



# DISTRIBUTED GENERATION

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## 1.0 Distributed Generation Basics

### 1.1 What is Distributed Generation?

Distributed generation (or DG) generally refers to small-scale (typically 1 kW – 50 MW) electric power generators that produce electricity at a site close to customers or that are tied to an electric distribution system. Distributed generators include, but are not limited to synchronous generators, induction generators, reciprocating engines, microturbines (combustion turbines that run on high-energy fossil fuels such as oil, propane, natural gas, gasoline or diesel), combustion gas turbines, fuel cells, solar photovoltaics, and wind turbines.

### 1.2 Applications of Distributed Generating Systems

There are many reasons a customer may choose to install a distributed generator. DG can be used to generate a customer's entire electricity supply; for peak shaving (generating a portion of a customer's electricity onsite to reduce the amount of electricity purchased during peak price periods); for standby or emergency generation (as a backup to Wires Owner's power supply); as a green power source (using renewable technology); or for increased reliability. In some remote locations, DG can be less costly as it eliminates the need for expensive construction of distribution and/or transmission lines.

### 1.3 Benefits of Distributed Generating Systems

Distributed Generation:

- Has a lower capital cost because of the small size of the DG (although the investment cost per kVA of a DG can be much higher than that of a large power plant).
- May reduce the need for large infrastructure construction or upgrades because the DG can be constructed at the load location.
- If the DG provides power for local use, it may reduce pressure on distribution and transmission lines.
- With some technologies, produces zero or near-zero pollutant emissions over its useful life (not taking into consideration pollutant emissions over the entire product lifecycle ie. pollution produced during the manufacturing, or after decommissioning of the DG system).
- With some technologies such as solar or wind, it is a form of renewable energy.

- Can increase power reliability as back-up or stand-by power to customers.
- Offers customers a choice in meeting their energy needs.

#### 1.4 Challenges associated with Distributed Generating Systems

- There are no uniform national interconnection standards addressing safety, power quality and reliability for small distributed generation systems.
- The current process for interconnection is not standardized among provinces.
- Interconnection may involve communication with several different organizations
- The environmental regulations and permit process that have been developed for larger distributed generation projects make some DG projects uneconomical.
- Contractual barriers exist such as liability insurance requirements, fees and charges, and extensive paperwork.

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## 2.0 Deregulated Power in Alberta

### 2.1 Basic Information on Deregulation

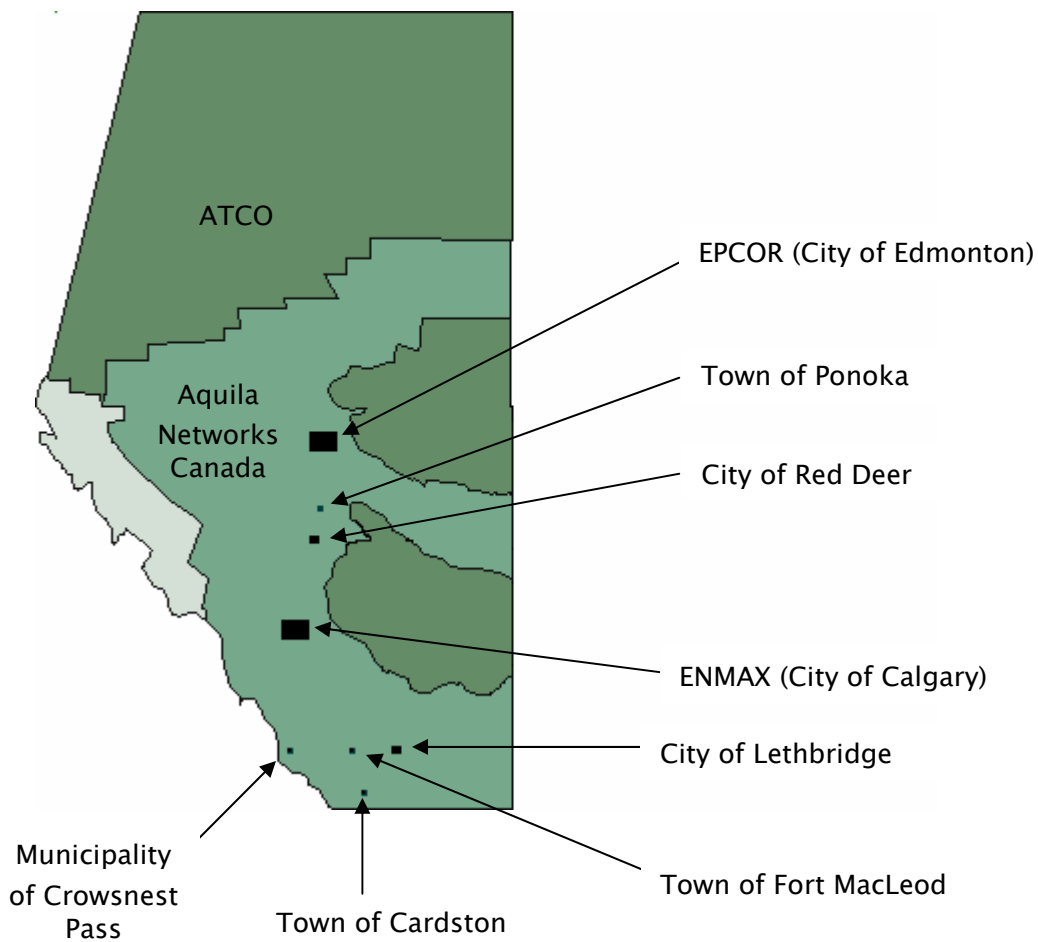
The restructuring of the electricity industry in Alberta has split the industry into three components: electricity generation, which is now *deregulated*; Transmission and Distribution of electricity, which is still *regulated*; and electricity retail, which is now *deregulated*.

