To: Inverness County Planning Advisory Committee

Inverness County Council

From: Planning Staff (EDPC)

Date: **July 6, 2023**

Reference: County of Inverness' Municipal Planning Strategy and Land Use By-law Concerning

the Regulation of Wind Turbine Development – Policy Review.

Recommendation:

This is a summary on the research conducted for the Wind Turbine Development Municipal Planning Strategy and Land Use By-law review. The purpose of this report is to inform Council and provide background information that compliments the Staff Report providing recommendations. There are two staff reports which address possible policy recommendations for Council's consideration. The first staff report includes short term recommendations related to setbacks of turbines from habitable dwellings. The second report includes a number of long term recommendations related to further citizen

Background Information:

Inverness County's MPS and LUB Concerning the Regulation of Wind Turbine Development were written in 2011 and last updated in 2012.

In May 2022, the Rhodena Wind Project was proposed by Community Wind Farms Inc. with ABO Wind Canada to place a wind farm of 15 turbines (reduced from 18 turbines) on the hills between Highway 19 and Trans-Canada Highway 105 along the coast.

In response to public concern, Planning Staff were tasked with reviewing the County's MPS and LUB regarding Wind Turbine Development by the Inverness County Council.

Overview of Wind Energy in Nova Scotia & the Benefits of Wind Energy:

In the 1970s, Nova Scotia had coal mines that provided cheap local electricity. However, many of the mines have closed since then. In 2015 only 20% of coal sourced by Nova Scotia Power was local, the rest was imported at a higher cost.

By March 2015, there were over 200 wind turbines in the Province of Nova Scotia. They provided 350 MW of power to the province, equivalent to powering 120,000 homes. Together, the turbines created a reduction of 800,000 tones in greenhouse gases annually and provided 60 full time positions for wind turbine operation and maintenance. The tax base for municipalities from wind turbines at that time was \$2 million dollars.

In 2015, wind energy made up 10% of the power Nova Scotians consumed. In 2021, wind energy made up 17% of the energy generated for Nova Scotia Power. Additionally in 2021, Nova Scotia Power had approximately 30% of its energy come from renewable sources. Presently, Nova Scotia Power is aiming for 80% renewable energy by 2030 and the Province of Nova Scotia is aiming to have net zero greenhouse gas emissions by 2050. This means the demand for wind energy will only increase. According to this wind map from Atlantic Centre for Energy, pictured below as Figure 1, Cape Breton holds significant potential for wind energy projects.

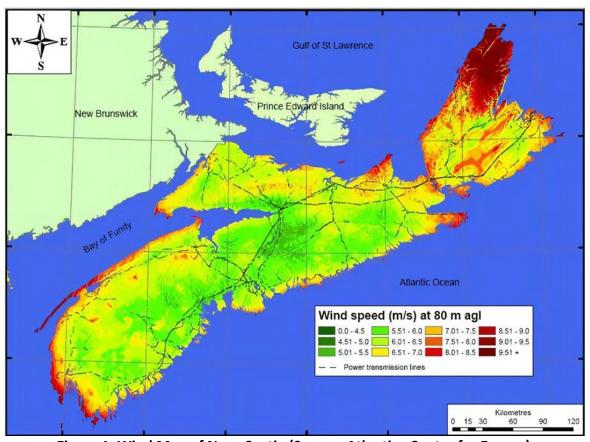


Figure 1. Wind Map of Nova Scotia (Source: Atlantica Centre for Energy)

Local Policy Analysis:

Looking at the surrounding Counties (Antigonish County, Richmond County and Victoria County), Inverness County has similar Land Use By-laws regarding the regulation of the development of wind turbines in comparison to Richmond County and Antigonish County. However, Inverness County lacks policy in some areas. These missing policies include a stronger setback for a larger wind energy facility, particularly for wind turbine developments with a nameplate capacity greater than two (2) megawatts or turbines requiring an Environmental Assessment as stipulated in the *Nova Scotia Environmental Act* and policy that notifies assessed neighbouring property

owners near the development.

Antigonish County, Richmond County and Victoria County all have provisions for setbacks of 1 000 m (3,280 feet) from residences. Antigonish County and Richmond County have this setback from residences for wind turbine developments with a total rated capacity greater than two (2) megawatts, or turbines requiring an Environmental Assessment while Victoria County has this setback from residences for wind turbine developments with a total rated capacity of more than 100 kW. Inverness County only has a basic setback from residences of 600 metres (1,969 feet) for Utility Wind Turbines.

Antigonish County, Richmond County and Victoria County also all have provisions to notify assessed neighbouring property owners near the development while Inverness County lacks this policy. Antigonish County and Richmond County do this notification via the Clerk of the County when an application is received while Victoria County requires the applicant to send this notice at minimum 60 days before the date a development permit application is submitted. Richmond County notifies all property owners within 200 metres of the subject property and Antigonish County notifies all property owners within 100 metres. Victoria County requires the notification of assessed property owners within a distance corresponding to the scale of the wind energy facility, see Figure 2 below.

Figure 2. Victoria County Notice to Property Owner Requirements		
Mini 140 metres (460ft)		
Small	360 metre (1180 ft)	
Medium	500 metres (1640 ft)	
Large	2000 metres (6560 ft)	

All Counties have two types of zones, one that only permits wind turbines with a capacity of 100kW or less and a zone that permits all wind turbine facilities. Antigonish County and Richmond County differ in their zoning as the entirety of each county is zoned to only permit wind turbines with a capacity of 100kW or less (domestic wind turbines) which means applicants looking to build a wind turbine or wind turbine facility of more than 100 kW (utility wind turbines) must go through a Land Use By-law Map Amendment Process or a Rezoning Process. This process would include aspects of community engagement by following the public participation program set out for the Municipality's Land Use By-law Map Amendment Process or Rezoning Process as mandated by the *Municipal Government Act*. Inverness County and Victoria County have both types of zones on their zoning map to permit utility wind turbines as of right through their Land Use By-law regarding the regulation of the development of wind turbines. An example of both types of zoning can be seen in Figure 3.

Presently, all four Counties permit the waiver of a setback from all adjacent lot boundaries if the adjacent property owner agrees to grant an easement binding on the current and future

landowners for domestic scale wind turbines. However, the Province of Ontario permits this waiver of a setback for buildings/dwelling and for large scale wind turbines.

Victoria County is unique in its approach to regulating Wind Turbines by including a requirement for a separate Wind Turbine License issued by the County. This Wind Turbine License issued by the County has its own By-law. The *Wind Turbine Licensing Development By-Law* requires the applicant to conduct public engagement, provide a detailed decommissioning plan, demonstrate how they will ensure funding for decommissioning and lists the punishments of offense among other policies. The requirements for a Wind Turbine License issued by the County include better public engagement but place much of the burden of the public engagement on the applicant.

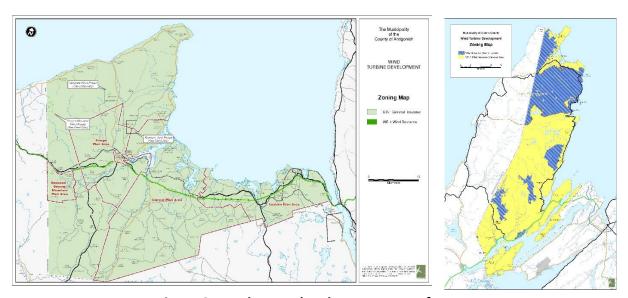


Figure 3. Local examples the two types of zones

Looking at the entirety of the province, of the 22 Land Use By-laws regarding the regulation of the development of wind energy analyzed by Colchester County, the largest setback requirement is 1 000 m (3,281ft). Additionally, the strictest sound level restriction found was 35 decibels outside a home or dwelling. Presently no municipalities in Nova Scotia have height restrictions.

When analyzing the bylaws and MPS for Inverness County there are no by-laws, policy or regulations regarding setback in relation to the number of turbines in a wind farm or wind project. There are only setbacks of individual turbines from residential homes and/or lot lines.

Victoria County and Halifax Regional Municipality Mainland's setbacks and corresponding classification of Wind Turbines is different from the other Counties. Their setbacks are in relation to "Wind Energy Facilities" rather than just a single Wind Turbine. Victoria County and Halifax Regional Municipality Mainland have the same definition of "Wind Energy Facility". The definition is as follows:

"Wind Energy Facility means a wind energy conversion system, the purpose of which is to produce electricity, consisting of one or more roof mounted turbines or turbine towers, with rotor blades, associated control or conversion electronics, and other accessory structures including substations, meteorological towers, electrical infrastructure and transmission lines..."

From the Land Use By-laws researched, Halifax and Victoria County also appear to be the only municipalities to include meteorological towers in their definitions of a "wind energy facility". All Wind Energy Facilities require notification of nearby residents 60 days prior to a Development Permit Application. This means residents will be alerted to the construction of a meteorological tower with the intention of future wind turbine development. This may help encourage developers to conduct early community engagement.

Communities have expressed similar concerns regarding the development of wind turbines with variations related to local community values and the local environment. These general concerns include visual impacts, noise and infrasound, negative impacts on health, decrease of property values, impacts on the environment and wildlife, and negative effects on tourism and recreation. Some, not all, other concerns noted include well water protection, decommissioning and site remediation, internet and telecommunication disruption, and construction/traffic.

Regarding health concerns and wind farms, though it has been suggested that wind farms have been linked to adverse health problems in people, a Health Canada study (last modified in 2014) found no direct link between adverse health affects and Wind Turbine Noise. The study states that Wind Turbine Noise (WTN) was not associated with general disturbance of sleep, dizziness, headaches/migraines, tinnitus, chronic health conditions such as diabetes and high blood pressure or self reported stress and lowered quality of life.

Wind Turbines and WTN are statistically associated with annoyance. The study goes on to say that it is this WTN annoyance that is related to several self reported health effects including but not limited blood pressure, tinnitus, dizziness, disturbed sleep, migraines, and perceived stress. The above associations were not dependant on the level of noise or distance from the turbines and were also observed in many cases of road traffic noise annoyance.

In Health Canada's feedback to the Westchester Wind Project Environmental Assessment Registration Document dated March 2022, Health Canada stated:

"LFN (low frequency noise) is not generally well perceived by the human ear. However, it may induce vibrations in lightweight structures in residences or sleeping quarters that may be perceptible or cause a "rattle". The properties of LFN allow it to travel further distances with less atmospheric attenuation than higher frequencies... LFN is also less susceptible to conditions that mitigate the transfer of noise from outdoors to indoors including structural barriers, environmental conditions, and topography..."

Health Canada's other comments in the report imply that this "rattle" can cause or is correlated with some of the annoyance individuals may feel regarding WTN. The report also suggests appropriate decibel levels for LFN that will prevent rattles and possibly the associated annoyance.

In the 2014 Health Canada study regarding WTN and Health, community annoyance was observed to drop at distances between 1km to 2km in Ontario, compared to PEI where almost all the participants who were highly annoyed by WTN lived within 550m of a wind turbine. However, Health Canada notes WTN is a more sensitive measure of exposure level than distance as it allows or the consideration of topography, wind turbine characteristics and the number of turbines at any given distance.

The Province of Ontario also acknowledges that a home or property could face combined impacts from the siting of multiple utility scale wind turbines within a 3.0 km radius. In the Province of Ontario, more utility scale turbines within a 3.0 km radius of the house/dwelling will result in larger required setback distances from the nearest turbine. Figure 5 shows the setback distances for multiple turbines based on the number of turbines and loudest turbine sound power level for turbines within a 3.0 km radius of the house/dwelling. Sound power level is a specification of turbine design determined by the manufacturer. Specifications for sound power level used for determining setbacks correspond to the sound emitted while operating at 95% of nameplate capacity rounded to the nearest whole number.

Figure 5. Setback Distances for Multiple Turbines Within a 3km Radius

Sound power level	1 to 5 turbines within 3km	6 to 10 turbines within 3km	11 to 25 turbines within 3km	26+ turbines within 3km
102 dBA	550 m	650 m	750 m	Noise study required
103-104 dBA	600 m	700 m	850 m	Noise study required
105 dBA	850 m	1000 m	1250 m	Noise study required
106-107 dBA	950 m	1200 m	1500 m	Noise study required
	Noise study required	Noise study required	Noise study required	Noise study required

The Province of Ontario's wind turbine setbacks are graduated with a largest possible setback of 1.5 km, which is 500 m more than the largest wind turbine setback in Nova Scotia of 1.0 km. However, the setbacks still may be too small to protect individuals from the effects of annoyance due to Wind Turbine Noise (WTN).

With respect to turbine height, the Canadian Renewable Energy Association (CanREA) provided input on Colchester's Wind Turbine By-law Review that considered wind energy developers. CanREA believes that municipalities in Nova Scotia should continue to not have height restrictions in order to provide flexibility since wind energy technology is constantly evolving. CanREA has noted that the sound level regulations of Nova Scotia's 2021 revised Environmental Assessment guidelines is 40 decibels outside a home or dwelling. CanREA is of the opinion that Colchester

should not add any further limitations on maximum sound level at the exterior of homes or dwellings. Finally, Colchester was looking at imposing the highest setback distance of 1000m or 1.0 km; CanREA asked that the County analyze this proposed setback thoughtfully as "unnecessary high setback distances can affect the optimal potential of wind development and all of its benefits".

Both CanREA and the Wind Energy Fact Sheets for Nova Scotia Municipalities acknowledges the importance of community engagement. In CanREA's Colchester Wind Turbine By-law Review, CanREA states:

"CanREA and its members appreciate and embrace the need to engage with local municipalities, Indigeneous Peoples, and diverse stakeholders early and consistently whenever a project is proposed... Effective and meaningful engagement is fundamental to the success of any renewable energy project..."

The Wind Energy Fact Sheets for Nova Scotia Municipalities notes:

"Community engagement should be part of the initial wind energy project planning and be maintained through commission, operation, maintenance and eventual decommissioning of the facility. Early and sustained involvement with the local community is essential to creating a successful project... When a community is well informed about wind energy and trusts its local processes, there is usually less opposition to a proposed wind energy project. Early and open community involvement encourages logical dialogue based on mutual respect."

Municipal planning tools, like land use by-laws, can promote early consultation. There are several municipalities that include specific consultation regulations for wind energy projects in their planning documents. The Wind Energy Fact Sheets for Nova Scotia Municipalities also provides many tips and tools for community engagement.

Conclusion:

Staff have noted that Inverness County's MPS and LUB Concerning the Regulation of Wind Turbine Development should be updated with stronger policy. However, the purpose of this Staff Report is to inform Council and provide background information that compliments a Staff Report providing recommendations and options.

Further recommended readings are Health Canada's Wind Turbine Noise and Health Study: Summary of Results and the Wind Energy Fact Sheets for Nova Scotia Municipalities by the Union of Nova Scotian Municipalities' Municipal Sustainability Office in consultation with Veterra Group.

