A Guide to Support Indigenous Renewable Energy Development in Alberta

Alberta Government

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PREFACE

Have you ever heard of Charles David Keeling? He can be considered one of the scientists that founded what we call today climate change science. Keeling, a chemistry PhD scientist, focused his career and research on the measurement and analysis of the concentration of carbon dioxide (CO_2) in the atmosphere. CO_2 is the most prominent of several greenhouses gases (GHG) found in the atmosphere and allows for temperatures suitable for living species. GHG can be viewed as a blanket around the earth that protects it. Without GHG, due to the distance between the earth and the sun, our planet's temperature would be around -18°C.

Keeling's work dates back to 1958 when he started recording CO_2 concentration levels from undisturbed air on the top of the Mauna Loa volcano in Hawaii, at 3,397 meters above sea level. In parallel, he also extracted ice cores in the Antarctic to estimate CO_2 concentration levels from trapped air bubbles in snowflakes from hundreds of thousands of years ago. The results show that CO_2 levels in the atmosphere have indeed varied in the last 400,000 years. This showcases the different eras in history, such as the ice ages. However, his research also provided evidence regarding an alarming trend.

For the last two centuries, after the start of the industrial revolution, CO_2 concentration levels in our atmosphere have reached levels never seen before in the history of human civilization on earth (2.5 million years ago). More concerning is the rapid and exponential growth of these levels since the 1950's. While still open to some debate, 97% of scientists worldwide agree that this increase has been caused by human activities.

Human made, or anthropogenic emissions, result from the combustion of carbon (burning of coal, gas and oil) contained in fossil fuels. These fossil fuels are being extracted and combusted into the air much faster than the millions of years it takes to form them. On the flip side, oceans and forests, known as sinks that capture CO_2 from the atmosphere, are increasingly being affected by phenomena such as ocean acidification (absorption of CO_2) or by the reduction of our earth's forests. This is reducing the ability of both sinks to capture CO_2 and to help maintain the carbon cycle.

The increase in CO_2 has strengthened the GHG effect, which will result in an increase of the earth's overall temperature. A slight temperature increase (2° to 3°C) would result in catastrophic effects such as extreme weather changes, increases in sea level (due to the melting of the Arctic and Antarctic ice), and disappearing islands. Some of these consequences are already occurring.

While these concerns became a topic of discussion in the scientific communities in the 1970's, it was not until 1992 that global awareness of climate change started, with the Rio Earth Summit on environment and sustainable development. Since then, some initiatives, such as the Kyoto Protocol, have been introduced to combat climate change, however, it is experiencing limited success. It was not until December, 2015, in Paris, during the Conference of Parties (COP) 21, that 195 government leaders committed to undertake ambitious efforts and strengthen their level of response to keep global temperature rise below 2°C. As part of this agreement, the Government of Canada signaled its intention to reduce greenhouse gas (GHG) emissions by 30% below 2005 levels by 2030.

In line with this, the Government of Alberta introduced its Climate Leadership Plan (CLP) in November 2015. In this Plan, the Government of Alberta established a priority goal to reduce GHG emissions from the electricity sector. In 2015, the electricity sector in Alberta accounted for 18% of total GHG emissions.

Around the globe, the use of technologies that harvest renewable energy sources such as wind or solar PV to generate electricity, while keeping low GHG emissions, has become a key driver to achieve this goal. In alignment with four of six policy directions of the CLP, Indigenous Relations has rolled out seven Climate Leadership Programs for Indigenous communities and organizations in Alberta. One of the programs announced was the Alberta Indigenous Green Energy Development Program (AIGEDP), which aims to support Indigenous communities and organizations to acquire an ownership stake in Alberta's rapidly-expanding renewable energy sector. This guidebook aims to support the participation in the AIGEDP.

Indigenous Relations, Renewable Energy Team

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USING THIS GUIDEBOOK

This guidebook provides an introduction to renewable energy, describes the current context for renewable energy development in Alberta and takes you through the project development process.

The publication includes seven chapters:

Chapter 1: Introduction to Renewable Energy gives an overview of the different types of renewable energy technologies and the various project scales available for development.

Chapter 2: Renewable Energy in Alberta provides an overview of the primary drivers in Alberta for renewable energy development, the key programs available, the regulations applicable during the development process and the main considerations for Indigenous communities.

Chapter 3: Considerations before Starting the Renewable Energy Development Process explains the most important factors to consider before starting a renewable energy project, including from a legal and financial perspective. It identifies the main parties involved in the development and implementation of renewable energy projects.

Chapter 4: The Project Development Process describes the main steps in the renewable energy project development process, including preliminary screening, predevelopment, development, construction, and operations and maintenance

Chapter 5: Engineering, Procurement and Construction (EPC) outlines each of the key EPC phases and what steps are involved.

Chapter 6: Operations and Maintenance outlines what is involved in the operations and maintenance of a renewable energy project and some of the key contracting, budgeting and project-specific considerations to keep in mind.

Chapter 7: Frequently Asked Questions answers the questions related to renewable energy technologies and the development process that are commonly asked.

You don't need to read the publication cover to cover in order to benefit from it. You may want to spend more time on some areas and less on others. Use the detailed Table of Contents to find topics that apply to your specific situation and needs. For your reference and to support better understanding of the information, the Glossary and Measurement Units and Abbreviations listing are found on page 145, and page 151 respectively.

Throughout the publication you'll find references to useful websites and other resources with further information on a variety of topics.

Boxes in green highlight some of the key take-aways from a section

Boxes in orange provide case studies and examples

Boxes in grey provide a closer look at specific technical concepts

CHAPTER 1:

Introduction to Renewable Energy

WHAT IS RENEWABLE ENERGY?

Renewable energy is any form of energy derived from a renewable energy resource. Alberta's Renewable Electricity Act defines a renewable energy resource as follows:

"an energy resource that occurs naturally and that can be replenished or renewed within a human lifespan, including, but not limited to,

1. moving water,
2. wind,
3. heat from the earth,
4. sunlight, and
5. sustainable biomass."

Renewable energy is energy that has been produced from a renewable energy resource, which is a resource that occurs naturally and can be replenished or renewed within a human lifespan.

Renewable energy can take a variety of forms, including:

> renewable electricity
> renewable heat
> renewable liquid fuels
> renewable solid fuels.

Figure 1 summarizes the different renewable energy types and the common technologies that are available to capture energy from these renewable resources.

The different renewable energy resources and how energy is produced from each will be explored in more detail later in this section.

Renewable energy generation, unlike energy generation from traditional fossil-fuels, does not emit high levels of greenhouse gases. Using renewal resources to meet energy needs typically results in less pollution of the air, water and land than using fossil fuels or nuclear energy sources. In addition, local decentralized renewable energy projects can offer some degree of energy independence and security and also bring additional jobs and other local economic development opportunities.

Some renewable electricity generating technologies include solar photovoltaics (PV), wind turbines, geothermal power plants, biomass power plants, small hydropower and tidal or wave energy power plants.

Some non-electricity renewable energy producers include solar space heating, solar water heating, direct-use geothermal energy and biofuels.

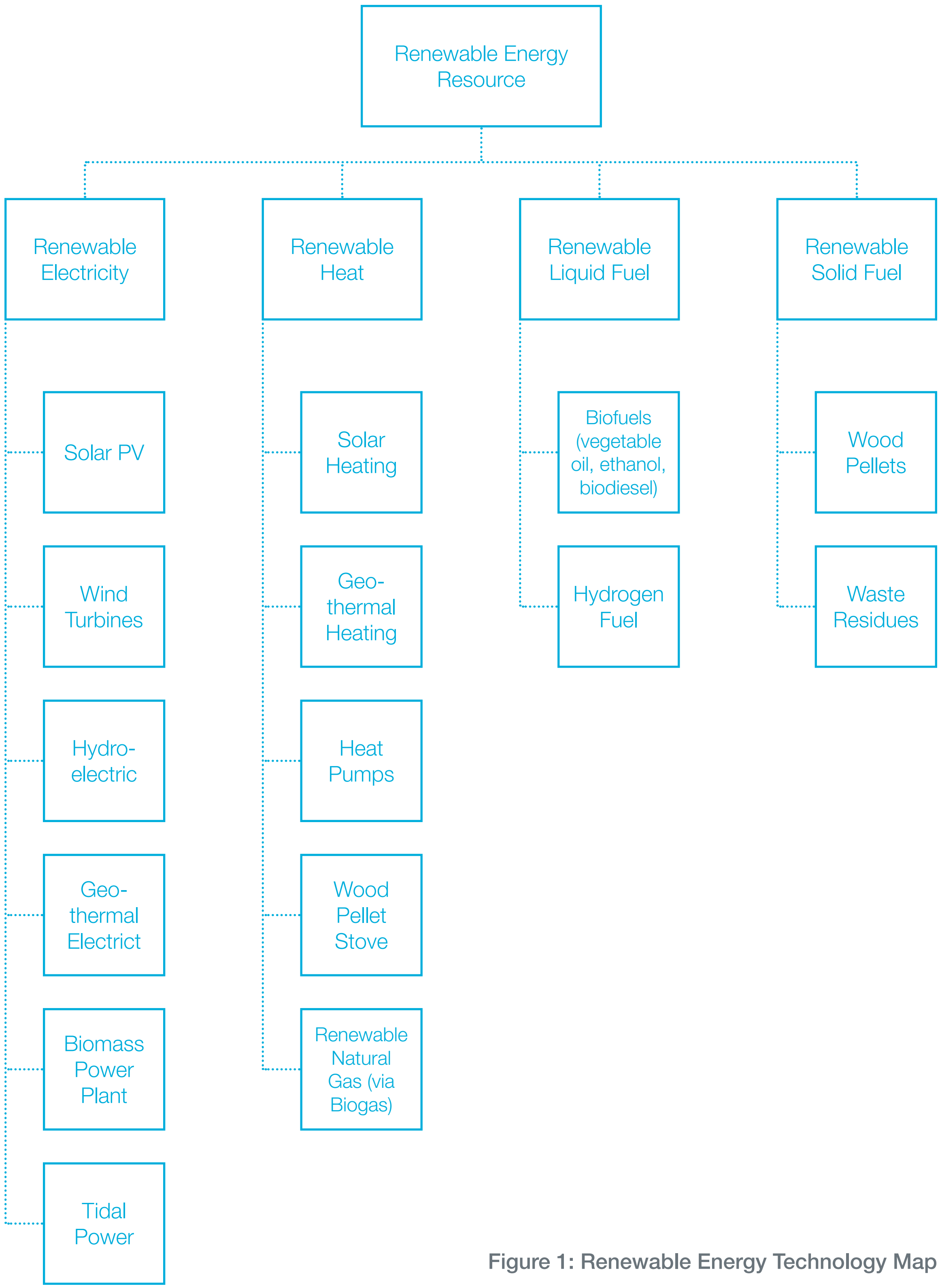


Figure 1: Renewable Energy Technology Map

Electric Capacity versus Electricity Generation (Power versus Energy)

Electric capacity—the ability to generate electricity—is measured in watts. To describe the capacity of a power plant, the terms kilowatt (kW = 1,000 watts), megawatt (MW = 1 million watts) and gigawatt (GW = 1 billion watts) are most commonly used.

Electricity generation is the process of producing electric energy by transforming other forms of energy using this capacity and is measured in watt hours (W-h). The terms kilowatt hour (kW-h = 1,000 W-h), megawatt hour (MW-h = 1 million W-h) and gigawatt hour (GW-h = 1 billion W-h) are most commonly used. A watt hour is the electricity made or used by a one watt device for one hour.

The amount of electricity produced by a facility over an hour or a year will be lower than the maximum rated capacity of the facility. Environmental characteristics of the site will prevent a facility from operating at 100% capacity all of the time. For example, solar PV panels will not produce any electricity at night, or a wind farm will not produce any electricity if the wind is not blowing. A plant's "capacity factor" is the average percentage of maximum capacity at which it generates electricity. For example, a solar PV facility that converts solar energy into electricity could have a capacity of 5 MW. If it generates 10,950 MW-h over a given year, its capacity factor is 25%. A plant's capacity factor is often measured annually due to the seasonal nature of some resources. The following shows a sample capacity factor calculation:

Total Generation Capacity = 5 MW * 8,760 hours per year = 43,800 MW-h
Actual Annual Generation = 10,950 MW-h
Capacity Factor = Actual Annual Generation / Total Generation Capacity
= 10,950 MW-h /43,800 MW-h = 25%

Average annual capacity factors for utility-scale electricity generation projects

Technology	Capacity Factor
Nuclear[1]	92%
Geothermal[1]	74%
Landfill Gas[1]	70%
Biomass[1]	56%
Natural Gas Combined Cycle[2]	49%
Coal[2]	67%
Conventional Hydropower[2]	22%
Wind[2]	35%
Solar PV[1]	25%

Source: U.S. Energy Information Administration[1] and AESO 2017 Market Statistics[2]

[1] U.S. Energy Information Administration, Electric Power Monthly, Annual Capacity Factors for Utility-Scale Generation Not Primarily Using Fossil Fuels, January 2018. https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b

[2] AESO 2017 Market Statistics. https://www.aeso.ca/download/listedfiles/2017-Annual-Market-Stats.pdf

SOLAR ENERGY

The sun's energy creates heat and light to support life on earth. Solar energy can also generate electricity or heat spaces and water. Several different types of technology are used to convert solar energy into electricity or heat.

Solar Photovoltaic (PV)

Solar PV panels convert sunlight directly into electricity. PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the PV effect. The PV cell consists of one or two layers of a semi-conducting material. When light shines on the cell, it creates an electric field across the layers, causing electricity to flow. A PV system does not necessarily need bright sunlight—it can generate electricity on cloudy days

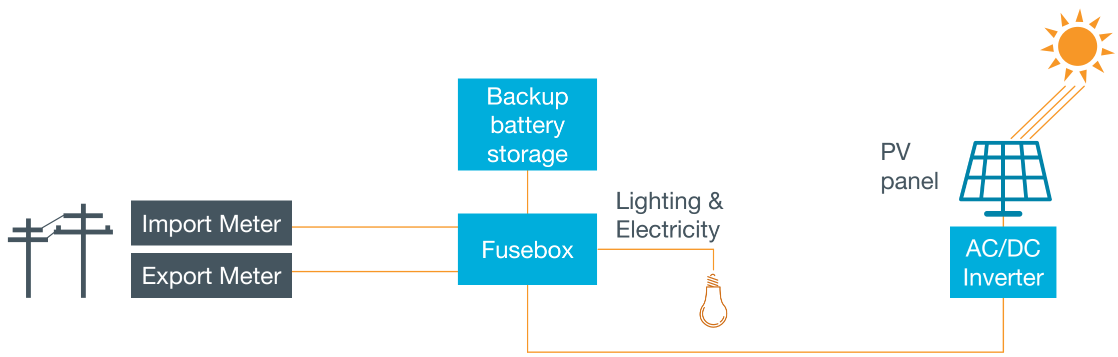


Figure 2: Electricity generation from solar energy – conceptual sketch

Solar Thermal Collectors

Solar thermal collectors absorb the incoming solar radiation, convert it into heat and transfer the heat to a fluid (typically air or water) flowing through the collector. The

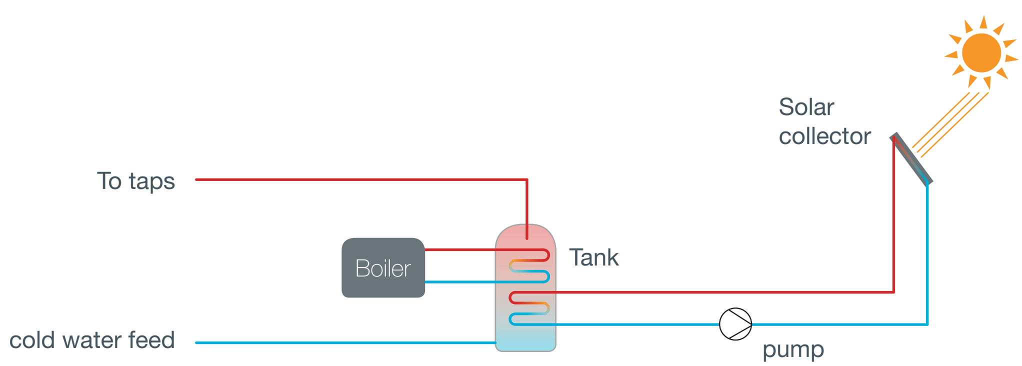


Figure 3: Heat generation from solar energy – conceptual sketch

two basic types of collectors are concentrating and non-concentrating (or stationary). Most of the solar thermal collectors installed in Alberta are non-concentrating, because only the southern latitudes in Alberta have enough solar intensity for concentrating solar plants. A 1-MW concentrating solar plant is installed in Medicine Hat as a demonstration project.

Solar Resource in Alberta

Alberta is one of the most solar-rich provinces in Canada and has an abundance of solar energy available. As of February 2018, there were more than 2,300 solar micro-generation facilities in Alberta with combined installed capacity of 24 MW.[3] There were also 77 proposed utility-scale solar electricity generation facilities with a combined capacity of more than 3,900 MW.[4] Calgary and Edmonton are both among the top five cities in Canada in terms of yearly PV potential. A solar resource map of Alberta is provided in Appendix E, page 170.

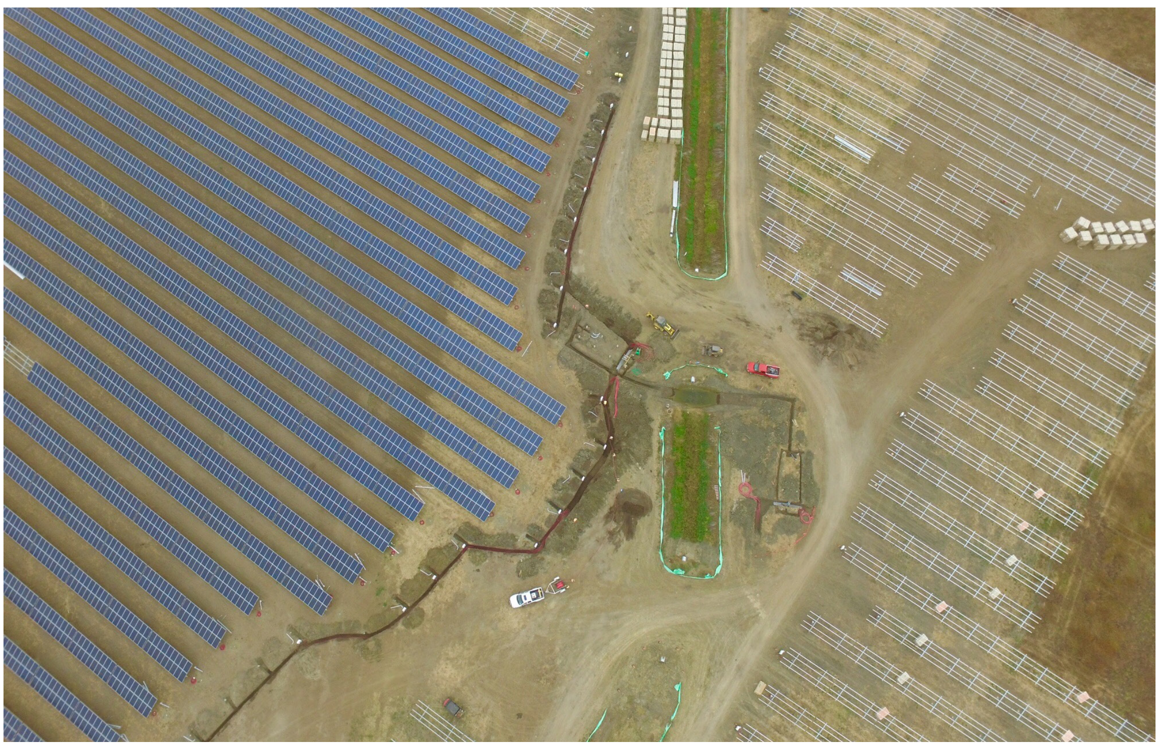


Figure 4: 17MW Brooks 1 Solar Power Plant, Alberta

[3] Alberta Electricity System Operator, Micro-generation in Alberta, February 2018. https://www.aeso.ca/download/listedfiles/2018-Feb-MicroGen.pdf

[4] Alberta Electricity System Operator, Final February 2018 Project List, February 2018. https://www.aeso.ca/assets/Uploads/Final-February-2018-Project-List.xls

WIND ENERGY

Wind energy indirectly comes from solar energy. As the sun heats up the earth's surface and the atmosphere at different rates, warm air rises and heavier, cooler air fills the void. This air movement creates wind. Wind energy is harnessed from the wind via mechanical means.

Wind energy has been used for over two millennia. Windmills were typically used to pump water or grind grains. Windmills were first used to generate electricity in the late 1800s and early 1900s. Since then, modern wind turbines have been designed to capture faster, less turbulent wind at a higher height to produce more electricity.

Wind Turbines and Wind Farms

A wind turbine typically has three blades connected to a tower. The two major types of wind turbines are horizontal axis and vertical axis turbines. The horizontal axis wind turbines are the most common type.

A wind farm is a collection of several wind turbines in the same area generating electricity.

If situated in a favourable site for wind availability, a well-designed wind energy system can offer many years of reliable, cost-effective, clean, low air pollution electricity.

Several wind farms exist in Alberta, primarily in southern and western Alberta. The first commercial wind farm in Canada was built near Pincher Creek, Alberta, in 1993.

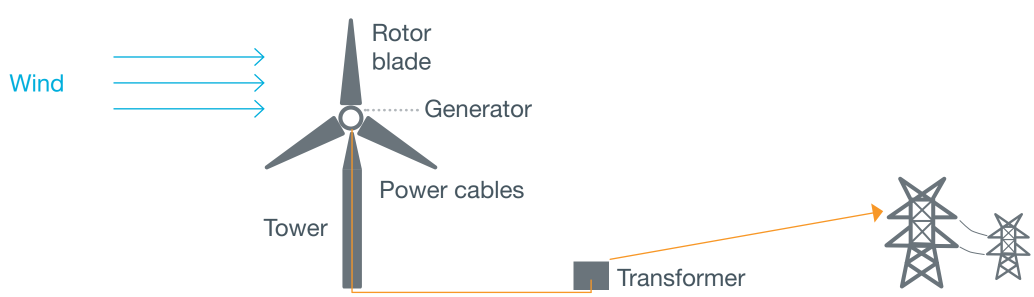


Figure 5: Wind energy system - conceptual sketch

Wind Resource in Alberta

Alberta has approximately 1,479 MW of installed wind capacity from 901 turbines across 38 projects as of January 2018. Wind power represented just under 9% of the electricity generation capacity in Alberta in 2016.[5] Based on wind resource assessments, it is estimated that over a third of Alberta's land base has wind resources suitable for wind energy production. From the results of the first round of Alberta's Renewable Electricity Program (REP), an additional 595.5 MW of wind capacity is expected to become operational by 2019. A wind resource map of Alberta is provided in Appendix E, page 170.

Figure 6: Wind Farm Near Pincher Creek Alberta

[5] CanWEA, Installed Capacity, 2016. https://canwea.ca/wind-energy/installed-capacity/

WATER ENERGY

Energy can be captured from water wherever a flow of water descends from a higher level to a lower level. The movement of water turns the blades of a turbine, which in turn generates electricity. Electricity generated from hydroelectric technology can either be produced from large-scale plants or micro-generation projects. Hydropower plants can be classified according to the type of operation.

Reservoir or Storage Plants

Reservoir plants are characterized by impounding water upstream of a dam structure to create a reservoir. Water is predominantly stored during high-flow periods and consumed for energy production during low-flow periods. Using stored water to generate energy creates some security against natural fluctuations in water availability caused by weather and seasonal variations. Reservoir size determines the amount of flow regulation. Alberta has approximately 800 MW of installed reservoir hydroelectric capacity. There are two relatively large units, Brazeau and Bighorn, and a system of 11 smaller units on the Bow, Spray and Kananaskis Rivers.

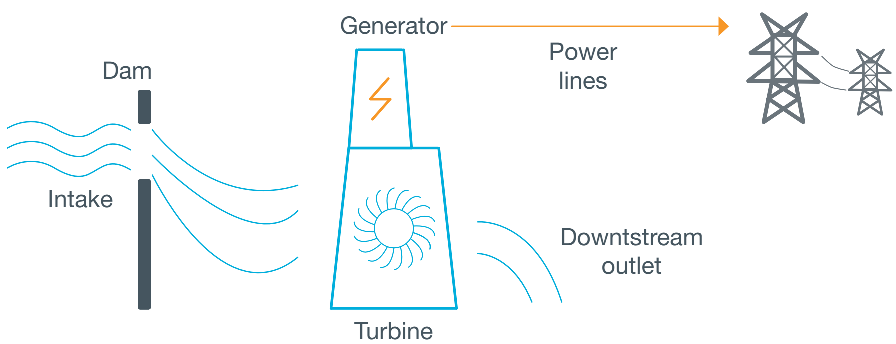


Figure 7: Reservoir hydroelectric power generation concept sketch

Run-of-river Plants

Run-of-river schemes generate electricity through the immediate use of the water flow. These plants rely on a river's natural flow and drop in elevation. They use a small ring dam to direct water toward the turbines. These units are smaller in scale then reservoir plants, with sizes ranging from 2 MW to 32 MW. Run-of-river plants are subject to weather and seasonal variations, which results in variable power generation and revenue uncertainty. Most run-of-river schemes have no storage capacity or limited storage, which limits peak power operation to a few hours. Approximately 100 MW of capacity is installed in Alberta.[6]

[6] Alberta Department of Energy, Energy Potential and Metrics Study – An Alberta Context, 2014. http://www.energy.alberta.ca/AU/Publications/Documents/2014EPMSstudy.pdf

Pumped Storage Plants

Pumped storage plants store water by pumping it from a lower reservoir or a river to a higher reservoir. Water is typically pumped during times of lower electricity demand (lower demand equals lower priced supply) to make more water available for electricity generation during peak demand periods. This process creates efficiencies of up to 80%—pumping uses 20% or more energy than is generated when an equal amount of water is released downwards through the turbine.

Water Resource in Alberta

According to the Canadian Hydropower Association, the technical potential for hydropower in the province is 11,800 MW. Current installed capacity is approximately 900 MW across approximately 23 projects.[7] In 2016, this represented 5% of the total electric capacity in Alberta.[7] Approximately 75% of this ultimate potential is contained in the Athabasca, Peace and Slave River basins in the northern part of the province. The remaining 25% is in the Red Deer, North Saskatchewan and South Saskatchewan River basins in the southern part of the province.[8] The current installed capacity is almost all in the North Saskatchewan and South Saskatchewan basins. A water resource map of Alberta is provided in Appendix E, page 170.

Figure 8: 32MW Oldman River Hydro Project

[7] Canadian Hydropower Association, Hydropower potential, 2018. https://canadahydro.ca/hydropower-potential/

[8] Alberta Electric System Operator, Annual market Statistics, 2017. https://www.aeso.ca/download/listed-files/2017-Annual-Market-Stats.pdf.

GEOTHERMAL ENERGY

Geothermal energy is the heat energy contained in the rock and fluid of the earth's crust and originating from the earth's core. Water near these heat sources will have higher temperatures than typical underground water resources. In some instances the water will be converted to steam. Geothermal energy can be harnessed for a variety of functions, including electricity production, direct heat and heat pump use.

Geothermal electric power plants use the hot water or steam to power a turbine, which in turn generates electricity. The technology could potentially make use of abandoned, suspended and even active oil and gas wells.

Many different geothermal technologies are available, but all systems generally require three key elements: heat, fluid and permeable reservoir.

Direct Use

Direct use of a geothermal resource means using the heat energy from the geothermal water directly. Examples of direct use include space heat for buildings, district heating, agriculture (soil and greenhouse warming), industrial (product heating or drying) and bathing (hot springs). Typically, a geothermal resource suitable for direct use is below 80 °C.

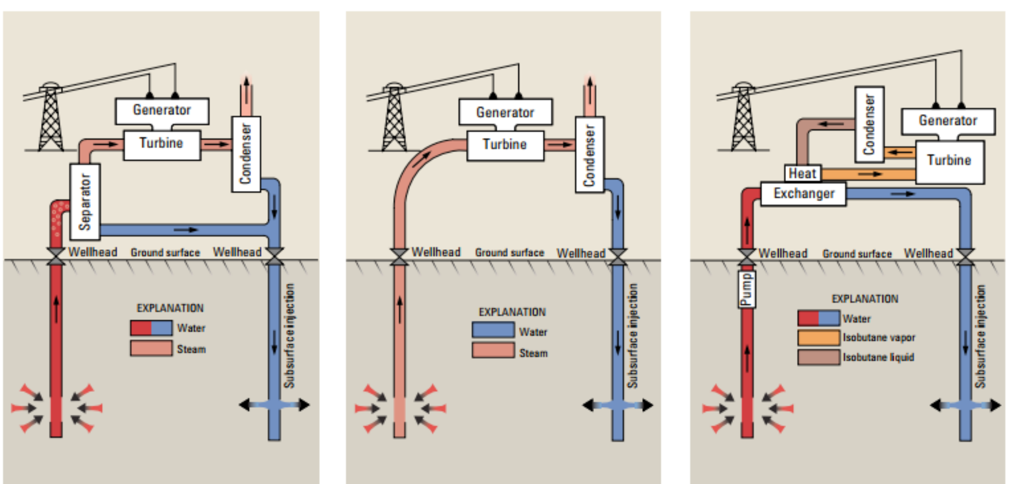


Figure 9: Geothermal power plant concept sketches, flash steam (left), dry steam (centre), binary cycle (right). Source: Adapted from United States Geological Survey[9]

[9] Duffield, W., and Sass, J., United States Geological Survey, Geothermal Energy – Clean Power From the Earth's Heat, 2003. https://pubs.usgs.gov/circ/2004/c1249/c1249.pdf

Ground-Source

Ground-source heat pumps use the earth or groundwater as a heat source in winter and as a heat sink in summer. Heat pumps are the most universally applicable geothermal technology.

Geothermal Power Plants

A number of different energy conversion systems can be used to take geothermal fluids, process them, produce electricity and then dispose of or recycle the fluids. Traditional types of plants include flash-steam, direct dry-steam and binary plants. Single flash-steam plants are the most common type, with 185 units in operation in 16 countries in 2014, and constitute 32% of all geothermal power plants, and 43% of the installed capacity. Conventional geothermal power plant technology required that reservoirs be hotter than 150 °C, but heat exchanger technology allows geothermal power plants to use reservoirs at between 80 °C and 150 °C to generate electricity. See Figure 9, page 14.

Geothermal Resource in Alberta

Geothermal energy has the potential to be a renewable source of heat and electricity with the ground temperatures measured in Canada. A report by Natural Resources Canada provides detail on the energy potential in Canada.[10] Currently, only direct use and ground source geothermal applications have been installed in Canada. No commercial geothermal power plants currently operate in Canada because of regulatory challenges. Some provinces are exploring the possibility of tapping into this resource, including Alberta[11] and Saskatchewan.[12] Alberta is currently reviewing the policy framework for deep geothermal, and as such, deep geothermal is not yet a defined resource in Alberta. A geothermal potential map of Alberta is provided in Appendix E, page 170.

[10] Geological Survey of Canada, Geothermal Energy Resource Potential of Canada, 2012. http://publications.gc.ca/collections/collection_2013/rncan-nrcan/M183-2-6914-eng.pdf

[11] Devon Dispatch, Geothermal well repurposing project moving ahead, 2017. http://www.devondispatch.ca/2017/10/16/geothermal-well-repurposing-project-moving-ahead

[12] Saskpower, Geothermal Agreement Signed, May 16 2017. http://www.saskpower.com/about-us/media-information/geothermal-agreement-signed/

BIOMASS ENERGY

Bioenergy is produced from renewable, biological sources, such as biomass. Biomass is plant material that can be turned into fuel (also known as biofuel) to supply heat and electricity. Bioenergy can be obtained from many forms of biofuels. Liquid biofuels can be used to run motor vehicles and forest wood residue can be used to run pulp mill and other industrial operations.[13]

Many sources of forest biomass are used to produce bioenergy:

> trees that are of harvestable age but are not suitable for lumber or other forestry products
> material harvested during stand thinning
> harvest residues
> trees killed by disturbances, such as fire, diseases or insects
> trees from plantations grown specifically to provide biomass for conversion to bioenergy.

Byproducts of industrial forest processes provide another source of biomass for bioenergy use. Among those byproducts are wood residues (such as sawdust, bark and chips) from harvesting and milling operations, and pulp residues (such as the lignin-rich “black liquors”) left over from the pulping process.

For biomass to be directed effectively into energy production, the biomass must be supplied at a competitive cost (or no costs) including transportation costs to the facility site. And its use for this purpose must cause minimal environmental impact. The biomass must also be of suitable quality for energy conversion and end use. Several emerging technologies are promising, but this guide focuses on current commercially available technologies.

Steam Technology (Combustion)

The most common way to produce energy from biomass is through combustion. The biomass is combusted in a boiler, and the resultant steam is used to run a turbine to generate electricity, similar to conventional fossil fuel forms of generation. In Alberta, the majority of biomass energy is used by the wood products and pulp and paper industries. These industries burn waste wood products to provide heat for their manufacturing processes. Typically biomass with less than 60% humidity is used in this or other combustion technologies. See Figure 10, page 17.

Biogas (Anaerobic Digestion/Landfill Gas Collection)

Biogas may be referred to as “renewable natural gas” or “green methane.” It contains approximately 70% methane. Biogas is created through the fermentation of organic

[13] Natural Resources Canada, Bioenergy from Biomass, 2016. https://www.nrcan.gc.ca/forests/industry/bioproducts/13323

feedstock, including manure, food processing waste or various plant life. The raw biogas can be combusted to produce electricity or steam and heat, or it can be transformed into bio-methane and used as a substitute for natural gas. Typically, biogas technology is suitable for biomass with greater than 65% humidity

Biomass Resource in Alberta

There are abundant biomass resources in Alberta. Forested lands cover 38 million hectares (ha), or 60% of the province. Agricultural lands cover 21 million ha over a wide geographic range. As of 2016, biomass electric capacity was 428 MW and represented 2.6% of Alberta's total capacity. Most of the bioenergy projects in Alberta use waste from the forestry or agriculture industry, which are often the most cost-effective sources of biomass, because it saves the waste from needing disposal and creates a cost savings for the facility. A biomass power plant requires 6.5–9 kt of biomass per year per megawatt of installed capacity. A biomass potential map of Alberta is provided in Appendix E.

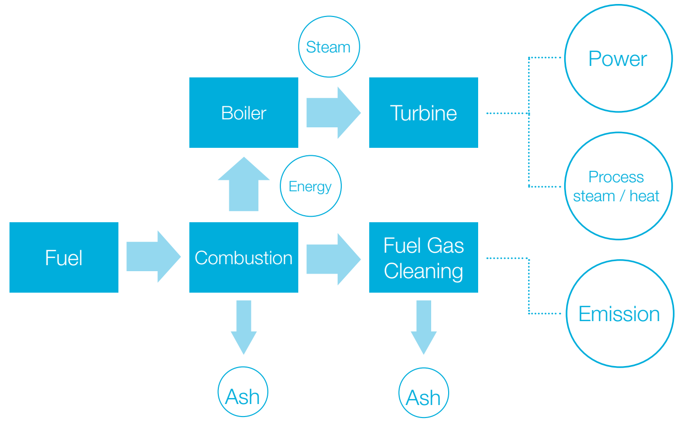


Figure 10: Biomass combustion plant concept sketch

Figure 11: Lethbridge biogas plant

CHAPTER 2

Renewable Energy in Alberta

ALBERTA'S ELECTRIC SYSTEM

Alberta Electric Grid

Like every other electric system, the Alberta electric grid includes a set of components to move electricity from where it is generated to where it is used. Table 1 provides a simple explanation of the most important aspects.

Table 1: Overview of key stakeholders in Alberta's electricity system

	Key Stakeholders	Role Description
AUC Alberta Utilities Commission	REGULATOR Alberta Utilities Commission (AUC)	The AUC regulates the utilities sector and the natural gas and electricity markets to protect social, economic and environmental interests of Alberta where competitive market forces do not. The AUC would be responsible for approval of any application for connection to the grid and any power plant approval.
aeso	SYSTEM OPERATOR Alberta Electric System Operator (AESO)	The AESO manages supply and demand of electricity in Alberta, including dispatching electricity, planning the system for the future and operating the provincial power grid. AESO is responsible for its safe, reliable and economic operation. AESO administers the wholesale electricity market, and the Renewable Electricity Program (REP).
	GENERATION ATCO Power TransAlta Capital Power Corporation ENMAX Energy Wind Farms Cogeneration Plants Others	Generating facilities convert various forms of energy into electric power and connect to either the transmission or distribution systems. The electricity is typically stepped up to a higher voltage to facilitate long-distance transmission.
	TRANSMISSION AltaLink ATCO Electric ENMAX Power EPCOR	Transmission lines connect the power produced at generating facilities to substations and large transmission-connected customers. These can be thought of as the electricity "highway" transporting it long distances. Owners of transmission infrastructure are referred to as Transmission Facility Owners (TFOs).