Power generated in Alberta is sold through the Power Pool of Alberta, a not-for-profit organization established in 1995 under the Electric Utilities Act that provides an open-access competitive market for electricity. The Power Pool of Alberta co-ordinates all electricity sales and purchases in the province, as well as all energy imports and exports; it also provides real-time control of the provincial electricity grid. Power Pool participants are companies or organizations that trade electricity through the Power Pool. Eligible participants include power producers and importers, retail buyers, self-retailers, exporters and other unique entities. This includes power generators, consumers and marketers. Power producers may include small or independent power generators and any electricity producer wishing to provide energy into the Alberta system and receive the real-time spot market price for the energy.

Because the transmission and distribution of electricity throughout Alberta has not been deregulated, the actual "wires" and associated facilities that bring electricity to homes and businesses continue to be operated as a public utility by their existing owners. Wires in Alberta are owned by 2 private utilities (ATCO Electric and Aquila Networks Canada), 8 municipally-owned utilities (EPCOR – City of Edmonton, ENMAX – City of Calgary, City of Red Deer, City of Lethbridge, Town of Cardston, Town of Fort MacLeod, Town of Ponoka and Municipality of Crowsnest Pass), and more than 100 rural electrification associations. At this time, an independent Transmission Administrator

created by the Electric Utilities Act is responsible for the administration of the province-wide transmission grid. This Transmission Administrator oversees the use of the transmission system to ensure the safe, reliable operation of the system, and to ensure that access to the transmission system is available on a non-discriminatory basis to all market participants who pay a common rate.

In order to connect a distributed generation system to the grid, the customer must apply to the utility (or utilities) that owns the wires in their area (now called a Wires Owner). See the map below for a general idea of which Wires Owner to contact in your region. The DG owner must also register with the Power Pool of Alberta and apply to the Alberta Energy and Utilities Board for approval. (See Section 5.0 for connection details).



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## 3.0 Technical Information

### 3.1 Safety Issues

Several issues relating to the safety of DG systems are a concern for EPCOR Utilities Inc.

- Islanding

Islanding occurs when a DG system is still generating power to the distribution system when the main breaker from the Wires Owner is open. In this case, the DG system would be the sole supplier of electricity to the distribution system. This is a concern for several reasons.

- i. **Safety concern for system maintenance**

If the Wires Owner's line workers are not aware that the DG system is still running, they may be electrocuted working on the line or other equipment connected to the line.

- ii. **Equipment damage to other Wires Owners customers**

If the DG is still generating while the main breaker from the wire owner is open, the voltage and the waveform from the DG may fluctuate and may not meet the acceptable standard. Existing customers who are connected to the distribution line are then fed by very poor quality of power from the DG. As a result, their light fixtures, motors and other electric equipment may be damaged or its life may be shortened. If the situation persists unnoticed for an unacceptably long time, a fire hazard may exist.

