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

unsm municipal sustainability office

verterra group Environmental Strategies Ltd.

April 2015

List of Wind Energy Fact Sheets

1. WIND ENERGY DEVELOPMENT IN NOVA SCOTIA
2. ELECTRICITY USE AND GENERATION OPTIONS
3. BASICS OF WIND ENERGY TECHNOLOGY
4. PHASES OF WIND ENERGY PROJECT DEVELOPMENT
5. APPROACHES TO SITING WIND TURBINES
6. ECOLOGICAL CONSIDERATIONS FOR WIND ENERGY
7. SOCIAL CONSIDERATIONS FOR WIND ENERGY
8. FINANCIAL CONSIDERATIONS FOR WIND ENERGY
9. COMMUNITY ENGAGEMENT AND WIND ENERGY
10. 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.

Union of Nova Scotia Municipalities
Municipal Sustainability Office
T: (902) 423-8331
E: dnielsen@unsm.ca
www.unsm.ca

Verterra Group
Environmental Strategies Ltd.
T: (902) 225-4436
E: janis@verterragroup.ca
www.verterragroup.ca

Front Cover Photo Sources: Communications NS / Riley Smith, Natural Forces

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.

Above Photo: Irish Mountain, Nova Scotia

SOURCE: COMMUNICATIONS NS

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.

Above Photo: Higgins Mountain, Nova Scotia

SOURCE: COMMUNICATIONS NS

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[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.[2] 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.[3] Please check this live link for up-to-date information, as it will change over time.

1 *http://energy.novascotia.ca/sites/default/files/renewable-electricity-plan.pdf*

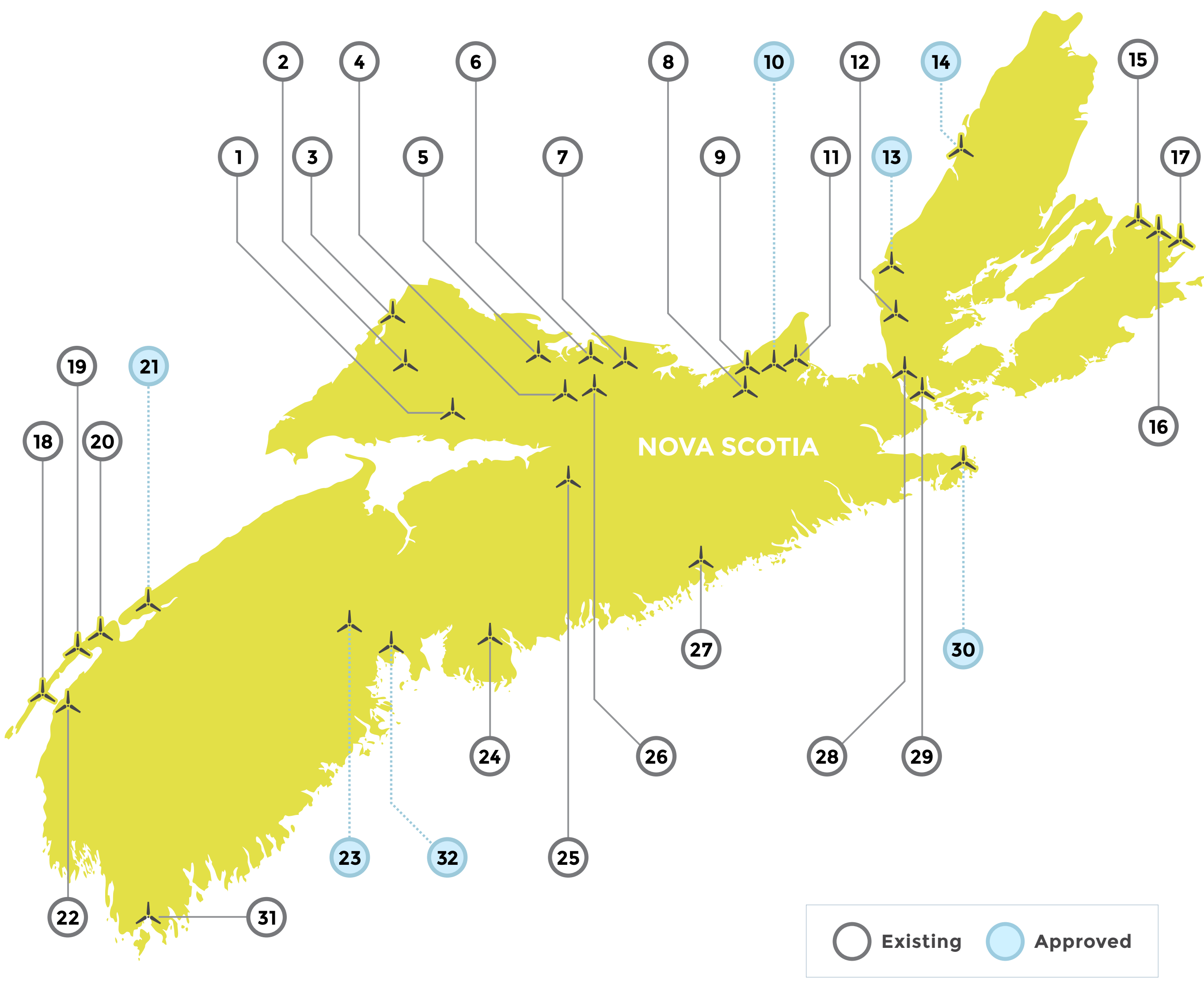
2 *www.novascotia.ca/just/regulations/regs/elecrenew.htm*

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

Dalhousie Mountain, Nova Scotia

Lingan, Nova Scotia

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 (50W x 2h =100Wh).