Table 1 continued: Overview of key stakeholders in Alberta's electricity system

Key Stakeholders		Role Description
	SUBSTATION AltaLink ATCO Electric ENMAX Power EPCOR	Substations are the connection points between transmission and distribution systems and act to step up or step down the voltage of the electricity to levels that support long-distance transmission (step up) or that the distribution system can handle (step down). (See page 24 for more details on this process.)
	DISTRIBUTION FortisAlberta ATCO Electric ENMAX Power EPCOR Rural Electrification Associations	Distribution lines carry electricity to homes, farms and businesses. Distribution can be thought of as the "secondary highway" or "gravel roads" of the grid. Owners of these distribution lines are called Wire Owners (WO). The organizations responsible for operation and maintenance of the distribution system are called Wire Service Providers (WSP). In most cases the WO and WSP are the same entity. However some WO's particularly some Rural Electrification Association's (REA's) have contracted with another WO to serve as WSP for their customers. (See page 24 for more detail.)
	RETAILERS Regulated Rate Retailers: Direct Energy ENMAX Energy EPCOR Energy (Edmonton) City of Lethbridge Utilities Competative Retailers	Retailers give customers a choice of electric service providers. Additional Competitive Retailers are available across Alberta. A full list of retailers can be found on the Alberta Office of the Utilities Consumer Advocate website.[14]
	ELECTRICITY END USERS	Electricity is delivered to the end user (homes, farms, businesses, etc.).

[14] Office of the Utilities Consumer Advocate, Retailers and Distributors. ucahelps.alberta.ca/retailers.aspx

Generation

As of the end of 2017, Alberta's total installed capacity was 16,346 MW.[15]

Figure 12 summarizes the annual generation capacity over time by resource type.

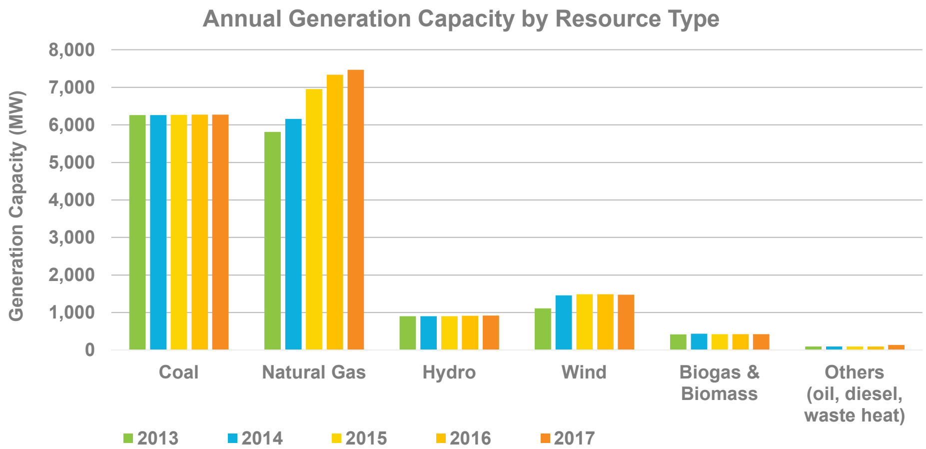


Figure 12: Annual generation capacity by technology. Source: Alberta Electric System Operator[15]

Alberta Electricity Market Analogy

Alberta's power market is similar to how the airline business operates:

> Power producers are like airlines. They compete against each other to serve customers. If they are inefficient, they go out of business.

> Transmission and distribution wires are like runways. We build one terminal and one set of runways and allow different airlines to use them. Electricity wires carry power from competing producers to customers. Wires are centrally planned, just like airport expansions are determined by local airport authorities. Airport expansion plans are charged to passengers on their tickets, just like transmission expansions are charged to customers.

> Retailers are like tour operators. They buy goods from the wholesale market (seats from airlines, or power from generators) and repackage them for end users. Power retailers and tour operators compete for business on cost or by offering different services (like green power, fixed priced power or floating priced power).

Source: Independent Power Producers Society of Alberta.[16]

[15] Alberta Utilities Commission, Annual Electricity Data – Installed Capacity, 2018. http://www.auc.ab.ca/pages/annual-electricity-data.aspx

[16] Independent Power Producers Society of Alberta, Alberta's Power Market – Electricity is complicated. Would an analogy help?, 2018. http://ippsa.com/albertas-power-market.php

Integration of Generation

A renewable energy power plant can be connected to the electric grid in different ways, as illustrated in Figure 13, page 23.

1. Connected behind-the-meter/behind-the-fence: The energy produced from the renewable energy project is directly used by the facility/building, so that less electricity needs to be purchased from the grid. If more electricity is generated than the building needs, the excess is exported to the grid. Behind-the-meter systems are typically in the range of a few kilowatts for homes, going up to hundreds of kilowatts or even a few megawatts for large buildings. For example, solar PV panel systems on the roof.
2. Connected to a distribution line: Medium-scale systems are connected to the local distribution line, not tied to a single load facility such as a home, or a building. Electricity produced is used by all facilities/buildings on the distribution system. System size is limited by the size of the distribution substation and can range from a few hundred kilowatts to 10–20 MW.
3. Connected to a transmission line: Similar to the generators on the grid today, large-scale centralized renewable energy systems can be connected to a high-voltage transmission system. For example, Oldman dam and Halkirk wind farm.

Dispatch

In systems such as Alberta's, where there is currently no infrastructure to support the economical storage of electricity, power must be used at the same instant it is produced. This lack of storage means generating plants must produce electricity in real time, as customers demand it. Peak demand typically occurs around dinner time on cold, dark winter evenings when people are cooking and using appliances and electronics. When there is increased demand for power, generation plants must start up additional turbines to produce the needed electricity. The AESO monitors an interconnected electric grid and dispatches power to meet Albertans' needs. Each section of the grid is interconnected with neighbouring sections to facilitate emergency support, co-ordinated operations and electricity purchases and sales. Minute-by-minute, hour-by-hour monitoring keeps the electric system physically stable as demand rises and falls, as generating units are ramped up or ramped down and as emergency situations are managed.

The Grid

Alberta's "interconnected electric system"—the grid—is an interconnected network of generating plants, substations and power lines that links with grids in other jurisdictions. Electric grids provide utilities with alternative power paths in emergencies, They make it possible for network participants to buy and sell power from each other and from other power suppliers.

Interties

Interties are power lines that connect Alberta's electric system to other jurisdictions. Alberta's grid is currently connected to grids in British Columbia, Saskatchewan and Montana. Interties act like a gate that can be opened or closed to allow the movement of electricity into or out of the province. Provincial power movement is dependent on a number of factors including outages and market conditions in and outside of the province. Interties provide access to emergency power when Alberta's generators are unable to produce enough to meet demand or when severe storms cause transmission equipment failures.

Transmission

Power generators depend on reliable transmission lines to carry electricity from where it is produced to where it is needed. Electricity transmission in Alberta is managed and regulated as a single, integrated province-wide system. AESO oversees the transmission system to ensure that it operates safely, efficiently and reliably. AESO oversees the design

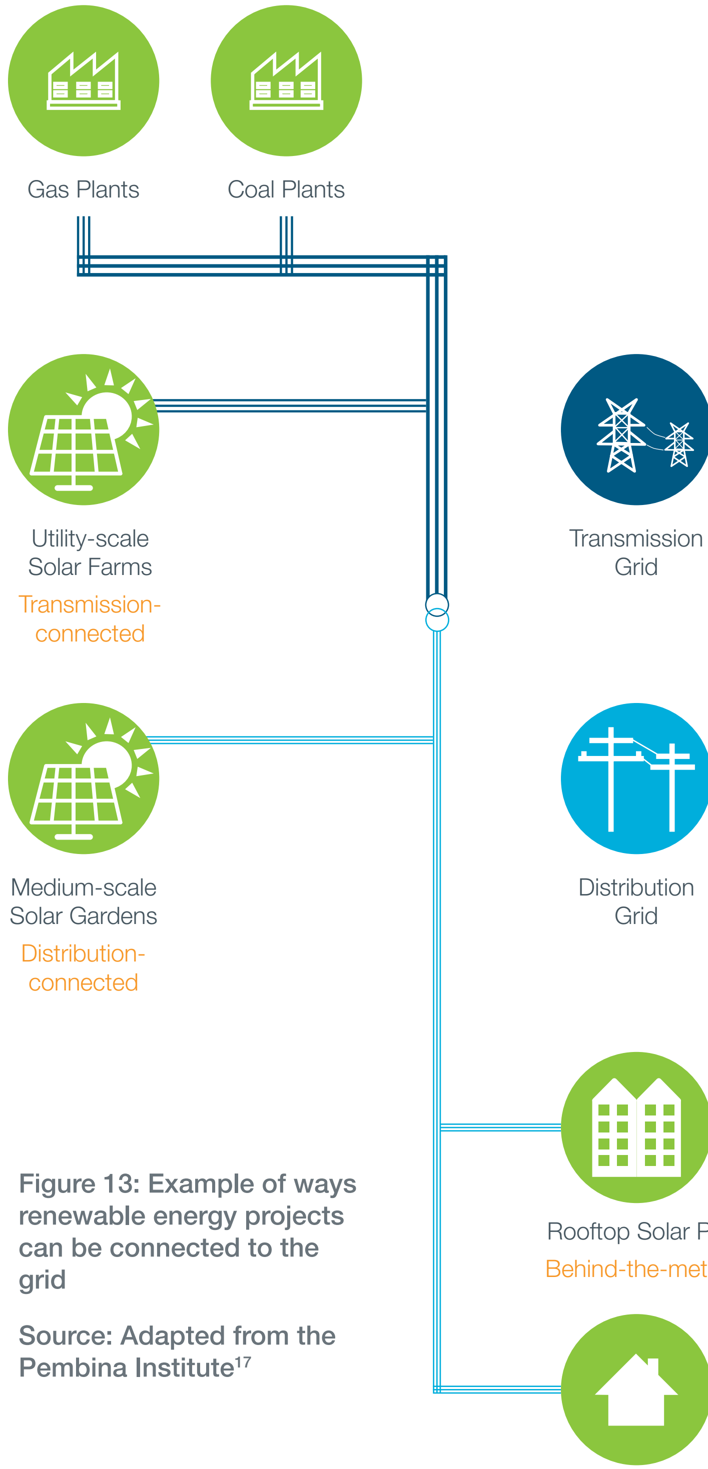


Figure 13: Example of ways renewable energy projects can be connected to the grid

Source: Adapted from the Pembina Institute[17]

[17] Pembina Institute, Alberta Community Solar Guide, November 2017. http://www.pembina.org/reports/alberta-community-solar-guide.pdf

and use of the system, and it ensures non-discriminatory access at fair prices.

Four utility companies are responsible for transmission services in Alberta. These companies "own, operate, build and maintain the system of high-voltage power lines and other electrical equipment that moves power from generators to towns, cities and large industrial customers."[18] Each company is responsible for reliable, economical operations in its area. Simplified transmission system diagrams can be found on the AESO website.[19]

Unlike WSPs and WOs, TFOs do not have exclusive service areas. Nevertheless, transmission facility ownership is still broadly reflective of distribution service areas. Alberta's major municipalities—Calgary, Edmonton, Lethbridge and Red Deer—own most of the transmission facilities within their city limits. Non-municipal transmission facilities owned by ATCO Electric or AltaLink generally reflect their associated distribution service area boundaries.

Why Step Up Voltage?

When electricity is transported over long distances, resistance in the wires converts some of the energy to heat. To minimize this power loss ("line loss"), step-up transformers change the low-voltage electricity produced by generators to high-voltage electricity, which moves more efficiently along transmission lines. Step-down transformers at more than 500 substations across the province reduce the voltage to a level that can be used to power homes and businesses.

Utility-scale renewable energy projects that are connected to the transmission system would need to connect to an existing substation, or an additional substation, along with all associated infrastructure, would need to be built to support a new project.

The AESO website contains transmission system diagrams of the existing and future electric system through the Long-Term Transmission Plan, which is published every two years.[20]

Distribution Systems

Distribution systems move electric energy from the high-voltage transmission system to individual customers' homes and workplaces. Distribution power lines and facilities operate at 25 kV or less. Most Albertans receive electricity from such distribution lines, which carry power that has been stepped down to a lower, usable voltage. Alberta's distribution system ownership reflects the province's electrical history. Calgary, Edmonton, Red Deer and Lethbridge own their own systems, as do the municipalities

[18] Alberta Utilities Commission, Transmission Rates, www.auc.ab.ca/pages/transmission-rates.aspx

[19] Alberta Electricity System Operator, Single Line Diagrams: AESO 2017 Long-term Transmission Plan, January 2018. www.aeso.ca/assets/Uploads/SLDs-AESO-2017-Long-termTransmissionPlan-Final.pdf

[20] Alberta Electric System Operator, Long-term Transmission Plan, 2018. www.aeso.ca/grid/long-term-transmission-plan

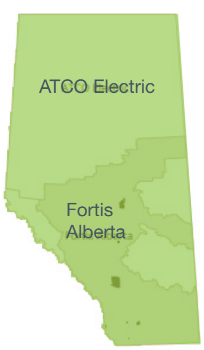
of Cardston, Fort Macleod, Crowsnest Pass and Ponoka. Forty-one rural electrification associations still provide distribution service in rural Alberta. The rest of the province has been assigned to one of two major distribution utilities, Fortis Alberta Inc. (generally in southern Alberta) and ATCO Electric (generally in northern and southeastern Alberta).

Most of Alberta's distribution lines and facilities are owned and operated by four utility companies. Alberta's four major WOs are regulated by the AUC, which approves the distribution tariff they are allowed to charge customers for the use of their services. These approved charges can be found on the AUC website.[21] Municipally owned distribution systems outside of Edmonton and Calgary are regulated by local city councils. Elected boards of directors regulate distribution systems operated by REA's.

WSPs, are responsible for building, maintaining and financing the portion of the electric system that delivers energy to customers' homes and businesses. In performing this role, WSP's enter into agreements with retailers—the companies from which customers buy their electricity. WSP's are responsible for:

> delivering electricity
> maintaining the distribution network, including upgrading and replacing power lines and facilities, and responding to power emergencies such as outages or fallen lines
> installing, maintaining and reading electricity meters
> providing consumption data and tariff billing information to retailers
> providing a default rate (the regulated rate option) to eligible customers in their service area.

Figure 14 below shows the service areas of the major WSPs in Alberta.



Municipalities operating DFOs

EPCOR (City of Edmonton)
ENMAX (City of Calgary)
Town of Ponoka
City of Red Deer
City of Lethbridge
Town of Fort MacLeod
Town of Cardston
Municipality of Crowsnest Pass

Rural electrification associations

Armena REA	Fenn REA	Rodey REA
Battle River REA	Heart River REA	Sterling REA
Beaver REA	Kingman REA	Stony Plain REA
Borradaile REA	Kneehil REA	Stry REA
Braes REA	Lakeland REA	Tomahawk REA
Claysmore REA	Lindale REA	V.N.M. REA
Delburne West REA	Mackenzie REA	Warwick REA
Devonia REA	Mayerhorpe and District REA	West Liberty REA
Drayton Valley REA	Montana REA	West Wetaskwin REA
Duffield REA	Nilon REA	Wild Rose REA
EQUS REA	North Parkland Power REA	Willingdon REA
Ermineskin REA	Peigan Indian REA	Zawale REA

Figure 14: Map of service areas of the major WSP's
Source: Adapted from Howell-Mayhew Engineering[22]

[21] Alberta Utilities Commission, Current rates and terms and conditions, http://www.auc.ab.ca/Pages/current-rates-electric.aspx

[22] Howell-Mayhew Engineering, Map showing Alberta's Wire Service Providers.

http://www.hme.ca/connecttothegrid/Map%20showing%20Alberta%27s%20Electric%20Distribution%20System%27s%20Owners.pdf

Electricity Market

Alberta's electricity market was restructured in 2001 to create a competitive framework for power generation (and the wholesale market) and retail suppliers. This restructuring was done because generation capacity needed to expand rapidly to keep pace with Alberta's economic growth and increased oil and gas development. This framework meant that investors bore the risk and investment was open to any competitive interests.

In the wholesale electricity market, any qualified generator can participate in the market where prices are set by hourly supply and demand overseen by AESO. Independent power producers first make competitive offers to sell their electricity into the wholesale power pool. The hourly pool price is then set based on supply and demand. How the hourly pool price is set is explained in detail on page 100.

From the wholesale market, electricity retailers purchase bulk electricity at the pool price based on their customers' projected demand. This wholesale electricity is moved from the centralized generation facilities to local substations through the high-voltage transmission lines. Retailers then re-package electricity into their own retail bundles and sell the retail electricity to end-use customers. End-use customers enter contracts with retailers to purchase electricity. These retail rates could be daily average floating rates, flat retail rates or the regulated rate option (RRO). This market structure is shown in Figure 15.

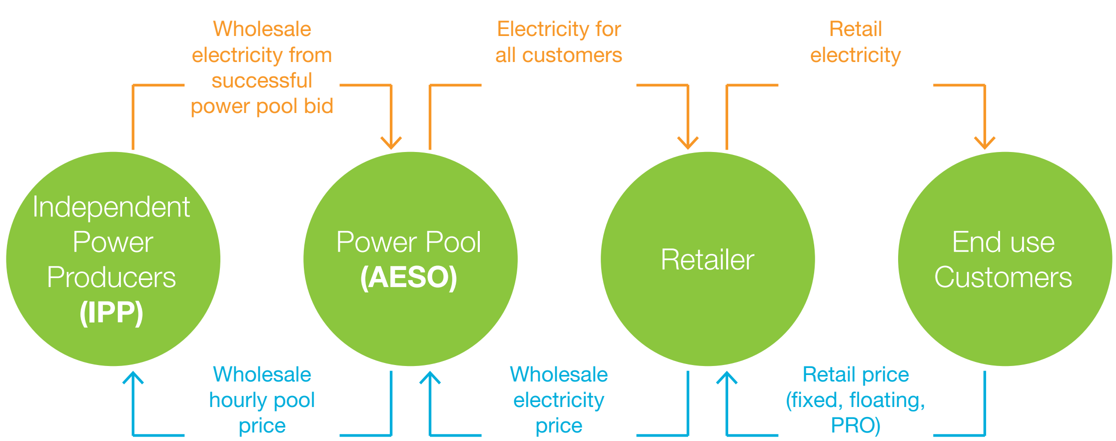


Figure 15: Overview of the key market dynamic of the Alberta electricity market

Electricity Charges

For any retail customer, the cost for electricity is made up of two main charges: the cost of energy consumed, and the cost of delivering the electricity.[23] The energy charges are based on how much electricity you used, whereas the cost of delivery of the energy is dependent on the wire services provider, and may have a fixed component, such as a fixed administration cost, and a variable component based on the amount of electricity consumed. [24, 25]

> Electricity Rate: The amount the customer pays the retailer per kilowatt hour of electricity. As mentioned, it can be based on a daily average floating rate, flat retail rate or the regulated rate option based on the agreement signed with the retailer.

> Delivery Charges: These charges are not for the electricity itself, but for delivery from the source to the customer. They are charges from your distributor and are sometimes separated into transmission and distribution charges passed down from the TFO and WSP:

  - Transmission: Transmitting electricity or moving gas over long distances from the source to your local area.
  - Distribution: Transmitting electricity or moving gas within your area, usually within your city or town.
  - Local Access Fee: Your distributor pays a fee to the local government to use municipal land for power lines and substations. The fee also gives your distributor the right to provide electricity to your community and covers municipal taxes on property and land. The fee is shared by all customers in the area. Each local government sets the fee based on provincial law.
  - Balancing Pool Rider: The balancing pool forecasts whether its assets will have a surplus or shortfall. Alberta's electricity consumers share this surplus or shortfall as a credit or charge on their bills, usually as a credit.
  - Riders: A rider is a charge or credit that adjusts your distributor charges. Riders exist for various reasons. They cover changes in circumstances since the AUC last approved your distributor's charges. They are also AUC approved.

[23] Office of the Utilities Consumer Advocate, Understanding your Bill. https://ucahelps.alberta.ca/understanding-your-bill.aspx

[24] Office of the Utilities Consumer Advocate, Transmission Charges. https://ucahelps.alberta.ca/electricity-transmission-and-distribution-charges.aspx

[25] Office of the Utilities Consumer Advocate, Rate Riders. https://ucahelps.alberta.ca/rate-riders.aspx

Electricity Market Transition

Current Market—Wholesale Energy Market Only

Alberta currently operates in a deregulated wholesale energy market based on supply and demand. Energy is bought and sold in real time from the lowest-cost generators first. More expensive generators are brought in as necessary, to meet demand.

The price generators receive from the wholesale market is currently low in contrast to past years as shown in Figure 16.

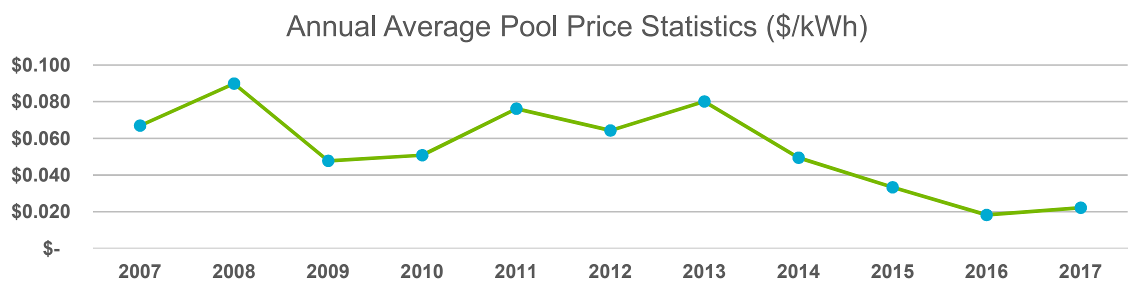


Figure 16: Historical annual average pool price ($/kWh). Source: Alberta Electric System Operator[26]

The transition from an energy-only electricity market structure to one that includes a capacity market started in November 2016. This change was made as a way to meet the Government of Alberta's objectives of achieving a lower-carbon, sustainable electric system by 2030. The Government of Alberta directed AESO to study the future stability of the electricity market in the province. Following its analysis, AESO found that the wholesale energy-only market would not result in price signals that would attract sufficient new investment in generation to ensure electricity market stability and reliability. As such, Alberta is adopting a capacity market design by 2021. The first capacity procurement is expected to take place in 2019 or 2020, with first delivery of capacity obligations in 2021.[27]

Future Market

A capacity market pays electricity generators and/or ancillary service providers for having the ability to reliably make power available regardless of how often they sell energy onto the grid. The purpose of the capacity market is to ensure there will be an

[26] Alberta Electricity System Operator, AESO 2017 Annual Market Statistics, 2018. https://www.aeso.ca/download/listedfiles/2017-Annual-Market-Stats.pdf

[27] Government of Alberta, Electricity Capacity Market. https://www.alberta.ca/electricity-capacity-market.aspx

adequate supply of electricity to meet the province's demand. This market structure avoids reliance on price volatility for future investment, while maintaining competitive market forces.

A capacity market is made up of two distinct markets:

> a market in which generators compete to sell energy (kW-h, MW-h, same as now)

> a market in which "capacity providers" compete for payments to keep capacity (kW, MW) available to supply electricity when required. Capacity may be in the form of generation, reduction of demand, or storage.

Generators can receive revenue from two different streams:

> energy payments, which are paid to the generator for the electricity sold

> capacity payments, which are paid to the generator for making generation capacity available on demand.

The capacity market is designed to ensure that sufficient reliable capacity is available by providing payments to encourage investment in new capacity or for existing capacity to remain available.

Eligibility to compete in capacity auctions will be determined through AESO's technical design process, which at the time of writing, is currently underway. A final market design is expected in mid-2018. The first procurement is expected to begin in 2019, and the first delivery period for capacity is expected in 2021.

Over the next 14 years, Alberta will need up to an estimated $25 billion of new investment in electricity generation to support the transition toward cleaner sources of energy and meet the electricity needs of a growing province. The transition to a new market structure that includes an energy-only market and a capacity market will help with that.

What is Electric Capacity?

Capacity represents a commitment to deliver electricity when needed, particularly in case of a grid emergency. A shopping mall, for example, builds enough parking spaces to be filled at its busiest time—Black Friday. The spaces are there when needed, but they may not be used year round. Capacity, as it relates to electricity, means there are adequate resources on the grid to ensure that the demand for electricity can be met at all times.

Source: PJM learning centre [28]

[28] PJM Learning Centre, Capacity Market (RPM). https://learn.pjm.com/three-priorities/buying-and-selling-energy/capacity-markets.aspx

RENEWABLE ENERGY POLICY IN ALBERTA

This section provides a brief overview of the key policy developments that promote a shift towards renewable energy in Alberta.

Climate Leadership Plan

The Government of Alberta announced the Climate Leadership Plan in November 2015. It is the province's roadmap and strategy to transition from a carbon-intensive economy towards a lower-carbon world. The key aspects of the plan include:

- tripling renewable energy to supply 30% of generation by 2030
- implementing a new carbon price on greenhouse gas emissions
- phasing out pollution from coal-generated electricity by 2030
- capping oil sands emissions to 100 Mt carbon dioxide equivalent per year
- reducing methane emissions by 45% by 2025.

Renewable Electricity Act

In accordance with the Climate Leadership Plan, the Government of Alberta legislated the goal of 30% renewable electricity generation in Alberta by 2030 in the Renewable Electricity Act, which was proclaimed in March 2017. The Renewable Electricity Act enables the Minister of Energy to direct the Alberta Electric System Operator (AESO) to develop the Renewable Electricity Program (REP) for the competitive development of large-scale renewable energy resources in Alberta. The key elements of the Renewable Electricity Act include:

- 30 by 30 target: 30% of Alberta's electricity generated from renewable energy sources by 2030
- developing a competitive renewable electricity procurement program
- defining renewable energy sources to include wind, solar, hydro, geothermal and sustainable biomass.

RENEWABLE ENERGY PROGRAMS IN ALBERTA

The introduction of the Climate Leadership Plan by the Government of Alberta has created many opportunities for job creation and private sector investment in the province's renewable energy market. Some of the grants and funding programs available in Alberta are highlighted below. This section provides a summary of each program along with a link to the relevant program documents for the most up-to-date information.

Renewable Electricity Program (REP)

The REP is a competitive bidding process with the target of procuring 5,000 MW of renewable electricity generation by 2030. Along with the other renewable energy programs developed under the Climate Leadership Plan, the REP contributes towards meeting the legislative mandate in the Renewable Electricity Act—the 30 by 30 target. The REP is open to all renewable technologies as defined in the Renewable Electricity Act.

Details for the REP Round 1 procurement:

- projects meet Alberta's definition of renewable electricity
- projects will be operational by the end of 2019
- offers 20-year contract terms consistent with international norms
- projects must be based in Alberta, be new or expanded, and be at least 5 MW or greater in size
- projects must be connected to existing transmission or distribution infrastructure to avoid indirect cost to electricity customers.

Results of Round 1 of the REP were announced on December 13, 2017. Four wind generation projects were selected to deliver nearly 600 MW of capacity at a weighted average bid price of $37/MW-h, which is the lowest renewable electricity pricing in Canada.[29]

Rounds 2 and 3 of the REP were announced on February 5, 2018. Round 2 has a procurement target of 300 MW and includes an Indigenous equity ownership requirement. Round 3 has a procurement target of 400 MW. For the latest news on the REP, visit the AESO website[30] or sign up for the stakeholder newsletter.[31]

[29] Alberta Electricity System Operator, REP Round 1 results, 2018. https://www.aeso.ca/market/renewable-electricity-program/rep-round-1-results/

[30] Alberta Electricity System Operator, REP news and updates, 2018. www.aeso.ca/market/renewable-electricity-program/rep-news-and-updates/

[31] Alberta Electricity System Operator, Stakeholder newsletter, 2018. https://www.aeso.ca/aeso/stakeholder-newsletter/

Alberta Indigenous Green Energy Development Program (AIGEDP)

The Alberta Indigenous Green Energy Development Program (AIGEDP) helps Alberta Indigenous communities and organizations acquire an ownership stake in Alberta's rapidly expanding renewable energy sector. The AIGEDP consists of two separate funding streams for activities directly linked to Climate Leadership Plan outcomes:

> Project Development

> Project Implementation.

The Indigenous Relations website provides guidance on program details, along with all relevant forms and application details.[32]

The Alberta Indigenous Green Energy Development Program (AIGEDP) helps Alberta Indigenous communities and organizations acquire an ownership stake in Alberta's rapidly expanding renewable energy sector.

Residential and Commercial Solar Program

The Residential and Commercial Solar Program provides rebates to homeowners, businesses and non-profits that install solar PV panel systems. The program is available for up to 15 kW for residential and up to 5 MW for commercial or non-profit applications. Projects that are eligible must be compliant with the Micro-generation Regulation.

The program is available to customers with properties located in Alberta. It provides a rebate of $0.75/W and aims to reduce total eligible system costs by up to 30% for homeowners and up to 25% for businesses and non-profits. More details on the program and eligibility can be found on the Energy Efficiency Alberta website.[33]

Alberta Indigenous Solar Program

The Alberta Indigenous Solar Program (AISP) provides grants to Alberta Indigenous communities to assist with the development and installation of small-scale solar PV panel systems on facilities owned by Indigenous communities or organizations. The purpose of the program is to encourage solar adoption within Indigenous communities, increase Indigenous participation in Climate Leadership Plan initiatives that reduce community greenhouse gas emissions as well as create more sustainable community energy generation. The program criteria include:

> compliance with the Micro-generation Regulation

> capacity greater than 2 kW but less than 1 MW

[32] Alberta Alberta Indigenous Relations, Alberta Indigenous Green Energy Development Program. http://indigenous.alberta.ca/AIGEDP.cfm

[33] Energy Efficiency Alberta, Residential and commercial solar program. https://solar.efficiencyalberta.ca

- grid-connected and off-grid projects are equally eligible
- covers up to 80% of the supply and installation of a project.

More details on the program and eligibility can be found on the Alberta Indigenous website.[34]

Other Renewable Energy Programs

Other programs available to support renewable energy development in Alberta include the following:

- On-farm Solar Photovoltaics Program [35]
- Alberta Municipal Solar Program [36]
- Indigenous Green Loan Guarantee Program. [37]

[34] Alberta Indigenous Relations, Alberta Indigenous Solar Program. http://indigenous.alberta.ca/AISP.cfm

[35] Alberta Agriculture and Forestry, On-Farm Solar Photovoltaics Program. https://www1.agric.gov.ab.ca/general/progserv.nsf/all/pgmsrv464

[36] Municipal Climate Change Action Centre, Alberta Municipal Solar Program. http://www.mccac.ca/programs/AMSP

[37] Energy Efficiency Alberta, Indigenous Green Loan Guarantee Program. https://www.efficiencyalberta.ca/indigenous-green-loan-guarantee/

DEVELOPMENT ON A FIRST NATION RESERVE

For a First Nations community, there are four possible reserve land management regimes:

1. Land is managed under the Indian Act, is administered by Indigenous Services Canada (ISC) and must follow the laws around designation of lands (the majority of First Nations lands currently fall under this system).
2. Land is managed by a First Nation under a Land Code pursuant to the Framework Agreement on First Nations Land Management (FNLM). The Land Code will identify the development process.
3. The First Nation has opted for self-government agreements and has its own land management policies. The land management policies established by the First Nation will need to be followed.
4. The First Nation has a modern treaty and has ability to write its own land acts. The treaty provisions or laws under the treaty will need to be followed.

Land Designation

The land designation process is a prerequisite for most economic development on reserve for First Nations who operate under the Indian Act. It is the legal requirement that allows for leasing on First Nation reserve land. Designated lands retain reserve status.

Section 39.1 of the Indian Act establishes the conditions that must be satisfied for designation to be valid.

A designation is voted on by the First Nation membership at a referendum vote administered by regional ISC staff in accordance with the Indian Referendum Regulations. If approved by the membership, the Minister of ISC, acting on the recommendation of the First Nation council, must still

Excerpts from the Indian Act concerning Designation

Designation

38(2) A band may, conditionally or unconditionally, designate, by way of a surrender to Her Majesty that is not absolute, any right or interest of the band and its members in all or part of a reserve, for the purpose of its being leased or a right or interest therein being granted.

Conditions

39.1 A designation is valid if it is made to Her Majesty, is assented to by a majority of the electors of the band voting at a referendum held in accordance with the regulations, is recommended to the Minister by the council of the band and is accepted by the Minister.

Leasehold Interest

The options available for leasehold interests on reserve vary from multiple leases between Canada and each developer, to a headlease between Canada and a First Nation corporation, which in turn subleases lands to developers.

accept the designation through a Ministerial Order, for it to become effective.

A designation will include the following key elements:

> term (length of time lands are to be designated)
> purpose (allowable activities under the designation)
> land description (legal survey of the land)
> additional conditions required (e.g., lessee, rent, etc.).

A current Phase I Environmental Site Assessment, Fair Market Rent Appraisal Report and Canada Land Survey must be completed prior to the designation vote.

Once the designation process is complete, the Minister can lease the lands to a third-party developer. The business terms of the lease are generally negotiated by the First Nation, subject to designation and ISC policies.

The following significant terms must be negotiated:

> term (cannot exceed the term of the designation)
> purpose (allowable activities under the lease)
> land description (must be within the designated area)
> rent (amount of compensation due for use of the land)
> rent review periods (how often the rent amount is to be reviewed).

Some reserve lands are held under Certificate of Possession, in which land is allotted to an individual band member in accordance with section 20(2) of the Indian Act. In this situation, the individual has the right to occupy and develop the piece of land or request that the Minister lease the land to a third party on behalf of the member. A designation is not required for leasing allotted lands, however ISC must obtain the consent of the Certificate of Possession holder and inform the First Nation Council prior to the execution of a lease.

Timeframes

The process for land designation can take from 7 to 18 months to complete. It has the following steps:

1. Preparation of supporting documentation; Environmental Site Assessment, appraisal, survey, designation and information documents
2. First Nation Band Council resolution is attained and voters list provided

3. Notice of referendum to community membership
4. Information meetings coordinated with community
5. Referendum vote takes place
6. First Nation Council recommendation provided to Minister
7. Ministerial Order approval.

For information about the land designation process and the steps required, contact ISC, which has a regional head office in Edmonton. It can provide further guidance on the process.

Alternative Land Management

Self-governing First Nations, First Nations operating under the First Nations Land Management Act and those with modern treaties are not required to follow the designation process set out in the Indian Act. They may pursue commercial opportunities in accordance with their own land code and laws.

Framework Agreement on First Nations Land Management (FNLM)

Under the FNLM framework agreement, First Nation signatories can take over the management and administration of their reserve lands independent of the Indian Act. The Crown continues to hold title to First Nation land, although it will have no management authority over the land. For a First Nation to lease land out under the FNLM regime, it must be operational under a ratified Land Code, which becomes the basic land law of the First Nation and replaces the Land Management provisions of the Indian Act. The provisions of the Indian Act that do not deal with land matters continue to apply to a First Nation with a Land Code. There are currently no Alberta First Nations that are operational under FNLM.

Self Governance

First Nations that have opted for self-government agreements have autonomy and control over decision-making, land management and law-making for their community. There are currently no Alberta First Nations that have opted for self-governance agreements.

Modern Treaties

First Nations with modern treaties have the ability to write their own land acts, which include land use planning and development, and zoning.

Regulatory Considerations

The regulatory considerations for a First Nations community will depend on where the development is to be located, the project scale and where it is connected to the grid:

If the land to be developed is on **First Nation reserve** land, the following items do apply:

> federal legislation and regulations
> First Nation land codes and laws, if they are operational under the First Nations Land Management Act.

The following do not normally apply:

> provincial legislation and regulations
> local land-use laws.

Depending on the specific situation your community is in, there will be intricacies in the specific provincial and federal regulatory considerations that apply to your project.

*Note: This information was reviewed by Indigenous Services Canada.

DEVELOPMENT ON METIS SETTLEMENT LANDS

Metis Settlements are not subject to the same land designation requirements as First Nation communities. In Alberta, unlike the rest of Canada, Métis people have negotiated certain lands to be reserved for them, known as Metis Settlements, under the Metis Settlements Act.

