

REPORT

PLANNING SERVICES

Meeting: GENERAL PURPOSE AND ADMINISTRATION COMMITTEE

Date: June 21, 2010 **Resolution #:** **By-law #:** N/A

Report #: PSD-078-10 **File #:** PLN 29.10

Subject: GREEN ENERGY ACT

RECOMMENDATIONS:

It is respectfully recommended that the General Purpose and Administration Committee recommend to Council the following:

1. THAT Report PSD-078-10 be received; and
 2. THAT any interested parties listed in Report PSD-078-10 be notified of Council's decision.
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Submitted by: 
Faye Langmaid/FCSLA, MCIP,
Acting Director of Planning Services

Reviewed by: 
Franklin Wu,
Chief Administrative Officer

FL/av
June 10, 2010

1.0 PURPOSE:

1.1 At the May 31st meeting, Council requested:

“That Municipal Staff provide a detailed report regarding wind turbine installations in the Municipality of Clarington, including the implications of the Green Energy Act upon Clarington residents.”

1.2 While Council was specific in requesting information on wind turbine installations, the Green Energy Act involves other forms of green power generation and the information regarding the background and process are general to all the forms of green energy covered by the Act. As such the report includes additional information beyond potential wind turbine installations in Clarington.

2.0 BACKGROUND

2.1 Ontario's Green Energy Act (GEA), and related amendments to other legislation, received Royal Assent on May 14, 2009. Regulations and other tools to implement the legislation were introduced through the month of September, 2009.

2.2 A Renewable Energy Facilitation Office (REFO) has been created within the Ministry of Energy and Infrastructure. The objectives of the Office are:

- a) to facilitate the development of renewable energy projects;
- b) to assist proponents with the approval processes and procedures, including public consultation, and
- c) to assist proponents of renewable energy projects with other potential requirements imposed by the Government of Canada.

2.3 The new Renewable Energy Approval (REA) process will support the Green Energy initiative and the Ontario Government's Climate Change Action Plan that aims to reduce greenhouse gas emissions, increase renewable energy generation and energy conservation and create thousands of green jobs in Ontario. Information on "Frequently Asked Questions" is available from the REFO office or on the website (Attachment 1).

2.4 The REA integrates provincial review of the environmental issues and concerns that were previously addressed through the local land use planning process (e.g. zoning or site planning), the environmental assessment process and the environmental approvals process (e.g. Certificates of Approval, Permits to Take Water). Municipalities no longer have an approval role for Green Energy projects, rather they have an information provision and commenting role.

3.0 REQUIREMENTS FOR A RENEWABLE ENERGY APPROVAL

3.1 Regardless of the renewable energy source (wind, solar, biogas and biomass, waterpower, geothermal) used to generate electricity most applications for an REA will require a core set of reports:

- a project description report;
- a construction plan report;
- a design and operations report;
- a decommissioning plan report; and
- a consultation plan report.

3.2 Additional documents will be required depending on the project location, equipment or technology being used to generate electricity. Requirements for technical reports are identified for each type of renewable energy generation facility. Drafts of these documents, among others, must be made available to the public by the applicant at least 60 days prior to the date of their final public consultation meeting, which must occur prior to submission of an application for an REA.

3.3 Under the REA Regulation, the different types of renewable energy generation facilities are categorized by class. Each class of project has unique requirements based on their nameplate capacity. Nameplate capacity is the maximum rated output of a generator under specific conditions designated by the manufacturer. Generator nameplate capacity is usually indicated in units of kilovolt-amperes (kVA) and in kilowatts (kW) on a nameplate physically attached to the energy generator.

RENEWABLE ENERGY SOURCE	REQUIRE REA?	GENERAL INFORMATION/NOTES
Wind Facilities		
Generating less than or equal to 3 kW of power.	NO	These turbines can generate enough energy to power your dishwasher and fridge.
Generating more than 3 kW but less than 50 kW.	YES. However, the requirements are scaled down to reflect the low impact nature of the facility.	These facilities are sometimes called "small wind" and could support from 2 to 38 households, or supplement a small commercial operation.
Generating 50 kW and over.	YES	These facilities could supplement larger scale industrial needs or more households than "small wind" facilities.
Solar Energy Facilities		
Any size roof-top or wall-mounted.	NO. However most facilities mounted on buildings, may require a municipal building permit.	Residential uses such as domestic hot water, pools; Commercial use to feed back into the grid.
Ground mounted generating less than or equal to 10 kW.	NO	These are typically found at hardware and outdoor stores.

RENEWABLE ENERGY SOURCE	REQUIRE REA?	GENERAL INFORMATION/NOTES
Ground mounted generating over 10 kW.	YES	The average power requirement of 5 to 10 mid-sized homes is 10 kW.
<p>Note: The Regulation does not contain provisions for ground mounted solar energy facilities based on soil classification (e.g. prime agricultural land). However, a directive issued by the Minister of Energy and Infrastructure to the Ontario Power Authority (OPA) for the Feed-in Tariff program instructs the OPA not to enter into contracts for ground-mounted solar photovoltaic facilities located on certain classes of prime agricultural lands and specialty crop lands.</p>		
Bio-Energy Facilities		
Thermal treatment, anaerobic digestion, biofuel combustion (e.g. biodiesel), and biogas.	YES. The requirements that must be met vary depending on the project location (e.g. on a farm), feedstock material and size (e.g. greater or less than 500 kW).	Other permits may be required for off-site inputs (i.e. Restaurant - food waste).
Water Power Facilities		
Wave energy, run of the river.	NO. These projects continue to require relevant environmental assessment and approvals processes under the Ministries of the Environment and Natural Resources.	Hydroelectric dams follow an entirely different process.