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/comfit*

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]

7 *http://www.digbydistrict.ca/renewable-energy.html*

Case Study Basic Stats

Location:

Within the Municipality of the District of Digby

Output:

34.3 MW

No. of Turbines:

24 (5 projects)

SOURCE: CRAIG NORRIS

Amherst, Nova Scotia

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[8]; it is 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 and Notes

Chester, Nova Scotia

Chester, Nova Scotia

Case Study Basic Stats

Location:

Municipality of the District of Chester

Output:

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]

9 *www.chester.ca/inform/metrics/kaizer-meadow-wind-turbine*

SOURCE: COMMUNICATIONS NS **Above Photo: Halifax, Nova Scotia**

Electricity Use and Generation Options

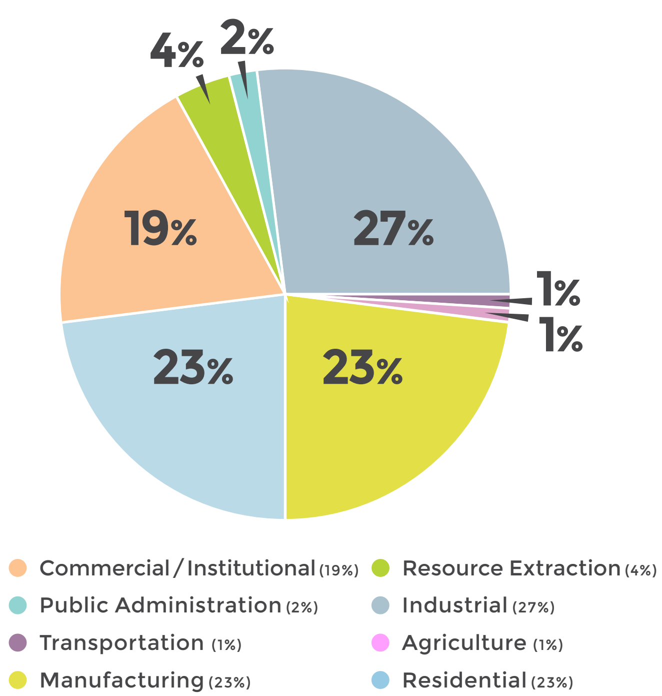
How do we use electricity in our daily lives?

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



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.

Oil
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.

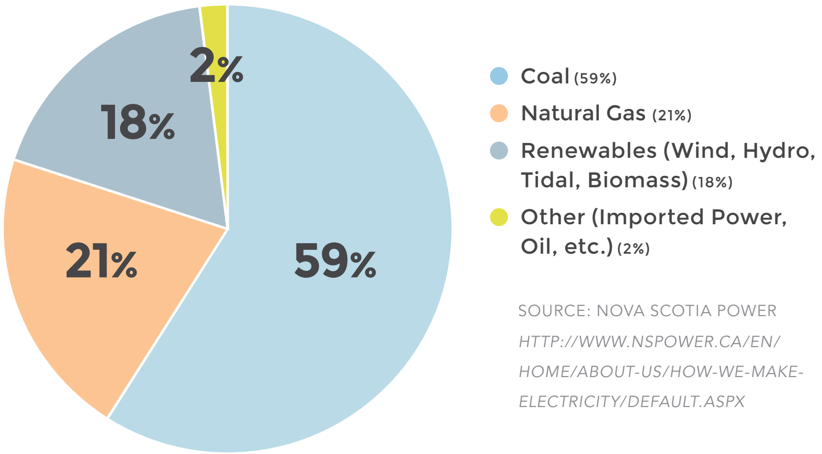
Wind
The pace of wind energy development in Nova Scotia remains strong. Many projects have recently been constructed or are under development. As of March 2015, there was 350 MW of installed capacity from wind generation in the Province.