The legislation created a unique landholding system. Fee-simple title to the settlement lands is held by letters patent granted by the Crown to the Metis Settlements General Council, which is a representative body comprised of councillors from all of the eight settlements. A special form of title, known as Metis title, is, in turn, held by each settlement's elected council and is capable of being transferred to individual settlement members. Interests in settlement lands cannot be held by non-settlement members and access for lease or development on Metis Settlements requires the approval of the settlement council.

Projects on a Metis Settlement must follow the Metis Settlement Bylaws, Metis Settlement General Council Policies, and the Metis Settlement Act.

Regulatory Considerations

The regulatory considerations for a Metis Settlement community will depend on where the development is to be located, the project scale and where it is connected to the grid.

If the land to be developed is on **Metis Settlement** land, the following items may apply:

- federal legislation and regulations, however, may not apply in every case
- provincial legislation and regulations
- local settlement land-use laws and policies.

Depending on the specific situation your community is in, there will be intricacies in the specific provincial and federal regulatory considerations that apply to your project.

ROLES AND RESPONSIBILITIES IN ALBERTA

Table 2, which continues on page 40, provides an overview of the roles and responsibilities of all the key stakeholders related to renewable energy projects in Alberta and will support better understanding of the regulatory section that follows.

Table 2: Roles and responsibilities of key stakeholders in Alberta

Key Stakeholders	Roles and Responsibilities
Alberta Utilities Commission (AUC)	The AUC regulates the utilities sector and the natural gas and electricity markets to protect social, economic and environmental interests of Alberta where competitive market forces do not. The AUC would be responsible for approval of any application for connection to the grid and any power plant approval. AUC Rule 24 (Rules Respecting Micro-Generation) set out the requirements for projects that meet the provisions and requirements for micro-generation as set out in the Micro-Generation Regulation. For all other power plants, AUC Rule 007 (Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments) sets out the requirements for power plant applications.
Alberta Environment and Parks (AEP)	The AEP is responsible for administering Alberta's Environmental Protection and Enhancement Act and accompanying regulations. In addition, AEP is responsible for administration of two specific directives associated with renewable energy development in Alberta: > Wildlife Directive for Alberta Wind Energy Projects (updated in 2017) > Wildlife Directive for Alberta Solar Energy Projects (released in October 2017, includes a solar energy checklist). AEP is also responsible for having final environmental approval for any connection requests with the AUC.
Transmission Facility Owner (TFO)	TFOs build, own and operate the transmission system within their service territories. There are four major TFOs in Alberta: AltaLink Management Ltd., ATCO Electric Ltd., ENMAX Power Corporation and EPCOR Utilities Inc.
Wire Service Provider (WSP)	WSPs are responsible for building, maintaining and financing the portion of the electric system that delivers energy to customers' homes and businesses. In performing this role, WSPs enter into agreements with retailers—the companies from which customers buy their electricity. The main WSPs in Alberta are EPCOR Distribution Inc., ATCO Electric, City of Lethbridge, ENMAX Power Corporation and Fortis Alberta. Rural electrification associations may also act as the WSP in some areas and are listed on the Alberta Federation of Rural Electrification Associations website.[38]

[38] Alberta Federation of Rural Electrification Associations, Service Providers. www.afrea.ab.ca/district_locator

Key Stakeholders	Roles and Responsibilities
Alberta Electric System Operator (AESO)	AESO manages the supply and demand of electricity in Alberta, including dispatching electricity, planning the system for the future and operating the provincial power grid. AESO is responsible for its safe, reliable and economic operation. AESO also manages the electricity spot market and administers the REP.
Alberta Energy	Alberta Energy develops all electricity policies including those guiding the REP, micro-generation, transmission and distribution, small-scale generation, and others. The Minister also has final authority on the REP.
Retailers	Customers have a choice when it comes to choosing an electricity retailer in Alberta. Retailers give customers a choice of electric service providers.

*Formerly Indigenous and Northern Affairs Canada (INAC)

REGULATORY CONSIDERATIONS

Permitting and legal issues at the community, provincial and federal levels should be considered when developing a renewable energy project. Generally, permitting and legal issues vary from community to community, so while there are a few things most communities will want to consider, it is always important to consult a legal advisor before a project is undertaken.

In order to determine which regulations would need to be considered for a project, it is advisable to engage with ISC and the AUC to discuss the project. They can provide further guidance on what needs to be considered. The AUC also sometimes will hold information meetings before an application to provide information about the process. At the time of writing, there had been no community or utility-scale renewable energy projects developed on First Nation reserve or Metis Settlement land. As such, some of the regulatory issues have not yet been identified. In addition, you may also wish to hire an expert in environmental assessments and permitting at a relatively early stage to help you create an overview or roadmap of anticipated environmental requirements.

The remainder of this section will identify the key regulations impacting renewable energy development.

Federal Legislation and Regulations

The following federal legislation and regulations are most relevant for renewable energy project developments on First Nation reserves:

- Indian Act
- First Nations Land Management Act
- First Nations Commercial and Industrial Development Act (FNCIDA)
- Canadian Environmental Assessment Act (CEAA) and Regulation.

Indian Act or First Nations Land Management Act

The governing legislation for land-related matters on First Nation reserves in Alberta (and across the country) is the Indian Act and its associated regulations. The exception is a First Nation that is under an alternative land management framework, such as the following (described in the previous section):

- opted out of the Indian Act and has ratified its own land code by community referendum
- opted for self governance
- signed a modern treaty.

First Nations Commercial and Industrial Development Act (FNCIDA)

FNCIDA allows the federal government to produce regulations for complex commercial and industrial development projects on reserves. The act essentially provides for the adoption of regulations on reserve that are compatible with those off reserve. This compatibility with existing provincial regulations increases certainty for the public and developers while minimizing costs. Federal regulations are only made under FNCIDA at the request of participating First Nations. The regulations are project-specific, developed in co-operation with the First Nation and the relevant province, and are limited to the particular lands described in the project. FNCIDA is not the guiding or operative legislation for on-reserve development in Alberta, but it may be relevant for some First Nation communities.

Canadian Environmental Assessment Act (CEAA) and Regulation

CEAA is applicable to an electricity generating facility or electric transmission line on federal land. CEAA and its associated regulations would apply on-reserve if the First Nation has not created and ratified its own scheme for administration of its own land (under FNLM).

Under CEAA, upon receipt of a project description, the Canadian Environmental Assessment Agency has 45 days to determine whether a federal environmental assessment is required. If it is, then an environmental assessment conducted by the Canadian Environmental Assessment Agency must be completed within 365 days. There are two types of assessments conducted under the CEAA:

> Environmental assessment by a responsible authority: The responsible authority could be the Canadian Environmental Assessment Agency, the National Energy Board or the Canadian Nuclear Safety Commission.

> Environmental assessment by a review panel: The review panel is composed of individuals appointed by the Minister of the Environment and supported by the Canadian Environmental Assessment Agency.

Both types of assessments can be conducted by the federal government alone or in co-operation with the province of Alberta.

Additional Federal Environmental Legislation

The following additional federal environmental legislation could be applicable depending on the project type and should be considered:

> Canadian Environmental Protection Act, 1999 (S.C. 1999, c. 33)

> Species at Risk Act (S.C. 2002, c. 29)

> Fisheries Act (R.S.C., 1985, c. F-14)

> Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22)

> Multi-sector Air Pollutants Regulations (SOR/2016-151)

- Canadian Ambient Air Quality Standards (CAAQS).

Alberta Legislation and Regulations

The following are the key legislation that regulates Alberta's energy resource and utility sectors or are applicable to renewable energy development in Alberta:

- Renewable Electricity Act
- Alberta Utilities Commission Act (governs the AUC)
- Hydro and Electric Energy Act
- Electric Utilities Act
- Market Surveillance Administrator
- Alberta Electric System Operator
- Environmental Protection and Enhancement Act
- Wildlife Act
- Wildlife Directive for Alberta Wind Energy Projects
- Wildlife Directive for Alberta Solar Energy Projects
- Water Act
- Alberta Land Stewardship Act and associated regional plans
- Safety Codes Act.

The key parties responsible for enforcement of regulations and adherences to the Acts are included in Table 2 on page 39-40.

While these provincial statutes apply to Metis Settlements, they normally do not apply on First Nation reserves. Provincial legislation, regulations and requirements can apply to the development of off-reserve infrastructure, including distribution and transmission lines and facilities and access roads needed to connect generation projects to the provincial electric grid.

The AUC approves all renewable energy projects in Alberta. The exception to this is micro-generation generating unit, where the AUC has developed a simplified set of approvals and interconnection agreements, this is covered in detail in the following section.

Regulatory Approvals and Permitting

Construction and Connection Approval

In Alberta, the scale of a renewable energy project affects not only the complexity, and cost of a project, but also the legislative and regulatory frameworks that apply to it. The

Alberta Utilities Commission (AUC) acts as the body that regulates the utilities sector and the natural gas and electricity markets in Alberta. The AUC approves all renewable energy projects in Alberta. The exception to this is micro-generation generating unit, where the AUC has developed a simplified set of approvals and interconnection agreements, that do not require filing a power plant application under Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments. In order for a project to qualify as a micro-generation generating unit, it must meet the provisions stated in the Micro-Generation Regulation, Section 1(1)(h):

"micro-generation generating unit" means a generating unit of a customer that:

I. Exclusively uses sources of renewable or alternative energy,

II. Is intended to meet all or a portion of the customer's total energy consumption at the customer's site or aggregated sites,

III. Has a total nameplate capacity that does not exceed the lesser of 5 MW or the rating of the customer's service,

IV. Supplies electric energy only to a site that is located on property that the customer owns or leases, and

V. Is located

    a. On the property referred to in subclause (iv), or

    b. On property that the customer owns or leases that is adjacent to the property referred to in subclause (iv).

In addition, in order to be exempt from filing a power plant application under Rule 007, the generating unit must meet the following requirements as stated in Rule 024: Rules Respecting Micro-Generation.

a. Does not directly and adversely affect any person;

b. Does not have any adverse environmental impact; and

c. The unit is constructed or altered and operated, in compliance with Rule 012: Noise Control.

If the above requirements are met, then the micro-generation generating unit would not require filing a power plant application under Rule 007, and instead, would only require notification of and approval from the applicable Wire Service Provider (WSP) under Rule 024: Rules Respecting Micro-Generation.

For all other power plants, Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments set out the requirements for AUC approval.

The following section outlines the required approvals process. It is split into the 3 main approval types currently available in Alberta based on the size and connection type of the project:

Micro-generation: Alberta's Micro-generation Regulation allows for a project that is intended for load offset (or self-supply) only. A micro-generation project is connected to the distribution grid and must be sized under 5 MW. Rule 024 under the Rules Respecting Micro-Generation, administered by the Alberta Utilities Commission (AUC), applies to this project scale.

Two types of micro-generators are covered under the Micro-Generation Regulation:

- small micro-generators (under 150 kW)
- large micro-generators (between 150 kW and 5 MW).

Utility-scale generation: Utility-scale generation refers to larger projects that are intended to produce and supply electricity to the grid for consumption across the province. A utility-scale generation project may be connected to the transmission or distribution grid and can be up to the limit specified by the WSP or TFO.

Small-scale community generation: Small-scale community generation falls between micro-generation and utility-scale generation. "Community" is not currently defined in the regulations, but the Government of Alberta is reviewing the approach to small-scale community generation. It is proposed that community generation, being smaller in scale, could be connected to the electric distribution system and could generate electricity from renewable or alternative sources. Community generation does not have a size definition, but would be is intended to enable communities (such as Indigenous communities, municipalities or co-operatives) to generate electricity for self-supply and to export excess to the grid as a source of revenue.

Table 3 on page 46 compares various factors for each of these scales of development and provides greater detail about Alberta regulations.

Mirco-Generation Projects (up to 5 MW)

Micro-generation projects as defined by the Micro-Generation Regulation, under the Electric Utilities Act, are renewable or alternative energy projects sized to offset all or a portion of a customer's total energy consumption, up to 5 MW. Development requires approval from the WSP but not the AUC (though AUC does act to resolve disputes) and must follow the rules outlined by the AUC's Rule 024 (Rules Respecting Micro-Generation) and receive approval from the WSP.

Table 3: Comparison of the different scales of a renewable energy project in Alberta

	Micro Generation	Small-scale Community Generation	Utility Scale	
			Distribution Connected	Transmission Connected
Capacity generation	Less than 5 MW up to 100% of aggregated loads's yearly demand	TBD	Up to the limit specified by the WSP or WO	Up to the limit specified by the TFO
Application process	> Provide notice to distribution facility owner > If the distribution facility owner objects, the matter may be brought to the AUC	TBD	> Notify/apply to AUC > Complete interconnection agreement with WSP or WO, or TFO > Register as a pool participant with AESO	
Compensation method	> Less than 150 kW: Receive credits valued at retail rate for excess electricity exported to the grid > More than 150 kW: Receive credits valued at hourly pool price for excess electricity exported to the grid	TBD	Receive cash (based on pool prices) from the AESO for electricity generation	
Metering	WSP is responsible for the cost of installing the required meter and for the collection of the electricity data	TBD	Owner is responsible for the metering cost and meter data management	
Pool participant	Not required to register with the AESO	TBD	Must register with the AESO to become a pool participant	
Relationship with Energy Retailer	Need to notify retailer of becoming a micro-generation customer	TBD	No change	
Timeline	1 month to 1 year	6 months to 2 years	3 – 10 years (technology dependent)	
Key Challenges	> Project costs per kW are typically higher than larger scale projects > Owner would still be dependent on grid supply for when system cannot supply entire electricity load > Owner would still be responsible for all distribution and transmission charges associated with grid supplied electricity	policy framework under development	> Capital intense > High level of development risk > Significant time for development and construction > Involves external players > Needs to be competitive with other power producers > More likely to require environmental impact assessments > More likely to require wildlife assessments	

There are three regulatory steps involved in the approvals process for a micro-generation project: [39]

1. Notice given to stakeholders
2. Application and and approval by WSP
3. Notice of intent provided to retailer or regulated rate option provider.

You are highly advised to read Rule 024 if you are interested in a micro-generation project. Figure 17 presents a flow chart summarizing the process for applying to become a micro-generator with a WSP, which is also outlined in the rest of this section.

Stakeholders Engagement

The first step to a micro-generation project is to notify stakeholders in accordance with Appendix A1 (Participant involvement program guidelines) of AUC Rule 007.[40] This appendix provides guidelines on the expected considerations, notices and consultations. The participant involvement program (PIP) requirements are less demanding for micro-generation projects than for larger projects.

Notify WSP of intent to become a micro-generator

After stakeholders have been notified by the community, the next step is to notify the WSP using Form A – Micro-Generation Notice, found in AUC Rule 024 or from the WSP website. The information to be filed out in the form includes:

- customer details
- project description
- confirmation of meeting all necessary municipal requirements
- confirmation of meeting requirements of AUC Rule 012 – noise control
- confirmation of meeting all applicable environmental requirements.

Due to different practices among WSP's, each WSP in Alberta has created its own specific instructions and supporting documents on how to become a distributed generator in its regions. Proponents are encouraged to contact the WSP directly regarding the specific procedures in their service area.

For more details on the application process for distributed generation and additional links to specific WSPs, refer to the AUC's Distributed-Generation Application Guideline (Version 1.0).[41]

[39] Alberta Utilities Commission, Rule 024 – Rules Respecting Micro-Generation, June 15, 2017. http://www.auc.ab.ca/Shared%20Documents/Rules/Rule024.pdf

[40] Alberta Utilities Commission, Rule 007 Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments, March 21 2018. http://www.auc.ab.ca/Shared%20Documents/Rules/Rule007.pdf

[41] Alberta Utilities Commission, Distributed-Generation Application Guideline (Version 1.0), August 20, 2013. http://www.auc.ab.ca/regulatory_documents/Reference/DistributedGenerationApplicationGuideline.pdf

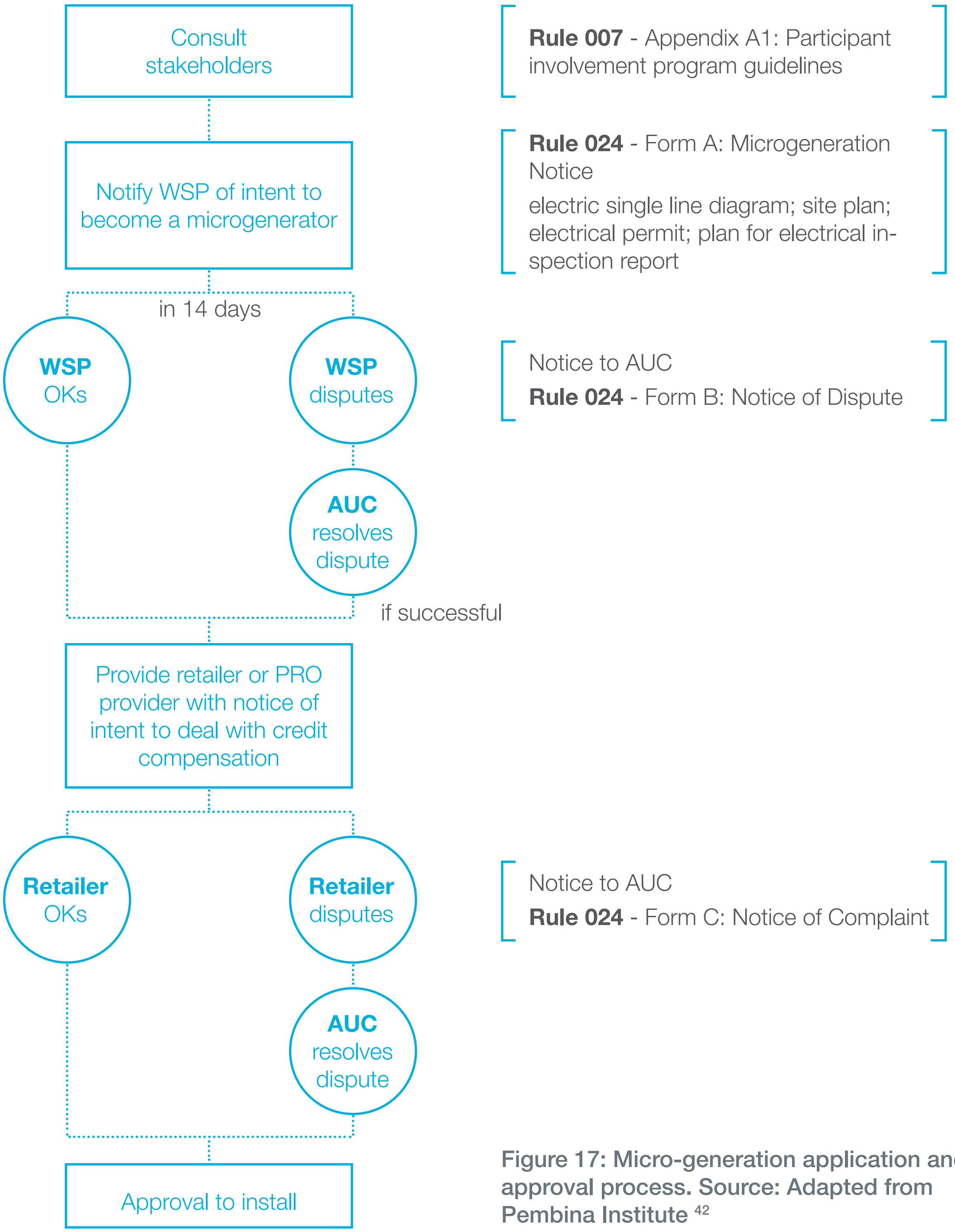


Figure 17: Micro-generation application and approval process. Source: Adapted from Pembina Institute [42]

[42] Pembina Institute, Alberta Community Solar Guide, November 2017. http://www.pembina.org/reports/alberta-community-solar-guide.pdf

In addition, the following supporting documents are required with submission:

> electric single-line diagram

> site plan

> electrical permit

> Electrical Inspection Report (to be submitted after installation of micro-generator is completed and inspected).

Once the WSP receives notice, it has 14 days to either accept or dispute the eligibility of the project, or to question any extraordinary costs that would be associated with the project. In the case of a dispute, the AUC would be responsible for settling any disputes.

Provide retailer or regulated rate option provider with notice of intent to deal with credit compensation

Upon approval by the WSP, the WSP will then provide notice to the community's retailer or regulated rate option provider of the micro-generation unit so the community can receive credit compensation for the energy generated.

Utility Scale Renewable Energy Power Plant

Currently, the Hydro and Electric Energy Act and associated regulation provide the legislative framework for a utility-scale renewable energy generator. As part of the regulation, a proponent that wants to construct and operate a utility-scale renewable energy generator must apply and receive approval from the AUC. Rule 007 sets out the application requirements for construction, operation and decommissioning of power plants, substations and transmission lines.[40] Reading Rule 007 is highly advised, but the rest of this section summarizes the process for approvals for either a distribution-connected generator or a transmission-connected generator.

Distribution-connected generation

A distribution-connected generation refers to a generation project that is connected directly to a lower-voltage electric distribution system. Such projects have minimal load, and are primarily built to export electricity directly into the local distribution grid. There are three regulatory steps involved in the approval process for distribution-connected generation projects:

1. application to and approval by the AUC
2. interconnection agreement with the WSP
3. registration in the AESO wholesale power pool.

[40] Alberta Utilities Commission, Rule 007 Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments, March 21 2018. http://www.auc.ab.ca/Shared%20Documents/Rules/Rule007.pdf

Under this regulatory framework, the electricity exported by the distribution-connected generation is compensated by AESO at the hourly wholesale pool price. A Demand Transmission Service tariff unique to the WSP also applies to distributed generators.[43]

The steps of the regulatory process regarding distribution-connected generation is outlined in Figure 18 and described in more detail below.

Notification and application

The first step in a distribution-connected generation project is to notify and apply to construct and interconnect the system to the grid. This process is governed by AUC Rule 007 (Application for Power Plants, Transmission Lines, Industrial System Designations and Hydro Developments). Project proponents or developers should notify the AUC about their intentions to develop a distributed generator and to seek clarification on the application procedure from them depending on the capacity of the project. As well, construction must comply with all relevant federal or provincial regulations and directives, as well as local land use plans that are applicable to the project.

Interconnection

Following notification and application to the AUC, the project proponent must contact the WSP operating in the area to determine how to connect to the grid. There are several distribution zones in Alberta that are managed by WSPs. If the generator is connecting to lines owned by a REA, the project proponent should also determine whether the REA should be contacted. The AESO website provides assistance with determining which zone your project is in.[44]

Registration

The final regulatory step for distribution-connected generation projects is to register with AESO as a pool participant. This step allows the electricity to be delivered and sold to the wholesale power pool or through alternative arrangements, such as a bilateral contract, direct sales agreement or net settlement instruction. (Chapter 4 has a section on Preliminary Financial Analysis that provides more detail on the different types of arrangements.) AESO recommends that power pool participants notify AESO two to three months prior to the in-service date. The applicant is responsible for following up with project proponents regarding further paperwork.

Transmission-connected generation

A transmission-connected generation project refers to a standalone generator that is connected directly to the transmission system. The connection process involves seven regulatory steps for the approval of a transmission-connected generator. According

[43] Alberta Utilities Commission, Distributed Generation Application Guideline (Version 1.0), http://www.auc.ab.ca/regulatory_documents/Reference/DistributedGenerationApplicationGuideline.pdf

[44] Alberta Electric System Operator, Understanding the market. http://www.aeso.ca/market/understanding-the-market

to AESO's Connection Process Overview, a typical timeline of 24 to 36 months is required to complete a connection process. A specific project's timeline depends on a number of factors, such as the time the customer takes to make decisions, the volume of active projects, the complexity of the project, stakeholder impact (e.g., landowner consultations), the availability of construction resources and the procurement of long lead time items (e.g., transformers).

Below is a brief description of AESO's staged connection process.[45]

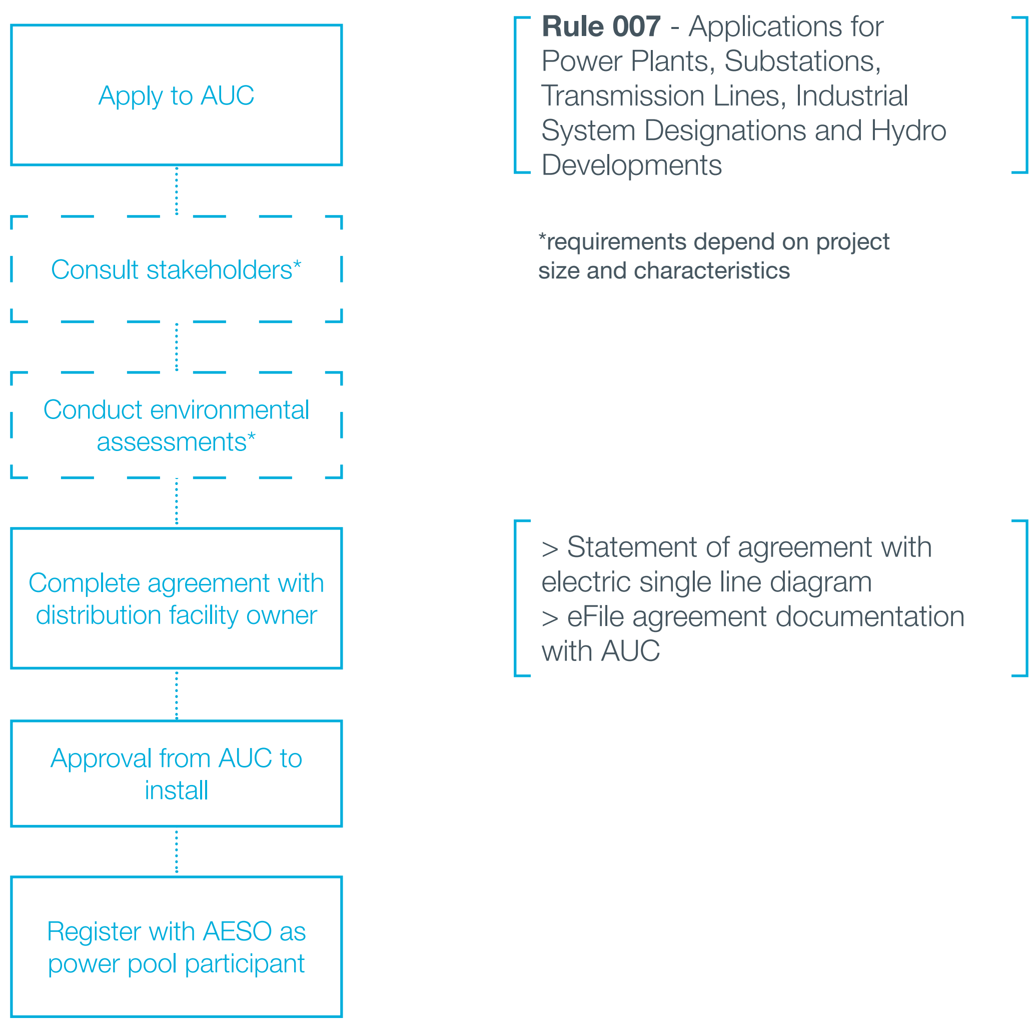


Figure 18: Distribution-connected generation application and approval process. Source: Adapted from Pembina Institute [46]

[45] Altalink, Estimated Timelines. http://www.altalink.ca/customers/estimated-timelines.cfm

[46] Pembina Institute, Alberta Community Solar Guide, November 2017. http://www.pembina.org/reports/alberta-community-solar-guide.pdf

Stage 0: Identify project (2 weeks)

Stage 0 is the inaugural stage of the Connection Process. At this stage, the customer identifies a request for a new connection project by submitting a System Access Service Request to AESO. The request is reviewed by AESO for completeness and the project is initiated. An AESO project co-ordinator is assigned who will be the facilitator of the Connection Process and the AESO point of contact for the TFO and customer for the life cycle of the project.

Stage 1: Connection study scope (8 weeks)

Stage 1 represents the scoping stage of the project. At the beginning of this stage, a project kick-off meeting takes place and discussions regarding the Connection Plan and Connection Study Scope commence. During this stage, an assessment will be made to determine AESO vs. TFO/Consultant involvement in connection studies and the Connection Proposal depending on the complexity of the connection and any system impacts. Customers are responsible for costs related to preparation of the Connection Proposal.

Stage 2: Connection proposal (14 weeks)

Stage 2 is the stage where the connection studies are completed and the Connection Proposal is finalized. The cost for the connection is included in the Connection Proposal. At the end of this stage, AESO accepts the Connection Proposal (or the customer accepts if AESO completes it). The customer must meet security requirements for Stage 3 costs related to the preparation of the Facility Application. The customer is required to provide specific machine data for dynamic studies in order to complete Stage 2.

Stage 3: Facility application (32 weeks)

Stage 3 is the stage where the Facility Application is completed. The TFO completes the Facility Application. The customer must meet security requirements for Stage 4 costs incurred from the time of filing to when the TFO permit and licence are issued by the AUC. Generators must have filed their Generator Facility Application with the AUC before they can complete Stage 3.

Stage 4: Application filings and AUC approvals (24 weeks)

Stage 4 is the stage where the Facility Application are filed with the AUC. The AUC timelines for processing and approving applications are outlined in AUC Bulletin 2009-025. To complete this stage, load customers must pay Customer Contribution and generators must pay Customer Contribution and Generator System Contribution in cash within 90 days of the AUC issuing the TFO permit and licence before construction can commence.

Stage 5: Construct and prepare to energize (16 weeks)

In Stage 5 construction of transmission facilities required for the connection commences. The customer and AESO are required to sign the corresponding System Access Service Agreement six weeks prior to energization. Data required to authorize energization of the facilities is required in order to complete Stage 5.

Stage 6: Energize, commission and close

Stage 6 marks the final stage of the Connection Process. An Energization Checklist/Deficiency List must be completed, upon which energization of the transmission facilities can occur. For generators, a commissioning period applies following which a Commissioning Certificate is issued. The TFO provides the final project costs and a true-up occurs so that project close-out can take place.

The AESO website provides details on the connection process.[47]

This AESO application process requires significant application fees based on the project capacity as well as submission of technical reports from third parties.

Becoming a Market Participant

Once approval from the AUC regarding construction and operation has been granted, for utility-scale projects, the project proponent will also need to register with AESO as a pool participant. The AESO document Information Document Becoming a Pool Participant ID#2010-002R provides additional guidance on the steps and timelines.[48] The AESO document Section 201.1 – Pool Participant Registration sets out the detailed rules registration as a pool participant and can be found on the AESO website.[49]

Figure 19 on page 54 summarizes the process.

[47] Alberta Electric System Operator, Get Connected. https://www.aeso.ca/grid/connecting-to-the-grid/connection-process/

[48] Alberta Electric System Operator, Information Document Becoming a Pool Participant ID#2010-002R, https://www.aeso.ca/assets/linkfiles/2010-002R-Becoming-a-Pool-Participant.pdf

[49] Alberta Electric System Operator, Section 201.1 – Pool Participant Registration, December 2015. https://www.aeso.ca/rules-standards-and-tariff/iso-rules/section-201-1-pool-participant-registration/

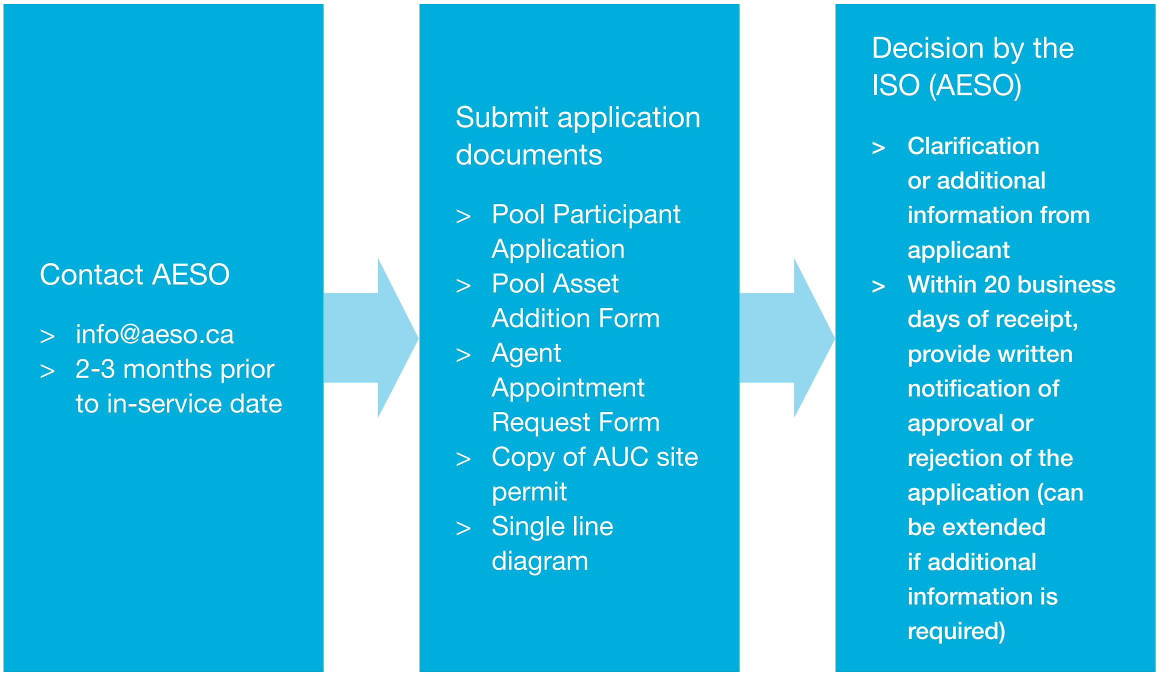


Figure 19: Summary of process for becoming a market participant

Approvals for Indigenous Communities

The Government of Alberta is currently working with ISC to look at issues related to how First Nations reserves will be addressed with respect to the AUC approvals process.

As part of Alberta's deregulated market framework, the Government of Alberta has implemented several mechanisms aimed at maintaining fair competition between municipally-owned entities and investor-owned entities competing in Alberta's electricity market. This has implications for Metis Settlements seeking to own generation projects, as Metis Settlements are defined as municipalities under the Electric Utilities Act.

In particular, Section 95 of the Electric Utilities Act requires a municipality to obtain approval from the Minister of Energy before it may own an interest in a generating unit. Specifically, Section 95 requires the Minister of Energy to establish procedures for an independent assessment when a municipality wants to build or purchase a generation project. The Section 95 assessment includes a critical review of the proposed project's detailed financial arrangements and includes a consultation with stakeholders identified by Alberta Energy. This process promotes competitive market behaviour by ensuring that a municipally owned generating unit does not have a tax advantage or any other financial advantage over investor-owned generating units.

However, a municipality is not required to go through a Section 95 assessment if the project meets one of the sets of conditions shown in Table 4 on page 55.

Table 4: Conditions in which a community is not required to undergo Section 95 of the Electric Utilities Act

Condition	Example	Statutory Authority
The project is located within the boundaries of the municipality, it is part of a process that is carried out on property owned or leased by the municipality, and the electricity produced by the project is incidental to the main purpose of that process.	A municipality builds a cogeneration project to support industrial operations.	Section 95(8), Electric Utilities Act
The project is located within the boundaries of the municipality, it is located on property owned or leased by the municipality, and a majority of the electricity produced annually by the project is used by the municipality on that property.	A municipality installs solar panels on a community building to offset electricity consumption on the building.	Section 95(9), Electric Utilities Act
The project meets the following conditions: a. An arrangement is in place to ensure that all of the electric energy produced by the project, in each hour, is purchased by the municipality for one or more sites, within the municipality's boundaries b. The municipality owns or leases property, including land or buildings, at the location of those sites. c. The municipality is responsible for paying the electricity bill for those sites. d. The municipality files a compliance plan with the Market Surveillance Administrator, detailing how it will comply with items (a) through (c). e. The Market Surveillance Administrator approves the compliance plan.	A municipality constructs a solar farm to power its municipal buildings. The municipality has signed a contract with an electricity retailer, whereby the retailer agrees to buy the electricity generated by the solar farm and bill the municipal buildings.	Municipal Own-Use Generation Regulation

CHAPTER 3

Considerations Before Starting the Renewable Energy Development Process

PROJECT MOTIVATORS

Before starting the renewable energy development process, it is important to ask questions that will help identify the key motivators for a community to pursue a renewable energy development.

Identification of the key project motivators will provide the source of commitment and purpose that are necessary to generate both the resources (funding and skilled human resources) to develop a project and the perseverance to make it happen through the long development and construction process.

A common mistake in the early stages of project development is to jump to technical or financial details before building consensus among project stakeholders.

A fundamental, but common, mistake in the early stages of project development is to jump to technical or financial details before building consensus among project stakeholders. It is important to establish a clear purpose of the project to help maintain and sustained the efforts needed to bring the project to reality.