Appendix A: Health Canada's Wind Turbine Noise and Health Study: Summary of Results Wind Turbine Noise and Health Study: Summary of Results

Background and Rationale

The Government of Canada is committed to protecting the health and well-being of Canadians. Jurisdiction for the regulation of noise is shared across many levels of government in Canada. Health Canada's mandate with respect to wind power includes providing science-based advice, upon request, to federal departments, provinces, territories and other stakeholders on the potential impacts of wind turbine noise (WTN) on community health and well-being. Provinces and territories, through the legislation they have enacted, make decisions in relation to areas including installation, placement, sound levels and mitigation measures for wind turbines.

Globally, wind energy is relied upon as an alternative source of renewable energy. In Canada wind energy capacity has grown from approximately 137 Megawatts (MW) in 2000 to just over 8.5 Gigawatts (GW) in 2014 (CANWEA, 2014). At the same time, there has been concern from some Canadians living within the vicinity of wind turbine installations that their health and well-being are negatively affected from exposure to WTN.

The scientific evidence base in relation to WTN exposure and health is limited, which includes uncertainty as to whether or not low frequency noise (LFN) and infrasound from wind turbines contributes to the observed community response and potential health impacts. Studies that are available differ in many important areas including methodological design, the evaluated health effects, and strength of the conclusions offered.

In July 2012, Health Canada announced its intention to undertake a large scale epidemiology study in collaboration with Statistics Canada (Statistics Canada Official Title: Community Noise and Health Study). The study was launched to support a broader evidence base on which to provide federal advice and in acknowledgement of the community health concerns expressed in relation to wind turbines.

Research Objectives and Methodology

The objectives of the study were to:

- Investigate the prevalence of health effects or health indicators among a sample of Canadians exposed to WTN using both self-reported and objectively measured health outcomes;
- Apply statistical modeling in order to derive exposure response relationships between WTN levels and self-reported and objectively measured health outcomes; and,
- Investigate the contribution of LFN and infrasound from wind turbines as a potential contributing factor towards adverse community reaction.

The study was undertaken in two Canadian provinces, Ontario (ON) and Prince Edward Island (PEI), where there were a sufficient number of homes within the vicinity of wind turbine installations. The study consisted of three primary components: an in-person questionnaire, administered by Statistics Canada to randomly selected participants living at varying distances from wind turbine installations; collection of objectively measured outcomes that assess hair cortisol, blood pressure and sleep quality; and, more than 4000 hours of WTN measurements conducted by Health Canada to support the calculation of WTN levels at residences captured in the study scope. To support the assessment and reporting of data, and permit comparisons to other studies, residences were grouped into different categories of calculated outdoor A-weighted WTN levels as follows: less than 25 dB; 25-<30dB; 30-<35dB; 35-<40dB; and greater than or equal to 40 dB. ¹

Detailed information on Health Canada's Wind Turbine Noise and Health Study methodology, including the 60-day public consultation and peer review process is available on the Health Canada website. The detailed methodology for the study is also available in the peer reviewed literature (Michaud et al., Noise News International, 21(4): 14-23, 2013).

Preliminary Research Findings

Health Canada has completed its preliminary analysis of the data obtained. Research findings are presented below in accordance with the study component in which they were obtained i.e. inperson, self-report questionnaire findings, objectively measured responses, and noise measurements and calculations. As with other studies of this nature, a number of limitations and considerations apply to the study findings including:

- results may not be generalized to areas beyond the sample as the wind turbine locations
 in this study were not randomly selected from all possible sites operating in Canada;
- results do not permit any conclusions about causality; and,
- results should be considered in the context of all published peer-reviewed literature on the subject.

A. Study Population and Participation

The study locations were drawn from areas in ON and PEI where there were a sufficient number of homes within the vicinity of wind turbine installations. Twelve (12) and six wind turbine developments were sampled in ON and PEI, representing 315 and 84 wind turbines respectively. All potential homes within approximately 600 m of a wind turbine were selected, as well as a random selection of homes between 600 m and 10 km. From these, one person between the ages of 18 and 79 years from each household was randomly selected to participate.

The final sample size consisted of 2004 potential households. Of the 2004 locations sampled, 1570 were found to be valid dwellings³ of which a total of 1238 households with similar

demographics⁴ participated, resulting in an overall participation rate of 78.9%. Participation rate was similar regardless of one's proximity to wind turbines and equally high in both provinces. The high response rates in this study help to reduce, but not eliminate, non-response bias⁵.

B. Self-Reported Questionnaire Results

Results are presented in relation to WTN levels. For findings related to WTN annoyance, results are also provided in relation to distance to allow for comparisons with other studies. WTN is a more sensitive measure of exposure level and allows for consideration of topography, wind turbine characteristics and the number of wind turbines at any given distance. To illustrate, two similar homes may exist in similar environments located at the same distance from the nearest turbine operating in areas with 1 small and 75 large wind turbines respectively. These homes would be treated the same if the analysis was conducted using only distance to the nearest wind turbine, however they would be completely different in terms of their WTN exposure levels.

The following were not found to be associated with WTN exposure:

- self-reported sleep (e.g., general disturbance, use of sleep medication, diagnosed sleep disorders);
- self-reported illnesses (e.g., dizziness, tinnitus, prevalence of frequent migraines and headaches) and chronic health conditions (e.g., heart disease, high blood pressure and diabetes); and
- self-reported perceived stress and quality of life.

While some individuals reported some of the health conditions above, the prevalence was not found to change in relation to WTN levels.

1. Self-reported Sleep

Long-term sleep disturbance can have adverse impacts on health and disturbed sleep is one of the more commonly reported complaints documented in the community noise literature. Selfreported sleep disturbance has been shown in some, but not all, studies to be related to exposure to wind turbines.

The Pittsburgh Sleep Quality Index (PSQI) is a frequently used questionnaire for providing a validated measure of reported sleep pathology where scores can range from 0-21 and a global score of greater than 5 is considered to reflect poor sleep quality. The PSQI was administered as part of the overall questionnaire, which was supplemented with questions about the use of sleep medication, prevalence of sleep disorders diagnosed by a healthcare professional and how sleep disturbed people were in general over the last year.

Results of self-reported measures of sleep, that relate to aspects including, but not limited to general disturbance, use of sleep medication, diagnosed sleep disorders and scores on the PSQI, did not support an association between sleep quality and WTN levels.

2. Self-reported Illnesses and Chronic Diseases

Self-reports of having been diagnosed with a number of health conditions were not found to be associated with exposure to WTN levels. These conditions included, but were not limited to chronic pain, high blood pressure, diabetes, heart disease, dizziness, migraines, ringing, buzzing or whistling sounds in the ear (i.e., tinnitus).

3. Self-reported Stress

Exposure to stressors and how people cope with these stressors has long been considered by health professionals to represent a potential risk factor to health, particularly to cardiovascular health and mental well-being. The Perceived Stress Scale is a validated questionnaire that provides an assessment of the degree to which situations in one's life are appraised as stressful.

Self-reported stress, as measured by scores on the Perceived Stress Scale, was not found to be related to exposure to WTN levels.

4. Quality of Life

Impact on quality of life was assessed through the abbreviated version of the World Health Organization's Quality of Life scale; a validated questionnaire that has been used extensively in social studies to assess quality of life across the following four domains: Physical; Environmental; Social and Psychological.

Exposure to WTN was not found to be associated with any significant changes in reported quality of life for any of the four domains, nor with overall quality of life and satisfaction with health.

The following was found to be statistically associated with increasing levels of WTN: annoyance towards several wind turbine features (i.e. noise, shadow flicker, blinking lights, vibrations, and visual impacts).

5 Annoyance

5.1 Community Annoyance as a Measure of Well-being

The questionnaire, administered by Statistics Canada, included themes that were intended to capture both the participants' perceptions of wind turbines and reported prevalence of effects related to health and well-being. In this regard, one of the most widely studied responses to environmental noise is community annoyance. There has been more than 50 years of social and socio-acoustical research related to the impact that noise has on community annoyance. Studies have consistently shown that an increase in noise level was associated with an increase in the percentage of the community indicating that they are "highly annoyed" on social surveys. The literature shows that in comparison to the scientific literature on noise annoyance to transportation noise sources such as rail or road traffic, community annoyance with WTN begins at a lower sound level and increases more rapidly with increasing WTN.

Annoyance is defined as a long-term response (approximately 12 months) of being "very or extremely annoyed" as determined by means of surveys. Reference to the last year or so is intended to distinguish a long-term response from one's annoyance on any given day. The relationship between noise and community annoyance is stronger than any other self-reported measure, including complaints and reported sleep disturbance.

5.2 Community Annoyance Findings

Statistically significant exposure-response relationships were found between increasing WTN levels and the prevalence of reporting high annoyance. These associations were found with annoyance due to noise, vibrations, blinking lights, shadow and visual impacts from wind turbines. In all cases, annoyance increased with increasing exposure to WTN levels.

The following additional findings in relation to WTN annoyance were obtained:

- At the highest WTN levels (≥ 40 dBA in both provinces), the following percentages of respondents were highly annoyed by wind turbine noise: ON-16.5%; PEI-6.3%. While overall a similar pattern of response was observed, the prevalence of WTN annoyance was 3.29 times higher in ON versus PEI (95% confidence interval, 1.47 - 8.68).
- A statistically significant increase in annoyance was found when WTN levels exceeded 35 dBA.
- Reported WTN annoyance was statistically higher in the summer, outdoors and during evening and night time.
- Community annoyance was observed to drop at distances between 1-2km in ON, compared to PEI where almost all of the participants who were highly annoyed by WTN lived within 550m of a wind turbine. Investigating the reasons for provincial differences is outside the scope of the current study.
- WTN annoyance significantly dropped in areas where calculated nighttime background noise exceeded WTN by 10dB or more.
- Annoyance was significantly lower among the 110 participants who received personal benefit, which could include rent, payments or other indirect benefits of having wind turbines in the area e.g., community improvements. However, there were other factors that were found to be more strongly associated with annoyance, such as the visual appearance, concern for physical safety due to the presence of wind turbines and reporting to be sensitive to noise in general.

5.3 Annoyance and Health

- WTN annoyance was found to be statistically related to several self-reported health effects
 including, but not limited to, blood pressure, migraines, tinnitus, dizziness, scores on the
 PSQI, and perceived stress.
- WTN annoyance was found to be statistically related to measured hair cortisol, systolic and diastolic blood pressure.
- The above associations for self-reported and measured health endpoints were not dependent on the particular levels of noise, or particular distances from the turbines, and were also observed in many cases for road traffic noise annoyance.
- Although Health Canada has no way of knowing whether these conditions may have either pre-dated, and/or are possibly exacerbated by, exposure to wind turbines, the findings support a potential link between long term high annoyance and health.
- Findings suggest that health and well-being effects may be partially related to activities that influence community annoyance, over and above exposure to wind turbines.

C. Objectively Measured Results

Objectively measured health outcomes were found to be consistent and statistically related to corresponding self-reported results. WTN was not observed to be related to hair cortisol concentrations, blood pressure, resting heart rate or measured sleep (e.g., sleep latency, awakenings, sleep efficiency) following the application of multiple regression models⁶.

1. Measures Associated with Stress

Hair cortisol, blood pressure and resting heart rate measures were applied in addition to the Perceived Stress Scale to provide a more complete assessment of the possibility that exposure to WTN may be associated with physiological changes that are known to be related to stress.

Cortisol is a well-establish biomarker of stress, which is traditionally measured from blood and/or saliva. However, measures from blood and saliva reflect short term fluctuations in cortisol and are influenced by many variables including time of day, food consumption, body position, brief stress, etc., that are very difficult to control for in an epidemiology study. To a large extent, such concerns are eliminated through measurement of cortisol in hair samples as cortisol incorporates into hair as it grows. With a predictable average growth rate of 1 cm per month, measurement of cortisol in hair makes it possible to retrospectively examine months of stressor exposure. Therefore cortisol is particularly useful in evaluating the potential impact that long term exposure to WTN has on one of the primary biomarkers linked to stress.

The results from multiple linear regression analysis reveal consistency between hair cortisol concentrations and scores on the Perceived Stress Scale (i.e., higher scores on this scale were associated with higher concentrations of hair cortisol) with neither measure found to be

significantly affected by exposure to WTN. Similarly, while self-reported high blood pressure (hypertension) was associated with higher measured blood pressure, no statistically significant association was observed between measured blood pressure, or resting heart rate, and WTN exposure.

2. Sleep Quality

Sleep was measured using the Actiwatch2TM, which is a compact wrist-worn activity monitor that resembles a watch. This device has advanced sensing capabilities to accurately and objectively measure activity and sleep information over a period of several days. This device is considered to be a reliable and valid method of assessing sleep in non-clinical situations. The following measured sleep impacts were considered: sleep latency (how long it took to fall asleep); wake time after sleep onset (the total duration of awakenings); total sleep time; the rate of awakening bouts (calculates how many awakenings occur as a function of time spent in bed); and sleep efficiency (total sleep time divided by time in bed).

Sleep efficiency is especially important because it provides a good indication of overall sleep quality. Sleep efficiency was found to very high at 85% and statistically influenced by gender, body mass index (BMI), education and caffeine consumption.

The rates of awakening bouts, total sleep time or sleep latency were further found in some cases to be related to: age, marital status, closing bedroom windows, BMI, physical pain, having a standalone air conditioner in the bedroom, self-reports of restless leg syndrome and being highly annoyed by the blinking lights on wind turbines.

While it can be seen that many variables had a significant impact on measured sleep, calculated outdoor WTN levels near the participants' home was not found to be associated with sleep efficiency, the rate of awakenings, duration of awakenings, total sleep time, or how long it took to fall asleep.

D. Wind Turbine Noise Measures Results

Note - To support a greater understanding of the concepts included in this section, Health Canada has developed a short Primer on Noise.

Scientists that study the community response to noise typically measure different sounds levels with a unit called the A-weighted decibel (dBA). The A-weighting reflects how people respond to the loudness of common sounds; that is, it places less importance on the frequencies to which the ear is less sensitive. For most community noise sources this is an acceptable practice. However, when a source contains a significant amount of low frequencies, an A-weighted filter may not fully reflect the intrusiveness or the effect that the sound may have (e.g. annoyance). In these cases, the use of a C-weighted filter (dBC) may be more appropriate because it is similar to the A-weighting except that it includes more of the contribution from the lower frequencies than

the A-weighted filter.

1. A- Weighted

More than 4000 hours of WTN measurements conducted by Health Canada supported the calculations of A-weighted WTN levels at all 1238 homes captured in the study sample.

• Calculated outdoor A-weighted WTN levels for the homes participating in the study reached 46 dBA for wind speeds of 8m/s. This approach is the most appropriate to quantify the potential adverse effects of WTN. The calculated WTN levels are likely to be representative of yearly averages with an uncertainty of about +/- 5dB and therefore can be compared to World Health Organization (WHO) guidelines. The WHO identifies an annual outdoor night time average of 40 dBA as the level below which no health effects associated with sleep disturbance are expected to occur even among the most vulnerable people (WHO (2009) Night Noise Guidelines for Europe).

2. Low Frequency Noise

Wind turbines emit LFN, which can enter the home with little or no reduction in energy potentially resulting in rattles in light weight structures and annoyance. Although the limits of LFN are not fixed, it generally includes frequencies from between 20Hz and 200Hz. C-weighted sound levels can be a better indicator of LFN in comparison to A-weighted levels, and were calculated in order to assess the potential LFN impacts.