SOURCES:
- NATIONAL ENERGY BOARD: *HTTP://WWW.NEB-ONE.GC.CA/CLF-NSI/RNRGYNFMTN/NRGYRPRT/NRGYFTR/2013/NRGFTR2013-ENG.HTML#S8;*
- CANADIAN ELECTRICITY ASSOCIATION: *HTTP://WWW.ELECTRICITY.CA/MEDIA/PDFS/ENVIRONMENTALLYPREFERRABLEPOWER/2-POWERGENERATIONINCANADA.PDF;*
- NOVA SCOTIA POWER: *HTTP://WWW.NSPOWER.CA/EN/HOME/ABOUT-US/HOW-WE-MAKE-ELECTRICITY/DEFAULT.ASPX*

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)



SOURCE: NOVA SCOTIA POWER *HTTP://WWW.NSPOWER.CA/EN/HOME/ABOUT-US/HOW-WE-MAKE-ELECTRICITY/DEFAULT.ASPX*

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

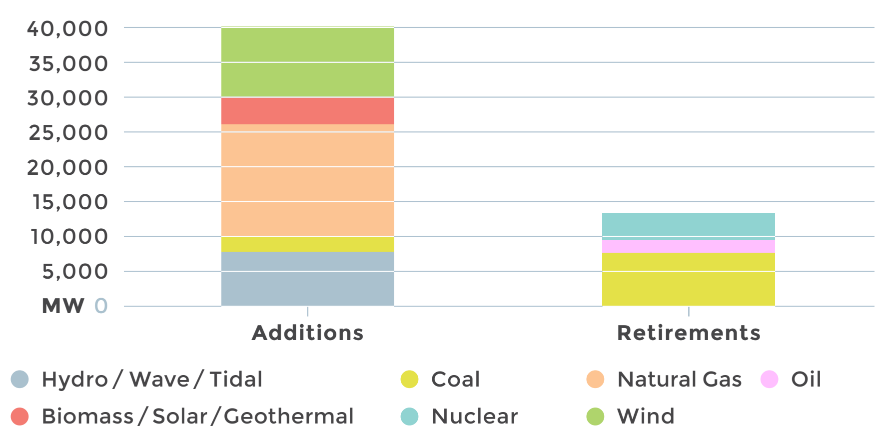
What is the future for electricity generation in Nova Scotia?

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 Plan[6], 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.

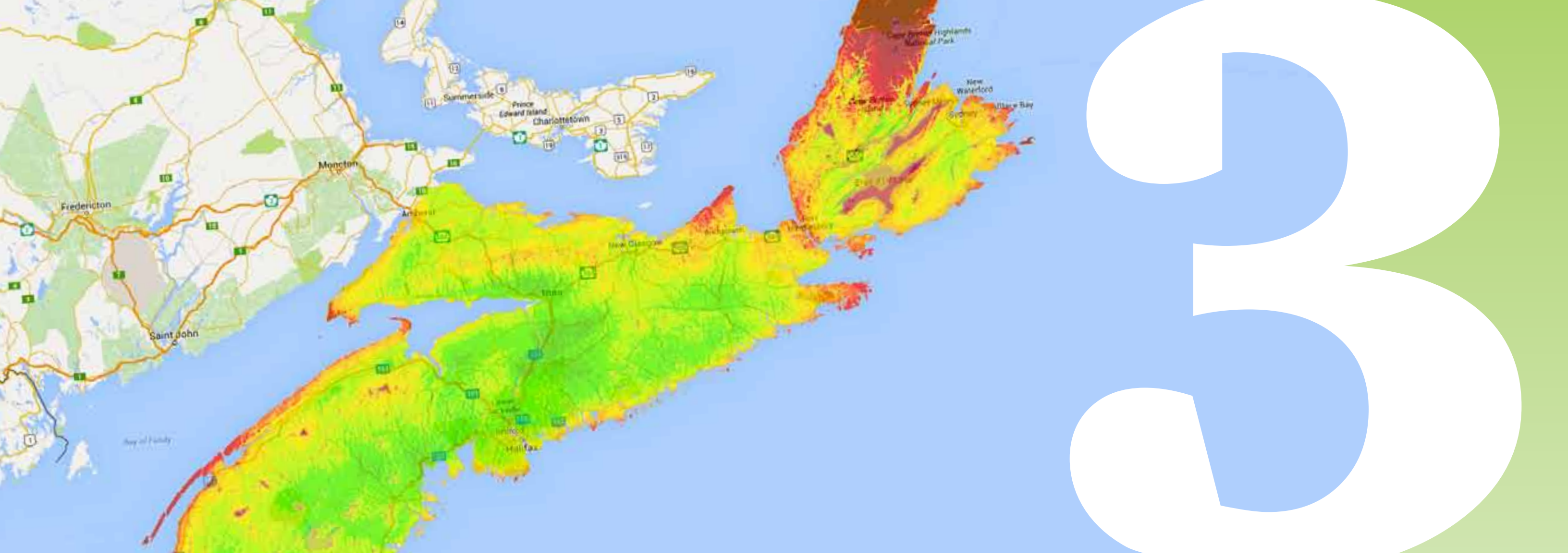
Chart 2C: Projected Changes to Electricity Generation by 2035 in Canada



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/files/renewable-electricity-plan.pdf*

7 *www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2013/nrgftr2013-eng.html#s8*



Above Photo: Nova Scotia Wind Atlas

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.[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).