Why Pursue a Renewable Energy Project?

The questions to consider that will help establish the key project motivators and potential project barriers before pursuing renewable energy development are organized around four themes:

> objectives
> economics
> policy
> technology.

Not all of the questions may be answerable before project development, but the more questions that can be answered positively the stronger the basis for pursuing renewable energy development.

Objectives

What are the reasons the community is interested in renewable energy development? The following questions will often help identify the most appropriate scale of development for the community:

> Is the community focused on reducing its own environmental impact?
> What are the community's current and future energy needs?

- Is the community focused on increasing energy security and reducing current and future utility costs for community members?
- Is developing a new revenue stream the focus?
- Does the community see renewable energy development, trades related to renewable energy project construction, or operating and maintaining renewable energy projects as a key business opportunity for the community?
- Is there a desire for the project to be located in the community?

Economics

Does the project make sense from a financial perspective? Based on the current and future costs of electricity, or the market rate of electricity, will the project be a net positive economically for the lifespan of the project? Some of the following questions should be asked:

- Will the project lead to reduced electricity costs for the community over the lifespan of the project?
- How much will the project cost?
- How much equity is required from the community?
- If the community is taking a loan for the project, can it afford the loan payments if the project is delayed?
- Can the community afford the upfront costs of the project?
- Is there a long term market and ability to sell the energy (e.g., wholesale energy market, bilateral agreement, financial power purchase agreement) and environmental attributes of the renewable energy generated (e.g., Emissions Offsets as defined in the Carbon Competitiveness Incentive Regulation, or Index Renewable Energy Credit as part of the REP)?
- Will the project lead to a suitable return on investment to the community?
- What would be the expected revenue to the community from the project?
- What programs are available to help overcome economic barriers?

See Glossary on page 145, to understand some of the terms.

Policy

What are the key policy hurdles that might prevent the project from being implemented? In particular, answer the following questions:

- What are the legal rules surrounding development on the land?
- What approvals are required from council to support the project?

Revenue Streams for Renewable Energy Projects

Micro-generation

Two types of micro-generators are covered under the Micro-Generation Regulation:

Small micro-generators (under 150 kW) are compensated on a monthly basis at daily average retail rates (the rates at which they purchase electricity), which does not allow access to peak hourly rates. A micro-generator is still responsible for paying for all electricity it purchases from the grid, as well as all fees associated with energy delivery, monthly administration, billing and interconnection. This kind of arrangement is known as “net billing”.

Large micro-generators (between 150 kW and 5 MW) are compensated for the energy they supply at the hourly wholesale prices of the power pool.

Utility-scale generation

Utility-scale projects are typically compensated through Alberta’s wholesale energy market (the power pool), which is an energy-only competitive market for electric supply. All generators are obligated to offer their power into the pool and are paid the hourly pool price for the energy they produce. The price is determined through supply and demand and set by the power pool itself. Generators can also enter into bilateral agreements with a buyer for the sale and purchase of electricity according to the terms agreed to.

Environmental Attributes

Environmental attributes are the recognized value attributable to renewable energy generation either in the form of i) the renewable aspect of the energy generated and, ii) the displacement and offsetting of greenhouse gas emissions compared to conventional types of generation such as coal or natural gas. These environmental attributes present an additional revenue opportunity for utility-scale renewable energy projects through the ability to sell the environmental attributes of the renewable energy they generate. Environmental attributes can be sold either in the form of greenhouse gas emission offsets to regulated emitters as part of Alberta’s Carbon Competitiveness Incentive Regulation (which replaced the Specified Gas Emitters Regulation on January 1, 2018), or in the form of renewable attributes through a RESA under the REP. An additional opportunity may be available by selling the renewable attributes to corporate entities or other buyers, such as universities or government agencies, to help those buyers meet their sustainability goals.

Capacity Payments

Renewable generators, particularly those with storage or on-demand generation capabilities, may also be able to receive capacity payments once the transition to a capacity market is complete in Alberta (expected to occur by 2021 and explained in Chapter 2, page 28.

Alberta’s wholesale energy market (the power pool), which is an energy-only competitive market for electric supply. All generators are obligated to offer their power into the pool and are paid the hourly pool price for the energy they produce. The price is determined through supply and demand and set by the power pool itself. Generators can also enter into bilateral agreements with a buyer for the sale and purchase of electricity according to the terms agreed to.

- What provincial or federal environmental regulations would be applicable (and might be a barrier to development)?
- What additional approvals will be needed (AUC, AESO, WSP, TFO)?

Technology

At this stage, an assessment of the renewable resources available to the community and the commercially available technologies to capture those resources will provide the community with a sense of what renewable energy and what technologies are most appropriate.

- What renewable energy resources are available to be developed?
- What technologies are commercially available to capture those energy resources?
- What key barriers could limit ease of construction of a renewable energy project on site?

COMMUNITY ROLE IN THE DEVELOPMENT PROCESS

There are several different actors in the renewable energy development process. Communities have many opportunities for involvement in either the development process or in the ownership or operation of a facility.

Table 5, which continues on page 62, describes each of the potential roles a community can take and its key considerations.

Table 5: Potential roles for the community in renewable energy project development and key considerationsv

Role	Key Considerations
Community as devel-oper	Communities that develop their own projects can benefit from project revenues. When deciding whether to develop a renewable energy project, communities should consider whether they have available land or buildings they can use or whether they would need to lease or rent property. Additional considerations: > Are the financial resources available to develop a project on their own? > Does the community have the risk appetite to finance a project directly or with a lender? > Are there internal resources to manage and develop the project successfully? > Does the community have access to trusted consultants and experts needed during the development process? > What timelines are needed to see the development process through? > What approval and permitting requirements will the project entail? > Do community members have concerns regarding the project?
Community as Partner	Communities that partner with developers can benefit from project revenues, while also having some control over the project direction. Before communities partner with a developer on a renewable energy project, they should consider the following: > How much electricity would this type of project generate? > What revenue would this system generate? > What ownership structure might be best? > Will the project ownership be transferred to the community at the end of the contract term? > Is there a possibility of purchasing an interest in the project later on? > What is the community's risk tolerance? > How will the project benefit the community? > Do community members have concerns regarding the project?

Role	Key Considerations
Community as project site owner	Communities may choose to allow renewable energy projects to be located on community-owned land or properties in return for lease payments or other benefits from developers. The funds communities earn from these projects can be reinvested in other local projects. The AIGEDP does not fund this type of agreement. With the funding available through the AIGEDP, communities are supported to move away from just a transactional engagement into a transformational engagement where communities acquire an ownership stake in projects. Round 2 of the REP included an Indigenous equity ownership requirement. Communities may negotiate agreements with developers to benefit their communities, such as upgrading the roof of a community building for a solar installation. Communities need to consider what each side stands to gain from an agreement and clarify key terms up front. For example, a community that is asked about hosting solar panels on reserve land, may want to know the following: > How much electricity would this system generate? > What revenue would this system generate for the developer and what are the revenue-sharing opportunities for the community? > Would this system be owned by the community or the developer? > What is the expected life of this system? > Will ongoing maintenance be required for this system? If so, who will carry it out? > Are there insurance or tax implications for this system? > Will this system be transferred to the community at the end of the contract term? > How will the project be decommissioned? > Is there a possibility of purchasing an interest in the project later on? > How will the project benefit the community? > How does the community feel about leasing the land for this type of project?

When it comes to the development of renewable energy projects, communities can play a number of different roles. For instance, communities can develop projects themselves, partner with developers as project co-owners or participate as project site owners.

LEGAL CONSIDERATIONS

Hiring experienced legal, accounting or financial advisors is an important step in evaluating and successfully completing renewable energy transactions and developments. Communities may find it helpful to hire lawyers who have specific renewable energy expertise because renewable energy projects tend to involve specialized legal issues and risks. Lawyers should ideally co-ordinate early on with tax and financial advisors to ensure that projects are developed in a tax-effective way.

If a community is approached by a developer, it is particularly important to ensure that the community has advisors looking out for the best interests of the community. Lawyers have a duty of loyalty to their clients. In projects involving multiple parties (such as a community, an investment company and a developer), it is important to know that the community has an advisor acting in the community's best interests. Often, each party (each investor and the development company) will need its own legal counsel to avoid a conflict of interest.

Typical renewable energy transactions that include a third-party developer or investor involve a number of legal agreements:

- Non-disclosure agreement (confidentiality agreement): An agreement to keep information confidential between parties and their advisors can facilitate negotiation and due diligence.
- Term sheet: A short, concise agreement can set out the proposed deal structure, general funding terms and objectives. Terms can be binding, non-binding or partially binding and can include payments to support a community in evaluating a sophisticated project being proposed by a third party.
- Formation documents: These documents are required to set up any legal entities and to clarify agreements between parties, including a shareholders agreement (for companies) or a limited partnership agreement (for limited partnerships).
- Leases: To secure the land required for projects, developers may proceed via options to lease or directly to leases, which allow for the use of property for a specified period of time and set payment and use terms. If projects are planned on First Nations land, these leases may require federal government and band council approval or alternative structures may be used. If secured financing is required, legal advisors should consult early with lenders regarding structures to ensure they will be comfortable taking security.
- Approvals: Some approvals and regulatory arrangements may require project entities or developers to take on legal obligations around the development and mitigation of project impacts.
- Financing agreements: These agreements may include term sheets, credit agreements, guarantees, security agreements, letters of credit and associated certificates and documentation. If multiple loans will be used (e.g., one for

construction and then a “take out” loan once the project is operational), multiple rounds of financing documents may be required.

> EPC and O&M agreements: Agreements to develop (Engineering, Procurement and Construction-EPC) and then Operate and Maintain (O&M) the project are discussed in more detail in Chapters 5, page 113, and 6, page 125.
> Principal agreements: These agreements usually include the Balance of Plant (BoP) agreement and the major equipment supply agreements for solar panels (Solar Panel Purchase Agreement) or wind turbines (Turbine Supply Agreements). They outline the specific components and auxiliary systems of the generator to be supplied, warranty period, installation (if applicable), equipment costs, service agreement terms and pricing (if applicable), payment schedules and other terms

Common Legal Structures

Communities may wish to explore a variety of legal structures to achieve their project development objectives. Ideally, this discussion should take place with experienced legal and tax advisors at an early stage. Considerations may include:

> protecting other assets from liability in the event that there is a problem with the project
> creating a project that is tax-efficient from the community’s perspective and that does not create taxation to communities that are exempt, which may involve a consideration of a number of factors, including project location
> providing hard caps on transaction costs and the flow of funds between the proposed development company and any development partner to reduce the chance of conflicts of interest
> setting out benefits for the community and its members.

Common recommended structures can include the use of companies (incorporated under the laws of Alberta or federally) or Alberta limited partnerships. Figure 20, page 65, illustrates how such a company might be structured.

Typically, a community or its development corporation will set up a subsidiary company to own its interest in the ultimate company or limited partnership that owns the renewable energy generation assets. If a limited partnership is used, it will have a general partner running the operations of the limited partnership. In this case, communities may wish to seek joint ownership of and board of director representation at the general partner, in addition to their limited partnership interest. This can help ensure a community has access to important information about the project and decision-making authority. Figure 21, page 66, illustrates how this limited partnership might be structured.

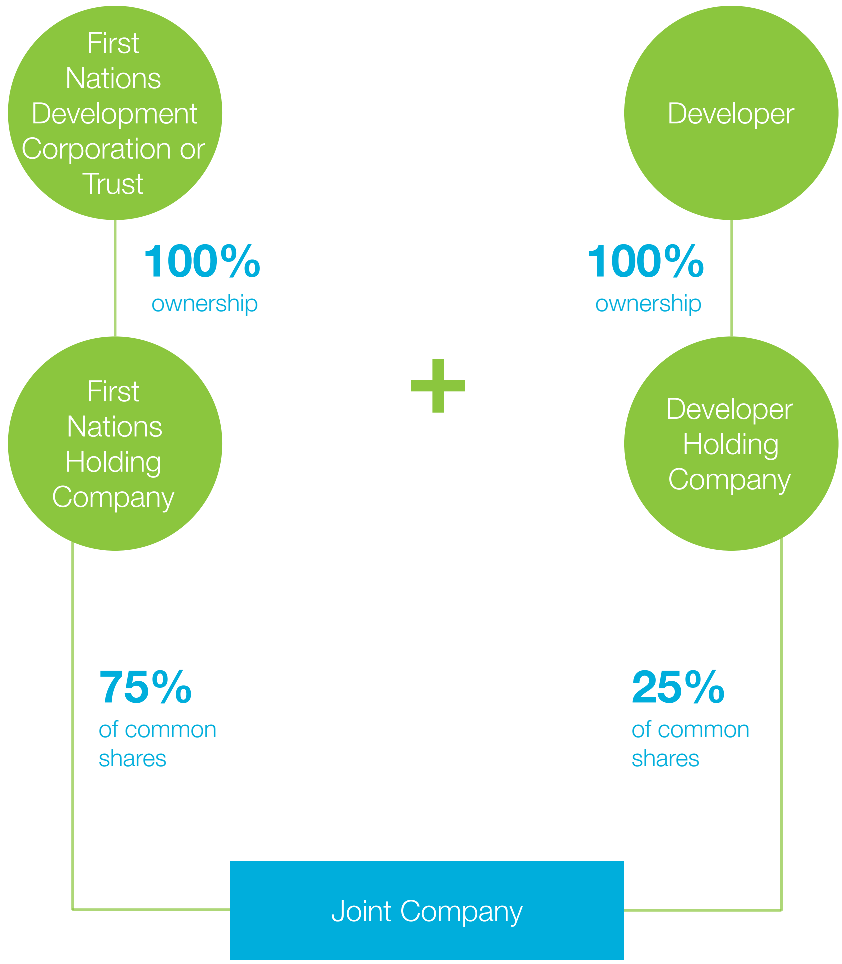


Figure 20: Sample organizational chart of how a company structure may look

It is also possible for a community or its development corporation to own a project directly or to enter into a joint venture or a general partnership (as opposed to a limited partnership). These approaches are generally not recommended because, unless they are combined with structural features that limit responsibility, they expose a community's other assets and revenue streams to liability in the event that there is a problem with the project (such as an injury or lawsuit).

In addition to tax considerations, communities are strongly advised to consider setting up detailed agreements to govern the operation of any company (unanimous shareholders' agreement) or limited partnership (limited partnership agreement). It is particularly important to understand any and all ways in which the community and any other investors (such as a developer) are being paid. In some cases, developers may seek payment not only as a limited partner or shareholder, but also for development, EPC or O&M services. In such a case, it is important to have a clear agreement about

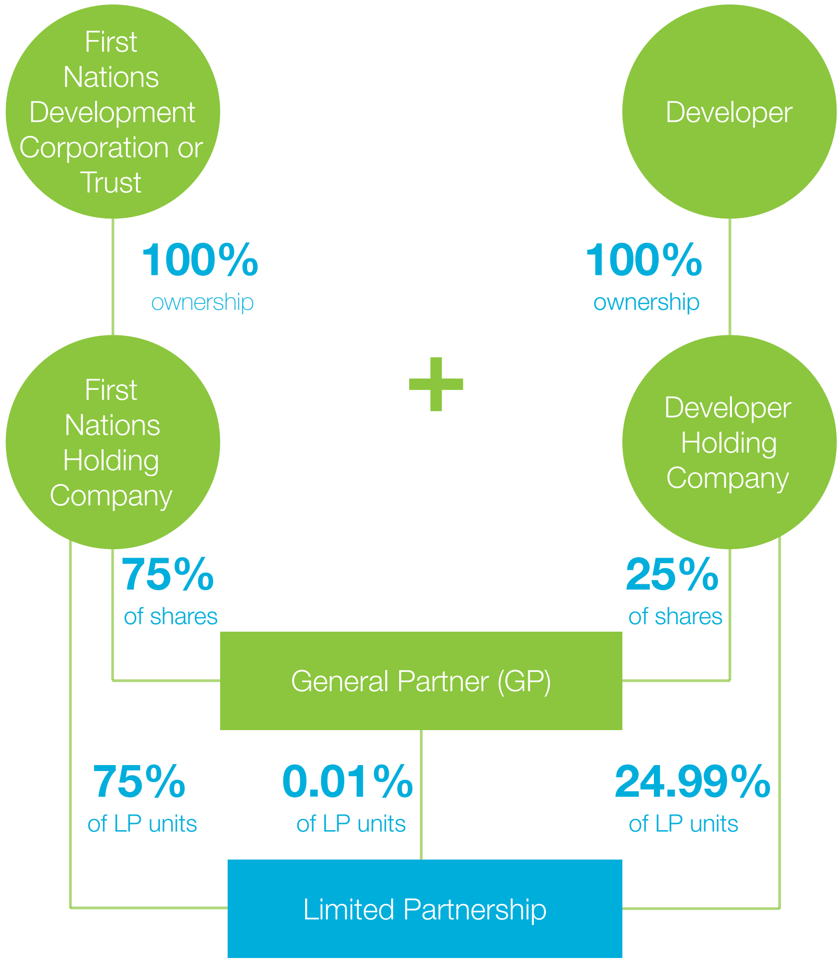


Figure 21: Sample organizational chart of how a limited partnership structure may look

the scope of any such payments to avoid misunderstandings or, in the worst case, conflicts of interest.

Non-equity Opportunities

In addition to receiving payments as a shareholder or limited partner, communities may wish to explore other opportunities for revenue generation. These opportunities can include requiring developers to enter into impact benefit agreements (IBAs), royalty agreements, leases, or alternative legal structures to compensate the community for any land it provides to the project. Communities may also enter into a wide variety of agreements to compensate services provided by the community And could involve sharing traditional ecological knowledge or providing development, operations or maintenance services. Communities may also wish to include in project budgets funding for ommunity meetings and update events throughout the life of a project.

Impact and Benefit Agreement (IBA)

IBAs are usually negotiated privately between communities and project developers. They often set out agreed-upon mitigation measures for anticipated project impacts and compensation. They can also involve benefit sharing from development activities. IBAs are project-specific, but they can include provisions related to employment; economic and business development; financial benefits; environmental protection; and social and cultural matters.

In the case of renewable energy projects, IBAs are not required by law in Alberta. Communities and developers may find it useful to enter into IBAs when developers are proposing projects that could affect their territories or Indigenous and treaty rights. IBAs can be used whether or not the community will be a partial owner of the proposed project. In cases of projects that might affect multiple communities' rights, communities with ownership in a renewable energy project may also be involved in the negotiation of IBAs with other potentially affected communities.

Communities interested in IBAs may find the following resources helpful:

> Supporting Aboriginal Participation in Resource Development: The Role of Impact and Benefit Agreements[50]

> Sample First Nations Impact, Benefits and Reconciliation Agreement[51]

[50] Kielland, N., Supporting Aboriginal Participation in Resource Development: The Role of Impact and Benefit Agreements, May 5, 2015. https://lop.parl.ca/Content/LOP/ResearchPublications/2015-29-e.pdf

[51] V, Lyle., Sample First Nations Impact, Benefits and Reconciliation Agreement, https://www.ictinc.ca/blog/reconciliation-as-part-of-first-nation-negotiations

Common Pitfalls and Risks

Tax: One of the greatest risks in the development of a large project is that it will use an ineffective structure from a tax perspective, thereby reducing net returns to a community. To mitigate this risk, tax advisors should be consulted early and regularly.

Proforma vs. reality: It is possible that a project will not be as profitable as it looks at the planning stages (often based on a proforma cash flow statement provided for the purpose of attracting an investment by a community). In addition to following the steps set out in this guide to evaluate a project, one of the best steps a community can take is to hire its own independent project advisor to help it determine a likely range of net income and to estimate risks based on similar projects. It is not recommended to make investment decisions based on proformas without obtaining third-party independent advice and review, no matter how trustworthy a developer seems or how lucrative a project appears.

Capital calls: Depending on project structuring, investors (including communities and developer partners) may be called upon to contribute capital (a capital call) in excess of the project budget. Communities may wish to specify whether an obligation to

The Importance of Development and O&M Fees

A renewable energy developer requests to make a presentation in front of Chief and Council. It provides a glossy presentation showing pictures of renewable energy projects and claims significant experience developing them. The developer also promises a very attractive return on investment if Chief and Council invest in the project with the developer on a 50/50 basis. It asks them to sign a binding letter of intent that would prevent them from partnering with other renewable energy developers, despite not having provided time for a detailed review of the proposed project.

Instead of signing the agreement, Chief and Council direct their financial and legal advisors to evaluate the project. They agree to sign a limited non-disclosure agreement that obligates them to keep information provided by the developer confidential, but which does not limit their rights to work with other developers.

Following their review, the financial advisors report that there is a strong chance that the project will not make distributions to shareholders (the First Nation and the developer, as shareholder) for many years after construction. Chief and Council ask why a developer would propose a project that is not likely to pay off for many years and the financial advisor tells them that, while the developer may not be receiving much money as a shareholder, it is charging very high costs to develop, operate and maintain the project, meaning that the developer gets paid, regardless of how well the project performs for the shareholders.

contribute to a capital call exists in a term sheet and any unanimous shareholders' agreement or limited partnership agreement.

Non-arm's-length transaction: It is not uncommon for developers to own part of a project and also to receive fees for development or other services provided. This arrangement can ensure that they get paid, even though a project is unprofitable for other investors, potentially creating an incentive that works against a community's interest to maximize returns for investors. Communities may wish to limit this likelihood by clearly understanding the scope of and limiting the payment of fees to developers and any non-arm's-length third parties.

Availability of financing: Large projects will typically require financing during construction and then financing secured on the project's assets (often provided as part of the same credit agreement) over the lifetime of the project. Particularly for projects occurring on First Nations land, lenders may require special assurances or structures to ensure that they will be repaid. Risk of these requests slowing down a transaction can be mitigated by working proactively with a financial advisor from an early stage to help ensure that lenders, when selected, are comfortable with the structure and underlying legal agreements in a transaction.

Project failure: Despite the best intentions, project failure can occur, for example because a solar panel or wind turbine is damaged. Various insurance products are available to cover project risks, and prudent reserves or financing features can be used to mitigate such events. Communities should ensure they have an opportunity to review and participate in the selection of and scoping of insurance policies.

Timing challenges: Evaluating and investing in a large renewable energy project can take a great deal of staff and advisor work, in addition to the time required of Indigenous Leaders. Various legal steps can require quick answers that may not be able to wait for regularly scheduled council meetings. As a result, communities interested in renewable energy projects may wish to designate a special committee to evaluate and move forward with renewable energy projects (or assign responsibility to a development corporation or trust). This step can ensure that decisions are being made on time and that documents are being provided to appropriate

Renewable Energy Project Insurance

Having the proper insurance for a project is important in order to reduce the risk to the community from potential project failure. Insurance coverage can reduce the risks from the following project issues:

- construction
- delay in start up
- operating risks
- machinery breakdown
- business interruption
- general third-party liability.

It is advisable to reach out to various insurance agencies early on to find one that understands renewable energy projects, as well as one that can provide the right coverage for the project.

parties on a timely basis. As part of this assignment, communities may find it helpful to specify under what circumstances, reports or approvals by Indigenous Leaders and Council are required. A collaborative approach between the community and the developer to develop a realistic timeline and meet key milestones is also an essential ingredient to successful projects.

Keeping good company: It is not uncommon for developers to approach communities with projections that appear very lucrative, but lead to significant risk for the community or which are unlikely to be realized once a project is developed. While it is impossible to remove all risk, investing time and budget in appropriately screening developers and partners can save significant costs down the road. Later in this chapter, the Selecting a Developer and Consultant section, page 81, outlines some key qualifications to look for in a developer. In addition, a sample preliminary developer questionnaire is included in Appendix D, page 167, to support communities in evaluating their potential business partners before they invest too much time conducting detailed due diligence on a project.

The Importance of Insurance

A Metis Settlement partners with an experienced developer to build a solar project involving both ground-mounted and rooftop solar PV panels. The rooftop panels are mounted on a large barn.

The project is developed and commissioned as planned, and as part of the negotiations with the project's long-term lender (a bank specializing in renewable energy loans), the developer, Metis Settlement and bank agree to obtain a comprehensive insurance policy for all of the panels. A year after commissioning, the panels are performing as planned and generating healthy profits for the Metis Settlement and the developer. During the winter, a heater being used in the barn malfunctions, causing the barn to burn down and permanently damaging the rooftop panels. In this case, the insurance covers not only the cost of rebuilding the barn and replacing the panels, but also lost profits for the period between the fire and the reconstruction of the barn and PV system (less a deductible). Without the insurance, the subsidiary company owned by the Metis Settlement and the developer would become insolvent.

Renewable Energy Financing

Renewable energy projects are typically long-term investments. The rate of return depends on many factors:

- scale
- cost
- technology efficiency
- amount of energy produced
- ownership structure
- use or sale of energy
- location
- incentives available
- financing terms
- lifetime of the technology.

An understanding of these factors is important, but it boils down to knowing the following:

1. Capital costs: cost incurred for project development
2. Resource: the resource available and what amount of energy will reliability be produced
3. Revenue: the revenue or savings generated by the project
4. Operating costs: all costs for ongoing operation and maintenance
5. Financing costs: any costs associated with financing.

Due to economies of scale, larger renewable energy projects are typically more cost effective than small-scale projects. A wind farm has a far greater return on investment than a solar electric system used to power one building. However, larger scale projects also require greater resources upfront (including capital, time and a renewable energy resource) that exceed the limits of many communities.

Life Cycle Cost of Energy

Cost comparisons between different energy sources are made by calculating the levelized cost of energy. Levelized costs represent the present value of building and operating a plant over an assumed lifetime. They are expressed in real terms to remove the effect of inflation. For energy sources that require fuel, assumptions are made about future fuel costs. The levelized construction and operations costs are then divided by the total energy obtained to allow direct comparisons across different energy sources. This analysis allows for a consideration of the costs associated with an energy project across its entire life cycle, and provides a more suitable way to compare generation types. The National Renewable Energy Laboratory has a simple levelized cost calculator on its website.[52]

[52] National Renewable Energy Laboratory, Simple Levelized Cost of Energy (LCOE) Calculator Documentation. https://www.nrel.gov/analysis/tech-lcoe-documentation.html

For all projects, understanding the specific incentive programs and policies in Alberta is crucial. These opportunities can reduce a community's upfront cost for investment or increase the revenue generated by a project over time. Programs, policies and incentives that should be investigated when evaluating renewable energy project economics include the ones outlined in Chapter 2, page 18. Chapter 4, page 84, details the financial analysis that is typically expected during the predevelopment and development stages.

Communities may also wish to work with experts to understand the risk that the project will not perform as projected in financial models (sometimes called "proformas") provided by developers and to understand which risks are likely to be covered by insurance policies and which will lower returns to investors. Proformas are useful tools to conduct "what if" analyses by varying the key inputs. This informs the development team where to apply resources to reduce project uncertainty and risk.

SECURING FUNDING FOR RENEWABLE ENERGY PROJECTS

In most cases, communities require financing to realize their renewable energy projects, either at the project level or in a "special purpose" holding company. Project financing (also referred to as "limited recourse financing") is used in the majority of infrastructure and renewable energy projects because it provides a long-term financing solution. Project financing is intended to limit lenders' recourse to the project's assets. If structured properly, project financing shields communities and developers from undesirable risks and financial exposure above their respective equity commitments. It also provides "leverage" (i.e., the percentage of debt relative to total project funding needs), which increases the return on the equity since senior debt has a lower cost than equity.

In order to evaluate their need for equity funding and/or project financing, communities should consider the factors that are summarized in this section.

Financial resources of the community: While the community's own financial resources may be sufficient to cover the cost of smaller renewable projects, larger projects may require financing. The community should evaluate what level of investment is desirable given the project's size and risks relative to the community's financial resources and risk tolerance. There are several ways to reduce a community's financial exposure, including the maximization of project financing and funding support offered in some cases by developers in the form of loans (equity loans).

Suitability of project financing: A project's ability to secure project financing relies on the visibility and reliability of future income. In this respect, the preferred situation for lenders is when a project benefits from a "take-or-pay" offtake contract, also referred to as a bilateral agreement. (It is commonplace for the term "power purchase agreement" to be used, as well.) Alberta's REP is also an example of a bilateral agreement because it involves the signing of a Renewable Energy Support Agreement (RESA). The main advantage of a take-or-pay bilateral agreement, financial power purchase agreement, or a RESA is that it generates a given price for each unit of electricity produced, eliminating price variations that projects would incur when selling to the Alberta Electricity Pool. Lenders may also consider other income sources, such as sales of environmental attributes (see 'Revenue Streams for Renewable Energy Projects' box on page 59 for explanation), and will evaluate the experience of the developer or community experience in developing projects of a similar nature and scale in evaluation project risk. Another important consideration is the cost of sourcing project financing, which may be prohibitive for smaller projects (see page 79, Entering into a Financing Arrangement). In addition, the pool of lenders that will consider limited recourse loans below $20 million is relatively limited in Canada. In cases where communities associate with developers, it is highly probable that developers will contribute the financial capacity, expertise and relationships that are key to facilitate project financing.

The Cost of Project Finance

After having teamed up with a project developer, a First Nation was able to secure a RESA for their 50MW wind power project in the last REP round in Alberta. The Project's total capital requirement is expected to amount to $100 million, including 80% from a Senior Debt loan ($80 million), and 20% from an equity injection by the sponsors ($20 million). The First Nation will finance its 25% equity stake ($5 million) into the project through capital from the community's own cash holdings, and an equity loan through the First Nations Financial Institution, which will be fully repaid from future dividend proceeds from the project received by the community. Remaining equity needs ($15 million) will be funded directly by the project developer from its cash holdings. To structure the senior debt, the project will pay senior debt lenders including upfront fees ranging between 1% and 3% of senior debt, In addition, the project will incur other expenses related to structuring the senior debt including, the reimbursement of certain expenses, and the fees to perform independent legal, technical and insurance due diligence. In this case, the upfront fees would represent approximately $1.6M, and the due diligence and other fees and expenses would be between one and two million dollars. For all projects (especially smaller projects than this example) a careful calculation of costs related to project financing needs to be compared with the advantage that Senior debt confers, such as a lower cost of capital, high leverage and satisfaction of most capital needs for a project. Refer to the glossary on page 145 for more information on Senior Debt.

Projects without project financing: Some developers, including primarily large integrated oil and gas companies and large utilities, may prefer not to secure financing at the project level. This financial structure is referred to as "balance sheet financing": in this case the developer sources 100% of its equity from the treasury of its parent company, which includes corporate debt. The challenge in this situation is that most communities do not have sufficient financial resources to invest in the project without project financing. In this case, the developer could entertain to finance the community's share of the project. Alternatively, the project would need to be structured to allow "dual" financing where the community and the developer would have different leverage, debt costs and profitability. In this case, the community would need to hire experienced financial and legal advisors to secure its own project financing and ensure that its interests remain aligned with the developer.

Typical Sources of Equity

The sponsors of any project that use project financing need to inject 100% of equity at financial close or to guarantee all or part of it through the issuance of irrevocable letters of credit.

Securing an Equity Loan:

During the late development stage of a wind power project not located on land owned by First Nations, a developer approaches a community to support the project and make an equity investment. The project is complex and on its way to secure project financing, despite the fact that some important risks have not been resolved. In order to simplify and expedite the community's investment, the developer agrees to make an equity loan using its own financial resources to cover the community's equity amount. The community hires a financial advisor to ensure that the project cash flows, as calculated in the financial model validated by the senior lenders, are sufficient to provide the community every year with the target residual cash flow after providing for the scheduled repayment and interest. The community can at any time secure its own financing and repay the equity loan, and it has an incentive to do so to secure a lower interest rate and repay the loan more rapidly. If the equity loan is not refinanced or otherwise repaid, it will be gradually repaid from the cash flows generated by the project. In any case, the community has mitigated any potential loss because the developer carries 100% of the cost and financial execution risk until the project is reasonably advanced, at financial close.

Working Collaboratively to Invest Equity and Raise Project Financing

In a second project located on land owned by the community, the community is involved with a developer from day one on the basis of a joint development agreement. Each undertakes to make an investment commensurate to their respective equity stakes. The community and the developer agree that their interests are aligned to secure the best terms at the lowest cost and decide to jointly select and engage a financial advisor to assist them in this process.

Communities can consider the following sources to fund their equity stakes in renewable energy projects:

- using the financial resources of the communities, including from their development corporations or Trust
- securing funding from grants and/or loan guarantees offered by governments (as described in Chapter 2, page 18)
- negotiating an "equity loan" agreement with a developer to cover partly or completely the community's equity commitment amount, either as a bridge loan in order for the community to secure its own financing later or until it is reimbursed from the project's dividend's proceeds (illustrated in the example box below).

When communities work with developers, some of the main features that need to be addressed are as follows:

- respective equity stake (in percentage and nominal amount), the target return on equity investment and project financing assumptions (unless the project is balance sheet financed, as explained in the previous section)
- if one party provides the project development asset, its valuation and payment terms, and each party's funding obligations going-forward
- prospective financing of the community's stake through an equity loan
- the level of exclusivity of the parties, especially to avoid a situation where one party competes against a project in the same REP round (e.g. developer has multiple projects each with a different community all competing against one another during the same REP round)
- the respective responsibilities of the developer and the community during early stage development, project execution and operations, and how these responsibilities will be remunerated
- the legal structure, its governance and voting rights
- the formation of a project committee to support the project
- an agreement on how decisions will be made and by whom
- an agreement on what level of involvement community leadership will have in the project
- how often and who will update community on the project.

Project Financing Steps and Timelines

Projects relying on project financing are required to follow strict discipline with the primary objective of making the project bankable and optimizing financing terms. The main reason for this requirement is that lenders rely solely on the project and have no other recourse. As a result, lenders and their advisors work to decrease the risk profile of a project and ensure that each risk is contractually and appropriately covered.

The appropriate time to enter the financing market is after the project is sufficiently advanced to have good visibility on all important line items of the financial proforma. At that stage, the project would have already entered into a bilateral agreement, a RESA or another source of revenue that makes the project bankable (e.g., sale of energy to the wholesale energy market, receipt of capacity payments, sale of environmental attributes etc.), and the sponsors would be in advanced negotiations of principal agreements, such as the Balance of Plant (BoP) agreement and the major equipment supply agreement for solar panels or turbines (together the "Principal Agreements"). Resource assessment studies by a developer's internal team and/or an external specialized consultant should also be completed.

Noting that some of the steps to secure project financing happen in parallel, as opposed to sequentially, one can outline the following typical steps:

1. Select and engage a financial advisor (and/or use the internal resources of the developer).
2. Build a financial proforma following best practices to assess and select different options, including financial solutions.
3. Reach the advanced negotiation stage of the principal agreements.
4. Select and hire the independent consultants (independent engineer, legal advisor and insurance advisor) that will draft the reports required by lenders (Lenders' Reports).
5. Elaborate the optimal financial solutions and financing strategy and select target lenders.
6. Draft a confidential information memorandum that provides a full description of the project (including its sponsors and advisors, the principal agreements, financial proforma extracts, risks and mitigants, etc.).
7. Distribute the confidential information memorandum to prospective lenders and receive indicative term sheets.
8. Select one or a short list of lenders, negotiate the term sheets and provide them with the Lenders' Reports.
9. Negotiate the credit agreements with the help of each party's counsel.
10. Finalize all items included in the financial close agenda, including the financial close proforma.

The 10 steps described above would require a minimum of six months. However, delays in key project milestone can substantially extend the necessary time to secure financing. Typical culprits causing such delays would be delays to secure permitting or land leases and the insufficiency of information to complete the Lenders' Reports.

Common Financing Structures

Long-term bank financing: Depending on market conditions, a group of 10 to 15 banks lead long-term financing transactions in Canadian dollars for renewable energy projects in Canada. This group is mostly composed of international banks based in Europe and in Japan, which typically seek additional profitability by syndicating part of their loans to smaller banks that do not have an international presence. In normal market conditions, this group of banks will offer financing during construction which will convert to long-term financing covering up to 18 years of operations. A limited number of banks are willing to add a few years when projects enter into power purchase agreements of 25 years of more.

Medium-term bank financing: Also referred to as "mini-perm," this group of Canadian and international banks will offer financing during construction which will convert to medium-term financing covering 5 to 10 years of operations. This financing is typically offered at a lower cost than long-term loans because it taps into shorter term funds that are typically at a lower cost for lenders. However, some developers prefer to secure long-term financing in order to avoid the refinancing risk at the end of the mini-perm.

Private placement: This type of financing has been commonly used by developers since the onset of large renewable energy projects in Canada two decades ago. Market participants are composed of financial institutions, primarily life insurance companies and pension funds, among which a relatively small group is experienced in leading transactions. Private placements typically offer financing during construction which will convert to long-term financing covering up to the power purchase agreement expiry, minus a "tail" of 6 to 12 months.