4.0 REQUIREMENTS SPECIFIC TO WIND TURBINES

4.1 The GEA sets out a number of classes for wind energy depending on the scale of the development. Much of the municipal and public concerns have been with respect to large scale turbines, rather than for small or micro sized turbines. The setbacks under the GEA for large scale wind turbines are shown in Figure 1 below:

Number of Wind Turbines	Setback in metres (m) from closest Point of Reception corresponding to wind turbine Sound Power Levels in decibels (dBA)				
	102 dBA	103 – 104 dBA	105 dBA	106-107 dBA	>107 dBA
1 - 5 turbines	550 m	600 m	850 m	950 m	Noise study required
6 - 10 turbines	650 m	700 m	1000 m	1200 m	
11 - 25 turbines	750 m	850 m	1250 m	1500 m	
26 + turbines	Noise study required				

4.2 Ontario Regulation 359/09 sets out the information requirements and processing requirements surrounding Renewable Energy Approvals for projects such as the large scale wind developments. Although noise and environmental studies can be required and mandatory minimum setbacks have been imposed; concern remains that the standards do not adequately address the human health concerns associated with wind farms. Separate requirements are also outlined for offshore wind projects, which are categorized as Class 5 Wind Facilities. An Off-shore Wind Facility Report is required for any Class 5 Wind Facility, as per O. Reg. 359/09.

5.0 MANDATORY CONSULTATION REQUIREMENTS

5.1 A component of the REA process is consultation with the general public, aboriginal groups and local municipality(s). A proponent must document what was learned through public consultation including how the project was changed in light of this information.

5.2 Public Consultation includes contact with landowners within 120 metres, a notice in the local newspaper and at least two public meetings. All of the studies and reports required as part of the REA process must be made available for public review prior to the last public meeting. Some small scale wind projects (generating less than 50 kW) are not subject to the public meetings or municipal consultation requirements of the Regulation.

5.3 Consultation with the municipality (or municipalities) is required for most renewable energy projects and must begin at least 90 days prior to the date of the final public consultation meeting. This must also be before the applicant submits an REA application. The Ministry of the Environment provides applicants with a form to document municipal feedback on matters related to municipal services and local infrastructure. The prescribed consultation form has two pages of questions for the Municipality to respond to.

5.4 The questions seek information regarding:

- Roads (access, Traffic Management Plans);
- Service Connections (location of service connections other than roads);
- Facility Other (landscape design, emergency procedures, easements); and
- Project Construction (site rehabilitation, locations of buried and above ground utilities, building code issues, natural and cultural heritage features).

5.5 The Municipality introduced a new fee for 2010 regarding the provision of comments and information for renewable energy projects.

5.6 Through the REA process, a proponent must consult, not *seek approval* from the Municipality. The only exception to this is when a renewable energy project requires the removal and use of aggregate materials. In this case, municipal approvals are sought for the aggregate license, not the REA.

6.0 RECENT CONTRACT APPROVALS BY ONTARIO POWER AUTHORITY

- 6.1 On April 8, 2010 Ontario Power Authority released the listing of contracts they have offered. The feed-in-tariff (FIT) administered by Ontario Power Authority is a straightforward way to contract for renewable energy generation. It provides standardized program rules, prices and contracts. Feed-in tariffs refer to the specific prices paid to renewable energy suppliers for the electricity produced by the generating facility. The pricing structure provides a reasonable return on investment and is differentiated by project size and technology type. The FIT Program is for projects over 10 kilowatts; and the microFIT Program is for projects 10 kilowatts or less.
- 6.2 Three contracts were offered FIT contracts, that affect Clarington. ZEP Windfarm Ganaraska in the Orono area, Clarington Windfarm by Leader Energy and Hybridyne Solarfarm. The Hybridyne Solarfarm proceeded with a rezoning application in advance of the Green Energy Act being introduced. As such, the Municipality played a more significant role and have more knowledge of this project.

7.0 WIND TURBINE PROPOSALS IN CLARINGTON

- 7.1 The Windfarms that have been proposed in Clarington have posted to their websites the area that they are studying (Attachment 2). The two windfarm projects have not to date consulted with the Municipality although we have been notified of their proposals. The ZEP Windfarm proponents held a public meeting in July 2009 in Orono.
- 7.2 The Clarington Wind Farm proposed by Leader Energy is for a 10 MegaWatt FIT contract which would be between 3-5 turbines. While the study area identified is large, the specific location of the turbines has not been provided to the Municipality.
- 7.3 The Ganaraska Wind Farm proposed by ZEP is for a 20 MegaWatt FIT contract which is 6-10 turbines. Again, the study area identified is large and the specific sites have not been provided to the Municipality, to date.
- 7.4 It is our understanding, the specific locations will not be made public until the 90 day REA consultation period is initiated by the proponents.