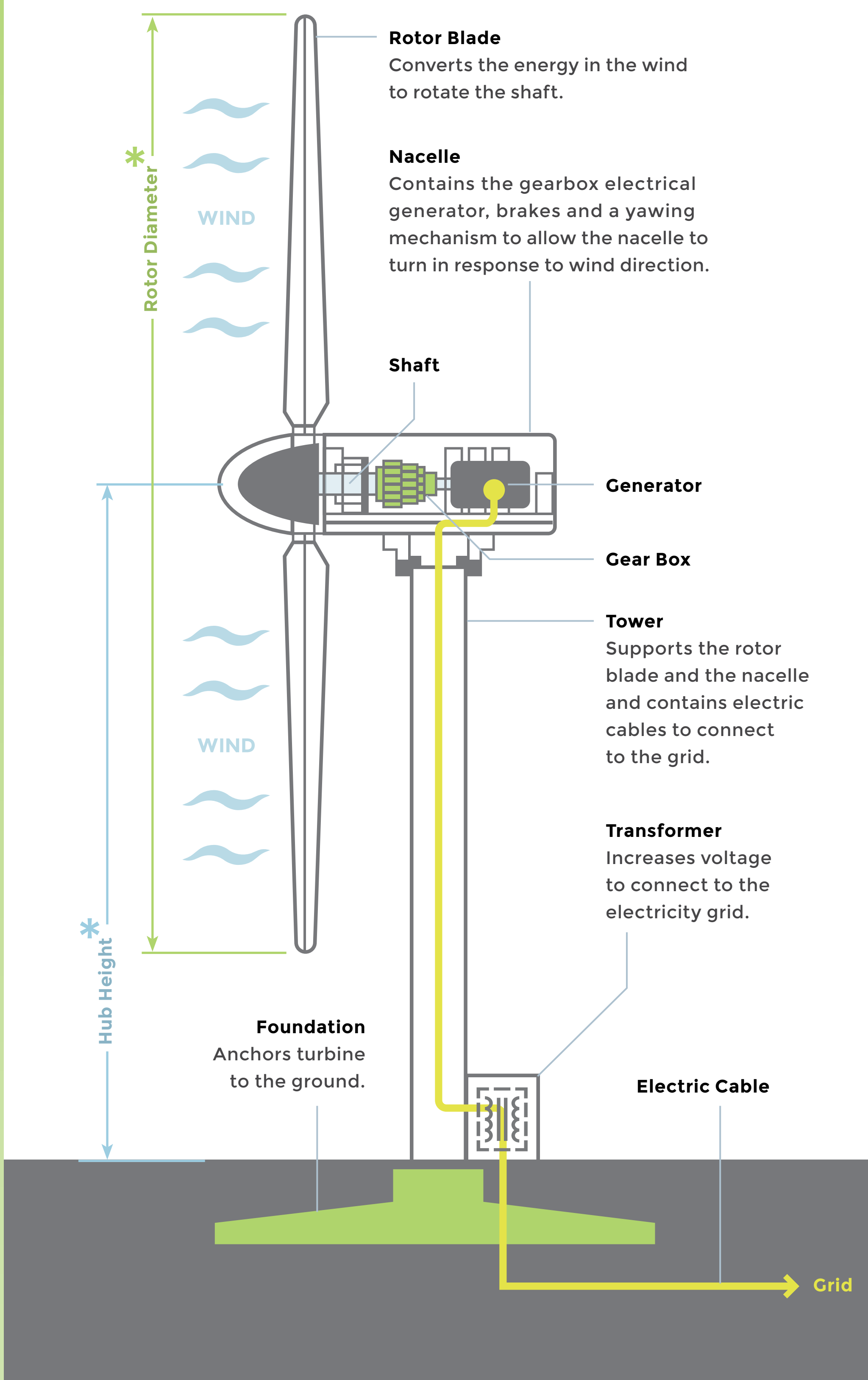
An average wind speed of 7 m/s is considered good for larger wind turbines; that is, at a height of about 80 m. This wind speed is comparable to driving 25 kilometres per hour (km/hr).

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.