Hybrid solutions: A number of hybrid solutions can be offered, using combinations of private placements with either types of bank financing or combined with sovereign support offered by countries that export turbines or turbine panels.

Selecting Lenders

There are important considerations to keep in mind when selecting a lender that are intimately related to a community or developer's risk tolerance, expertise, tendency to be hands on (or not) and style. These considerations may also be related to the renewable energy project itself, because its feasibility may depend on the optimization of the financial structure and the resulting value-added provided by financial leverage.

Some experience-based considerations:

> It is important to thoroughly assess different financial solutions—a financial solution that is best for one project may not be suitable for another project. For instance, in the current market conditions, a private placement will typically provide less leverage for a given project. However, the placement pricing is based on long-term

rates (as opposed to short-term rates for banks) and may provide a longer loan than banks. All these items need to be considered before selecting a financial solution.

> It is important to create competition among lenders, but not too early. Since the relative competitiveness and appetite among lenders of the same type changes regularly, an early selection can lead to a suboptimal choice.

> The community and developer risk tolerance needs to be discussed and confirmed, especially when considering solutions that imply a refinancing risk.

> Make sure to get confirmation from each lender whether they will use their own fund or if they will seek to syndicate their loans before and/or after financial close. It is not advisable to select a lender that does not keep a material portion of the loans in its books, as it typically leads to increased costs. Some lenders cannot keep long-term loans in Canadian dollars which is important to know.

Entering into a Financing Arrangement

Here are some of the key features that need to be negotiated with lenders:

> the maximum gearing of the loan (e.g., 85% of total costs) and other debt-sizing criteria that may limit leverage

> the all-in interest rate that results from all the fees charged to a loan (e.g., an upfront fee, the applicable margin on reference interest rates, commitment fees, syndication fees, etc.)

> other fees chargeable to the project, such as letter of credit fees and agency fees

> the ability to refinance without penalties (referred to as "Make Whole")

> the maximum term of the loan and required "tail" before power purchase agreement expiry

> the permitted timing of equity injection relative to the senior debt: equity first, equity last or pari-pasu.

Transactions Involving Renewable Projects

While the previous sections focused on the financial structure of projects in late-stage development, it is also possible for communities to acquire an equity stake in renewable energy projects or to monetise partially or fully the equity of projects they have been involved in. The valuation of such transactions depends greatly on their timing and on whether specific key milestones have been attained.

When projects reach a certain stage of development, they are evaluated using a discounted cash flow (DCF) methodology, which consists of discounting all future cash flows using a discount rate (the "discount rate") that reflects the risk profile of the project at a given time. The lower the discount rate, the higher a project's value. The future cash flows that are discounted include the project's residual value corresponding to the residual useful life remaining at the end of the power purchase agreement. At all development stages below, the project's value can substantially decrease if the developer relied on unrealistic assumptions that can be challenged by the buyer or if the developer fails to execute the project up to expectations.

Whether a community is a buyer or a seller, the following considerations should be considered when evaluating a project, in ascending order of development:

Projects in early development stage: Small developers who do not have the financial resources to realize the projects are typical sellers. However, since there is a considerable pipeline of renewable energy projects in Alberta, the ability of developers to make a profit depends greatly on the competitiveness of such projects and their likelihood to secure a power purchase agreement or RESA. The value of each project is often calculated as a fixed amount per megawatt or as a fraction or multiple of historical costs, and part of its payment can be delayed or subject to securing a power purchase agreement or RESA and/or financial close.

Projects with a power purchase agreement, RESA or other sources of revenue that makes the project bankable: If and when a project wins a competitive tender or demonstrates stable, long-term revenues, a project's value is normally evaluated using the DCF methodology. This normally results in a substantially higher value than at the early stage.

Fully permitted projects: When a project reaches full permitting, its ability to reach financial close is normally confirmed and the developer has increased visibility and control over the project's execution. This lower risk and the fact that the pool of potential buyers is larger (as some funds only purchase projects that are fully permitted) justifies a lower discount rate and therefore a higher valuation based on the DCF methodology.

Projects at commencement date of delivery: Since the construction risk is behind, a lower discount rate is warranted which results in a higher valuation.

Projects with 18 to 24 month operating history: This is when a project potentially reaches its highest value –all else equal—the best timing to realize such value.

SELECTING DEVELOPERS AND CONSULTANTS

Development of a renewable energy project requires specific knowledge including technical, financial, contracting, legal, environmental and operational aspects. Working with an experienced project developer or hiring an expert to help you through the process can provide the knowledge and experience needed to successfully develop a project. This section provides some key qualifications to look for. Appendix C, page 164, includes a screening questionnaire to help you evaluate potential partners or consultants.

Developer Qualifications

The most likely scenario will be that the community will work jointly with a renewable energy project developer. Working with an experienced and qualified developer is more likely to result in accurate financial forecasting and a successful project.

The following provides some key developer qualifications that communities may wish to consider when selecting a developer to work with:

- a proven track record of capabilities and successful projects similar in type (including generation type) and size
- experience working with First Nations or Métis communities
- an understanding of the specific requirements in Alberta with respect to renewable energy development
- strong company financials; low bankruptcy risk
- strong advisory team, with industry-specific expertise (legal, financial, technical, etc.)
- proficiency and standardization in procurement:
  - construction contracts
  - O&M contracts
  - AESO rules
  - bilateral contracts
  - permitting requirements
    - AUC approvals
    - interconnection (WSP or TFO requirements)
    - AEP approvals

- technical requirements
- quality assurance/quality control protocols

> adequate insurance coverage for the proposed type and scale of development

> availability of references to past projects (which should be contacted, especially other First Nations or Métis communities).

Consultant or Advisor Qualifications

Development of a renewable energy project is a large undertaking that involves many different specialties. If the community does not have a great deal of understanding on renewable energy and the development process, it is recommended to hire a consultant or advisor. The consultant would act on the community's behalf, and since the consultant is hired by the community, they should have the best interests of the community ahead of the developers. Working with an advisor whose opinion you can trust and who has the necessary experience and qualifications to successfully guide the community could be a great way to reduce the community's project risk.

Depending on specific community needs, it is likely that the assistance of more than one consultant or advisor may be required. For example, one consultant may cover the development aspect of projects, while another consultant may advise the community on financial aspects. In this respect, it is noteworthy that the financial evaluation of renewable projects relies mainly on cash flows and that a specialised financial advisor is typically better equipped to provide advice than a standard accounting firm. Note that when the community enters a project that is advanced enough in discussions with lenders, the community and advisors can request the reports prepared by the independent advisors to avoid duplicating due diligence costs.

The following provides some key project advisor considerations when selecting a consultant to work with and when establishing the contractual relationship:

> a proven track record of capabilities and successful projects similar in type (including generation type) and size

> experience working with First Nations or Métis communities

> an understanding of the specific requirements in Alberta with respect to renewable energy development

> an understanding of the specific considerations required for development on First Nations reserve or Metis Settlement

> references to past projects, which should be asked the following:

- What was the work the consultant did for you?
- Were there any significant changes to the scope of work during the project? If so, why?
- What was working it like with the consultant?

  - Was communication and responsiveness of the consultant adequate?
  - Was the work completed as you expected?
  - Would you hire this consultant again?
- strong company financials; low bankruptcy risk
- strong industry-specific expertise (legal, financial, technical, etc.).

Contract or Agreement Considerations

- Ensure any agreement or contract with the consultant has a termination clause included that allows you to end the relationship in case the consultant is not performing as expected.
- The agreement should include the following details:
  - scope of work
  - clear pricing terms
  - listing of team allowed to work on the project
  - timing
  - insurance requirements
  - termination clause
  - revisions to work plan
  - conflict of interest.

CHAPTER 4

The Project Development Process

PROJECT DEVELOPMENT PROCESS

Development Process Overview

Renewable energy projects are complex, and there are many important steps a developer must complete to bring a project to commercial operation.

There are a number of planning steps that the developer must complete before proceeding to construction.

Timeframes associated with these steps depend on the type of renewable energy employed and whether the project is receiving support from a program with specific timeline expectations. For example, successful projects under Round 1 of the REP, and which subsequently sign a RESA are expected to meet specific constructing requirements, and achieve commercial operation by December 2019.

This section focuses on providing an overview of the key steps involved in the renewable energy development process.

Additional Resources on Renewable Energy Development

There are a number of additional tools and resources the community might want to use consult with in order to better understand the renewable energy development process.

- **IRENA Project Navigator** is an online platform providing guidance to assist in the development of bankable renewable energy projects.[53]
- **U.S. Office of Indian Energy:** Renewable Energy Online Learning provides an online curriculum on developing and financing renewable energy projects on tribal lands.[54]

[53] International Renewable Energy Agency, Project Navigator. https://navigator.irena.org/index.html

[54] U.S. Office of Indian Energy, Renewable Energy Online Learning. https://www.energy.gov/indianenergy/renewable-energy-online-learning

Table 6, page 87, depicts the typical steps and timelines involved in developing a renewable energy project in Indigenous communities. Please note, the table represents a general overview of the process and does not provide an exhaustive list of all development requirements.

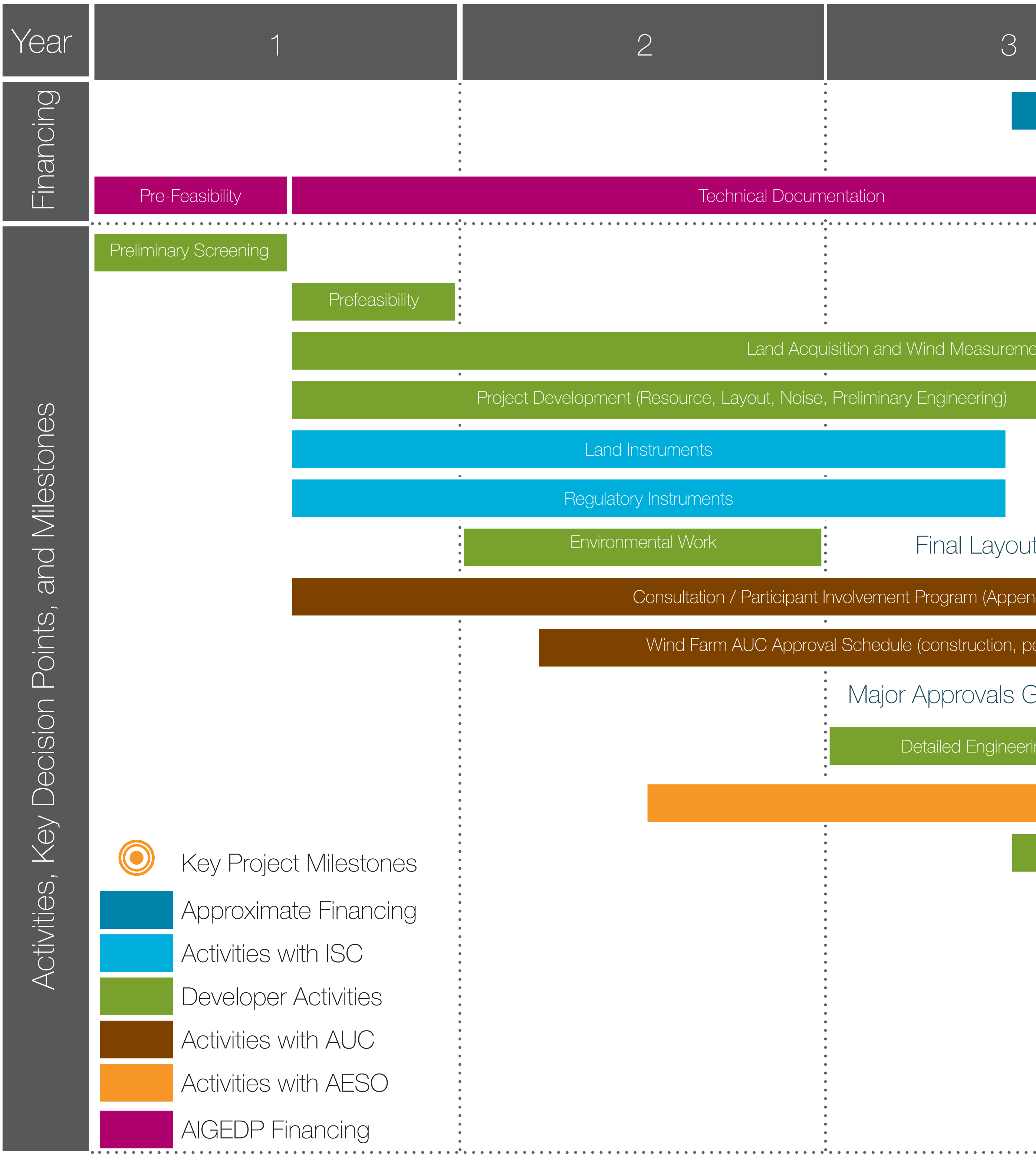
The actual project development process rarely follows such a linear process, and there is overlap between some stages. Figure 22, page 88-89, shows a sample of a more detailed project schedule for a large wind farm development with the key activities and milestones identified. It should be noted that this is an idealised project schedule; every project will deviate with separate challenges.

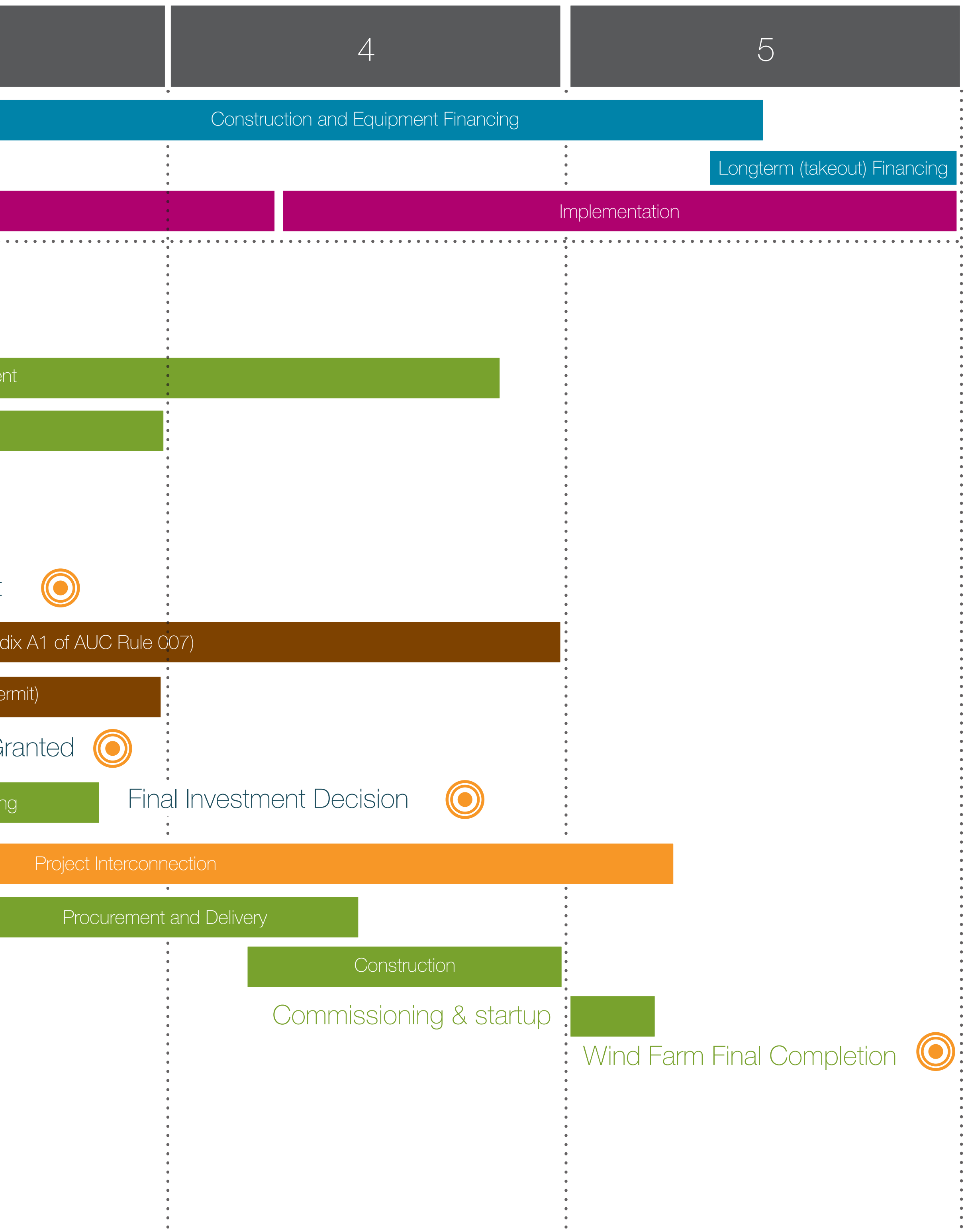
Table 6: Typical Steps in Developing a Renewable Energy Project

	Stage	Timeframe		
		Micro-generation	Distributed Generation	Transmission Connected Generation
0	Land Designation or Metis Settlement Council approval	up to 12–18 months		
1	Preliminary screening (involves resource maps and other basic tools to choose technologies and sites to pursue further)	1–6 months	4–12 months	4–12 months
2	Predevelopment	1–6 months	3–12 months	3–12 months
3a*	Development	2–4 months	18–36 months	18–48 months
3b*	WSP/TFO approval process	4 months	12–18 months	12–18 months
3c*	AUC approval process	None typically required if application is not contested and requirements in AUC Rule 024 have been met	Varies depending on complexity, can be over a year depending on a number of factors including if an oral hearing is held	
4	EPC	1–4 months	12–48 months	12–48 months

*Once development has progressed to a suitable stage, the AUC and WSP/TFO approval process can be started, 3a and 3b would then happen simultaneously

Figure 22: General, idealized, timeframes for a utility-scale project

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5
Construction and Equipment Financing
Longterm (takeout) Financing
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Final Investment Decision
Project Interconnection
Procurement and Delivery
Construction
Commissioning & startup
Wind Farm Final Completion

Project Development and Uncertainty

Risk is defined as a condition in which there is a possibility for a loss. This loss can be measured in several ways, such as time, opportunity or, most commonly, financial loss. Uncertainty is where the outcome is unknown. Situations of high uncertainty are also the riskiest and have the highest opportunities for loss. The goal of the developer during the development process is to limit the uncertainty of a project through careful planning and contracting of specific studies or assessments in order to mitigate as many of the risks as possible.

The job of the project developer is to look for critical flaws before spending too much money developing projects that have little chance of success.

Communities may wish to ensure they have clear opportunities to exit a project development process and have limits on their obligation to contribute capital to mitigate their risk. Figure 23 outlines a general methodology that can be followed to manage project risk throughout the development process.

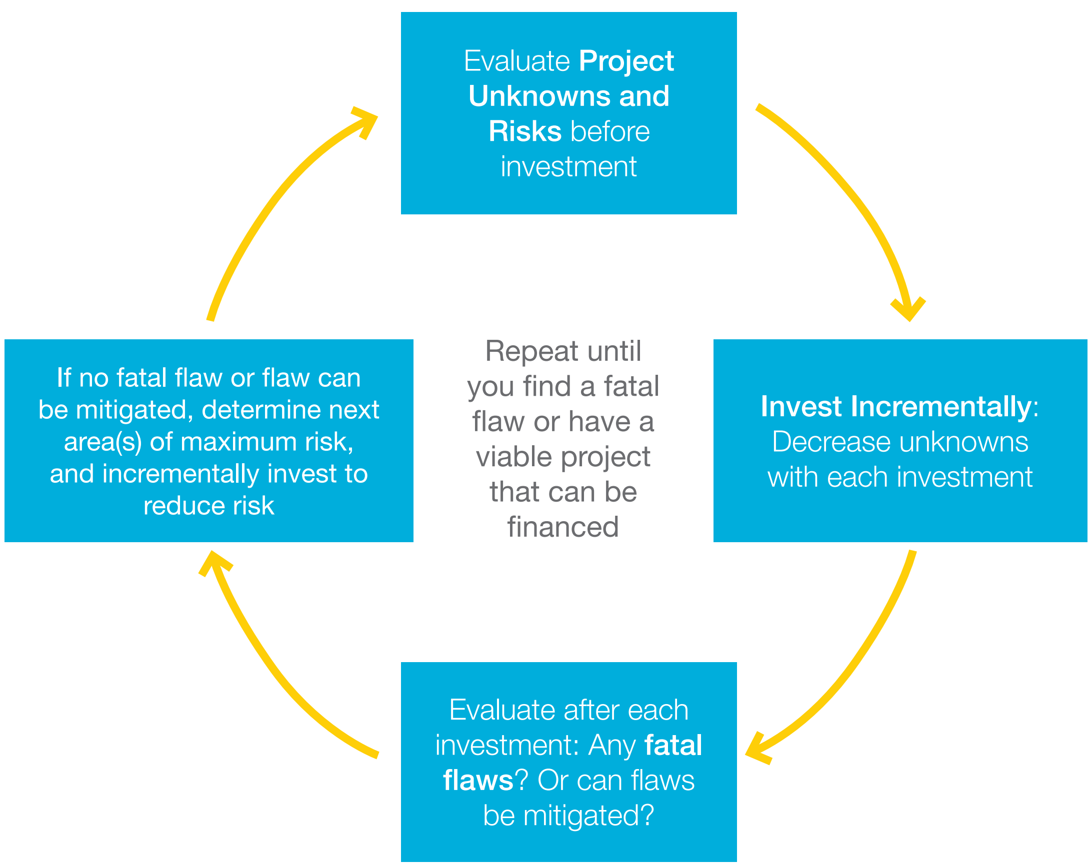

Figure 23: Methodology for managing project risk throughout the development process

Fatal Flaw Analysis

This analysis is started in the earlier stages of the project development process to determine if there are any significant issues that could potentially rule out a project*. It helps to avoid unnecessary use and loss of resources that could be used in other more suitable projects.

Elements of this analysis often include:

- Regulatory framework review
- High level environmental review of the site
- Assessment of the ability to access distribution or transmission systems and the capacity available
- Analysis of potential markets for the energy and/or environmental attributes
- Calculation of a preliminary capital requirements and levelized cost of energy

*Note: A fatal flaw analysis is also often done on a set of potential projects to help select only those worth investing additional resources into. While a fatal flaw can be identified and rule out a project at one particular time, this process also helps to identify situations where if circumstances are different in the future, for example, changes to regulations, environmental conditions, accessibility of the site, markets, would then make a project viable.

STAGE 1: PRELIMINARY SITE SCREENING

The first step in the process is to ssess potential sites.

At a minimum, this involves identifying a site of sufficient size that is suitable for the type of renewable energy project that is being proposed (e.g., wind, ground-mounted solar or rooftop solar, etc.) and whether the project can connect to the grid from this location.

During the preliminary screening, at a minimum, the following factors should be considered:

> Are there any site characteristics (fatal flaws) that would render a renewable energy project impossible for that site?
> Are the site characteristics appropriate and are the minimum required resources (e.g., solar radiation, wind speed or biofuel) available for the proper long-term operation of the renewable energy plant at the location?
> Is connection to the grid possible?
> Do local energy costs, incentives and utility policies provide an economic basis to support development?

Developers may investigate several sites, paying particular attention to the factors noted above, before coming to a decision. They should also investigate the cost of the development and their financing needs.

Availability of Renewable Resources

In order to determine if a certain renewable energy project makes sense, communities will need to assess the renewable energy resource available. The first steps in resource assessment involve community knowledge and resource maps. See Appendix E on page 170 for renewable energy resource maps. Community knowledge simply refers to the fact that community members know the ecological characteristics of their land. This embedded knowledge can at the very least determine what resources to investigate further. The next step is to consult with resource maps. Resource maps will put what a community might already know about their resource into context for renewable energy project development. For example, a community is likely to know that wind speeds are high in a certain area. A wind map can show average wind speeds and wind power classes for the site which are more precisely relevant to wind energy development.

For each renewable resource, the section below provides some general rules of thumb on how to identify an appropriate site that has sufficient renewable resources.

Solar

In general, for ground mount solar PV applications, depending on land topography and topographic cover:

> Area needed: 2–3 ha per megawatt of capacity

> Land orientation: south-facing slopes or flat is ideal

> Land slope: slopes less than 10%

> Irradiance level: at least 1,000 kW-h/kW

> Shading: limit proximity to trees and structures.

There are a number of solar resource maps, datasets and software available to help that are available including:

> Natural Resources Canada: Photovoltaic and solar resource maps[63]

> International Renewable Energy Agency: Solar Map.[64]

The EPA has published a decision tree that can be used to help screen potential sites for solar PV development.[65]

A resource to review if the community is considering a utility-scale solar energy project is a guide for developers and investors created by the International Finance Corporation titled Utility-Scale Solar Photovoltaic Power Plants: A Project Developer's Guide.[66]

Wind

The following can be used as some rules of thumb that can be considered during this preliminary screening of a wind farm project:

> Area needed: Approximately 35 ha (± 60%) per megawatt of capacity is needed to accommodate the setback and spacing requirements of a wind farm. The large variability is due to site specific factors, such as configuration, wind resource, turbine selection and other factors. At least 1 ha is needed to support a 100-kW turbine.

> Wind speeds: Wind turbines will start to turn in wind speeds of as low as 3 m/s, but wind speeds above a minimum of 5.5 m/s are typically needed to provide enough of a financial incentive to justify a utility-scale wind farm.[67]

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[63] Natural Resources Canada, Photovoltaic and solar resource maps, March 20, 2017. http://nrcan.gc.ca/18366

[64] International Renewable Energy Agency, Published Maps. https://irena.masdar.ac.ae/gallery

[65] Environmental Protection Agency, Screening Sites for Solar PV Potential, April 2015. https://www.epa.gov/sites/production/files/2015-04/documents/solar_decision_tree.pdf

[66] International Finance Corporation, Utility-Scale Solar Photovoltaic Power Plants – A Project Developer's Guide, 2015. https://www.ifc.org/wps/wcm/connect/f05d3e00498e0841bb6fbbe54d141794/IFC+Solar+Report_Web+_08+05.pdf?MOD=AJPERES

[67] NREL, Wind Data, Link: https://www.nrel.gov/gis/data-wind.html

Resource characterization of wind resources during the development phase requires the use of monitoring towers as close as possible to the proposed project site at a suitable height since local resources varies greatly from the averages shown in wind resource maps. However, initial site screening activities typically use wind resource maps to quickly identify sites that may be suitable.

A wind resource map for Canada can be found on the Canadian Wind Energy Atlas.[68] The map allows you to enter in specific latitude/longitudes, a postal code, or by clicking on the interactive map on a specific location to see the average wind speed in the area.

The EPA has published a decision tree that can be used to screen potential sites for wind development.[69]

Geothermal

Geothermal energy can be used to provide heat or electricity depending on the temperature of the fluid available:

- more than 150 C: direct electricity generation using steam from the hot fluid
- 80 C to 150 C: electricity generation through use of a heat exchanger
- less than 80 C: provide heat for buildings, greenhouses, industrial processes and other direct uses of geothermal energy.

On the Canadian Geothermal Energy Association (CanGEA) website, a geothermal favourability map can be found for Alberta, as well as a summary report that shows the temperature and geothermal favourability at various depths across Alberta.[70]

Biomass

A biomass energy plant or biogas power production facility requires establishing a secure, year-round, stable supply of biomass of sufficient quality. For biomass either on-site or off-site, it is important to consider the following:

- fuel combustibility or high heating value of the biomass
- mass and seasonality of available biomass
- distance from site and transportation costs
- price for the biomass
- storage requirements for biomass

[68] Government of Canada, Canadian Wind Energy Atlas, June 2016. http://www.windatlas.ca/maps-en.php

[69] Environmental Protection Agency, Screening Sites for Wind Energy Potential, April 2015. https://www.epa.gov/sites/production/files/2015-04/documents/wind_decision_tree.pdf

[70] Canadian Geothermal Energy Association, "Alberta Geothermal Favourability Maps", https://www.cangea.ca/alberta-geothermal-favourability-maps.html

- fuel preparation needed (e.g., drying, pelleting, shredding and/or grinding)
- depending on the type and quality of heat being needed, biomass requirements should be measured in tonnes.

A resource to look at if the community is considering a biomass energy project is a guide for developers and investors created by the International Finance Corporation.[71]

Though the guide focuses on developing countries, many of the key considerations are covered.

Table 7 on page 96 provides the amount of biomass that would be needed to support plant sizes utilizing various technologies.

Biomass Supply Agreements

A biomass supply agreement is essential for ensuring a viable biomass-to-energy project, if the necessary biomass is not owned by the project owner, or if the community is interested in acting as a supplier to a biomass energy project.

The agreement is between the biomass energy project and the biomass supplier and the most important factor to incorporate in a biomass supply agreement include the following:

- quantity of biomass (tonnes per day, delivered on-site) and what happens if the supplier does not supply biomass in accordance with the agreement
- quality of biomass (typically weight and moisture content), how quality is determined, and what happens if the specifications are not met
- price of biomass (dollars per tonne) and how the price varies with quality parameters
- place of delivery
- rejection criteria and consequences of late delivery.

[71] International Finance Corporation, Converting Biomass to Energy: A Guide for Developers and Investors, 2017. https://www.ifc.org/wps/wcm/connect/7a1813bc-b6e8-4139-a7fc-cee8c5c61f64/BioMass_report_06+2017.pdf?MOD=AJPERES

Table 7: Biomass requirements to support plant sizes of varying technologies

Electrical Generating Capacity	1–5 MW	5–10 MW	10–40 MW
Plant Type	Minimum biomass input*		
Combustion plants using a water/ steam boiler	20–100 t/day	100–200 t/day	200–900 t/day
Combustion plants using Organic Rankine Cycle (ORC) technology	50–200 t/day	200–500 t/day	N/A
Biogas power production with gas engine	40–200 t/day	N/A	N/A

Source: International Finance Corporation[72]

*Biomass tonnages at an average energy value of 10 GJ/t, assuming 100% load.

Hydropower

Hydropower potential is highly site-specific and is dependent on two key parameters:

> Head: the vertical distance the water falls

> Flow: the quantity of water falling.

The head of a project is a relatively easy parameter to establish from elevation data. Most hydropower sites are categorized as low or high head. Low head refers to a change in elevation of less than 3 m. A minimum vertical drop of at least 0.6 m is typically needed to support even small-scale hydroelectric systems.[73]

Flow is the quantity of water falling, but is far more challenging to quantify. Seasonal and annual variability in a stream means that hydrometric data on-site should be collected for a minimum of one or two years. This baseline data can then be correlated to regional hydrometric data for developing long-term hydrometric records for the site. It is possible to start with regional hydrometric data to provide a preliminary assessment of a project's viability however, this comes with a level of uncertainty that can have far reaching implications from design, environmental consideration and economic viability.

[72] International Finance Corporation , Converting biomass to Energy: A Guide for Developers and Investors, June 2017. https://www.ifc.org/wps/wcm/connect/7a1813bc-b6e8-4139-a7fc-cee8c5c61f64/BioMass_report_06+2017.pdf?MOD=AJPERES

[73] U.S. Department of Energy, Planning a Microhydropower System. https://www.energy.gov/energysaver/planning-microhydropower-system

Grid Connection

In order to supply energy to where it's needed, the renewable energy system must connect to the Alberta electric grid. The ability to physically connect to the grid is very important and is dependent on physical constraints and approval by AESO, the AUC and the WSP or TFO. The proximity to a connection point and the available capacity at that location are important determining factors as a project that is too far away from a suitable connection point or that requires significant grid upgrades might be too expensive to justify further consideration. Depending on the size of the project, who is responsible to pay for these upgrades differs:

> Micro-generation: The WSP is responsible for costs associated with interconnection. However the WSP may file a notice of dispute if it deems connection of the micro-generation system extraordinary. The AUC will provide final judgment in this case.

> Utility-scale (distribution or transmission connected): The project owner would be responsible for paying for the costs of interconnection according to the commercial terms established by the WSP or TFO and AESO (refer to the AESO connection process).

Local Energy Costs, Incentives and Utility Policies

The energy price that the project could receive and other incentive programs available will affect the overall economic feasibility of the project. Programs like the REP and the AIGEDP will help support the financial feasibility of a project and it is important to understand the eligibility requirements and key application requirements.

STAGE 2: PREDEVELOPMENT

The predevelopment phase is typically conducted by a small team and is designed to produce the basic information needed to green light a project, choose between potential sites or decide what type of project to pursue (e.g., solar vs. wind project). The aim is to give an overview of all critical elements of the project, from the site, technologies, environmental and social impacts and costs, prior to significant investment of time and money in the development stage.

This stage typically involves completion of a prefeasibility study. Appendix F, page 177, provides a checklist of what elements you should expect from a prefeasibility study.

The predevelopment process should answer the following key questions:

- Is/are the site(s) available for development? Do you have land designations, community support, council approval (if on reserve) or current owner willingness to lease land (if off reserve)?
- Is the site appropriate for development?
- Is there a sufficient renewable resource on the site?
- Is the project financially attractive?
- What critical issues or risks are associated with the project and can they be mitigated?
- What is the recommended road map going forward?

Site Selection

After a site has passed through the preliminary site screening, there are a number of factors that are typically assessed to determine if a site is still suitable for development. If there are multiple sites that have been identified in the preliminary site screening, then each would be assessed at this stage.

Land Rights

It must be confirmed whether there are known barriers to conveying the land rights required to develop the project. For First Nation reserve land this is dependent on being able to acquire the council approval and the needed land designation. For Metis Settlement lands, Metis Settlement Council approval will be needed. See the section on Development on Reserve or Settlement Lands in Chapter 2, page 18, for more detail on this subject. It may be useful to consult with lenders at an early stage to ensure that any land rights

> During this early-stage of project development, it must be confirmed whether there are known barriers to conveying the land rights required to execute the proposed project.

will meet the requirement of construction and dismiss lenders, who may have special requirements to ensure that their financing conditions are met.

Grid Connection

Another key consideration is the ability to connect to the grid in order to supply electricity. At this stage, it is important to assess the site and identify any potential fatal flaws in the existing electric infrastructure or capacity. Often, electric infrastructure can be upgraded to support new generation, however the ability to do so may be cost prohibitive and represent an insurmountable fatal flaw. The following key factors will influence the cost of interconnection:

> Capacity, type and age of existing grid infrastructure: Some locations may have a limited capacity to support interconnection of new renewable energy projects, which would limit the size of any potential renewable energy project. Some locations may not support interconnection due to the type or age of the existing infrastructure. In either of these cases, substantial upgrades to the transmission or distribution infrastructure may be required, which would carry a very large cost. It is important to contact AESO and the local WSP or TFO early in the process when selecting a site.

> Location of existing grid infrastructure: If a renewable energy project is located far from existing grid infrastructure or if there are significant barriers between the site and the substation, the process of obtaining approvals and building the required transmission lines to connect to the grid can quickly become very costly.

Site Characteristics

Are the site's physical characteristics appropriate for development? The key site characteristics to look at will depend on the type of renewable energy technology, however the following are typically important to consider:

> Are there any land use constraints (e.g., federal or provincial protected areas or parks)?

> What is the site topography (i.e., the shapes and features of the surface)?

> Are there any obvious environmental issues of the site (typically completed through a desktop environmental screening)?

> Is the ground and terrain suitable to support the system? (Has a geotechnical assessment been completed?)

> Is the area a potential flood zone?

> How close are other forms of development (e.g., residential, railroads, etc.)?

> Is there access to a suitably graded road for transportation of equipment and continued operation and maintenance?

> Is there access to rail for the transportation of equipment?

Preliminary Technology Selection and Project Design

Once the site has been selected, an appropriate technology can be selected and a preliminary design can be developed that will help to establish the project economics. For example, given a specific wind speed at a specific elevation at the site, a wind turbine can be selected at this stage and a preliminary design developed. Based on this step, potential project revenue can be calculated from an estimate of the total energy the site could generate, minus any host load in the case of a micro-generating facility. Factoring this along with expected installation and operating costs and projected future electricity costs will provide an estimate of the returns and payback period for the project.

Estimating Renewable Energy Production

Characterization of renewable resources involves investment in the costs of engineering professionals, data collection, and, in the case of a wind project, installation of temporary monitoring tower for two years to verify the renewable resource for a particular site. At this stage in the development process, when the greatest uncertainty exists, resources are generally characterized using national or regional mapping data, publicly available data from nearby weather stations or resource monitoring stations, and some limited site investigation.

Preliminary Financial Analysis

Once initial details of the project design have been established, a preliminary financial assessment of the project can be completed to see if the potential project is financially attractive. This will include a preliminary assessment of the following:

- revenue model (also known as proforma or financial model)
- installed costs (also known as capital costs or CAPEX)
  - How much will the project cost to build?
  - What incentives are available?
  - How long will it take to build?
- operating costs
- financing costs.

