Landowners' Guide to Wind Energy in Alberta

Tim Weis • Alex Doukas • Kristi Anderson
(Micro-generation appendix by Gordon Howell)

September 2010

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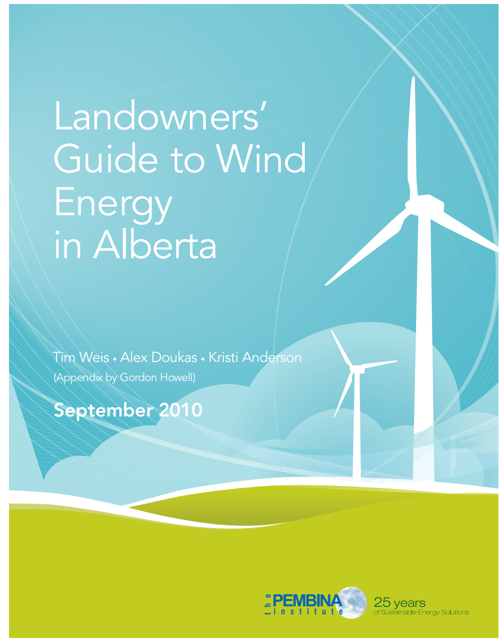

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Weis, Tim, Alex Doukas and Kristi Anderson
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About the Pembina Institute

The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. The Pembina Institute's engaging monthly newsletter offers insights into its projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews at www.pembina.org/enews/subscribe.

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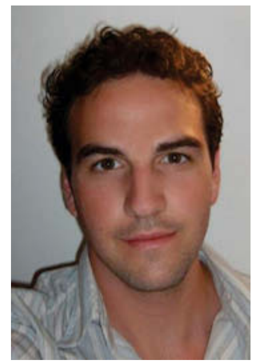

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1. Getting Started

1.1. Who Is This Guide For?

This guide is for landowners in Alberta who are considering wind energy projects on their land. Whether you are interested in erecting and owning your own wind turbine, leasing land to a commercial wind developer, or developing wind energy on your land through other ownership models, this guide will help to explain what you can expect from the wind energy development process. It also describes ways to get involved in decision-making around wind projects in your area and tools to help ensure that wind development occurs in a responsible way that is mutually beneficial to the landowner, the wind developer and the community.

This guide may also be useful to commercial wind developers and to people who are seeking responsible development in their communities.

While much of the information in this guide is applicable for wind energy development across Canada, some issues are specific to Alberta. People living outside Alberta should contact their local jurisdictions for specific information. This guide should not be substituted for legal advice. The information was accurate at the best of the authors' understanding at time of publication, but regulations may have been updated or changed since then.

It is the responsibility of landowners to educate themselves about wind energy development, and this guide can be used as a tool in that process, but it is by no means the only source that you should rely upon.

The contents of this guide are entirely the responsibility of the Pembina Institute and do not necessarily reflect the views or opinions of those who supported this work or offered input into it.

1.2. How to Use This Guide

The *Landowner's Guide to Wind Energy in Alberta* is intended to be a reference document that you can use in a few ways. Reading it from cover to cover will give you a good understanding of wind energy in Alberta. Alternatively, peruse the table of contents and flip to various sections to increase your knowledge about specific topics related to wind energy. If you are planning to develop your own wind energy project, this guide will provide the basics for you to get started. Finally, this guide will prove especially valuable to help you prepare for meeting prospective wind energy developers who express interest in your land.

For ease of reference, this guide is divided into two parts. *Part I: Wind Energy Background* presents background information so you can effectively converse with developers, regulators and neighbours on various subjects related to wind energy in Alberta. It starts off with an overview of wind energy in Alberta, followed by an introduction to wind turbine technology. The section continues with an electricity market

Wind farms located on or adjacent to landowners' properties can result in long-term payments
PHOTO: TIM WEIS, THE PEMBINA INSTITUTE

primer, followed by a discussion of potential environmental impacts and health considerations. Section 7 provides an introduction to the financial benefits of wind energy projects as well as tax implications. The final section discusses the social and community impacts of wind projects.

Part II: Wind Energy Development will give you the tools for negotiating with prospective wind energy developers or for getting started on your own wind energy project. Section 9 provides an introduction to the developer's process for seeing a project through from inception to operation. Section 10 describes the various approvals and reviews that a developer must obtain prior to commencing construction of a project. This section will give you an understanding of what regulators are looking for and what a landowner's involvement in the public consultation may be.

Sections 11, 12 and 13 would be useful reading before sitting down with a land agent or other developer representative. Section 11 deals with the various forms of ownership that wind energy proponents have employed. Section 12 is a valuable primer on types of compensation from developers and Section 13 explains options, leases and easements, and various clauses that are commonly found in these agreements, along with a few you may want to consider adding to the agreement.

If you are considering developing your own wind energy project, turn to Section 14 for advice on getting started, and refer back to Section 10 for the list of approvals you will require. You will also find the developer checklist in Section 15 to be helpful, as well as the appendix, Alberta's Micro-Generation Regulation, which outlines the process in Alberta that allows you to connect a small-scale wind turbine to the grid.

Part I

Wind Energy Background

2. Wind Energy in Alberta

2.1. Wind Energy Markets

The global wind energy market continues to grow at a rapid rate: total installed capacity more than doubled between 2005 and 2008.[1] Over the past decade, wind energy has been the fastest-growing source of electricity worldwide. Technologies range from small turbines suitable for electrifying a single home or farm to "utility-scale" turbines of 3 MW (megawatts) or more, which are capable of generating enough electrical energy every year for hundreds of average-sized homes.

Wind turbines of different sizes may be appropriate for different applications. A remote community could use a combined wind-diesel system to provide electricity to its residents, while a single off-grid building could use a small turbine with a battery backup. An individual person might want to install a medium-sized wind turbine to offset his or her personal electricity consumption. It is also possible that several farmers in a rural community might decide to jointly develop a much larger 10 MW, community-owned project comprised of a number of large, utility-scale wind turbines to deliver energy to larger electricity loads elsewhere.

In many cases landowners will be approached by private developers looking to lease land for commercial projects. Utility-scale developments (greater than 1 MW) require substantial capital costs (over $1 million), but they benefit from economies of scale and generate electricity at a far lower price per unit of output than residential-scale developments.

Alberta's economically viable wind energy potential is enormous. Until recently, Alberta was Canada's leading province in wind energy generation, but it was surpassed by Ontario and Quebec in 2008. As of June 2010, Alberta had over 650 MW of installed wind generating capacity (see Figure 1), which was 5% of total generation capacity in the province and resulted in 2% of annual electricity generation.

At the Soderglen wind farm in Fort McLeod, Alberta, an area with relatively high wind speeds, a typical 1.5 MW wind turbine can generate about 5.21 million kWh (kilowatt hours) of electricity annually.[2] This annual output provides enough electrical energy for about 720 typical Alberta households.[3]

Wind energy continues to be a growing industry in Canada and globally. Current provincial targets and programs across Canada would result in up to 16,000 MW of capacity in operation by the year 2015 — almost five times the 2009 levels. Germany, which has approximately half the land area of Alberta and a considerably weaker wind resource, already had 22,250 MW of installed wind generation capacity at the end of 2007. In 2007, 35% of all new additions to electricity capacity in the United States was from wind; in Europe, 40% was from wind.

As of March 2010, proponents of more than 7,400 MW of wind energy projects[4] have applied for approval from the Alberta Electric System Operator (AESO) to connect to the grid. While not all of this capacity will likely be developed, the size of the queue shows the level of interest in Alberta's plentiful wind resources.

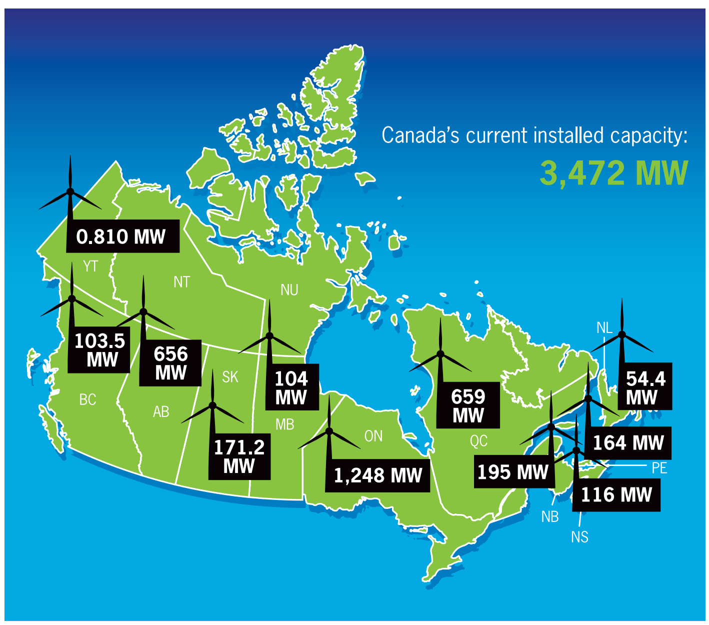

Figure 1: Canada's wind capacity as of June 5, 2010

SOURCE: CANADIAN WIND ENERGY ASSOCIATION[5]

2.2. Alberta's Wind Resource

Wind turbine performance is very sensitive to wind speeds, which are usually measured in metres per second (m/s). The best wind resources are found high in the mountains and far out at sea, but these are very difficult to develop. The most cost-effective wind developments tend to be in areas where the winds are the strongest and that also have access to electricity transmission lines with the capacity to accept new generation.

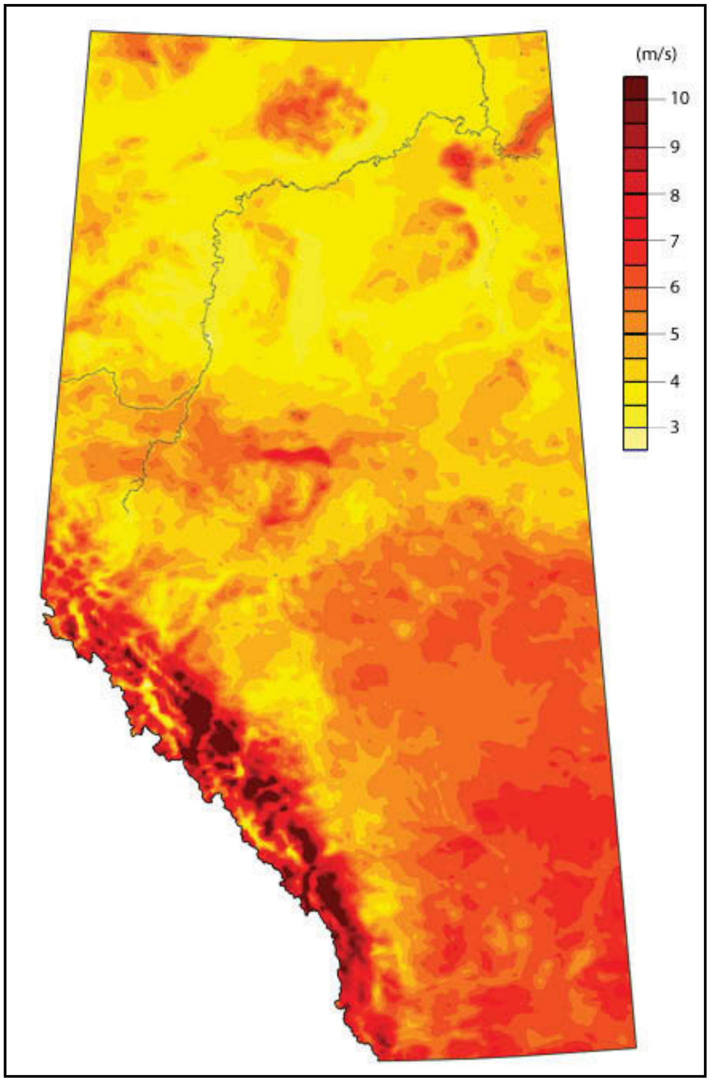

Figure 2: Map of wind speeds in Alberta at 50 m

SOURCE: CANADIAN WIND ENERGY ATLAS[6]

In Alberta many of the best sites are found in the south, but there are numerous windy areas elsewhere in the province (Figure 2). Regions with an average annual wind speed of at least 6–7 m/s (22–25 km/h) or greater at a height of 80 m above the ground (the typical tower height) are considered to be potentially economically viable areas for commercial wind energy development.

"We're definitely seeing an increase in the number of people across the country that are interested in renewable energy sources to reduce costs and demand on the energy grid," said Farm Credit Canada president and CEO Greg Stewart.[7]

With great potential for wind development in Alberta, landowners can reap the benefits of participating in renewable energy in a number of different ways. There are however some (rare) examples of projects where local landowners have not been happy with the development. To ensure that wind is developed responsibly and to the satisfaction of all involved, it is important that landowners understand their rights and the responsibilities they undertake when entering into agreements with commercial wind developers or when developing their own wind projects.

3. Wind Technology Overview

3.1. Wind Turbine Basics

Wind turbines are machines that harness some of the energy in the wind to turn a generator housed inside the turbine's nacelle. For the purposes of this guide, "wind turbine" refers to the kind of turbine typically found in Alberta: a conventional, horizontal axis, three-blade model, as shown in Figure 3.

Wind turbines have the following components:

- **rotor** (blades), which uses the energy in the wind to rotate the rotor shaft
- **nacelle** (housing for the drive train), which typically contains the gearbox and generator (although some manufacturers, such as General Electric and Enercon, have turbines that function without gearboxes)
- **tower**, which supports the rotor and the nacelle
- **other equipment**, such as electrical controls, cables and grid-connection equipment

3.1.1. Wind Speeds and Turbine Operation

Wind turbines typically generate electricity in winds of 4.5–25 m/s (about 16–90 km/h). Typical wind turbines begin rotating in winds of 3–4 m/s (about 11 km/h) and will continue turning in winds at that speed.

In high winds, often in excess of 25 m/s, automatic controls in the wind turbine will slow the rotor by changing the angle of the blades until a brake can be applied. Often, the rotor will not brake to a stop but will spin slowly even when it is not generating electricity. This constant motion keeps the rotor bearings lubricated.

At sites with a relatively high average wind speed, turbines generate some amount of electricity approximately two-thirds of the time.[8]

3.1.2. Wind Turbine Size

Wind turbines come in a wide range of sizes. Smaller models include tiny turbines on cabins or sailboats that provide electricity to electronics and on-board instruments, as well as much larger household-scale wind turbines, which can have rotors 3–15 m in diameter[9] and often have a "hub height" (the distance from the ground to the center of the rotor) of 10–30 m or more. For these kinds of small turbines, the Canadian Wind Energy Association recommends that the tower height should be at least 10 m above anything within 100 m of the tower.[10]

Commercial-scale wind turbines can have towers more than 100 m tall with rotor diameters of more than 125 m. Many of the typical commercial-scale turbines presently installed in Alberta have hub heights of 40–80 m and rotor diameters of 50–80 m.

The nameplate capacity of a wind turbine generator, in kilowatts (kW) or megawatts (MW), indicates the rated electrical power that the turbine is capable of generating. A turbine's actual average power output depends strongly on the site wind speeds, how well the system is sited and whether or not the particular turbine is suited for the site's wind duration and speed profile.

The two factors that have a significant impact on energy output are the local wind speed and the diameter of the turbine's rotor blades. The energy output increases with the square of the rotor

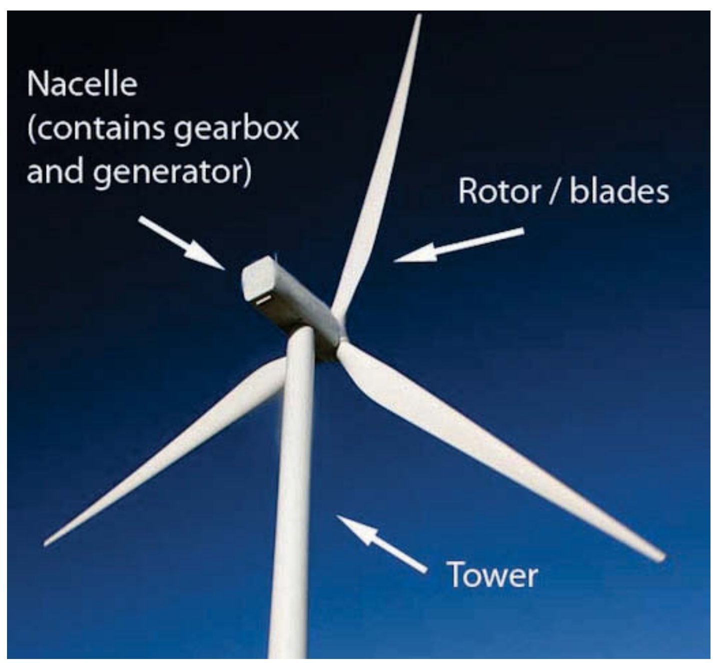

Figure 3: Wind turbine components
PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

diameter: if you increase the rotor diameter by a factor of two, the energy that can be captured increases by a factor of four (two squared). However, wind speed is even more important because the energy available is a cubic function of wind speed. In other words, if wind speed is doubled, the available energy increases by a factor of eight (two cubed). For this reason, money is better spent on raising the height of the turbine tower (wind speeds increase with height) or on choosing a better location with greater wind exposure rather than on a rotor with larger blade diameter.

3.1.3. Tower Types

Larger turbines are installed on free-standing towers without guy wires (cables that help stabilize a structure), while smaller turbines may be installed on a tower either with or without guy wires. All new commercial-scale wind turbines in Alberta are likely to use a large-diameter, tubular tower (Figure 4) rather than a lattice tower (Figure 5), both to increase structural strength and to improve aesthetics. Lattice towers encourage perching by birds, particularly raptors, which increases the risk of collision, but the larger rotors on tubular towers are more likely to result in death, particularly if a raptor enters the zone next to the nacelle.[11] Taller structures also pose a greater risk to migratory bats, which migrate at an altitude that corresponds to the rotor area.

Figure 4: Tubular towers are the norm for utility-scale turbines

PHOTO: TIM WEIS, THE PEMBINA INSTITUTE

Figure 5: Lattice towers are sometimes used for small to medium-sized wind turbines

PHOTO: JIMMY ROYER

3.2. Cost Basics

Wind turbine prices are based on the size of the generator. Costs are often calculated in dollars per installed kilowatt. The installed cost of a wind turbine includes feasibility studies, grid connection and engineering work along with construction, purchase and transportation of the turbine. Wind projects can benefit from economies of scale, because putting up multiple turbines at once allows developers to amortize the one-time development costs, such as installing an electrical substation, connecting to transmission lines and securing the appropriate project approvals from provincial and federal regulators.

In Alberta, a large wind turbine typically costs around $2–2.5 million per megawatt of installed capacity.[12] Therefore, a typical 2 MW wind turbine has an installed cost of about $4–5 million, although development costs can vary substantially depending on the site, the type of turbine and other factors.

A smaller turbine, such as a 10 kW unit (the size that would provide enough annual electrical energy for a small farming operation in areas of excellent wind resources, such as in southern Alberta) might cost $35,000 to $50,000.[13] Smaller wind turbines tend to have a substantially greater price per kilowatt than larger, commercial-scale turbines. Additionally, smaller wind turbines are placed on shorter towers and therefore operate in slower (and often more turbulent) winds. Smaller wind turbines are less sophisticated than their utility-scale counterparts and thus tend to operate less efficiently. (Compare the efficiency and engineering of ATVs vs. cars, for example.) These factors all mean that larger turbines tend to generate electricity more cheaply than smaller turbines and give better economic returns.

When wind developments are scaled up from residential to commercial sizes, the price of wind electricity decreases because of the previously mentioned increase in turbine efficiency, the reduced cost of installation per unit of capacity and the exposure to greater wind speeds.[14] Where a small turbine (below 100 kW capacity) might cost $3,500 to $5,000 per kilowatt of installed capacity in Alberta, a larger turbine might cost $2,500 per kilowatt.[15] As a result, if multiple landowners are considering small grid-connected wind turbines on their properties, it might make financial sense for them to pool their resources and build one larger wind turbine. This financial advantage is part of the reason why co-operative wind ventures are popular in parts of Europe.

Table 1 shows some of the costs related to residential and commercial wind developments.

Figure 6 shows the cash flow for a sample residential wind project. The payback period — the time until the revenues generated by the project cover the capital investment — is 16 years.

This example scenario was calculated with the following conditions:

- Capacity: 10 kW
- Installed cost of turbine (including infrastructure development): $33,504
- Price of electricity offset by wind energy: 7¢/kWh
- Payment: 100% cash (no loan interest)
- Operations and maintenance costs: 0.5¢/kWh (typically 1.5¢/kWh for large, grid-connected wind turbines)

It is very important to note that this scenario assumes relatively good wind speeds at the site and proper installation. Small wind turbines are notorious for being built in relatively poor wind regimes because of construction constraints, limited tower heights and a lack of understanding of the importance of exposure to high-quality, unobstructed winds.

Table 1: Initial cost for residential and commercial wind developments

	Residential	**Commercial**
Preparation	Resource assessment Economic analysis Cursory wildlife assessment Permitting: • *Micro-Generation Regulation* or *AUC Rule 007 Section 4: Small Power Plant Applications Less Than 1 Megawatt (MW)* • NAV Canada, Transportation Canada, Alberta Transportation, municipal development, building (in some cases) and electrical permits	Wind resource assessment Feasibility study Electrical grid-connection studies Environmental assessment (preconstruction wildlife surveys) Extensive permitting process and government liaison: • *AUC Rule 007 Section 3: Power Plant Applications 1 Megawatt (MW) or Greater* • Land agents set up contracts with landowners • Public consultation
Equipment and construction costs	Wind turbine Site preparation Foundation Crane rental (in some cases) Inverter Battery bank or grid connection	Wind turbines Roads Crane pads, laydown areas, parking lots Substation Transmission line Foundations Grid-connections Crane rental

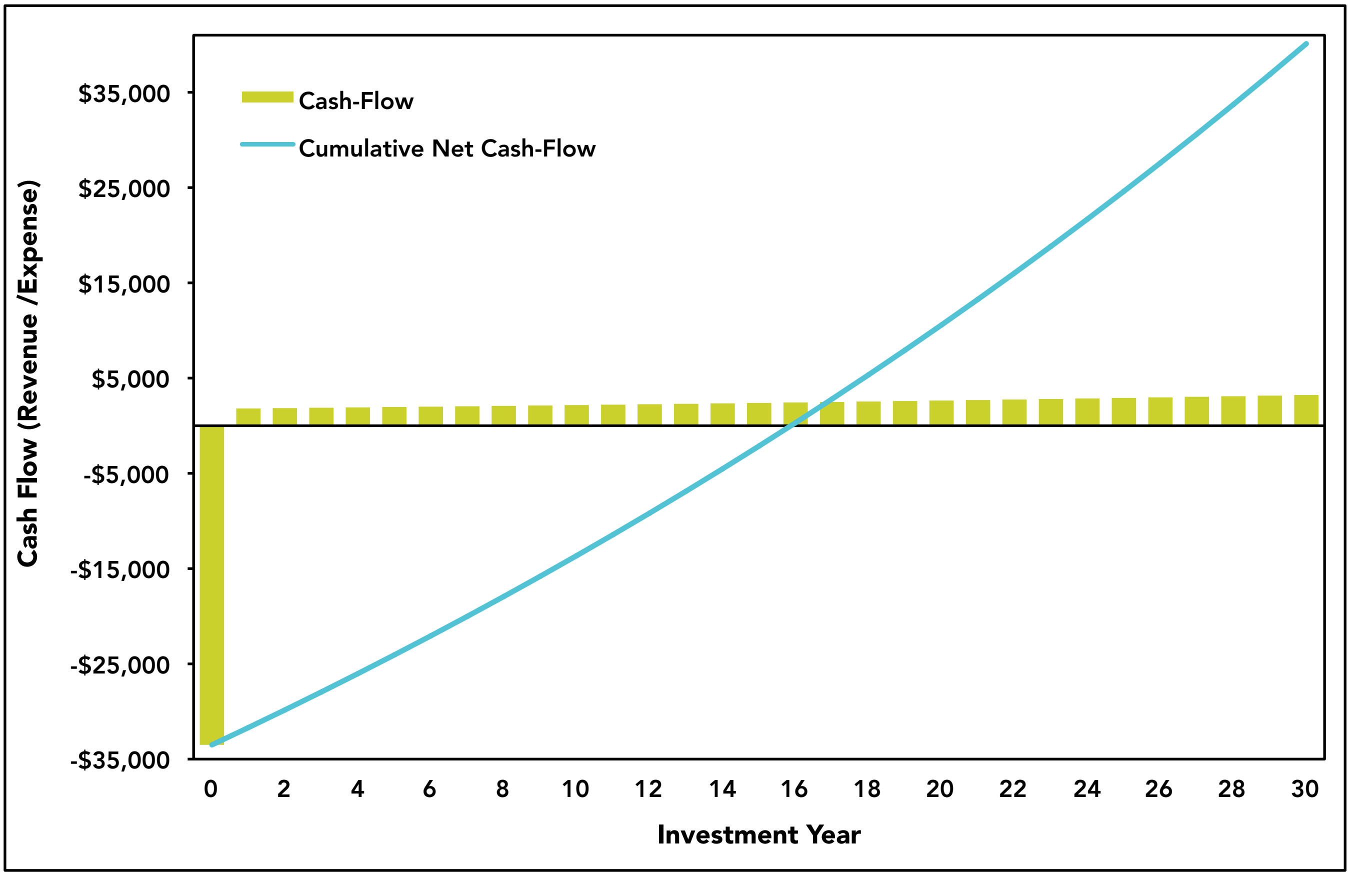

Figure 6: Example 30-year nominal dollar cash flow for a well-sited, well-maintained small wind turbine

SOURCE: U.S. DEPARTMENT OF ENERGY[16]

3.3. Measures of Wind Turbine Productivity

As with all electricity generating plants, wind turbines do not operate at the rated or "nameplate" capacity all the time. The annual capacity factor describes the average power output of an electric generating plant over the course of a year as a portion of its rated power. For wind turbines, this number is largely dependent on the energy resource in the site's wind regime.

In southern Alberta, large wind turbines can achieve annual capacity factors of 35% if they are located in a good wind regime. For comparison, capacity factors for run-of-river hydro can be 40–50%, and a new biomass thermal plant might be expected to operate 80% of the time. Other technologies, like coal, operate at capacity factors as high as 80–85%, while some natural gas plants that are used to meet peak demands can have capacity factors as low as 10–20%. Smaller wind turbines tend to have lower capacity factors, largely because their lower towers mean they operate in weaker winds. Multiplying the nameplate capacity by the capacity factor and by 8,760 hours in a year (8,784 hours in a leap year) will give an estimate of the energy that a turbine will generate in a year.

The scale of investment will dictate the degree to which the future productivity of a wind turbine needs to be calculated. Major wind farms require detailed studies that collect several years of wind data to determine statistical distributions of wind speeds as well as to model long-term trends and local topography. These studies can predict quite accurately what the output of a given wind turbine will be at a particular site. However, for a residential wind turbine, an estimate using local weather data and a manufacturer's published power curve may be enough to decide whether or not to proceed with an installation.

3.4. What Is the Grid?

The "grid" refers to the electricity grid: the electrical equipment and wires (transmission and distribution lines) that connect our farms, homes, businesses and industries to sources of electricity, such as wind turbines and coal-fired generating plants. There are two distinct components of the electricity grid: high-voltage transmission that transports large amounts of electricity over large distances, and low-voltage distribution that distributes electricity from substations to farms, homes and businesses. Large generating plants are connected to the high-voltage transmission grid, while small generating plants (regardless of the energy source) are connected to the distribution grid. Depending on the location and size of wind farms, they can be connected to either the transmission or the distribution system. Both systems have limits to how much electricity they can carry, which is important for any new electricity project that wants to connect to the grid.

Access to the grid is extremely important for any grid-connected wind project. Without access to the grid, wind-generated electricity cannot be sold to the provincial electricity market overseen by the AESO.