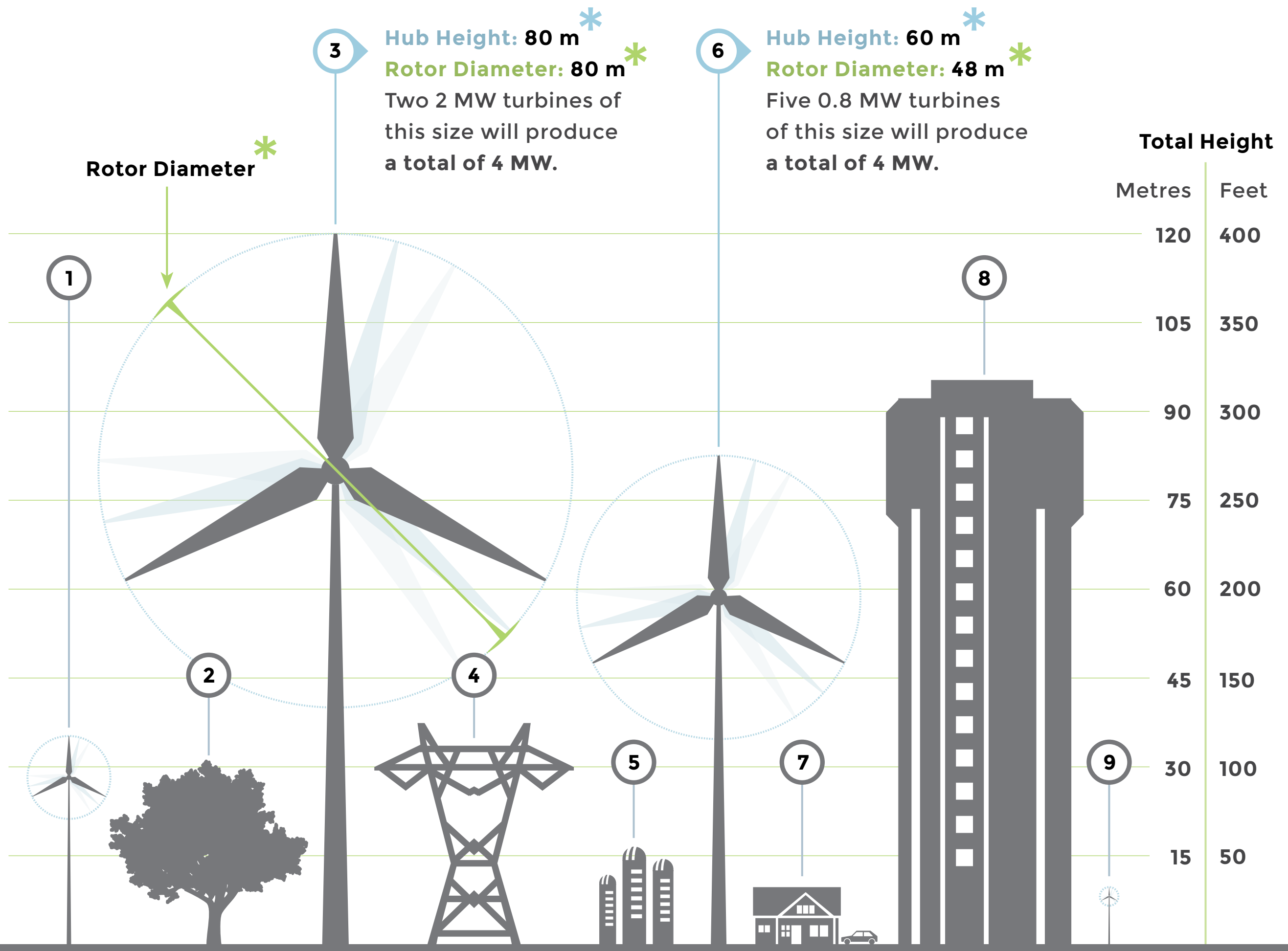
What are the different sizes of wind turbines?

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.



1 Small 50 kW Turbine 40 m • 115 ft

2 Large Elm Tree 30 m • 100 ft

3 Large 2 MW Turbine 120 m • 400 ft

4 Transmission Tower 38 m • 125 ft

5 Large Farm Silos 20 m • 55 ft

6 0.8 MW Turbine 85 m • 275 ft

7 Two-story Home 10 m • 30 ft

8 Fenwick Tower, Hfx. 100 m • 320 ft

9 Micro 2 KW Turbine 10 m • 30 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

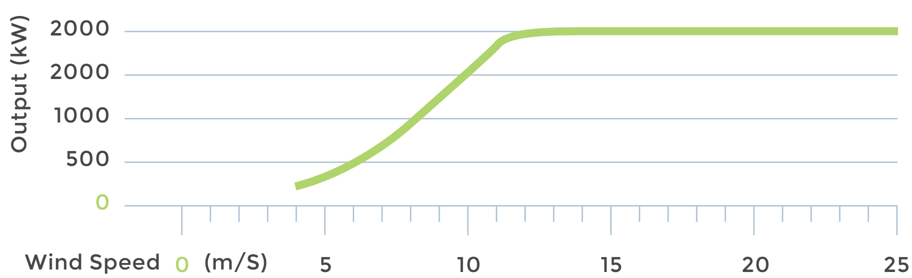
Watts Section, Nova Scotia

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.

Chart 3A: Typical Turbine Power Curve



BASED UPON A TYPICAL WIND TURBINE BROCHURE

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.