- Calculated outdoor dBC levels for homes ranged from 24 dBC and reached 63 dBC.
- Three (3)% of the homes were found to exceed 60 dBC⁷.
- No additional benefit was observed in assessing LFN because C- and A-weighted levels
 were so highly correlated (r=0.94) that they essentially provided the same information. It
 was therefore not surprising that the relationship between annoyance and WTN levels
 was predicted with equal strength using dBC or dBA and that there was no association
 found between dBC levels and any of the self-reported illnesses or chronic health
 conditions assessed (e.g., migraines, tinnitus, high blood pressure, etc.)
- Sound pressure levels were found to be below the recommended thresholds for reducing perceptible rattle and the annoyance that rattle may cause.

As LFN is generally considered to be an indoor noise problem, it was of interest to better understand how much outdoor LFN makes its way into the home.

 At a selection of representative homes, Health Canada measurements showed an average of 14dB of outdoor WTN is blocked from entering a home at low frequencies (16 Hz - 100 Hz) with closed windows compared to an average reduction of 10dB with windows partially open.

3. Infrasound

Long-term measurements over a period of 1 year were also conducted in relation to infrasound levels.

- Infrasound from wind turbines could sometimes be measured at distances up to 10km from the wind turbines, but was in many cases below background infrasound levels.
- The levels were found to decrease with increasing distance from the wind turbine at a rate of 3dB per doubling of distance beyond 1km, downwind from a wind turbine.
- The levels of infrasound measured near the base of the turbine were around the threshold of audibility that has been reported for about 1% of people that have the most sensitive hearing.

Due to the large volume of acoustical data, including that related to infrasound, analysis will continue over subsequent months with additional results being released at the earliest opportunity throughout 2015.

Data Availability and Application

Detailed descriptions of the above results will be submitted for peer review with open access in scientific journals and should only be considered final following publication. All publications by Health Canada related to the study will be identified on the Health Canada website.

Raw data originating from the study is available to Canadians, other jurisdictions and interested parties through a number of sources: Statistics Canada Federal Research Data Centres, the Health Canada website (noise data), open access to publications in scientific journals and conference presentations. Plain language abstracts outlining the research and identifying the scientific journals where papers can be found will further be published to the Departmental website.

Health Canada's Wind Turbine Noise and Health Study included both self-reported and physically measured health effects as together they provide a more complete overall assessment of the potential impact that exposure to wind turbines may have on health and well-being.

Study results will support decision makers by strengthening the peer-reviewed scientific evidence base that supports decisions, advice and policies regarding wind turbine development proposals, installations and operations. The data obtained will also contribute to the global knowledge of the relationship between WTN and health.

Footnotes

- 1. Categories are mutually exclusive. Only six out of 1238 dwellings in the study were above 45dBA; an inadequate sample size to create an additional category.
- 2. A more detailed presentation of the results will be submitted for publication in scientific journals. Results should only be considered final following peer-review and publication in the scientific literature.
- 3. 434 were not valid dwellings; upon visiting the address Statistics Canada noted that the location was either demolished for unknown reasons, under construction, vacant for unknown reasons, an unoccupied seasonal dwelling, residents were outside the eligible age range, or not a home at all.
- 4. Some minor differences were found with respect to age, employment, type of home and home ownership.
- 5. Non-response bias may be a problem depending upon the extent to which non participation is associated with the exposure of interest (in this case wind turbine exposure). This study did not include a non-response survey, however refusing to participate was not related to the distance between the resident and the nearest wind turbine.
- 6. This type of analysis identifies the personal and situational variables that best explain the variation observed in the objective measures after adjusting for all variables that are known to have an influence on the effects being assessed.
- 7. For sources that operate at night in rural environments, a dBC limit somewhere between 60 dBC and 65 dBC has been recommended to minimize community complaints/annoyance associated with LFN, See discussion in Broner (2011). A simple outdoor criterion for assessment of low frequency noise emission. Acoustics Australia Vol 39, Issue 1, pp 7-14.

Appendix B: Wind Energy Fact Sheets for Nova Scotia Municipalities

















Wind Energy Fact Sheets for Nova Scotian Municipalities

Supporting municipalities in making informed decisions on wind energy

Union of Nova Scotia Municipalities

Municipal Sustainability Office

Produced in Consultation with Verterra Group





April 2015



List of Wind Energy Fact Sheets

- WIND ENERGY DEVELOPMENT IN NOVA SCOTIA
- ELECTRICITY USE AND GENERATION OPTIONS
- BASICS OF WIND ENERGY TECHNOLOGY
- PHASES OF WIND ENERGY PROJECT DEVELOPMENT
- APPROACHES TO SITING WIND TURBINES
- 6 ECOLOGICAL CONSIDERATIONS FOR WIND ENERGY
- 5 SOCIAL CONSIDERATIONS FOR WIND ENERGY
- FINANCIAL CONSIDERATIONS FOR WIND ENERGY
- 9 COMMUNITY ENGAGEMENT AND WIND ENERGY
- POLICY AND PLANNING FOR WIND ENERGY
 - ACKNOWLEDGEMENTS AND QUALIFICATIONS
 - FURTHER READING AND EXPLORATION



Supporting municipalities in making informed decisions on wind energy

Drawing on research from existing resources and best practices, this set of fact sheets provides Nova Scotia-specific content on topics related to wind energy development and a comprehensive source of information to help municipalities understand the opportunities and challenges of wind energy.



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Executive Summary

We have choices in Nova Scotia

In the 21st century, using local renewable electricity sources will provide energy security, help stabilize electricity prices and protect Nova Scotians from the volatility of fossil fuel pricing and costs associated with future regulation of greenhouse gas emissions. Wind has become an important part of this renewable electricity mix. We must make the best choices to ensure that wind energy is well planned and maximizes benefits to Nova Scotia.

Municipalities can realize numerous environmental, financial and social benefits from developing large and small wind energy projects; some are already delivering millions of dollars in new tax revenues in Nova Scotia alone. Other benefits include payments to local farmers and landowners, opportunities for local business, and stabilized energy prices, especially for municipalities that build their own wind turbines for electricity use.

Over the last decade, many large- and small-scale turbines have been constructed in Nova Scotia. over 200 from Cape Breton to Yarmouth. By March 2015, there was 350 MW of installed capacity from wind generation in the Province, enough to power 120,000 homes and reduce greenhouse gas production by as much as 800,000 tonnes per year.

Every technology that generates electricity, from non-renewable or renewable sources, presents challenges and opportunities. Balanced comparison from ecological, social and financial perspectives can help communities make decisions about their energy future. These fact sheets are designed give elected officials, municipal staff and interested citizens balanced information on wind energy development.



Higgins Mountain, Nova Scotia

Lingan, Nova Scotia

Nova Scotians benefit from making informed decisions on electricity generation and its use

We use a lot of electricity every day, and while we are becoming more efficient, projections show that we are going to keep doing so. To enjoy sustainable prosperity, Nova Scotia must continue to become more energy efficient and make wise choices about how our electricity is generated.

Electricity is generated by thermal generating stations using fossil fuels and technologies that harness renewable sources (wind, tidal, hydro, biomass). Many of the coal mines in Nova Scotia that have provided cheap local electricity since the 1970s have closed; only 20% of coal supplied to Nova Scotia Power is local – the rest is imported at a higher cost.

Harnessing local electricity sources like wind, natural gas, biomass, hydro, solar and tidal provides local benefits. Our need for electricity can be met with local sources, combining and balancing thermal generation with intermittent sources like wind energy. Nova Scotia municipalities have great opportunity to develop local renewable electricity sources, including wind turbines.

Municipalities should play a significant role in deciding how to integrate wind energy in their communities. There are many different municipal policy and planning mechanisms across the Province; to make informed decisions in planning and approving a wind energy project, a community must be constructively engaged from the beginning.

This set of fact sheets focuses on wind energy in the context of other renewable and non-renewable energy sources. They can be used as a set or individually; they can be skimmed, or mined for detail. They were developed for municipal staff and elected officials as well as residents. The package of ten fact sheets concludes with web links for further reference.

As Nova Scotia enters the next phase of wind energy development, municipalities can benefit from and expand upon lessons learned, here and elsewhere, to maximize benefits to local communities.



Wind Energy Development in Nova Scotia

What is the history of wind energy in Nova Scotia?

Since the early 1900s, privately-owned wind turbines have been used to generate electricity in Nova Scotia; on farms, they provided power for lighting and heating. More recently, they have been used to power equipment and irrigation systems.

In 2002, the first modern large-scale wind turbines were erected in Grand Etang, Inverness County and Little Brook, Digby County. These single turbines have outputs of 0.7 MW and 0.6 MW respectively, each producing enough electricity for about 450 homes.

In 2006, a private developer built the first wind farm in Nova Scotia on Pubnico Point in the Municipality of the District of Argyle. Seventeen turbines were connected to the electrical grid, each with an output of 1.8 MW and together powering about 10,000 homes. This project sells fixed-cost electricity to Nova Scotia Power under a 20-year power purchase agreement and pays the Municipality about \$200,000 per year in taxes.

Since 2006, there have been major advances in wind technology and expertise, and many large-and small-scale turbines have been constructed in Nova Scotia. Like any innovative technology, wind turbines present both opportunities and challenges. Wind energy has already made an important contribution to electricity generation and, with insightful planning, will continue to do so, providing significant environmental, social and economic benefits for municipalities.

Where are the wind turbines operating or planned in the Province?

From Cape Breton to Yarmouth, over 200 turbines dot the Province as of March 2015. More than half are independently-owned; the remainder are owned by Nova Scotia Power. At this time, the 200 turbines supply approximately 10% of Nova Scotia's overall electricity needs. This percentage will increase with installation of more large and small wind turbines, including a large-scale wind energy project with 34 turbines expected to start generating electricity by mid-2015.

In 2010, the Nova Scotia Department of Energy released its Renewable Electricity Plan^o ¹ to promote renewable energy, including wind. Since then, new wind energy projects have helped meet the regulated target of generating 18.5% of our electricity from renewable energy in 2013. Renewable Electricity Regulations mandate targets of 25% by 2015 and 40% by 2020. ³ By 2020, over 500,000 homes will be running on renewable electricity, more than enough energy for every residential customer in Nova Scotia.

Table of Existing and Approved Turbines in Nova Scotia as of March 2015

#	LOCATION	MW	TURBINES
1	Higgins Mountain	3.6	3
2	Springhill	2.1	2
3	Amherst	31.5	15
4	Nuttby Mountain	50.6	22
5	Tatamagouche	0.8	1
6	Spiddle Hill	1.7	4
7	Fitzpatrick Mountain	1.6	2
8	Glen Dhu	62.1	27
9	Maryvale	6	4
10	Irish Mountain	2	1
11	Fairmont	4.6	2
12	Creignish Rear	2	1
13	South Cape Mabou	2	1
14	Grand Étang	0.7	1
15	Lingan	15.6	7
16	Glace Bay	0.8	1

#	LOCATION (CONT)	MW	TURBINES
17	Donkin	0.8	1
18	Tiverton	0.9	1
19	Digby Neck	30	20
20	Digby	0.8	1
21	Granville Ferry	2	1
22	Little Brook	0.6	1
23	South Canoe	102	34
24	Goodwood	0.6	1
25	Brookfield	0.6	1
26	Dalhousie Mountain	51	34
27	Sheet Harbour	1.5	1
28	Point Tupper	0.8	1
29	Point Tupper	22.6	11
30	Sable Wind	13.8	5
31	Pubnico Point	30.6	17
32	Kaizer Meadow	2.0	1

Please Note: Information contained in the table above and on the following map is taken from the Nova Scotia Power Wind Farm Map. Please check this live link for up-to-date information, as it will change over time.

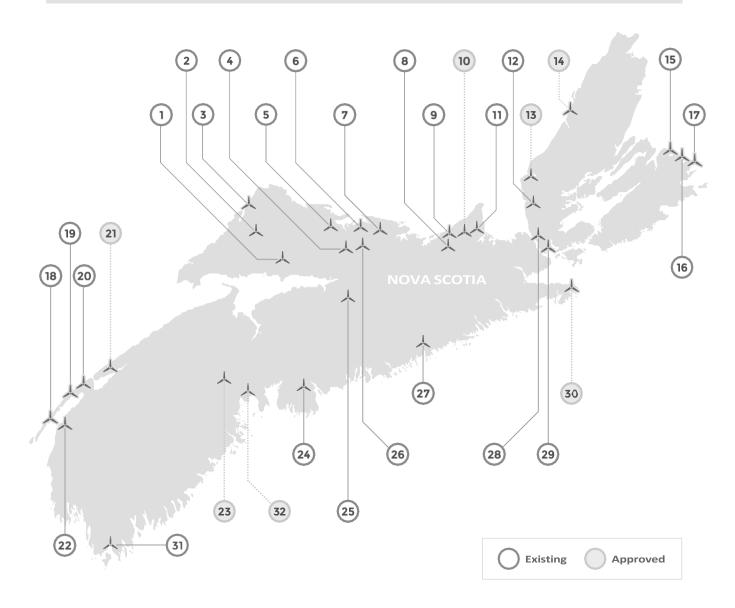
^{% 1} http://energy.novascotia.ca/sites/default/ftles/renewable-electricity-plan.pdf

^{% 2} www.novascotia.ca/just/regulations/regs/elecrenew.htm

^{🗞 3} www.nspower.ca/en/home/about-us/how-we-make-electricity/renewable-electricity/wind-farm-map.aspx



Map of Existing and Approved Turbines in Nova Scotia as of March 2015



Get to Know Wind Energy

Watts (W):

Used to describe the rate of electricity use; for example, a 50 watt bulb uses 50 watts of power.

Prefixes are often used to describe large amounts of electricity:

- 1 Kilowatt (kW) = 1000 watts – used to describe the power used by a typical home.
- 1 Megawatt (MW) = 1000 kW – used to describe the power production of a large-scale wind turbine.
- 1 Gigawatt (GW) =
 1000 MW used to
 describe the power used on
 scale of an electrical grid.

Watt-hours (Wh):

used to describe the amount of energy. For example, a 50 watt bulb turned on for 2 hours would use 100 Wh of energy (50 W x 2h = 100 Wh).

- 1 gigawatt-hour (GWh) =
- 1 million kilowatt-hours
- used to describe the amount of energy used by regions over time.

What contribution has wind energy made to Nova Scotia?

Already a significant renewable source, wind energy promises to continue to make a major contribution to Nova Scotia's electricity future. Small-scale wind turbines (typically defined as 50 kW or less) generate electricity that can be used on-site or sold to Nova Scotia Power. Large-scale wind turbines can be developed by Independent Power Producers ⁴ or community-based groups, including municipalities, under the Community Feed-in-Tariff (COMFIT) Program ⁵. Wind turbines can also produce electricity for private owners: in some cases, excess electricity can be sold to Nova Scotia Power under the Enhanced Net Metering Program. ⁶

Under the Nova Scotia Department of Energy's 2010 Renewable Electricity Plan, these programs enable municipalities, the private sector, First Nations, co-operatives and non-profit groups to participate in developing wind energy. This brings local investment, short- and long-term employment, and tax revenue to the municipality.