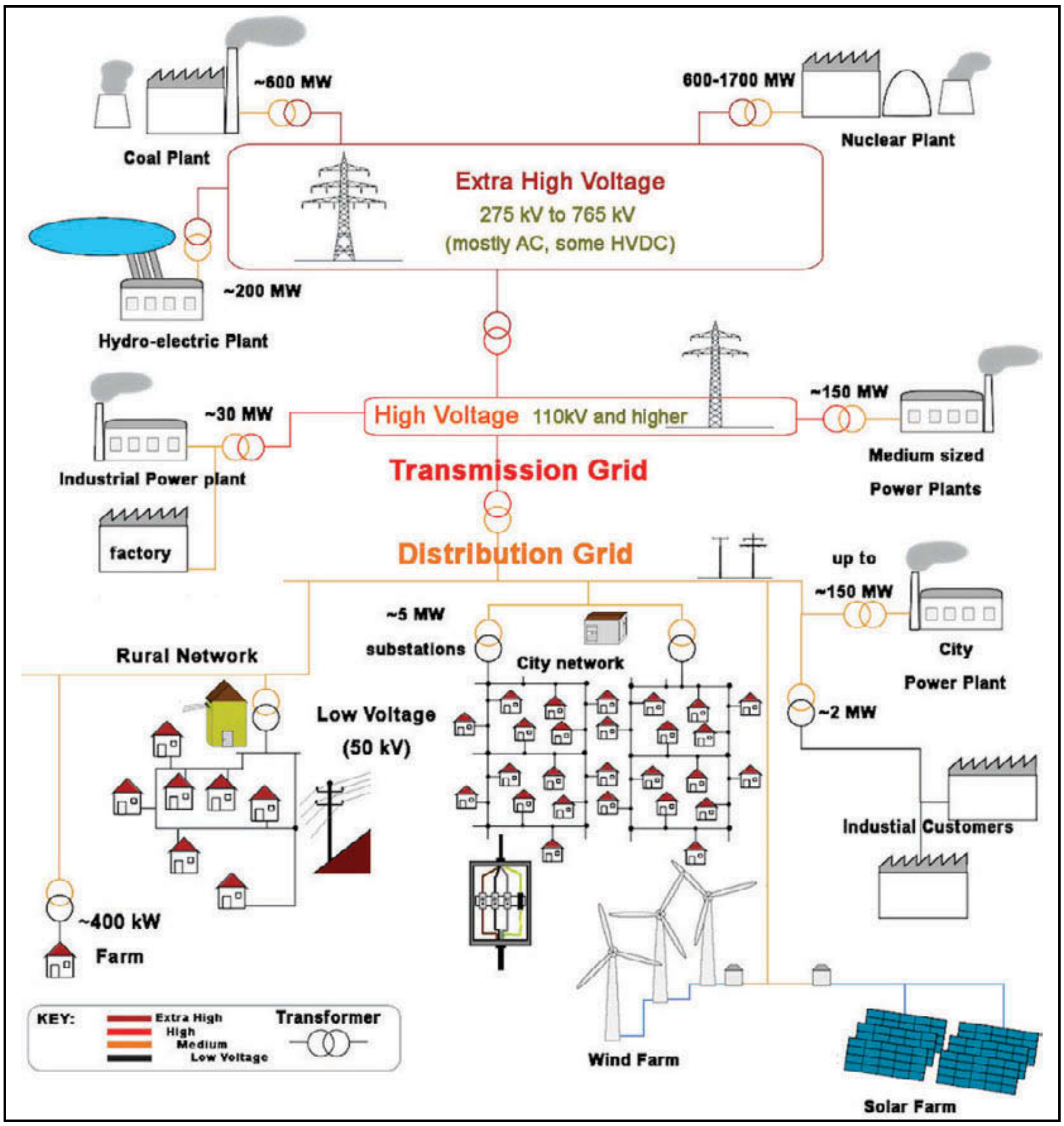

Figure 7: Example of typical components of the electric grid

ILLUSTRATION: J MESSERLY, BASED ON GERMAN ORIGINAL BY STEFAN RIEPL[17]

4. Alberta's Electricity Market

4.1. Deregulation

In the early 1990s, the Government of Alberta implemented a strategy to decrease its role in the electric industry, increase competition and expose firms to the discipline of market conditions.[18] The restructuring of the wholesale electricity market in Alberta was complete by 2001. This process involved changing the sale of electricity from a regulated-rate market, where prices were set by rate-hearings based on the budgets proposed by utility companies, to a competitive market, where prices are set by the real-time demand for the supply of electricity.

The prediction by Alberta's government was that this competition would eventually lead to less-expensive electricity for consumers. Initially, electricity prices soared after deregulation, which indicated that demand was significantly outstripping supply. However, the promise of high electricity prices attracted developers, and by 2006, 3,300 MW of new generation had been added to Alberta's grid.

Wind energy developers were especially interested in the opportunities presented by an open market.[19] In other jurisdictions an Independent Power Producer (IPP) must typically wait for government to issue a request for proposal for wind electricity development. In Alberta, an IPP could conduct its own feasibility analysis to determine if the going rate for electricity would support an investment in developing a wind energy facility.

The AESO is the independent operator of Alberta's electric grid and Alberta's hourly wholesale electricity market. The market has more than 200 participants and annual energy transactions of about $9 billion. The wholesale real-time electricity market is managed by the System Coordination Centre, which is constantly staffed by a team of system controllers. System controllers dispatch electricity to meet demand and monitor the operating status and stability of the provincial electric system.

The AESO uses an online energy trading system to facilitate the real-time wholesale electricity market. Offers for the supply of electricity and bids for the demand of electricity from market participants are entered into the system, which provides market information for the system controllers and all participants.[20] This information can be seen online at ets.aeso.ca.

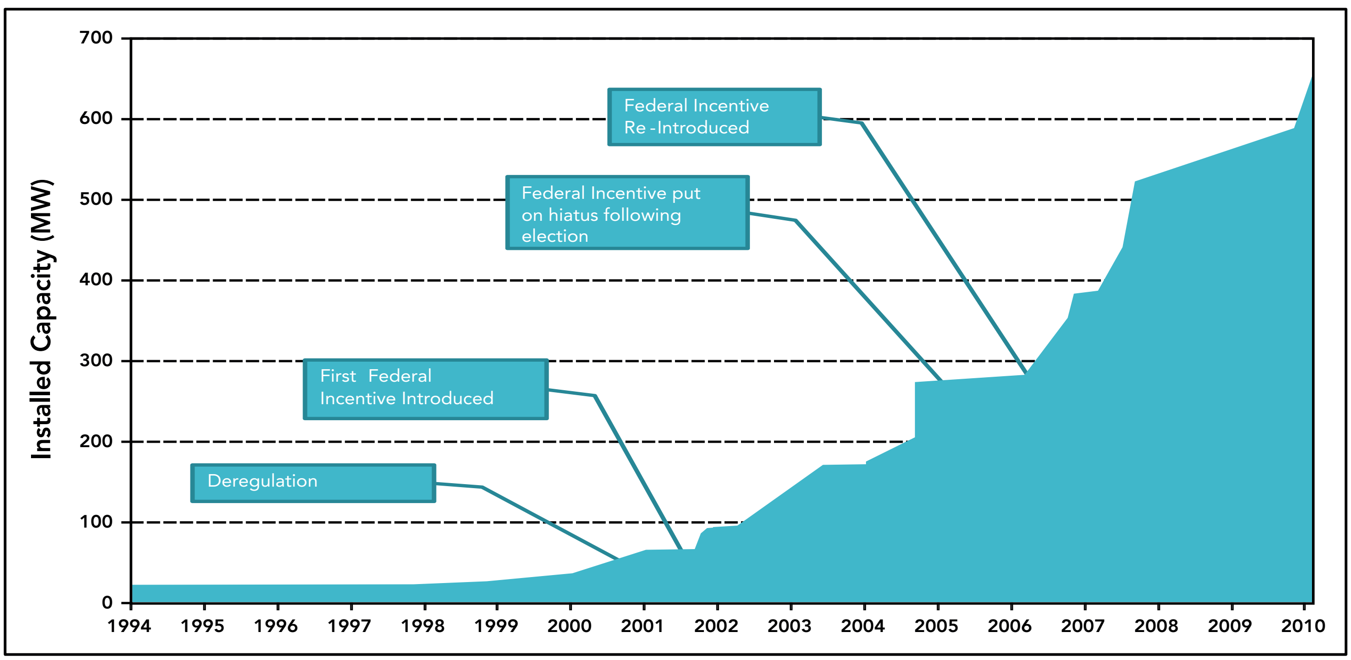

Figure 8: Historical development of wind turbine installations in Alberta

SOURCE: BASED ON DATA COMPILED FROM THE CANADIAN WIND ENERGY ASSOCIATION

4.2. Past Wind Development in Alberta

Alberta was the first province in Canada to have a commercial wind farm in operation: the Cowley Ridge wind farm generated 60 million kWh of electricity in 1997. Since then, the wind energy industry in Alberta has grown significantly, particularly after the implementation of a federal 1¢/kWh generation incentive in 2002. There has been no provincial counterpart to this incentive. The importance of the federal incentive is illustrated in Figure 8. It shows the growth rates when the incentive was suspended in 2006 and after it was reinstated and expanded in 2007.

The 2007 electricity profile for Alberta reported 1.45 billion kWh of wind energy generated, which is about 2.5% of the load. The current installed capacity of wind turbines in Alberta is 653 MW, putting the province in third place nationally behind Ontario and Quebec. Table 2 summarizes the large wind developers currently operating in Alberta.

Table 2: Utility-scale wind farms operating in Alberta as of June 2010

Wind Farm/Site	Size (MW)	Developer	Date Installed
Castle River Wind Farms	0.6	TransAlta Wind	Nov. 1997
Cowley Ridge North Wind Farm	19.5	Canadian Hydro Developers (acquired by TransAlta Wind in December 2009)	Oct. 2001
Chin Chute Wind Farm	30	Suncor, Acciona, Enbridge	Nov. 2006
Kettles Hill Phase I	9	ENMAX	Mar. 2006
Kettles Hill Phase II	54	ENMAX	Jul. 2007
Lundbreck	0.6	Lundbreck Developments Joint Venture A	Dec. 2001
Magrath	30	Suncor, Enbridge, EHN	Sep. 2004
McBride Lake	75.24	ENMAX, TransAlta Wind	Jun. 2003
McBride Lake East	0.66	TransAlta Wind	Dec. 2001
Old Man River Project	3.6	Alberta Wind Energy	Mar. 2007
Sinnott Wind Farm	6.5	Canadian Hydro Developers	Nov. 2001
Soderglen Wind Farm	70.5	Nexen, Canadian Hydro Developers	Oct. 2006
Summerview Wind Farm	1.8	TransAlta Wind	Apr. 2002
Summerview Wind Farm	68.4	TransAlta Wind	Sep. 2004
Summerview 2 Wind Farm	66	TransAlta Wind	Feb. 2010
Taber Wind Farm	81.4	ENMAX	Sep. 2007
Tallon Energy Project	0.75	Tallon Energy	Jan. 2004
Taylor Project	3.38	Canadian Hydro Developers	Jan. 2004
Waterton Wind Turbines	3.78	TransAlta Wind	Nov. 1998
Weather Dancer 1	0.9	EPCOR, Peigan Nation Reserve	Sep. 2001
Castle River Wind Farm	9.9	TransAlta Wind	Jan. 2000
Castle River Wind Farm	29.04	TransAlta Wind	Jan. 2001
Cowley Ridge	21.4	Canadian Hydro Developers	1993/1994
Blue Trail Wind Farm	66	TransAlta Wind	Nov. 2009
TOTAL (MW)	**652.95**		

SOURCE: CANADIAN WIND ENERGY ASSOCIATION[21]

4.3. Micro-Generation Regulation

The Alberta government introduced its micro-generation regulation in early 2009 to streamline the process of connecting any micro-sized, renewable energy generator to the electrical grid. This regulation applies to people who wish to produce electricity using an environmentally friendly, renewable fuel source to power their home, farm or business.

There are two categories of micro-generation: small (less than 150 kW in generation capacity) and large (greater than 150 kW but less than 1 MW in generation capacity).

The micro-generation regulation simplifies the process of connecting micro-generators to the grid and receiving credit for power sent to the grid. The details of the regulation are discussed in the appendix of this guide.

A recently announced federal energy loan program through Farm Credit Canada[22] offers a variable or fixed interest rate valid for up to five years, with payments either monthly, quarterly, semi-annually or annually. This loan program is designed specifically for producers and agri-business owners who want to generate their own renewable energy. It could be used to help finance projects that are eligible for micro-generation.

4.4. Relation to Other Provincial Policies

An emerging issue for wind development in the province is Alberta's new Land-use Framework and how it will be applied across the province.

Alberta's Land-use Framework aims to help manage the impacts of development on land, air and water. It involves the development of seven regional land-use plans for the province. Presently, it is not clear how the land-use framework is likely to affect wind energy developments, although its implementation could have significant implications for wind development in certain parts of the province.

For example, examining wind development projections for the Southern Foothills — the area of the province where most wind development has occurred to date — indicates that 138 hectares of land were taken up by wind turbine footprints in 2005. This number is projected to increase to 371 hectares by 2055. The total land-use footprint for all uses would be 83,509 hectares by 2055 in a business-as-usual scenario. This suggests that wind turbines have a relatively small land footprint compared to other uses, although land-use issues may still arise under the new framework depending on where development occurs.[23]

Any federal or provincial support for wind energy would also obviously affect project economics in Alberta and could help make wind development more viable in a number of locations. Presently, there is no provincial financial support for wind development, and the federal ecoEnergy for Renewable Power program was not renewed in the 2010 federal budget, resulting in very little government-sponsored financial incentive for wind development in Alberta at the time of this guide's writing.

Two commonly used types of policies that would immediately enable expansion of wind energy in the province, thereby providing rural landowners with a reliable source of income, are the feed-in-tariff (FIT) and the renewable portfolio standard (RPS). FITs encourage the development of renewable energy by obligating utilities to pay pre-established above-market rates for renewable power fed onto the grid. The tariffs, which usually vary depending on the type of resource used, provide renewable generators with a set stream of income from their projects. FITs are common in Europe, and Ontario is the first jurisdiction in Canada to introduce them. An RPS requires electric utilities and other retail electric providers to provide a specific percentage or amount of customer electricity with eligible renewable resources. Both a FIT and an RPS are compatible with a deregulated market.

5. Environmental Impacts

5.1. Emissions

Wind turbines, which are considered to have one of the lowest life cycle environmental footprints of any electricity-generating technology, produce emissions-free electricity. Some emissions result from other parts of a wind turbine's life cycle, such as manufacturing and construction, but on a cradle-to-grave basis the emissions per unit of electricity generated are significantly lower than for electricity generated from coal or natural gas.

5.1.1. Criteria Air Contaminants

On a life cycle basis, the air contaminants resulting from wind farms are extremely low. They are negligible compared to fossil fuel–based electricity generation because a wind farm emits no air contaminants from the generation of electricity.

The small amount of emissions that occur on-site are from the tailpipes of vehicles used during construction, maintenance and decommissioning.

5.1.2. Toxic Pollutants

Toxic pollutants, sometimes referred to as hazardous air pollutants or toxic substances, include some of the heavy metals, such as lead, mercury, cadmium compounds and chromium compounds. Wind turbines do not emit any toxic pollutants. Mercury continues to be of immense concern with respect to coal combustion.[24]

5.1.3. Greenhouse Gases

Some greenhouse gas (GHG) emissions result from the manufacture and installation of wind turbines. Approximately 70% of these emissions are generated from the combined production of concrete (including cement), aluminum and steel.[25] A number of life cycle studies concur that GHG emissions from coal- and gas-fired electricity are well over 10 times higher than life cycle emissions from wind. Figure 9 illustrates typical GHG emissions from electricity sources in Alberta.

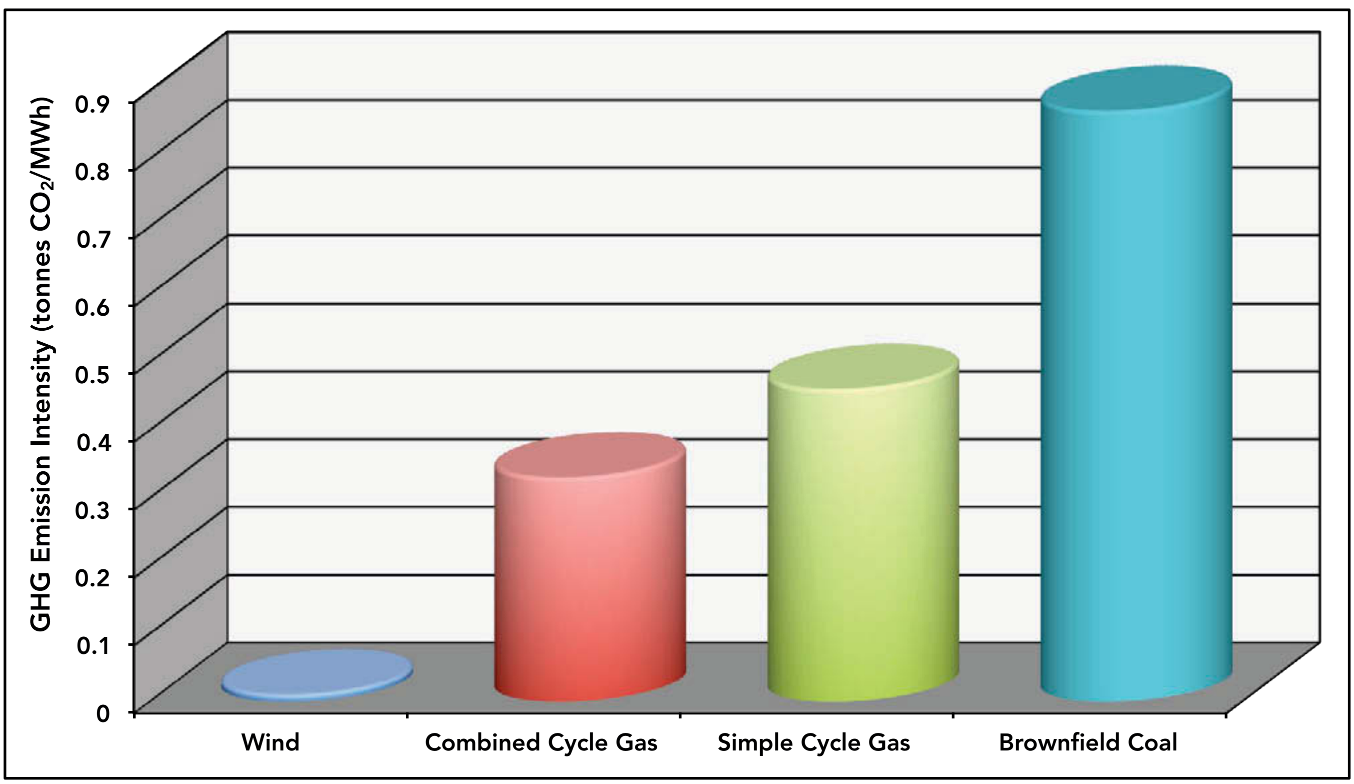

Figure 9: Greenhouse gas emission intensities for various electricity sources
SOURCE: AESO LONG-TERM TRANSMISSION SYSTEM PLAN (2009)

5.2. Wildlife Impacts

All forms of electricity generation present risks to wildlife, and wind turbines are not excluded from this reality. However, the scale of the impacts as well as the impacts of other alternatives is very important to bear in mind. Table 3 shows the relative risks to wildlife from different electricity generation sources at each life cycle stage.

The combustion of coal results in the highest potential risks to wildlife because it contributes to acid rain, which damages plant life and water systems, and to mercury magnification through the food chain, which results in poisoning of higher-level predators, including hawks and eagles.

The construction of large-scale conventional hydroelectric generating stations (not run-of-the-river) result in the loss of large areas of terrestrial and aquatic habitat upstream and downstream, and block fish migration through the construction of reservoirs or impoundments. Huge solar photovoltaic systems can, depending on their location, disrupt the habitat of mammals.

Almost all forms of electricity generation and electricity transmission and delivery can result in collision and electric field shock risks to birds and bats. Collision objects vary with the electricity generation source. In the extraction of oil and natural gas fuels, birds and bats collide with offshore drilling platforms. Electricity generation from coal and nuclear sources pose collision risks for bats and birds with stacks and cooling towers.

Alberta Sustainable Resource Development (SRD) has wildlife guidelines for wind energy projects in Alberta.[26] The guidelines focus on southern Alberta, where most wind development has occurred in the province. Potential areas of concern include “direct mortality of wildlife resulting from collisions with wind turbines and associated structures (e.g., transmission lines).”[27]

Table 3: Potential levels of relative wildlife risk by life cycle stage and electricity generation source

	Life Cycle Stage and Relative Risk for Potential Harm to Wildlife					
Electricity Fuel Source	Resource Extraction	Fuel Transportation	Facility Construction	Electricity Generation	Transmission and Delivery	Decommission Facility
Coal	Highest Potential	Lower Potential	Lower Potential	Highest Potential	Moderate Potential	Lower Potential
Oil	Higher Potential	Highest Potential	Lower Potential	Higher Potential	Moderate Potential	Lower Potential
Natural Gas	Higher Potential	Moderate Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Nuclear	Highest Potential	Lowest Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Hydro	None	None	Highest Potential	Moderate Potential	Moderate Potential	Higher Potential
Wind	None	None	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Solar PV (building mount)	None	None	Lowest Potential	Lowest Potential	Moderate Potential	Lowest Potential

SOURCE: NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY[28] AND GORDON HOWELL[29]

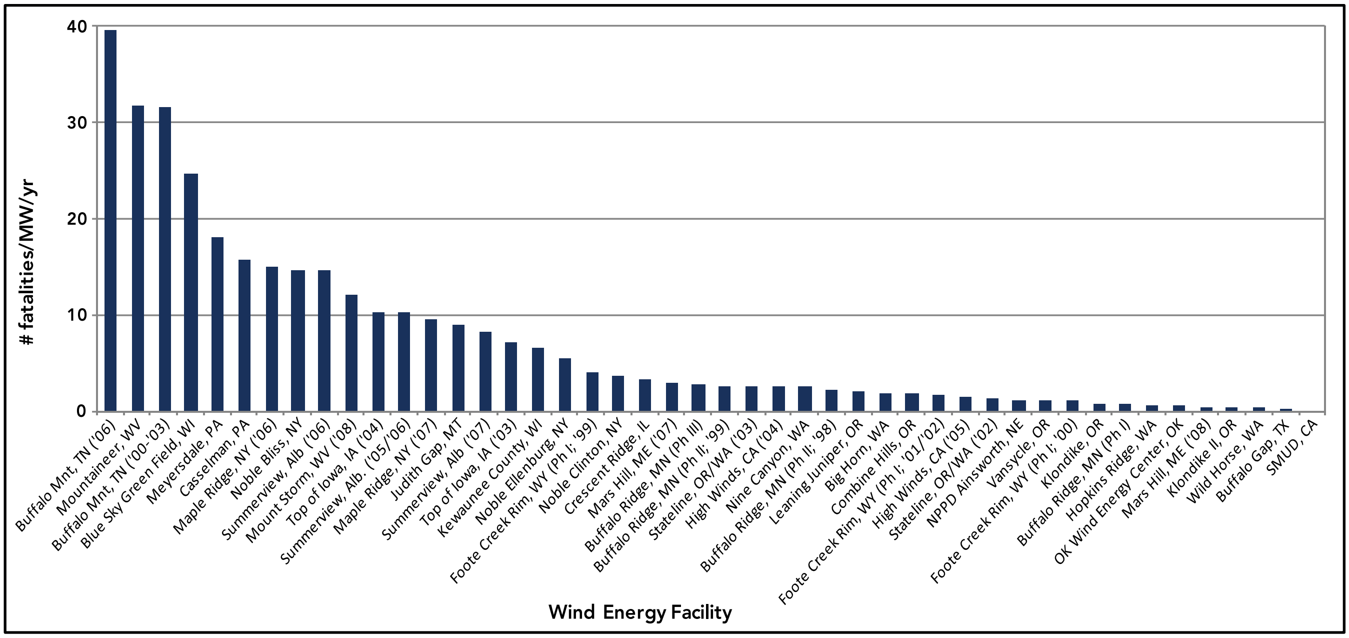

Figure 10: Summary of bat mortality rates at various U.S. wind energy facilities

SOURCE: NATIONAL WIND COORDINATING COLLABORATIVE[30]

Birds and bats may be killed through collisions with wind turbine blades or towers. Bats may also be killed by air pressure changes associated with spinning turbine blades. These impacts can be mitigated through care in the siting of turbines (e.g., avoiding bird staging areas and common flyways, as well as ridges where air currents may increase collisions with raptors) and by restricting the operation of turbines at certain times of year (e.g., spring and fall bird migration) and during certain weather conditions when adverse effects on birds and bats are more likely.

In terms of their relative contribution to bird fatalities, wind turbines rank fairly low compared to buildings and windows, electricity transmission lines and even cats. It is important to note, however, that as wind turbines grow in number, so too could their contribution to bird mortality. For that reason, it is important to ensure that wind development is carried out responsibly and with due diligence. Poorly sited wind turbines are a real risk to wildlife, particularly for sensitive species and sensitive areas. Comprehensive bird and bat studies are typically a mandatory and central part of the environmental permitting process for wind developments.

Fatality rates for birds and bats are highly variable among facilities and regions of the province. Bat fatality data collected from wind farms in the United States is shown in Figure 10. Bats can be particularly sensitive to wind turbines, so an adequate setback from key bat habitat is important to reducing fatalities for affected species.

SRD also indicates that disturbance of wildlife (including species at risk, such as the sage grouse) remains a potential negative aspect of wind development if steps are not taken to mitigate development impacts. Disturbance may be caused by increased human activity at wind farms and possibly by the movements of rotor blades. This may result in decreased productivity and wildlife avoidance of habitat in the area. Bird Studies Canada states: "It is possible that the greatest adverse effect that wind energy facilities may have on birds is disturbance to breeding and wintering birds.… The potential should be considered at all sites.… This is especially important in areas where species at risk are present … in prairie habitat where certain susceptible bird species are found breeding."[31]

Environmental impacts can and do happen at wind projects, but they can often be reduced by responsible developers. Monitoring post-construction impacts can provide important information to mitigate issues that may arise and add to the growing pool of knowledge of best practices for new developments.

This benefit was well illustrated by Alberta-based TransAlta in Pincher Creek in southern Alberta.[32] Post-construction monitoring of wind turbines revealed an unusually high number of bat deaths occurring near the turbines. TransAlta teamed up with researchers at the University of Calgary, who found out that the bats were being killed not by striking the turbine blades, but because of the drop in air pressure near the wind turbine blades which caused fatal injuries to their lungs. Further research resulted in management techniques to limit turbine operation in the hours of heaviest bat migration during the year, reducing bat deaths by up to 60%.

5.3. Environmentally Significant Areas

Environmentally significant areas (ESAs) are places in Alberta that are important to the long-term maintenance of biological diversity, soil, water and other natural processes. They contain rare or unique elements in the province, or elements that may require special management consideration because of their conservation needs.

The Government of Alberta keeps a register of ESAs and identifies the level of significance as provincial, national or international. Figure 11 shows the locations of ESAs in Southern Alberta.

Any area identified as environmentally significant, including provincial parks, national parks, conservation areas and crown land, would need to be considered in the overall decision-making process for determining suitable locations for any new development, including wind energy projects.