Above Photo: Amherst, Nova Scotia
SOURCE: CRAIG NORRIS

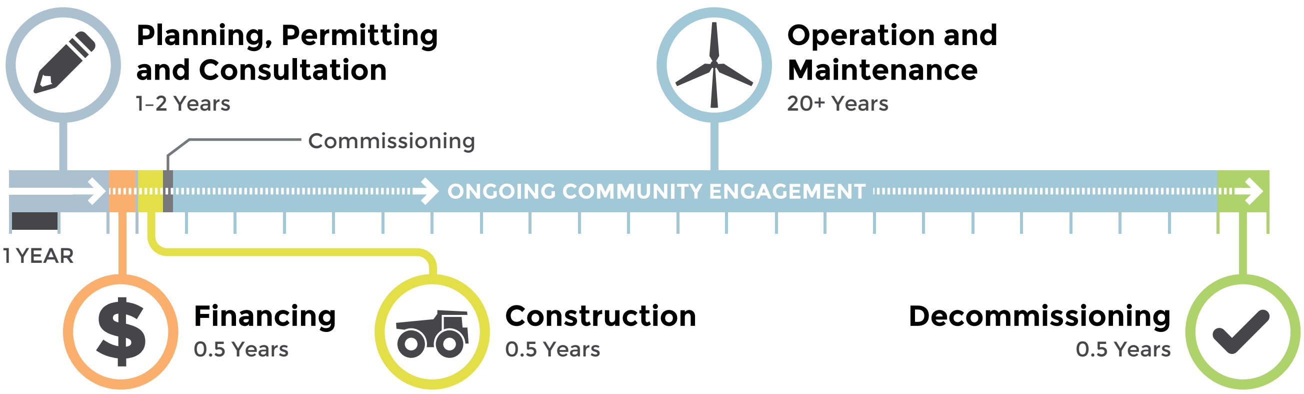
Phases of Wind Energy Project Development

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.



■ Digby, Nova Scotia

■ Amherst, Nova Scotia

What is involved in planning and permitting?

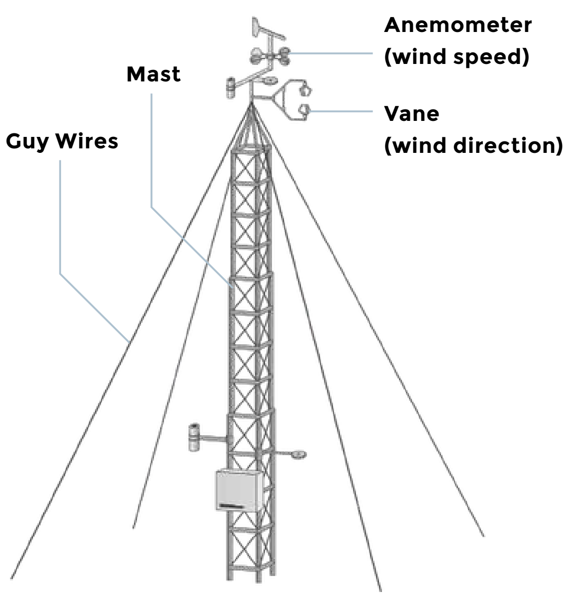
For any proposed wind energy project, large or small, the first step is a preliminary review to identify any known “deal breakers”, conditions that could prevent success of the project, whether ecological, financial or social. The goal is to limit risk, because the planning and permitting for a wind 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.[1] 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.

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

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

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.

Glen Dhu, Nova Scotia

Seaport Market (Roof), Halifax

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.

Above Photo: Boularderie, Cape Breton
SOURCE: NATURAL FORCES

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

Atlantic Superstore, Porters Lake, Nova Scotia

Watts Section, Nova Scotia

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.

Above Photo: Church Point, Nova Scotia SOURCE: COMMUNICATIONS NS

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[1] 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.

Oil

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.

Wind

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[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:

Municipality of the County of Cumberland

Output:

31.5 MW

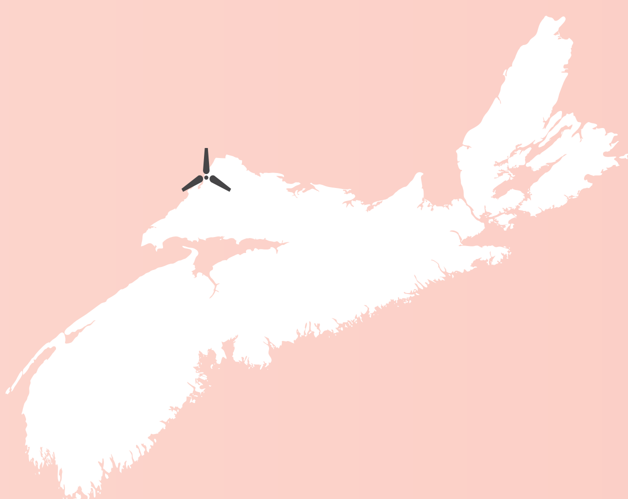
No. of Turbines:

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[5].

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.



5 *http://www.novascotia.ca/nse/ea/amherst.wind.energy.project.asp*

Above Photo: Sheet Harbour, Nova Scotia
SOURCE: COMMUNICATIONS NS

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 annoyance 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[1] 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.