Here are a few general statistics on wind energy in Nova Scotia as of March 2015:

- » Total number of turbines in Nova Scotia: 200
- » Installed wind power in Nova Scotia: 350 MW
- » Equivalent homes powered by wind: 120,000
- » Tonnes of greenhouse gas emissions reduced: 800,000 tonnes per year
- » Capital investment in wind energy: approaching \$1 billion
- » Tax base for municipalities: about \$2 million per year
- » Long-term employment: over 60 full-time positions in turbine operation and maintenance

At this time, Nova Scotia consumes about 10,500 GWh of electricity per year. Wind energy now satisfies about 10% of our overall electricity requirements. Additional large and small wind energy projects are expected online later in 2015. Wind energy's proportional contribution will increase as new turbines – both large and small – are installed in Nova Scotia.

^{\$} 4 http://energy.novascotia.ca/renewables/programs-and-projects/commercial-renewables

^{% 5} http://energy.novascotia.ca/renewables/programs-and-projects/comftt

^{% 6} http://energy.novascotia.ca/renewables/programs-and-projects/enhanced-net-metering



Digby, Nova Scotia

Digby, Nova Scotia

Case Study: DIGBY RENEWABLE ENERGY HUB

Like many Nova Scotia municipalities, the Municipality of the District of Digby and the Town of Digby have diverse end users of energy, resources, and infrastructure, including harbours, islands, hybrid ferries, wind turbines, tidal resources, fishing fleets, highways, and distinct communities. There are many options for renewable energy: tidal, wind, biogas (using mink waste as feedstock) and co-generation energy, as well as the introduction of electric vehicles, which will all play major roles in the region in the near future. Five wind energy projects, ranging from a single large-scale turbine (0.6 MW) to a wind farm with twenty large-scale turbines (30 MW) are in operation. Tidal energy technology, from project development to evaluation of infrastructure at the Port of Digby, is underway.

Both the Municipality of the District of Digby and the Town of Digby stand to gain from becoming a regional renewable energy hub because sustainable domestic energy production will produce direct and indirect economic benefits in their area – all in the effort to become the "Greenest County in Nova Scotia" 7



Case Study Basic Stats

Location:



Within the Municipality of the District of Digby

Output:



34.3 MW

No. of Turbines:



24 (5 projects)



Amherst, Nova Scotia

6

What is a municipality's role in a wind energy project?

Municipalities play important roles in wind energy development. Municipal staff and elected officials can do much to encourage and facilitate projects appropriate to their unique municipality:

- » As educators, municipalities can provide residents with balanced wind energy information.
- » As land-use planners, they can develop fair and technically accurate approaches to regulate future projects.
- » As consumers of electricity, municipalities can generate part of what they need for their facilities with wind turbines.
- » As owners of wind energy facilities, municipalities can generate revenue by investing in well-planned and executed projects.

How can a municipality profit from wind energy?

The direct benefits are primarily financial, including tax paid to the municipality by the project owner, and possibly net profits from municipal ownership of a wind energy facility.

- » In terms of municipal revenue, wind turbines that produce electricity are exempt from regular municipal taxes; instead, tax is based on capacity of the wind turbines. However, all associated land and buildings remain taxable at the regular rate. The specific taxation rate is defined in the Wind Turbine Facilities Municipal Taxation Act tis currently \$5500 per megwatt (MW), plus increases based on the Canadian Consumer Price Index at the end of the 2005 calendar year.
- » In terms of ownership, profits depend on percentage of ownership, cost to develop the project (including debt servicing), and energy production; a project's economic viability varies accordingly. There are now several municipally-owned wind energy facilities in Nova Scotia, some of which are featured in the fact sheets that follow.

^{%8} http://nslegislature.ca/legc/statutes/windturb.htm

What are the indirect benefits of hosting a wind energy project?

Some of wind energy's many indirect benefits to a municipality are highlighted below; each is examined more fully in a separate fact sheet.

Environmental

- » Offsets use of fossil fuels with clean renewable wind energy
- » Reduces greenhouse gas emissions and other air pollutants
- » Improves electrical grid efficiency where energy is used locally

Social

- » Empowers communities and develops local partnerships
- » Provides options for socially responsible investing
- » Utilizes and develops community-based expertise

Economic

- » Provides more local benefits than imported energy sources; it is estimated that every dollar invested in wind energy is multiplied three-fold within the community
- » Geographic distribution of projects across the province will promote local economies and provide jobs
- » Reliance on unpredictable imported energy sources from worldwide markets is reduced

A well-planned project can maximize these benefits, as well as reduce any negative impacts.

The following nine fact sheets provide additional information. Fact Sheets 2, 3 and 4 focus on the basics of electricity generation, wind energy, and phases of project development. Fact Sheet 5 provides an overview of approaches to siting wind turbines. Fact Sheets 6, 7 and 8 take a more detailed look at possible ecological, social and financial implications. Fact Sheets 9 and 10 present best practices in community engagement and policy and planning considerations. The Fact Sheets close with a list of hyperlinked references for more reading and exploration in wind energy.

My Ideas



Chester, Nova Scotia



Chester, Nova Scotia

Case Study Basic Stats

Location:

9

Municipality of the District of Chester

Output:

4

2.0 MW

No. of Turbines:



1

Case Study: KAIZER MEADOW WIND PROJECT

After five years of planning, testing and permitting by the Municipality of the District of Chester, a 2 MW wind turbine 25 km north of the Village of Chester began generating power in January 2014. Preliminary work included testing wind at the site to verify that the project made financial sense; Council decided to proceed with the COMFIT program in 2011. Following study and consultation, an environmental assessment was approved by Nova Scotia Environment in late 2012.

The wind turbine is owned by the Municipality and is located near the Kaizer Meadow Environmental Management Centre. The power generated is fed into the local power grid with fixed rates paid to the Municipality (13.1¢ per kWh for wind power over 50 kW for a 20-year period, per the COMFIT program). Profits from this \$5.5 million project were expected to be about \$150,000 in the first year. As the 15-year mortgage declines, profits increase; in the final years of the 20-year project, the Municipality will realize about \$330,000 in revenue annually. 9





Electricity Use and Generation Options

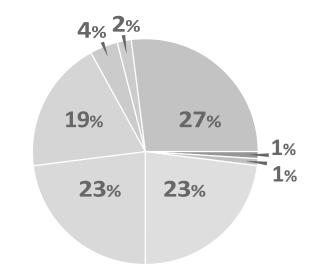
How do we use electricity in our daily lives?

We already consume a lot of electricity every day in our workplaces, schools and homes, and while we are now using it more efficiently, future projections indicate that consumption will increase.

Based on World Bank data on electricity usage, Canada is among the highest per capita consumers of electricity, § 1 at over 16 MWh. We surpass ten other countries with the highest total GDP (gross domestic product). Our consumption is greater than Japan and Germany combined, and is exceeded only by Norway and Iceland.

Electricity is generated from various primary energy sources, renewable and non-renewable; as a secondary form of energy, it is conveniently distributed to users. Let's consider how we use electricity, and our choices in how it is generated.

Chart 2A: Canadian Electricity Demand by Sector



Commercial / Institutional (19%)

Resource Extraction (4%)

- Public Administration (2%)
 Transportation (1%)
- Industrial (27%)
 Agriculture (1%)
- Manufacturing (23%)
- Residential (23%)

SOURCE: STATISTICS CANADA, ENERGY STATISTICS HANDBOOK, 2012: HTTP://WWW.STATCAN.GC.CA/PUB/57-601-X/57-601-X2012001-ENG.HTM

^{%1} http://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC

What are the primary sources of electricity in Nova Scotia?



Coal

Many of the mines that provided coal for electricity generation in Nova Scotia have closed. Only 20% of coal supplied to Nova Scotia Power is local; the remainder is imported at higher cost, typically from the USA or Colombia.



Natural Gas

As a cleaner-burning fossil fuel, natural gas for electricity generation has been in demand. Nova Scotia Power has converted one thermal generating station to use natural gas.



Nuclear

Although there is no nuclear generation in Nova Scotia, it exists elsewhere in Canada, including New Brunswick, which is connected to Nova Scotia through a transmission line.



Oi

Until the 1970s, a lot of our electricity was generated from imported oil. Nova Scotia coal then became a cheaper local alternative. Reduction in oil use is expected to continue.



Biomass

Organic matter, like wood and wood waste, can be burned to generate electricity. Most production is small-scale, but larger biomass plants have recently been added to the grid in Nova Scotia.



Hydro

Nova Scotia has had hydroelectric generation since the early 20th century, and it will continue to play an important role in meeting electricity demand. The Maritime Link, a 500 MW transmission line from Newfoundland to Nova Scotia, will allow importation of hydro-generated electricity from the Lower Churchill Project.



Solar

Active solar energy generation is mostly off-grid in Canada. Nova Scotia is examining broader uses for solar generation, and small-scale solar projects are on the increase.



Wave & Tidal

One of the few tidal plants in the world is in Nova Scotia; the 20MW Annapolis Tidal Power Plant opened in 1984. Nova Scotia is making significant investment in tidal energy research and plans for projects large and small.



Wind

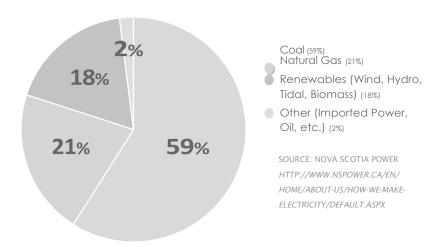
The pace of wind energy development in Nova Scotia remains strong. Many projects have recently been constructed or are under development. As of March 2015, there was 350 MW of installed capacity from wind generation in the Province.

SOURCES:

How is electricity generated in Nova Scotia?

Thermal generating stations using fossil fuels and renewables (wind, tidal, hydro, biomass) generate our electricity. Nova Scotia Power owns and operates its own electricity generation, renewable and non-renewable, and purchases renewable electricity from other power producers throughout the Province. It also imports electricity through a transmission line connecting our province to New Brunswick. It is expected that the Maritime Link Project will allow importation of more renewable electricity by 2017.

Chart 2B: Generation Mix, Nova Scotia (as of 2012)



Thermal generation (coal, natural gas, oil, and biomass) are dispatchable sources of electricity, meaning that electricity can be added to the grid as needed. Wind, tidal and solar sources are non-dispatchable - they are intermittent - at times they do not produce electricity. Intermittent generation creates challenges in planning and operating our electrical system.

In March 2015, Nova Scotia had approximately 350 MW of wind energy capacity. More wind energy projects are in the planning stage or under construction, including a large project of 100 MW and several smaller COMFIT projects. Like tidal and solar, wind energy is a non-dispatchable source of electricity. The integration of both dispatchable and non-dispatchable sources of electricity into the existing electrical grid is a key consideration in planning additional wind energy projects. This was one outcome of the Electricity System Review (April 2015). ²

Get to Know Wind Energy

Environment Canada reports that coal-fired sources supply only about 15% of Canada's electricity, but these are responsible for 77% of greenhouse gas emissions from the electricity sector.

In 2012, federal regulations set performance standards for 2015 that will result in emission limits and eventual phasing-out of coal-fired generation facilities. %3

As of June 2014, the federal and provincial governments finalized an equivalency agreement containing changes to provincial laws that allow Nova Scotia to opt out of federal regulations. § 4

Nova Scotia's Greenhouse Gas Emissions Regulations were revised to extend existing electrical emission caps to the years 2021–2030. %5

^{% 2} http://energy.novascotia.ca/electricity/electricity-system-review

^{%3} http://laws.justice.gc.ca/eng/regulations/SOR-2012-167/

^{% 4} www.gazette.gc.ca/rp-pr/p1/2014/2014-06-28/html/reg3-eng.php

^{% 5} www.novascotia.ca/just/regulations/regs/envgreenhouse.htm



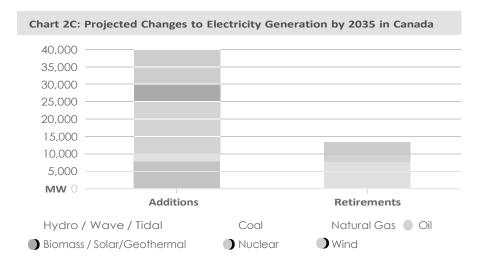
Lingan, Nova Scotia

What is the future for electricity generation in Nova Scotia?

Electricity generation in Nova Scotia began with renewable electricity in the form of hydro dams in the mid-19th century. They were followed by large fossil fuel thermal generating stations which used oil, then coal, and are now shifting to natural gas. At one time, Nova Scotia coal provided as much as 80% of our electricity. Now the trend is toward renewable electricity; hydro still exists, but wind and biomass are already "mainstay" replacements, while tidal and solar are in the development stage.

Since the 2010 Renewable Electricity Plan⁶6, the major shift toward renewables has been in wind energy. Large and small projects have been constructed and are supplying electricity to the grid, and many more are being developed.

The National Energy Board ⁷ projects that total electricity generation capacity in Canada will increase by an average of 1% annually. Use of fossil fuels that we relied on in the past is expected to decline with the shift to renewables and cleaner fossil fuels. Aging generation facilities will need to be replaced for reliability, economic and/or environmental reasons. Renewables will increase to compensate for reductions in fossil fuel generation and supply additional demand. This Canadian trend is expected in Nova Scotia as well.



We have choices in Nova Scotia. Moving toward local renewable sources will help stabilize electricity prices in the future and provide energy security. This will help protect Nova Scotians from the volatility of international fossil fuel pricing and the regulation and possible future costs of greenhouse gas emissions. Wind is an important part of this renewable electricity mix.

^{% 6} http://energy.novascotia.ca/sites/default/ftles/renewable-electricity-plan.pdf

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Basics of Wind Energy Technology

How is electric energy harnessed from the wind?

Wind energy develops in response to temperature changes on the earth's surface and the rotation of the earth, as well as variations in topography and other factors. Nova Scotia has an exceptional wind regime; partly due to our strong coastal winds, we have some of the highest average wind speeds in Canada.

In 2007, the Province commissioned the Nova Scotia Wind Atlas. ⁶ ¹ This map shows the predicted wind speed at varying heights above ground level and is an important first step in identifying possible locations for wind energy projects before investing in site measurements. Because it was developed from computer models, site-specific measurements are required for any wind project planning.

The Nova Scotia Wind Atlas shows higher wind regimes in predictable locations – coastlines and highland areas. Feasible wind energy projects require a minimum average wind speed, which varies with the specific project. Wind conditions that are too fast or too gusty are not suitable for turbines. Every wind turbine has its own generation capability relative to a constant wind speed.

Like sailboats and airplanes, wind turbines are designed to function with the wind. Wind turbines vary in size, from a small turbine powering a municipal facility to many large turbines selling electricity to the grid.

Wind energy is a mature technology. In the past 20 years, there have been many advances in the industry to improve efficiency and reduce sound. Possible impacts are discussed specifically in Fact Sheets 6 to 8; this fact sheet presents the basics of the technology.

^{% 1} www.nswindatlas.ca

Get to Know Wind Energy

Wind Speed Units and Ranges: Wind speed is typically measured in metres per second (m/s).