8.0 HEALTH ISSUES RELATED TO WIND TURBINES

8.1 Public and Municipal Concerns with Respect to Renewable Energy Development

Although there are a range of public concerns from aesthetic to environmental, one of the most prominent local concerns has been the impact of large scale wind turbines on human health. In areas of Bruce and Dufferin Counties, where wind farms are already constructed, there have been a number of cases of 'wind turbine syndrome', which has symptoms including:

- Loss of sleep or sleep disturbance,
- Headaches / migraines,

- Inner ear ringing or Tinnitus,
- Dizziness,
- Vertigo,
- Blurred vision,
- Heart palpitations,
- High blood pressure,
- Psychological stress, or
- Gastrointestinal problems.

Although the GEA includes setbacks of a minimum of 550 metres to sensitive receptors, members of the public concede that this distance is insufficient to combat known and unknown human health impacts.

- 8.2 In the past two years there have been three notable studies by medical professionals which has concluded that there are no known adverse health impacts from wind turbines, where the turbines have been properly sited:
1. *"Wind Turbine Sound and Health Effects An Expert Panel Review"* prepared for AWEA and CANWEA.
 2. *"The Health Impact of Wind Turbines: A Review of the Current White, Grey, and Published Literature"* prepared by Chatham-Kent Public Health Unit.
 3. *"The Potential Health Impact of Wind Turbines"* prepared by the Chief Medical Officer of Health recently released by the Association of Municipalities of Ontario (Attachments 3 and 4).

9.0 CONCLUSIONS

- 9.1 The Green Energy Act and the related regulations, exclude municipalities (both upper and lower tier) from the approval process. Council could support or oppose a project by notifying the Ministry of Energy and Infrastructure in writing. Council can also express to the proponent their support or opposition to a project.
- 9.2 The municipal role is to provide the information required on the Consultation Form when requested. The Consultation Form is provided by the proponent as part of the REA process. The Municipality has set a \$5,000 fee to prepare this information. To date, other than Hybridyne Solarfarm, no requests for information have been submitted to the Municipality.
- 9.3 The REA process is administered by the Renewable Energy Facilitation Office. The Municipality will continue to provide as much information to the public and assist the REA process as much as possible.

Attachments:

Attachment 1 - Frequently Asked Questions –Renewable Energy Approval:

http://www.mei.gov.on.ca/en/energy/renewable/index.php?page=refo_office

Attachment 2 – Windfarm Study Areas in Clarington

Attachment 3 – AMO Policy Update – Wind Turbines

Attachment 4 – Synopsis:

http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf

Frequently Asked Questions – Renewable Energy Approval

Why does the ministry believe a setback of 550 metres for wind turbines is a safe distance?

- The minimum setback for wind projects of 550 metres will ensure noise levels do not exceed 40 decibels at buildings used by people, such as a residence. Forty decibels is approximately the noise level experienced in a quiet office or library.
- The setbacks rise with the number of turbines and the sound level rating of selected turbines. For example, a turbine with a sound power level of 106 decibels has to meet a setback of 950 metres from the nearest receptor.
- We're confident that the science around 550 meters is sound. We used the most conservative modelling available nationally and internationally, and our experiences in Ontario and that of other jurisdictions supports this.
- Going forward, the Ministry of the Environment will develop the science to monitor and measure low frequency noise, as currently there are no established and accepted protocols. In the future, wind farm operators may be required, through conditions of the Renewable Energy Approval, to monitor and address perceptible low frequency noise once acceptable protocols for doing so have been established.

Will renewable energy development be permitted in wetlands and other ecologically sensitive areas?

- Protecting significant natural features such as wetlands and the hydrologic functions they support are important to this government.
- The REA establishes clear rules to continue to protect significant natural features and sensitive water bodies so that renewable energy project applicants know they must protect these important features and the hydrologic functions they support.
- Renewable energy facilities will not be permitted in provincially significant wetlands in Southern Ontario or coastal wetlands.
- In some instances a renewable energy facility may be permitted within 120 metres of provincially significant wetlands, but only if an environmental impact study demonstrates the ability to mitigate negative effects and is confirmed by the MNR.

How will species at risk, birds and bats be protected?

- The ministry is committed to ensuring that renewable energy projects are protective of the natural environment.
- Existing rules under MNR's Endangered Species Act will remain. Applicants must obtain a permit under the Endangered Species Act from MNR should their project have the potential to negatively affect a species or habitat protected under the Act.
- As part of the REA for most project types, a study of the potential impacts on wildlife habitat must be completed to the satisfaction of the MNR.
- The proposed process integrates existing study requirements with provincial standards to ensure the natural environment is protected.

How will the environment be protected now that the Environmental Assessment Act powers have been removed?

- The new process integrates existing previous study requirements with provincial standards to ensure the natural environment is protected.
- The Renewable Energy Approval process ensures transparent decision making and provides opportunity for public participation in the process.
- The new process replaces what was largely a proponent driven environmental assessment framework and replaces it with clear provincial rules and requirements.

How will the new approval process be any faster than the existing process?

- The ministry has introduced a streamlined approvals process and a service guarantee that bring with them greater certainty for developers who follow the rules.

How will I be consulted if there's a project in my community?

- The renewable energy approval process ensures transparent decision making and provides opportunity for public participation in the process.
- Applicants must provide written notice to all adjacent land owners, as well as public notice within a 120 metre radius of the proposed renewable energy generation facility at a preliminary stage of the project planning, and post at least two consecutive notices in a local newspaper.
- For most projects, applicants must also consult with local municipalities on specific matters related to municipal land, infrastructure, services and information and will be required to post a notice in a local newspaper of general circulation within the municipality where the project is located.
- Once ready to submit the application for Ministry of the Environment review, the applicant will be required to hold at least two community consultation meeting to discuss the project and its potential local impact.
- Any required studies must be made available for public review 60 days prior to the date of the second or final community consultation meeting.
- Municipal input is an important part of the REA process, and through a transparent decision making process local concerns can be addressed in a timely manner.