- iii. **Damage to the DG owner's generator**

If the DG is still generating while the main breaker from the wires owner is open, the DG equipment may be damaged when the wires owner's main breaker is closed due to closing out of synchronism.

To ensure the safety of a DG system, EPCOR recommends contracting with an experienced professional engineer registered with APEGGA (Association of Professional Engineers, Geologists and Geophysicists of Alberta) for the design and installation of the system. They will ensure the system is in compliance with provincial and national guidelines and the interconnection guidelines provided by the wires owner.

### 3.2 Power Quality

- Power quality is important because many electric devices and appliances are designed to function at a specific voltage and frequency. In North America, AC (alternating current) power is delivered at 120 and 240 Volts and 60 Hz (cycles per second). If power is not delivered properly, it may result in appliance malfunction or damage. In the worst situation, fire hazard is a possibility.

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## **4.0 EPCOR's Contributions**

### **4.1 Research at the University of Alberta**

EPCOR is currently a partner in sponsorship of a distributed generation research project at the University of Alberta. The project is looking at reducing anti-islanding costs to enable small independent power producers to tie small generators onto distribution systems more cost-effectively. Successful results from this research will promote use of small alternate energy sources by reducing cost barriers.

### **4.2 Active Member of Outside Committees**

- i. A group in Alberta that includes representatives from ENMAX, EPCOR, ATCO Electric, the City of Calgary, the Canadian Standards Association, the Alberta Government Safety Service Department, Electrical Inspectors, and the DG industry are reviewing the Canadian Electrical Code with the purpose of modifying it to reduce some of the challenges of interconnection while maintaining stringent safety requirements. Aquila Networks Canada has shown interest in reviewing the final recommendations. Once recommendations are made, they must be submitted to provincial and national bodies for review, debate and approval before any changes can be accepted.
- ii. EPCOR is participating on Micro-Power Connect, a cross-Canada committee sponsored by Natural Resources Canada, CanMET Energy Technology Centre-Varenes, with representation from Electro-Federation Canada, the Standards Council of Canada, the Canadian Standards Association, utilities and the DG industry across Canada. This committee is identifying and resolving barriers to the connection of DG to the distribution system. This committee is currently in the process of writing a cross-Canada guideline for interconnection for micro-power generators.
- iii. EPCOR has been a member of many provincial committees on distributed generation, including a technical committee. The technical committee produced two technical documents that are posted on the Department of Energy website.
- iv. EPCOR has posted two documents of its own that define its requirements for the interconnection of DG systems. These documents are "Application Guide for Power Producers - *Interconnection of Generators to EDI's Distribution System*" and "Technical Guideline for Interconnection of Generators to the Distribution System." These documents are currently posted on the EPCOR Distribution and Transmission website:

[www.epcor.ca/EPCOR+Companies/EPCOR+Distribution+and+Transmission/Distributed+Generation+Information/Application+Guide+for+Power+Producers.htm](http://www.epcor.ca/EPCOR+Companies/EPCOR+Distribution+and+Transmission/Distributed+Generation+Information/Application+Guide+for+Power+Producers.htm) OR  
[www.epcor.com/EPCOR+Companies/EPCOR+Distribution+and+Transmission/Edmonton+Distribution+Services/Distributed+Generation+Information/Technical+Guideline+for+Interconnection+of+Generators+to+the+Distribution+System.htm](http://www.epcor.com/EPCOR+Companies/EPCOR+Distribution+and+Transmission/Edmonton+Distribution+Services/Distributed+Generation+Information/Technical+Guideline+for+Interconnection+of+Generators+to+the+Distribution+System.htm)

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## 5.0 Get Connected - How to Get Grid-Tied

Below are some tips on getting your DG system up and running. This list is not a complete step-by-step instruction guide, rather it gives a general idea of whom to talk to and where to get started. The procedures may differ with different wires owners and different generation systems.