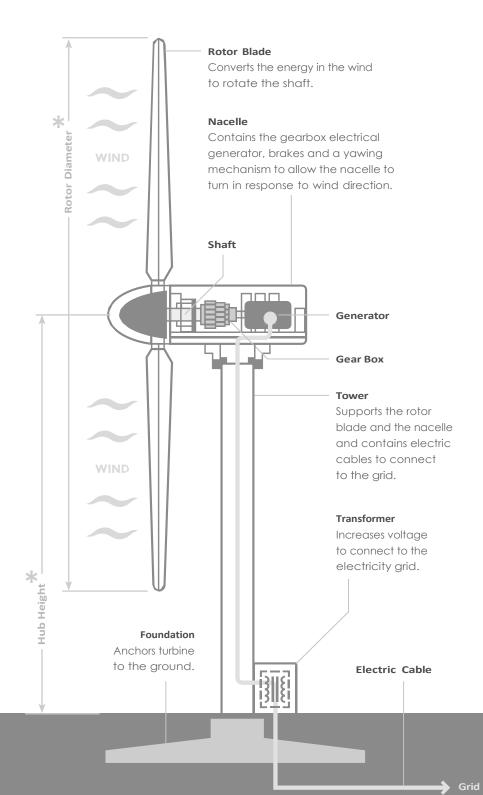
An average wind speed of 7 m/s is considered good for larger wind turbines; that is, at a height of about 80 m. This wind speed is comparable to driving 25 kilometres per hour (km/hr).

For smaller wind turbines, the rotor blades are lower to the ground-typically 30 m or less – where the average wind speed is lower, often under 4 m/s.

Smaller wind turbines cost less to install; however, due to the lower wind speeds, energy produced by smaller wind turbines is generally more expensive per Wh than energy produced by larger turbines.

How does a wind turbine generate electricity?

When wind passes over turbine blades, the resulting pressure differential causes them to spin, which turns the shaft connected to the generator. The generator converts the mechanical energy to electricity. Electricity can be supplied to the turbine owner and/or the grid once the voltage is adjusted.



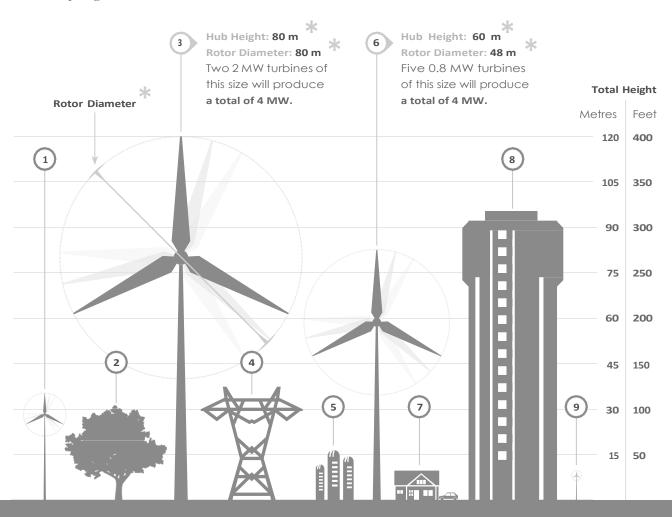
What are the different sizes of wind turbines?

Wind turbines are designed for a wide range of power outputs. Large turbines may have an output of 3 MW or more; in Nova Scotia, they are typically 1.5 MW or 2 MW. The Government of Nova Scotia defines smaller turbines as 50 kW or less.

Height of the tower, or "hub height", of a typical larger turbine is about 80 m. On some turbines the distance across the circle made by the spinning blades, or "rotor diameter", may be 80 m; in this case, the length of one blade is 40 m, so that for this size turbine, the blade tip crests at a peak height of 120 m. Energy output is related to wind speed and rotor diameter: the higher the wind speed and the greater the rotor diameter, the more electricity is generated.

As turbine height increases, larger rotor diameters are possible. This increases the swept area, allowing more energy to be captured from the wind. Energy output is proportional to the swept area: electricity generation increases with the square of rotor diameter.

Smaller turbines convert less energy from the wind because wind speeds are often slower closer to the ground and the swept area is smaller, but they can be more practical and offer many municipal applications. A local example is the 50 kW wind turbine providing a portion of the electricity for a water treatment facility owned by the Town of New Glasgow.



Large Elm Tree 30 m • 100 ft

Large 2 MW Turbine

120 m • 400 ft

Transmission Tower
38 m ● 125 ft

Large Farm Silos 20 m • 55 ft

^{0.8} MW Turbine 85 m ● 275 ft

Get to Know Wind Energy

Nova Scotia consumes and generates about 10,500 GWh of electricity per year. As of March 2015, there was about 350 MW of installed wind capacity, representing about 10% of our overall electricity demand.

Every megawatt of wind turbine capacity

reduces our greenhouse gas emissions by as much as 2,500 tonnes per year. This is the equivalent of electricity used in about 350-400 Nova Scotia homes.



Antigonish, Nova Scotia

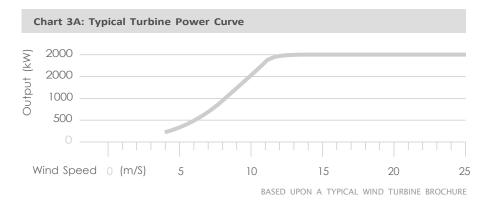


Watts Section, Nova Scotia

How efficient are wind turbines?

Wind turbines typically start spinning to produce electricity at wind speeds of about 3 m/s or about 10 km/hr. This is called the "cut-in wind speed". Ideally, operational wind speeds are steady, with constant direction. When wind direction changes, a modern wind turbine uses its yawing mechanism to rotate the nacelle on the stationary tower. At speeds that are too high, over 25 m/s or 90 km/hr, the wind turbine will shut itself down and stop spinning. This is called the "cut-out wind speed".

An ideal wind speed is typically 12 m/s or about 45 km/hr. The typical output curve for a wind turbine shows that, above a certain point, increases in wind speed will not increase power output. This upper limit is called the "nameplate capacity"; it is based on the capability of the wind turbine's electrical generator.



Under ideal operating conditions, a wind turbine with a 2 MW nameplate capacity will generate 2 MW of power. Operating conditions can be environmental and/or mechanical. If the wind turbine operated optimally for a year, it would generate 17 GWh of energy; like other forms of electricity generation, wind turbines do not typically operate at their highest efficiency – closer to about 6 GWh would be expected.

Over the course of a year, environmental and mechanical conditions vary. A well-sited wind turbine may generate about 35 to 40% of its nameplate capacity. This percentage is known as its "capacity factor". The capacity factor of thermal generating stations ranges from about 50 to 80%. Because of stoppages for maintenance or breakdowns, no power plant generates power 100% of the time.

To be conservative in planning wind energy projects, 30% is often used as the capacity factor. This estimate of power production makes conservative assumptions about environmental conditions like wind speed and mechanical components like the yawing mechanism.



Phases of Wind Energy Project Development

How long between project planning and generating electricity?

It usually takes three to four years from initial project planning until the wind energy project is "commissioned", that is, generates electricity for its owner and/or the grid. The timeline depends on factors ranging from the size of the project to financing and availability of wind turbines. Once the project is commissioned, it can be expected to operate for 20 years or more.

Smaller wind turbines, 50 kW for example, are generally quicker to plan and install; costs and logistics are simpler, and consultation with communities and stakeholders need not be as extensive.

Community engagement should be part of initial wind energy project planning and be maintained through commission, operation, maintenance and eventual decommissioning of the facility. Early and sustained involvement with the local community is essential to creating a successful project.





What is involved in planning and permitting?

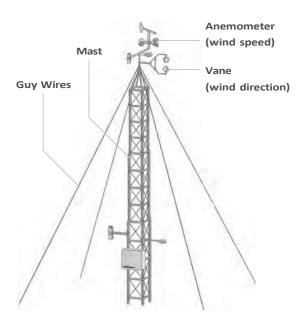
For any proposed wind energy project, large or small, the first step is a preliminary review to identify any known "deal breakers", conditions that could prevent success of the project, whether ecological, financial or social. The goal is to limit risk, because the planning and permitting for a wind energy project are expensive, especially for larger projects.

Risk Assessment

Once obvious deal breakers are eliminated, the feasibility of the proposed project is reviewed in greater detail. This includes negotiating land control, completing a wind resource assessment, analyzing site constraints, beginning the process of grid connection with the utility, and undertaking preliminary engineering design for turbine pads and access roads. The process entails an estimate of costs and revenue over the project's lifetime; it must be demonstrated that the project is economically viable in order to secure financing.

Wind Resource Assessment

Wind resource assessment is a crucial component of project planning. The measured wind speeds on a site may be much more or less than the Nova Scotia Wind Atlas's computer models indicate. Meteorological towers must be installed to gather a year or more of wind speed data; this information also informs site planning, as wind speeds can vary across the site.



Environmental Assessment

Environmental permitting is often completed concurrently with a wind resource assessment. A Class I Environmental Assessment (EA) is required in Nova Scotia for any wind energy project 2 MW or greater. This is a public process and includes 30 days of public review within a 50-day regulatory review period. Guides are available to explain the EA process. After consideration of public comments and other factors, the Minister of Environment will approve the project with conditions, require more review, or reject the project.

EA reports are publicly available ² and extremely detailed, involving numerous studies and analyses. Some of the components analyzed for wind energy projects appear in the table below. Studies of these components are factored into site planning to minimize environmental and social effects. Site planning includes placement of turbines, along with related infrastructure like site roads and electrical lines.

Table 4A: Valued Ecological Components and Socio-Economic Issues

PHYSICAL	BIOPHYSICAL	SOCIO-ECONOMIC
Ambient Air	Wetlands and Watercourses	Land Use
Ground and Surface Water	Fish and Fish Habitat	Resources: Aboriginal and Archaeological
Ambient Noise	Migratory and Breeding Birds	Vehicular Traffic
Ambient Light	Flora	Telecommunications
	Fauna	Health and Safety
	Rare and Endangered Species	Local Economy

Depending on the site and the project, other permits may be required; these applications are made after a successful EA process. Some examples are: a Special Move Permit from the Department of Transportation and Infrastructure Renewal to transport a large turbine to the site, or a Watercourse Alteration Approval from the Department of Environment if an access road needs to cross a stream. Municipal permits, if needed, involve a process separate from the EA.

EA approvals almost always include conditions to be met by the project; for example, follow-up monitoring for effects on birds and bats, and possible monitoring of sound from the turbine.

Get to Know Wind Energy

Consultation with stakeholders like municipal government, regulators, local businesses, residents, and the Mi'kmaq of Nova Scotia is an important part of planning.

Early, meaningful and ongoing engagement of the community and the Mi'kmaq is crucial in the success of wind energy projects, even if the project is smaller than 2 MW and an EA is not required.



Boularderie, Cape Breton



Boularderie, Cape Breton

^{% 1} http://www.novascotia.ca/nse/ea/docs/EA.Guide-Proponents.pdf

[%] 2 http://novascotia.ca/nse/ea/projects.asp

Get to Know Wind Energy

Here are some statistics related to construction of large-scale wind turbines:

As many as 40 to 45 concrete trucks may be needed for one large-scale turbine foundation. Ten to fifteen additional trucks may be needed to transport turbine components.

Turbine towers are usually transported in three pieces on special trailers; each piece may be 25 or 30 m in length. To accommodate the trailers, roads must be five or six metres wide, perhaps up to twelve metres.

Ideally, turbines are placed to best capture wind energy; usually a minimum distance of six to ten times the rotor blade length separates turbines. Placement must also consider site specifics like topography, wetlands, distances from homes, etc.

How long will construction take and what should I expect?

Significant investment, sometimes millions of dollars, is needed for the construction phase of wind energy projects. The work is complex; it includes everything from procuring the turbines to preparing the access roads to connecting the turbines to the grid before the project can be commissioned.

Generally, construction of a larger scale wind energy project takes six months, beginning with surveying and clearing the site (which may be done in winter to minimize ecological damage, like disturbance of nesting birds). Building the footprint includes access roads and pads for the turbine and crane, which need a firm base when the turbines are assembled. Electrical works must be constructed within the site and to connect to the grid. Finally, the site is stabilized to prevent erosion.

Table 4B: Typical Timing of Large Wind Energy Project Construction

		Typical Schedule In Months				
	1	2	3	4	5	6
Surveying and Siting Activities						
Access Road and Crane Pad						
Crane Pad & Turbine Foundation						
Electrical Works						
Wind Turbine Assembly and Installation						
Removal of Temporary Works and Site Restoration						

Residents will experience truck traffic for short intervals over a few months. Good project planning can accommodate a community's specific needs, for example, school hours. As with any construction project, noise and dust may be generated; mitigations should be in place to minimize disruption to residents and the local environment.



What can I expect from an operating wind turbine?

Wind energy projects, large and small, are generally planned to function for 20 years. With proper maintenance and repairs, they often operate much longer.



Turbine Control Mechanisms

Wind turbines have various control mechanisms. Nacelles rotate to make sure the blades are facing the prevailing wind – this is called "yawing". A blade pitch mechanism adjusts the angle of the blades. Sometimes the turbine blades don't move, even with a light wind blowing; this is because turbines have a "cut-in speed" and it is inefficient for them to operate below this wind speed.

Rotor brakes and sensors allow turbines to shut down in response to ice buildup on the blades or very high gale winds. At ideal wind speeds, from about 12 to 25 m/s, a turbine can operate at its nameplate capacity; at average annual wind speeds, a turbine operates at about one third of this capacity. A Supervisory Control and Data Acquisition (SCADA) system is usually installed within the turbine to enable remote monitoring and control.



Maintenance, Monitoring and Repairs

Routine procedures like performance monitoring, maintenance and follow-up environmental surveys occur during a turbine's operational lifetime. Over a 20-year period, turbine components may break down and need repair or replacement. In the first years of operation, work is often completed by the turbine manufacturer's technicians, who can train local staff to take over operation and maintenance tasks. Small amounts of oil and lubricants are used for maintenance.

Environmental surveys often check the area around the turbines for bird and bat carcasses. Regular maintenance reduces complaints associated with mechanical sound from a turbine in need of service. Nearby residents should be given contact information for the wind energy project operator, in case there are questions or complaints.

Get to Know Wind Energy

What about small wind turbines? The phases in a wind energy project (as shown on page 1 of this Fact Sheet) are the same for small wind turbines, but the complexities, costs and benefits are scaled down.

For a very small wind turbine located on an existing building, one year may be sufficient to obtain financing, complete Nova Scotia Power's interconnection agreement, procure engineering, and purchase/install the turbine.

Most small wind turbine projects, between 10 to 50 kW of capacity, do need direct wind measurements to predict output and secure financing. Up to a year of meteorological data may be necessary to ensure that the site has good wind. Because small wind turbines are closer to the ground, the effect of obstructions, like buildings, on the wind regime has to be considered.

The four 2 kW turbines on the roof of the Halifax Seaport Farmers' Market are an example of a very small wind energy project that provides electricity directly to its owner.