How will Aboriginal communities be consulted and the impacts on their rights considered as part of the approval?

- Aboriginal consultation will be mandatory for the applicant as part of the regulatory requirements for a Renewable Energy Approval.
- While the Crown will delegate certain procedural aspects of consultation to an applicant, the duty to consult rests with the Crown. The Crown will work to ensure that the duty to consult is fulfilled prior to a project being eligible for approval.
- During this process, aboriginal communities will have an opportunity to raise issues and concerns with the applicant and the ministry.
- If the applicant has not already appropriately considered impacts on Aboriginal and treaty rights, the Director can direct them to go back and consult before accepting their application for review.
- The Director will also consider the impacts of a project on aboriginal and treaty rights when setting conditions in the renewable energy approval.

What role will municipalities have in siting wind turbine projects?

- The ministry recognizes the importance of local decision making with respect to specific matters related to municipal land, services and information.
- A proponent of a renewable energy project will have to consult with local municipalities prior to applying for a Renewable Energy Approval.
- The ministry has developed a template for this consultation, which the proponent will use to relay project specific matters raised by the municipality. This document is to be submitted to the ministry as part of the application.
- The renewable energy approval process would ensure transparency of decision making and provide opportunity for municipal engagement in the process.

How do I know if my project needs approval?

- **Wind power** facility projects over three kW will require a Renewable Energy Approval (REA). The requirements that must be met to obtain a REA vary depending on the project's output (mW). For wind facilities generating between three and 50 kW, known as small wind projects, requirements are simplified and there are no mandatory setbacks. Facilities mounted on buildings may require building permits. For further information, contact the local building permit department.
- **Solar power** facility projects that are roof-top or wall-mounted solar facilities are exempt from a Renewable Energy Approval. Any ground-mounted solar facility capable of producing over 10 kW will require a REA. Ten kW is the average energy requirements of five to 10 households and uses a surface area of about 55 square metres.

- **Bio-energy** power facility projects must use biogas or biomass source material as defined under the Electricity Act. Bio-energy projects that are located on a farm and are already subject to an approved Nutrient Management Strategy under the Nutrient Management Act are exempt from obtaining a Renewable Energy Approval.
- **Water power** facility projects do not require a Renewable Energy Approval. The Water Power Class Environmental Assessment dated October 2008 is the source document for understanding the rules governing the development of water power projects. Water power projects must also obtain the existing permits and approvals from the Ministry of the Environment and Ministry of Natural Resources.
- For more information on renewable energy generation projects, and what is required for approvals, please contact the **Renewable Energy Facilitation Office** at REFO@ontario.ca or 1-877-440-REFO(7336) or (416) 212-6582.

As a developer do I have to send multiple applications to different ministries to get my project approved?

- The Ministry of the Environment now has a single approval. The process integrates existing study requirements with provincial standards to ensure the natural environment is protected.
- The Ministry of Natural Resources will continue to issue its approvals under its existing legislation but in a fashion that is coordinated with the Renewable Energy Approval providing clear guidance to help proponents through the process.
- Though multiple approvals are being issued based on experience and mandates of various ministries there will still be a one-window approach for renewable energy project approvals through a facilitator's office.