1 *http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php*

Spiddle Hill, Nova Scotia

Spiddle Hill, Nova Scotia

Case Study Basic Stats

Location:

Municipality of the County of Colchester

Output:

150 kW and 1.6 MW

No. of Turbines:

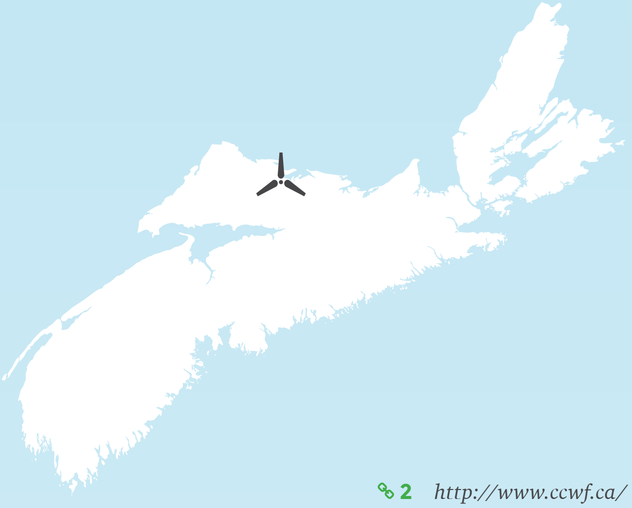
5 (3 small and 2 large)

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[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.



2 *http://www.ccwf.ca/*

3 *https://sites.google.com/site/nswindenergystudy/*

Above Photo: Dalhousie Mountain, Nova Scotia

SOURCE: COMMUNICATIONS NS

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.[2]

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[3] 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.

Oil

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 cost-effective, 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 13.1¢ per kWh, locked in for a 20-year period. In 2014, Nova Scotia Power's domestic service energy charge was 14.251¢ 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.[4] 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/files/files/Electricity-Review-What-We-Heard-Scope-of-Work.pdf*

SOURCE: HTTP://WWW.MUNICIPALITY.GUYSBOROUGH.NS.CA

Guysborough, Nova Scotia

SOURCE: HTTP://WWW.MUNICIPALITY.GUYSBOROUGH.NS.CA

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[7]. 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.

7 *http://www.municipality.guysborough.ns.ca/sable-wind*

Community Engagement and Wind Energy

Above Photo: Fairmont, Nova Scotia
SOURCE: RILEY SMITH

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.


SOURCE: COMMUNICATIONS NS

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.

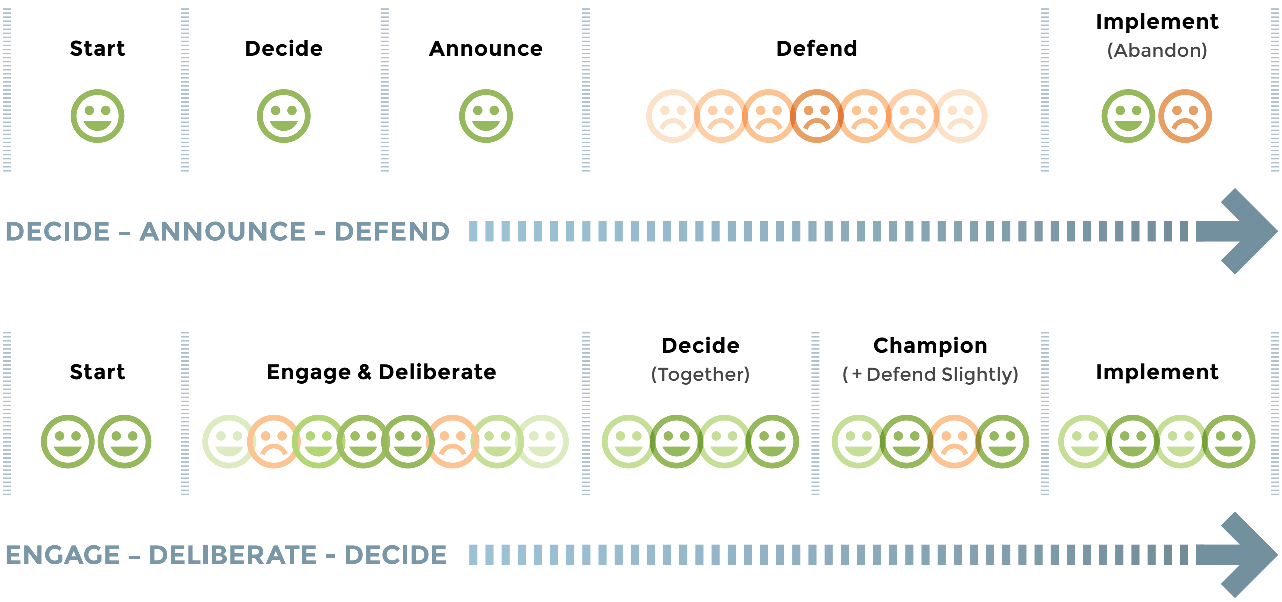
Amherst, Nova Scotia

Digby, Nova Scotia

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.