Light and Sound

From a distance, larger turbines are seen, rather than heard. In any community, opinions on the aesthetics of wind turbines vary. Project planning for larger wind energy projects often includes a visualization to give residents an idea of how the completed project will look. The nacelle will be lit – usually with a red light – in accordance with Transport Canada requirements.

Functioning wind turbines do produce sound. The amount depends on factors like turbine type, local topography and environmental conditions, wind speed, and humidity. As part of an environmental assessment (EA) or to comply with a municipal by-law, predictive modeling can demonstrate minimal effects on local communities in keeping with environmental and health guidelines. Project planning considers size of project, separation distance from dwellings, and turbine siting to minimize the effects of sound.

"Shadow flicker", which occurs when rotating blades are positioned directly between the sun and the viewer, is another potential effect that will be minimized during project planning. Site planning and signage will be used to minimize risks of "ice throw", a rare buildup of ice on turbines that may be shed near the tower during operation.

What happens 20 years after construction?

At the end of a turbine's operating life, it can be refurbished for further use. If this is impractical, the turbine is disassembled and removed. The site could be re-powered with new wind turbine technology; if not, it would be decommissioned and the land reclaimed. Land reclamation is usually negotiated as part of land agreements. Because of their economic value, turbines are not abandoned. A well-maintained turbine often operates beyond 20 years, but when it reaches the end of its operating life, valuable parts and materials can be recovered.





Approaches to **Siting Wind Turbines**

What factors contribute to a good energy site?

All wind energy developers - municipalities, community groups, private sector companies, First Nations or large electricity users – start by finding a potential site. The next step is determining whether there are any ecological, social or financial "deal breakers" for the proposed site.

Siting wind turbines, large or small, is an iterative process. Each new piece of information could stop the project or justify more study of the selected site.

Key questions in considering a potential site:

Is there enough wind at the proposed turbine hub height?

The NS Wind Atlas is a good starting point, but site measurements will be needed.

How far away are homes and other sensitive land uses?

Social and ecological considerations are important constraints.

How will the site be accessed?

For transport and maintenance of turbines, access is required, e.g., from public roadways.

How close is the site to the electrical grid or direct user of electricity?

To reduce costs, siting close to the user or the distribution or transmission lines is a priority.

Will the site comply with municipal land use by-laws and zoning requirements?

These vary across the Province and often depend on the size of turbine.

Will construction be straightforward?

Constructability is crucial to project costs, and varies with site elevations, geotechnical, and structural conditions.

What are key considerations in project siting?

Beyond the technical and legal considerations, wind energy projects should be sited to maximize benefits and minimize costs associated with ecological, social and financial aspects. Integrating these three considerations – ecological, social and financial – will result in well planned wind energy projects that support true sustainability.

If the site gets a check mark in the these areas, additional study will occur to verify that this site and its proposed site design are suitable. In all cases, more study and analysis is needed before any wind energy project can go ahead.

Figure 5A: Siting Considerations



Technical & Legal

- » Wind resource
- » Proximity to electricity user or grid
- » Capacity of the electricity user or the grid
- » Constructability, e.g., existing roads, topography, etc.
- » Ground conditions, i.e., geotechnical
- » Land ownership or ability to lease / purchase
- » Access from public roadways
- » Adherence to municipal zoning and by-laws
- » Requirements for municipal, provincial or federal permits and approvals



Ecological

- >> Consideration of wetlands and streams
- » Setback from bat hibernacula
- » Setback from bird and raptor migration corridors and important nesting areas
- » Suitable distance from provincial parks and protected areas
- » Consideration of known sensitivity of site flora & fauna



Social

- » Proximity to residential properties, schools, hospitals, etc.
- » Aboriginal and archaeological resources and traditional uses
- » Suitability with adjacent land uses
- » Local attitudes and involvement in project planning
- » View plane considerations



Financial

- » Site specific costs for land, unique studies or construction
- » Predicted electricity production based on wind resource
- » Fixed power purchase agreement or feed-in-tariff
- » Overall payback during turbine operation







What about connecting to the grid?

Some wind turbines generate and supply electricity directly to the load customer; they are "inside the fence", like the 100 kW turbine at the Superstore in Porters Lake. Installed in 2009, it supplies about 25% of the store's power needs. Other wind turbines supply energy directly to the electrical grid for Nova Scotia homes, farms, and businesses. When turbines are not sited "inside the fence" for direct use of their generated electricity, proximity to and capacity of the grid must be considered.

The electrical grid consists of high voltage transmission and lower voltage distribution lines. Large wind energy projects, like the thirty-four 1.5 MW turbines on Dalhousie Mountain in Pictou County, connect to the transmission line. Transmission lines often run along large steel or wooden towers, to move electricity through the Province and beyond.

Electricity carried by transmission lines is sent through distribution substations and transformers that reduce it to a voltage level safe for delivery via street poles to homes and businesses. Smaller wind energy projects, like the single 1.5 MW turbine in Watt Section, Sheet Harbour, connect to the distribution line. In these cases, electricity produced by wind turbines is used locally.

The proximity, voltage and capacity of the electrical grid are vital considerations in siting a wind energy project that proposes to sell to Nova Scotia Power or other electrical utilities.

For projects that are not part of Nova Scotia's feed-in-tariff (COMFIT) or net metering programs, a power purchase agreement can be negotiated, typically a 20-year agreement for Nova Scotia Power to purchase electricity at a fixed rate.

Site-specific wind energy data is required, based on measurements from meteorological towers (often referred to as "met towers"), to estimate electricity production. Predicted production is a key element in gauging the revenue stream for a wind turbine. An inaccurate estimate of wind resource may overestimate electricity production and lead to construction of a project that is not financially viable.

For projects planned as part of the COMFIT program, proximity to distribution lines is a priority, as is sufficient capacity in the local distribution network to use the wind-generated electricity.

How and when would local residents participate?

By the time a site is proposed to the community for a possible wind energy project, it has undergone preliminary review to determine that there are no obvious "deal breakers". Community consultation usually begins with a site feasibility assessment. Local residents should be engaged before a meteorological tower is erected on the site. Early community involvement lays a foundation for communication and trust in later stages of a project's development.

The Halifax Regional Municipality's land use by-laws include meteorological towers in their definition of a "wind energy facility"; notification of nearby residents is required 60 days prior to a development permit application for a meteorological tower.

Ideally, residents will have had the opportunity to discuss local energy planning and integration of renewable energy planning in their community, either during preparation of the Integrated Community Sustainability Plans in 2010 or the Municipal Climate Change Action Plans in 2013. Understanding generation, distribution and use of electricity at a community level is an excellent foundation for local residents to discuss proposed wind energy projects, including site selection.

What additional studies may be completed?

If a site passes preliminary review, additional studies, including at least one year of meteorological data on wind speeds, will be conducted to develop a solid business case for the wind energy project. Additional studies of technical, legal, economic, ecological, social and financial factors, ranging from geotechnical assessment to bird migration surveys, will be completed.

The unique aspects of the site and size of the proposed project will determine the extent of the studies. For projects 2 MW or larger, more studies are required because the project must undergo a provincial environmental assessment (EA). As part of community engagement, the progress and outcomes of these studies should be shared with local residents.

Once a site is selected, how is it designed?

Whether the proposed wind turbines are large or small, micro-siting of the turbines will occur when the necessary information is gathered. A large wind energy project often requires a large site; specific turbine locations depend on local topography and wind resource, but must

complement ecological, social and financial considerations. For example, higher elevations on a site may have the best wind resource, but may not be selected if access roads require crossing of wetlands. As in site selection, the process of site design is iterative.



Ecological Considerations for Wind Energy

What ecological issues are raised by wind energy?

Domestic renewable energy production makes our way of life more sustainable and provides many ecological benefits. Using a local resource like wind to generate electricity doesn't require extraction, processing or water, and doesn't produce air or water pollutants or other wastes.

However, wind energy projects must be carefully planned to ensure that their construction and operation do not have negative ecological impacts. A poorly-sited development can damage valued wetlands, harm species at risk, or result in collisions with birds or bats. These and many other issues are reviewed in the environmental assessment (EA) required for any wind energy project with a generation capacity of 2 MW or more. Smaller wind energy projects are not subject to an EA because the risk of environmental and social effects is less.

Site selection is critical in developing a large wind energy project with minimal ecological impact. Reviewing potential project sites involves many considerations, such as wind resource, but ecological factors are paramount. Once a site is selected, up to two years of planning, studies and consultation will be done before an EA is filed with the Province. With good site selection and planning, ecological impacts can be minimized or eliminated.

Producing electricity with renewable local resources reduces dependence on fossil fuels and resulting air emissions and greenhouse gas production, which mitigates climate change and benefits the local and global environment.

Do different sources of electricity have different environmental impacts?

Different electricity technologies raise different environmental considerations. Brief overviews of each, based on a Canadian Electricity Association of power generation study, appear below. The study considered air emissions, greenhouse gas production, water use, resource extraction, wastes and other issues. Impacts associated with manufacturing any of these technologies are not addressed.



Coal

Burning coal creates air pollutants and greenhouse gas emissions. Coal-fired generators require water for cooling and create a thermal discharge to receiving waters as well as solid wastes like fly ash. In Nova Scotia, coal electricity generation produces significant air emissions including carbon dioxide, a greenhouse gas.



Natural Gas

Like coal and oil, natural gas is an extracted fossil fuel that uses thermal generation to create electricity, but it is cleaner, producing fewer air emissions and less greenhouse gases and thermal discharge.



Nuclear

Nuclear requires extraction of uranium and has high cooling water demands; the most significant concern is the production and management of radioactive wastes from nuclear processes.



Oi

Oil's impacts are similar to those of coal-fired generators, but are less intense in terms of air emissions and cooling water requirements.



Biomass

Combustion of biomass produces some air pollutants and greenhouse gases; the amount depends on the resource and specific technology. The source and harvesting of the biomass are key factors.



Hydro

There are no air emissions from combustion, but reservoir hydro creates greenhouse gas emissions in the form of methane. The main impacts are on the river/lake and watershed itself, including fish and fish habitat.



Solar

There are no direct adverse effects on air or water, and no wastes directly produced by photovoltaic solar.



Wave & Tidal

Environmental effects of both wave and tidal power are site-specific, so site-specific research is generally required. The primary concern is fish and their habitat.



Winc

There are no wastes or emissions from operational turbines, but there are potential bird and bat collisions.

% 1 http://www.electricity.ca/media/pdfs/EnvironmentallyPreferrablePower/2-powergenerationincanada.pdf

How is wind energy part of the climate change solution?

Each year, our society releases millions of tonnes of carbon dioxide by burning fossil fuels, which contributes to climate change. In Nova Scotia, this is mainly from coal. While wind energy is not the sole answer to climate change, it can be instrumental in reducing greenhouse gas emissions. Climate change is a significant threat to our local ecosystems.

According to the Intergovernmental Panel on Climate Change's recent report, "Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems" (IPCC 2014 2).

Of all energy production technologies, wind energy appears to have the lowest lifecycle emissions. Wind-generated electricity produces no greenhouse gas emissions. Manufacture and transport of the turbine and associated equipment do produce greenhouse gases, but the European Wind Energy Association \$\gamma_3\$ states that it takes a turbine only three to six months to compensate for the energy that goes into its manufacture, installation, operation, maintenance and decommissioning at the end of its life.

Electricity generation is responsible for about half of Nova Scotia's greenhouse gas production. There are no silver bullets to address climate change, but decreasing our use of fossil fuels to make electricity and increasing our use of renewable sources like wind could lower greenhouse gas emissions substantially.

How can wind energy's ecological impacts be minimized?

Site planning considers ecological factors like wetlands and watercourses, fish and fish habitat, migratory and breeding birds, flora and fauna, and species at risk and of conservation concern. Selecting a site distant from important bird areas and bat hibernacula will reduce collisions. Micro-siting of turbine pads, electricity lines and access roads can avoid or minimize interaction with wetlands and watercourses. For larger projects, studies will be completed as part of the EA; for example, determining where there is low potential for affecting plant or animal species at risk.

Monitoring of carcasses under turbines has shown minimal collision kills with birds and bats, but this remains an important consideration, particularly if species at risk or of conservation concern, like the Little Brown Bat, are in the area. This species was once the most common bat in Nova Scotia but is now threatened by White-nose Syndrome and listed as Endangered 4.

^{% 2} http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

^{% 3} http://www.ewea.org/

^{% 4} http://novascotia.ca/natr/wildlife/biodiversity/species-list.asp



Amherst, Nova Scotia

Amherst, Nova Scotia

Case Study Basic Stats

Location:

9

Municipality of the County of Cumberland

Output:

4

31.5 MW

No. of Turbines:

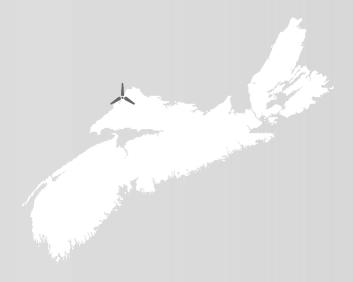


15

Case Study: AMHERST WIND ENERGY PROJECT

Outside the Town of Amherst, near the New Brunswick border, there are fifteen 2.1 MW wind turbines owned by a private company. Because the project is sited on more than 400 hectares of agricultural lands near the John Lusby Marsh National Wildlife Area, the Chignecto National Wildlife Area, and the Amherst Point Bird Sanctuary, there were unique ecological sensitivities to consider. After several years of planning and studies, the environmental assessment (EA) was filed in 2008 %.

Nova Scotia Environment approved the project with many Conditions of Approval, typical for a large wind energy project. They included post-construction bird and bat monitoring and development of an Environmental Protection Plan to ensure compliance with the Species at Risk Act and the Migratory Birds Convention Act. Post-construction monitoring for birds and bats includes carcass searches to verify the EA's prediction that no significant adverse residual environmental effects are likely, including any to birds and other wildlife.





Social Considerations for Wind Energy

What social issues are raised by wind energy?

Municipalities that commit to becoming more sustainable through domestic renewable energy production derive direct and indirect community benefits; many indirect benefits are financial or environmental, like lower greenhouse gases and air emissions, stabilized long-term electricity costs, a larger tax base, and more jobs. While these are important, affordable electricity is often cited as the foremost social issue.

For a community to accept a wind energy project — or any electricity generation facility - the local benefits must outweigh the costs. In the case of wind turbines, larger projects elicit the greatest number of social concerns, including noise, health effects, property values, and view planes. Wind energy projects have been identified as a particular source of annoyance for some community members.

Health Canada recognizes annoyance as a reaction to community noise which can lower quality of life. The World Health Organization also considers annoyance an adverse health effect. The source is most commonly road traffic, but can also be wind turbine noise. Levels of annovance are reduced when there are personal benefits, like land leasing fees and community improvements. Residents' perception of the sight or sound of wind turbines affects their feelings of annoyance. A well-planned project with transparent community engagement can set the stage for increased acceptance and lower levels of annoyance. Negative effects can be minimized through good site selection, project planning and community consultation.

What about different sources of electricity and the community?

To be an efficient resource, electricity has to be produced in or near a community; the question is, what form of electricity generation technology makes a good neighbour? The social costs of different options, like risks to health and climate, are weighed below:



Coal

Coal is a major part of thermal generation in Nova Scotia. Coal-fired generation is located near the communities of Trenton, Lingan, Point Tupper and Point Aconi. These communities have cited concerns about air quality and emissions, including particulate matter.