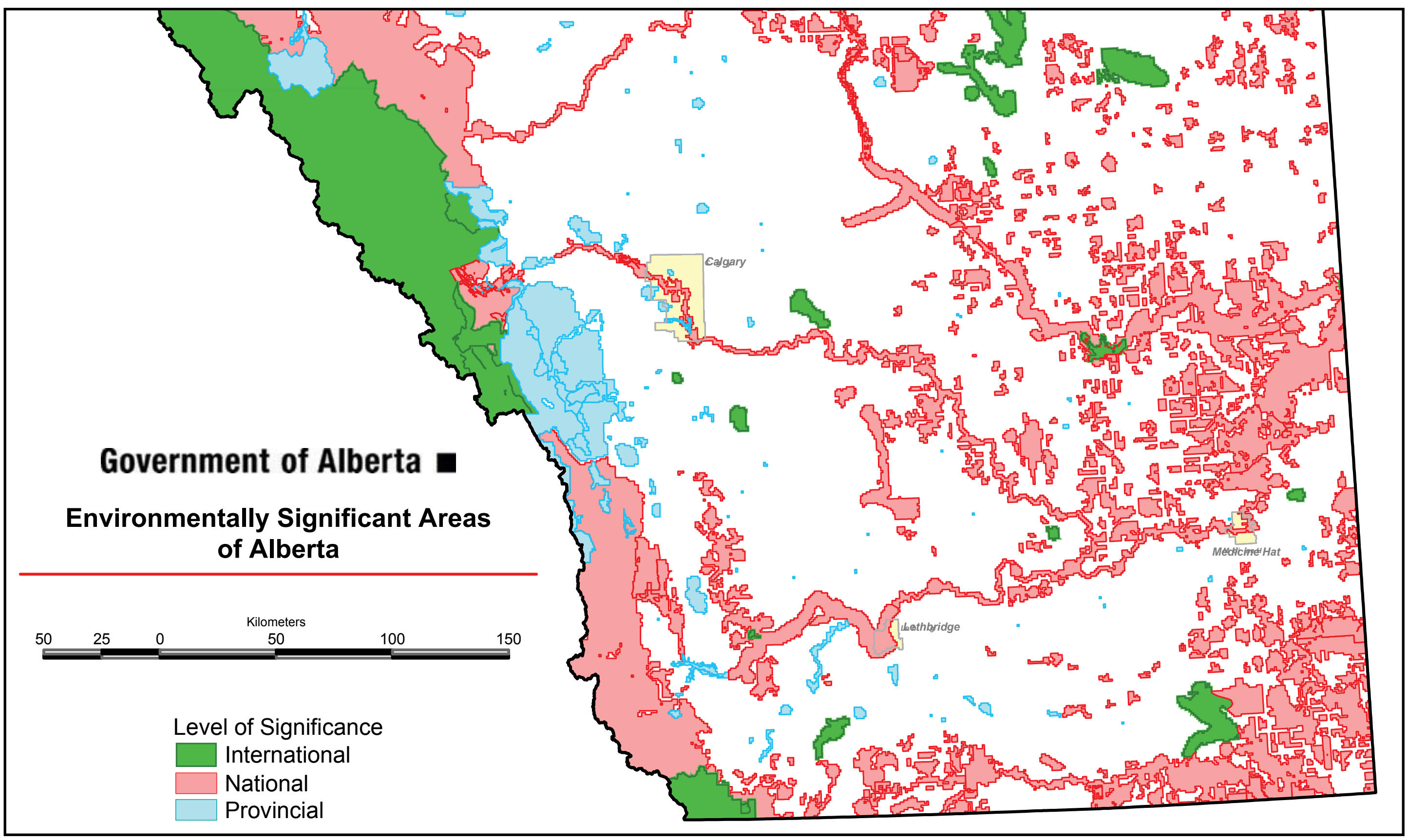

Figure 11: Environmentally significant areas in Southern Alberta

ALBERTA TOURISM, PARKS AND RECREATION[33]

5.4. Effects on Natural Habitats

SRD identifies habitat loss and degradation resulting from wind farm infrastructure, such as access roads, as an environmental concern for poorly sited or designed wind projects.

Wind turbines have small individual footprints, but they require road access for construction and maintenance and trenching to bury electricity distribution lines. Construction, which tends to be the most disruptive part of the wind development process, can cause significant land disturbance (see Figure 12). The installation of wind farms on intact native prairie and in forested areas can cause or contribute to adverse environmental impacts associated with vegetation clearing, habitat fragmentation and the increased accessibility of landscapes to motorized vehicles.[34]

Adverse environmental impacts may include the loss of native grasslands and other habitats important for wildlife. Direct loss of plant communities may also directly affect rare plant species or unique vegetation communities. Plant communities could be further affected by the introduction and spread of exotic or invasive plants along roads and at construction sites. Erosion of inappropriately designed access roads can cause further degradation. One example of this kind of degradation and inappropriate development is in California's Tehachapi Pass,[35] where gullies have formed as a result of poor erosion control practices. While these situations are not the norm for development, they represent development practices that should be avoided.

Protecting native prairie is an important environmental issue in some parts of Alberta because intact native prairie is rare and sensitive habitat. The prairie ecozone is one of the most intensively developed landscapes in the world. For example, Manitoba has lost 99.9% of its native prairie, Saskatchewan 83.6% and Alberta 61%.[36]

Figure 12: Wind turbines have their most significant land impacts during construction

PHOTOS: TIM WEIS, THE PEMBINA INSTITUTE

Not only have there been great losses in the overall extent of prairie landscapes, but the remaining tracts of prairie have become highly fragmented. Habitat fragmentation is a serious problem with developments that occur in natural habitats, such as native prairie. The quality of native prairie and its value to wildlife depends on the degree to which it remains intact. Many prairie species require large tracts of unspoiled native grassland to support their entire life history. Thus, the few places where significant expanses of native prairie endure are rare and important to the continued existence of this ecozone. Maintaining the integrity of large tracts of native prairie is essential to maintaining a healthy prairie ecosystem. Significant development in these landscapes has the potential to have adverse impacts on many species at risk that make their home there.

In general, development of any kind should be avoided in native prairie. Restricting or prohibiting wind development where environmentally sensitive areas would be adversely affected will reduce impacts on rare habitats and species. Low-impact techniques for installing and maintaining turbines may also be available. Smarter siting, such as locating wind turbines on cultivated lands and brownfield sites where land has already been cleared and roads developed, can also reduce or eliminate additional impacts.

If wind energy development is to take place on native prairie, specific guidelines must be followed. Considerably more work is required in native prairie prior to and during construction and in the follow-up. Rare plant surveys must be undertaken and species at risk surveys may be required. A historical resources overview will be necessary and a historical resource impact assessment may be required. Although the guidelines that are currently available are based on oil and gas activity in native prairie, many of the activities that require mitigation are the same, such as road construction.

Refer to the ERCB's *Petroleum Industry Activity in Native Prairie and Parkland Areas*[37] and the SRD document "Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat Within Grassland and Parkland Natural Regions of Alberta"[38] for guidance on working in native prairie. The SRD document specifies the setback distances for certain activities in relation to sensitive wildlife habitat. It should be read in conjunction with another SRD document, "Wildlife Guidelines for Alberta Wind Energy Projects".[39] If construction will take place on native prairie, it is recommended to follow Alberta Environment's *Native Plant Revegetation Guidelines for Alberta*.[40]

The best way for developers to minimize disturbance in native prairie is to avoid it as a development site, especially environmentally significant areas, sensitive areas and areas with vegetation types that are hard to restore. Where possible, developments should be located on lands that have been previously disturbed. If avoidance is not possible, developers can reduce their impacts by following established guidelines. Predevelopment surveys for rare species and communities should be carried out to properly site individual turbines, roads and related infrastructure with appropriate setbacks from sensitive habitat. The cumulative effects of multiple developments in an area also need to be considered explicitly. During construction, contractors should be informed about best practices and should follow an environmental management plan specifically designed for the site. After construction, reclamation activities should use natural recovery and/or native plants. The disturbed area should be monitored to ensure reclamation success.

In some cases, it is possible that wind development can have a positive environmental impact if it helps reduce landscape fragmentation. If the additional revenue that a wind development provides increases the financial viability of agricultural operations, the financial incentive to sub-divide and sell land for residential or recreational development may be reduced. This is particularly true in the large contiguous areas of rangeland in southern Alberta and the foothills. These areas are an important source of ecosystem services, providing wildlife habitat, playing a key role in maintaining water quality in the headwaters of prairie rivers, and sequestering carbon in the root systems and soil of native grasslands.[41] These rangelands also have recreational, aesthetic and cultural value for rural residents and urban Albertans. Many tracts of native prairie have a high potential to contain culturally significant resources.

A potentially more beneficial environmental impact could arise if income from wind energy development allows landowners to set aside other lands for protection and preservation. This benefit can even be a direct component of negotiations and contracts by either party.

Given the tenuous economics of Alberta's livestock and ranching industry in recent years, and the development pressures on rangeland as the province's population increases, wind development may in some cases help provide a supplemental source of income that can ease some of these financial stresses. Wind development may thereby contribute to maintaining the large areas of contiguous rangeland that support both livestock and ecosystem services.

6. Health Considerations

Since the early 1980s, more than 68,000 turbines have been installed around the world, with more than 30,000 currently operating in North America. As a result, thousands of people have lived and worked near large wind turbines for decades, and numerous potential health impact studies have been conducted. A very small number of people have reported experiencing conditions such as headaches and difficulty sleeping, which has prompted numerous studies for peer-reviewed scientific journals and government regulatory bodies. A 2006 study for the U.K. Department of Trade and Industry found "there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines."[42] The U.K. National Health Services found that a frequently referenced study claiming to provide evidence of health impacts from wind development actually provides "no conclusive evidence that wind turbines have an effect on health."[43]

In 2009, an international panel comprised of medical doctors, audiologists and acoustics professionals from the United States, Canada, Denmark and the United Kingdom published a review of the literature on wind turbines and health impacts. The panel also noted that while some people may find the sounds annoying, there is no evidence that sounds or vibrations from wind turbines, whether they can be heard or not, have any direct adverse physiological effects.[44] In May 2010, the chief medical officer of Ontario, Dr. Arlene King, released a study stating that "the scientific evidence does not demonstrate any direct causal link between wind turbine noise and adverse health effects."[45]

6.1. Sound

Concerns have been raised that noise produced by wind turbines can be a source of annoyance that may affect the quality of life and perhaps the health of nearby residents. Depending on topography and atmospheric conditions, turbine noise can be audible from a distance of over 1 km.

As wind speed increases, noise from the turbine is likely to increase, but there will also be a corresponding increase in the ambient noise from the wind itself. Factors that can affect noise transmission from the wind turbine include terrain, weather and geology.

The existence of so-called "wind turbine syndrome" remains a matter of controversy. While no definitive, population-based studies have indicated that symptoms such as difficulty sleeping, headaches and nausea are any higher than within the general population, these effects are occasionally reported, and it is possible that some individuals may be particularly sensitive to disturbance and associated health impacts from turbine noise. However, the evidence indicates that "wind turbine syndrome" is based on misinterpretation of physiologic data, and that the features of the so-called syndrome are merely a subset of annoyance reactions.[46]

Dr. Ray Copes, Director of Environmental and Occupational Health with the Ontario Agency for Health Protection and Promotion, consolidated research on a number of common public concerns around wind energy.[47] His review concluded that there is no evidence of noise-induced health effects at levels emitted by wind turbines, although some people may find the sound annoying, which may result in stress and sleep disturbance.

In Ontario, Chatham-Kent Public Health examined whether health problems could be attributed to wind turbines. It found that as long as the Ministry of Environment guidelines for location criteria are respected (550 m in Ontario), the impacts of wind turbines on the health of local residents would be "negligible." The report concluded: "Although opposition to wind farms on aesthetic grounds is a legitimate point of view, opposition to wind farms on the basis of potential adverse health consequences is not justified by the evidence." In October 2009, Ontario's Chief Medical Officer of Health issued a memorandum stating that, while some people may find the noise from wind turbines "annoying," a comprehensive scientific review found "no evidence of noise-induced heath effects at levels emitted by wind turbines."[48]

In 2009, the Canadian and American wind energy associations established a scientific advisory panel to evaluate wind turbine sound and health effects. The results were published in December 2009.[49] Following review, analysis and discussion, the panel reached agreement on three key points:

1. There is nothing unique about the sounds and vibrations emitted by wind turbines.
2. The body of accumulated knowledge about sound and health is substantial.
3. The body of accumulated knowledge provides no evidence that audible or sub-audible sounds from wind turbines have any direct adverse physiological effects.

6.1.1. Sound Levels

Sound pressure levels are measured on a logarithmic scale with units of decibels (dB). At a distance of 350 m, the sound from modern wind farms is about equivalent to the noise level in a quiet room (30–50 dB). The Alberta Utilities Commission (AUC) has set a nighttime sound level maximum from electricity generating facilities of 40 dB LAeq* at a resident's home.[50] The sound level is measured at a distance of 15 m from the nearest or most affected dwelling. This limit takes into consideration that the attenuation of noise through the walls of a dwelling should decrease the indoor sound levels to where normal sleep patterns are not disturbed.[51]

Sound levels from wind turbines pose no risk of hearing loss or any other health effect. The levels of sound associated with wind turbine operations are considerably lower than industry levels associated with noise-induced hearing loss. Studies have shown that noise-induced hearing damage does not occur below levels of 85 dB.[52]

Ontario has tried to avoid any concerns by implementing a province-wide minimum setback requirement of 550 m. There can be merits to such an approach, but it can also have unintended consequences. For example, a community in Barrie, Ontario, tried to build a project on the site of a local landfill but was prevented because of the setback requirements — even though the operation of the landfill was far noisier than the operation of the turbine would be.

Before they are approved, wind projects must demonstrate that they meet limits on noise and minimum setbacks. As a result of advances in technology, the sound levels emitted by modern wind turbines have steadily decreased, but they are not perfectly silent. Figure 13 compares sound from modern utility-scale turbines to other everyday sounds.

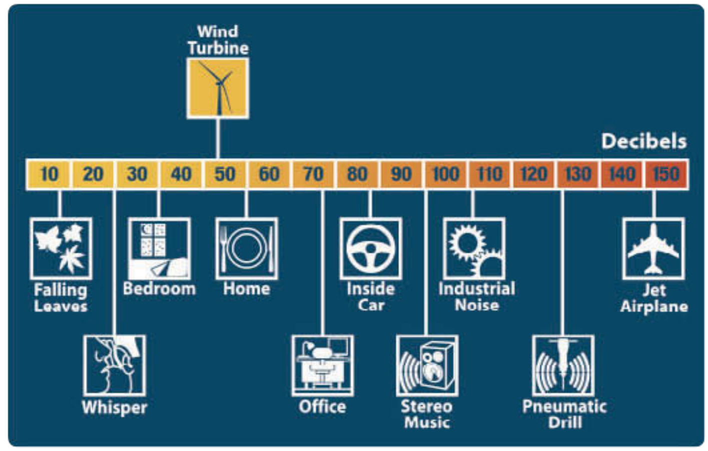

Figure 13: Noise levels from modern wind turbines compared to other sources

ILLUSTRATION: CANADIAN GEOGRAPHIC MAGAZINE[53]

6.1.2. Low-frequency Noise

Low-frequency noise is sound in frequencies below 200 Hz. Human hearing is most sensitive between 1,000 and 20,000 Hz, but low-frequency noise, and even infrasound (noise below 20 Hz), can be audible if it is loud enough. Under many conditions, low-frequency noise below 40 Hz cannot be distinguished from environmental background sound from the wind itself.

The low-frequency sound emitted from wind turbines is at a level of 50–70 dB, which is well below the audible threshold. There is a consensus among acoustic experts that the infrasound from wind turbines is of no consequence to health.[54]

Chronic exposure to extreme levels of low-frequency noise can lead to vibroacoustic disease, which can cause a variety of illnesses. However, this disorder typically only affects people who are occupationally exposed to extremely high sound pressure (like airplane mechanics), and there is no data that suggests low-frequency noise at lower volumes affects health. People affected by vibroacoustic disease are chronically exposed to low-frequency noise typically at sound levels of 120 dB to 135 dB (120 dB is 10 million times louder than 50 dB). In its 1999 guidelines for community noise, the World Health Organization considers inaudible low-frequency noise — the category under which the low-frequency noise from wind turbines typically falls — to be of no concern from a public health perspective.[55]

* The LAeq notation indicates that the measurement is of "equivalent continuous A-weighted sound pressure level," which means that the sound pressure level is averaged over time and weighted to reflect the audible frequency range.

6.1.3. Noise Variation

A report carried out for the U.K. Department of Business Enterprise and Regulatory Reform concluded that the complaints were not caused by low-frequency noise, but by amplitude modulation of aerodynamic noise from the wind turbines.[56] Amplitude modulation occurs when aerodynamic noise from wind turbines occurs with a high degree of fluctuation (typically around once per second). These sound levels are similar to the ambient noise levels in urban environments.

A small minority of people exposed to amplitude modulation report annoyance and stress associated with noise perception. The low-frequency sound emitted by spinning wind turbines could possibly be annoying to some people when winds are unusually turbulent, but there is no evidence that this level of sound could be harmful to health.[57]

6.2. Electromagnetic Field Exposure

People are exposed to electromagnetic fields (EMFs) on a daily basis in homes and workplaces. EMFs are generated by household wiring, plug-in electrical appliances, fluorescent lighting, computer monitors, photocopiers, fluorescent lights, electric heaters and electric tools.

There are four potential sources of EMF exposure in wind projects:

1. the generators in the wind turbines
2. the underground network cables between the turbines and the substation
3. the electrical transformers in the substation
4. the transmission lines connecting the substation to the electricity grid

There is no scientific consensus on health risks from magnetic fields. EMF concerns are not specific to wind energy, however, and in most wind projects the highest EMF exposure would come from transmission lines, not the turbines themselves.

Health Canada states that there is no need to take action regarding daily exposures to electric and magnetic fields at extremely low frequencies, and that there is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those located just outside the boundaries of transmission line corridors.[58]

6.3. Shadow Flicker

Wind turbines have been observed to produce a shadow flicker effect as the blades rotate. This effect is seen only by an observer facing the sun in specific locations near the turbine at specific and limited times of day.

The distance that a shadow is cast from a wind turbine depends on a number of factors including time of day, tower height, blade length, terrain, latitude and time of year. The amount of bright sunshine determines the amount of time that shadow flicker can be observed. The intensity of the shadow flicker is greatest directly to the north of the turbine, but the distance that this intensity is observed is the smallest. The shadow distance is greatest to the east or west at latitudes in Alberta. For example, in southern Alberta, based on a tower height of 80 m, and a blade length of 40 m, on flat ground, the maximum distance that a weak shadow would fall is 1,334 m to the east or west. The shadow would only reach these distances for brief periods at sunrise and sunset. The maximum distance that a shadow would fall directly to the north is 345 m. Shadow frequency would be highest within this zone north of the turbine, diminishing towards the northeast or northwest. No shadow will fall directly south of the turbine at this latitude.

Shadow flicker, when present, generally lasts a very short period of time and only occurs when specific conditions are present, and often only for a few days a year at many sites. Typically it is only an issue within 300 m of a modern wind turbine, although this depends on the size of the turbine blades, the time of year, and the local terrain.

Although shadow flicker can result in health effects if the flicker rate is above 2.5 cycles per second (Hz), commercial-scale wind turbines produce a flicker rate that is less than half this threshold. Shadow flicker from large-scale turbines has a frequency of 0.5–1.4 Hz.

In southern Alberta, wind farms are often located on agricultural land
PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

The frequency of shadow flicker depends on the revolutions per minute of the rotor. As a result, smaller turbines can have higher-frequency flicker rates, but they are too small and operate too quickly to create a significant shadow. According to the American Epilepsy Foundation, frequencies of 5–30 Hz can trigger an epileptic seizure. Therefore, wind turbines are absolutely no threat to people with epilepsy or to photosensitive individuals.

Although no evidence currently exists that shadow flicker has health effects at the flicker frequencies seen with commercial-scale wind turbines,[59] shadow flicker is generally considered an annoyance, and it should be minimized as much as possible.

6.4. Visual Impacts

Visual impacts are a major concern for those living near wind farms. Perception of visual impact has also been shown to affect noise perception.[60] Again, aesthetics do not pose a health risk, but the effect of wind turbines on a viewscape can be a legitimate concern. As such, developers typically use photo and video imaging tools to illustrate the potential visual impact of a wind project before it is built. Turbine positions can be adjusted accordingly to make the overall impact more acceptable to the local community. There are physical restrictions on where wind turbines can be placed and for a given project there are often more and less desirable locations to maximize the performance of a turbine. Community consultations and input can help to find siting solutions that are acceptable to both developers and the local community.

6.5. Public Health and Safety

Numerous studies have concluded that the normal operation of wind turbines poses no negative health effects for humans.[61] As with any industrial development, there are risks, however small, associated with equipment failures. Appropriate precautionary steps must be taken, such as avoiding the area around wind farms during extreme weather events or heavy ice storms.

6.5.1. Falling Ice and Ice Throw

In spite of the cold climate, ice formation on wind turbine blades in Alberta is not a common event, due to low relative humidity (particularly in the winter). In fact, unlike projects in Whitehorse, Yukon, icing is such a rare event that developers in Alberta do not need to equip their turbines with anti-icing protection. Nonetheless, ice can form on turbine blades during regular operation.

Ice changes the weight and aerodynamic properties of the blades, altering the turbine's performance to the point where the control system often shuts down the turbine automatically. It is difficult for the turbine to re-start itself until the ice has melted off.

Humidity levels and temperature determine whether clear "glaze ice" or finger-like "rime ice" form on the blades, and whether the ice that forms will be released as the rotor turns, resulting in ice throw.

Glaze ice usually forms at temperatures just below freezing, often as a result of freezing rain. Glaze ice tends to fall straight down from the blades when the sun melts the ice. Rime ice forms when fog vapour contacts cold surfaces. It tends to develop into a protruding formation on the front of the turbine blades. Rime ice is less streamlined and is more apt to be thrown in smaller pieces as it leaves the turbine blade. It tends to be a more frequent occurrence in humid areas, such as parts of Quebec, where open bodies of water are present throughout the winter.

Ice fall from stationary 2 MW turbine blades is estimated at less than 50 m from the turbine base — the length of the blades plus however far the wind might blow a piece of ice as it falls. Ice released from moving blades is mostly confined to within 15–100 m from the turbine's base. European studies have identified a safe distance of 200–250 m. A U.S. study recommends 230–350 m to limit risk to a 1 in 10,000 to 1 in 100,000 annual strike chance.[62] This means that turbines should typically be located a fair distance from roads and residences to ensure safety in case of ice throw. Caution should be used by anyone approaching a wind turbine after an icing event has occurred.

6.5.2. Catastrophic Structural Failure

As with any piece of industrial equipment, there is always a chance of turbine failure due to extreme weather or other types of structural damage. To date, there have been no documented cases of blade or tower failures in Canada. Data from the Netherlands collected between 1980 and 2001 show partial or full blade failure rates ranging from 1 in 2,400 to 1 in 20,000 turbines per year. When rare blade or tower failures have occurred, the maximum reported distance travelled by an entire turbine blade was 150 m; the maximum reported distance for a turbine blade fragment was 500 m. Unlike other industrial accidents, blade or tower failures produce no toxic emissions.

6.5.3. Health and Safety Benefits

It is important to re-iterate that wind energy can directly reduce the amount of fossil fuels — primarily coal, in Alberta — used to generate electricity. Such a reduction is a health benefit for the entire society, because burning coal is directly linked to negative human health effects, including asthma, respiratory illnesses and cancers. Coal use also causes long-term environmental damage from the emissions of airborne mercury, acid rain precursors and greenhouse gases.

While care is always needed in developing and operating wind turbines, on balance their operation helps improve overall public health and safety.

7. Economic Impacts

7.1. Landowner Rents

Wind energy development on agricultural land provides an additional revenue stream to landowners who lease land to wind companies. According to the Canadian Wind Energy Association, the average payment per turbine in the Pincher Creek area in 2004 was $3,000 per year.[63] Because turbine sizes and performance continue to evolve, these rates are subject to change.

Landowners may receive a flat rental payment, a portion of revenue (i.e., wind royalty) or a combination of the two types of payments. Each model has associated risks and potential benefits for landowners.

Payments to landowners may be allocated solely to the owner of the land on which the development occurs, or on an area basis within the wind farm. The latter model provides residents in proximity to the wind farm with direct financial benefit from the development.[64] This arrangement reflects the fact that some impacts of wind development (e.g., effects on viewscape and noise) may be felt by all local landowners, not just those with turbines on their property. It also reduces "turbine envy," an understandable response when what is seen as a cash windfall is received by landowners who have a turbine on their property, while their neighbours receive nothing. This issue cannot be eliminated completely, however, because there is inevitably a boundary beyond which no payments occur.

While Prince Edward Island has established royalty sharing arrangements for wind for adjacent landowners, no such guidelines exist in Alberta.

7.2. Local Economic Development

In addition to direct rent payments, wind development often has significant spin-off benefits for local residents and communities. The construction and operation of wind farms creates the need for jobs (high-skilled and general labour) and business opportunities in rural areas, which in turn can stimulate other economic opportunities.

The potential for job creation from wind development compares favourably to other sources of electricity, creating local jobs that would not result from electricity generated elsewhere. For example, a study by the New York State Energy Research and Development Authority found that wind energy produced 27% more jobs per kilowatt-hour than coal plants and 66% more jobs than natural gas plants.[65] A single wind farm in Pincher Creek, Alberta has created seven full-time jobs to operate and maintain the turbines, while 18 person-years of employment were created during its construction.[66]

Wind farms can also significantly increase the tax base for rural municipalities, supporting the provision of municipal services and infrastructure that benefit all residents. For example, the Municipal District of Pincher Creek in southern Alberta currently receives approximately 27% of its revenue from wind farms.[67] When the 30 MW Chin Chute Wind Power Project was completed, the proponents announced a joint $30,000 gift to the Municipal District of Taber in recognition of their support for the wind power project. The funds, which were additional to the taxes paid to the municipality, were put toward the municipal district's park enhancement fundraising effort, specifically towards a new amphitheatre, stage area, lighting structure and sound/projection booth.[68] Wind energy has been recognized throughout North America as an engine of economic development and diversification for rural communities.[69]

Community or co-operative ownership of wind turbines is another way of ensuring significant local economic benefits from wind development. This model for development has been particularly popular in some European countries, notably Denmark. Research has shown that locally-owned wind projects create five to 10 times more economic activity in the local community than large developments owned by companies from outside the community and region.[70] Local ownership, and the economic benefits and the sense of greater control that go with it, can increase acceptance of large-scale wind development.[71] Farmer-owned co-operatives and corporations for wind development have been established in both Canada[72] and the United States.[73] On the other hand, co-operatives can be more difficult to develop and to raise capital for, and they also pose a financial development risk.

Wind projects generally do not interfere with existing land uses, even though wind farms require a significant amount of overall land due to wind turbine spacing requirements. Typically, only about 2% to 5% of the actual land leased for a wind farm is occupied by the wind turbine foundations, other electrical components, roads, etc., leaving the remaining land available for other uses. However, the amount of land occupied by wind project components can vary from project to project and is somewhat dependant on design and construction considerations that can be negotiated by landowners prior to wind farm construction.

7.3. Impact on Property Values

The impact of wind development on property values is a common concern of landowners in the vicinity of wind projects. However, the available evidence indicates that wind development does not have an adverse effect on property values.

One study examining more than 25,000 properties within 8 km of wind farms found that there was no indication that property values decreased as a result of wind farms being sited nearby. For the majority of projects, the study found that property values rose more quickly for those properties within sight of the wind farm rather than those than in the rest of the community. Values of properties within sight of the wind farm also increased faster once the projects came online than they had before the wind farms were operational.[74]

Studies show that views of wind farms do not decrease property values

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

The report noted, “Although there is some variation in the three cases studied, the results point to the same conclusion: the statistical evidence does not support a contention that property values within the view shed of wind developments suffer or perform poorer than in a comparable region. For the great majority of projects in all three of the cases studied, the property values in the view shed actually go up faster than values in the comparable region.”[75]

Another study based on a nation-wide survey of tax assessors in areas with wind projects found “no evidence supporting the claim that views of wind farms decrease property values.”[76] A more recent 2009 study carried out by Lawrence Berkeley National Laboratory found no evidence of widespread property value impacts on homes near wind developments.[77] The study assessed data “from almost 7,500 sales of single family homes situated within 16 km of 24 existing wind facilities in nine different U.S. states.”

