2030. Is something missing?

On January 21, 2009, the Ottawa Citizen reported that the construction on all but one LNG port facility in Canada was being put on hold as price in North America was too low for Russian gas to be supplied to North America. "With the recent surge in prices in Europe and the extremely high prices in Asia, the gas will go there, not to North America, where prices are rather low." On the same week, the Globe and Mail reported that Russian Gas supply had just been reestablished to Europe via the Ukraine, but at a price that had increased significantly. All of this poses a challenge for a strategy that is concentrating on Natural Gas as a major contributor to Ontario's electrical supply.

8. The impact on Ontario's and Canada's environmental conditions.

Summary:

- Environmental benefits claimed from wind turbines usually identify that they will result in significant improvement in Ontario and Canada's green house gas emissions. Calculation of the impact shows that the gains are not what might be expected, and barely have a measurable effect.
- Impacts on wildlife, birds and bats are not fully addressed.
- Potential impacts on ground water resources have not been addressed.
- The impacts on challenges to the social environment have not been addressed.

Recommended Resolution:

- Please describe the situation honestly so that the public can be fully informed.

Often the position is put forward that installation of wind turbines is critical to resolve the issue of climate change or the increase in CO_2 emissions. In reality, even if Ontario installs 5,000 MW of wind turbines, the reduction in Canada's CO_2 emissions will be about 0.35% In fact, Canada's CO_2 emissions increased about 33.2% in the last 10 years. Thus the increase in CO_2 emissions is about 100 times greater than will be reduced by wind turbines. In fact, CO_2 emissions are expected to increase significantly over the next ten years as we plan to triple our tar sands oil production. Even a full 25,000 MW of wind generation in Canada will mean that the wind turbines will be providing a negligible improvement to our CO_2 emissions (of about 1%). It is clear that those who pose in front of rows of wind turbines suggesting that they are solving Canada's CO_2 emissions have not done the basic calculations.

Wildlife, birds, (particularly raptors) and bats[xxxiv] seem to be significantly impacted by wind turbines. Reduction in the number of raptors and bats can impact the number of rodents and insects, and thus impact agriculture.

20-year leases renewable at the discretion of the wind company impact family farms. If the farm ownership changes hands (such as a transfer from parent to child) leases typically allow the wind company to have first rights of refusal to purchase the farm.

Piling driven deep below the foundation sometimes supports bases for wind turbines. This piling, 50 to 70 feet below the foundation may pose a challenge to contamination of the water table.

The lack of provincial standards has resulted in significant fractionation of community relationships, and loss of community spirit, as each community battles the issues, and raises the same issues, and animosities. This is having a significant impact on rural community spirit, and can be said to be poisoning the social environment people live in.

9. Issues That Need Resolution

The Issue of Public Safety Risk from Wind Turbines:

Summary:

- Hydro One has established setback standards to protect transmission lines from wind turbine accidents, but the public have no similar protection
- MOE, who approve wind turbine installation have no setback standards, nor intention to develop any
- Proponent recommended setback standards are inadequate to protect the public
- Lack of standards results in installation of turbines where posted cautions then advise public to avoid provincial highways, without providing alternatives
- Risk is not calculated the same for wind installations as other generating means

Recommended Resolution:

- Establish standards to protect the public based on actual Ontario experience and international recommendations
- Calculate risk for wind turbines consistent with the risk calculation for other generating systems

The Impact of Noise From Wind Turbines

Summary:

- False expectations of the impact of wind turbine noise are raised by government and industry publications and web sites
- Wind profile changes at night have been clearly proven from data monitoring over 2 years in Ontario showing that at night ground wind speed falls, while wind speed at hub level rises, resulting in increased noise at night, yet MOE guidelines still support false claims that wind turbine output only goes up when ground speed wind rises
- MOE standards to penalize cyclic noise are not being applied for wind turbines
- MOE are issuing Certificate of Approval AIR documents for wind turbines in contravention of their own standards for how to calculate wind turbine noise
- MOE Officers are quoting incorrect information to citizens with concerns about wind turbine noise