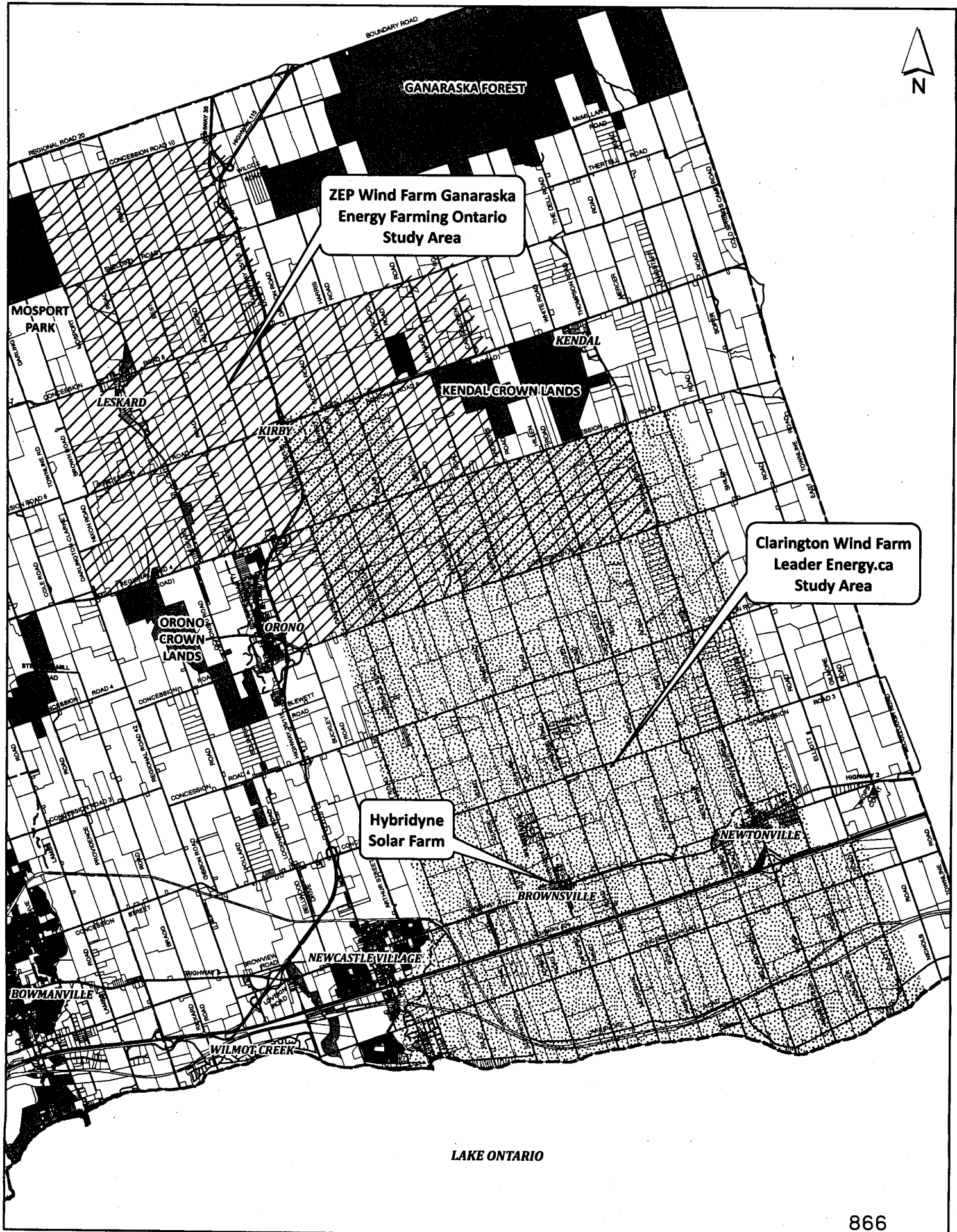
What happens to wind and other renewable energy projects that are part way through the current approval process?

- It is proposed that projects currently holding all required approvals for their facility, such as a Certificate of Approval, will not require a Renewable Energy Approval and will not be subject to the new rules, unless or until an amendment to the Certificate of Approval is required.
- The ministry recognizes that there are projects where substantial work has been done to date but yet all final approvals have not been obtained.
- Projects that have an Ontario Power Authority contract and have issued a notice of Completion at the time of the regulation's proclamation continue with EA process and apply for a Certificate of Approval. These projects, however, must comply with the 550 metre minimum noise setback and the new property and road setbacks will apply.
- Some projects – such as solar and biogas/biomass – do not require an environmental approval under the current rules, but will require a REA under the new rules. If these projects have an OPA contract and would have not been prohibited under municipal zoning prior to proclamation, they will be able to apply for a Certificate of Approval instead of a Renewable Energy Approval.

- It is proposed that where projects that have ministry approvals (e.g., a Permit to Take Water or Certificate of Approval) will not be required to get a Renewable Energy Approval unless there is a need for a change to the approval or permit.

What if I have a question about the application? Is there someone that I can contact for more information/assistance?

- For more information, please contact the Renewable Energy Facilitation Office (REFO) by email: REFO@ontario.ca, or by telephone: 1-877-440-REFO(7336) or (416) 212-6582





AMO Policy Update – May 27, 2010

Wind Turbines

Chief Medical Officer of Health Releases Review of Potential Health Impact of Wind Turbines

A technical working group led by the Chief Medical Officer of Health (CMOH) has just released a synopsis of existing scientific evidence on the potential health impact of noise generated by wind turbines. The results are of interest to the municipal sector because the working group sought to answer questions commonly raised by those concerned with perceived health effects of wind turbines such as:

- What scientific evidence is available on the potential health impacts of wind turbines?
- What is the relationship between wind turbine noise and health?
- What is the relationship between low frequency sound, infrasound and health?
- How is exposure to wind turbine noise assessed?
- Are Ontario wind turbine setbacks protective from potential wind turbine health and safety hazards?
- What consultation process with the community is required before wind farms are constructed?
- Are there data gaps or research needs?

The review concludes that while some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. There was no support for claims that the noise, shadow flicker, electromagnetic fields, vibration, ice throw, or low frequency sound associated with wind turbines cause adverse health effects.

In terms of the regulatory environment governing wind turbines (a synopsis of which is available under Policy Issues on the AMO website), the report found the 550 m setback is adequate but that community engagement deserves "greater attention in future developments". Early engagement of the affected community at the outset of planning for wind turbines is important to not only address perceived health concerns about wind farms but also to address issues of fairness and equity, which also may influence attitudes about effects on health.

AMO Contact: Scott Vokey, Energy Services Coordinator, email: svokey@amo.on.ca, (416) 971-9856 ext. 357

The Potential Health Impact of Wind Turbines

Chief Medical Officer of Health (CMOH) Report
May 2010

Summary of Review

This report was prepared by the Chief Medical Officer of Health (CMOH) of Ontario in response to public health concerns about wind turbines, particularly related to noise.

Assisted by a technical working group comprised of members from the Ontario Agency for Health Protection and Promotion (OAHP), the Ministry of Health and Long-Term Care (MOHLTC) and several Medical Officers of Health in Ontario with the support of the Council of Ontario Medical Officers of Health (COMOH), this report presents a synopsis of existing scientific evidence on the potential health impact of noise generated by wind turbines.