A study completed by John Simmons Realty Services and Canning Consultants Ltd. and commissioned by the Canadian Wind Energy Association in 2010 found “where wind farms are visible, there was no empirical evidence to indicate that rural residential properties realized lower prices than similar residential properties within the same area that were outside of the viewshed of a wind turbine.”[78]

No currently published studies provide sound evidence of adverse impacts on property values from wind development. Because a number of complex factors can influence property values over time, it is difficult to say with certainty how wind projects impact property values in every circumstance. Certainly landowners should be aware that any encumbrances taken on as a result of a lease or an easement may have an impact on property value, depending on the content of the agreement and what restrictions it imposes on the landowner, and the extent of the rights it grants the tenant (the wind developer); however, this is one of the reasons the landowner is compensated through royalties or other fees paid by the wind developer for the development of the project.

7.4. Property and Income Tax Implications

In Alberta, land agreements for wind development typically see the developer paying the increased taxes from the wind development on the land. However, it is important for parties to agree on how taxes are paid on leased land. For example, the landowner is still assessed for the tax liabilities on their property (including the value of wind energy equipment), and so must pay the property tax as assessed. Contracts between landowners and wind developers should indicate when the total cost of the property tax associated with the wind turbines and other equipment will be paid to the landowner to ensure that the landowner does not run into cashflow issues when trying to pay taxes.

When entering into agreements with wind developers, it is important that there is clarity around who bears the tax burden of the income from wind electricity and associated sales. In particular, it is important for landowners to keep in mind that how they are compensated by a developer can impact their tax treatment (for example, a larger one-time lump sum may incur a higher tax penalty than several smaller payments made over a longer term). For utility-scale turbines, it is advisable to consult with a tax professional prior to embarking on the project.

For landowners who develop their own wind project and sell the energy, the income is considered taxable income from the perspective of the Canada Revenue Agency. However, owners of wind turbines can take a variety of allowable deductions against income from renewable energy sales.[79] The largest of these deductions is depreciation expense, and a special provision of the tax act allows the homeowner to write off the cost of their system more quickly than would normally be the case. The result is lower tax payments on the same revenues in early years of the development, thereby deferring the tax burden. Once the equipment is fully depreciated, then full revenues are taxed.

Wind energy equipment is classified as a Class 43.2 asset, for which accelerated depreciation is allowed at a rate of 50% declining balance per year. Other allowable deductions include loan interest for the purchase of the wind system, any additional insurance premium paid, and repairs and maintenance of the system. It is advisable to consult with an accountant with a thorough understanding of tax law prior to filing income taxes. An accountant will be able to determine the appropriate deduction amounts for landowners who generate and sell their own electrical energy.

8. Social and Community Impacts

In addition to economic development, wind energy projects have a variety of social and community benefits, including increasing community capacity, strengthening networks and increasing environmental awareness and sense of place. Community capacity refers to the ability of community residents to organize and transform their resources to achieve desirable objectives, such as environmental management, economic development or resolution of health issues. The process of capacity building relies heavily on collaboration and partnerships.

When wind projects are developed jointly between the community and an outside developer or by a community cooperative, community members can benefit from assuming roles that result in individual skill development, including organizing meetings and negotiating contracts. In order for community cooperatives to be fully equipped to manage the development of a wind farm, members can benefit from bringing in outside expertise. Training and workshops can provide transferable skills, and increase the human resource capacity of the communities as a whole.

Sustainable community economic development and economic diversification can provide new sources of employment and revenue. This in turn helps to re-establish a sense of place for community members, particularly for resource-reliant communities that have experienced non-renewable resource depletion or the social challenges of unpredictable boom-bust cycles.

Agriculturally dependent communities can also benefit from wind development, because the income provided from wind energy can support agricultural operations and may provide some small assistance in maintaining family farms — an economic and social benefit to communities.

Growing annual crops is a major source of income for many landowners who might consider leasing land for a wind energy development. The overall impact of a wind farm on cultivated land is minimal, but some crops may be damaged or lost for one growing season if workers drive through parts of cultivated fields during construction. In wet conditions, driving through fields could cause rutting, which could also diminish crop yields. To offset these impacts, developers can offer compensation for the reduction in crop yields if they occur.

Landowners may be required to restrict hunting on land where wind turbines are located in order to prevent damage to the wind turbine or to protect the liability of the wind developer should a turbine malfunction. Restrictions on hunting will affect both landowners and non-resident hunters.

As discussed in Section 6.4, wind turbines alter the appearance of the landscape. However, there are several things that can be done to minimize the disruption posed by wind turbines. One of the guiding principles used is that a lesser number of large turbines may be more visually appealing than a larger number of small turbines. Other elements, such as visual uniformity, maintaining simplicity and open spacing, as well as prevention of erosion and site clean-up after construction, will improve the aesthetic appeal of a wind farm.[80] Through the use of modelling tools, developers can seek input from landowners to help determine what layout and locations will minimize any visual impacts.

In some areas of Alberta, oil and natural gas extraction provide a source of income for landowners. The installation of wind turbines in areas where oil or gas activity is common can reduce access for further oil or natural gas development. Conversely, pipelines and wells present on the landscape limit the choice of sites for the installation of wind turbines. Some other elements of community benefits are covered in more detail in Section 7, which explores the economic benefits and impacts of wind energy development.

Part II

Wind Energy Development

9. Project Development Process

From testing wind resources to decommissioning a wind turbine at the end of its life, there are numerous steps to developing a wind project in Alberta. The typical stages of development are outlined in this section. Some of the steps may not occur linearly but may be concurrent or overlap to some degree.

1. *Pre-feasibility study*

The first step in any project is to find a promising site with no "fatal flaws" that would potentially prevent a project from being developed. Wind speeds in the area can be approximated by using wind maps and local Environment Canada and/or airport data. An initial economic analysis is performed to determine if the site is potentially viable and worth further investigation.

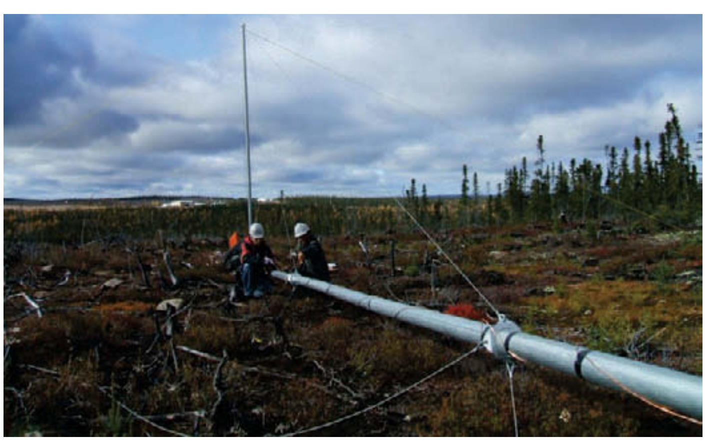

Figure 14: Wind monitoring towers

2. *Land acquisition*

Early in the process, developers usually approach landowners to negotiate "option" agreements to use their land. As the project develops further, the developer will seek to convert the option agreements into firm long-term land lease agreements. This process is described in more detail in Section 11.

3. *Wind resource assessment and feasibility study*

Usually the first critical step in developing a wind project is assessing the wind resource. Scientists and engineers use meteorological towers to measure wind speed and other climatic conditions (see Figure 14). Wind monitoring towers are often installed at heights of up to 80 m. A wind resource assessment takes at least a year to complete, and often runs up to 18 to 24 months to ensure high quality data is collected. This data is then used to estimate how much energy the wind farm will generate and whether there is a sound business case for the development.

Other considerations that go into the feasibility study are access to transmission line capacity and to transportation.

4. *Constraints analysis*

Once the developer has obtained initial wind resource data and has secured a sufficient land area to sustain a project, it is advisable to carry out a constraints analysis. This consists of using databases and maps to determine the location of socioeconomic features, such as residences, roads and community halls, and sensitive environmental areas, such as wetlands and other natural habitat. A site visit should be conducted to verify these features. Appropriate setbacks are then determined based on provincial regulations and guidelines. The result of this work is a map that indicates the location of these features and the recommended or required setbacks from the feature. The remaining land within the project area is what is available for the developer to use for installing turbines, the substation and transmission towers, and constructing access roads. Underground cabling is not subject to all of these same setbacks.

5. Preliminary engineering design

Wind data is combined with information about the site topography at and around the site to design an optimal wind farm. Engineers use this data to consider wind flow, turbine performance, turbine wake effects, sound levels as well as other factors that might impact turbine placement (also known as "micrositing"). This stage also involves the initial design of the access roads and turbine foundations and consideration of the connection to the electricity grid.

6. First Nations consultation

Early in the project development process, it is advisable for developers to seek input from First Nations. First Nation groups currently occupy a much smaller area than their traditional territory. Although restricted by private ownership, activities carried out in traditional territories include hunting, collecting plants for food or medicinal purposes, and visiting sacred sites.

The Crown has a duty to consult with First Nations regarding development of new projects, but this responsibility is delegated to project developers. In order to fulfill this responsibility, developers must send correspondence describing the project to any affected First Nations. If possible, the developer should meet with the First Nation community to inform community members about the project and obtain input.

Additional due diligence regarding First Nations includes determining whether the project is within an area where unsettled claims exist. Developers can contact the department of Indian and Northern Affairs Canada to obtain this information. They should also correspond with the Métis Nation of Alberta.

7. Economic analysis

Developers must demonstrate the economic viability of their project in order to raise the funds to build the wind farm. The cost of turbines and their installation is estimated, along with the cost of the other project components, including payments to landowners, roads, electrical components such as substations, operation and maintenance, etc. These costs are weighed against the estimated income from the energy generation of the wind farm over the lifetime of the project.

8. Initial financing

Before advancing a project through various stages that consume extensive time and resources, a developer must have sufficient access to capital. The stages are not as costly as purchasing and installing the turbines and other equipment, but the costs are hundreds of thousands of dollars plus the time or wages that the developer invests. These next steps are also critical for obtaining large amounts of financing to support the construction of the project.

9. Environmental assessment

Environmental assessments are conducted to identify significant adverse impacts on valued ecosystem components including landscape, plants and wildlife, soil and water. Valued socioeconomic components such as land use or other activities such as aviation and telecommunications, and features such as residences and cemeteries are included in the assessment. If significant adverse impacts are identified during the environmental assessment, the project design is modified to avoid or mitigate them.

10. Detailed engineering design

Information from the geotechnical analysis is combined with the final constraints analysis, mitigation measures and wind resource data to create the final layout and construction plan for the wind farm. The detailed engineering design includes the location of all components of the wind farm, such as roads, cabling, turbines, substation, and transmission towers, a technical description and drawings of each component, and a comprehensive description of how components will be moved to the site, what equipment will be required for construction, and how construction will take place. An environmental plan should accompany the design to provide contractors with explicit information on how to carry out their work and ensure they are mitigating adverse environmental impacts.

11. Public consultation, community education and input

Developers will perform public consultation and seek input from the community in various ways at certain stages of project development. Developers make initial contact with the community through the process of obtaining land options. Whether developers meet with landowners directly or use the services of land agents, this is the first opportunity for developers to gain support for a project and seek input about possible landowner concerns.

Although it is not a requirement of most environmental assessments, it is recommended for public consultation to take place as part of this process. The results of the environmental assessment and the detailed engineering design should be provided to the public for comment. In order to avoid costly changes at a later date, it is advisable to seek public input on the preliminary design following the constraints analysis.

Public consultation is a requirement for submission of an AUC power plant application. The details of who must be included in the AUC consultation process are included in Section 10.2.11. Depending on the municipal permitting process, there may be various opportunities to present information about the project to the public. For example, a public hearing may be required to make a change to the zoning in the proposed project area to allow for a wind energy facility district overlay (as is the case in Cypress County).

12. Permits and approvals

As with any other major electricity generating project, developers must seek municipal, provincial and federal permits before the project can go ahead. See Section 10 for the list of permits, approvals and reviews required in Alberta.

13. Financing

Once a project has reached this stage a developer needs to access several million dollars in order to finance the project. This can be a challenging step given Alberta's deregulated market and the risk that that brings. Developers often look to acquire long-term contracts or power purchase agreements (PPAs) to assist in leveraging these loans. This step involves significant financial risk on behalf of the project developer. Securing a good PPA is often one of the most challenging elements of wind project development. Potential customers for a PPA in a deregulated market include industrial operations, large commercial owners, and electricity retailers. In a regulated market, the crown corporation agrees to the PPA early in the process, allowing developers access to financing. If a developer in Alberta does not obtain a PPA, the results of the feasibility analysis using risk assessment parameters will be used to seek financing. The high level of revenue uncertainty will force financiers to demand a higher rate of return on their investment. Therefore, only projects with exceptional revenue potential will be financed.

14. Equipment manufacturing and procurement

The wind turbine parts are manufactured and pre-assembled into the main components at the factory, and then shipped to the wind farm site where assembly is completed. Transportation of the wind turbines to the site can take several trucks for each turbine, and can have impacts on local traffic. Developers work with Alberta Transportation and the municipality to determine the transportation plan for moving the oversized loads (tower segments, blades, and crane) to the foundation sites.

15. Site preparation

In the meantime, crews prepare the site for installation: they construct access roads, clear land where turbines will be erected and lay foundations for the turbines. Often, up to 40 concrete trucks are required to pour the foundation of each turbine alone. In a project currently being developed with 220 utility-scale turbines in New York State, truck traffic for foundation pouring and the construction of gravel access roads was estimated at 8,600 to 10,800 trips over the life of the project, with the vast majority of these trips occurring during the construction phase.[81] Of course, these trips would be spread out over multiple properties, but it is important for landowners to understand that the development of a wind project typically means significant large truck traffic during the construction phase, along with attendant noise and dust issues that may arise.

16. Construction

Once all components arrive at the wind farm, the turbines are assembled. A very large crane is used to erect the tower and install the nacelle and rotor with its hub and blades. On the ground, the electrical collection network is installed and connected to the grid through the substation.

17. Commissioning

All the individual turbines and the fail-safe equipment is tested before the wind farm becomes fully operational and begins generating electricity.

18. Operation and maintenance

Regular maintenance and monitoring activities include monitoring and analyzing performance, conducting environmental surveys and performing preventive maintenance and repairs on the turbines and other project components. In the first few years, it is common for the turbine manufacturer's technicians to operate the wind farm under a maintenance and/or warranty agreement. During this process they train local staff who later take over.

19. Decommissioning

At the end of the wind turbine's life, if it is not going to be refurbished, it is taken offline, disassembled and removed. The decommissioning process can be very important for landowners as it is crucial to ensure beforehand that responsibility for the decommissioning and removal of defunct turbines from land is negotiated prior to project development. If the site is still valuable for the generation of wind energy, the developer may wish to negotiate new leases and repower the site with new technology.

20. Remediation and reclamation

After decommissioning, the disturbed land is remediated and reclaimed according to details worked out between the landowner and developer in the lease or easement agreement. It is important for landowners and developers to ensure that both parties are satisfied with the reclamation, that the wind project is dealt with responsibly at its end of life, and that the land is returned to a state similar to that it had been in prior to the wind development.

21. Orphan projects

If a developer ceases to operate during the course of a wind farm's life, through bankruptcy or some other cause, the responsibility of the wind project will fall to the creditors who take control of it (which in the case of a bankruptcy is typically the bank). With the regulatory and legal regime in Canada, this means that the entity which takes control of the project will still be bound by the original agreement made between the developer and the landowner. Under current economic conditions, the materials in wind turbines are quite valuable, meaning that even if orphaned wind turbines were not functional, it would still likely be economical to remove a turbine in order to recover the materials it is comprised of.

10. Approval Process

All electricity generation projects must obtain approvals before development. Approvals ensure that the development meets the standard imposed by authorities.

Provincial and federal approvals, permits or clearances are also required to ensure that environmental, historical and transportation considerations are taken into account.

10.1. AUC Facilities Application Process

The Alberta Utilities Commission (formerly the Alberta Energy Utilities Board) is the provincial regulator for electricity generation facilities (including wind turbines) as well as transmission lines and electric substations. The AUC is meant to function as a clearinghouse to ensure that all other approvals are dealt with as part of the application process. The AUC has attempted to comprehensively map out the requirements for any development through a series of rules, guidelines and directives. The relevant document for wind power development is Rule 007 (formerly AEUB Directive 028).[82]

The nine key steps in the energy facilities application process are carried out under the auspices of the AUC (see Figure 15). In its decision, the AUC may

1. approve the application
2. approve the application with conditions
3. deny the application

The success of an application to the AUC has two results: an approval to construct and operate, and a connection order that directs the developer to connect the wind farm to the grid.

For more detailed information on each step of the AUC facilities application process, consult the *AUC Public Involvement in Needs or Facilities Applications* brochure available on the AUC website or contact the Facilities Division of the AUC at 403-592-4403.[83]

Wind energy is not regulated by the Energy Resources Conservation Board but by the AUC under regulations and rules that deal with electricity generating facilities. One very important difference for landowners to note in the regulation of wind resources compared to oil and gas resources is that the Surface Rights Act does not apply to the wind resource — prospective developers do not have "right of entry." Only landowners may decide if they want to participate in wind development, and they must approve a development and grant land access rights through legal means (such as through a contract like an easement or lease).

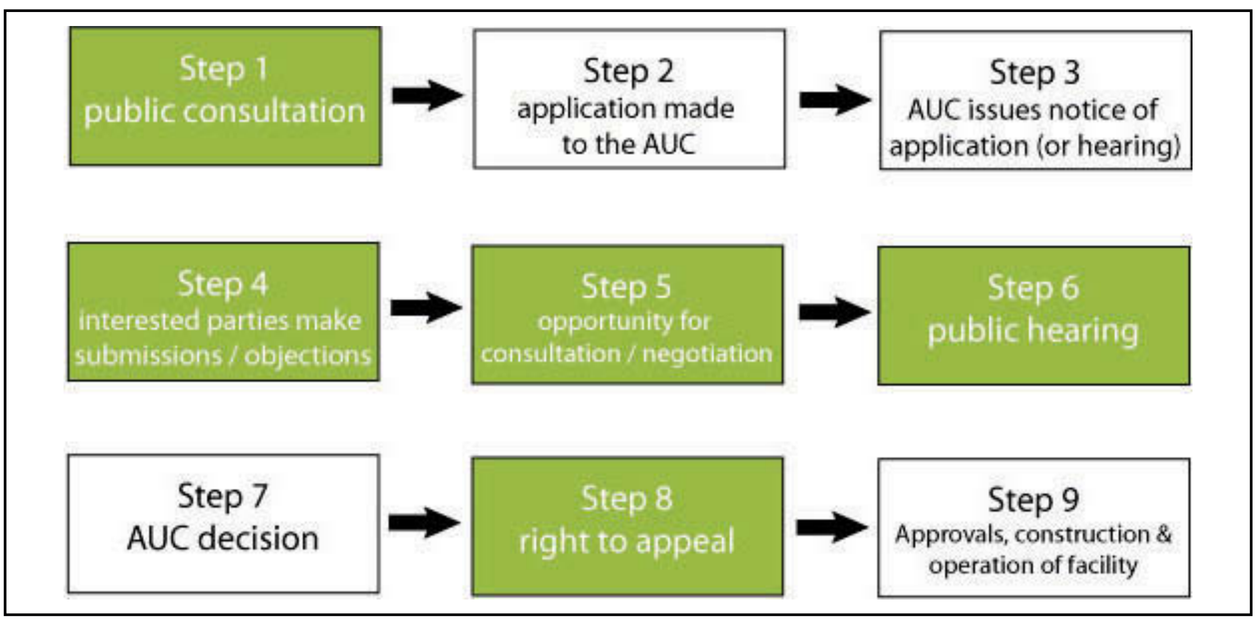

Figure 15: The AUC facilities application process

The shaded steps are those with the most opportunity for landowner involvement.

10.2. Opportunities for Landowner Involvement

Landowners whose rights will be directly affected by the development of wind facilities have several opportunities to get involved in the AUC application process (see Figure 15). It is important to note that AUC approvals are required not only for construction, but also for the operation, alteration and decommissioning of electricity generation facilities in Alberta.

Different requirements and rules apply for different sizes of electricity generation facilities. If you plan to erect a wind turbine that is less than 1 MW in capacity on your own land for the purpose of generating power for your own needs, then you should apply under the micro-generation regulation (described in the appendix). If the purpose of the facility is to sell electricity into the grid, then you need to complete the "Small Power Plant Application Schedule" found in the AUC's Rule 007. For wind projects larger than 1 MW, other requirements apply to the AUC facilities application process.

10.2.1. Public Consultation

Public consultation requirements for wind developers (and other proponents of electricity generating facilities) are set out by the AUC under Rule 007.[84] Proponents filing facilities applications are required to conduct "effective public consultation in the area of the proposed needs, or facilities project(s), so that concerns may be raised, properly addressed and if possible, resolved."[85]

"Applicants are required to develop an effective participant involvement program that includes persons whose rights may be directly and adversely affected by the nature and extent of a proposed application.… Potentially-affected parties are strongly encouraged to participate in the initial public consultation, as early involvement in informal discussions with an applicant may lead to greater influence on project planning."

A participant involvement program must be completed prior to submission of a facilities application and must include the requirements set out in Appendix A of AUC Rule 007, such as

1. the distribution of a project-specific information package
2. responding to questions and concerns
3. discussing options, alternatives and mitigating measures

Applicants are also expected to be sensitive to the timing constraints on the public (e.g., planting, harvesting, calving seasons and statutory holidays).

Local authorities and Alberta SRD play an important role in the plan for orderly land use and are expected by the AUC to be involved at an early stage in planning a participant involvement program. Local authorities may be well positioned to help applicants identify needs in the community related to a proposed development.

If the scope of the project changes, such as a change to the surface location, the applicant is also required to notify all persons included in the initial consultation program of the proposed change. Should a dispute arise, the AUC expects the parties to discuss the issues and options for resolution and encourages the use of third-party mediators.

10.2.2. Are Landowners Consulted?

The AUC also defines which landowners are directly affected: "For power plant developments, the applicant must provide public notification to all occupants, residents, and landowners within 2,000 m measured from the edge of the proposed power plant site boundary. The applicant must provide personal consultation to all occupants, residents, and landowners within 800 m measured from the edge of the proposed power plant site boundary. For major power plant applications, if there are populated areas just outside the 2,000-m limit, applicants should consider including those areas in the public notification." Despite this clarity, Rule 007 also states: "The Commission cannot predetermine the precise extent and scope of your program, because every application is unique and each project may present circumstances that must be dealt with on an individual basis."[86]

The AUC does not specify that freehold lease owners must be consulted, but crossing agreements between pipeline owners and the wind energy developer are required when cables or roads intersect with a pipeline. Development of a wind project may restrict access to mineral resources on the same land, so if a wind energy project is being contemplated, developers and landowners may wish to consult freeholders to minimize potential conflicts.

It is important that developers exercise due diligence in identifying those who may be affected by a development. Developers rely upon land titles and county records to obtain contact information for landowners who are included in the developer's consultation program. In Alberta, a relatively high rate of error in the addresses tied to land titles certificates has been identified. This means that if title addresses are used as an initial point of contact for those who may be impacted by a development, the real landowner or titleholder might not be informed of it until later in the process. Landowners should check whether these records are accurate in order to ensure that they will be included in the consultation program.

Developers must ensure that they explore all avenues in contacting those who may be potentially impacted. The onus is on the project proponent to demonstrate that they have made their best effort to consult relevant parties, and to provide proof of that fact to the AUC.

10.2.3. Submissions

After the initial consultation process, project proponents submit a facilities application to the AUC, in which they identify any unresolved objections or concerns from the consultations. A public notification is issued (typically in local newspapers), with information on how different stakeholders can become involved in the process.

At the end of the process, the applicant must indicate any outstanding objections and/or concerns that they are aware of and must attach a written summary of the outstanding issues to the application. If the issues are not resolved, the AUC may decide to hold a hearing to consider the application.

Landowners and other parties who wish to participate in an AUC proceeding must make a written submission for public participation. The written submission should describe your concern with the application, and how it may directly and adversely affect you.

The AUC expects those who submit facilities applications to keep stakeholders informed, even if an application is withdrawn. It is the responsibility of the project proponent to include everyone involved in the process in all correspondence and updates during the development, implementation and outcome of the proposed project.

10.3. Reviews and Permits

10.3.1. Rule 012—Noise Control/ Noise Study

The AUC's Rule 012 deals with noise control for facilities including wind turbines. The most recent version of Rule 012 includes sections specific to wind turbines. The rule lays out the permissible sound levels as well as requirements for conducting noise impact assessments, which are compulsory when developing wind projects of any size.

Noise levels must be limited to the permissible sound levels which are based on the nighttime basic sound level (40 dB LAeq for rural areas) with adjustments for daytime, the nature of the activity and actual ambient sound level, as well as the character of the noise (temporary or permanent).

The rule specifies that wind turbine noise must be modelled using wind speeds of 6–9 m/s (21–32 km/h) to predict a worst-case condition. At these wind speeds, the wind turbine noise may be greater than or equivalent to the wind noise. The modelling must also include cumulative effects of adjacent wind turbines and adjacent energy-related facilities. The predicted noise levels must then be compared to the permissible sound level.

Following construction of a wind farm, if complaints arise, the AUC may order a Comprehensive Sound Level Survey be completed. Because the wind speed at which the rotor begins to turn is above the maximum wind speed that Comprehensive Sound Level surveys are usually completed, the survey is conducted in wind speeds of 4–6 m/s (about 14–22 km/hr). It is necessary to minimize the impact of wind noise on the results so wind speed must be measured in the vicinity of the microphone in a manner that does not affect the noise measurement.

More details on Rule 012 and its specific application are available at the AUC website.[87]

10.3.2. Transport Canada Review

Transport Canada reviews and advises developers on the lighting and marking that may be installed on objects that are deemed to be a hazard to air navigation.[88] Proper lighting and marking of wind turbines is important for aviation safety. Transport Canada does not otherwise provide or deny a permit to construct the wind farm. New standards for marking and lighting wind facilities were accepted in November 2009 but have not yet been published.

The standard notes that the application of its requirements can vary depending on terrain features, geographic location, overall layout of the structures, and angles of approach. This most recent amendment also points out that lighting on wind turbines and wind farms should be done in a fashion as to minimize the possibility of bird fatalities and interference with nighttime astronomical study.

Different lighting and marking requirements are specified for wind turbines that are less than 150 m in height to the tip of the blade, and those that are taller than 150 m in total height. Requirements may include the colour of the turbines, lighting and beacons.

If a wind farm is proposed near an airport, the airport may have the capability to deny an application through zoning rights (municipal permit). In addition to Transport Canada's review, an Aeronautical Obstruction Clearance Form must be completed when a proposed structure is within an airport's obstacle limit, within 6 km of an aerodrome, or taller than 20 m.

10.3.3. Alberta Transportation Permit

AUC approvals for wind also require Alberta Transportation approval, to ensure that appropriate setbacks from roads are observed for safety reasons. Applications for approval are required from Alberta Transportation for all proposed developments within 300 m of a provincial highway right-of-way boundary or within 800 m of the centre point of an intersection of the provincial highway with another public road.[89]

10.3.4. NAV Canada Review

While NAV Canada (the body that operates Canada's civil air navigation service) is not an approving body, it reviews wind development plans for projects that may affect air navigation. If the proposed wind farm is found to not conflict with air navigation safety (e.g., owing to interference with radar), then NAV Canada will issue a non-objection letter. Without such a letter, an applicant would not receive AUC approval. Applicants must provide the precise geographic location of each wind turbine comprising a proposed development, as well as the ground elevation and structure height for every turbine. NAV Canada reviews the development in terms of its affects on air navigation and aircraft safety, including the distance of the wind farm from airports and landing strips. More information on the NAV Canada review process can be found on their website.[90]

10.3.5. Alberta Culture and Community Spirit Approvals

Under the Historical Resources Act, the Minister of Culture and Community Spirit can order a person to "carry out an assessment to determine the effect of the proposed operation or activity on historic resources in the area where the operation or activity is carried on."[91]

The Minister can require a historical resource impact assessment to ensure historical resources are not affected, although voluntary measures are typically undertaken to avoid areas with a high potential for historical resources. Alberta Culture and Community Spirit staff should be consulted to determine what kinds of assessments potential development sites must undergo.