Figure 9A: Community Engagement Models



SOURCE: JANIS ROD

SOURCE: JANIS ROD

Higgins, Nova Scotia

Digby, Nova Scotia

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.[1]

1 *http://canwea.ca/pdf/canwea-communityengagement-report-e-final-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.[2]

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

My Ideas and Notes

2 *www.novascotia.ca/nse/ea/docs/ea-proponents-guide-to-mikmaq-consultation.pdf*

Fairmont, Nova Scotia

Fairmont, Nova Scotia

Case Study Basic Stats

Location:

Municipality of the County of Antigonish

Output:

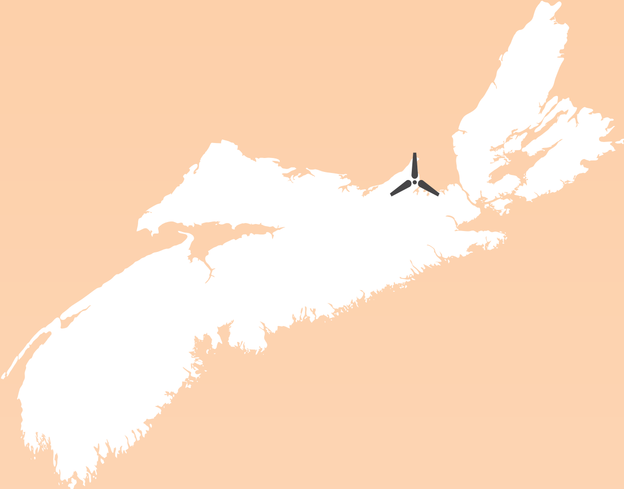
4.6 MW

No. of Turbines:

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.



Above Photo: North Shore, Nova Scotia SOURCE: COMMUNICATIONS NS

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.[1] Each 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 *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[2]. 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.[7]

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*

SOURCE: EMILY TIPTON

Sandy Point, Nova Scotia

SOURCE: EMILY TIPTON

Sandy Point, Nova Scotia

Case Study Basic Stats

Location:

Sandy Point,
Nova Scotia

Output:

50 kW

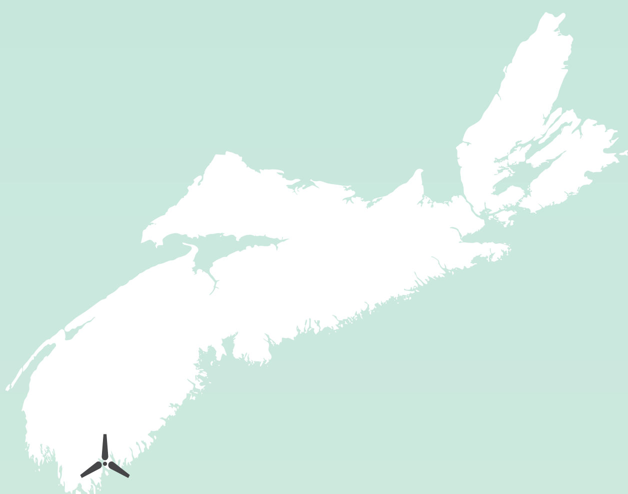
No. of Turbines:

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.[8] 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.



8 *http://www.municipalityofshelburne.ca/municipal-planning-strategy-and-land-use-by-law-l-100.html*

Acknowledgements

The Wind Energy Fact Sheets were developed by Verterra Group (Janis Rod), for and in collaboration with UNSM (Debbie Nielsen).

Our team's work was greatly enhanced by the contributions of expert advisors from municipalities, the provincial government, academia and the private sector who provided their time, passion, knowledge and experience.

In particular, we wish to thank those who contributed to this project before the first words were written and saw it through to completion, including Aldric d'Entremont, Municipality of the District of Argyle; Ian Watson, Municipality of the County of Kings; Terry Thibodeau, Municipality of the District of Digby; Bruce Thompson, Blue Sky Electricity Cooperative; and Lukas Swan, Dalhousie University.

Special thanks to Alan White, Creative Director at Boson 1, the graphic designer who worked with Verterra Group. Alan's professionalism, attention to detail and creative skill make this series of fact sheets user-friendly and a pleasure to read. *(www.boson1.ca)*

Our final acknowledgement and thanks go to our editor, Julie Kronenberger, for taking highly technical information and making it accessible to a range of readers.

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.


SOURCE: CRAIG NORRIS

Amherst, Nova Scotia

SOURCE: COMMUNICATIONS NS

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/*

My Ideas and Notes

SOURCE: COMMUNICATIONS NS

Nutby Mountain, Nova Scotia

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

Union of Nova Scotia Municipalities
Municipal Sustainability Office

T: (902) 423-8331
E: dnielsen@unsm.ca

www.unsm.ca

Verterra Group
Environmental Strategies Ltd.

T: (902) 225-4436
E: janis@verterragroup.ca

www.verterragroup.ca

April 2015