Recommended Resolution:

- Revise MOE Wind Turbine Noise Guidelines to remove increase in wind turbine noise based on false expectations of a constant wind shear profile
- Revise MOE Wind Turbine Noise Guidelines to be consistent with MOE standards to penalize cyclic noise.
- Properly apply MOE standards that are in effect, and correct Certificate of Approval documents that were issued in error resulting in situations above the MOE standard

The Issue of Health Effects From Wind Turbines

Summary:

- Adverse health effects are being noted by people in Ontario after the installation of wind turbines
- Medical evidence has been published of physiological adverse effects of the noise from wind turbines

Recommended Resolution:

- We request that the Province of Ontario immediately put in place a moratorium on further industrial wind turbine installations to stay in effect until the completion and public review of a comprehensive and scientifically robust health study of the effects of wind turbines.
- We ask you make a commitment to expeditiously correct problems caused by already established wind turbine installations.

The Effect on Municipal and Provincial Economies

Summary:

- Wind turbines have a special tax assessment status and pay little municipal taxes
- A demonstrated impact on real estate sales in their area within 3 nautical miles of wind turbines has been shown to exist
- Increased power cost for wind turbine generated power will have an impact on Ontario's competitiveness

Recommended Resolution:

- It is the prerogative of the Ministry of Energy to select energy supply options, but the true costs of options should be clearly stated, rather than making statements about wind being a "fuel-less" generating source which are easily misinterpreted to think it means low cost.

The impact of wind turbines on the ability to meet Ontario's energy needs.

Summary:

- Wind generation demands both backup and a storage option. Natural gas backup for wind poses significant costing concerns

Recommended Resolution:
The full costing and implications of any generating option should be revealed

The impact on Ontario's and Canada's environmental conditions.

Summary:

- Environmental benefits claimed from wind turbines usually identify that they will result in significant improvement in Ontario and Canada's green house gas

emissions. Calculation of the impact shows that the gains are not what might be expected, and barely have a measurable effect.

- Impacts on wildlife, birds and bats are not fully addressed.
- Potential impacts on ground water resources have not been addressed.
- The impacts on challenges to the social environment have not been addressed.

Recommended Resolution:

- Please describe the situation honestly so that the public can be fully informed.

Footnote References Follow:

[i] "Re: Bruce to Milton Transmission Reinforcement Draft Environmental Assessment", personal letter, Enza Cancilla, Manager, Public Affairs, Hydro One Networks Inc. to William Palmer, dated November 3, 2008.

[ii] Ontario Provincial Policy Statement available at www.mah.gov.on.ca/Page1485.aspx

[iii] Personal letter, Ms. Doris Dumais, Director, Approvals Program, Environmental Assessment and Approvals Branch, Ontario Ministry of the Environment to William Palmer, April 9, 2008.

[iv] "Studies into ice shedding and blade failure conclude that risks to objects or individuals directly drop off significantly with increasing distance from the turbine itself. It is clear then that public safety can be ensured by establishing setbacks between turbines and non-inhabited areas (e.g. property lines and roads) on the basis of a set distance from the area immediately under the turbine. CanWEA recommends a distance of blade length plus 10 metres from public roads, non- participating property lines and other developments." Quoted from "Canadian Wind Energy Association Position on Setbacks for Large-Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario – September 28, 2007" available via www.canwea.ca

[v] A Channel News, April 28, 2008 shows video clip of reporter standing behind sections of failed blade on the ground with the turbine in the background, clearly demonstrating that blade portions bigger than he hit the ground. See also "Lightning Damage to Turbine Covered" reported in Tillsonburg News, May 4, 2007 available at http://www.windaction.org/news/9367 quotes Mike Crawley, president and CEO of AIM PowerGen "The blade took a direct hit from lightning and buckled, but did not separate from the rest of the turbine" – an interesting conflict with the previous footnote.