10.3.6. Municipal Development Permit

Municipal zoning and bylaw decisions can have a large affect on whether wind development is viable in a given municipality. There are no standards across municipal approaches to wind development in Alberta, so each municipality may treat wind projects differently. It is important for landowners and developers to be familiar with the specific municipal approvals and requirements that must be met for wind projects.

Depending on a municipality's land use bylaw, a wind project may be considered a "discretionary use" on land zoned for agricultural production, or it may require re-zoning of land to a different land use (such as light industrial).

Permits for the installation of meteorological towers must be obtained from county offices.

Municipalities often also set bylaws around setbacks of wind turbines from structures, dwellings, roads or other infrastructure.

Lamont County, for example, provides specific guidance on wind energy systems through its planning and development department.[92] It has provisions around securing wind turbines with fences, the requirement for underground transmission lines when connecting wind turbines to distribution and transmission systems, and a number of other issues.

In Cypress County, it is necessary to first apply for a land use change. Once approved, a wind energy facility overlay is applied to the existing zoning (usually agricultural), which allows turbines to be constructed and existing land uses to continue. The overlay must be approved by council, which requires a background report and a presentation to council in a public hearing. The council hearing includes a discussion of turbine type, its connection to transmission lines and a summary of local environmental impacts. Following the land use change, a developer must apply for a development permit for each quarter section included in the project area. The development permit includes information about construction, operation and decommissioning of the project.[93]

10.3.7. Municipal Permits for Construction

Once a development permit is issued, building, electrical, plumbing and gas permits are required.[94] Because a wind turbine is an electrical device, an electrical permit is required before the project is installed. Only master electricians can obtain an electrical permit for a wind project. There are no issues in obtaining electrical permits. Large developments that include a heated structure with washroom facilities for operations and maintenance staff also require plumbing and gas permits.

10.4. Environmental Impact Assessments

10.4.1. Provincial

No provincial environmental assessment is required for wind farms in Alberta, but for projects greater than 1 MW in size, the AUC requires a project review by SRD prior to an approval being granted by the AUC. Environmental consultants must follow guidelines from SRD.[95] These guidelines call for one year of pre-construction wildlife surveys, including surveys for rare plants and other species at risk in addition to seasonal bird surveys. SRD recommends two years of pre-construction bat monitoring. The field research and review by SRD helps reduce the risk that sensitive wildlife and rare plants will be affected, and it provides some assurance that the developer has performed due diligence with respect to protecting the environment. Wind energy developers can be held liable if they are in contravention of the Species at Risk Act or other environmental legislation.

10.4.2. Federal

There are several triggers for a federal environmental assessment (EA). Under the *Canadian Environmental Assessment Act* (CEAA), any project requiring federal permits from the list of regulations known as the “Law List” must also have an EA. The Law List regulations that may occasionally apply to wind projects are *The Fisheries Act* and *The Navigable Waters Act*.

As well, projects must undergo an EA when the federal government has contributed to funding; for example, through the former Wind Power Production Incentive and the EcoEnergy Initiative. Natural Resources Canada controls the funds from these initiatives and is the responsible authority for the EA. It is obligated to share the EA with other departments, such as the Canadian Wildlife Service, for their review.

Wind development may also be affected by the *Migratory Birds Convention Act*,[96] which prohibits the disturbance, destruction and taking of a nest or egg of a migratory bird. Environment Canada’s Canadian Wildlife Service provides guidelines on protocols for monitoring the impacts of wind turbines on birds, as well as guidance for environmental assessments of wind turbines as they relate to birds.[97] The *Species at Risk Act* may also be relevant to wind projects. This act protects plants and animals considered to be “wildlife species at risk” from disturbance.[98]

10.5. Siting Considerations

Environmentally sensitive wildlife and landscape features should be considered when siting wind turbines. Alberta SRD has established wildlife guidelines for wind energy projects in the province,[99] including recommended setbacks from important wildlife habitat such as wetlands and avoidance of landscape features such as prominent ridges that may concentrate populations of birds or bats. The Altamont Pass in California is one example of poor turbine siting that has resulted in significant bird mortality according to numerous studies.[100]

In order to determine the locations where wind turbines should be placed, along with the siting of other project elements including cabling, connections to the transmission grid, substations and other ancillary equipment, a developer should conduct the following studies.

10.5.1. Ecological Studies

Desktop Studies: Review air photos and maps for natural habitat and sensitive sites; research the location of the project area in relation to Environmentally Significant Areas, internationally significant wetlands, Important Bird Areas, parks, and natural and protected areas; locate rare plants and sensitive species; research environmental site conditions.

Field Studies: Conduct seasonal surveys of birds and other wildlife, especially species at risk; perform bat monitoring; confirm location and status of sensitive sites

10.5.2. Socio-economic Studies

Desktop Studies: Determine the location of residences, community buildings, cemeteries and other valued sites or structures; research the local socio-economic conditions; determine the proximity of archeological and paleontological resources to the project area; determine potential interference with televisions and radio communications; perform noise modelling.

Field Studies: Meet with landowners to determine the location of additional objects to avoid and to hear any specific concerns the landowner may have; perform a Historic Resources Overview or Historic Resources Impact Assessment[101] if there may be or are archaeological and paleontological resources near or in the project area.

Developers hire consultants to perform some or all of this work due to the specialized nature of the studies.

The outcome of this work will be a constraints overlay map, which landowners can use to guide development to areas that are compatible with wind energy and that avoid sensitive ecological sites and areas that are valued by landowners.

Other measures that should be taken for responsible project siting include determining potential resource concerns; determining any significant landscape features that may attract wildlife; determining the presence and extent of native grasslands and other important natural habitats; performing pre-construction wildlife surveys and rare plant surveys; and monitoring sites after construction to identify any wildlife impacts.

Environmentally sensitive wildlife and landscape features should be considered when siting wind turbines

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

11. Ownership Models

There are a number of different financial and ownership models that can be used to develop wind projects. The most familiar model in Alberta is currently developer-owned projects, where a commercial wind development company comes to individual landowners asking to lease part of their land in order to erect wind turbines.

While this is currently the dominant ownership model in Alberta, there are other ways that landowners can participate in wind development, including installing a smaller wind turbine to offset their own electricity consumption or installing a wind turbine themselves or jointly with others for selling electricity to the grid. Each option has different risks and rewards (see Figure 16).

Figure 16: Relative risk of ownership options

11.1. Individual Land Lease to Developers

To date, the vast majority of wind development activity in Alberta has been concentrated on leasing private land for commercial wind farms. In this form of development, a landowner leases their land (or a portion of their land) to a commercial wind development company that will install, own, and operate the wind turbines. The developer sells the electricity generated by the wind turbines to a customer under contract. The landowner receives a royalty payment or rent for the use of their land for the period of the lease.

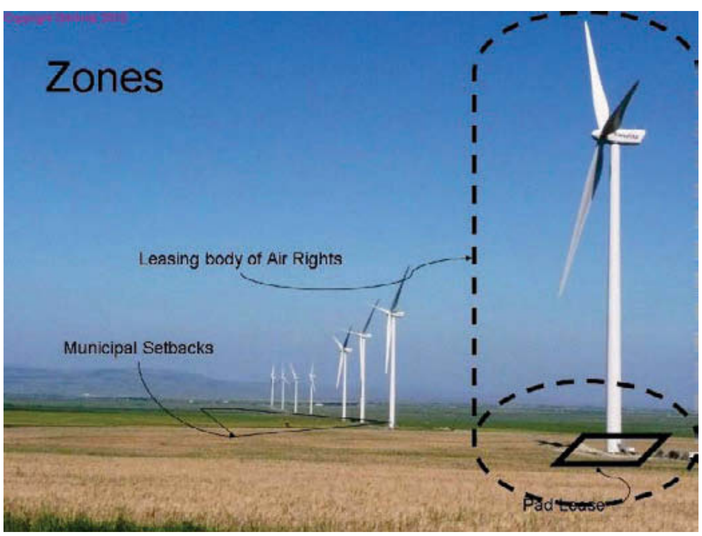

Figure 17: Development zone leases (air lease, pad lease) and municipal setbacks

PHOTO: GRAHAM GILCHRIST, FARMERS' ADVOCATE OFFICE

When a landowner leases land to a wind developer, most of the financial, technical, and legal risk is borne by the developer. The landowner's principal risk is entering a long-term agreement with a company in which the landowner has limited decision-making ability regarding the design and operation of the facility. Leasing land for wind development is a trans-generational and typically binding decision. Leases with the landowner are tied to the land, and are therefore applicable to the landowner, subsequent landowners and their heirs. Leases usually run for a minimum of 20 years, and in some cases will continue for up to 80 years.[102]

11.1.1. Leasing Air Rights

Landowners adjacent to a wind project may also be asked to lease air rights to wind developers; that is, to agree to restrict development on their lands so as not to interfere with the wind regime in the area of some wind turbines. This agreement may entail some kind of a covenant or easement that contains certain restrictions that a landowner accepts and agrees to be compensated for. An example of one such restriction might be a limitation on the height of buildings that a landowner can construct on their land.

11.2. Investor/Landowner-owned Turbines

In Germany, Denmark and the Netherlands, many utility-scale wind turbines are owned by the landowners themselves. The landowner develops, owns and operates the wind turbines or contracts others to do so. Unlike leasing land to a wind developer, the financial, technical and legal risk is carried by the landowner, but the landowner also exclusively reaps the direct financial rewards.

In Europe, there are numerous institutions, such as banks, consulting companies and service contractors, that help to streamline this process and make installing your own large wind turbine possible. It may still be a difficult proposition to effectively embark on this type of development in Alberta due to a lack of institutional capacity to deal with these types of arrangements.

Institutional support for landowners who wish to install a wind turbine to offset their own electricity generation under the micro-generation regulation (see appendix) is becoming available. Farm Credit Canada recently announced an Energy Loan program that provides preferred interest rates and no loan processing fees on the first $500,000 of a loan for farmers interested in switching to renewable energy sources such as wind (and also including biogas, geo-thermal and solar electricity).[103]

For more on developing your own small wind project (less than 1 MW) and resources that can help you through this process, refer to the Canadian Wind Energy Association's *Small Wind Turbine Purchasing Guide*[104] and siting guidelines.[105]

11.3. Shared Ownership of Wind Turbines

Many wind turbines in Germany, Denmark, and the Netherlands are owned jointly by neighbouring landowners, or owned jointly with investors from neighbouring communities. The landowner may not own the wind turbines in their entirety but may own an equity interest. As such, the development risks are spread over many investors while the landowner retains some say in the management of the wind project. In shared ownership, the landowner may receive a royalty for land rent plus a percentage of returns from the business, whether a co-operative or corporation.

The Toronto Renewable Energy Co-operative developed a wind turbine in downtown Toronto as a joint venture between Toronto Hydro and citizens in the City of Toronto (see Figure 18).[106] A similar joint venture was developed by the Peace Energy Co-operative in Dawson Creek, B.C., with AltaGas Limited Partnership and Aeolis Wind Power Corporation.[107]

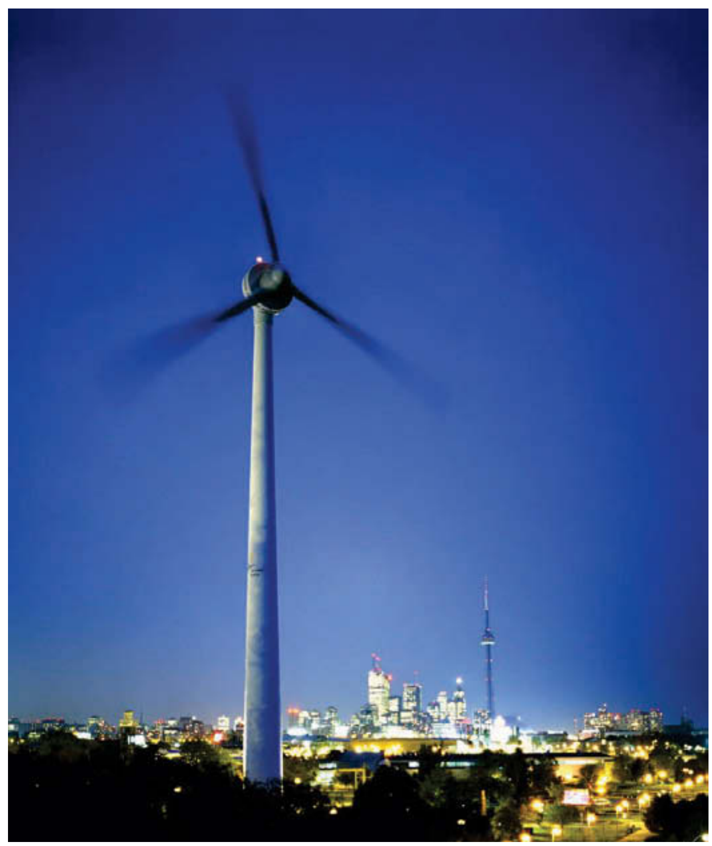

Figure 18: Canada's first co-operatively-owned wind project was a turbine installed by the Toronto Renewable Energy Co-operative

PHOTO: TORONTO RENEWABLE ENERGY CO-OPERATIVE

12. Negotiating with Developers

Before entering into any kind of an agreement related to optioning or leasing land, a landowner should retain legal counsel (preferably with wind industry experience) to ensure that they can fully understand the legal implications of an agreement.

Some initial questions that landowners should consider when entering into an agreement with a wind developer:[108]

- How much land do you need for construction and operation of the project, and how long will it be used for?
- What kind of payments will I receive and on what schedule?
- How will the project affect how I currently use my land or how I may use my land in the future?
- Who is responsible for decommissioning the project and reclamation of the land at the end of the lease?
- Who pays the taxes associated with the project, and how?
- Is a wind project the right option for my land, considering what I intend to use it for?
- What ongoing activities (i.e., operation and maintenance tasks) will continue on the land over the life of the project?
- Where will turbines, access roads and the substation be located?
- What liabilities is the landowner responsible for?
- Which electrical lines will be underground and which above ground?

These and many other questions are explored in more detail below, but it's critical that a landowner understands the answers to these key questions — and others — before signing an agreement.

12.1. Landowner Compensation

Landowner compensation for wind development is usually structured in one of four ways:[109]

1. one-time lump sum payment
2. fixed option/rental payment at scheduled intervals
3. royalty payments as a percentage of gross revenues
4. some combination of the above

Land agreements for wind development typically include an "option to lease" (or "option") period that can allow a project developer time to conduct feasibility studies and determine if a site is suitable for a project, although often the entity optioning the land is not the final developer (more on that, and on the specifics of option agreements, later in this guide).

12.1.1. One-time Lump Sums

Conventional wisdom and experience suggests that lump sum payments should be avoided where possible. This may be the reason that this form of payment is quite rare. There is only one known instance in Alberta where a lump sum payment was used, and this was at the request of the landowner.[110] There are three main disadvantages to the landowner of this payment method:

1. Because the value attached to the wind project is paid out to the landowner in one payment at the beginning of the project, the wind project no longer provides value to the land, and thus the land value might be reduced for heirs or if the land is sold in the future because it has liabilities (the lease agreement and the presence of the turbines) but no ongoing fiscal reward — there are no additional payments coming to potential new owners of the land. Wind development land agreements often span 30–50 years, so the short-term thinking behind a lump sum payment may not be best in the long term.
2. A lump sum means that the landowner has no interest in the wind development. Tensions may arise around the continued operation of the project because it will seem as though no benefits are flowing to the landowner, and the landowner will have no reason to ensure that the operation of the development is optimal.[111]
3. There is no opportunity to receive longer-term benefits if the wind farm performs better than expected, or if there is an increased value at a later date (for example for carbon credits).

Developers tend to be reluctant to issue one-time lump sums because they can be very significant in size.

12.1.2. Fixed Payments

Fixed payments provide certainty around how much a landowner can expect every payment period. A landowner may wish to attempt to negotiate a price escalator over time so that inflation does not reduce the value of the payments over time. Another benefit of fixed payments is that they provide assurance that the landowner will be paid even if wind turbines are not generating as expected or if there are maintenance issues that reduce electricity generation. The biggest drawback of fixed payments is that the landowner's potential to reap financial rewards from the project might be more limited if the project performs well.

It is also often in the wind developer's best interest to ensure some other form of compensation for a landowner other than just a fixed payment; some form of generation-based compensation ensures that the landowner has an interest in working with the developer to try and optimize the electrical output and performance of the wind farm.[112] Landowners can help with the operation of the wind farm in a number of ways. For example, a landowner hosting a wind project can watch for any kind of maintenance issues and inform the developer when turbines are not operating. A landowner who is receiving a royalty payment dependant on the operation of the wind project might also be more vigilant in preventing damage to turbines (for example, such as from the discharge of firearms on the property).

12.1.3. Royalty Payments

Royalty payments typically have both greater risks and rewards for landowners. Royalty payments — where the landowner receives a portion of the project revenues (note that it is important to distinguish between royalties on total project revenues and electricity sales, as there can be sales of other commodities, such as Renewable Energy Certificates and emission offsets) — ensure that both the landowner and the wind developer have an interest in keeping the wind turbines spinning and generating electricity. The issue with royalty payments for landowners, particularly in Alberta's deregulated electricity spot market where prices can be difficult to predict, is that payments are variable. Landowners will never be sure exactly how much of a payment they will receive ahead of time. Landowners receiving royalty payments also must have audit rights enshrined in their agreement or contract with the wind developer to ensure they have access to information on how much electricity the wind turbines are generating, what price it is being paid by the electricity spot market (or details of a power purchase agreement, now less common since deregulation in Alberta). This allows landowners to ensure that they are receiving the amount agreed upon in the contract.

Very often, a combination of both royalties and fixed payments are pursued by developers and landowners, providing a guaranteed minimum payment and the potential to benefit from good project performance through a royalty payment.[113]

Table 4 provides a quick reference for some of the pros and cons of each type of compensation model.

A properly sited wind turbine poses minimal risks to birds

PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

Table 4: Summary of benefits and drawbacks of landowner payments

Arrangement	Advantages	Disadvantages
Royalties	General: • Take into account varying productivity • Give landowner incentive to work with developer to place the turbines on the most productive locations • Give landowners and developers incentives to ensure continuous electricity generation • Easy to verify if based on gross revenue	Landowner: • Difficult to verify electricity and revenue generated by each turbine: • Individual turbine generation information is hard to obtain • Individual turbine metering is not required, so royalties are based on a proportionate share of the entire project, not on individual turbines. • Individual monitors on turbines do not reflect the energy sold because they do not account for losses in the electrical system • Developers generally do not like to share competitive turbine productivity data
Royalties/Minimum Guarantee Combination	• Same as above, with additional benefits from an up-front fee or a minimum guarantee	• Same as above
Flat or Fixed Fee (per turbine or per acre or per MW installed)	Landowner: • Provides steady, predictable income stream • Protected in years of low energy and/or revenue Developer: • Does well in high-production/revenue years General: • Can be used to compensate a landowner for use of land for an access road crossing the property, even if turbine is not installed on the land • Clarity and transparency • Easy to verify	Landowner: • Forgoes potentially higher, if fluctuating, level of income associated with royalty payments Developer: • Expenses are harder to bear in years of low electricity generation and/or revenue General: • Payments do not mirror actual revenue generated • Eliminates the economic incentive for the landowner to co-operate with the developer to ensure maximum electricity generation
Lump Sum	Landowner: • Source of immediate cash Developer: • Does not have to provide payments in subsequent years	Landowner: • Does not provide steady income stream Developer: • Must provide lump sum up front Both: • Bad "fit" to have financial transaction complete but physical use ongoing

SOURCE: COMMERCIAL WIND ENERGY DEVELOPMENT IN WYOMING: A GUIDE FOR LANDOWNERS[114]

When considering variable royalty payments, it is important to understand that the year to year performance of a wind project is not guaranteed, particularly in the case of Alberta where the deregulated electricity market means sale prices of electricity on the spot market can be difficult to predict.

- Year-to-year royalty payments dependent on future performance of the wind project have an element of risk. There will be years that they underperform and years that they over-perform the average. The landowner should also inquire about the possibility of some turbines ceasing operation over the years and how that would affect royalties.
- Developers need to have a very good understanding of the expected performance of their wind farm in order to get their project financed. In fact, most financial institutions will require a third-party independent validation of their feasibility study. Winter months when winds tend to be strongest (due largely to a higher air density) can be very different than summer months, and landowners should ensure that a proper analysis (ideally based on at least one full year of on-site wind measurement) is completed when negotiating royalty rates. It is in both parties' best interest to make sure unrealistic expectations are not set by either party.
- When negotiating both commercial and non-commercial terms, a landowner should bear in mind that wind projects in Alberta are for-profit investments for their owners, so as with any business transaction, the onus is on both parties to negotiate a mutually-beneficial arrangement.

12.1.4. Recommendations for Landowners

Landowners should consider the following when negotiating compensation agreements with wind developers:[115]

- Consider what you're giving in exchange for the revenues from the wind project. Are you giving up a significant source of value for your land? Leases and easements should be explicit about which rights are covered by the agreement.
- Carefully weigh your alternatives before you sign. There is still considerable interest in wind energy in Alberta. Land that is currently attractive for wind development may remain attractive for such development, depending on how the market changes. However, if your neighbours all agree to work with a developer, your land may become an "island" of no value to other developers, because it will not be accessible for other projects.
- Compensation levels should be related to rights the landowner is relinquishing.
- Different sites in the same wind farm will have different wind regimes. Ask for projections based on your specific land contribution to the project.
- When royalties as a percentage of revenue is on the table as a compensation option, audit rights (the rights to check the bookkeeping of the wind developer to make sure you're getting your fair share) should be clearly defined in the contract.
- Work with other landowners to ensure you get a fair deal and to ensure the community is happy. A group of landowners will have more power than an individual when negotiating or marketing their land.

Many of the following questions are excerpted from "Wind Energy Production: Legal Issues and Related Concerns for Landowners" by Roger McEowen:[116]

- How does the developer intend to use the land? Does the agreement contain a construction clause that limits the period of time that wind energy structures can be constructed while providing adequate compensation to the landowner for restricting the use of the land during that time? What other restrictive covenants are there in the agreement?
- Can the developer assign (or transfer) the agreement to another party? If so, the agreement should contain a clause that maintains the original developer's liability if the assignee defaults on the agreement.
- Does the agreement have an indemnification clause that releases the landowner for any liability incurred as a result of activities permitted (such as crop tenants, custom harvesters, and subsurface

tenants) on the property subject to the wind energy agreement?

- What are the landowner's rights concerning agricultural, recreational and other usage of the property?
- Does the agreement have a clause that requires the landowner to be treated as favourably as adjacent or nearby landowners who are executing similar agreements?
- Does the agreement include a clause requiring the removal of all improvements the developer makes upon termination of the agreement?
- Do you require the agreement to be recorded (not just a memorandum of the agreement) to eliminate the necessity of having to locate a copy of the lease in the event of sale or mortgage of the property?

12.2. Potential Impacts on Agricultural Land

Research by the New York State Department of Agriculture and Markets explored the impacts on agricultural land from wind development.[117]

Two types of agricultural impacts may result from the construction of wind farms on agricultural land. One impact is the permanent loss of productive land as a result of the installation of the access roads and turbine towers, as well as the facilities needed for connecting the wind farm to an existing electric transmission line. The other impact is the damage to the soil resources in areas disturbed during construction. Both of these impacts can be minimized with proper planning and communication, and through ensuring that the construction contractors follow an Environmental Protection Plan.

Locating access roads along edges of fields and separating subsoil and topsoil when excavating for foundations or trenches are two examples of efforts that can be made to minimize wind farm construction damage to fields. Seeding can often fail if adequate topsoil is not present, or topsoil is mixed with subsoil, preventing remediation efforts once construction is completed. Landowners can negotiate provisions to ensure compensation for damaged cropland if appropriate construction procedures are not followed. Sometimes, imported topsoil is needed to properly restore areas where topsoil is removed and not replaced, where excessive subsoil and topsoil mixing occurs, or where compaction of the subsoil is not remediated prior to replacing the topsoil.

Landowners should be aware that additions of structures like guy wires, additional access roads, and other such structures can result in a loss of productive land and can also reduce the efficiency of field operations by creating obstacles for machinery.

12.3. Implications for Surface Rights, Mineral Rights and Access

Many landowners in Alberta will already be familiar with the province's Surface Rights Act. It is extremely important for landowners to understand that **Alberta's Surface Rights Act does not apply to wind development**. Importantly, land cannot be expropriated for a wind development.

It is important to note that surface and mineral rights may conflict with the development of wind projects if the development of a project interferes with access to surface or subsurface resources. Ownership of "minerals only" titles on land by a third party may complicate wind development. Landowners should ensure that developers of a proposed wind project do their due diligence to address any potential conflict with mineral and subsurface rights holders that may cause a conflict or delay in the development of a project.

12.4. Compensation Rates

Landowners are often asked to enter into contracts for periods of 20 or 30 years with little information about what constitutes a fair level of compensation for siting a wind turbine on their land. Generalized figures are often tossed around, yet specific regional circumstances are one of the main factors in determining how well landowners are compensated by wind developers. There are widely varying rates of compensation, and this section will discuss what factors can affect that compensation, and what historic compensation levels look like for Alberta and other selected jurisdictions.

Limited information is available about specific compensation rates for wind projects in Alberta because such information is often considered competitive and confidential and is often protected by non-disclosure agreements. This section of the guide should be read with one major caveat in mind: there is no ideal compensation formula presented in this guide, but you can use the information here to help inform your idea of what constitutes a fair deal. Compensation levels are constantly changing and depend so much on specific project-by-project circumstances that readers are encouraged to use this chapter only as a jumping-off point to get started.

Even within Alberta, landowners should be aware that compensation levels are not necessarily consistent from project to project. Just as there is more or less oil in some plays than others, in wind development there is more or less of a wind resource in some areas than others. For example, land in the Provost area might command significantly less per acre than in Wild Steer Butte or Pincher Creek because of the lower average wind speeds. However, other factors affect the attractiveness of a wind project such as distance to transmission lines.

Differences in rates of compensation between jurisdictions are a result of a number of factors, described in Section 13.4 of this guide. Looking to compensation rates in Ontario, for example, will be misleading for an Alberta landowner. Ontario's Green Energy Act and the feed-in tariff policy it implemented mean that electricity from wind turbines typically fetches a much higher price there than in Alberta.

12.5. Trends in Compensation Models

Despite significant variation in levels of payment to landowners, some trends can be derived from published compensation data. The most important piece of information for landowners to know is that projects today tend to pay more than older projects, both on a per-megawatt and per-turbine basis. This means that relying on old ballpark figures of "$X per turbine per year" is not a sound approach.

For example, Alberta's Castle River Wind Farm, constructed between 1997 and 2001, consists of 60 turbines rated at 600 kW. In contrast, the 2006 Kettles Hill project has 5 turbines rated at 1.8 MW, almost three times higher in nameplate capacity than the Castle River turbines. Where you might get a hypothetical figure of $2,000 per turbine per year in the case of the Castle River Wind Farm, you'd get a figure of $6,000 per turbine per year in the Kettles Hill project if the nameplate capacity were in proportion to the electricity generated.

Another trend is that in addition to payment by developers to landowners for the land taken out of use by wind turbines, developers will offer payments for land taken out of use by meteorological towers. Payments for damage to crops during construction or maintenance should also included in compensation agreements.