Revenue Model

The revenue model is developed based on the following:

- What the project will produce: This will depend on the technology selection and project design.
- How much of it the project will produce: This will depend on the technology selection and project design.
- When is it produced: This will depend on the technology selection and project design.
- How long the renewable energy system will be in operation: This will depend on the technology selection.
- How much it can be sold for and what subsidies are available: The price the produced energy can receive and the subsidies available will depend on the project scale and the agreements or contracts that the project can secure. In addition, the sale of the environmental attributes either through the greenhouse gas emissions offset market or through the REP and RESA can also factor into the revenue model. The different markets and arrangements for these sales are described below.

Utility Scale

Wholesale Market

Once a utility-scale generator has gone through all of the regulatory approval, project interconnection and pool participant registration steps, the facility can then participate in the wholesale energy market and offer their power into the pool and be paid the hourly pool price for the energy they produce. The box on page 102 provides more detail on how this hourly pool price is determined. Typically, an average pool price based on the expected generation profile of the renewable energy technology will be applied to complete the preliminary financial analysis. Chapter 2, page 18, provides the historical pool price from 2007 to 2017. Additional historical and real time pool price data can be found on the AESO website.[74]

Bilateral Agreement or Contract

This type of arrangement goes by a number of different names in Alberta. For the purposes of this document we will refer to it as a bilateral contract, but it is also sometimes referred to as:

- Direct/Physical Power Purchase Agreement
- Direct Sales Agreement
- Physical Bilateral Procurement.

[74] Alberta Electric System Operator, Reports, 2018. http://ets.aeso.ca/

How Is the Pool Price Set?

The pool price is the dollar cost of a megawatt hour of electricity at the end of a given hour that is paid to electricity generators for supplying electricity by retailers (such as your local service provider). Typically, retailers purchase this electricity to supply residential and business customers, as well as large industrial customers.

The process of setting the pool price is highly detailed. Every minute, the highest priced electricity block that is dispatched, is designated as the System Marginal Price (SMP). Each hour, the pool price is calculated by averaging all 60 of these one-minute SMPs. The SMP is posted to the AESO website in real time and the pool price is then posted after the end of the hour. The pool price is used in financial settlement to calculate payments to suppliers and charges to wholesale customers.

In the simplest terms, the pool price is the average of 60 one-minute system marginal prices accumulated over an hour.

More detail on how the pool price is set can be found from this factsheet from the AESO website.[75]

A utility-scale generator can enter into a bilateral agreement directly with a buyer for the sale and purchase of electricity in the future. The actual dispatch and delivery of that electricity takes place in real time, through the wholesale market (the power pool), and the exchange between seller and buyer is registered with AESO as a net settlement instruction. By doing so, AESO will exclude the contracted volume of electricity from the buyer's monthly settlement and from the renewable generator's metered generation. Outside the power pool, the buyer pays the generator according to the price and terms agreed to, and legal title to the electricity and environmental attributes is transferred to the buyer.

Financial or Virtual Power Purchase Agreement

This type of agreement is also commonly referred to as a contract for differences. Unlike a bilateral agreement, it does not transfer legal title to the electricity to the buyer. Instead, the generator and buyer agree to a specific volume of electricity at a specific price and term. Typically, the environmental attributes will be transferred to the buyer (refer to pg. 59 for more information on environmental attributes).

The generator retains ownership and sells the electricity into the wholesale market at the hourly pool price. If the hourly pool price is lower then the agreed to price, then the buyer pays the generator the difference. Similarly, if the hourly pool price is greater then the agreed to price, then the generator will pay the buyer the difference. At the

[75] Alberta Electric System Operator, Determining the Wholesale Market Price for Electricity https://www.aeso.ca/download/listedfiles/Wholesale-Market-Price-Fact-Sheet-020311.pdf

end of each month, quarter or year (as per the agreed upon interval in the agreement) the aggregate of these differences is calculated and paid by one party to the other. It is important to note though that in this situation, the generator would settle with AESO and be paid directly by AESO for the electricity it delivered to the grid based on the hourly pool prices. Similarly, the buyer would pay AESO for the electricity it consumed from the grid.

More information about this type of agreement can be found in a recently published Pembina Institute report.

This type of arrangement is shown in Figure 24.

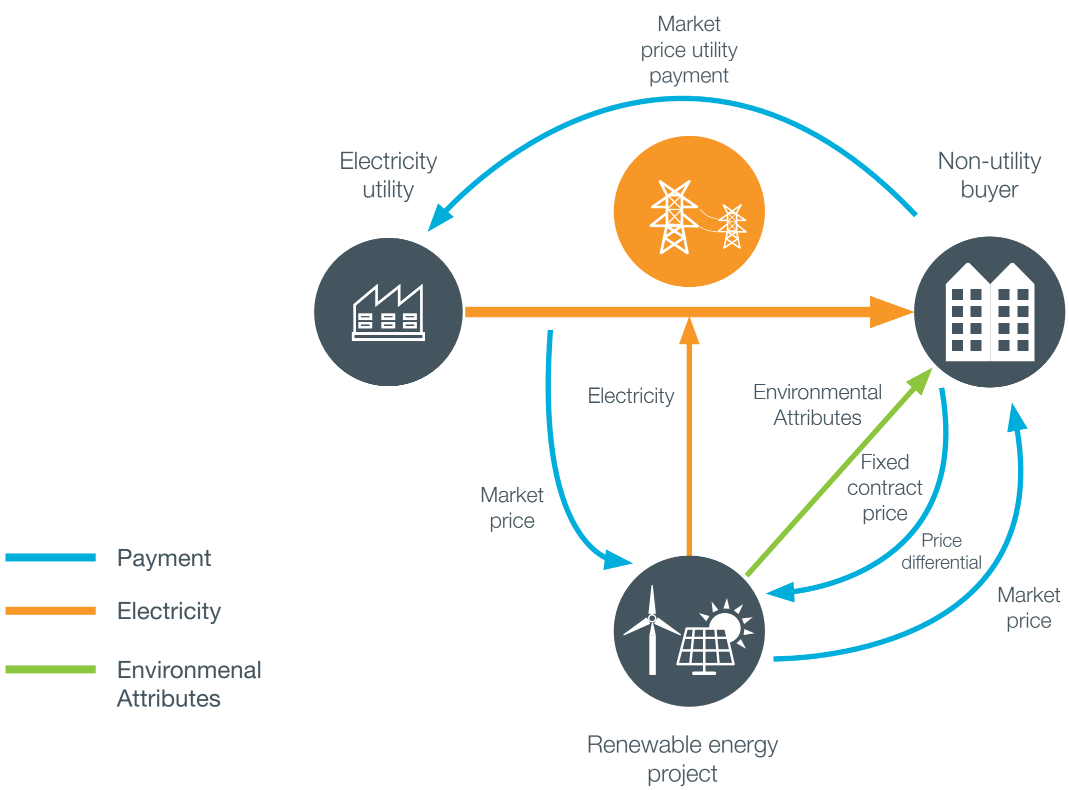

Figure 24: Structure of a Financial Power Purchase Agreement transaction. Source: Adapted from the Pembina Institute[76]

[76] Pembina Institute, Plugging In: Opportunities to procure renewable energy for non-utility companies and institutions in Alberta, 2018. http://www.pembina.org/reports/plugging-in-2018.pdf

Environmental Attributes

An additional revenue opportunity for utility-scale renewable energy projects is the ability to sell the environmental attributes of the renewable energy generated.

Renewable Electricity Support Agreement

Through the Government of Alberta's REP, a Renewable Electricity Support Agreement (RESA) is signed with the successful projects. A RESA is not an agreement to purchase power, like a bilateral contract, but is structured similarly to a financial power purchase agreement. The projects still participate in the wholesale energy market, but through the RESA, they are provided support payments for the environmental attributes the project produces. Through the Indexed Renewable Energy Credit payment mechanism, the government guarantees winning projects a certain price per megawatt hour generated. If the pool price is below that price the government pays the difference; if the pool price is above that price project proponents pay the government the difference. For more information on the REP or RESA, visit the AESO website.[77]

Greenhouse Gas Emission Offsets

Renewable energy projects can also generate and sell greenhouse gas emission offsets to regulated emitters as part of the Carbon Competitiveness Incentive Regulation. Emission offsets cannot be sold for projects receiving support payments through the RESA. Emission offsets allow for large industrial emitters to comply with their reduction obligations under the Carbon Competitiveness Incentive Regulation by purchasing offset credits from other activities that have voluntarily reduced their emission in Alberta. To qualify for offset credits, projects must follow strict government approved protocols that ensure emissions reductions are real, demonstrable, quantifiable, additional to what would have occurred otherwise and registered on the Alberta Emission Offset Registry. Once registered, the emission offsets can be sold to Alberta's large emitters that have not met their provincially mandated reduction obligation. The price facilities pay for the emission offsets is market driven so the price varies. More information on greenhouse gas emissions offsets can be found on the Alberta Environment and Parks website.[78]

Micro-generation

Small Micro-generators (under 150 kW)

For any electricity supplied to the grid (net of the amount consumed), a small micro-generator producing electricity for an individual facility or aggregated sites can receive a financial credit on a monthly basis. The generator will be responsible for paying for any electricity consumed and all associated transmission and distribution charges

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[77] Alberta Electric System Operator, Renewable Electricity Program, 2018. www.aeso.ca/market/renewable-electricity-program

[78] Alberta Environment and Parks, Offset Credit System Protocols, 2018. http://aep.alberta.ca/climate-change/guidelines-legislation/specified-gas-emitters-regulation/offset-credit-system-protocols.aspx

associated with that electricity, but will receive a credit for the electricity supplied back to the grid based on the average retail rate. This is known as a “net billing” approach.

Large Micro-generators (between 150 kW and 5 MW)

For any electricity supplied (net of the amount consumed), a large micro-generator is compensated at the hourly wholesale prices of the power pool. As with a small micro-generator, the generator would still be responsible for paying for any electricity consumed and all associated transmission and distribution charges associated with that electricity.

Installed Costs

At this stage, developers will use average installed costs for different renewable energy technologies and capacities. For installed costs, they are almost always represented on a dollar per capacity basis and applied to the estimated system size.

For example, based on the site, renewable energy technology and resource characterization, the proponent estimates that the site could support a 5-MW solar PV facility. The developer, based on its knowledge and experience with the project technology, could estimate the capital costs based on the following equation:

Capacity x Installed Cost/kW Capacity = Estimated Installed Costs

5,000 kW x $1,750/kW = $8.75 million

Appendix A, page 152, provides a range of installed costs associated for each renewable energy technology from various resources that look at the costs associated from renewable energy projects globally.[79, 80, 81] The costs (in USD) are obtained through extensive surveys with industry participants and includes projects from Canada. There is currently no similar Canadian-specific study that is publicly available, and we believe that the numbers provided in the cited resources give readers of this guide a good sense of the scale of costs associated with renewable energy projects at various scales. The exception to this are the costs for solar energy projects in Ontario, which were available through a report published by the Canadian Solar Industries Association (CanSIA) on the installed costs in Ontario in 2017.[82]

[79] Lazard, Lazard’s Levelized Cost of Energy Analysis – Version 11.0, November 2017. https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf

[80] IRENA, Renewable Power Generation Costs in 2014, January 2015. https://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Power_Costs_2014_report.pdf

[81] IRENA, Renewable Power Generation Costs in 2017, January 2018. http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_2017_Power_Costs_2018.pdf

[82] Canadian Solar Industries Association, FIT/mFIT: 2017 Price Review, 2016. http://www.cansia.ca/uploads/7/2/5/1/72513707/160802_-_cansia_submission_re_2017_fit-mfit_price_review_vf_20.pdf

Operating Costs

For renewable energy projects, with the exception of biomass projects, there are few operational expenses, because maintenance fees tend to be low. Some technologies may require major maintenance part way through the lifetime of the plant. For instance, inverters in solar plants may need to be replaced well before the PV modules.

The main operations and maintenance costs associated with projects include:

> annual operations and maintenance
> accounting/audit costs
> leases
> a separate operations fee to the body that manages the holding company (if applicable).

Communities may want to have their advisors review any development and O&M costs going to developers for reasonableness and to determine whether communities or their development corporations should receive some development and/or O&M costs for their role in helping the project succeed. Most other costs depend on the way the project has been financed.

At this stage, operating costs are typically calculated based on a dollar per kilowatt per year basis, so that operating costs can be quickly and easily calculated depending on the project size. Appendix A, page 152, provides a range of operations and maintenance costs associated with each renewable energy technology.

Financing Costs

Renewable energy generators require an up-front investment, which may be spread over the duration of construction. Financing costs will depend on the following:

> How much money is needed to be borrowed?
> How much will it cost (borrowing fees and interest) to borrow the money?

Once operating, no further injections of capital are typically required except for planned major maintenance or unless a major incidence happens, which can be avoided if insurance is used or cash is kept in a major incidence account. Through these mechanisms, the risk of a reduced return to investors may be avoided.

Communities may want to carefully review all transactional documents to determine whether they could be liable to make up any cashflow shortages in the event that the company owning the project requires an unexpected capital injection.

Preliminary Regulatory and Approvals Assessment

Projects may require a variety of approvals and permits before construction can be started. The main regulatory approvals, permitting actions or processes that, if not achieved, may stop the project are covered in detail in Chapter 2, page 18. Again, the main regulatory approvals and permits that need to be considered are:

> Land Designation (First Nation only)
> Band Council Resolution (First Nation only)
> Metis Settlement Council approval (Métis only)
> AUC approval for construction and operation (excluding micro-generation)
> interconnection approval (WSP or TFO and AESO)
> federal environmental regulation requirements
> provincial environmental regulation requirements
> local bylaws
> regional land use plans.

Permitting can be a time-consuming process and is resource intensive in terms of human resources and money. In this early stage, identifying all necessary permitting activities and documenting the requirements is the first step. This is done while looking for fatal flaws or the expectation of serious conflicts that may challenge the ability of the project to be permitted. For large projects, it is often useful to hire a consultant who specializes in environmental and electrical approvals and to request an "approvals roadmap" that supports project planning and budgeting, while also ensuring that time-consuming studies that must be completed at certain times of the year are performed on timelines that do not impact overall project delivery.

While no permits are typically secured at this point in the project, co-ordination with authorities (e.g., AUC, AESO, WSP/TFO, AEP, etc.) should occur to establish the cost and schedule impacts of each permit process, along with the information required to proceed. The exception to this is Metis Settlement Council approval, or band council resolution supporting the project and Land Designation, which is recommended to be secured, or in process of being secured before or early in the development process.

STAGE 3: DEVELOPMENT

Once project feasibility and conditions for site control are established in the predevelopment stage, it is appropriate to continue the full development of the necessary site and legal documentation to convey the rights to use the site.

Once a potential project is found to have passed through the preliminary screening and predevelopment stages, it moves into Stage 3, development. It is during this stage that the information needed to develop a financeable renewable energy project is brought together.

This stage represents the largest commitment of time and money to prepare the project for financing and construction. In the development stage, the investment required may increase dramatically as all the necessary documentation for the project is generated and negotiated by engineering, contract and legal professionals. This effort can entail significant resources (1% to 5% of total project costs) and can take from nine months to three years (or more) for large-scale projects.

At the end of the development stage there must be sufficient information to justify proceeding with the project or not, and that further investment in development level work will not proportionally reduce the risk or uncertainty related to the project.[83]

The areas of the project where there must be a high degree of confidence are:

> design of the renewable energy system

> ability to construct and operate the renewable energy system

> ability to connect to the grid

> the financial model, and that a reasonable return on investment can be achieved.

The key aims at the end of the development process are to:

> finalize scope, cost and timeframe and obtain funding for project's execution

> formulate a co-ordinated and clear view of the major project elements with respect to technical, environmental, legal, administrative, commercial, financial and organizational issues and processes

> develop a project proposal that can be brought to potential lenders or financial institutions.

[83] U.S. Department of Energy, Large-Scale Renewable Energy Guide: Developing Renewable Energy Projects Larger Than 10 MWs at Federal Facilities – A Practical Guide to Getting Large-Scale Renewable Energy Projects Financed with Private Capital, 2013. https://www.energy.gov/sites/prod/files/2013/10/f3/large-scalereguide.pdf

Detailed Resource Engineering

Investment in resource engineering and analysis, data collection, and modeling is pursued in this stage as well. The result of this investment is to increase the confidence factor around the energy that can be captured by a particular resource, effectively reducing the expected error in production estimates. As an example, for a solar project, uncertainty of annual or monthly production for a particular site can be estimated to within 10% to 20% using desktop studies with minimal investigation; after full characterization using engineering methods, the uncertainty can be reduced to within 3%.

Other capital providers such as banks and lending institutions typically seek a high degree of certainty, while equity investors or other structured investors may tolerate more uncertainty if able to demand a higher return in compensation.

Site Acquisition

Once project feasibility and conditions for site control are established in the predevelopment stage, it is appropriate to continue the full development of the necessary site and legal documentation to convey the rights to use the site.

Investment in the preparation of site information necessary to close financing and start construction occurs during this stage. Costs include, but are not limited to the following:

- preparation and negotiation of legal documents, including contracts defining terms for the land lease. In some cases, projects proceed first with an option to lease a property, pending confirmation of financing and/or regulatory approvals, while in other cases, projects proceed directly to a lease agreement.
- documentation of rights of access including easements and/or rights-of-way. For First Nations communities, permits or licences for roads or utilities on reserve land will be negotiated with and approved by Canada under section 28(2) of the Indian Act; or through community land codes under FNLM. For development on Metis Settlements approval must be granted by Metis Settlement Council, engagement of members should have taken place.
- assignability of these rights to third parties including financial institutions
- responsibilities of all parties with respect to liability, insurance requirements and indemnification clauses
- technical information, such as land surveys and geotechnical studies.

Technology Selection and Project Design

Once a project progresses to the development stage, major investment is going into all aspects, including technology. In this stage, initial assumptions and conceptual (33% complete) engineering drawings are brought through to design development (66–95% complete).

Ultimately, if the project progresses to the next stage, construction documents with full specifications for bid and contract procurement (100% complete) would be developed during the Engineering, Procurement and Construction (EPC) phase (detailed in Chapter 5, psge xx). Depending on the organization of the project team and the scale of the project, a single third-party EPC firm may be providing engineering, procurement and construction services. This is an approach common for smaller scale projects, however for larger scale projects, it is more common for the developer to hire an "owners engineer" to complete the design and develop the necessary plans, specifications and procurement documents to be bid on by construction contractors. This step is explored in more detail in the following chapter, page 113.

Detailed Financial Model

During the development stage, all the key variables associated with the preliminary financial model are revisited based on the additional project details determined during this stage. The financial model is refined so that there will be a much higher degree of confidence in all of the financial model inputs.

Revenue Model

Based on the more detailed project design and resource engineering, a more accurate estimate of the energy that can be produced (amount produced when it is produced) will be developed and a more accurate revenue model can also be developed. In addition, at this stage, any potential subsidies that the project could obtain should be well understood. During this stage there should also be a clear sense of the price and terms for the sale of the electricity generated and the environmental attributes.

Installed Costs

Costs for the specific equipment and installation costs needed for the project will be developed at this stage. A high degree of confidence in the installed costs are expected at this stage, so quotes from equipment suppliers, installers, or EPC contractors are typically obtained and integrated into the financial model.

Operating Costs

To obtain a high degree of confidence, quotes are typically obtained from third-party O&M contractors or estimated based on the expected resource requirements and expected useful life of equipment as well as associated replacement costs. For biomass projects, quotes are typically obtained from biomass providers based on the amount of biomass needed, and biomass supply agreements are developed. Wind turbine suppliers typically offer service agreements for the operation of their wind turbines that range in timeframes of 3 to 15 years. Both wind and solar panel providers also have guarantees on the performance of their equipment that would be incorporated into the financial model.

Financing Costs

At this stage, communities may find it helpful to seek early engagement with potential lenders, even if final loan-arrangements will be obtained later. Seeking early engagement with lenders will help to identify how much the community can borrow and how much it will cost to borrow that money. Early engagement will also help to ensure that project structures are as financeable as possible and help avoid expensive changes at later stages to deal with avoidable lender concerns.

Permit

The major investment in permitting is executed in the development phase. At this stage, the project should have passed several iterations of fatal flaw analysis and matured with regard to design to the point that it can be clearly presented for project permitting and approval. The AESO, AUC or WSP (for micro-generation) process has been detailed in Chapter 2.

Business Plan

At the end of the development stage, in order to attract funding or business partners, it may be necessary to develop a business plan. This plan ensures that the entire business process is considered early on and establishes tools that will help to monitor the development of the business.

A business plan may begin as a simple document, but as the project develops into an operational business, it could become a larger and very detailed document that includes all the information that defines the renewable energy business.

The business plan answers the following important questions:

> Who are you and what are the products that the business will provide?
> What is the ownership structure of the business and where will it be located?
> What is the market for the products?
> What are the projected financials (assets, liabilities, revenue and expenses) and financing needs of the business? This component is often called a "proforma" cashflow projection or income projection
> What resources, people and equipment does the business need during its start-up phase and ongoing operation?
> What are the risks of the business and how are they going to be minimized?
> What is the timeline for the project or initiative?

A business plan template is included in Appendix B, page 160, for reference. Note that not every section may apply to the project and that the business plan may need to contain additional information or have a different structure.

Concluding the Development Process

At the end of the development phase, there should be a clear understanding of whether a project is viable.

At this stage the following should be well understood and documented:

> ownership structure
> project team
> all permitting requirements have been granted
> interconnection plan and agreement has been completed
> all capital costs have been identified with a high degree of confidence
> O&M costs have been identified with a high degree of confidence
> financing structure has been finalized
> project design has been developed (50–66% for smaller scale projects, 90–95% for larger scale projects).

With the above information established, a final project decision will now be made whether to proceed with the next stage of development, which is the EPC stage. This phase is finalized with the release of funds from the lender.

CHAPTER 5

Engineering, Procurement and Construction

Once the project has moved past the development stage and financing has been secured, the next step is the:

- detailed engineering design and specification development for the project (100% design)
- procurement of all the equipment and materials necessary
- construction and commissioning of the renewable energy plant.

For renewable energy projects, this is usually carried out by an EPC contractor, through an EPC contract.

One of the benefits of bringing on a single EPC contractor is that only one contract needs to be developed, and the EPC contractor would then have full responsibility to complete the project on time, within budget and within the specified performance. However this usually also means that the contractor is paid a higher fee for managing and taking responsibility for all the risks of the project. This arrangement is also sometimes called turnkey construction contracts, as the developer needs to only "turn a key" to start operation of the completed project.

This EPC contract can be separated into multiple contracts, but care must be taken to spell out responsibilities, so that all parties are clear on who is managing various risks and the overall process. In some cases, overall co-ordination is performed by the owner (if it has the in-house engineering expertise and experience in similar projects) or by an engineering company that is hired as a management contractor acting on behalf of the owner (owner's engineer). This owners engineer is oftentimes brought in during the project development phase to support or complete all of the engineering and design work needed during the development stage. Having an owner's engineer serve as an independent advocate for the owner and provide experienced engineering to support the design and construction of the project is often a strategy used for larger scale projects.

It will be up to the community to determine the best arrangement based on the community's expertise and experience, as well as its risk tolerance. For example, the community could act as the general contractor and manage the various vendors required for construction if it has relavent experience. This would then mean that only the engineering and procurement aspects of the project would need to be contracted out. The following are the key considerations for the community when deciding what sort of arrangement should be considered:

- Does the community have the experience and expertise to carry out any of the EPC phases?
- What is the community's risk tolerance?

The following sections will briefly go through each of the key EPC phases to provide a general overview of what steps are involved. It is not the intention of this guide to go into a large amount of detail for this section as it is recommended that the community work with a developer or consultant that has experience managing the EPC process for any large-scale projects.

The section also is written assuming a single EPC contractor has been brought on. However, regardless of the contract strategy selected, the key activities and considerations at each phase will be similar, the main difference being who will be responsible.

Selecting an EPC Contractor

The EPC contractor can have an important impact on the quality of the system in terms of system safety, performance and durability.

A RFP process is a good practice to be carried out in the selection of an EPC contractor. Appendix D provides a list of some of the key qualifications that should be considered when selecting an EPC contractor.

EPC Contracts

Once an EPC contractor has been selected, then an EPC contract is developed where the EPC contractor is typically made responsible for all the activities from design, procurement, construction, to commissioning and handover of the project to the owner.

The benefit of an EPC contract is that the contractor generally assumes full responsibility for all design, engineering, procurement, construction, commissioning and testing activities. Given this transfer of risk, the scope of work detailed within the EPC contract should be detailed enough to ensure that all key tasks relating to the construction have been considered and specified.

In the case of a renewable energy generator, the key elements of a strong EPC contract are outlined in the box on the next page.

Performance Testing

Performance testing is important as it allows for the comparison of the actual performance of a generator compared to its designed performance so that the contractor can correct any sources of underperformance.

EPC Contracting Checklist

Below is a checklist of basic requirements that should be considered during the EPC contracting process.

- ☐ Legal and Technical Advisors engaged to advise on form of contract.
- ☐ Scope of work drafted to include all engineering, procurement, construction, commissioning and testing tasks.
- ☐ Proposed contractor able to provide security by way of performance bond or parent company guarantee. Security to remain in place until Final Acceptance (FA) is achieved.
- ☐ Payment milestone profile drafted to be suitably protective; milestone amounts sized to accurately reflect works completed with sufficient funds held back until plant is taken over.
- ☐ Contractor provides a defects warranty period of at least two years commencing on the date of provisional acceptance.
- ☐ Defined terms, such as 'commissioning,' 'work completion,' 'provisional acceptance' and 'final acceptance' are clear and measurable.
- ☐ Contract contains provision for performance testing at two to three stages during the contractor's warranty period.
- ☐ Contract contains provision for obtaining compensation (Liquidated Damages) in event of delay or plant underperformance.
- ☐ Liquidated Damages sized to be a genuine pre-estimate of losses likely to be incurred.

EPC Scope of Work

The scope of work covered in the EPC contract should include:

> supervision
> management
> labour
> requirement to train and/or hire community members
> system equipment
> temporary works
> materials required to complete construction.

All technical requirements should be fully specified within a schedule to the contract. These should be suitably prescriptive and unambiguous. The more detailed and accurate the scope of work, the lower the risk that requests for a scope change will be made by the contractor during the construction phase. The contract should also clearly define points that designate where the contractor's scope of work ends.

If there are specific roles during the EPC phase that the community will play, then it is important that they be detailed in the EPC contract and that both contractor, community, developer and other stakeholders are in agreement.

Price and Payment Structure

Once the contract is signed, the contractor commits to delivering the project for a fixed price. The contract price should cover all the contractor's obligations under the contract and all items necessary for the proper design, execution and completion of the project.

During the construction phase, payment will typically be made to the contractor by way of milestones relating to the completion of individual work items. The payment schedule should be fair and reasonable for both parties and should allow the contractor to remain "cash neutral" throughout the build process, as the contractor will be paying the sub-contractors and equipment providers on a regular basis. Payment milestones should be drafted to be clear, measurable and made on completion (rather than commencement) of the individual scope items.

An example payment schedule is shown on the following page.

	Payment Due Upon	% of contract price
1	Advance payment	10–20%
2	Civil works completed	10–20%
3	Delivery of components to site (based on what is delivered)	40–60%
4	System installed	5–15%
5	Grid connection achieved	5–15%
6	Mechanical completion	5–10%
7	Provisional acceptance (system taken over by owner)	5–10%

Completion and Handover

The contract should clearly outline the criteria for completing the contractor's scope of work and when handover of the completed system to the owner can occur. This typically takes the form of a number of acceptance tests and inspections to be conducted by the owner or an independent third party that demonstrates that the system has been installed and is performing as per the requirements of the contract.

Figure 25 outlines the key completion events occurring during the construction phase. These are described in more detail to follow. Typically an EPC contractor will provide a 2- to 5-year warranty period, two years being typical industry standard. This warranty will often cover lost revenue, including downtime to correct faults, and the performance of the system.

Guaranteed Completion Date

The contract should include a guaranteed completion date, which is typically either specified as a fixed date or as a fixed period after commencement of the contract. The key point is that the owner needs to be certain what date the system will be exporting to the grid and therefore generating a return on the investment. Inability to meet the expected completion date may have important implications from a regulatory and/or financial perspective.

To mitigate the risk of the owner suffering financial loss resulting from the contractor failing to deliver a completed system to the agreed timetable, the contract should include a provision for claiming financial compensation ("liquidated damages" or LDs) from the contractor. LDs should be sized to be a genuine estimate of the loss or damage that the owner will suffer if the system is not completed by the target

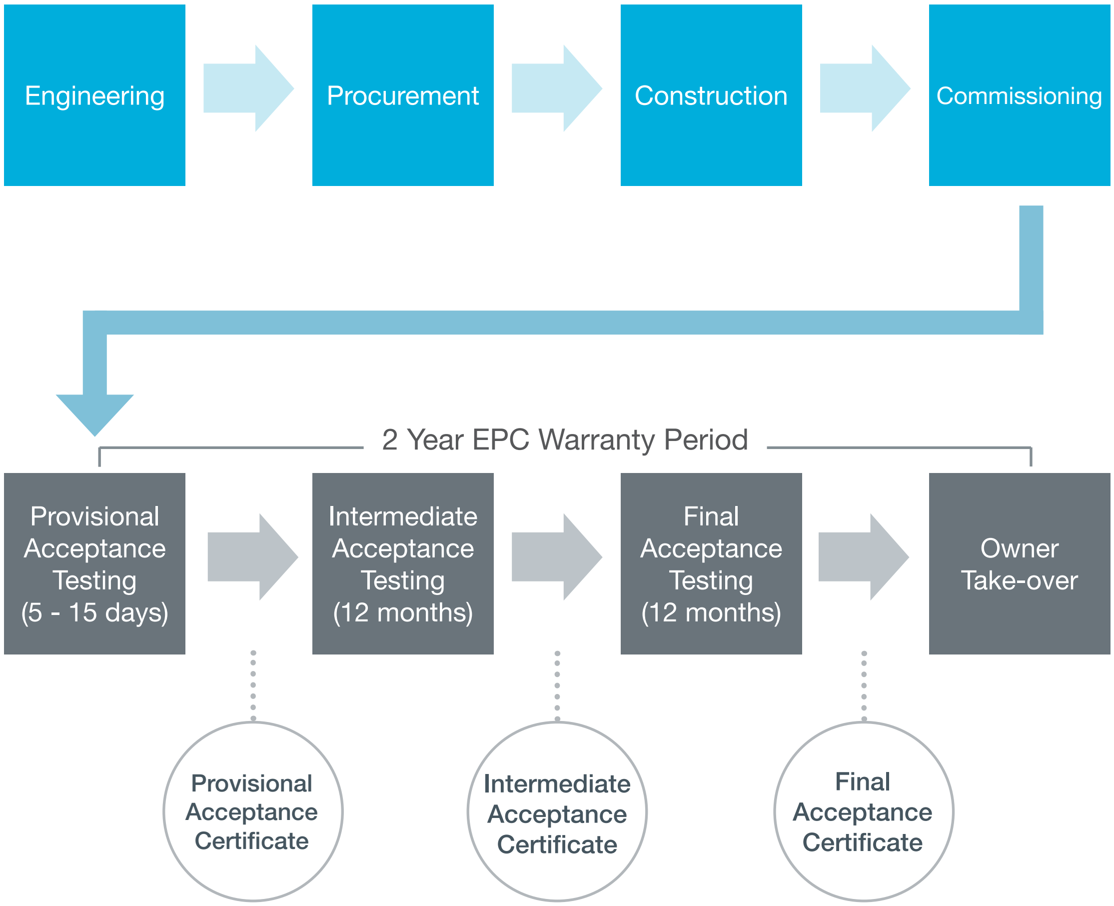

Figure 25: Key Completion Events During the Engineering, Procurement, and Construction Phase

completion date. These are usually expressed as a rate per day that represents the estimated lost revenue for each day of delay.

Engineering

This phase involves final system design and development of all construction documents (100% complete). This is also known as the project plan set. Depending on the project, this phase can be completed by the EPC contractor or by the owner's engineer. In the latter case, this phase may come before selection of an EPC contractor and before establishing the EPC scope of work. This situation is more common for larger scale renewable energy projects, due to the high capital requirements to construct the project, designs will typically be at 90–95% completion by the end of the development phase, ahead of financial close. This high level of certainty regarding the engineering and design is often needed for lenders to feel comfortable and to close financing.

In either case, this phase will see to it that the final design be completed to a sufficient level of detail to:

- address any questions that permitting authorities may have during the permitting process
- provide enough detail to any questions that the construction crew may have during construction.

A robust and detailed plan set can be considered a very important indicator of construction quality and consistency.

The following are a list of drawing types and items that would typically be developed during this phase:

- site layout and orientation plan
- civil and structural drawings
- electrical layout and single line diagram of system
- geotechnical documents
- transportation route analysis and diagrams
- layout of temporary vs. permanent structure and roads.

Procurement

The procurement phase involves finding and selecting the suppliers and subcontractors that can supply the materials and services required to construct the designed renewable energy system.

The key stages of this phase are:

- preparing all necessary bid documentation
- inviting suppliers or subcontractors to participate
- reviewing quotes and selection of suppliers or subcontractors
- review and signing of agreements with selected suppliers or contractors.

Transmission and Distribution Design and Procurement

This phase would also include all necessary transmission or distribution design and procurement required for connection of the project to the grid.

Construction

This phase involves all activities related to construction of the renewable energy system, including:

- preparation for and building of all civil works required (e.g., access roads, crane paths and pads, foundations, etc.)
- assembly or construction of the renewable energy system.

Key aspects of the construction stage that will be the responsibility of the EPC contractor or the separate general contractor brought on to the project during this stage include:

- construction project management
- work plan and schedule, including:
  - milestones
  - task sequencing
  - risk management
- quality management
- environmental management
- Occupational Health and Safety management.

Construction project management: involves project management techniques to oversee the construction of a project, from its beginning to its end. This involves managing all the different elements involved in the construction process, which includes:

- permitting
- civil works
- renewable energy system
- grid connection.

Work plan and schedule: Development of a realistic and comprehensive construction plan is a vital tool for the construction planning and management. The plan should sufficiently detail all tasks and the expected timescales for completion along with any restrictions.

Quality management: Controlling construction quality is essential for the success of a project and should be defined clearly and in detail in the contract specifications. A quality plan is an overview document that details all work, deliveries and tests to be completed within the project. This allows work to be signed off by the contractor and enables the developer to confirm if the required quality procedures are being met.

Environmental management: Any environmental hazards identified for the project will need to be mitigated during the construction process according to an environmental management plan. Contractor performance and adherence to the plan should be monitored and corrected as necessary.

Occupational Health and Safety: Occupational Health and Safety (OH&S) of the project work force should be carefully overseen. Apart from ethical considerations, the costs of not complying with OH&S legislation can represent a major risk to the project.

Commissioning

Once the renewable energy system has been physical constructed, the commissioning process is carried out to certify that:

- the generator installation is complete
- the generator complies with grid and safety requirements
- all the owner's requirements have been met.

Successful completion of the commissioning process is crucial to achieving acceptance and handover of the system from the EPC contractor to owner.

During this phase, if tests are unsuccessful, then design modifications and even legal action may be required if the system cannot meet performance and reliability guarantees made by the EPC contractor.

The following provides a general overview of the commissioning activities that will be carried out for each of the renewable energy system types.

Solar PV

Commissioning activities of a solar PV power plant would involve testing of all of the major elements of the system including: PV module strings, inverters, electric infrastructure, support structures and tracking systems (where applicable).

Wind Farms

Commissioning tests will usually involve standard electrical tests for the electric infrastructure as well as the turbine and the inspection of routine civil engineering quality records. It will usually take a period of six months for the wind farm to reach full, mature, commercial operation. During that period, the electricity production will increase from a level of about 80–90% after commissioning to the long-term level of 97% or more of the estimated production.

Hydroelectric

Commissioning of a hydroelectric power plant involves all hydropower elements including water retaining structures, power waterways, hydromechanical equipment, transmissions facilities, ecological conveyances such as fish ladders, ecological flow devices and so forth. This process involves multiple steps including both a dry and wet run, and takes several months to complete.

Geothermal

Commissioning includes the testing of all power plant components and associated equipment and includes fine-tuning the power plant's efficiency, pressures from the wells and other parameters, which can take several months to complete.

Biomass

The commissioning phase for a biomass plant project includes a cold test, a hot test, a functional test, a trial run and a performance test. During the cold test, all signals—from the individual components to the control system—are tested to ensure that they are connected correctly. During the hot test, the plant actually starts to operate on the main fuel, and all controls and regulations are trimmed and optimized. When the cold and hot tests are finalized, the contractor must demonstrate that the plant can operate and perform as it was supposed to do.