[vi] "Winds Too Much for Turbine" Article ID 912918 The Sault Star, Sault Ste. Marie, Ontario, February 22, 2008 States, "An extensive investigation is underway to determine why the turbine sustained a damaged blade and has been inoperable for more than three weeks. "We believe the blade was damaged after the turbine shut itself down," said Jim Deluzio, general manager of Ontario Wind Operations with Brookfield Power Corp. "The investigation will look into the possibility of a defective blade. . . . Winds were high but the blade should not have been damaged."

[vii] CKCO Television News, Joel Bowey Reporting, Sept 26, 2006, Southern Ontario News at 6:00. "The De Lange Turbine is 140 feet tall, with 600 pound blades that traveled to nearly hit the house 300 feet away."

[viii] "Happy Birthday Huron Wind – a year of shared experiences, dated Dec. 1, 2003, Available at www.huronwind.com includes the following statements,

- "Designed with grounding to withstand most lightning strikes, the wind turbines at Huron Wind experienced some doozies during the first year of operation in what proved to be a very stormy year. Five of the strikes resulted in damage to turbine blades and caused lengthy outages while a crane and blade specialist were brought to site to complete repairs."
- "In mid-February, a half-millimetre gap was discovered between the concrete foundation and the tower base on Turbine No. 3. Subsequent probes into the concrete revealed a fracture and led to a decision to shut the entire wind farm down to complete remedial work while it was under warranty. During the following weeks, epoxy was injected into the concrete foundations to add strength and iron brackets were installed on a footing to the tower bases to provide stiffer support."

(This latter Huron Wind near catastrophic failure was noted to have occurred shortly after a similar Vestas V80 turbine in Germany collapsed due to a failure in the support tower on Dec. 18, 2002). – See http://www.caithnesswindfarms.co.uk/page4.htm and click on the link to "The Full Accident List" for a 72 page pdf file with links to the source reports of wind turbine accidents for a summary of international wind turbine accidents.

[ix] Braam, H.; Rademakers, L.W.M.M."Guidelines on the environmental risk of wind turbines in the Netherlands" ECN-RX--04-013; February, 2004; 6 pages, Presented at Global Wind Power, Paris, France, 2-5 April, 2002. Available at "Energy Research Centre of the Netherlands Publications" http://www.ecn.nl/publications/ (search for Author Braam)

[x] "Evaluation of Wind Shear Patterns at Midwest Wind Energy Facilities" May 2002, N. Kelly and B. Smith, National Renewable Energy Laboratories, US Department of Energy, report NREL/CP-500-32492 available at www.nrel.gov/docs/fy02osti/32492.pdf

[xi] "Towards a Wind Energy Climatology at Advanced Turbine Hub Heights" Marc Schwartz and Dennis Elliot, National Renewable Energy Laboratory, US Department of Energy, Report NREL/CP-500-38109 available at www.nrel.gov/docs/fy05osti/38109.pdf

[xii] Photograph by William Palmer at 9:48 am on December 1, 2006 from public roadway of delivery to Enbridge Ontario Wind Project lay-down site on Bruce County Road 20.

[xiii] Personal Letter, William Pol, Manager of Planning (London), IBI Group, to Jean and Bill Palmer, dated June 23, 2006, in support of personal letter from Scott Dodd, Director Power Generation Enbridge Ontario Wind Power LP to William Palmer dated June 6, 2006 which referred to the "study by Alexi Clark" and study by "Derek Taylor" that identified "a 50 to 100 m setback was sufficient to protect the public using nearby roadways."

[xiv] Alexi Clarke, "Windfarm Location and Environmental Impact" Open University, Milton Keynes, June 1998, pp 55 - 57, and Derek Taylor and Marcus Rand, "How to Plan the Nuisance Out of Wind Energy" Town and County Planning, May 1991, pp 152 - 155.