12.6. Negotiating Non-commercial Terms with a Wind Developer

While financial compensation for hosting a wind project is often top of mind for both landowners and developers, there are a host of non-commercial terms that landowners can try to negotiate with a developer to ensure that they can live in relative harmony with a wind project. Often negotiating non-commercial terms is as important to landowner satisfaction with a wind project on their property as negotiating the financial terms of an agreement. The following list is not comprehensive, although it may help provide landowners with some examples of the kinds of non-commercial terms that may be negotiable with a wind developer.

- Development and turbine construction/operation/decommissioning:
  - » All colours and finishes should be matte, non-reflective and unobtrusive.
  - » Traffic volume requirements can sometimes be negotiated to try to limit unnecessary trips.
  - » Request a visual simulation of what the project is expected to look like to gauge the visual impacts.
  - » Distance or geographic relation to water wells can be negotiated to protect wells from spills and contamination from lubricants used in turbines and substations.
  - » Ensure proper training of construction contractors and staff to minimize adverse land impacts.
  - » Minimal turbine lighting — ensure any lighting is clad.
  - » Request that storage of flammable hazardous materials is carried out as per the Alberta Fire Protection Act and the Gas Protection Regulations.
  - » Decommissioning plan: A security bond or letter of credit may be required to address decommissioning and reclamation of sites should a single turbine or entire wind farm be taken out of service.
- Residential setbacks:
  - » Dust: minimize impact of dust from gravel roads by ensuring a setback between access roads and residences.
  - » Distance from residences: mitigate concerns around nuisance and safety issues such as shadow flicker and ice throw. No universally accepted standards are in place in terms of ice throw avoidance.
  - » Consideration should be given to distance from schools and built up areas such as hamlets and residential areas, as well as other occupied structures such as community centers and recreation areas.
- Social constraints:
  - » Mitigating impacts to the viewshed (visual impacts), particularly lookouts, etc.
  - » Ensure design of wind farm allows for large machinery access in agricultural production (farm equipment such as sprayers, etc.) for example by requesting that ditches along access roads are filled in to permit machinery to go across roads.
- Transportation allowances:
  - » Provide for clear vision triangles: to ensure safety, request that no building, fence, tree or similar obstruction to visibility that is more than 1 m above road grade be located near intersections or sharp curves in roads.
  - » Maintain distance from small airports or unregistered runways used for private planes unless agreed in a lease that these runways will not be used.

12.7. Pooled Landowner Land Lease to Developers

Most often in North America, wind project developers lease land from individual landowners. Developers lease the land to install their wind turbines or ancillary structures, such as roads, transformers, electrical substations and transmission or distribution lines. Although some leases provide payments for neighbouring properties that don't have turbines or ancillary structures on them, others do not. This can result in a conflict between landowners referred to by wind energy policy pioneer Paul Gipe as "turbine envy."

Those with properties that have no turbines and no financial benefit from the project may be frustrated that they are not sharing in the financial benefits of their neighbours, even though they may be affected in some ways by the nearby wind turbine. They may be more likely to oppose the project as a result.

A number of models have been devised to deal with this issue. In Northern Europe, land pooling arrangements among neighbouring landowners are a popular approach. Landowners agree to come together and aggregate their land for the purposes of leasing it to wind developers, and the association or pool leases the land to the wind development company. In this way all the landowners receive some compensation from the wind project even if they do not have a wind turbine installed directly on their property.

There is also precedent for this kind of agreement across Canada, in Ontario, P.E.I. and Alberta, in various formats and methodologies.

In Alberta, many developers are now approaching new projects with a pooled leasing approach. This means that the total percentage of project revenues that projects can afford to compensate landowners with (typically around 1.5% to 2% of gross revenues according to several Alberta wind developers) is spread among numerous landowners, even some without turbines or other structures on their land, but those whose land is most disturbed tend to receive additional compensation for the disturbance. If the developer is able to come up with a good boundary for the wind project, they may be able to ensure that all landowners in the boundary have an opportunity to participate in the project. This can help to mitigate community concerns around wind development and reduce "turbine envy" issues.

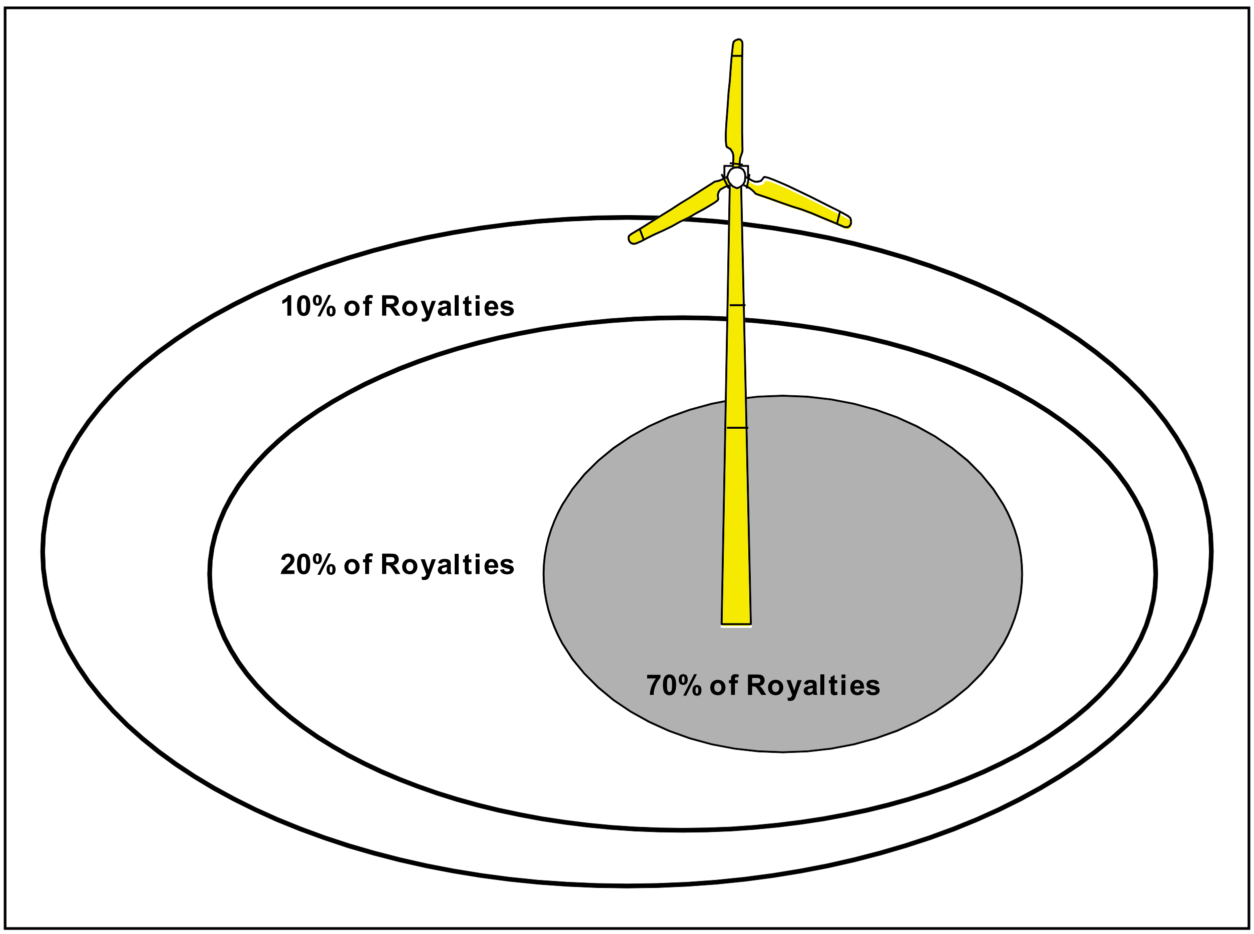

Figure 19: Illustration of a pooled leasing approach
ILLUSTRATION: COURTESY OF PAUL GIPE

13. Options, Easements and Leases

Option agreements, land leases and easements are three different types of agreements that wind energy developers can enter into with landowners.

"Option to lease" agreements are used early in a project development to allow a developer an opportunity to test the wind resource at a site and exercise a right to obtain a lease or easement with a landowner at a later date. Other studies that may occur during this phase, such as wildlife surveys or grid interconnection studies, help the developer determine the viability of the site.

A lease is a contract that provides a developer with possession of a specified amount of land for a certain period of time. The term is usually 20 years or longer in many wind energy land lease agreements.

Easements are similar to leases, in that they provide a wind developer with the rights to use an amount of land while the landowner maintains ownership of it over the specified easement term. Each type of agreement is described in more detail in the sections below.

13.1. Option Agreements

"Option to lease" agreements, often just called option agreements, are typically used during early project development when a wind energy developer wants to test the wind resource on a particular site and isn't yet sure if a project on that site would be viable. An option agreement allows the wind developer to pay a fee, usually a fixed annual payment, to give that particular wind developer the first opportunity to develop the landowner's property.

An option agreement leaves the wind developer with two choices at or before the end of the option period: the developer may enter into a long-term lease agreement with the landowner, or can release the landowner from further obligation. Often wind developers will use the option period to test the wind resource to determine if the land is worth developing, or will attempt to sort out other issues (i.e., access to transmission) to determine whether a project will be economical before exercising the option and entering into a long-term lease agreement.[118]

Land option agreements are legally binding, and like all contracts related to wind development, should be reviewed by a landowners' lawyer before finalizing any agreement.

Options typically run from three to five years; landowners should be wary of tying their land up with an option for too long a period of time if other developers could be interested. For areas with electricity transmission constraints, options may have to run to five years from a developer perspective, because the transmission development process can take a long time to get started.

13.1.1. Right of First Refusal

Rather than an option agreement, a landowner may wish to negotiate a right of first refusal with a wind developer. This right simply allows the developer an opportunity to match the terms of any proposed sale or lease to another party in the future, while an option agreement may establish the price or other terms of a potential future sale or lease.

The benefit of a right of first refusal is that it does not take the property entirely out of the wind development market if better offers arise over time. However, other developers may be very hesitant to try to acquire property that is subject to a right of first refusal because of the risk that the developer holding the right of first refusal could simply match their offer and acquire the land.

A developer bound by a right of first refusal is obligated to inform the rightholder when an offer is made to lease or purchase their land. A landowner might negotiate some provisions in a right of first refusal, such as having the right not to apply to offers by family members.[119]

13.1.2. Wind Resource Measurement Options

As previously stated, an option to use land for the purposes of assessing the wind resource often runs from one to five years. Developers will typically want at least one year of continuous data to assess the resource. Fees for the right to install a meteorological tower (a wind test tower) can be paid as an annual fee, a flat fee or as a fee for the amount of land taken out of cultivation. A 60-m meteorological tower with anchors will take about 1 hectare of cropland out of service. Currently a typical annual rent payment for such a tower is approximately $2,000.[120] The developer will also pay for weed control around the tower. If a developer requires help from the landowner in collecting or monitoring the data from the meteorological tower, the landowner should also be compensated for this role. However, data is typically downloaded via cell phone, therefore assistance with data collection would only be needed in very remote areas where cell service is not available.[121]

A landowner may wish to maintain a right of first refusal so that they can purchase the wind data if another offer is made to buy it. This is very valuable data that would be sold for hundreds of thousands of dollars.[122] This test data is valuable and may be useful to the landowner in future wind development negotiations.[123]

13.1.3. Multiple Lease Agreements

Landowners may want to consider a number of different leases for their wind rights prior to signing an agreement. If a number of wind companies are interested in a particular piece of land, a landowner could agree to enter into a long-term lease with the developer that is first able to meet certain project milestones, such as obtaining approvals. However, it is unlikely that a developer would agree to this, because it creates considerable barriers to financing the project.[124] It is important to note that land lease agreements are legally binding contracts between the landowner and the developer, so a landowner cannot legally sign multiple lease agreements with multiple developers for the same piece of property.

Difficulties can arise from this approach if neighbouring landowners sign leases with different wind developers. Prior to signing a lease, it can be help to consider what the collective landownership base has decided or is planning to do. Reaching consensus among neighbours strengthens the prospects for every landowner because the project as a whole can be more successful. If an individual landowner signs a lease with a different company than all of its neighbours, it will be excluded from the project and cut off from possible development by the company that they signed on with.

13.1.4. Auctioning Wind Rights

If you have received multiple offers from wind developers to lease your land, you may want to consider auctioning the wind rights to the developer with the best offer. Bids from developers should include not just the lease payment amount but also the length of contract, your possible participation in the project (if desired), and other non-price factors. Landowners with extensive parcels of land in an area of good to excellent wind resources are most likely to have the opportunity to auction wind rights. Alternatively, if a group of landowners are able to assemble a very large tract of land, this creates an opportunity to auction wind rights.

13.1.5. Option Agreement Length

As previously stated, option agreements typically run between one and five years in length. Due to the modest financial payment to the landowner, a land option agreement that lasts longer than five years should be considered carefully, as it could unduly tie up a landowner's options. Option terms less than three years are not economically viable for project proponents, and present unacceptable risk. Most options are 5–15 years. Most projects cannot go through the option to construction phase in less than five years.[125]

13.2. Leases and Easements

13.2.1. Land Leases

Importantly, the lease is just one part of a wind development project. While there is often an initial payment for signing a lease, the bulk of the revenue that a landowner can expect from a land lease occurs only after the project is built and electricity is sold on a continuing basis. Land lease agreements are complex documents that may run with the land for 20 to 80 years, or even longer. They should be carefully considered.

13.2.2. Easements

An easement conveys limited rights to use a portion of a landowner's property rights, either on the land or in the air. Often, easements are assumed to be created in perpetuity, which means they attach to the land forever. However, a written easement agreement can provide a cut-off point and last for only a specified period of time.

The most common type of easement is the right to travel over another person's land, also known as a right-of-way. Other common easements include the right to construct and maintain a roadway across the property or the right to build and maintain a transmission line over the land.

Easements are also often referred to as either affirmative or negative easements. In an affirmative easement, the landowner grants the developer the right to do something on the property, such as cross the property to install and repair testing devices or turbines, or to erect and maintain transmission lines. In a negative easement, the landowner agrees not to do something on his or her land in order to benefit the neighbouring land. For example, a landowner may grant a developer a negative wind easement on his property by agreeing not to build anything that would block a neighbouring turbine's access to the flow of the wind.

13.2.3. Differences Between Leases and Easements

Although they may appear to be practically the same, leases and easements are legally distinct agreements. They secure different types of property rights, and they impose different default terms and obligations. Often in the wind development industry, the words "lease" and "easement" are used somewhat interchangeably. Leases can even contain easements within them, and an easement may also contain a lease. This can create confusion, so it is important that the substance of all legal documents is carefully reviewed, preferably by a legal professional.

A lease is a contract to "rent" property according to the agreement's terms, usually for a specified length of time. An easement simply grants a right to another party to use part of a property for a specific purpose.

13.3. Important Elements of Land Agreements

13.3.1. How Wind Projects Are Bought and Sold

Before entering into any land agreement related to wind development, Alberta landowners should understand how projects, leases and other land rights are bought and sold. Often, a project (and the land rights acquired for it) may go through several hands before actually ending up with the developer that will construct the project.

Some interests looking to acquire land may only be speculators looking to "flip" the project at a later date. If an interest is looking to option land and market an area, they should be up front with landowners and not suggest that they will be constructing a project. Generally, landowners should be wary of anyone with an option agreement who promises a certain number of turbines on their land. At this early phase of development, it is very difficult for a developer or land acquisition company to make such promises to a landowner, as issues like turbine siting are dependent on so many variables, from environmentally sensitive features the developer may not yet know about to the quality of the wind resource in a particular area.

Generally, developers with a proven track record that can demonstrate to a landowner why they should be the "operator of choice" for a project warrant preferential treatment. Even developers with "iron in the ground" in other projects should be closely scrutinized by landowners prior to entering any agreement, although those without a track record should be given even more scrutiny.

13.3.2. Uses of the Land

To be functional, land agreements must describe in as much detail as possible how both parties can use the land. Developers will likely want to collect wind data, conduct environmental testing, construct the wind farm, create access roads where needed, install connecting electric lines, and have the ability to do all other activities necessary to the generation, collection, and transmission of electricity on the site.

Conversely, landowners should be sure to clarify their remaining rights to use the land. Activities that are typically of particular interest include planting, cultivating, and harvesting crops;

grazing livestock; developing mineral resources on the land; cutting timber; hunting; maintaining wildlife habitat; and entering upon and inspecting the property.

One issue that frequently comes up is what approval rights, if any, the landowner maintains over the final siting of both the wind turbines and any access roads. Farmers, for example, will likely want to ensure access roads are built so that disturbance of any ongoing farming operations is minimal. Similarly, the agreement should carefully spell out who maintains those roads and who may use them. Construction of a wind farm will result in some level of crop damage, as will major maintenance activities. Lease or easement agreements should provide compensation rates for damage to crops.

Another issue that often comes up in negotiating these kinds of wind land agreements is the right of the landowner to hunt on the land. Typically agreements should allow residents of the property to eradicate vermin, predators, rodents, etc. that go after livestock, but they often do not allow for sport hunting on the land. Part of the reason is damage that firearms can cause to wind turbines. A new rotor for a commercial wind turbine may cost $400,000 and renting a crane to pull down the rotor may cost $40,000, so the cost of repairs may far outweigh the benefits of allowing firearms to be used nearby.

13.3.3. Land Area Subject to the Agreement

Developers will typically want to maximize the amount of property subject to a land agreement early on in the development process, because it allows maximum flexibility to design and lay out the turbines, roads and other structures once wind data has been collected and modelling has been conducted. The developer will also want to have control over obstructions in the area that could interfere with the speed and flow of the wind.

Landowners will usually want to limit the amount of property impacted by a wind land lease agreement. This maintains the landowner's ability to lease and use the land that's not under the agreement land for other purposes. Landowners should be careful when negotiating the amount of land subject to an agreement.[126]

13.3.4. Length of Agreement

Land lease agreements tend to be a minimum of 20 to 30 years in length, which is the average lifetime for most wind turbines. Some leases are longer, and typically will include provisions to allow the developer to repower the project with newer turbines to replace older turbines in order to generate more electricity as technology advances.

13.3.5. Extensions

Agreements may include an option for an extension beyond the initial term. Landowners and developers should negotiate whether, and under what conditions, the developer will have the right to repower the project (replace the turbines and equipment with newer equipment to generate more electricity), and whether it will require a new agreement to be negotiated.

13.3.6. Income and Property Tax

Different types of wind agreements and compensation structures will have different income and property tax consequences. Receiving large lump sum payments may result in higher income taxes for a landowner than negotiating smaller, more numerous payments over time. Landowners should seek tax advice from a tax expert before signing any agreement, to ensure that they are maximizing their benefits and minimizing their liability on both property tax and income tax issues.[127]

13.3.7. Payment of Taxes

An agreement should ensure that the developer will pay for any increases in taxes (such as property taxes) resulting from the wind project. Whether the taxes are paid directly by the developer or added to the property tax bill of the landowner and reimbursed by the developer should be negotiated at the time of signing the lease, keeping in mind that timing of the reimbursement is crucial to ensure that the landowner does not run into cash flow issues when trying to pay a very large tax bill prior to being compensated by the developer.[128]

13.3.8. Assignment of Contract Rights by Developer

The agreement should also specify whether the landowner and developer may assign their contractual rights to other parties. (I.e., can a developer turn over the contract to another developer, and what consent would that require from the landowner, if any?) Wind developers often seek rights to assign or sublease their rights within a land agreement, and they will often seek the right to do this in the lease without always requiring approval from the landowner for the assignment of rights. One example of why developers might do this is to allow another developer to complete the project if the original developer is unable to do so.[129]

The landowner may negotiate to receive more information about the developer's plans for contract rights. A landowner could request a list of circumstances in which the landowner's written permission must be obtained before an assignment of rights could be made, ensuring that the landowner could review the qualifications of the party being assigned the rights and can assess the nature of the assignment. A landowner may also wish to negotiate that if there is an assignment of rights, the landowner receives separate compensation for the switching of hands of the project. This may also be a way to test the claims of the land agent or developer regarding their plans to develop the project rather than flip it to another party.

13.3.9. Assignment of Rights by Landowner

Lease agreements should specify whether the landowner or wind developer may assign any contractual obligations or rights to third parties. Wind developers typically look for rights to sublease or assign their rights without future consent of the landowner. These rights may be required for a wind developer to obtain financing, but landowners can ensure there is a contractual obligation that they be notified of every transfer of rights or obligations so that they can know who is ultimately responsible for any default or breach of the lease agreement.[130]

13.3.10. Restrictive Covenants

Any lease entered into by the landowner is assigned to the land and will stay with the land and not the landowner. These agreements may require inclusion on the landowner's deed to the property. The wind developer's right to use the landowner's property under the lease may be contained in a restrictive covenant on the deed to the property. The agreement should ensure that the landowner can retain the ability to use the property for other compatible uses, and they should be compensated for loss of use.

13.3.11. Non-disclosure Agreements

Developers typically require non-disclosure agreements with landowners to ensure that competitive information is protected. Landowners may find that sharing lease information with neighbours may be allowed by some wind developers. If developers are offering similar terms to neighbours, which is typically best practice in wind development to avoid conflict within a community, sharing lease information with some neighbours should not be an insurmountable obstacle in negotiations.

13.3.12. Mortgages and Other Creditor Considerations

If the property is subject to a mortgage or other creditor claim, the landowner should consider the impact of any wind-related negotiations on the terms of that agreement. When there is a mortgage on the land, often the mortgage agreement will require that the lender be involved in the negotiations with the wind developer, and at a minimum the lender will likely need to provide formal consent to the lease in order for it to be finalized.[131]

The landowner should also consider whether the land lease agreement could affect overall property value in way that could allow a creditor to claim that the debt owed by the landowner is under-secured and seek immediate payment.[132] Other issues that the landowner should investigate are whether any creditors have a mortgage that could allow them to claim part of the landowner's payments under the wind land lease agreement, and very importantly, how the agreement with the developer could affect the landowner's ability to obtain additional financing in the future. Again, because of the complexity of the interactions between these different agreements and different parties, experienced legal counsel should be consulted by landowners prior to entering into an agreement.[133]

13.3.13. Development Costs

An agreement should stipulate that the developer will assume all costs associated with the wind development and its operation and maintenance, unless otherwise specified.

13.3.14. Wind Rights

Landowners may wish to reserve the right to install their own wind turbines on their land so long as they do not interfere with the developer's turbines. If this clause is negotiated in the lease, it will often include a size limit for additional wind turbines and describe how they must be situated with regard to the developer's turbines.

13.3.15. Neighbouring Landowner Wind Rights

Landowners adjoining a wind project may be able to seek some compensation if they are prohibited from developing the wind resource on their own land due to the development of the adjacent wind project. Wind developers can also compensate neighbouring landowners by siting ancillary structures, such as roads or transformers, on neighbouring land. Neighbouring landowners may also request to lease their land and be included in the royalty pool if a developer has set one up.

13.3.16. Housekeeping and Maintenance of the Property

Landowners should ensure than an agreement states that the wind developer is responsible for keeping the site clean from debris resulting from the construction or operation of the wind farm. All housekeeping and land maintenance terms should be spelled out in the agreement, including other non-commercial housekeeping terms, such as visual condition of the turbines (i.e., when they should be repainted if they are becoming an eyesore).[134]

13.3.17. Liability

Generally, landowners should require a clause in any lease requiring the developer to indemnify the landowner from claims for any future loss or damage to persons or property arising from the developer's use of the land. These clauses will sometimes also stipulate that the party found to be at fault will pay the other party's reasonable legal costs should a dispute arise.[135]

Landowners should ensure that a developer has adequate insurance to protect against possible risks, including damage to property, structures, equipment, livestock, and crops owned by either party; personal injury or property damage suffered by third parties (including during construction and maintenance of the turbines); environmental impacts; and business interruption. Landowners should insist on seeing certificates of insurance for a developer to ensure that the developer's insurance is adequate to handle any liability issues that may arise.[136]

Landowners should ensure that the agreement specifies that the developer is responsibility for any future environmental liability created by the wind project, including releases of hazardous materials.

13.3.18. Hazardous Materials

The developer should be responsible for releases or spills of any hazardous materials, anhydrous ammonia, oils of any kind, fibreglass, and any other hazardous materials of concern. The lease should state that "no hazardous or toxic materials may be stored permanently on the landowners' property and that such materials stored temporarily must be stored properly and safely," and that the landowner should be informed of the presence of such materials.[137]

13.3.19. Damage to Property or Existing Structures

The developer is responsible for paying for all gates, fences, drainage tiles or other structures damaged during construction. The agreement should provide adequate time post-construction for the landowner to determine if there is damage to surface or subsurface drainage, as it may not appear immediately. The lease should also discuss whether landowners should be compensated for gravel or other fill materials mined from the landowner's site for the construction of access roads or used in the concrete for the foundation, and at what rate compensation is provided.[138]

The landowner can also request that the wind developer take all prudent steps to minimize the impact on the landowner and the existing use of the land by buried transmission lines, transformers, substations, roads and so on. Some developers specify in the lease that they will do so. If not, this provision should be included at the landowners' insistence.

13.3.20. Property Access

Wind developers require access to the land for operation and maintenance of the wind turbines. The developer may require 24-hour a day access to allow for repairs in a timely fashion. This is in the interests of both the developer and the landowner if the landowner is receiving some kind of royalty payment from the developer. Access requirements should be carefully spelled out in the lease, and the landowner should also specify points of entry to the property in the lease that will minimize adverse impacts on the land or adjacent landowners, and can indicate access routes that use existing rights-of-way or along fence lines. The developer's operating plan should detail procedures such as washing of vehicles to prevent transport of weeds into cropland or sensitive wildlife habitat. Landowners can try to negotiate provisions to review or help develop the operating plan.[139]

13.3.21. End of Project Life, Decommissioning and Site Restoration

The agreement should address what happens to any remaining wind structures at the end of the agreement term or in the event of an early termination. The lease should describe who determines when the wind turbines will be removed and who will pay for their removal.

Specific timelines for compliance should also be included. The agreement should clearly state what must be done to remediate or remove remaining access roads, underground cables, and the concrete foundations, among the different project elements. Each wind turbine may have a foundation as deep as 10 m below ground. For agricultural lands, a common practice is to remove all visible traces of the project (except usable roads) but the underground installations would be left in place to the extent that the land can be returned to its previous use.

13.3.22. Bond

Some municipalities require a bond to be paid up front to ensure that decommissioning of a wind project can occur regardless of the solvency of the project proponent at the end of the project's life. Where such requirements do not exist municipally, a lease agreement may also detail requirements for the developer to guarantee there will be funds available for the decommissioning process at the end of the project's life.

13.3.23. Grid-connection

Wind turbines intended for commercial electricity generation need to connect to an electrical line, usually a high-voltage transmission line, in order to facilitate the sale of the electricity into the provincial market. Transformers and substations may be required to facilitate connection to the grid. A lease should specify where other structures such as transformers and substations will be constructed on the property and how the landowner will be compensated. An agreement should specify that all electrical distribution and transmission lines are to be buried underground, below plough depth.[140]

13.3.24. Dispute Resolution

The agreement should set out in detail what dispute resolution process the parties will use should disputes arise that the parties cannot resolve between themselves. These dispute resolution mechanisms may include arbitration or mediation, and can even specify how an arbitrator is decided upon. A landowner should consult with legal counsel to decide what type of dispute resolution process is best to include in an agreement considering the potential cost of such legal action. An agreement should also outline how the parties will determine whether contractual obligations have been met to their satisfaction and what the penalties are for failure to meet any obligation.[141]

13.3.25. Termination of the Agreement

Any agreement should describe the details of its termination. Who can terminate an agreement, when, and with what cause should be carefully detailed in a lease agreement. It is often the responsibility of the landowner to provide written notice to the operator that the operator is in default. The operator will then have a specified period of time to remedy the default. If that period expires with no remedy provided, the lease may be terminated. Some examples of causes that might be written into a lease that could trigger termination include:[142]

- bankruptcy or insolvency
- failure to make agreed payments
- failure to meet project development milestones (such as acquiring permits and approvals) within a specified period
- abandonment of turbines

13.3.26. Legal Risk

The standard agreements with which a land agent or developer will approach a landowner may be heavily written to favour the proponent. Significant legal work may be required by the landowner to review a proposal and to make a counter offer. Some developers in Alberta and elsewhere offer some money to landowners from whom they are seeking a lease agreement in order for the landowner to hire a lawyer to review an agreement.