Handover

Following the commissioning phase, the project will then progress through three levels of acceptance until final takeover by the owner.

Provisional Acceptance

This refers to the stage at which the contractor has complied with all of its construction-related obligations and the plant is ready to be handed over to the owner. The criteria for achieving this acceptance should have been clearly outlined in the EPC contract. This will typically include:

- grid connection and energization achieved
- performance testing
- all handover documentation has been provided

Original Equipment Manufacturer (OEM) Warranty

The defects warranty and performance warranty described here are provided by the EPC contractor. Each piece of equipment associated with the system also has its own OEM warranty, that would cover each according to the typical lifespan of each piece of equipment. For example:

- Solar modules: up to 25 year OEM warranty
- Inverter: up to 10-year OEM warranty.

> O&M training has taken place.

Once provisional acceptance has been achieved, the owner would typically be obliged to make the final milestone payment to the contractor, at which point 100% of the contract value would have been paid. The provisional acceptance date would also mark the commencement of the contractor's warranty period, which typically lasts for two years.

Intermediate and Final Acceptance

The EPC contractor will typically be required to deliver a number of guarantees:

> Defects warranty: It would be normal for the contractor to provide a system defects warranty for a specific period. The length of this warranty depends on the technology type, but typically is at least two years following the date of provisional acceptance for most technology types. This makes the contractor responsible for the correction of any defects that may be identified during this period.

> Performance warranty: In addition to the short-term performance test at provisional acceptance, for some technologies, it is industry standard for the contractor to provide a Performance Guarantee to be measured at one or two separate occasions within the defects warranty period. Testing plant performance annually removes the risk of seasonable bias affecting the performance calculation and allows for a true assessment of system performance.

Given that an EPC warranty period typically lasts two years from the date the system is accepted by the owner, performance testing over the first year of operation is commonly referred to as the **intermediate acceptance test**.

Performance testing during the second year of plant operation is commonly referred to as **final acceptance testing**. If these performance tests are passed (along with other contractual conditions) then an Intermediate Acceptance Certificate (IAC) and Final Acceptance Certificate (FAC) may be signed.

If the performance measured during either of the tests were less than the guaranteed levels, then the contractor would be required to compensate the owner based on the contractual obligations. This typically comes in the form of Liquidated Damages (LD) to compensate for anticipated revenue losses over the project lifetime.

CHAPTER 6:

Operations and Maintenance

Once a project is handed over, it is important that the ongoing operations and maintenance (O&M) activities, including repair and replacement (R&R) are carried out for the project. These activities are important and are vital to the successful performance and lifespan of any renewable energy system.

Depending on the role the community has with the project, this work could be carried out by trained members of the community or by a third party, in either case under an O&M agreement. This section will provide an overview of the key O&M activities associated with each renewable energy technology. Appendix G, page 179, also includes resources for training programs that can help support capacity building in the community.

Why Is O&M Important?

A well-devised O&M program improves lifetime project performance and energy production. The following are some of the benefits of proper O&M approaches:

- reduce system downtime
- increase system lifetime
- ensure safety
- reduce risk of project failure or underperformance
- increase efficiency and energy generation.

What does it entail?

An optimal operations and maintenance program includes the following aspects:

- robust quality assurance in the planning and construction phase
- comprehensive asset management
- a balance of preventive and corrective O&M activities.

O&M issues should be taken into consideration in the design, engineering and construction phases. Early consideration of O&M activities ensures selection of low maintenance alternatives and the required access to and around equipment for maintenance.

The following sections outline the specific O&M requirements and budgeting considerations in general and then for each renewable energy technology.

General O&M Approaches

Operation includes the following five areas:

1. Administration of Operations: Ensures effective implementation and control of O&M activities.
2. Conducting Operations: Ensures efficient, safe and reliable process operations.
3. Directions for the Performance of Work: Specifies the rules and provisions to ensure that maintenance is performed safely and efficiently.
4. Monitoring: Maintains monitoring system and analysis of resulting data to remain informed on system status.
5. Operator Knowledge, Protocols, Documentation: Ensures that operator knowledge, training and performance will support safe and reliable plant operation.

Maintenance include the following four types of activities:

1. Administration of Maintenance: Effective implementation, control and documentation of maintenance services and results. This activity overlaps with "Administration of Operation".
2. Preventive Maintenance: Routine inspection and servicing of equipment. This approach reduces unplanned system downtime.
3. Corrective or Reactive Maintenance: Repair and replacement of equipment after failure occurs.
4. Condition-based Maintenance: Anticipating failures based on real-time data and prioritizing maintenance activities and resources.

O&M Contracts

There are two types of O&M contracts:

- Fixed price: (also known as full wrap) covers all O&M needs for a fixed annual price
- Pay-per-use: (also known as cost-plus) includes a fixed price to cover several recurring O&M procedures and per-task payment for corrective maintenance.

For an O&M contract, the system owner may consider a guarantee or a performance contract. This is done to ensure a specified performance indicator is guaranteed. Some examples of a performance indicator include:

- response time guarantee
- availability guarantee

- performance ratio guarantee
- energy production guarantee.

It is recommended to account for changes in weather, force majeure or anticipated degradation (for example, using weather-corrected performance ratio). Ideally, O&M agreements should also contain clear termination provisions allowing a community to exit the agreement and replace providers at their discretion.

Budgeting

The cost of O&M for each technology is variable depending on the characteristics of the project, such as:

- project size and complexity
- design
- equipment
- project site
- environmental conditions at the site (e.g., snow, dust, pollen, humidity, wildlife)
- warranty terms (regularly scheduled maintenance to conform to the manufacturer's instructions).

Appendix A, page 152, includes information on the range of budgeting for O&M as a guideline. Overall, the O&M costs can be categorized as fixed or variable costs:

- Fixed O&M costs: insurance, administration, fixed grid access fees and service contracts for scheduled maintenance.
- Variable O&M costs: scheduled and unscheduled maintenance not covered by fixed contracts, replacement parts and materials, and other labour costs.

SOLAR-SPECIFIC CONSIDERATIONS

Compared to other power generating technologies, solar PV power plants have low operating and maintenance requirements. However, proper maintenance of a PV plant is essential to maximize both energy yield and the plant's useful life.

Cleaning

Soil accumulation on the PV modules causes power loss and reduced revenue. Determining an optimal cleaning interval depends on the seasons, local rainfall patterns and dust characteristics of the site. In addition, the following parameters will affect the decision of how often to clean:

- cost of cleaning (both labour and materials)
- rate of soil accumulation (which determines the percentage of power loss)
- site's capacity factor (a higher capacity factor means a higher availability of solar resource, which increases the reward for cleaning)
- value of the solar power (a higher value of the delivered power increases the reward for cleaning)
- PV module efficiency (lower-efficiency modules require more area to be cleaned for the same benefit).

There are simulation software tools that account for the soil accumulation and rain based on hourly data for the specific site in order to calculate an optimal cleaning interval. However, many plant operators follow a simple, low-risk policy of washing once or twice a year.

Snow and Ice Removal

The array design can increase or decrease snow accumulation. Generally, snow slides off steep arrays (above 30-degree tilt). Snow removal by mechanical means (i.e., shovel or rake) damages the modules and wiring, so it is not recommended. Instead, snow removal is by powerful turbo-fan or brushes and squeegees, however, extreme care is required to prevent damage. Labour cost for snow removal is about $50 to $75 per hour or about $5.40/sq. m of array area.

Heating to melt snow is an option, however, it is usually not cost effective.

Appendix A, page 152, includes a guideline on the annual O&M costs for renewable energy technologies. Table 8, page 130, lists a number of typical O&M activities for solar PV and their recommended interval frequency. National Renewable Energy Lab has published a report regarding O&M best practices for solar PV systems that can be found on their website.[84]

[84] National Renewable Energy Laboratory, Best practices in Photovoltaic System Operations and Maintenance: 2nd Edition, 2016. https://www.nrel.gov/docs/fy17osti/67553.pdf

Table 8: Frequency of Solar PV O&M Practices. Source: Adapted from North American Board of Certified Energy Practitioners[85]

Solar PV	As required	Monthly	Semi-annually
Inspect modules for damage			x
Address array shading issues	x		
Remove debris around array	x		
Inspect array mounting system			x
Adjust array tilt	x		
Check inverter and/or charge controller for correct settings		x	
Inspect and clean all electrical equipment			x
Monitor system for voltage and current	x	x	
Inspect battery enclosure (if a battery storage system has been installed)		x	
Inspect battery terminals and connections (if a battery storage system has been installed)		x	
Equalize batteries (if a battery storage system has been installed)	x	x	
Water batteries (if a battery storage system has been installed)	x	x	
Measure specific gravity of each battery cell (if a battery storage system has been installed)	x	x	
Load-test batteries (if a battery storage system has been installed)			x
Capacity-test batteries (if a battery storage system has been installed)			x

[85] North American Board of Certified Energy Practitioners, NABCEP PV Installation Professional Resource Guide, 2016. http://www.nabcep.org/wp-content/uploads/2016/10/NABCEP-PV-Resource-Guide-10-4-16-W.pdf

WIND-SPECIFIC CONSIDERATIONS

The operations and maintenance costs (O&M) can account for a large portion (11–30%) of the overall lifecycle costs of a wind farm.

Typically, the annual operation and maintenance cost increase over the lifetime of the wind turbine, especially in the later years of a 20- to 25-year useful life.

There is a higher risk of repair and replacement for the various equipment pieces over time, usually after the warranty expires. All aspects of wind turbine maintenance have established industry best practices:

> towers
> rotors, blades and hubs
> gearboxes
> generators
> balance of plant
> data collection and reporting.

Recent technological developments in wind technology has significantly reduced the annual average O&M costs of wind energy systems in the last three decades. Table 9 outlines the frequency of key operation and maintenance activities.

Table 9: Frequency of Wind Farm O&M Practices

Wind Farms	As required	Monthly	Semi-annually
Tighten screws and bolts – electrical and mechanical			x
Check for frayed wires			x
Check for insect or other debris build-up on blades and clean off (with water, no solvents)			x
Check for rust and remove using manufacturer's recom-mended lubricant			x
Have the entire wind system inspected by trained technicians at least once a year (tower, storage devices and wiring)	x	x	
Change the gear oil, coolants, seals, brake pads and filters	x	x	
Grease the bearings	x	x	
Adjust sensors and actuators	x	x	

GEOTHERMAL-SPECIFIC CONSIDERATIONS

For small, geothermal heat pumps or ground source heat pumps, the operation and maintenance of these systems is fairly minimal and similar to that of any other pump. However, for geothermal power plants, there will be specific operations and maintenance requirements depending on the geothermal system, properties of the geothermal resource, as well as geographical settings. It is not possible to go through each technology and the specific considerations. Therefore, Table 12 outlines the maintenance requirements applicable to the most common geothermal power plants.

For geothermal power plants the maintenance requirements can be divided into:

- steam supply system (wells, pipelines, separator, infrastructure, etc.)
- power plant (turbine, generator, cooling system, substation, etc.).

For a geothermal electric power plant, some of the typical maintenance practices and activities are listed in Table 10.

Table 10: Frequency of Geothermal Electric Plant O&M Practices

Geothermal Electric Power Plant	As required	Monthly	Semi-annually
Cleaning existing wells			x
Drilling new make up wells	x		
Descaling and cleaning of well valves		x	
Repair of any leaks in steam pipes		x	
Inspection and cleaning of separators (separate steam from fluid)		x	
Turbine lubrication and hydraulic system component mainte-nance		x	
Overhaul of turbine and auxiliaries	x		
Generator bearing lubrication			x
Cleaning of condenser and cooling system	x		
Gas extraction system inspection and repair		x	

HYDROPOWER-SPECIFIC CONSIDERATIONS

Hydropower plant components are constantly stressed by a number of factors which affect the life of the individual components of the power plant. Costs associated with maintenance work represent a significant share of the total operational costs for a hydropower plant. This means that proper O&M planning is crucial for long-term economic hydro power plant operation.

As one of the oldest renewable energy technologies, best practices have been established for O&M of all parts of a hydropower plant, which include:

- water intake, power water system and associated equipment
- turbine and auxiliary equipment
- generator and auxiliary equipment
- transformer and switchyard.

For a hydroelectric power plant, the typical maintenance practices and activities are listed in Table 11 on page 134.

Table 11: Frequency of Hydro Power Plant O&M Practices

Hydro Power Plant	Weekly	As required	Monthly	Semi-annually
Facility inspection	x			
Dam safety inspection			x	
Monitoring and Inspection of reservoir and water conductor system (system in which water flows through from the reservoir to the electricity generation equipment, aka spillway)				x
Inspection and repairs to turbine runners		x		x
Maintenance of speed governors and all associated equipment				x
Conduct impedance tests of the generator				x
Conduct recommended maintenance of generator and auxiliary equipment				x
Check generator foundation and tighten bolts				x
Clean or replace generator air coolers and bearing oil coolers				x
Inspect current transformers, potential transformers for overheating or temperature rise				x
Monitor and filter oil of transformer and switchyard				x
Clean transformer bushings and insulator strings			x	

BIOMASS-SPECIFIC CONSIDERATIONS

Operation and maintenance requirements of a biomass plant is closer to a conventional oil or gas-fired plant then a renewable energy project. However, a biomass plant is also more complex and requires a larger staff than a conventional oil- or gas-fired plant, as well since it requires more equipment for handling of large tonnages and storage space for volumes of biomass feed stock.

Operation of a biomass plant includes a number of tasks and responsibilities which include:

- scheduling of power and heat production and fuel supply
- operating and monitoring all functions of the plant and equipment
- operation of fuel reception and handling, including weight measuring and quality control
- operation and handling of systems for byproducts of the combustion process (e.g. bottom ash, fly ash and other byproducts)
- planning and ordering of necessary maintenance work and securing plant before start of work.

Maintenance for a biomass plant is similar to that of a traditional oil or gas fired plant, except there is additional equipment from fuel storage and handling equipment. Table 12 outlines the frequency of key operation and maintenance activities.

Table 12: Frequency of Geothermal Electric Plant O&M Practices

Biomass Plant	As required	Monthly	Semi-annually
Fuel Storage and Handling Equipment - Fueling	x		
Fuel Storage and Handling Equipment - Change of lubrication oil			x
Fuel Storage and Handling Equipment – Check and change of tired, rollers, bearings, etc.	x		
Change of wear parts of boiler	x		
Flue gas cleaning			x
Turbine lubrication and hydraulic system component maintenance		x	
Electric system maintenance	x	x	
Controls and instrumentation calibration and replacement	x	x	
Balance of plant maintenance (piping, chemicals, filters, gaskets, valves)	x		x

CHAPTER 7

Renewable Energy Frequently Asked Questions

GENERAL

What is renewable energy?

Renewable energy is energy that has been produced from a renewable energy resource, which is a resource that occurs naturally and can be replenished or renewed within a human lifespan. See Chapter 1, page 5, for a more in depth explanation.

Why renewable energy?

Renewable energy generation, unlike energy generation from traditional fossil-fuels, does not emit high levels of greenhouse gases. Using renewal resources to meet energy needs typically results in less pollution of the air, water and land than using fossil fuels or nuclear energy sources. In addition, local decentralized renewable energy projects can offer some degree of energy independence and security and also bring additional jobs and other local economic development opportunities.

What is the difference between a grid-connected (grid-tie) and stand-alone (off-grid) system?

A grid-connected system is connected through a meter to the electric distribution lines that provide electricity to a facility. This connection can be through either the transmission system or to the distribution system.

A stand-alone system is not connected to the main electric distribution line. Instead, an off-grid renewable energy system can work with batteries, or with an off-grid diesel generator in a hybrid configuration. In the case of batteries, a charge controller acts as a balancing unit to optimize the electricity generation from the renewable energy source, and the charge-discharge cycle of the batteries when electricity is being consumed.

SOLAR ENERGY SYSTEMS

What is a solar PV system?

A solar panel is made up of many, smaller units called photovoltaic (PV) cells. The PV cells convert sun's energy into electricity by producing direct current (DC). The DC electricity is then taken to the inverter to be converted into alternating current (AC) for everyday use in your home or business.

What are the different components of a solar PV system?

> Solar array: solar panels typically mounted on a south-facing roof or on a large field

> Inverter: converts solar energy (DC) to match utility power (AC).

Can hail damage my solar panels?

Not likely. Solar panels are made with tempered glass. In most cases, standard testing requires the panels to withstand hail up to 2.5 cm in diameter, travelling at 80 km/h.

Is there enough solar energy in my location?

You may review the map of solar availability in Alberta in Appendix E, page 170, to see how much solar energy is available in your location.

Is my available land or roof a good site for solar?

An unobstructed, clear view of the sun is desired. Shading from buildings, vegetation or any other kind of structure will lower the access to sunlight, reducing the performance of a solar PV system. You may also want to ensure your roof structure can hold the weight of a solar PV array system.

How do I find a reputable solar technology supplier and installer?

The Solar Energy Society of Alberta has an industry directory of solar companies that operate throughout Alberta.[86] The Canadian Solar Industries Association (CanSIA) also has a directory.[87]

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[86] Solar Energy Society of Alberta, Alberta Solar Providers Directory. https://www.solaralberta.ca/directory/alberta-solar-providers

[87] Canadian Solar Industry Association, Solar Industry. http://web.cansia.ca/Solar-Industry

WIND ENERGY SYSTEMS

What is a wind turbine and how does it work?

A wind turbine works just like a fan but in reverse: instead of using electricity to create wind, a wind turbine uses wind to generate electricity.

Are wind turbines noisy?

Generally, the turbine noise is masked by the sound of the wind itself. As the technology has improved, newer models make less noise. A wind turbine can create two types of sounds: a mechanical hum made by the generator and a "whooshing" sound produced by the rotating blades. The sound pressure levels for modern wind turbines at a distance greater than 400 m are typically less than 40 decibels, which is comparable to the lowest limit of urban ambient sound. AUC Rule 012 sets out the requirements for noise control, including permissible sound levels for generators, substations, or transmission lines.

Do wind turbines affect human health?

Health Canada conducted a large-scale epidemiology study looking at wind turbine noise and health.

The results of the study can be viewed online.[88]

Do wind turbines kill birds and bats?

A report from Environment Canada looking at human-related avian mortality in Canada found that avian mortality from wind turbines was low relative to other sources of mortality (cats, power distribution line collisions, collision with buildings, road vehicle collisions).

The study is available on the Avian Conservation & Ecology Journal website.[89]

In addition, AEP has a set of Wildlife Directives for wind power projects have to adhere.[90]

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[88] Government of Canada, Wind Turbine Noise and Health Study: Summary of Results, October 30, 2014. https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html

[89] Avian Conservation & Ecology, A Synthesis of Human-related Avian Mortality in Canada, 2013. http://www.ace-eco.org/vol8/iss2/art11/

[90] Alberta Environment and Parks, Wildlife Land Use Guidelines, 2018. http://aep.alberta.ca/fish-wildlife/wildlife-land-use-guidelines/default.aspx

HYDROPOWER

How does hydropower work?

There are a number of different hydropower technologies, but at a fundamental level, all of them produce electricity using the force of moving water, be it from waves, tides, river flows or impounded reservoirs. In conduit projects, for example, small turbines—the devices that create electricity—are placed into existing infrastructure like irrigation canals. The water flows through the turbines, turning blades which are connected to a shaft that spins a generator and generates power that is then sent out to homes and businesses through transmission lines.

What are the environmental impacts of large hydroelectric plants?

Hydroelectric plants that require a dam that creates a reservoir (or a dam that diverts water to a run-of-river hydropower plant) may obstruct fish migration. A dam and reservoir can also change natural water temperatures, water chemistry, river flow characteristics and silt loads. All of these changes can affect the ecology and the physical characteristics of the river. These changes may have negative effects on native plants and on animals in and around the river. Reservoirs may cover important natural areas, agricultural land or archeological sites. A reservoir and the operation of the dam may also result in the relocation of people. The physical impacts of a dam and reservoir, the operation of the dam and the use of the water can change the environment over a much larger area than the area a reservoir covers.

Can I generate electricity from a fast flowing river without a fall?

In theory this is possible but the amount of power available is very small in comparison to sites where there is a vertical change in elevation.

How much water do I need?

The more water is available, the higher the power potential of the site. It is important to remember that it will rarely be appropriate to use all of the water at a site for ecological reasons. The amount of water needed for a certain amount for power depends on how far it falls, so if the water supply is only a small stream but it can be harnessed high up on a hillside, there might still be a significant amount of power available.

BIOMASS

What is biomass? What is bioenergy?

Biomass is fuel that is developed from organic materials, a renewable and sustainable source of energy used to create electricity or other forms of power. One form of bioenergy (biopower) is carbon neutral electricity generated from renewable organic waste that would otherwise be dumped in landfills, openly burned or left as fodder for forest fires.

Biomass can be made from agricultural and forestry residues and some industrial wastes and crops grown solely for energy purposes. Biomass is an attractive fossil-fuel alternative because it is a renewable resource that is more evenly distributed over the earth's surface than finite fossil-fuel energy sources such as coal, oil and natural gas, and may be developed using more environmentally friendly technologies.

Does biomass contribute to an increase in greenhouse gases?

If sustainably harvested and managed, biomass can be used to generate energy on demand with virtually no net contributions to global greenhouse gas. Burning biomass to create clean electricity releases no new carbons back into the atmosphere. Instead, it releases what would be released naturally as the organic matter decomposed.

Does biomass power result in over-harvesting of trees and deforestation?

Biomass power does not pose a threat to forests, farmland or crops. It is not economically viable for a biomass power plant to clear forests or chop down trees solely for the purpose of converting the trees into biomass to make electricity. Biomass is most cost effectively made from crops specifically planted for that purpose or from residuals of paper mills, wood collected from the forest floor, tree trimmings and remainder wood from current, sustainable logging practices.

GEOTHERMAL

Are geothermal resources renewable?

Geothermal energy is literally heat from the earth, and the earth's heat is essentially limitless. As far as today's science can determine, the centre of the earth has been very, very hot for some 3.9 billion years and will continue to be hot for at least that far into the future. At the earth's core, 6,400 km deep, temperatures can reach upwards of 5,000^{o}C. In addition, the underground water or steam used to convert heat energy into power will never diminish if managed properly, because precipitation will continue to recharge geothermal reservoirs. Geothermal resources can be considered renewable on timescales of technological/societal systems and do not need geological times for regeneration as fossil fuel reserves do.

Do geothermal power plants emit smoke?

No, the visible plumes seen rising from water cooled geothermal power plants are actually water vapor emissions (steam), not smoke, and are caused by the evaporative cooling system. No combustion of fuels occurs to produce electricity at a geothermal facility.

Where is geothermal energy available?

Hydrothermal resources—reservoirs of steam or hot water—are available primarily in the western states, Alaska and Hawaii. However, Earth energy can be tapped almost anywhere with geothermal heat pumps and direct-use applications. Other enormous and world-wide geothermal resources—hot dry rock and magma, for example—are awaiting further technology development.

What makes a site good for geothermal electric development?

Hot geothermal fluid with low mineral and gas content, shallow aquifers for producing and reinjecting the fluid, location on private land to simplify permitting, proximity to existing transmission lines or load and availability of make-up water for evaporative cooling. Geothermal fluid temperature should be at least 150°C, although plants are operating on fluid temperatures as low as 100°C.

Do geothermal plants use hot springs and other geothermal surface features?

While surface features such as geysers or fumaroles are typically useful in identifying the locations of geothermal resources, these features are not used during geothermal development. Instead, drilling that extracts geothermal resources takes place close to these features. In fact, it is impossible to extract geothermal resources, for the purpose of large-scale utility development, from geothermal surface features themselves. Further, while almost all geothermal resources currently developed for electricity production are located in the vicinity of natural geothermal surface features, much of the undeveloped geothermal resource base may be found deep under the Earth without any corresponding surface thermal manifestations.

GLOSSARY

Alberta Interconnected Electric System (AIES): All transmission facilities and all electric distribution systems in Alberta that are interconnected. (The AIES does not include systems or facilities within the service area of the City of Medicine Hat or of a subsidiary of that city, unless the city passes a bylaw that is approved by the Lieutenant Governor in Council under section 138).

Balance of Plant (BoP): All supporting components and auxiliary systems of a renewable energy system other than the electricity generating unit itself.

Balance sheet financing: Balance sheet financing refers to situations when a sponsor uses its own funds to fund a project. In this case, the sponsor uses liquidity from various sources such as retained earnings and credit lines to fund the project. The project may or may not be structured as a SPV (also defined in this glossary).

Biomass: Organic matter that is used to produce synthetic fuels or is burned in its natural state to produce energy. Biomass fuels include wood waste, peat, manure, grain byproducts and food processing wastes.

Bilateral Agreement: A utility-scale generator can enter into a bilateral agreement directly with a buyer for the sale and purchase of electricity in the future. The actual dispatch and delivery of that electricity takes place in real time, through the wholesale market (the power pool), and the exchange between seller and buyer is registered with AESO as a net settlement instruction. By doing so, AESO will exclude the contracted volume of electricity from the buyer's monthly settlement and from the renewable generator's metered generation. Outside the power pool, the buyer pays the generator according to the price and terms agreed to, and legal title to the electricity and environmental attributes is transferred to the buyer.

Bridge loan: A short-term loan to fund cash outflows before permanent financing is in place.

Capacity: The maximum sustainable amount of electric energy that can be carried or delivered in a second under ideal circumstances. Capacity is a term that can be applied to a transmission system or to a piece of equipment, such as a generating unit, electric service or appliance. It is measured in watts, kilowatts or megawatts.

Capacity Factor: The ratio of the average electricity load during a defined time period to the rated capacity of a renewable energy system (or any electrical equipment).

Contract for Differences: See "Financial Power Purchase Agreement"

Demand (electricity): The volume of electric energy delivered to or by a system, by part of a system or by a piece of equipment at a given instant or averaged over any designated period of time.

Distribution System (electric): The final stage in the delivery of electricity from the transmission system to individual customers. Distribution comprises the plant, works equipment, systems and services necessary to distribute electric energy in a service area at a voltage of 25 kV or less.

Distribution-connected Generation: An electricity generating unit that is interconnected with an electric distribution system.

Distribution Facilities Owner: See "Wire Owner"

Dual financing: When two sponsors desire to finance a project differently, a project may be structured to allow one sponsor to provide balance sheet financing, and the other to secure project financing at the SPV level, or into a SPV holding entity (also explained in this glossary).

Equity first: Under an equity first structure, all equity needs are injected into the project before the SPV is able to drawdown on senior debt.

Equity injection: Point in time when equity capital is injected by sponsors into a project in exchange for equity in such project.

Equity investor: Invests money into a company or project in exchange for a share of ownership in it. In general, the equity investor supplies its financial resources in anticipation of future dividends and capital gains.

Equity last: Under an equity last structure, all equity needs are first guaranteed by irrevocable LCs, and subsequently injected into the project after the SPV has made all permitted drawdowns on the senior debt.

Equity loan: Loan taken by a project sponsor to fund such sponsor's equity investment in a project.

Engineering, Procurement and Construction (EPC): A form of contracting arrangement where the contractor carries out the detailed engineering design of the project, procures all the equipment and materials necessary, and then constructs to deliver a functioning asset to the client.

Financial Power Purchase Agreement: Financial power purchase agreements are transacted directly between the generating facility and the power purchaser, but legal title to the power is not transferred to the power purchaser. Instead the generation facility sells their renewable power directly to the grid and receives the open market price. The power purchaser pays the difference to the generating facility when the market price is lower then the agreed upon purchase price; and vice versa. This is also commonly known as a contract for differences or a fixed-for-floating swap and is similar to the Renewable Energy Support Agreement pricing structure.

Generating Unit: The components of a power plant that produces, from any source, electric energy and ancillary services, and includes a share of the following associated facilities that are necessary for the safe, reliable and economic operation of the generating unit, which may be used in common with other generating units: (i) fuel and fuel handling equipment; (ii) cooling water facilities; (iii) switch yards; (iv) other items;

Geothermal Energy: The thermal (heat) energy that is generated and stored in the Earth. This energy resource can be used to provide direct heat and to generate electricity.

Grid: See "Alberta Interconnected Electric System."

Intertie: A transmission facility or facilities, usually transmission lines, that interconnect two adjacent electricity control areas.

Irrevocable letters of credit "LCs": A financial instrument issued by banks and used by sponsors or banks to guarantee certain obligations. In the context of project finance, LCs may be issued to guarantee the timely and complete injection of equity by the sponsors, or to back the debt service reserve account ("DSRA"). LCs are advantageous as they are typically cheaper than cash reserves for sponsors that have sufficient financial strength to issue LCs to the project in case the sponsors fail to do so. It is irrevocable because the letter of credit cannot be cancelled or modified unless all parties agree to the modifications.

Limited recourse loans: In project finance, the projects are usually structured to limit the recourse of Senior Debt lenders and other parties to the assets of a SPV, which explains why "limited recourse" and "non-recourse" financing have the same meaning as project financing. The borrower of the loan is the SPV (also defined in this glossary) as opposed to the sponsors of the project. This structure allows to limit the claims of Senior Debt lenders to the assets of the SPV in the event of default, with no recourse to the sponsors assets and projects that are not owned by the SPV. If the borrower defaults on schedule payments or covenants, lenders can exercise their rights with respect to the collateral and exercise certain "step-in" rights into the SPV. If the collateral is insufficient to make up for the unpaid portion of the loan amount, lenders have no claim against the project sponsors.

Market Participant: Is 1) any person that supplies, generates, transmits, distributes, trades, exchanges, purchases or sells electricity, electric energy, electricity services or ancillary services, or 2) any broker, brokerage or forward exchange that trades or facilitates the trading of electricity, electric energy, electricity services or ancillary services;

Net Billing: A procedure for subtracting the electric energy supplied out of a micro-generation site during the billing period from the electric energy delivered into the micro-generation site or aggregated sites during the billing period. The net charge or credit to the micro-generator is based on the resulting net usage of electric energy during the billing period.

Net Settlement Instruction (NSI): Allows buyers and sellers of electrical energy to enter directly into contracts with other power pool participants for an agreed upon amount of power, at a negotiated price, ove ra specified time period in the future. The net settlement instruction must be registered with the AESO.

Operations and Maintenance (O&M): The decisions and actions regarding the control and upkeep of property and equipment. O&M are inclusive of, but not limited to actions focused on systems control and optimization and the performance of routine, preventive, predictive, scheduled and unscheduled actions to prevent equipment failure or decline and to increase efficiency, reliability and safety

Pari-passu: Under a pari-passu structure, all senior debt and equity funds are called and injected in their respective proportion, at the same rate and according to the same schedule.

Pool Price: The hourly price for electric energy, established and reported by the Alberta Electric System Operator (AESO) in accordance with the rules for electric energy exchanged through the power pool.

Power Purchase Agreement: See “Bilateral Agreement”

Power Purchase Arrangement: During the restructuring of Alberta’s electricity industry, Power Purchase Arrangements was one mechanism used to transition to a fully deregulated market. These Power Purchase Arrangements were intended to allow the facility owners of the power generating facilities a reasonable opportunity to recover their fixed and variable costs of generation while transferring the right to offer the output of the plants into the power pool to intermediaries. Note the acronym PPA is used here but is also often used to refer to power purchase agreements as well.

Proforma: A set of calculations that projects the financial return that a proposed project is likely to create.

Renewable Electricity Support Agreements (RESP): Agreement executed by the Alberta Electric System Operator (the “AESO”) and each successful proponent that is selected by the AESO at the end of the competitive process as part of the REP. The RESA will govern the development and operation of the Generator’s renewable energy project and will establish the terms and conditions upon which the Generator will be entitled to receive support payments in exchange for providing the AESO with all Renewable Attributes which are generated in relation to the Project.

Renewable Electricity Program (REP): The REP is a competitive bidding process with the target of procuring 5,000 MW of renewable electricity generation by 2030.

Rural Electrification Association (REA): Member-owned electric distribution systems that serve farm members within a specific geographic boundary. Each REA has an elected board of directors that handles the business operations of the REA

Senior debt: Senior debt is a term used in project finance to refer to the main source of capital for renewable projects. Senior debt providers typically rely on sponsor experience and the credit strength of a long term offtake agreement (such as a power purchase agreement or a RESA) to provide long term financing up to the offtake agreement's expiry. Senior debt lenders such as banks and life insurance companies have first rank security on all SPV assets and cash flows, providing them priority to secure principal and interest payments over equity distributions and third party liabilities and claims, and some "step-in" rights in specific cases. Since senior debt lenders have no recourse to the sponsors (as explained in the special purpose vehicle definition) they require the sponsor to engage independent consultants to make a legal, technical and insurance due diligence to ensure that the loan size is adequate, that the project meets their conservative risk profile and that appropriate reserves and covenants are agreed upon. While the acquisition of senior debt can be costly, it can allow to secure a high level of leverage, for example 80% senior debt and 20% equity.

Solar (power): A process that produces electricity by converting solar radiation directly into electric energy or into thermal energy to produce steam to drive a turbine to generate electricity.

Special purpose vehicle ("SPV"): Is a legal entity or an agreement between persons created to attain narrow and specific objectives, for example to build, operate, and own a renewable energy project. It may be formed through limited partnerships, general partnerships, trusts, corporations, limited liability corporations or other entities. SPVs are typically used in project finance to limit the recourse of lenders, as explained in the Limited Recourse Loans definition. The most currently used SPV structure in Canada is the limited partnership, which allows to limit sponsors exposures to their investment in the SPV.

Special purpose holding entity: In some cases, a sponsor may create a holding SPV to hold its stake in a SPV, for example when dual financing is used (also defined in this glossary).

Sponsor: Sponsors are involved in originating and structuring a project. Sponsors are generally the project owners with equity investment in the project. It is possible for a single company or for a consortium to sponsor a project.

Term sheet: A term sheet is an agreement setting forth the basic terms and conditions of senior debt financing, equity or other types of funding. A term sheet serves as a template to develop more detailed legal documents. After specific milestones agreed upon in the term sheet are met, the parties usually undertake to draft, negotiate an execute binding definitive agreements.

Transmission: The transfer of electricity over a group of interconnected lines and associated equipment between the points of supply and the points at which it is transformed for delivery to customers or to other electric systems.

Transmission Facility Owner (TFO): The term used by regulatory agencies to describe an electric transmission system wire owner.

Transmission System (electric): An interconnected group of electric transmission lines and associated equipment for moving or transferring electricity in bulk between points of supply and points at which it is transformed for delivery over the distribution system lines to customers or is delivered to other electric systems.

Virtual Power Purchase Agreement: See "Financial Power Purchase Agreement"

Alberta Wholesale Market: The market in which bulk electric energy in Alberta is sold to market participants for resale to end-users. Also referred to as the "Power Pool"

Wire Owner (WO): Term used by regulatory agencies to describe an electric distribution system wire owner.

Wire Service Provider (WSP): The organization given the authority to operate certain functions relating to the operations and maintenance (O&M) of an electric distribution system for a wire owner, as defined in the Electric Utilities Act.

MEASUREMENT UNITS AND ABBREVIATIONS

Celsius (C): A unit of temperature. Water freezes at 0 C and boils at 100 C (at sea level).

Gigajoule (GJ): One billion joules.

Gigawatt (GW): One billion watts.

Hectare (ha): A unit of land area equal to 10,000 sq. m. (1 ha = 2.5 acres)

Joule (J): A unit of energy equivalent to the work done by a force of one Newton pushing on an object for one metre.

Kilogram (kg): A unit of mass. (1 kg = 2.2 pounds)

Kilojoule (kJ): One thousand joules.

Kilometre (km): One thousand metres. (1 km = 0.6 miles)

Kilotonne (kt): One thousand tonnes.

Kilovolt (kV): One thousand volts.

Kilowatt (kW): One thousand watts.

Megajoule (MJ): One million joules.

Megatonne (Mt): One million tonnes.

Megawatt (MW): One million watts.

Metre (m): A unit of distance. (1 m = 39 inches)

Tonne (t): One thousand kilograms; also called a metric ton.

Volt (V): A unit of electric potential or electromotive force between two points on a conducting wire. Commonly referred to as the unit of electric charge.

Watt (W): A unit of power equal to one joule of energy per second. It measures the rate of energy conversion. A typical household incandescent light bulb uses electric energy at a rate of 25–100 W.

Watt hour (W-h): A unit of electric energy equal to one watt of electric power used steadily for one hour.

APPENDIX A

Renewable Energy Capital and O&M Costs

Renewable Energy Capital Cost Comparison

The tables below provide a range of installed costs and maintenance and operations costs associated with each renewable energy technology from aggregated industry data and are subject to changes. Most technologies also have levelized costs of energy curves that have been steadily decreasing over time.