[xv] "Assessment of Ice Throw Risk for the Proposed Huron Wind Farm" document number 3174/BR/01 by Garrad Hassan and Partners Limited for Ontario Power Generation, dated April 30, 2002, which was received from Enbridge Ontario Wind Project to William Palmer, dated June 12, 2006, as an attachment to their letter of reply to my previous correspondence. The Enbridge cover letter states "The majority of the ice falls directly in the area below the turbines … according to the attached *Assessment of Ice Throw Risk for the Proposed Huron Wind Farm*, the risk of ice throw impacts from the wind farm is negligible." However, in fact, Section 3.2 "Observations at Site" in the *Assessment* notes in tabular format 13 icing events from 14 Dec 1995 to 1 April 2001 for the Tacke TW600 wind turbine at the Bruce Information Centre including comments such as, "10 Jan 1998, Many ice pieces, largest piece 12 x 12 x 2 inches, pieces up to 100 m from turbine." Or "23 Feb 1996, about 1 ton of ice on the ground. During my weekly inspection, found many pieces of ice at the base of the turbine. .. estimated about 1000 pieces of ice on the ground … largest pieces were 5 inches long 2 inches think and 2 inches wide. The Pieces were scattered up to 100 metres from the base of the windmill." It is of interest to note that the Tacke turbine has a blade radius of 21 metres, and thus the report sent to substantiate the claim in the Enbridge letter that the ice would fall "directly in the area below the turbine" hardly did so then it documented ice pieces were recorded at up to 100 metres away from the turbine base.

[xvi] "Risk Analysis of Ice Throw From Wind Turbines" by Henry Sieffert, a paper presented at BOREAS 6, April 2003, notes the calculation of ice throw from turbines

both operating and at standstill. The paper notes conclusions from the WECO (Wind Energy production in COld climates) work and gives the equations d = (D + H) x 1.5 for operating turbines and d = (v/15) x (D/2 + H) for shutdown turbines, where d = ice throw distance in metres, D = rotor diameter in metres, H = hub height in metres, v = wind velocity in metres/sec.

Solving for a turbine with D = 82 metres, H = 80 metres, and v = 10 metres per second (typical figures for modern wind turbines) finds the operating turbine ice throw distance as 243 metres, and the shutdown ice throw distance as 80 metres. (A higher wind speed of 20 metres per second as might occur at hub height would result in a shutdown turbine ice throw distance of 161 metres.)

[xvii] M.P. Lablanc, Garrad Hassan, "Recommendations for Risk Assessments of Ice Throw and Blade Failure in Ontario" Document Number 38079/OR/01. Prepared for Canadian Wind Energy Association, 31 May 2007, posed on the CANWEA Web Site.

[xviii] "Risk Analysis of Ice Throw from Wind Turbines" by Henry Sieffert et al, DEWI (German Wind Institute), 2003.

[xix] CANWEA fact sheet 7, "Visual and Sound" states, "At 300 meters from the base, the sound they (modern wind turbines) make has been electronically measured and compared to a whispering voice." See www.canwea.ca and note the link to "Fact Sheets"

[xx] "Info Sheet, How Can Municipalities Encourage Wind Energy Development" on the Ontario Ministry of Energy Web site states, "Did you know … ambient noise from passing cars or rustling leaves is often greater than the sound of a wind turbine." See www.energy.gov.on.ca/english/pdf/conservation/2131027_windturbines.pdf

[xxi] "Manufacturers of modern wind turbines have also reduced noise levels to that of a quiet whisper." See Ontario Power Authority web site http://www.powerauthority.on.ca/Page.asp?PageID=924&SiteNodeID=234

[xxii] See "A Quiet Solution – Noise Levels" that defines a "soft whisper" as 15 dBA, or a "whisper or rustling leaves" as 20 dBA at www.quietsolution.com/Noise_Levels.pdf

[xxiii] Ontario Ministry of the Environment "Noise Guidelines for Wind Farms", October 2008. To view go to the Environmental Registry Website at www.ebr.gov.on.ca and enter registry number 010-3595. The Decision Notice contains a link to the final Noise Guidelines for Wind Farms.