13.3.27. Qualification of Agents

Leasing of land for wind is dealing in real estate. Landowners should do their homework to ensure a land agent that they are dealing with is qualified to deal in wind development.

Several land-related characteristics can affect compensation to landowners for wind development
PHOTO: DAVID DODGE, THE PEMBINA INSTITUTE

13.4. Factors Influencing Compensation

Some of the following section is adapted from Windustry's "Wind Energy Easements and Leases: Compensation Packages."[143]

13.4.1. Land Characteristics

Several land-related characteristics can affect compensation to landowners for wind development. Land value, geography, access to transmission line capacity, current land use and potential alternative land uses are all factors that affect the level of compensation for siting wind turbines. Both land scarcity and high energy costs contribute to variability in compensation levels between regions.

When siting any wind turbines, the wind resource is of paramount importance, although wind resource does not seem to drive compensation levels unless combined with other key factors. The Farmers' Legal Action Group notes that "[t]he windiest sites in North Dakota have significantly more wind than the windiest sites in Illinois, but they do not command higher prices. There are two main ways that wind resource can affect compensation levels: 1) higher levels of energy generation can result in increased project revenue that can be passed on to the landowner through royalties or 2) specific characteristics of a region's wind resource can create competition, which can influence compensation levels. Where suitable windy land is scarce and demand for wind energy exists, competition for these sites might drive compensation levels up. A situation where windy land is abundant, but demand for wind energy is low might have the opposite effect."[144]

13.4.2. Transmission Access

Along with finding an attractive wind resource, access to transmission capacity is probably the most important criteria for a wind developer searching for a site. Good access to transmission lines with capacity for additional generation is an asset that could command higher compensation.

13.4.3. Land Value

Land value is typically not a primary driver of compensation levels, but the influence of land value on landowner compensation levels is easiest to discern when land value is very high or very low. For agricultural land, the revenue from hosting wind turbines is an added income stream. When considering whether a wind developer's compensation package is adequate, a landowner must consider the value of other land uses that have to be given up in order to host the turbines.

13.4.4. Turbine Size

As already discussed, turbine size is one of the clearest determining factors for landowner compensation levels. Most new wind turbines for commercial projects are approaching 2 MW in nameplate capacity.

13.4.5. Price of Electricity

The price of electricity can be another dominant determining factor for landowner compensation levels depending on how the developer has structured its business case. The price that a project owner receives for the wind electricity directly determines royalty payments (along with the turbine's generation performance and the site's wind resource). Even when a landowner receives fixed payments, those payments are likely established at least in part by the anticipated electricity purchase price and the overall economics of the project. Since royalties are dependant on the amount of electricity generated, these can be affected by turbine downtime. Landowners may wish to try and negotiate an inferred generation level to ensure that at least some portion of a royalty is paid regardless of the electricity generation.

13.4.6. Public Policy

Any factor that influences the economics of wind projects can also influence landowner payments, including public policy incentives. Government support for wind energy is often a significant factor in determining the overall profitability of a project. For example, with its recently introduced Green Energy and Economy Act, Ontario currently has an extremely attractive wind electricity incentive regime in place, especially when compared to Alberta, largely due to the stability and predictability of long-term prices for wind projects. Public policy can also create markets for wind energy through renewable electricity standards, goals, and specific mandates for renewable energy. These kinds of policies influence the prices paid for wind energy and the selection of locations for wind project development, and thus which landowners have the opportunity to host turbines and to some extent how much they are paid.

13.4.7. Competition and Alternatives

As with other markets, the price paid for leasing windy land is somewhat determined by competition. Landowner payments might be higher in regions where landowners have multiple offers for leasing their land or have considered developing their own projects, creating competition for the wind developers seeking out leases. There are also cases where landowners have negotiated better deals by working together as a group or offering added value to developers by doing some of the project predevelopment work themselves. See Section 12.7 for more details on land pooling and other ways that landowners can work together.

13.4.8. Community Support

The local community's general support for or skepticism about wind energy can have some influence on landowner compensation levels. A developer sensing reluctance in a community might try to "sweeten" their contracts in order to convince more people to sign on. Alternatively, a developer in such a position might look to provide broader benefits to the whole community rather than the individual landowners.

13.4.9. Community and Landowner Knowledge

Landowners who have done their homework and know their options tend to have the best results when negotiating land agreements. Landowners working together might provide an easier basis for a wind developer to negotiate on, as there is only one point of contact to negotiate with representing a bloc of landowners in the same vicinity. However, landowners must first agree amongst themselves on the provisions of a deal and upon the selection of a representative to deal with developers.

No single factor determines landowner compensation levels. A variety of interacting factors have varying levels of influence for different projects.

13.5. Developing Your Own Project

In Ontario, Minnesota and Iowa, among other provinces and states, many landowners are turning to wind projects that they can have a more direct ownership stake in. By sharing a much greater portion of the risk, landowners investing in community-owned wind can sometimes reap a proportionally larger return from the wind. Although Alberta has historically seen wind electricity developed primarily by commercial developers, it is possible for landowners to develop their own wind projects through one of the ownership models described in Section 11.

14. Developer Checklist

Developers are not all created equal. Landowners should ensure that they have answers to their questions if there are multiple developers interested in their land. There are many non-monetary considerations that may affect the landowner's choice of wind developer (see Section 12.6). The following checklist can help in making decisions about which developer to enter into an agreement with.

Corporate Background

- Human and financial resources
- Financial health/investor backing
- Development and relationships (contractors)
- Supply agreements (manufacturer relationships, availability of turbines)
- Past litigation by the developer or against the developer

Development and Operations History

- Projects developed to date (number, location, size)
- Projects sold
- Percentage of projects developed
- Development, construction and operations financing (balance sheets)
- Equipment used and supply agreements

Project Information

- Project size
- Land required
- Land leased to date
- Target wind farm capacity (in MW) and number of turbines for property and neighbouring properties
- Property to be encumbered/level of encumbrance
- Intended power purchaser
- Project sale options

Project Status

- Wind resource assessment status (meteorological towers installed/data collected)
- Resource information
- Grid-connection (study, application, agreement?)
- Studies (heritage, wildlife, noise, etc.)
- Anticipated equipment

Project Grid-connection

- Location of grid-connection point
- Grid-connection studies
- Transmission line/substation capacity
- Rights of way (secured and yet to be secured)

Agreement

- Form provided
- Term and renewal
- Milestones and timelines (for assessments, studies, etc.)
- Development covenant (e.g., minimum capacity to be installed on property)

Compensation

- Execution fee
- Option fee
- Installation fee
- Royalty percentage and escalator; minimum royalty
- Other fees (roads, transmission, renewal, wind prospecting)

Owner Development Allowed

- Small wind turbine
- Solar electricity
- Oil, gas or mineral development

Glossary

Alberta Electric System Operator (AESO)

The agency established by the Government of Alberta to independently operate Alberta's electricity transmission grid and hourly wholesale electricity market.

Note: AESO provides access and transmission pricing services to all transmission grid users.

anemometer

device that measures wind speed

Note: Anemometers are used as part of wind resource assessment studies. The anemometer typically is installed on a guyed tilt-up tower at the anticipated location and height of the potential wind turbine.

capacity factor

the average percent of a wind farm's rated output over a period of time

Note: This is an important performance indicator that allows farms and turbines to be easily compared between time periods, locations and technologies. It is found by dividing the actual electrical energy generated by a turbine over a year by the product of the generator's rated capacity and the number of hours in a year.

commissioning

process of ensuring that what has been delivered to a turbine owner is what the owner purchased as stated on the purchase agreement

Note: A commissioning process is usually thought of as determining if a device is operating within its normal parameters or other parameters as defined by the purchase agreement, but it only depends on what the purchase agreement states for commissioning.

community wind energy

locally-owned, commercial-scale wind projects that optimize local benefits

debt

amount of money borrowed and owed by one party to another.

Note: Bonds, loans, and "commercial paper" are considered debt.

decommissioning

process of dismantling a turbine and restoring the site to pre-project conditions or another agreed-upon outcome

demand

power drawn by electrical loads

Note: Demand is measured in kilowatts or megawatts.

depreciation

accounting method used to attribute the cost of an asset over the span of its useful life

Note: The project cost, or a portion of the project cost, can be assigned as a loss on the project's balance sheet to reduce the tax base of the project.

discount rate

interest rate used in determining the value of future cash flows in present-day funds

distributed generation

electricity generators that are distributed throughout a utility's service area instead of being concentrated at a central location

Note: This term is commonly used to indicate non-utility sources of electricity, including on-site generation. In effect, all generators regardless of size are "distributed" because they are located in many places around the province.

distribution generation

electricity generator connected to the electrical distribution system

distribution system

poles, wires, transformers, insulators, disconnects, breakers, fuses, and other associated equipment that deliver electric energy from the local substation to individual households

Note: Typically, the distribution system is defined as electrical lines and associated equipment where the operating voltage is less than 34.5 kilovolts.

due diligence

investigation of a particular investment from as many angles as possible to best understand the risks, rewards, and opportunity costs

Note: Lenders, investors, contractors, and equipment suppliers will be much more willing to work with people who can demonstrate that they know the terms and concepts well and understand the industry.

easement

legal right to use the real property of someone else for a specific purpose

equity

ownership in any asset after all debts associated with that asset are paid off

Note: The meaning of equity depends very much on its context.

grid

network of transmission or distribution lines used to move a commodity from its source to consumers

hub height

height of a tower on which a wind turbine is mounted as measured from the ground to the centre of the turbine blade's rotation axle

Independent Power Producer (IPP)

owner of an electricity generator that is not owned by a public utility

interconnection (grid-connection)

process of connecting an electrical generator to the electricity grid or the physical location of the connection of an electrical generator to the electricity grid

interconnection agreement

legally-binding document that defines the technical and contractual terms under which an electric utility will permit a generator owner to connect their generator to an electrical transmission or distribution system

internal rate of return (IRR)

financial calculation that compares the present value of a project's expected revenues with the present value of its expected costs

Note: An IRR calculation is used to determine the discount rate at which the two present values are equal. By doing this calculation, investors are able to see the project's expected rate of return.

investor-owned utility (IOU)

1) utility owned by private investors as different than one owned by a public trust or agency
2) commercial, for-profit utility as different from a co-op or municipal utility, which are subject to different regulations in some jurisdictions

kilowatt (kW)

unit of power of any form of energy, that is, a measure of the rate of doing work or instantaneous rate of energy use

Note: 1 kW is equal to 1,000 watts. A 100-watt light bulb uses 100 watts when it is illuminated.

kilowatt-hour (kWh)

unit of energy of any form, that is, a measure of how much energy is used over time

Note: 1 kWh is equal to 1,000 watt-hours. This is the basic unit for measuring electric energy. A 100-watt light bulb that is illuminated for 10 hours uses 1 kilowatt-hour of energy (10 hours x 100 watt-hours = 1 kWh).

Landowner Wind Energy Association (LWEA)

group of landowners working together to have more control over the wind leasing process than they would have individually

load

1) amount of electric energy consumed over a duration of time
2) an electricity-consuming device or devices that are connected to an electrical system

Note: Peak load is the greatest amount of electrical energy consumed over an hour in a year.

locally-owned

when one or more members of the local community has a significant direct financial stake in a project other than through land lease payments, tax revenue, or other payments in lieu of taxes

megawatt (MW)

unit of power of any form of energy

Note: 1 MW is equal to 1,000 kilowatts or 1 million watts. 1 MW of electrical power can light up 10,000 of 100 W light bulbs.

megawatt-hour (MWh)

unit of energy of any form

Note: 1 MWh is equal to 1,000 kilowatt-hours or 1 million watt-hours.

meteorological tower/mast

tower containing equipment that assesses the wind resource

Note: Generally a meteorological tower will have anemometers, wind direction vanes, temperature and pressure sensors, and other measurement devices attached to it at various levels above the ground.

multiplier effect

factor pertaining to the local economy and wind project development that describes how increased spending in one part of a economy starts a chain reaction that results in an overall increase in economic activity

nameplate capacity

amount of electrical power that a wind turbine is able to generate at a specific set of environmental and mechanical conditions, known as the "rated" conditions.

Note: A wind turbine that has a 1 MW nameplate capacity will generate 1 MW of power when operating at its rated conditions.

net billing

off-site post-measurement invoicing process that accounts for the amount of electrical energy separately imported and exported between a customer and an electric utility

Note: Net billing allows utility customers to easily be credited for exporting any excess electricity onto the utility distribution grid when their wind or solar system, for example, generates more energy than they are using at the time. Net billing provides the total amount of exported and imported energy separately between meter readings so that discounted, equal or premium prices may be applied to the exported and imported amount of energy.

net metering

on-site real-time measurement process using one bi-directional meter with one data register in which the meter itself measures the net imported and exported electrical energy between a customer and an electric utility

Note: Net metering permits utility customers to easily be credited for exporting any excess electricity onto the utility distribution grid when their wind or solar system, for example, generates more energy than they are using at the time. Net metering provides only the net imported or exported energy between meter readings, which to the customer ends up being the same as equal-rate net billing. Any difference in export *vs.* imported prices only applies to the net export or imported energy and not to the total exported or imported energy.

operations and maintenance agreement

contract for operating and maintaining a project which defines terms, fees, schedules, and other details

off-peak

electricity supplied during periods of low system consumption.

peak demand

greatest demand placed on an electric system

power

rate of energy flow

Note: The standard unit of measure is a joule per second, which is encapsulated in the term watt (W).

power curve

electrical power generated by a specific wind turbine over its complete range of operating wind speeds

Note: This is used with wind speed and duration data to determine the potential for electricity generation at a project site.

power purchase agreement (PPA)

contract to buy the electrical energy and/or other electrical products generated by an electric generating plant

setback

distance from the base of a structure to existing easements, roads, buildings, bodies of water, or other geographic or man-made structures or property lines

Note: This term is used in siting and permitting for the construction of structures.

shadow flicker

regular, intermittent and moving shadows caused by the rotating blades of a wind turbine when seen on the ground and nearby structures

substation

assembly of equipment in an electric power system through which electrical energy is passed for transmission, distribution, interconnection, transformation, conversion, or switching

transmission

transfer of high-voltage electric power from generating plants to customer loads or distribution systems at a distance ranging from nearby to hundreds of kilometres

turbine

device for converting the flow of a fluid (air, steam, water, or hot gases) into mechanical motion that is often used to generate electricity or to generate thrust, such as in a jet aircraft

watt (W)

unit of power of any form of energy

Note: 1 W is equal to a flow of one joule of energy per second.

Appendix:

Wind Turbine Micro-Generators in Alberta, Regulatory Permitting and Approvals

A.1. Connecting a Micro-Generator to the Grid

This appendix provides you with information about the process to obtain regulatory approvals for your wind turbine generator to connect to the electrical grid as a micro-generator.

All electricity generators need to have various developmental and safety approvals before they are permitted to be installed and connected to the electrical grid. Connecting to the grid and handling of the energy generated are two completely separate matters governed in Alberta by two acts:

1. The Hydro and Electric Energy Act (HEEA) (31 pages) governs the connection of all generators to the electrical transmission and distribution grids in Alberta.[145] The AUC enforces the HEEA through its Rule 007, "*Applications for Power Plants, Substations, Transmission Lines, and Industrial System Designations.*"[146]
2. The Electric Utilities Act (EUA) (120 pages) governs the measurement, handling and sale of electricity.[147] The AUC enforces the EUA through its Rule 021, "*System Settlement Code Rules.*"[148] Section 95 of the EUA regulates the ownership of generators by municipalities.

Alberta's Micro-Generation Regulation (AR27-2008) is a re-interpretation of the EUA and greatly simplifies the grid connection process for micro-generators.[149] It is nine pages long and came into effect on January 1, 2009. The AUC enforces the Micro-Generation Regulation through its Rule 024, "*Rules Respecting Micro-Generation.*"[150] The intent of the Micro-Generation Regulation is to regulate the development of micro-generators and the sale of electrical energy from them.

If a wind turbine generator is not eligible under the Micro-Generation Regulation, it can be grid-connected using the distributed generator interconnection process as regulated by the AUC's Rule 007. There can be considerable additional costs in applying for grid-connection as a distributed generator and in monthly charges from the wires service provider.

A.2. Wind Generator Configuration

Your micro-generator is connected to the electric distribution system owned by your wires service provider.

In most cases, the wind generator will likely be installed in a "load-offset" configuration. This is a configuration where the generator generates electrical energy first for consumption at the site of the generator, as shown in Figure 20. Whenever there is too much electrical energy for the site on an instantaneous basis, the excess is automatically exported onto the grid.

For lineman safety purposes, the wind generator will need to be disconnected from the grid or automatically shut down during electrical outages. The generator may or may not incorporate a battery bank that provides for electrical power during the outage. Discuss decisions about which configuration is best for you with a reputable wind system supplier.

You purchase electrical energy from your energy retailer. The wind energy used directly at your site reduces the amount and cost of your purchased energy. The electrical energy that is in excess of your own energy consumption on a second by second basis is exported onto the grid and is sold to your energy retailer. The energy retailer credits your bill for it.

The energy from the wind generator just feeds the site breaker panelboard generally, and not any particular piece of electrical equipment. The total annual energy generated is compared to the annual site energy consumption regardless of whether the energy is used on site or exported.

Both imported and exported energy are measured by a bi-directional energy meter using units of kilowatt-hours. Wind turbine generators will export electrical energy to the grid whenever it is windy and the on-site electricity consumption is low. The amount of electrical energy exported at any moment depends on the wind speed, the size of the generator and the amount of electrical energy being used on site at the time. This configuration is different than so-called "merchant generators," where the sole purpose is to sell electrical energy into the electrical transmission or distribution system for a profit. Their on-site energy consumption is very small in comparison to the total amount of electrical energy generated.

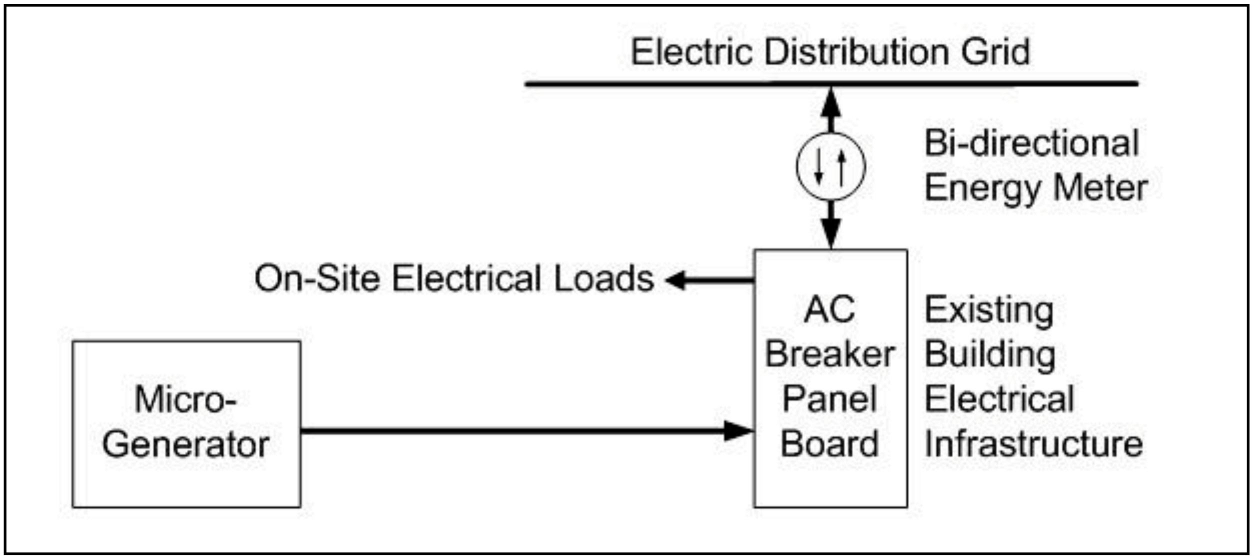

Figure 20: Typical configuration of a micro-generator to grid connection

A.3. The Micro-Generation Regulation

The Micro-Generation Regulation is intended to cover only load-offset generator configurations. Merchant generators are regulated by the AUC's Rule 007. Most of the Micro-Generation Regulation is very clear, but a few grey areas are still to be clarified (see Section A.9).

To be considered under the Micro-Generation Regulation, the following conditions need to be met:

1. The generator "exclusively uses sources of renewable or alternative energy." [Micro-Generation Regulation 1(1)(h)(i)]
   Wind generators qualify for this. The full definition for this clause can be seen in the regulation.
2. The amount of energy generated "is intended to meet all or a portion of the customer's electricity needs." [Micro-Generation Regulation 1(1)(h)(ii)]
3. The generator "is, at the time of construction or installation of the generating unit, sized to the customer's load or anticipated load or a portion of it, as evidenced by a total nominal capacity of the generating unit that does not exceed the rating of the customer's service." [Micro-Generation Regulation 1(1)(h)(iii)]
   This paragraph covers the situations where someone installs a wind generator to generate all their annual electrical energy, and then becomes energy efficient afterwards, thus generating significantly more electrical energy than their annual energy consumption.
4. The aggregated rating of all the grid-connected generators at the site "has a total nominal capacity not exceeding 1 MW." [Micro-Generation Regulation 1(1)(h)(iv)]
   "Capacity" always refers to the rating on the wind generator's nameplate. This clause will likely accommodate all the requests for micro-generator wind turbines.

5. The generator "is located on the customer's site or on a site owned by or leased to the customer that is adjacent to the customer's site." [Micro-Generation Regulation 1(1)(h)(v)]
6. The generator must be connected to "an electric distribution system" as implied by Micro-Generation Regulation 1(1)(k). This will likely accommodate all the applications for micro-generator wind turbines because transmission systems are intended for very large generators and long distances.

The Micro-Generation Regulation divides micro-generators into two categories, based on the aggregated nameplate capacity ratings of all the generators at a site:

1. Large micro-generators: greater than 150 kW and less than or equal to 1,000 kW (1 MW). Generators of this size would typically be employed on larger farms and businesses.
2. Small micro-generators: less than or equal to 150 kW. Generators of this size would typically be employed on most farms and smaller businesses.

The AUC's Rule 024 further establishes a category of mini micro-generators, which are less than 10 kW and use DC to AC inverters to connect the electricity source to the electric distribution system. This is a subset of small micro-generators. This size and type of micro-generator would likely be found on homes and small farms. Inverters are used in solar photovoltaics, some micro-wind turbines, some micro-hydro turbines, fuel cells, some Stirling engines and some waste heat generators.

The Micro-Generation Regulation requires wire service providers to cover all the metering, meter data handling and any installation costs incurred by the micro-generator except costs that they consider to be out of the ordinary. Their costs are added to the rate base and recovered from all customers. See Notice of Dispute section below for the handling of extraordinary costs.

A.4. Micro-Generator Wind Turbine – Steps to an Operational System

Connecting a wind generator to the grid requires careful consideration of legal and safety matters, equipment choices and installation details.

The following information describes the step-by-step regulatory process for obtaining permits and approvals for connecting a micro-generator wind turbine to the electrical grid. There are 11 or 12 paperwork steps to obtain the regulatory approvals for a micro-generator wind turbine, depending on its size and type. There is an additional step to sell your exported electricity.

Step 1. Micro-Generator Documents

Find your latest electricity bill. It is sent to you by your electrical energy retailer. The top part shows the charges from the energy retailer. The bottom part shows the charges from the wires service provider.

Contact your wires service provider to obtain four documents:

- The Alberta Utilities Commission Application Guide (37 pages)
  This document is used everywhere in Alberta except for Medicine Hat. It describes the process for connecting micro-generators to the grid. It provides micro-generator information, helpful recommendations, flow charts of the application process, single-line diagrams, the micro-generator application form and the dispute and complaint forms.
- The Alberta Utilities Commission micro-generator application form with the wires service provider's name on it (1 page)
  This document collects information about your project. It is uniform throughout the province except for Medicine Hat and for small differences with Fortis Alberta and Central Alberta REA.
- The wires service provider's operating agreement (2–10 pages)
  This is a legal document that contains the information on the responsibility and expectations of you and your wires service provider. You will need to sign it.

- The wires service provider's terms and conditions (1–100 pages)
  This is a legal document that describes the terms and conditions under which the wires service provider provides you with their generator grid-connection service.

You may also wish to download and read the wires service provider's technical interconnection requirements document (about 70 pages). It discusses their requirements for your generator's or inverter's grid-connection specifications.

With some wires service providers you can download this information from their web space. It is recommended that you do not contact government departments or agencies for this information, because your prime relationship is with your wires service provider and your energy retailer.

Step 2. Wind Energy Analysis

- Electricity bills
  - » Get at least one year's worth of electricity bills together and add up the amount of electrical energy you use over the year.
- Wind generator specifications
  - » Determine which wind generator you are going to use.
  - » Determine the kVA size of the transformer on your yard pole. Its size is written on the side of the transformer.
  - » Determine how much electrical energy your wind generator will generate for a year. For household-sized wind generators, you should be able to get an estimate of this from your generator supplier in writing. For larger generators it is important to consider the recommendations in this report about pre-feasibility and wind resource assessment.
  - » If your generator's rated capacity is greater than your site transformer size, or if your generator will generate more electrical energy than you consume in a year, then you run the significant risk that your wind generator will not be accepted as a micro-generator.

Step 3. Site Plan

- Prepare a site plan showing where the micro-generator will be located. Show the tower and rotor arc; show the distances of the generator from your property lines and from the houses of your nearest neighbours; show setbacks and building locations; indicate names of neighbours with land abutting the property on which the generator is located.

Step 4. Wildlife Assessment

- Send the wind generator and the site information to the local wildlife biologist with Alberta Sustainable Resource Development for review and comments about setbacks from sensitive wildlife habitat. Alberta Sustainable Resource Development does not have a regulatory control over wind generators less than 1,000 kW, but their opinion and influence on your decisions is very important in reducing hazards to wildlife.
- Contact your local Alberta Sustainable Resource Development office.

Step 5. NAV Canada Land Use Proposal

- NAV Canada operates Canada's civil air navigation service. You are required to submit a Land Use Proposal to them in order to ensure that your wind generator will not affect air navigation. They will issue an objection letter or a non-objection letter depending on the results of their review. If the generator is constructed against an objection letter then NAV Canada will pursue legal means to prevent the construction of it.
- Contact NAV Canada at 1-866-577-0247 or landuse@navcanada.ca, or see www.navcanada.ca and search for "land use."

Step 6. Municipal Permits

- Ask your municipality's permit office whether a development permit and a building permit are needed.

  - » Note that an electrical permit will always be needed. The electrical contractor you hire to connect your wind generator to the grid will obtain the electrical permit.
  - » Some municipalities require information including shadow flicker, and noise information, an analysis for noise to the property lines, and engineering-stamped drawings of the foundation and tower showing compliance with CSA standards. Some municipalities may require a public meeting prior to consideration of the permit. Some municipalities restrict the number of wind generators for personal use.
- If required, prepare and submit your development permit application along with any fees.
- Find out when the municipal planning meetings are held (typically every two weeks) and when the municipality staff needs all the information in order to prepare a report to present to the planning meeting (typically at least two weeks before the meeting).
- Every municipality is different. Usually they have a form to fill out that requires site information. They also want you to submit your site plan and an elevation view.
  - » The site plan can be as simple as making a .jpg photo file from the view of your site on Google Earth and drawing a mark where each generator will be located.
  - » The elevation view can use existing or new engineering drawings. You can also take a photo of your site from a road and draw the generators on it.
- If the municipal planning meeting accepts your application, they usually advertise it for two weeks or so to see if anyone objects and then you receive your development permit.
- Some municipalities don't have land use bylaws that permit wind generators, especially in residential areas. It can easily take a year of work to obtain a development permit where a wind generator is not already accepted as a "permitted use."
- If required for the building permit, have the wind generator's tower and foundation designed or checked by a structural engineer.
- If required, prepare and submit the building permit application to the municipality or to their permitting contractor (1 page) along with any fees.
  - » A building permit checks for structural safety. The permitting process varies with the municipality.
  - » You will need your development permit # before you will be able to receive your building permit, but submit the building permit information anyways so that they can evaluate it.
  - » Once you receive your development permit, inform the building permit contractor.