Technology	Total Capital Cost ($USD/kW)
Solar PV – Rooftop Residential	$3,125–3,560
Solar PV – Rooftop C&I	$2,000–3,750
Solar PV – Community	$1,938–3,125
Solar PV – Crystalline Utility Scale	$1,375–1,100
Solar PV – Thin Film Utility Scale	$1,375–1,100
Solar Thermal Tower with Storage	$3,800–10,000
Geothermal	$4,000–6,400
Biomass Direct	$1,700–4,000
Wind – Onshore	$1,200–1,650

Source: Lazard[91]

Installation Type	Project Capacity (kW)	CanSIA Installed Cost ($CAD/kW)
Rooftop	6	$2,840
Rooftop	10	$2,750
Rooftop	100	$2,580
Rooftop	500	$2,400
Non-Rooftop	10	$2,580
Non-Rooftop	500	$2,270

Source: CanSIA[92]

[91] Lazard, Lazard's Levelized Cost of Energy Analysis – Version 11.0, November 2017. https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf

[92] Canadian Solar Industry Association, FIT/mFIT: 2017 Price Review, August 2, 2016. http://www.cansia.ca/uploads/7/2/5/1/72513707/160802_-_cansia_submission_re_2017_fit-mfit_price_review_vf_20.pdf

Renewable Energy Operation and Maintenance Costs

Technology	Fixed O&M ($USD / kW-year)	Variable O&M ($USD/ MW-h)
Solar PV – Rooftop Residential	$20–25	-
Solar PV – Rooftop C&I	$15–20	-
Solar PV – Community	$12–16	-
Solar PV – Crystalline Utility Scale	$9–12	-
Solar PV – Thin Film Utility Scale	$9–12	-
Solar Thermal Tower with Storage	$75–80	-
Geothermal	-	$30–40
Biomass Direct	$50	$10
Wind – Onshore	$30–40	-

Source: Lazard[91]

Unsubsidized Levelized Cost of Energy Comparison

Technology	Unsubsidized LCOE ($USD/MWh)
Solar PV – Rooftop Residential	$187–319
Solar PV – Rooftop C&I	$85–194
Solar PV – Community	$76–150
Solar PV – Crystalline Utility Scale	$46–53
Solar PV – Thin Film Utility Scale	$43–48
Solar Thermal Tower with Storage	$98–181
Geothermal	$77–117
Biomass Direct	$55–114
Wind – Onshore	$30–60

Source: Lazard[91]

Wind Power

Capital Costs Breakdown

Wind turbines (including towers and installation) are the main cost item in developing a wind project. The capital costs of a wind power project can be distilled into the following major categories:

> Turbine cost: rotor, blades, gearbox, generator, power converter, nacelle, tower and transformer

> Civil works: construction costs for site preparation and the foundations for the towers

> Grid connection costs: transformers and sub-stations, as well as the connection to the local distribution or transmission network

> Planning and project costs: can represent a significant proportion of total costs and include costs such as feasibility and development studies, legal fess, construction management, etc.

> Other capital costs: construction of roads, buildings, control systems, etc.

The table below outlines the capital costs breakdown across these categories.

Cost share of:	% of capital costs
Wind turbine	64–84%
Grid connection	9–14%
Construction	4–10%
Other capital	4–10%
Source: IRENA[93]	

[93] IRENA, Renewable Power Generation Costs in 2014, January 2015. https://www.irena.org/Document-Downloads/Publications/IRENA_RE_Power_Costs_2014_report.pdf

Solar PV

Capital Costs Breakdown

The capital cost of a PV system is composed of:

> PV module cost: interconnected array of PV cells

> Balance of System cost: structural system, electric system costs (e.g., inverter, transformer, wiring, etc.) and the soft costs of system development (e.g., feasibility, labour costs for installation, etc.).

The table below outlines the capital costs breakdown across these categories.

Cost share of:	% of capital costs
PV module (crystalline silicon)	60–80%
Balance of System	20–40%

Source: IRENA[93]

Hydropower

Capital Costs Breakdown

Hydropower is a capital-intensive technology with long lead times for development and construction due to the significant feasibility assessments, planning, design and civil engineering work required. There are three major cost components for hydropower projects:

> Civil works: hydropower plant construction, including any infrastructure development required to access the site and the project development costs

> Electro-mechanical equipment: costs related to electro-mechanical equipment

> Project development: planning and feasibility assessments, environmental impact analyses, licensing, fish and wildlife/biodiversity mitigation measures, development of recreational amenities, historical and archaeological mitigation, and water quality monitoring and mitigation. Due to the long lead times of hydro projects (7 to 9 years), this also includes a portion of costs due to the need for working capital and interest during construction.

The table below outlines the capital costs breakdown across these categories.

Cost share of:	% of capital costs
Civil works	30–40%
Electro-mechanical equipment	30–50%
Project development	10–30%

Source: IRENA[93]

Biomass

Capital Costs Breakdown

Technology options largely determine the cost and efficiency of biomass power generation equipment, although equipment costs for individual technologies can vary significantly, depending on the region, feedstock type and availability, and how much feedstock preparation or conversion happens on site. There are three major cost components for a biomass fired power generation project:

> Project development: design and engineering, project management and environmental assessment

> Storage and handling of biomass: fuel handling equipment, pre-treatment of biomass, storage for fuel and ash

> Main process equipment: boiler, turbine, electric systems, balance of plant

> Civil works: the building, as well as on-site roads.

The table below outlines the capital costs breakdown across these categories for a steam cycle biomass energy plant and a biogas plant.

Cost share of:	% of capital costs	
	Steam Cycle	Biogas
Project development	10%	10%
Storage and handling equipment	10%	20%
Main process equipment	60%	55%
Civil works	20%	15%

Source: International Finance Corporation[94]

[94] International Finance Corporation , Converting Biomass to Energy: A Guide for Developers and Investors, June 2017. https://www.ifc.org/wps/wcm/connect/7a1813bc-b6e8-4139-a7fc-cee8c5c61f64/BioMass_report_06+2017.pdf?MOD=AJPERES

Geothermal Power Generation

Capital Costs Breakdown

Geothermal power plants are capital-intensive, but they have very low and predictable running costs. The main costs of a geothermal power plant are composed of the following:

- Resource identification and evaluation: drilling of production and re-injection wells
- Field infrastructure: geothermal fluid collection and disposal system and other surface installations
- Power plant and its associated costs
- Project development
- Grid connection costs.

The table below outlines the capital costs breakdown across these categories for a geothermal project.

Cost share of:	% of capital costs
Resource identification and evaluation (including test well drilling)	6%
Drilling of production and injection wells	27%
Field infrastructure	9%
Power plant	58%
Source: Geothermal Energy Association[95]	

[95] Geothermal Energy Association , A Handbook on the Externalities, Employment, and Economics of Geothermal Energy, October 2006. http://www.geo-energy.org/reports/Socioeconomics%20Guide.pdf

APPENDIX B

Sample Business Plan Contents

Cover Page and Table of Contents

The business plan should start with a company name, legal address, email address, owners, and contact person. The table of contents should list the key sections of the business plan.

Executive Summary

The executive summary is a key component of the business plan that conveys clear and coherent message of the proposed venture. The summary is one-to-three pages and provides an overview of the business, the short-term and long-term goals and why the business would potentially succeed in the market.

Profile and History of Your Organization

This section describes the company's history or provides background information on how the project was thought of and developed. This section should showcase any significant company history, such as the development of any past renewable energy projects or other successful business ventures.

Business Model

The business model provides an overview of the project structure, technology, location, equipment and size of the project. The model will also identify key stakeholders involved in the project as well as their roles, percentage of ownership acquired, qualifications and their past experience with working on renewable energy projects. An organization structure can be provided in the appendices of the business plan.

The business model might include details about the following:

- a description of the project-technology, equipment, size, location, etc.
- the location of the business operations
- the business ownership, structure and investment
- management team and accountability
- the experience of the owners, management and other key personnel.

Financial Plan

The financial plan is one of the most important elements of the business plan. This section should provide information on the financial needs of the project, planned sources and timing of financing, and projections of its revenues, cash flow, and profits.

Financing can be sourced from a number of sources including equity contributions, grants, and loans.

A financial plan will also take financing costs such as debt and equity and sensitivity cost analysis into consideration.

Risk Management Plan

A risk management plan identifies all potential primary and secondary risks related to the project. The plan outlines how risk management activities will be performed and monitored throughout the entire lifecycle of the project until commercial operation. Once the risks have been identified, a contingency plan must be provided in order to minimize those risks in the future.

Marketing Plan

The marketing plan outlines the marketing strategy and how a business would attract customers to its products or services to a level that would ensure the success of the business. For a renewable energy project, the customer could be a buyer of the renewable energy, or of the environmental attributes. This section can also be used to describe what is being offered and why it is an attractive project for the financing community and/or for the community.

Operations Plan

The operations plan should provide information on issues that may arise through the day-to-day operations of the renewable energy project, such as:

- equipment needed
- staffing requirements
- qualifications and training required for staff
- maintenance and operational requirements and responsibilities (e.g. internal staff, external third party maintenance provider, or operator)
- contingency plan for major repairs and equipment replacement.

Implementation Timeline

The implementation timeline charts out how the project will progress to commercial operation. It provides a road map of the specific actions, timing and responsibilities for each activity needed to move the project forward towards being a commercial operation.

Appendices

The appendices should be referenced in the main sections of the business plan and may contain documentation and other supplementary materials that strengthen the business plan. Examples of appendices include engineering diagrams and reports, approvals documentation, partnership agreements, management biographies, or any other supporting documents that help the reader in understanding the business plan. It should also be noted that the business plan is a living document, and should evolve and grow as new opportunities, or issues, are identified. The size and complexity of the project will determine the amount of detail needed within the business plan.

Source: Adapted from Independent Electricity System Operator[96] and Commission for Environmental Cooperation[97]

[96] Independent Electricity System Operator, Indigenous Relations – Developing a Renewable Energy Project. http://www.ieso.ca/get-involved/indigenous-relations/renewable-energy-in-ontario

[97] Commission for Environmental Cooperation, March 2010, Guide to Developing a Community Renewable Energy Project in North America.

APPENDIX C

Project Developer Questionnaire

These questions can be asked during preliminary discussions with a Proposed Partner ("Partner") and before a presentation to council or an investment committee to provide context and obtain a sense of developers motivations and relevant experience.

Partner Name:

Project Name:

Abbreviated names:

Note: include/reference all supporting documents

Issue	Status	Responsible	Comments and Applicable Supporting Documents
1. Full legal names and contact information of all potential partners, all principles, directors and officers as well as any parties who brokered introduction ("Key Parties")			
2. Partner Objectives Examples: > obtain access to markets that they may not otherwise have > increase access to natural resources such as minerals or forestry > obtain access to the particular aboriginal groups' business > gain access to a larger aboriginal market > gain access to government set-aside programs > gain access to government grants > direct financial investment from the aboriginal partner			

Issue	Status	Responsible	Comments and Applicable Supporting Documents
3. Past experience the community or councillors/ advisors have with Key Parties (if any)			
4. Partner management expertise/experience			
5. Nature of proposed project			
6. Other dealings with First Nations or Indige-nous groups in Canada or abroad (and list)			

APPENDIX D

EPC Contractor Qualifications Checklist

EPC Contractor Organizational Qualifications Checklist

Trade Licences

- ☐ The EPC Contractor should have all professional and trade licences required to practise in Alberta.

Work History

- ☐ The EPC Contractor should have a successful track record of design and construction of similar type and scale projects, completed on time and on budget. At least 3 years company work experience in design, engineering and installation of commercial renewable energy systems. It may also be helpful if the EPC Contractor has experience working with or for First Nations or Métis communities or businesses.

Financial Solvency

- ☐ The EPC Contractor should have the financial resources to successfully complete the project and to meet all warranty obligations. This can be shown through documentation such as audited financial statements, bank references and supplier references.

Health and Safety

- ☐ The EPC Contractor should have and maintain a health and safety manual that establishes appropriate rules and procedures concerning workplace safety, including rules related to: reporting health and safety problems, injuries and unsafe conditions; risk assessment; and first aid and emergency response.

Insurance

- ☐ An EPC Contractor must maintain appropriate levels of insurance relative to project scale, complexity and associated risk. This coverage should include the following:
- ☐ Commercial general liability (CGL) insurance
- ☐ CGL umbrella policy
- ☐ Professional liability insurance, also known as errors and omissions (E&O) insurance
- ☐ Property insurance (builder's risk), written on an "all-risks" structure and replacement cost basis; alternatively, this may be covered under the Developer's coverage, depending on the specific arrangement between parties
- ☐ Commercial vehicle insurance

- Workers compensation insurance
- Insurance policies should name the developer or owner and any intermediaries as additional insured(s) and certificate holder(s). Legal agreements between the Developer/Owner and EPC Contractor should require additional insured specification.

EPC Performance Security

- Surety bonds, or performance bonds, are typically provided by an insurance company) to back the performance of the EPC Contractor and ensure that the construction project is completed even if the EPC Contractor goes bankrupt.
- Payment bonds are insurance that ensures that subcontractors get paid even if the EPC Contractor goes bankrupt, and thus there are no liens against the facility upon completion.

EPC Engineer Insurance

- Insurance requirements for project engineers should be relative to the scale and scope of the project, but should include at least the following:
- Professional liability (E&O) insurance
- Commercial general liability insurance
- Commercial vehicle insurance
- Workers compensation insurance
- Insurance policies should name the Developer/Owner and any intermediaries as additional insured(s) and certificate holder(s).

Defined Quality Management Plan

- The EPC Contractor shall have a quality management plan that includes all elements of the company's customer service policy and other quality assurance practices. The plan should be distributed to all company employees and contain a Quality Manual, as defined by International Organization for Standardization (ISO) 9001:2008, which includes documented statements of a quality policy and quality objectives.

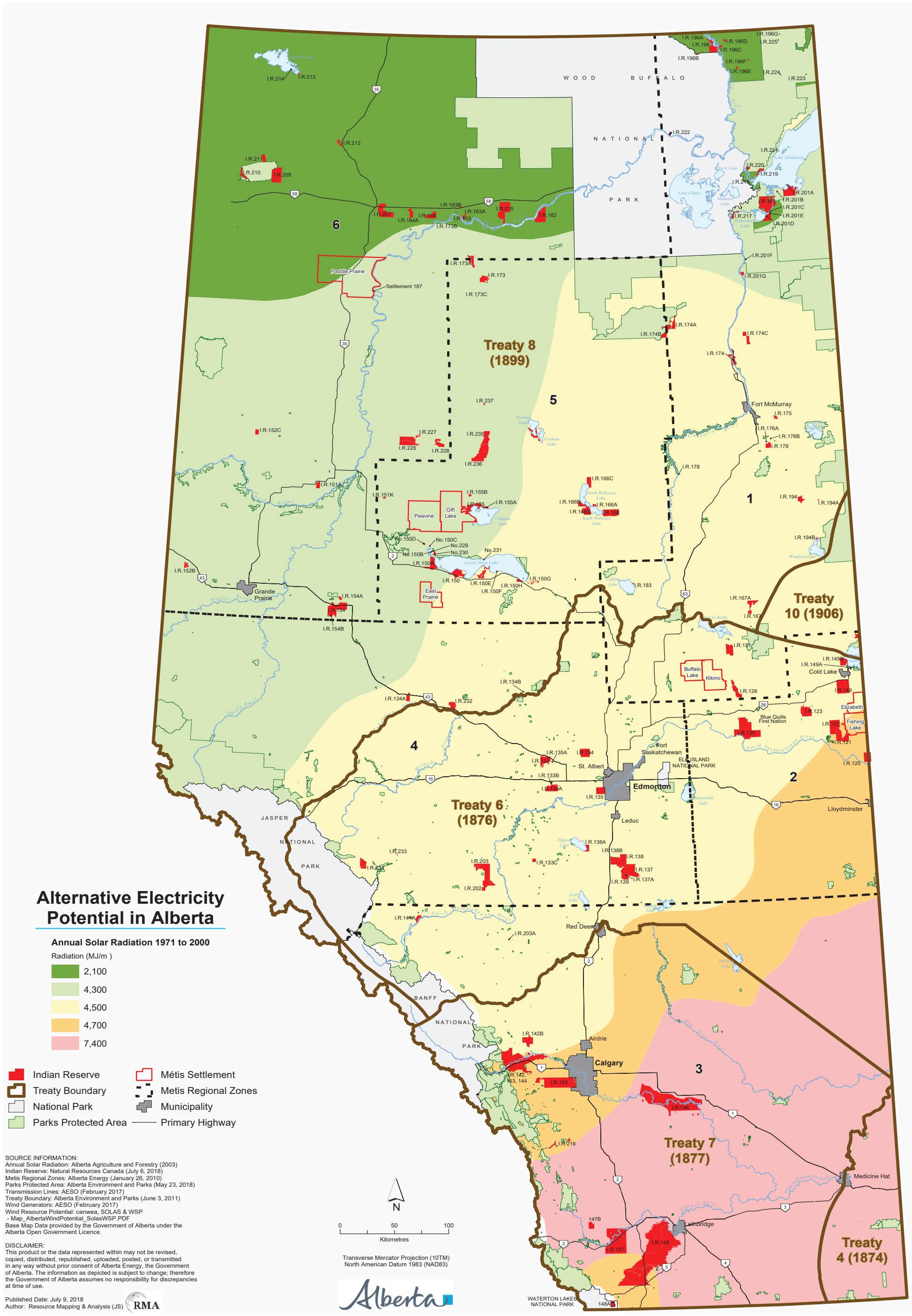
Source: Adapted from National Renewable Energy Laboratory [97]

[97] Alberta National Renewable Energy Laboratory, Best Practices in Commercial and Industrial (C&I) Solar Photovoltaic System Installation, December 2015. https://www.nrel.gov/docs/fy16osti/65286.pdf

APPENDIX E

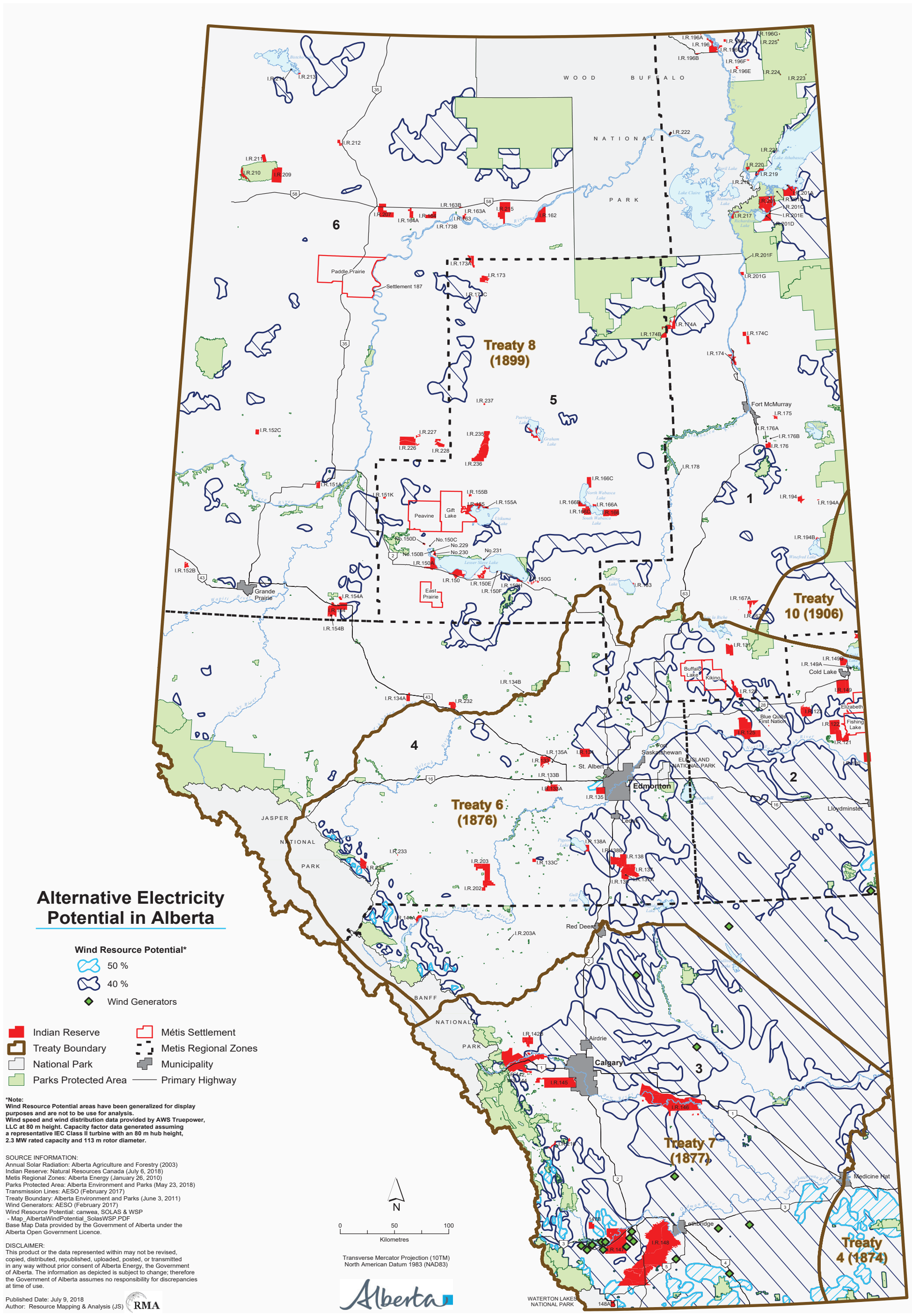
Renewable Energy Resource Maps

Solar Potential in Alberta



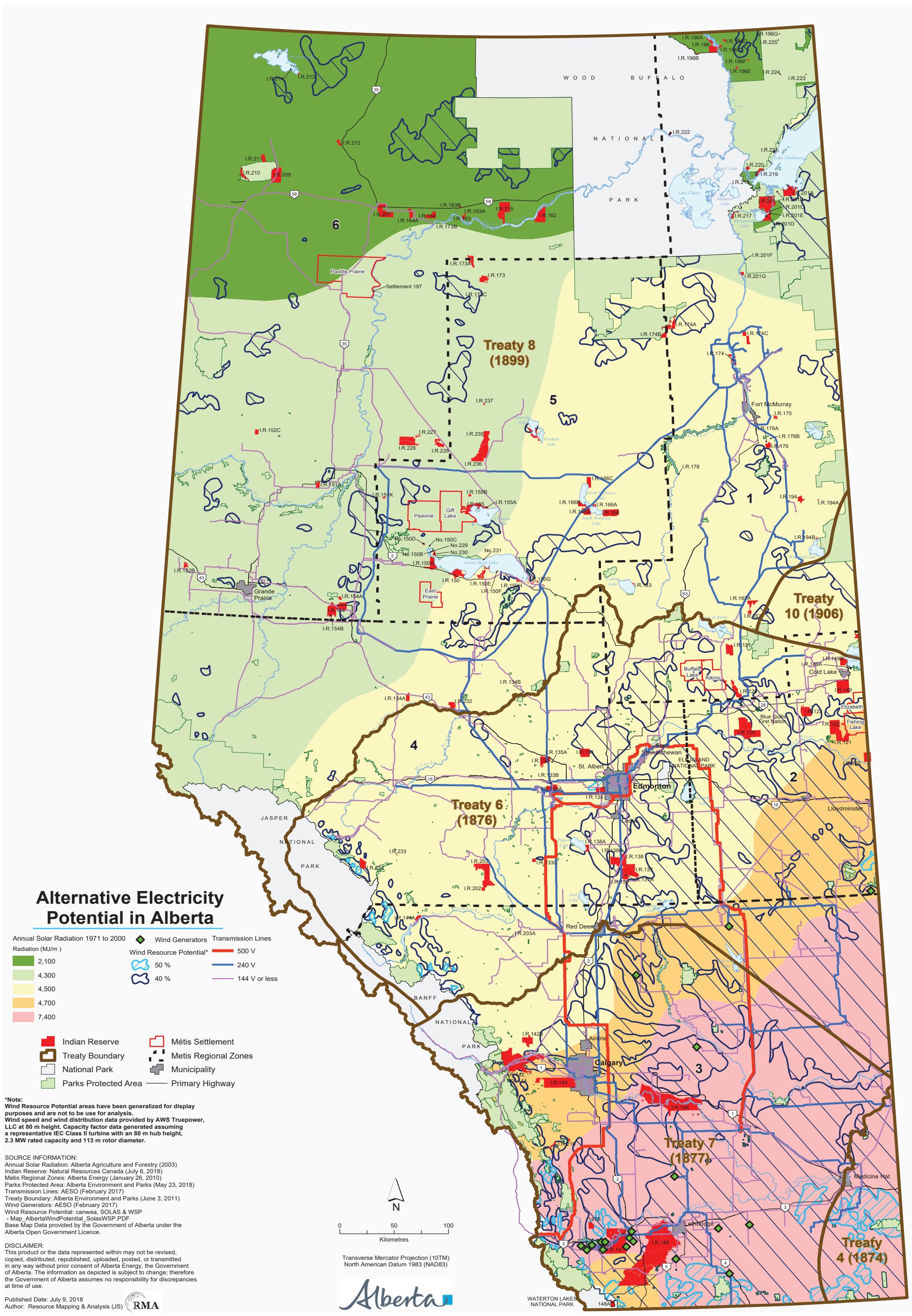
Alberta Energy, 2018, Solar Electricity Potential in Alberta.

Wind Potential in Alberta



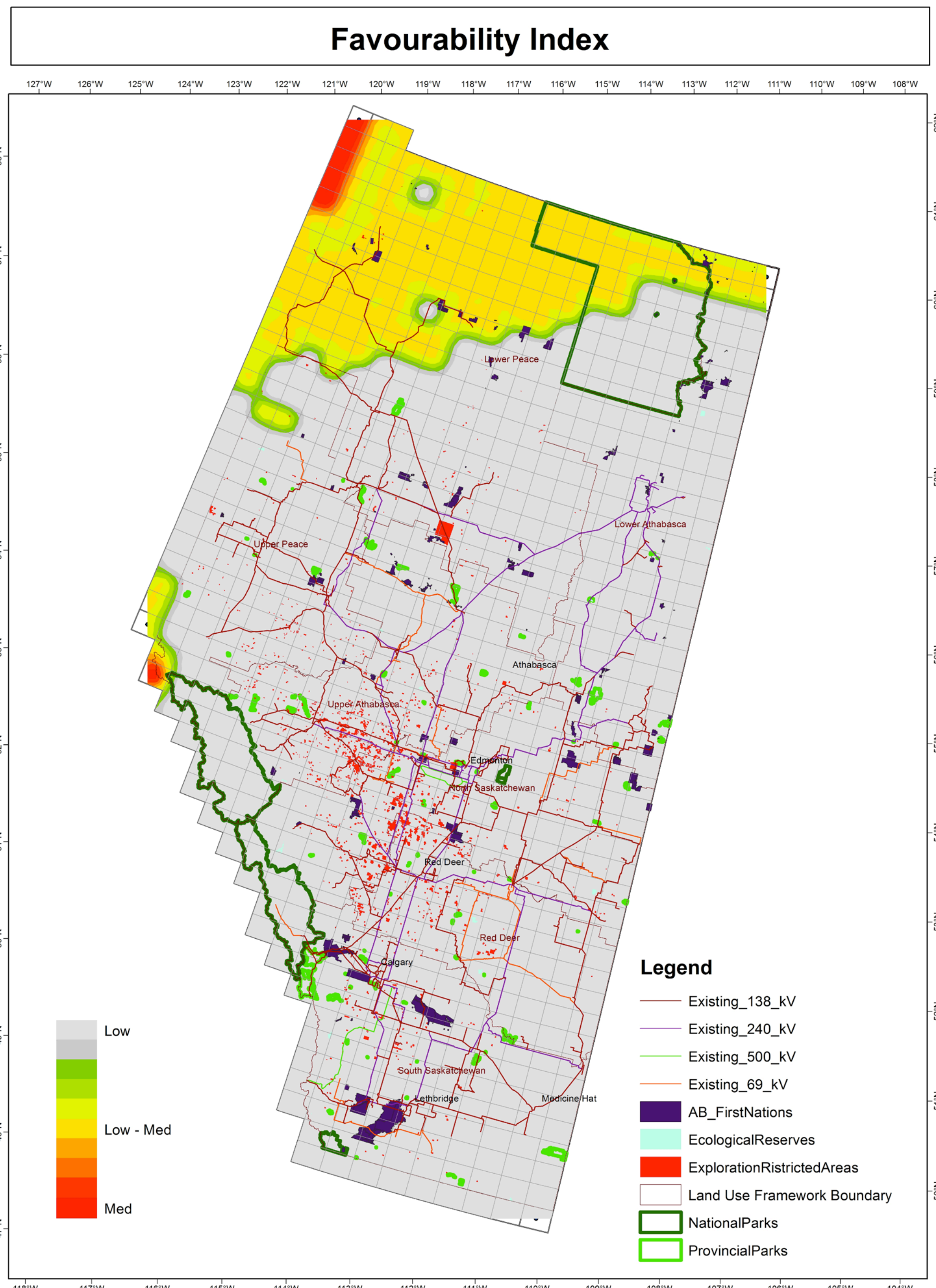
Alberta Energy, 2018, Wind Electricity Potential in Alberta.

Alternative Electricity Potential in Alberta



Alberta Energy, 2018, Alternative Electricity Potential in Alberta.

Geothermal Potential in Alberta

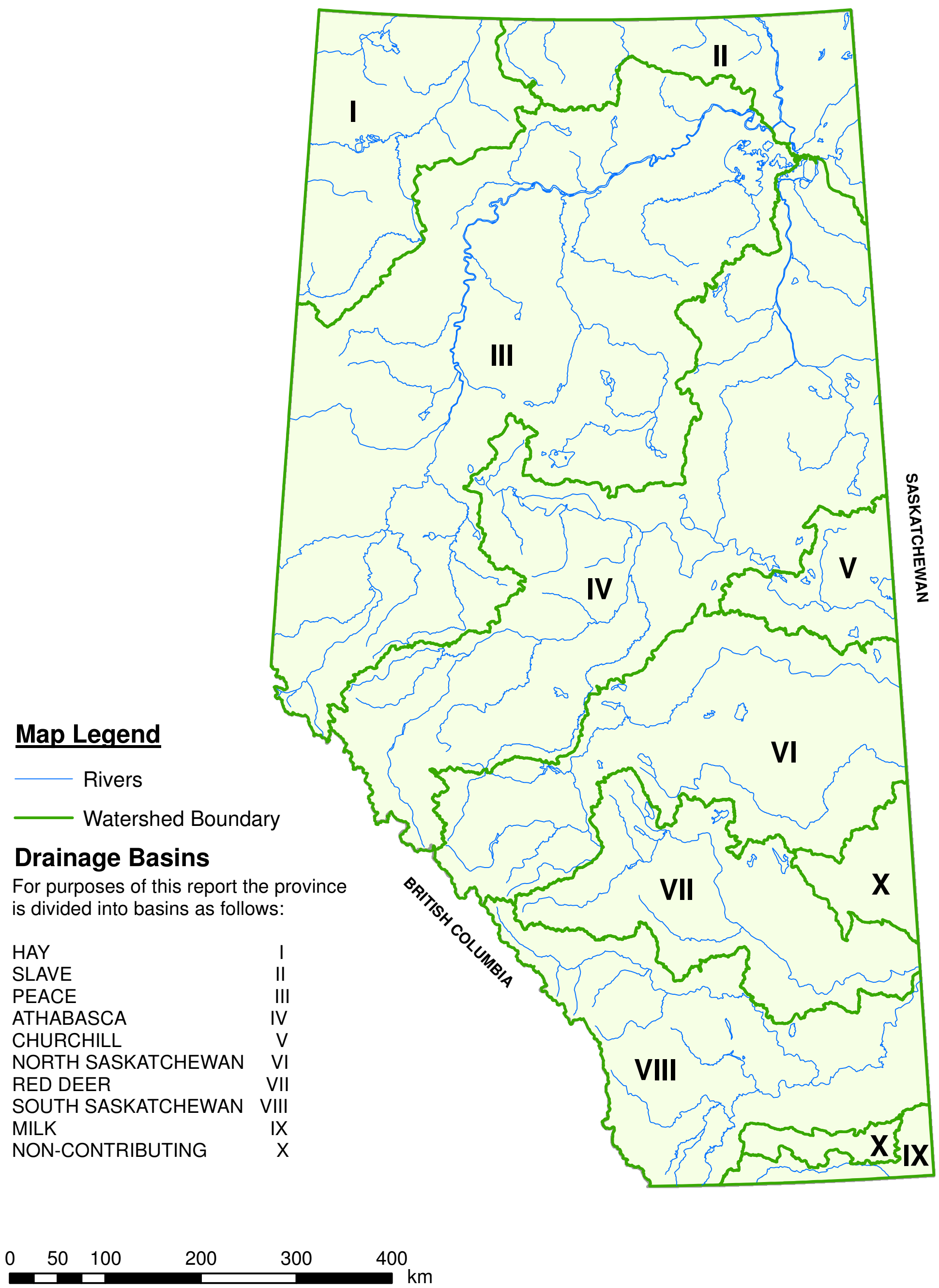


Canadian Geothermal Energy Association, 2010, Favourability Index.

Biomass Potential in Alberta

Alberta Innovates, 2016, Biomass Cover.

Hydroelectric Potential in Alberta



Hatch, Final Report for Alberta Utilities Commision: Update on Alberta's Hydroelectric Energy Resources, February 26, 2010.

APPENDIX F

Prefeasibility Study Checklist

Prefeasibility Study Checklist

Identification of Project Opportunity

- ◻ Description of the project

Potential technical concepts:

  - ◻ Characterization of resource potential
  - ◻ Interconnection strategy

Preliminary legal assessment of site:

  - ◻ Barriers to land rights
  - ◻ Necessary site approvals
  - ◻ Initial agreements for site control

- ◻ Expected energy production
- ◻ Preliminary project design
- ◻ Preliminary assessment of energy sales (if applicable)
- ◻ Insurance policies should name the Developer/Owner and any intermediaries as additional insured(s) and certificate holder(s)

Risk Assessment

Site Risk:

  - ◻ Preliminary assessment of site characteristics such as topography, drainage characteristics, flood zones, groundwater, etc.
  - ◻ Preliminary assessment of site constructability and any potential ongoing operation and maintenance issues of the site
  - ◻ Preliminary assessment of capacity and ability to connect to the grid

Environmental, Historical, Cultural or Permitting Risks:

  - ◻ Preliminary environmental assessment
  - ◻ Preliminary assessment of permits and licensing requirements
  - ◻ Historic, cultural or archeological site assessment

Finance:

  - ◻ Preliminary revenue model / financial analysis
  - ◻ Preliminary assessment of construction costs
  - ◻ Preliminary assessment of operating costs

APPENDIX G

Renewable Energy Training and Employment Programs

Renewable Energy Training

Reflecting the growing importance of renewable energy globally, in Canada, and in Alberta, there is an increased interest in renewable energy courses, and training being offered by universities, colleges, industry associations, and nongovernmental organizations. These training opportunities provide the necessary knowledge and skills needed to succeed.

The renewable energy industry employs a wide range of professionals with a great variety of knowledge and skills. The range includes those involved in research of materials, parts, systems, and resource assessment; and in manufacturing, design, installation, sales, and operation and maintenance of the systems and their components.

The industry also requires an array of skills associated with general aspects of a business enterprise, such as sales, financing, data processing and human resources management.

The following provides a list of the training programs currently available in Alberta. However, this is in no way and exhaustive list, and we do not have firsthand experience with any of them. The listing here is not an endorsement, and you should look into any training in detail before making a decision.

Community Colleges and Industry led Training

- GridWorks: 1, 3, 5 day solar PV courses
- Iron and Earth: Solar Skills training
- Lethbridge College: Wind Turbine Technician program
- Lakeland College: Renewable Energy & Conservation Certificate
- Northern Lights College: Wind Turbine Technician and Solar Thermal Installer
- Canadian Solar Institute: 2,5 day solar PV, and 3 day small wind turbine workshops
- Green Arrow Corp. Akamihk: First nation owned renewable energy company, provides solar installation training

Technology Institutes

- NAIT: Alternative Energy Technology two-year diploma
- SAIT: Green Building Technologies

Universities

- University of Calgary: Masters in Sustainable Energy Development

Industry Associations

- Canada Green Building Council: Green buildings and energy efficiency including PV
- Decentralised Energy Canada (DEC): DEC training and education
- Women in Renewable Energy: Seminars and networking events
- Solar Energy Society of Alberta: Seminars and classes

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Alberta Government