[xxiv] "Evaluation of Wind Shear Patterns at Midwest Wind Energy Facilities" May 2002, N. Kelly and B. Smith, National Renewable Energy Laboratories, US Department of Energy, report NREL/CP-500-32492 available at www.nrel.gov/docs/fy02osti/32492.pdf also, "The Sounds of High Winds: the effect of atmospheric stability on wind turbine

sound and microphone noise", Rijksuniversiteit Groningen, (12 May 2006) Godefridus (Frits) P. van den Berg.

[xxv] "Wind Power Metrology" Erik L. Petersen, Niels G. Mortensen, Lars Landberg, Jørgen Højstrup and Helmut P. Frank, Risø National Laboratory, Roskilde, Denmark December 1997.

[xxvi] Presentation by Dr. James W.S. Young, PhD., P.Eng. to Ontario Municipal Board Hearing PL060986, dated 22 March 2007.

[xxvii] "At the closest residence, the sound of the wind turbine generators is principally discernable as a characteristic repetitive "swoosh" sound." Brian Howe, HGC Engineering (principal sound consultant for CANWEA) "Assessment of Sound and Infrasound at the Pubnico Point Wind Farm". Second International Wind Turbine Noise Conference, 2007 Lyon.

[xxviii] Ontario Ministry of the Environment, Ontario MoE Regulation NPC-104 requires that a 5-dBA penalty be applied for cyclic noise, "*Cyclic Variations"*
"If a sound has an audible cyclic variation in sound level such as beating or other amplitude modulation then the observed value shall be increased by 5." Available via the Ministry of the Environment Web Site, www.ene.gov.on.ca

[xxix] "Special attention should also be given to: noise sources in an environment with low background sound levels; combinations of noise and vibrations; and to noise sources with low-frequency components." … "It should be noted that low-frequency noise, for example, from ventilation systems, can disturb rest and sleep even at low sound pressure levels." … "When noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. For noise with a large proportion of low-frequency sound a still lower guideline value is recommended." … "Sound levels during the evening and night should be 5–10 dB lower than during the day. Noise with low-frequency components require lower guideline values." … "If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low-frequency components are present, noise measures based on A-weighting are inappropriate. The difference between dB(C) and dB(A) will give crude information about the presence of low-frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health." World Health Organization, Guidelines for Community Noise, edited by Brigitta Berglund, Thomas Lindvall, Dietrich H Schwala,

[xxx] "Uncloaking the Nature of Wind Turbines – Using the Science of Meteorology" William KG Palmer, presented to the Second International Meeting on Wind Turbine Noise, Lyon France, September 2007. www.windturbinenoise.com

[xxxi] E Mail, G.W. Tomlinson, Senior Environmental Officer, MOE to Ms. Barbara Ashbee-Lormand, January 21, 2009 – Subject Re: Windmill Noise

[xxxii] "Infrasound and low frequency noise dose responses: Contributions" by Mariana Alves-Pereira (ERIAS-Universidada Lusofona, Lisbon, Portugaul) and Nuno A.A. Castelo Branco (Center for Human Performance, Alverca, Portugal). Presented at Inter-Noise 2007, Istanbul, Turkey.

[xxxiii] Toyota Prius II Battery Pack, described in http://www.cleangreencar.co.nz/page/prius-battery-pack uses consists of 38 prismatic NiMH modules connected in series. It delivers a nominal 273.6 Volts and has a 6.5 Ah capacity (or 1778 watt hours = 0.00178 MWh). The battery pack weighs 53.3 kg

[xxxiv] Proceedings of the Wind Energy and Birds/Bats Workshop: Understanding and Resolving Bird and Bat Impacts Washington, DC May 18-19, 2004, Co-Sponsored by The American Wind Energy Association and The American Bird Conservancy. *"Wind energy is able to generate electricity without many of the environmental impacts (air and water pollution, mercury emissions, and greenhouse gas emissions) associated with other energy sources. This can significantly benefit birds, bats, and many other plant and animal species. However**, the direct and indirect local impacts of wind plants on birds and bats continue to be an issue**. The populations of many bird and bat species are experiencing long-term declines, due to the effects not only of energy use, but of many other human activities."*