Step 7. Transport Canada Aeronautical Obstruction Clearance Review

Transport Canada reviews and determines the lighting and marking that may be required on objects that are deemed to be a hazard to aviation safety and visibility to pilots.

- You are required to submit an Aeronautical Obstruction Clearance Form to them. They will respond with comments on the Form indicating their lighting and marking requirements, if any.
- Contact Transport Canada Aerodrome Safety at 1-403-495-5181.

Step 8. Alberta Transportation Roadside Development Permit

- You are required to obtain a Roadside Development Permit from Alberta Transportation when your wind generator is within 300 m of a numbered highway and 800 m from the intersection of a numbered highway.
- Contact your local Alberta Transportation office, or see www.transportation.alberta.ca, and search for "roadside development application."

Step 9. Wind Generator System Electrical Design

- Get a qualified engineer, engineering technologist, your equipment supplier or an electrician to do an electrical design of your wind generator system. The person who is qualified to do this will depend on the size of your generator. The design will include choices for wire size, wire routing, wire length, wire protection, disconnects, breaker size, system labels, controls, and transformers.
- Wind generator systems, of course, need to be designed and installed according to the minimum conditions as laid out by the Canadian Electrical Code. The designer also needs to be aware of Section 84 of the Canadian Electrical Code and its rules regarding the need for warning notices and disconnects. You need to ask your wires service provider whether they will require your system to have a disconnect switch where its open blades are visible (called a visible-break disconnect).
- Get your electrical designer to draw a single-line diagram, which is an electrical diagram showing only single lines between the components to indicate that one feeds the other. See the AUC's Micro-Generator Application Guide for details and a sample.

Step 10. Petroleum Registry of Alberta

If you are classified as a small or large micro-generator (but not a mini micro-generator), your wires service provider will need to apply to the AUC for the approval of your system. They will need a business associate (BA) code from you before applying to the AUC as part of the AUC's standard application management process. You need to supply your wires service provider with this code with your application form. The Petroleum Registry of Alberta assigns and manages these codes.

- Complete the BA code application form online at the website of the Petroleum Registry of Alberta at www.petroleumregistry.gov.ab.ca/PR62.asp and click on "Apply for Access."
- The online registry is usually available from 6 a.m. to 9 p.m., Monday to Friday. See www.petroleumregistry.gov.ab.ca/PR49.asp for the calendar. The registry form is rather convoluted because it applies primarily to oil well installations than electricity generators. Phone 1-800-992-1144 for the Registry Help Desk. You should receive your BA code by email in a couple of days.

Step 11. Micro-Generator Application

- Fill out and submit your micro-generator wind turbine application form to your wire service provider. See the AUC's Micro-Generator Application Guidelines for details on filling it out. The application will include the micro-generator application form, the single line diagram and the site plan. A separate application is required for each turbine.
- The wires service provider will review your application and has two weeks to respond to you. If they approves of your wind turbine as a micro-generator, then you can proceed with its construction. If your turbine is not approved then they will file a Notice of Dispute with the AUC. See Section A.6 for understanding the dispute process.
- Ask your wires service provider about their system commissioning requirements to ensure that they are comfortable with how you will be checking the correct operation of your wind generator.
- Arrange for metering with your wires service provider. See Section A.5 for metering options.

Step 12. Wind Turbine Purchase, Construction, Inspection and Commissioning

- Only purchase wind generator equipment and components that contain electrical certification marks that are valid in Canada. Require your equipment supplier to provide specification sheets that show that their products are approved to Canadian electrical standards.

- When the products are delivered, physically check the electrical certification of each electrical component to ensure that their nameplate contains the authorised certification mark.
- It is highly advised that your wind generator be constructed by a qualified wind generator installer. Installing a wind generator is beyond the scope of most do-it-yourself projects. Selecting a qualified wind generator installer is very important. These systems are relatively new and not many installers have experience with them.
- It is highly recommended that all electrical work be done by a qualified and experienced electrical contractor rather than doing it yourself. Your electrical contractor will get the system inspected. Electrical installations are subject to strict legal and municipal regulations including relevant health and safety legislation. Installers need to be aware of the requirements of relevant municipal permitting regulations, installation obligations, electrical safety and manufacturer compliance.
- Notify your wires service provider of your completed installation and send them a copy of your electrical inspection report.
- Sign the interconnection operating agreement with your wires service provider. They will automatically install the bi-directional meter as required by the Micro-Generation Regulation. See Section A.6 if they don't. Get their permission to turn on your wind generator.
- Follow the commissioning procedures recommended by the manufacturer in order to commission your wind generator. This is important so that you know it is fully operational.

Table 5 gives an estimated duration for each of the steps listed above.

Table 5: Micro-Generator Application Process – Elapsed Time

	Step	Range of elapsed time to complete the step
1.	Micro-Generator Documents	30 minutes to 2 days depending on whether you download them or have them e-mailed to you
2.	Wind Energy Analysis	1 day to 1 week depending on the availability of analysis services
3.	Site Plan	2 hours to 1 day
4.	Wildlife Assessment	1 to 2 weeks for the response
5.	NAV Canada Land Use Proposal	1 to 2 hours to prepare the submission; up to 6 weeks for their response
6.	Municipal Permits	Development permit: 2 days to 1 week to prepare depending on how much information you already have about your site; 1 to 2 months for the response depending on whether you are in synch with their meeting schedule; up to 1 to 2 years depending on whether the municipality already has a policy to approve micro-generators as a "permitted use" or if they are considered a "discretionary use" Building permit: 1 week to 1 month depending on what is required
7.	Transport Canada Aeronautical Obstruction Clearance Review	1 to 2 hours to prepare the submission 1 to 4 weeks for the response
8.	Alberta Transportation Roadside Development Permit	1 to 2 hours to prepare the submission 1 to 2 weeks for the response
9.	Wind Generator System Electrical Design	Design: up to 4 hours depending on complexity and how much information is at hand Single-Line Diagram: 15 minutes to 4 hours depending on whether you start from a blank paper or fill in a sample diagram by hand
10.	Petroleum Registry of Alberta	2 days to 1 week
11.	Micro-Generator Application	15 minutes to 1 hour to prepare the submission Up to 2 weeks for the Wires Service Provider to reply Up to 12 weeks depending on whether your application is disputed
12.	Wind Turbine Purchase, Construction, Inspection and Commissioning	3 months to 1 year depending on available equipment and installation services

A.5. Payment for Exported Electricity

Electrical energy is sold and purchased in Alberta through a wholesale electricity market (formerly called the Power Pool). This is established and operated by an organisation whose function is called an Independent System Operator (ISO). The ISO in Alberta is the Alberta Electric System Operator (AESO). The market price of electrical energy changes every 5 minutes according to supply and demand, and is aggregated and paid hourly to market participants.[151] Often, the hourly price can run from 1¢ to 6¢/kWh at night, 4¢ to 10¢ in the daytime, and 50¢ to $1/kWh in grid emergencies.

After construction of your micro-generator, you need to notify your energy retailer about it in order to be paid for your exported energy. This is usually a straight-forward process, but first you need to speak with someone at the energy retailer's office who knows about micro-generators. Some wires service providers notify your energy retailer about your micro-generator directly, even though it is basically illegal for them to do this. Some energy retailers don't know what to do with your information when you tell them so it is important to be persistent until you are connected with someone that can help you.

The price that is paid for the electrical energy that a micro-generator exports onto the grid is whatever you and your energy retailer negotiate and agree. [See Micro-Generation Regulation 7(5)]

If you and your energy retailer cannot agree on the price, then the exported energy payment price depends on the type of energy meter that is used to measure the exported energy. Note that all electrical energy is measured in a kWh. The types of meters available for micro-generators depend on the category of the micro-generator:

- Large micro-generator: must be a bi-directional interval meter, which provides energy consumption readings every 15 minutes
- Mini or small micro-generator: can be either a bi-directional cumulative meter or a bi-directional interval meter, which is your decision. If an interval meter is selected then the mini- or small micro-generator is considered as a large micro-generator for all energy payments. You need to tell your wires service provider what type of meter you want. If they don't install the correct meter, then you can issue a notice of complaint to the AUC. See Section A.6 for more information on this.

If the micro-generator's exported energy is measured by an interval meter, then the payment price for the exported energy is the hourly price of the electricity market. This price is applied to the hourly exported energy as summed from the 15-minute readings.

If the micro-generator's exported energy is measured by a cumulative meter, then the payment price for the energy exported is the same as the energy retailer's retail price for purchased energy. This price is applied to the exported energy as determined from typically monthly meter readings. Note that this price does not include the price from the wires service provider for delivering your electrical energy to your site.

Payments are made in the form of a credit on the subsequent electricity bill. Any outstanding credits are settled at the end of 12 months. It is not likely that there will be much if any annual net credits due to the grid connection charges on each bill, which are based on the amount of time you are connected to the grid.

Typically of course the energy retailer does not want to negotiate this exported electricity price, even though their payments to you are at no direct cost to them. This is because the payments come from the AESO either through the electricity market in the case of the interval meter or through what is known as "unaccounted for energy" in the case of the cumulative meter.

The wires service provider will automatically install the meter at your site, without cost for the meter, for its installation, for reading the meter and for handling the meter data.

Both of these meter types separately measure how much energy is imported and how much energy is exported. This is called "net billing," which is an off-site post-measurement invoicing process. It can provide more flexible payment options than "net metering." Net metering uses a standard kWh meter that measures in either direction. A net meter only has one register and only provides one reading for the net exported energy minus imported energy.

A.6. The Micro-Generator Regulation's Dispute Resolution Process

If the wires service provider does not agree that your application meets the requirements of the Micro-Generation Regulation, then they are not permitted to deny you directly. Instead, they must issue a notice of dispute to the AUC within 14 days of receiving your application asking the AUC for permission to deny your application. An example of the notice of dispute is on page 35 of the AUC's Micro-Generator Application Guide.

In addition, if the wires service provider wishes to ask you to pay for any costs to connect you to their distribution system, then they are not permitted to ask you for these costs directly, instead they must issue a notice of dispute to the AUC within 14 days of finalizing the costs indicating what they consider to be extraordinary costs, and asking the AUC for permission to assess you for those costs.

If you have a complaint against your wires service provider, such as if they don't provide an interval meter without cost for a small micro-generator, you can issue a notice of complaint against them. You must issue your complaint within 14 days from receiving the denial from them. You fill out the 1-page notice of complaint form on page 36 of the AUC's Micro-Generator Application Guide and send it to the AUC.

In any of these cases, the AUC will review the application and the dispute or complaint, ask for clarifying information from you and from the wires service provider, rule on the issue, deliver their decision and require you and the wires service provider to respond accordingly.

The Micro-Generation Regulation is not clear what would happen if there are other disputes or complaints, such as the wires service provider not responding within 14 days of your application. Because the AUC has strong arbitration and enforcement roles in settling issues between parties, it is likely that you or your wires service provider could approach the AUC to settle any issue.

A.7. Micro-Generator Interfaces

Electricity generators are typically configured as "induction," "synchronous" or "inverters." Induction generators need an external excitation voltage in order for it to start generating; synchronous generators generate their own voltage waveform independent of the waveform on the grid to which they are connected (and so they need to be operated in phase with the grid); inverters, also known as static inverters (as opposed to rotating motor-generator inverters), are electronic devices that convert direct current (DC) electricity into alternating current (AC) electricity. All DC generators require connection to an inverter in order to generate energy for on-site AC electrical equipment and the grid.

Wind turbine generators can incorporate induction, synchronous or DC generators. Some small wind generators generate variable frequency current and so are connected to AC to DC to AC inverters, which take the wild-frequency AC current and convert it to grid-frequency current in phase with the grid.

A.8. Power Factor and Micro-Generators

The electricity grid is not just about electricity flowing through wires. It is an extremely complex marvel of physics and electrical engineering. One engineering characteristic of the grid is called "power factor."

Background

"Energy" accomplishes "work." Power is the speed at which the energy accomplishes the work. Power factor is the ratio between active power and apparent power in the electricity grid.

Active power is the speed of the useful work that we want to accomplish with the electric energy. Apparent power is what the electric power *appears* to be, except that it is reduced by what is known as reactive power. Reactive power is the speed at which electric energy is stored in magnetic fields caused by the electric current flowing in wires and in electric fields caused by the electric voltage between the wires. This stored reactive energy is an electric inertia that reduces the speed of work that the apparent power can do.

Practical Consequences

The stored energy in the wires in the grid and in electricity consuming equipment causes electric currents to flow back to the generators from the loads without accomplishing the useful work that we want to be done by the electrical equipment. It causes more energy to be wasted in carrying the electricity back and forth.

These circulating currents add to the current that does do the work and so larger and thus more expensive wires, transformers, switchgear and generators are required.

Wires service providers supply customers with "apparent electric energy" (measured in kVAh), but only bill them for "active electric energy" (measured in kWh). Standard energy prices in the industry accommodate the energy losses and meter differences associated with a minimum power factor of 0.9 under peak conditions.

Wires service providers typically charge additional costs to commercial or industrial customers who have a power factor below this value, or require that they employ power factor correction equipment.

The cheapest power factor for generators, load customers and the wires service providers is a value of one, which is when the reactive power is zero and so the active power and apparent power have the same value. Correcting low power factors can be accomplished in ways that go far beyond the intent of this report. Though inverters typically have power factors of one, they can also be designed to help correct power factor for sites that have power factor issues caused by electrical consuming equipment in order to assist the grid.

Site Power Factor Issue

When an on-site generator generates electricity into the site's loads, the amount of real power drawn from the grid is reduced, but the amount of reactive power used by the loads remains unchanged. As a result, the power factor decreases dramatically. In fact, when the site starts to export electricity, the power factor is at zero.

The wires service providers' terms and conditions of service require that you maintain power factors above 0.9; however, this is not possible, as described above. Though your site may be able to meet the power factor requirement the majority of the time, it cannot meet the requirement all of the time. For unknown reasons, this does not seem to have been raised or addressed by Alberta's wires service providers. Your wires service provider should know whether any of this is an issue for your site.

It is not known whether a wires service provider could afterwards charge a micro-generator owner additional fees or require power factor correction.

A.9. Sizing a Micro-Generator for its Electricity Generation

A wind generator can be sized to provide a portion or all of the annual site energy consumption, or sized to meet a particular budget.

The amount of electrical energy that a wind generator can generate strongly depends on a number of site conditions, including the rated capacity of the generator, its speed-power performance curve, the wind speeds where it is located, its height above the ground, and the turbulence and wind shading caused by nearby obstructions such as trees and building. Wind speeds are significantly affected by local hills and other landforms. It has been found that the speed-power curves of some small wind generators cannot be reliably used in estimating the performance of the generator.

It is recommended that a wind generator be only purchased from local reputable suppliers that can confidently estimate its annual energy generation in writing along with a reasonable annual variance.

One method of obtaining a reasonable wind energy generation estimate is by using RETScreen, Natural Resources Canada's pre-feasibility analysis spreadsheet software, which is downloadable without cost from www.retscreen.net. RETScreen has data for many locations around the world. It can be used in combination with wind speed data from Wind Atlas, www.windatlas.ca, which provides simulated wind speeds for regularly spaced intervals across Canada. For technical reasons, you must take care in estimating the wind energy generation. The results of your simulation could well be reasonable if qualified wind suppliers also assess the site conditions and your results.

A wind generator's "capacity factor" is important to note here (see Section 3.3 of this report). There can be many wild guesses about the energy generation of a small wind generator, so its capacity factor should be calculated in order that it can be compared to what may be reasonable for your area.[152] Annual capacity factors of 35% may be reasonable in very windy areas for large wind generators. Smaller wind turbines tend to have lower capacity factors, typically 20% and down to 10% in low wind-speed areas.

A.10. Sizing a Micro-Generator to be within the Micro-Generation Criteria

In order that a wind generator is eligible under the Micro-Generation Regulation, the regulation limits its size and location in three ways:

1. *The amount of energy generated "is intended to meet all or a portion of the customer's electricity needs." [Micro-Generation Regulation 1(1)(h)(ii)]*

   The phrase "all or portion" is evaluated on an annual basis. To understand whether your wind generator meets this condition you need to know your annual electrical energy consumption and the predicted amount of annual electrical energy to be generated.

   It is not clear whether a wind generator will be permitted to be considered under the Micro-Generation Regulation if it consistently generates more electrical energy annually than a site consumes. Some wires service providers appear to accept this and some don't.

   Because of the use of the term "intended," this clause can be interpreted as meaning either of the following:

   - "The goal for the amount of energy generation is to meet all or a portion of the annual energy consumption," which implies that "all or a portion" is the minimum annual amount of energy generation.
   - "The amount of annual energy generation cannot exceed the annual on-site electrical energy consumption," which implies that the annual energy consumption is the maximum permitted to be generated.

   We would prefer the former interpretation, but some wires service providers and the AUC have interpreted it as meaning the latter. If your wind generator generates more electricity than you use then you would need to do one of the following:

   a. intentionally consume more electrical energy before you submit your application
   b. reduce the size of your generator
   c. submit your application as a micro-generator and then wait to possibly challenge the clarity of this clause to the AUC if your wires service provider denies your application

2. *The generator "is, at the time of construction or installation of the generating unit, sized to the customer's load or anticipated load or a portion of it, as evidenced by a total nominal capacity of the generating unit that does not exceed the rating of the customer's service." [Micro-Generation Regulation 1(1)(h)(iii)]*

   There are two known grey areas in the interpretation of this clause:

   - What does "load" mean?
     a. To some people it means "annual energy consumption in kWh per year."
     b. In the design of electrical systems it means "peak power consumption in kW."

   We would prefer the former interpretation, but there have been cases where a wires service provider has converted the annual site energy consumption in kWh into average demand in kW, and then denied a wind turbine as a micro-generator because the generator's capacity in kW was greater than the average demand.

   Comparing average site usage power in kW to generator capacity in kW is not an appropriate understanding of the operation of wind turbines. It does not consider the wind generator's capacity factor (typically 20 to 35%) and the site load capacity factor (typically 1 to 20%). If such a case arises again, it would be good for the generator owner to challenge the denial to the AUC.

- What does "customer's service" mean?
    a. To the customer and to the Canadian Electrical Code, "customer service" means the amperage rating of the main breaker panel in the house.
    b. To the wires service provider this typically means your site's distribution transformer rating.

We would prefer the former interpretation. To understand whether your wind generator meets this condition you need to know your turbine's rated capacity, the size of your distribution transformer (on your yard pole in rural areas), and the current rating of the main breaker on the main panel board at the building on your site.

For example: A 100-amp main house breaker as de-rated to 80% can accommodate a 19 kW generator; a 200-amp house breaker can accommodate a 38 kW generator. Typically a 100-amp service on a house would have a 10 kVA transformer, which apparently has an over-capacity rating of 150%. There have been cases where a wires service provider has denied a 20 kW wind turbine on a house with a 10 kVA transformer because turbine did not satisfy this clause, though the house breaker did satisfy the clause. If such a case arises again, it would be good for the micro-generator owner to challenge the denial to the AUC.

3. *The generator "is located on the customer's site or on a site owned by or leased to the customer that is adjacent to the customer's site". [Micro-Generation Regulation 1(1)(h)(v)]*

"Site" is defined to mean "a customer's unique end-use service delivery point for electricity services." [Micro-Generation Regulation 1(1)(m)]

There are two known grey areas in the interpretation of this clause:

- What does "unique end-use service delivery point" mean?
    a. This is most clearly understood to be a parcel of land with one meter where a wind generator would be connected to the loads going through that meter.
    b. It is not clear whether it also includes a parcel of land with more than one meter to the same customer, such as where a house has one meter and a wind turbine has a separate meter on the same land.

We would prefer the latter interpretation be included.

- What does "adjacent to" mean?

It may be that this clause would disqualify a wind turbine from being a micro-generator in a situation where a customer owns three pieces of land: piece A has the load service and is bordering piece B, piece B has no load service and is bordering piece C, and piece C has the wind generator and is not bordering piece A. It is not clear whether the generator would meet this clause even though the customer's intent would be on generating their own energy.

We would prefer that any piece of land be included regardless of where the energy consumption and generation are located.

A.11. Safety Equipment Required for the Grid-Connection of Micro-Generators

Required Certification Mark

All electrical components and equipment must contain an authorized certification mark integrated into its nameplate that is one of the certification marks shown in the Electrical Safety Information Bulletin STANDATA LEG-ECR-2.[153] No other mark is valid. If any piece of electrical equipment does not have an authorized certification mark it is not permitted to be offered for sale, sold, nor installed. No electrician is permitted to install it. No electrical inspector is permitted to allow an electrical installation to pass an electrical inspection with uncertified equipment in it.

Anti-islanding

An electrical "island" is where a portion of the electric distribution system continues to operate during an electrical outage. If not properly controlled, this can present an extreme safety hazard to linemen working on the distribution system. To ensure proper safety, a generator is either required to shut down during an electrical outage or completely disconnect itself from the distribution system. This shut down or disconnection, called anti-islanding, is of utmost safety importance to wires service providers.

Inverters and other electronic control equipment that are certified to shut down or disconnect during electrical outages, continuously monitor characteristics of the grid, such as voltage and frequency, to detect when an electrical outage is happening. When the outage is detected, the electronic controls shut down or disconnect their equipment within milliseconds of the outage, and then continue to monitor the grid to detect when the outage ends. When the outage ends, then they wait for five minutes to ensure that the grid is stable before turning on their generating equipment again.

Inverter Anti-islanding

Grid-connected inverters are required to be approved to Clause 15 of the Canadian Standards Association (CSA) inverter standard, C22.2 No.107.1, and to be certified for connecting to the grid. The certification to Clause 15 of this standard ensures that, during an electrical outage, the inverter will either properly shut down or, if connected to a battery bank, disconnect from the grid and remain operational.

Inspecting Equipment for Certification

It is highly recommended, as a condition of purchase for all your electrical equipment that you include in your purchase agreement a clause that states that all the equipment must meet Canadian certification, and require that your supplier provide you with evidence of this in writing before you purchase your equipment. This could save you considerable costs, delays and hassle if the equipment is not properly certified. It is also recommended that you check your equipment for these certification marks immediately upon delivery and decline to receive them if they don't have the correct marks.

If a piece of equipment does not contain such a mark, then require your supplier to phone the Canadian Standards Association at 1-800-463-6727 (press 3) to inquire whether it is able to get a special inspection or not. If the equipment does not have a mark then considerable costs, delays and issues can arise, the costs of which could be more than $5,000, with delays of months or the distinct possibility of the equipment not being permitted to be used.

Safety of Synchronous and Induction Generators

Synchronous and induction generators also require electronic controls that either shut down or disconnect the generator from the grid during electrical outages. You need to ensure that these controls are certified for connecting to the grid in Canada and that your wires service provider approves of them and their anti-islanding settings.

Authority of the Wires Service Provider

Rule 84-002 of the Canadian Electrical Code requires that the connection arrangements of your wind generator be agreeable to your wires service provider. You need to ask them about their requirements to connect to the grid. Your wind generator must not adversely affect the safety of their electric system.

Grid Disconnect Switches

Rule 84-024 of the Canadian Electrical Code specifies the characteristics of the grid disconnect switch required on your wind generator. Contact your wires service provider to ensure that your plans are acceptable to them. If your system is inverter-based, typically your wires service provider will accept your branch circuit breaker as the grid disconnect, but it is recommended however that a separate disconnect be installed if the inverter or generator is out of sight or more than 5 m from the breaker panelboard.

A.12. Micro-Generator Performance Measurement

There are a number of ways to measure the performance of your wind generator. The simplest is by installing a standard utility-certified kWh energy meter on your generator's output before it feeds into the breaker panelboard. You would then read the energy meter as often as you want and put the readings onto a spreadsheet in order to keep track of them and do a simple analysis.

Many inverters and other electronic equipment also have web site data-feed capabilities, where they can export their performance data directly through high-speed internet onto a web site of their manufacturer for you to access, usually for free. If your budget permits, you could purchase separate monitoring equipment from a variety of manufacturers and suppliers to measure, display and analyze the performance of your wind generator.

Along with the above measuring instruments, you could also manually read the import and export channels of your site's utility energy revenue meter and calculate a number of other very interesting parameters. The equations for these simple calculations are as follows:

Duration of time between meter readings [days]

$$T_{ELAPSED} = \text{date, time of present reading} - \text{date, time of previous reading} \qquad \text{Eqn 1}$$

Site energy consumption fed directly from grid [kWh/day]

$$E_{IMPORT} = (\text{present reading of utility import kWh meter} - \text{previous reading}) / T_{ELAPSED} \qquad \text{Eqn 2}$$

Wind energy exported directly to grid [kWh/day]

$$E_{EXPORT} = (\text{present reading of utility export kWh meter} - \text{previous reading}) / T_{ELAPSED} \qquad \text{Eqn 3}$$

Wind energy generation [kWh/day]

$$E_{WIND} = (\text{present reading of wind generation kWh meter} - \text{previous reading}) / T_{ELAPSED} \qquad \text{Eqn 4}$$

Site energy consumption [kWh/day]

$$E_{LOADS} = E_{WIND} + E_{IMPORT} - E_{EXPORT} \qquad \text{Eqn 5}$$

Site energy consumption fed directly from wind [kWh/day]

$$E_{DIRECT} = E_{WIND} - E_{EXPORT} \qquad \text{Eqn 6}$$

Average wind power generation [kW]

$$P_{WIND} = E_{WIND} / 24 \qquad \text{Eqn 7}$$

Net fraction of site energy consumption provided by the wind generator [%]

$$F_{WIND} = E_{WIND} / E_{LOADS} \qquad \text{Eqn 8}$$

Net fraction of site energy consumption provided directly by the grid [%]

$$F_{IMPORT} = E_{IMPORT} / E_{LOADS} \qquad \text{Eqn 9}$$

Net fraction of site energy consumption provided directly by wind [%]

$$F_{DIRECT} = E_{DIRECT} / E_{LOADS} \qquad \text{Eqn 10}$$

Fraction of daily wind generation that is exported [%]

$$F_{EXPORT} = E_{EXPORT} / E_{WIND} \qquad \text{Eqn 11}$$

Wind generator system final yield [hours/day] [154]

$$Y_{WIND} = E_{WIND} / \text{wind generator rated capacity [in kW]} \qquad \text{Eqn 12}$$

Wind generator system capacity factor

$$CF_{WIND} = Y_{WIND} / 24 \qquad \text{Eqn 13}$$

Endnotes

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151 The latest and historic prices of Alberta's Electricity Market may be viewed through the AESO's Energy Trading System at ets.aeso.ca. The AESO document, *Determining the Wholesale Market Price for Electricity* (available at www.aeso.ca/files/fastfacts_det_market_5_may06.pdf) provides information about how the electricity market is calculated.

152 Capacity factor equals annual electricity generation (or consumption) in kWh per year divided by the number of hours in the year (8766) divided by the rated wind generator capacity in kW. Units: %.

153 Electrical Safety Information Bulletin, STANDATA LEG-ECR-2, www.municipalaffairs.gov.ab.ca/documents/ss/STANDATA/electrical/330-LEG-ECR-2unsigned.pdf.

154 A system final yield is the amount of time that the generator could have operated at its rated capacity in order to generate the same amount of energy that was actually generated.