The review concludes that while some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct health effects, although some people may find it annoying.

1

Introduction

In response to public health concerns about wind turbines, the CMOH conducted a review of existing scientific evidence on the potential health impact of wind turbines in collaboration and consultation with a technical working group composed of members from the OAHPP, MOHLTC and COMOH.

A literature search was conducted to identify papers and reports (from 1970 to date) on wind turbines and health from scientific bibliographic databases, grey literature, and from a structured Internet search. Databases searched include MEDLINE, PubMed, Environmental Engineering Abstracts, Environment Complete, INSPEC, Scholars Portal and Scopus. Information was also gathered through discussions with relevant government agencies, including the Ministry of the Environment and the Ministry of Energy and Infrastructure and with input provided by individuals and other organizations such as Wind Concerns Ontario.

In general, published papers in peer-reviewed scientific journals, and reviews by recognized health authorities such as the World Health Organization (WHO) carry more weight in the assessment of health risks than case studies and anecdotal reports.

The review and consultation with the Council of Ontario Medical Officers of Health focused on the following questions:

- What scientific evidence is available on the potential health impacts of wind turbines?
- What is the relationship between wind turbine noise and health?
- What is the relationship between low frequency sound, infrasound and health?
- How is exposure to wind turbine noise assessed?
- Are Ontario wind turbine setbacks protective from potential wind turbine health and safety hazards?
- What consultation process with the community is required before wind farms are constructed?
- Are there data gaps or research needs?

The following summarizes the findings of the review and consultation.

Wind Turbines and Health

2.1 Overview

A list of the materials reviewed is found in Appendix 1. It includes research studies, review articles, reports, presentations, and websites.

Technical terms used in this report are defined in a Glossary (Page 11).

The main research data available to date on wind turbines and health include:

- Four cross-sectional studies, published in scientific journals, which investigated the relationships between exposure to wind turbine noise and annoyance in large samples of people (351 to 1,948) living in Europe near wind turbines (see section 2.2).
- Published case studies of ten families with a total of 38 affected people living near wind turbines in several countries (Canada, UK, Ireland, Italy and USA) (Pierpont 2009). However, these cases are not found in scientific journals. A range of symptoms including dizziness, headaches, and sleep disturbance, were reported by these people. The researcher (Pierpont) suggested that the symptoms were related to wind turbine noise, particularly low frequency sounds and infrasound, but did not investigate the relationships between noise and symptoms. It should be noted that no conclusions on the health impact of wind turbines can be drawn from Pierpont's work due to methodological limitations including small sample size, lack of exposure data, lack of controls and selection bias.
- Research on the potential health and safety hazards of wind turbine shadow flicker, electromagnetic fields (EMFs), ice throw and ice shed, and structural hazards (see section 2.3).

A synthesis of the research available on the potential health impacts of exposure to noise and physical hazards from wind turbines on nearby residents is found in sections 2.2 and 2.3, including research on low frequency sound and infrasound. This is followed by information on wind turbine regulation in Ontario (section 3.0), and our conclusions (section 4.0).

2.2. Sound and Noise

Sound is characterized by its sound pressure level (loudness) and frequency (pitch), which are measured in standard units known as decibel (dB) and Hertz (Hz), respectively. The normal human ear perceives sounds at frequencies ranging from 20Hz to 20,000 Hz. Frequencies below 200 Hz are commonly referred to as "low frequency sound" and those below 20Hz as "infrasound," but the boundary between them is not rigid. There is variation between people in their ability to perceive sound. Although generally considered inaudible, infrasound at high-enough sound pressure levels can be audible to some people. Noise is defined as an unwanted sound (Rogers et al. 2006, Leventhall 2003).

Wind turbines generate sound through mechanical and aerodynamic routes. The sound level depends on various factors including design and wind speed. Current generation upwind model turbines are quieter than older downwind models. The dominant sound source from modern wind turbines is aerodynamic, produced by the rotation of the turbine blades through air. The aerodynamic noise is present at all frequencies, from infrasound to low frequency to the normal audible range, producing the characteristic "swishing" sound (Leventhall 2006, Colby et al. 2009).

Environmental sound pressure levels are most commonly measured using an A-weighted scale. This scale gives less weight to very low and very high frequency components that is similar to the way the human ear perceives sound. Sound levels around wind turbines are usually predicted by modelling, rather than assessed by actual measurements.

The impact of sound on health is directly related to its pressure level. High sound pressure levels (>75dB) could result in hearing impairment depending on the duration of exposure and sensitivity of the individual. Current requirements for wind turbine setbacks in Ontario are intended to limit noise at the nearest residence to 40 dB (see section 3). This is a sound level comparable to indoor background sound. This noise limit is consistent with the night-time noise guideline of 40 dB that the World Health Organization (WHO) Europe recommends for the protection of public health from community noise. According to the WHO, this guideline is below the level at which effects on sleep and health occurs. However, it is above the level at which complaints may occur (WHO 2009).

Available scientific data indicate that sound levels associated with wind turbines at common residential setbacks are not sufficient to damage hearing or to cause other direct adverse health effects, but some people may still find the sound annoying.