### 5.1 Communicate with your Electrical Wires Company (called the Wires Owner)

- i. Determine which utility is the Wires Owner in your area (see map in Section 2.0)
- ii. Ask the Wires Owner for their interconnection guidelines and application form. The interconnection document is very technical. This also has a list of steps that you can take in getting your system design accepted by the Wires Owner so you can proceed with its installation. As DG is a highly technical specialized area, you should have a professional engineer or engineering firm assist you in the development of the DG system.
- iii. Check with APEGGA (the Association of Professional Engineers, Geologists and Geophysicists of Alberta) on the requirements of a professional engineer to design the system and to approve the design and the drawings.
- iv. Complete the wires owner's application to connect to their distribution wires.
- v. In EPCOR's distribution service area, see EPCOR's interconnection guides for contact information (interconnection guides can be found online – Section 4.2iv)

### 5.2 Communicate with the Alberta Energy and Utilities Board (EUB)

Website: [www.eub.gov.ab.ca](http://www.eub.gov.ab.ca)

- i. Complete the EUB small generator application form (FORM GB-2000-03: "Application for a Small Generator (less than 1 MW))"

This can be downloaded from the EUB website:

Address: <http://www.eub.gov.ab.ca/BBS/requirements/ils/gbs/gb2000-03.htm>

OR: From the EUB homepage following these links:

- Rules, Regulations, Requirements
- Information Letters, Interim Directives, General Bulletins
- General Bulletins
- GB-2000-03 New EUB Application Form for Small Electric Generators

Note: this form requires that an agreement be reached with the interconnecting Wires Owner

The form also requires several supporting documents:

- ii. Plant site plot plan and single line diagram: This drawing is also required for communication with the wires owner and the professional engineer who designs your DG system. It must show your house on your lot, where the service entrance (meter) is, and where the generator will be.
- iii. Do a Noise Impact Assessment as per EUB document ID 99-8 "Noise Control Directive".

This can be downloaded from the EUB website:

Address: <http://www.eub.gov.ab.ca/BBS/requirements/ils/ids/id99-08.htm>

OR: From the EUB homepage following these links:

- Rules, Regulations, Requirements
- Information Letters, Interim Directives, General Bulletins
- Interim Directives
- ID-99-08 Noise Control Directive

- iv. Conduct a Public Involvement Program in accordance with EUB Document IL 89-04 "Public Involvement in the Development of Energy Resources".

This can be downloaded from the EUB website:

Address: <http://www.eub.gov.ab.ca/BBS/requirements/ils/ils/il89-04.htm>

OR: From the EUB homepage following these links:

- Rules, Regulations, Requirements
- Information Letters, Interim Directives, General Bulletins
- Information Letters
- IL 89-04 Public Involvement in the Development of Energy Resources

### **5.3 Get your system installed and inspected for electrical safety**

- i. Since deregulation, some electrical inspections in Alberta are done by private companies and some by municipal Wires Owners. A list of agencies contracted by Alberta Municipal Affairs that do electrical inspections can be obtained by contacting the Municipal Affairs office. Other agencies can be found under Inspection Services in the Yellow Pages.
- ii. Contact your Wires Owner to determine whether you have adequately met their requirements. If so, you will receive permission to interconnect to the electrical system.

### **5.4 Communicate with the Power Pool of Alberta <[www.powerpool.ab.ca](http://www.powerpool.ab.ca)>**

- i. Electricity exported to the grid from a DG system must be measured. Electricity from small DG systems is usually not large enough to warrant separate metering

- ii. Running your meter backwards is called "net metering" and is not legal in Alberta. The DG industry is working with the government and Wires Owners on resolving metering issues. Contact the wire owner in the area your DG is located in and they will advise you on the type of metering allowed.
- iii. To sell electricity in Alberta, you must sell it to the Power Pool of Alberta, and so you must be a participant in the Pool. This has a fee of \$150 + GST per year as of 2002.
- iv. Sales of electricity require an interval meter and purchase of metering services from a company called a "meter data manager" who reads your meter.
- v. If your DG system is more than 25 kW in generating capacity, or if you have several DG systems that together total more than 150 kW of generating capacity, you are required to install interval metering regardless of whether you sell the excess to the Pool.
- vi. Since deregulation, retail sales of electrical meters for distributed generation energy supplied to the grid have been privatized and meters are no longer automatically supplied by utilities. The utility offers distributed generation metering as an optional service, and meters can also be purchased from private companies found under "Meters" in the Yellow Pages. However, metering the power delivered from the grid to the distributed generation site remains a wire owner responsibility.
- vii. You also need to provide metering information to the Load Settlement Agent responsible for your service area. The Power Pool of Alberta will be able to direct you to the appropriate Load Settlement Agent.
- viii. Please check with the Power Pool of Alberta to determine if there are any further requirements.