Natural Gas

Natural gas provides about one fifth of current electricity generation in Nova Scotia. Communities near coal-fired plants often view natural gas as a more acceptable alternative. A cleaner burning hydrocarbon, natural gas produces fewer air emissions, including the particulate matter which concerns many who live near thermal generating stations.



Nuclear

Nova Scotians may be using nuclear-generated electricity transmitted from New Brunswick; there are no existing or proposed nuclear plants in Nova Scotia.



Oil

Oil-fired generation is a small part of Nova Scotia's thermal generation mix; it has community issues similar to coal.



Biomass

Social acceptance of biomass plants is very specific to the site and project; concerns relate to particulate matter from burning biomass feedstock and the sustainability of harvesting techniques.



Hydro

As with biomass, social acceptance of run-of-river and reservoir hydro projects varies. Larger projects gain less acceptance if there is concern about impacts to land use and local ecology, especially related to traditional uses by the Mi'kmaq of Nova Scotia.



Solar

Photovoltaic solar generates no noise or emissions. This technology is well-suited for many communities, even dense urban areas.



Wave & Tidal

Because they are often at some distance from neighbouring communities, there may be less concern with wave and tidal; however, issues of fishing and traditional use by the Mi'kmaq of Nova Scotia need to be addressed.



Wind

The size and number of turbines, as well as setback distances from dwellings, are the factors most likely to influence community acceptance of wind energy projects. Concerns about noise and visual impacts are most commonly cited, but both are subjective and greatly influenced by perception of the project.

Are wind turbines noisy?

As wind turbine design has evolved, sound emissions have been dramatically reduced, mainly in the mechanical components; the remaining audible sound is primarily the 'swoosh' of wind moving past the turbine blades. Sound can be predicted and measured. It is reported in decibels at the A-weighted level (dBA), frequencies which correspond to human hearing. Sound models can be accurate (often to 3 dBA) if used correctly; they include input for ground cover, topography and climatic conditions like wind speed and humidity.

In Nova Scotia, a guideline of 40 dBA has been adopted as the maximum sound level outside of a dwelling, and is a requirement for wind projects 2 MW or more in nameplate capacity to be approved under the Nova Scotia Environmental Assessment (EA) process. This level is in line with many other jurisdictions, as well as the World Health Organization's recommendation, which deems 40 dB to be protective of sleep. This sound level is comparable to a quiet street in a residential area. Noise is the perception of sound; unwanted sound is considered noisy.

Can wind turbines affect human health?

In certain weather conditions, there is potential for ice throw, release of ice build-up on the blades. Ice thrown from a moving turbine blade will not go beyond a distance of two or three times the turbine height (240 m for a typical large-scale turbine). There is also potential for shadow flicker, an effect created when wind turbine blades rotate in front of a low-level sun. Projects undergoing an EA need to show that shadow flicker levels at nearby dwellings do not exceed 30 hours total per year or 30 minutes maximum in one day based on clear sky assumptions. Both of these risks are well known and can be addressed with good site planning.

There has been much debate on the effects of audible sound, low frequency sound and infrasound. To assess the potential impacts of wind turbine noise on community health and well-being, Health Canada completed a study which found that self-reported sleep disturbance, self-reported illnesses, and self-reported perceived stress and quality of life were not associated with wind turbine noise exposure. However, statistically significant relationships were

found between increasing wind turbine noise levels and the reporting of high annoyance due to noise, vibrations, blinking lights, shadow and visual impacts from wind turbines. In all cases, annoyance increased with exposure to higher noise levels. The study found a significant increase in annoyance when noise levels exceeded 35 dBA. It was also found that low frequency noise correlated well to the audible range. Results for infrasound are still being evaluated by Health Canada and are expected to be released later in 2015.

Annoyance can affect health; the Health Canada study determined that wind turbine noise annoyance was statistically related to both self-reported and measured health effects. Community acceptance of wind turbines often determines perception of noise and resulting levels of annoyance.

Wind turbines also have beneficial human health affects by displacing fossil fuel electricity generation, which produces greenhouse gases and other air emissions leading to health risks.

 $[\]begin{tabular}{ll} \$ 1 & http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php \\ \end{tabular}$



Spiddle Hill, Nova Scotia

Spiddle Hill, Nova Scotia

Case Study Basic Stats

Location:

9

Municipality of the County of Colchester

Output:



150 kW and 1.6 MW

No. of Turbines:



5 (3 small and 2 large)

Case Study: SPIDDLE HILL WIND ENERGY PROJECT

After the Colchester-Cumberland Wind Field (CCWF) was approved to operate as a Community Economic-Development Investment Fund (CEDIF) in 2007, momentum for this community-based wind energy project began to build. Seven years later, three 50 kW turbines and two 800 kW turbines are operating on private land leased on Spiddle Hill between Tatamagouche and Earltown in the northern part of Colchester County ². The Spiddle Hill Wind Energy project now delivers renewable electricity to the local community via the distribution grid.

The project is well supported at the local level. In a survey of three wind energy projects in Nova Scotia ⁶ ³, this project showed the highest sense of community ownership. This was attributed to its being locally initiated, providing opportunities for local investment, and being perceived as having greater community participation in the planning process.

Most research shows that local ownership, community involvement, and public education increase community acceptance and support for a specific wind energy project.





Financial Considerations for Wind Energy

What financial issues are raised by wind energy?

Municipalities that become more sustainable through domestic renewable energy production reap direct and indirect economic benefits; for example, from taxes (per the Wind Turbine Facilities Municipal Taxation Act 1) and sometimes from land leased directly to the project. Additional benefits include potential jobs and contracts, primarily during construction, and land leased to a project by community members.

If a municipality owns some or all of the wind energy project, the net profits are direct. Project planning, including siting, is key to ensuring the project's financial viability. Each project has unique financial considerations based on number and size of turbines, wind speeds, construction and land costs, interconnection details, and necessary studies and consultation programs. The cost of studies, construction and ongoing operation is compensated by the sale of electricity produced, which is why wind resource studies, desktop and in the field, are essential.

Renewable energy like wind offsets combustion of fossil fuels which produce gases and other air emissions leading to climate and health risks. Nova Scotia's Integrated Community Sustainability Plans and Municipal Climate Change Action Plans show the real cost implications of climate change for municipalities. Adaptation to rising sea level and extreme weather leads to costs for roads and infrastructure. A 2011 report on adaptation to climate change in Canada forecasts a cost of \$5 billion by 2020, much of which may fall to local municipal governments. A 2011 report of the cost of \$5 billion by 2020, much of which may fall to local municipal governments.

Electricity produced with local renewable resources creates more stable long-term electricity rates and reduces dependence on imported fossil fuels with unstable markets, as well as possible future health costs from air quality-related illnesses. Local renewable electricity projects often sign long-term agreements, like a 20-year power purchase agreement, which lock in costs. Energy cost security benefits a municipality, its businesses, institutions and residents.

^{%1} http://nslegislature.ca/legc/statutes/windturb.htm

^{% 2} http://www.fcm.ca/Documents/reports/PCP/paying_the_price_EN.pdf

What are the cost implications of different sources of electricity?

Every electricity source has different economic considerations. Brief descriptions of each, based on a Canadian Electricity Association of power generation study, appear below. They do not include extended financial benefits, like those from local development, or indirect costs like health or climate. Long-range pricing forecasts for electricity generation show increases for fossil fuels and decreases for nuclear and most renewable energy sources.



Coal

Coal has the largest share of thermal generation in Nova Scotia, partly because its current costs are well within the range of wholesale electricity generation cost. Long-range risks may include additional costs of greenhouse gas emissions and volatility of the international market.



Natural Gas

Costs for natural gas remain higher and more volatile than coal, but its lower emissions may reduce risk of future costs due to regulatory changes. Current costs are slightly higher than wholesale electricity generation cost.



Nuclear

Current costs of nuclear are comparable to natural gas electricity generation, but expected to decrease in the long term.



Oi

Oil-fired generation is a very small source of generation in Nova Scotia and can be very expensive. Costs are typically above wholesale electricity generation cost.



Biomass

Costs of feedstock are critical in costing of biomass for electricity generation; as a result, costs can vary substantially.



Hydro

Run-of-river projects produce some of the cheapest electricity, with reservoir hydro a close second; costs are site-specific.



Solar

Although some applications are costeffective, photovoltaic solar remains much more expensive than other technologies. Costs are projected to decrease significantly in the coming decade.



Wave & Tidal

Wave and tidal power are considered emerging technologies in Canada. Costs vary significantly and are expected to decrease for efficient future applications.



Wind

Costs of wind energy vary with project specifics, but at their most efficient are well within wholesale electricity generation cost. Cost tends to be higher for smaller projects, which is reflected in existing Community Feed-in-Tariff (COMFIT) Program rates.

^{\$} 3 http://www.electricity.ca/media/pdfs/EnvironmentallyPreferrablePower/2-powergenerationincanada.pdf

Can wind be cost-competitive with other sources of electricity in Nova Scotia?

Even as recently as ten years ago, wind was considered by many to be too expensive. Since then, more efficient technology and more local experience constructing and operating wind turbines have made wind energy cost-competitive. Nova Scotia's feed-in-tariff rate for wind turbines with a capacity above 50 kW is 13.1ϕ per kWh, locked in for a 20-year period. In 2014, Nova Scotia Power's domestic service energy charge was 14.251ϕ per kWh; electricity rates are expected to increase over the next 20 years. Wind energy costs are competitive, and will become more so as the cost of fossil fuels increases.

In 2014, Nova Scotia Power completed its Integrated Resource Plan for long-term operation of the electricity system, including necessary capital investments. The study concluded that the cost of integrating wind energy rises sharply above 600 MW of installed wind generation; as a non-dispatchable source of electricity, it requires capital investment for upgrades to ensure reliable system operation.

Operational costs for non-renewables are expected to rise due to the increasing cost of fossil fuels, possible future carbon pricing, and the cost of complying with future air quality regulations or renewable targets. These levelized cost estimates of different sources of electricity, meaning capital and operating cost over a lifetime, are highly sensitive to assumptions.

How can we estimate the indirect cost of burning fossil fuels?

Beyond direct capital and operating costs of generating and distributing electricity, the burning of fossil fuels, particularly coal, has real ecological and social costs associated with greenhouse gases and other air emissions, like particulate matter.

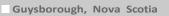
In a joint report, the Pembina Institute, Asthma Society of Canada, Canadian Association of Physicians for the Environment and the Lung Association 5 estimated the true cost of coal as a source of electricity in Alberta. Using coal to generate 60% of the province's electricity would result in indirect costs for health and climate risks equivalent to additional consumer charges of 3.6¢ to 13.7¢ per kWh.

The Nova Scotia Department of Energy has committed to making health and environmental factors part of future studies that examine the potential costs associated with different electricity generation technologies and fuel sources 6. Full cost accounting is vital to understanding the true financial implications of all sources of electricity generation.

The real cost of environmental and health effects is often seen at the municipal level, such as damage to municipal infrastructure from extreme weather events, or exacerbated health problems from burning fossil fuels.

- % 4 http://tomorrowspower.ca/irp
- % 5 http://asthma.ca/pdf/costly-diagnosis.pdf
- % 6 http://energy.novascotia.ca/sites/default/ftles/ftles/Electricity-Review-What-We-Heard-Scope-of-Work.pdf







Guysborough, Nova Scotia

Case Study Basic Stats

Location:



Goldboro & Melford and Sable Wind

Output:



250 kW and 13.8 MW

No. of Turbines:



11 (5 small and 6 large)

Case Study: DISTRICT OF GUYSBOROUGH

The Municipality of the District of Guysborough has invested in five AOC 15 – 50 (50 kWh) turbines (three in Goldboro and two in Melford) and six Enercon E-82 (2.3 MW) turbines at Sable Wind (near Canso, Hazel Hill and Little Dover communities). Guysborough was the first municipality in Nova Scotia to own and operate multiple small turbines through the COMFIT program and also the first to be the majority owner / operator of a large wind energy project. The small wind turbines represent a \$2 million investment and the large wind energy project an investment of over \$27 million ⁹ Both projects will provide a recurring source of revenue to the Municipality for at least 20 years.

The Municipality will receive direct revenue from selling electricity from the projects it owns, jobs and other economic opportunities during construction and operation, and increased tax revenue from these wind energy projects. Service upgrades associated with these wind developments have also improved system reliability for local customers.





Community Engagement and Wind Energy

What are the benefits of early and open community involvement?

When a community is well informed about wind energy and trusts its local planning process, there is usually less opposition to a proposed wind energy project. Early and open community involvement encourages logical dialogue based on mutual respect.

It begins with education. Education about wind energy must be factual and presented from different perspectives. Wind energy projects can have both positive and negative impacts. Myths about wind energy can lead to fear; balanced information and consistent communication can dispel them.

Nova Scotia municipalities have discussed sustainability and climate change in developing their Integrated Community Sustainability Plans (ICSPs) and Municipal Climate Change Action Plans (MCCAPs). These often included dialogue on energy generation, distribution and use, typically focusing on renewable energy sources like wind.

These discussions set the stage for later engagement on specific wind energy proposals and proposed projects based on education. Ideally, dialogue on wind energy development doesn't start with a proposal to install wind turbines but is rooted in broader discussion of electricity needs and sources.

Early and open community involvement increases the likelihood that a proposed project will meet the values and expectations of the community. Engagement is a two-way street; it ensures that the community is well informed and that municipal leaders and project developers understand its needs.



Higgins Mountain, Nova Scotia

How can communities be better engaged?

Community discussions on sources of electricity, its distribution and its use introduced as part of local planning initiatives like ICSPs and MCCAP should continue. The broader goals created in these plans form a solid foundation for wind energy projects; additional citizen involvement will lead to appropriate wind energy projects being developed in communities.

Municipal planning tools, like land use by-laws, can promote early community engagement in specific wind energy projects. For example, Halifax Regional Municipality requires that wind energy developers notify nearby residents before installing a meteorological tower. This ensures that residents are aware of a proposed project early on, and often motivates developers to engage earlier as a result. Informally, municipal leaders can advise project developers, private companies or municipal public works staff on appropriate ways to engage the community.

There is no one "right" way to engage a community; the approach will be as individual as the municipality. Elected officials and municipal staff are the experts on the dynamics of their community; however, there are best practices for community engagement specific to wind energy development described later in this Fact Sheet.

Who should be consulted in planning a wind energy project?

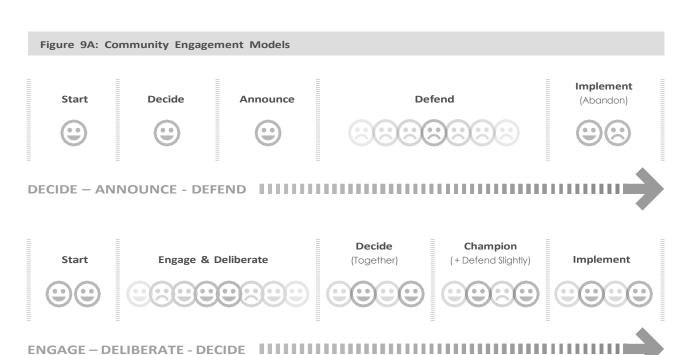
The community comprises residents and their leaders, businesses, institutions and community groups, with a range of demographics and opinion. Consultation should be designed to reach different ages and education levels, as well as different points of view. All members of the community are stakeholders in the proposed wind energy project; the plan for engagement needs to consider their unique concerns.