Studies in Sweden and the Netherlands (Pedersen et al. 2009, Pedersen and Waye 2008, Pedersen and Waye 2007, Pedersen and Waye 2004) have found direct relationships between modelled sound pressure level and self-reported perception of sound and annoyance. The association between sound pressure level and sound perception was stronger than that with annoyance. The sound was annoying only to a small percentage of the exposed people; approximately 4 to 10 per cent were very annoyed at sound levels between 35 and 45dBA. Annoyance was strongly correlated with individual perceptions of wind turbines. Negative attitudes, such as an aversion to the visual impact of wind turbines on the landscape, were associated with increased annoyance, while positive attitudes, such as direct economic benefit from wind turbines, were associated with decreased annoyance. Wind turbine noise was perceived as more annoying than transportation or industrial noise at comparable levels, possibly due to its swishing quality, changes throughout a 24 hour period, and lack of night-time abatement.

2.2.1 Low Frequency Sound, Infrasound and Vibration

Concerns have been raised about human exposure to “low frequency sound” and “infrasound” (see section 2.2 for definitions) from wind turbines. There is no scientific evidence, however, to indicate that low frequency sound generated from wind turbines causes adverse health effects.

Low frequency sound and infrasound are everywhere in the environment. They are emitted from natural sources (e.g., wind, rivers) and from artificial sources including road traffic, aircraft, and ventilation systems. The most common source of infrasound is vehicles. Under many conditions, low frequency sound below 40Hz from wind turbines cannot be distinguished from environmental background noise from the wind itself (Leventhall 2006, Colby et al 2009).

Low frequency sound from environmental sources can produce annoyance in sensitive people, and infrasound at high sound pressure levels, above the threshold for human hearing, can cause severe ear pain. There is no evidence of adverse health effects from infrasound below the sound pressure level of 90dB (Leventhall 2003 and 2006).

Studies conducted to assess wind turbine noise indicate that infrasound and low frequency sounds from modern wind turbines are well below the level where known health effects occur, typically at 50 to 70dB.

A small increase in sound level at low frequency can result in a large increase in perceived loudness. This may be difficult to ignore, even at relatively low sound pressures, increasing the potential for annoyance (Jakobsen 2005, Leventhall 2006).

A Portuguese research group (Alves-Pereira and Castelo Branco 2007) has proposed that excessive long-term exposure to vibration from high levels of low frequency sound and infrasound can cause whole body system pathology (vibro-acoustic disease). This finding has not been recognized by the international medical and scientific community. This research group also hypothesized that a family living near wind turbines will develop vibro-acoustic disease from exposure to low frequency sound, but has not provided evidence to support this (Alves-Pereira and Castelo Branco 2007).

2.2.2 Sound Exposure Assessment

Little information is available on actual measurements of sound levels generated from wind turbines and other environmental sources. Since there is no widely accepted protocol for the measurement of noise from wind turbines, current regulatory requirements are based on modelling (see section 3.0).

2.3 Other Potential Health Hazards of Wind Turbines

The potential health impacts of electromagnetic fields (EMFs), shadow flicker, ice throw and ice shed, and structural hazards of wind turbines have been reviewed in two reports (Chatham-Kent Public Health Unit 2008; Rideout et al 2010). The following summarizes the findings from these reviews.

- **EMFs**
Wind turbines are not considered a significant source of EMF exposure since emissions levels around wind farms are low.
- **Shadow Flicker**
Shadow flicker occurs when the blades of a turbine rotate in sunny conditions, casting moving shadows on the ground that result in alternating changes in light intensity appearing to flick on and off. About 3 per cent of people with epilepsy are photosensitive, generally to flicker frequencies between 5-30Hz. Most industrial turbines rotate at a speed below these flicker frequencies.
- **Ice Throw and Ice Shed**
Depending on weather conditions, ice may form on wind turbines and may be thrown or break loose and fall to the ground. Ice throw launched far from the turbine may pose a significant hazard. Ice that sheds from stationary components presents a potential risk to service personnel near the wind farm. Sizable ice fragments have been reported to be found within 100 metres of the wind turbine. Turbines can be stopped during icy conditions to minimize the risk.
- **Structural hazards**
The maximum reported throw distance in documented turbine blade failure is 150 metres for an entire blade, and 500 metres for a blade fragment. Risks of turbine blade failure reported in a Dutch handbook range from one in 2,400 to one in 20,000 turbines per year (Braam et al 2005). Injuries and fatalities associated with wind turbines have been reported, mostly during construction and maintenance related activities.



Wind Turbine Regulation in Ontario

The Ministry of the Environment regulates wind turbines in Ontario. A new regulation for renewable energy projects came into effect on September 24, 2009. The requirements include minimum setbacks and community consultations.

3.1 Setbacks

Provincial setbacks were established to protect Ontarians from potential health and safety hazards of wind turbines including noise and structural hazards.

The minimum setback for a wind turbine is 550 metres from a receptor. The setbacks rise with the number of turbines and the sound level rating of the selected turbines. For example, a wind project with five turbines, each with a sound power level of 107dB, must have its turbines setback at a minimum 950 metres from the nearest receptor.

These setbacks are based on modelling of sound produced by wind turbines and are intended to limit sound at the nearest residence to no more than 40 dB. This limit is consistent with limits used to control noise from other environmental sources. It is also consistent with the night-time noise guideline of 40 dB that the World Health Organization (WHO) Europe recommends for the protection of public health from community noise. According to the WHO, this guideline is below the level at which effects on sleep and health occurs. However, it is above the level at which complaints may occur (WHO 2009).

Ontario used the most conservative sound modelling available nationally and internationally, which is supported by experiences in the province and in other jurisdictions (MOE 2009). As yet, a measurement protocol to verify compliance with the modelled limits in the field has not been developed. The Ministry of the Environment has recently hired independent consultants to develop a procedure for measuring audible sound from wind turbines and also to review low frequency sound impacts from wind turbines, and to develop recommendations regarding low frequency sound.

Ontario setback distances for wind turbine noise control also take into account potential risk of injury from ice throw and structural failure of wind turbines. The risk of injury is minimized with setbacks of 200 to 500 metres.

3.2 Community Consultation

The Ministry of the Environment requires applicants for wind turbine projects to provide written notice to all assessed land owners within 120 metres of the project location at a preliminary stage of the project planning. Applicants must also post a notice on at least two separate days in a local newspaper. As well, applicants are required to notify local municipalities and any Aboriginal community that may have a constitutionally protected right or interest that could be impacted by the project.

Before submitting an application to the Ministry of the Environment, the applicant is also required to hold a minimum of two community consultation meetings to discuss the project and its potential local impact. To ensure informed consultation, any required studies must be made available for public review 60 days prior to the date of the final community meeting. Following these meetings the applicant is required to submit as part of their application a Consultation Report that describes the comments received and how these comments were considered in the proposal.

The applicant must also consult directly with local municipalities prior to applying for a Renewable Energy Approval on specific matters related to municipal lands, infrastructure, and services. The Ministry of the Environment has developed a template, which the applicant is required to use to document project-specific matters raised by the municipality. This must be submitted to the ministry as part of the application. The focus of this consultation is to ensure important local service and infrastructure concerns are considered in the project.

For small wind projects (under 50 kW) the public meeting requirements above are not applicable due to their limited potential impacts.

4

Conclusions

The following are the main conclusions of the review and consultation on the health impacts of wind turbines:

- While some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects.
- The sound level from wind turbines at common residential setbacks is not sufficient to cause hearing impairment or other direct adverse health effects. However, some people might find it annoying. It has been suggested that annoyance may be a reaction to the characteristic “swishing” or fluctuating nature of wind turbine sound rather than to the intensity of sound.
- Low frequency sound and infrasound from current generation upwind model turbines are well below the pressure sound levels at which known health effects occur. Further, there is no scientific evidence to date that vibration from low frequency wind turbine noise causes adverse health effects.
- Community engagement at the outset of planning for wind turbines is important and may alleviate health concerns about wind farms.
- Concerns about fairness and equity may also influence attitudes towards wind farms and allegations about effects on health. These factors deserve greater attention in future developments.

The review also identified that sound measurements at residential areas around wind turbines and comparisons with sound levels around other rural and urban areas, to assess actual ambient noise levels prevalent in Ontario, is a key data gap that could be addressed. An assessment of noise levels around wind power developments and other residential environments, including monitoring for sound level compliance, is an important prerequisite to making an informed decision on whether epidemiological studies looking at health outcomes will be useful.

Glossary

A-weighted decibels (dBA)

The sound pressure level in decibels as measured on a sound level meter using an A-weighted filter. The A-weighted filter de-emphasizes the very low and very high frequencies of the sound in a manner similar to the frequency response of the human ear.

Decibel (dB)

Unit of measurement of the loudness (intensity) of sound. Loudness of normal adult human voice is about 60-70 dB at three feet. The decibel scale is a logarithmic scale and it increases/decreases by a factor of 10 from one scale increment to the next adjacent one.

Downwind model turbines

Downwind model turbines have the blades of the rotor located behind the supporting tower structure, facing away from the wind. The supporting tower structure blocks some of the wind that blows towards the blades.

Electromagnetic fields (EMFs)

Electromagnetic fields are a combination of invisible electric and magnetic fields. They occur both naturally (light is a natural form of EMF) and as a result of human activity. Nearly all electrical and electronic devices emit some type of EMF.

Grey literature

Information produced by all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing, i.e., where publishing is not the primary activity of the producing body.

Hertz (Hz)

A unit of measurement of frequency; the number of cycles per second of a periodic waveform.

Infrasound

Commonly refers to sound at frequencies below 20Hz. Although generally considered inaudible, infrasound at high-enough sound pressure levels can be audible to some people.

Low frequency sound

Commonly refers to sound at frequencies between 20 and 200 Hz.

Noise

Noise is an unwanted sound.

Shadow Flicker

Shadow flicker is a result of the sun casting intermittent shadows from the rotating blades of a wind turbine onto a sensitive receptor such as a window in a building. The flicker is due to alternating light intensity between the direct beam of sunlight and the shadow from the turbine blades.

Sound

Sound is wave-like variations in air pressure that occur at frequencies that can be audible. It is characterized by its loudness (sound pressure level) and pitch (frequency), which are measured in standard units known as decibel (dB) and Hertz (Hz), respectively. The normal human ear perceives sounds at frequencies ranging from 20Hz to 20,000 Hz.

Upwind model turbines

Upwind model turbines have the blades of the rotor located in front of the supporting tower structure, similar to how a propeller is at the front of an airplane. Upwind turbines are a modern design and are quieter than the older downwind models.

Wind turbine

Wind turbines are large towers with rotating blades that use wind to generate electricity.

Appendix 1: List of Documents on Wind Turbines

Journal Articles and Books

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