As rights holders, the Mi'kmaq of Nova Scotia should be consulted early and in a meaningful way on proposed wind energy projects. The nearest Mi'kmaq Band Council should be contacted, as well as the Kwilmu'kw Maw-klusuaqn, also known as Mi'kmaq Rights Initiative. The Mi'kmaq claim title and right to hunt, fish and harvest in all traditional uses of land in Nova Scotia. These claims are subject to ongoing negotiations between the Mi'kmaq and the Nova Scotian and Canadian governments.



Which approach would you choose in planning your wind energy project?

Consider a single large turbine proposed in two different Nova Scotia communities with similar characteristics. In one scenario, the community is made aware of the proposed turbine only after the plan has been well developed. This is the Decide – Announce – Defend model: it is more likely to elicit opposition, which may put the proposal at risk. The other scenario begins community engagement in the early stages of project planning. Community members are part of the discussion and decision making. This is the Engage – Deliberate – Decide model: it is more likely to result in a proposal that is acceptable to the community.





What are some best practices for community engagement?

Community engagement plans should reflect the proposed project's scale and scope and the stakeholders' expected level of interest. The spectrum of engagement may range from informing and consulting the community to programs that actively involve the community. Communities can become true partners in a project where they actively collaborate or empower decision making.

Table 9A: Spectrum of Engagement (International Association for Public Participation)

Level of Public Impact	Example Techniques	
Inform	Fact Sheets; Websites; Open Houses.	
Consult	Public Comment; Focus Groups; Surveys; Public Meetings.	
Involve	Workshops; Deliberative Polling.	
Collaborate	Citizen Advisory Committees; Consensus Building; Participatory Decision-Making.	
Empower	Citizen Juries; Ballots; Delegated Decision.	

The Canadian Wind Energy Association has developed a best practice guide for community engagement and public consultation. It suggests the most common tools for involving the community, like open houses, formal presentations, workshops, community advisory committees, toll-free telephone line, one-on-one briefings, site visits, informal communication and project website. ⁹⁴

^{%1} http://canwea.ca/pdf/canwea-communityengagement-report-e-ftnal-web.pdf

If there is negativity and opposition, how should it be addressed?

Any proposed change in a community can result in opposition; no diverse community will see issues from a single perspective. While there are now many wind turbines in Nova Scotia, their development has been relatively recent; there are bound to be different points of view on wind energy.

Questions should be expected and encouraged in any community engagement process. If questions are not met with direct and timely responses, the initial interest may turn to negativity and opposition.

Negativity and opposition should be handled respectfully. It is important that the perspectives of those expressing concerns be understood; at that point, the facts can be clarified and presented so that options can be examined. It is essential to show respect at all times, share information in a balanced manner, and demonstrate empathy for the reasons underlying citizens' concerns.

What are the regulatory requirements for public and Mi'kmaq consultation?

For some wind energy projects, there are provincial regulatory requirements for consultation. For a wind energy project 2 MW or more in name plate capacity, an environmental assessment (EA) is required. Under the Environmental Assessment Regulations, the Minister of the Environment must consider the consultation activities undertaken, the concerns expressed by the public and the Mi'kmaq, and the steps taken to address concerns.

The provincial government is committed to a coordinated, meaningful consultation process with the Mi'kmaq of Nova Scotia. The Province has a duty to consult with the Mi'kmaq when proposed activities have the potential to impact traditional rights, including title and treaty rights like hunting, fishing and harvesting. Wind energy project developers have an important role in this consultation process.

Several municipalities in Nova Scotia include specific consultation requirements for wind energy projects in their planning documents. These vary across the Province.

[©] ₀ 2	www.novascotia.ca/nse/ea/docs/ea-proponents-guide-to-mikmaq-consultation.pdf

	My and	Ideas Note	es	



Fairmont, Nova Scotia



Fairmont, Nova Scotia

Case Study Basic Stats

Location:

8

Municipality of the County of Antigonish

Output:

4

4.6 MW

No. of Turbines:

ivo. or rurbines.



2

Case Study: FAIRMONT WIND FARM

A 4.6 MW wind energy project in the Municipality of the County of Antigonish, the Fairmont Wind Farm began producing electricity in November, 2012. One-on-one discussions with land owners and municipal staff began in July 2009 and public consultation began in February 2010. Consultation tools included a website, private meetings, mail-outs, public meetings, media reports, and direct engagement with the Mi'kmaq, as well as meetings with municipal staff, elected officials and provincial government staff. During the public comment period of the EA, no negative comments were received on the proposed large wind energy project.







Policy and Planning for Wind Energy

How is wind energy planned in Nova Scotia?

Governance of wind energy projects takes place at both provincial and municipal levels. Generally, no direct planning or approval of wind energy projects is required at the federal level; however, federal programs have encouraged wind as well as other forms of renewable electricity generation and may continue to do so.

Nova Scotia has developed resources to support wind energy development, like the Wind Atlas. The Department of Energy also sets policy and programs to legislate and support wind energy development, like the 2010 Renewable Electricity Plan which defined programs for feed-in-tariff and net metering. The Renewable Electricity Regulations amended in 2014 mandated targets for electricity from renewable energy. The Plan and Regulations are introduced and referenced in Fact Sheet 1. The Province requires certain procedures and approvals, like an environmental assessment for wind energy projects 2 MW or larger.

Under the Municipal Government Act, land use planning for wind turbines and associated infrastructure is the responsibility of local governments. Lach municipality must develop appropriate land use planning tools for small and large wind turbines. These may include specific setbacks, zoning, development agreements, etc. Some municipalities have no formal land use planning other than a municipal planning strategy (MPS) and land use by-law (LUB) developed specifically for wind turbines.

Policy and planning for wind energy crosses provincial and municipal jurisdictions. The Province creates policies to encourage and regulate various forms of electricity generation and issues specific approvals. Yet each municipality must determine its own approach to land use planning for wind energy, recognizing the community's unique character as well as the public's interest in reducing greenhouse gases through renewable electricity generation. Local governments must make their own decisions on wind energy development.

 $^{\%\,1 \}quad http://novascotia.ca/dma/publications/mga.asp$

My Ideas
and Notes

What are the Province's plans for electricity generation?

The Province has initiated an Electricity System Review based on the 2010 Renewable Electricity Plan and the Renewable Electricity Regulations. The Regulations mandate 25% renewable electricity by 2015 and 40% by 2020 %. The Review includes studies of new technologies, market trends in supply and demand, and emerging trends in utility governance, as well as citizen consultation. It is supported by the Electricity Reform Act, legislation that sets the stage for change 3. By creating a framework for renewable-to-retail regulations, it prepares to open the market to renewable energy producers. The current goal is for the market to open in mid-2016.

Our electrical system is expected to undergo changes in physical infrastructure as well as legal aspects of producing, buying, selling, and cost structure which will influence proposals for renewable energy development like wind turbines. Local governments will need to stay current with changes at the provincial level to ensure that land use planning is in place for development proposals.

How can Nova Scotia municipalities govern wind energy?

Local governments will have a number of ways to control wind energy development. The Association of Municipal Administrators in Nova Scotia (AMANS) created a model Wind Turbine Development By-Law ⁴, focused on smaller local governments that may not have existing land use planning, to help them develop their own by-laws for wind energy.

The AMANS model by-law includes definitions, details on zoning provisions, requirements for a development permit, separation distances, public consultation and additional requirements specific to turbine size. While an individual wind turbine can be developed "as of right" when its plan conforms to land use zoning and it is issued a development permit, a wind farm would require a development agreement under the AMANS model by-law. Typically, a wind farm is defined as a group of large commercial wind turbines; however, this can be interpreted by each municipality. A development agreement allows specific terms to be negotiated, depending on the proposal, and requires one public hearing. Development agreements can be appealed to the Utility and Review Board.

^{% 2} http://www.novascotia.ca/just/regulations/regs/elecrenew.htm

^{%3} http://nslegislature.ca/legc/bills/62nd_1st/1st_read/b001.htm

^{% 4} www.amans.ca/index.php?/about-ama/projects-and-resources.html

How should municipal governments develop and revise their planning policies?

Consultation with residents, local experts and wind developers is essential to developing and updating planning policies. It is important to understand the implications of policy tools like setbacks and zoning for wind energy development. In 2010 the Department of Energy funded a pilot

project with the Municipality of the County of Cumberland and Municipality of the District of Shelburne. A Primer on Wind Energy Planning for Nova Scotia Municipalities summarized their efforts in public consultation, mapping and planning policy development %5.

What is the range of setbacks in municipal by-laws?

Many by-laws identify setbacks from a property boundary and/or separation distances from a habitable building – they specify minimum distances from the proposed turbine location. These often vary according to size of turbine; distances increase for larger turbines. The Union of Nova Scotia Municipalities developed the Model Wind Turbine By-laws and Best Practices Report and a summary of wind by-laws for Nova Scotia municipalities 6; both are useful resources with a range of planning tools.

Several municipalities have adopted a 1000 m separation distance for large-scale turbines. Many are shorter, or proportional to turbine dimensions or sound thresholds. By contrast, typical setbacks for small-scale turbines are often 1.5 to 2 times the turbine height (for a 30 m turbine, 45-60 m.) Some by-laws contain no specifications as to the number of turbines installed and make no distinction between large and small turbines.

How can benefits to my municipality be maximized?

Communities that host wind energy projects, large or small, stand to receive many benefits, including local employment (especially during construction), land leasing, tourism opportunities, possible education programs, partnerships with community groups and an annual regulated municipal tax base starting at \$5500/MW. 57

Most project developers appreciate collaborating with local governments, and will work with them to increase local benefits. Municipalities that are part or full project owners maximize their financial return.

There are many examples of successful wind energy projects in Nova Scotia, some identified in these Fact Sheets. Municipalities in Nova Scotia and elsewhere who currently have nearby wind energy projects are excellent resources for those interested in hosting or developing their own wind energy project.

^{%5} http://www.sustainability-unsm.ca/our-work-on-renewable-energy.html

^{% 6} http://www.sustainability-unsm.ca/our-work-on-renewable-energy.html

^{%7} http://nslegislature.ca/legc/statutes/windturb.htm



Sandy Point, Nova Scotia



Sandy Point, Nova Scotia

Case Study Basic Stats

Location: Sandy Point, Nova Scotia Output: 50 kW

No. of Turbines:

1

Case Study: DISTRICT OF SHELBURNE

In 2011, the Municipality of the District of Shelburne proactively developed their Municipal Planning Strategy (MPS) and accompanying Land Use By-law (LUB) to support development and management of wind energy resources within the municipal boundaries. This was achieved in consultation with residents and experts in the industry. The goals were to promote wind energy development, with a particular focus on small-scale projects and to address any potential impacts associated with wind turbines. In Spring 2015, their MPS and LUB were being updated for small turbines.

One 50 kW wind turbine was commissioned in late 2013. This municipally owned small-scale wind turbine at Sandy Point is generating electricity at 49.9 cents per kWh, with the expectation of generating \$15,000 per year for the Municipality after operating costs. The project was developed under the Community Feed-in-Tariff (COMFIT) Program and meets the broader sustainability goals of the Municipality and the specific zoning and setbacks in the MPS and LUB.



*

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*

Qualifications

Planning, constructing and operating wind energy projects involve many stakeholders, including communities, developers and governments, all of whom have different perspectives. Our goal was to create a series of easy-to-read fact sheets that balance these perspectives and provide current, factual information, recognizing that there are many other sources of information on the costs and benefits of wind energy.

The material we present here is well researched and reviewed; it is based on data and information publicly available at the time of writing. Research, policies and technologies, as well as Nova Scotia's experience with operating wind turbines, are likely to change over time.

Many direct sources of information are provided, as well as links for further reading. We encourage municipalities and interested citizens alike to review different sources of information and form their own opinions. Managing wind energy development requires ongoing learning and regular review and updates to policy.





Higgins Mountain, Nova Scotia

Further Reading and Exploration

The best practices for wind energy development are constantly evolving. Current statistics on wind energy and other electricity generation will also change over time. These Fact Sheets contain many specific references and resources to support Nova Scotia municipalities in making informed decisions about wind energy planning. The list below provides references for further reading and exploration to encourage readers to stay informed about wind energy and electricity generation in general. To provide a balanced perspective, there are links for non-governmental, governmental and industry organizations, provincial, national, and international.

Nova Scotian Resources:

Ecology Action Centre - Energy Issues

% www.ecologyaction.ca/issue-area/energy-issues

Nova Scotia Department of Energy - Electricity and Renewables

% http://energy.novascotia.ca

Nova Scotia Environment - Environmental Assessment and Consultation

% http://novascotia.ca/nse/ea

Nova Scotia Power - Electricity Generation

% https://www.nspower.ca/en/home/about-us/how-we-make-electricity/default.aspx

Nova Scotia Wind Atlas

% www.nswindatlas.ca

Union of Nova Scotia Municipalities – Municipal Sustainability Office

% www.sustainability-unsm.ca/home.html

Canadian and International Resources:

Canadian Electricity Association – Power for the Future

% http://powerforthefuture.ca

Canadian Wind Energy Association

% http://canwea.ca

Health Canada – Wind Turbine Noise and Air Quality

% http://www.hc-sc.gc.ca/ewh-semt/index-eng.php

International Energy Agency - World Energy Outlook

% www.worldenergyoutlook.org

National Energy Board – Energy Information

% www.neb-one.gc.ca/nrg/index-eng.html

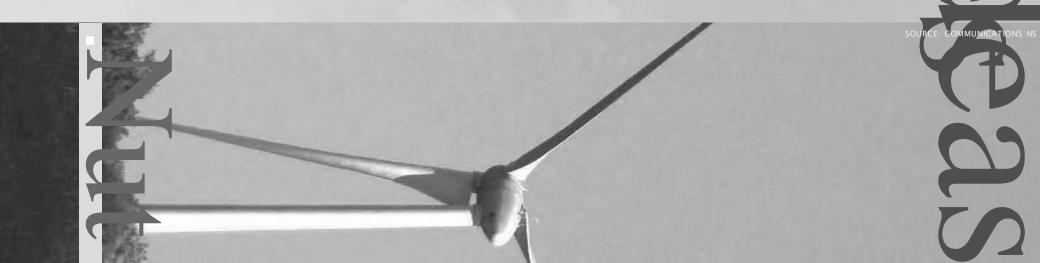
Pembina Institute – Renewable Energy

% www.pembina.org/re

World Health Organization - Air and Noise

% www.who.int/phe/health_topics/en/







Wind Energy Fact Sheets for Nova Scotian Municipalities

Supporting municipalities in making informed decisions on wind energy

Union of Nova Scotia Municipalities • Municipal Sustainability Office Produced in Consultation with Verterra Group



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