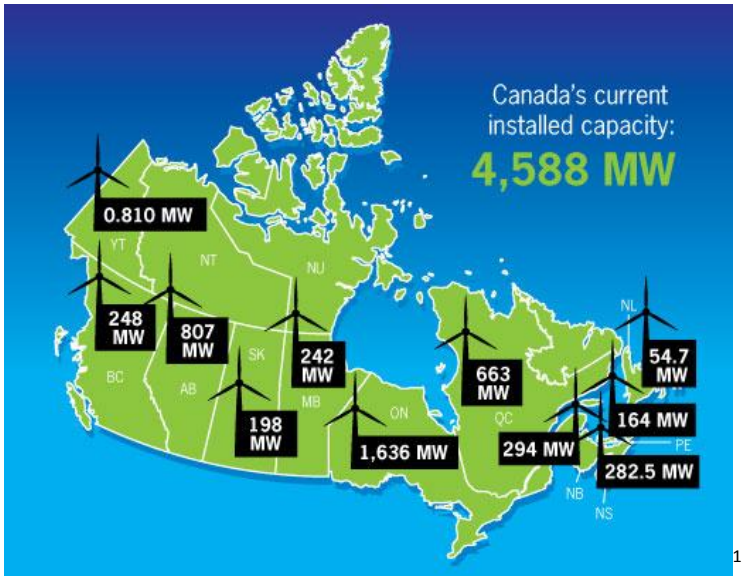
# A Green Sector Overview

## Utility Scale Wind

Wind turbines are a common site in many European countries – Denmark, for example, generates 20% of its electrical supply from wind energy. Lower production costs, technical improvements in reliability and productivity, and the increasing cost of traditional sources of energy (oil and gas) have driven the expansion of wind energy production in Canada. Since 2000, actual installed capacity of wind energy has increased from 137 MW to 4,588 MW.

Along with this increase in generation capacity, the physical size of wind turbines has increased dramatically since 1980. For a 1.8 MW turbine (typical for a wind farm in Canada) there are four main large components: the nacelle (63,000 kg), turbine blades (39 m long), turbine tower (65 m tall and 132,000 kg), and foundation (9-10 m deep and 4 m across).



[1]

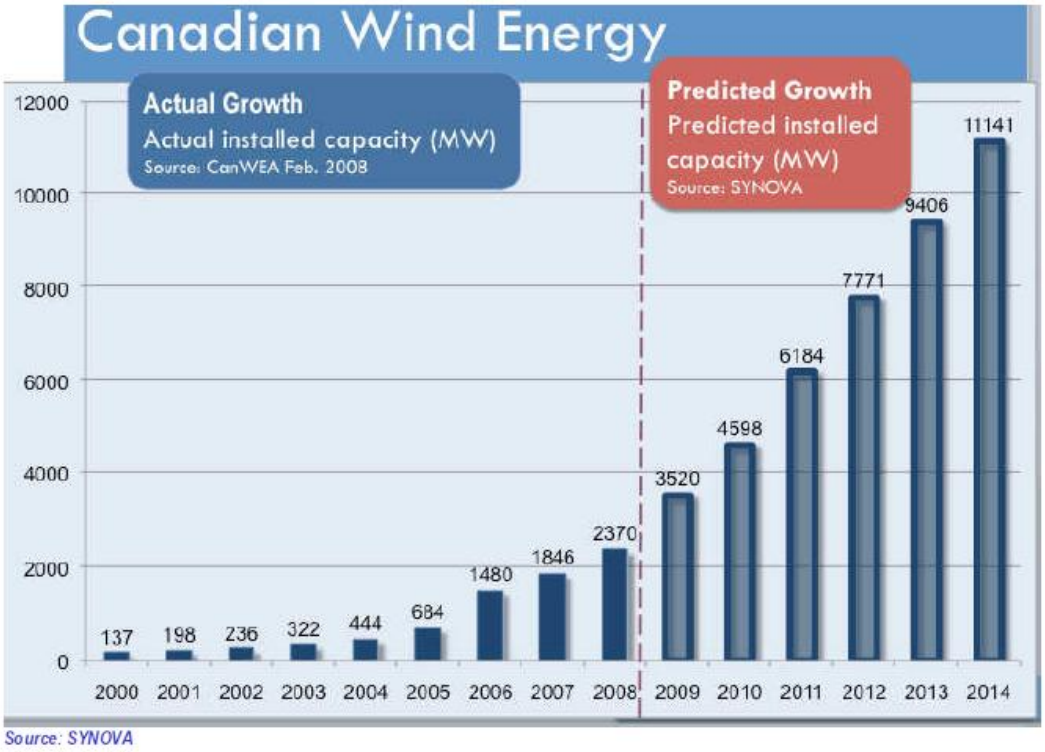
As opposed to some small wind turbines (those with a capacity of less than 300 kW), utility scale wind farms connect directly to the electrical grid and can generate enough electricity to power thousands of homes. A typical modern wind turbine can power approximately 500 homes and wind farms in Ontario can consist of more than 50 individual turbines.

Even with their immense size, the installed cost for large wind turbines per kW produced is one of the lowest among renewable energy generation technologies. The total cost of a large scale wind farm ranges from $2.20 to $2.80 per Watt of generating capacity, with the turbine making up approximately 70-75% of the cost.

[1] From Canadian Wind Energy Association, www.canwea.ca

## The Market

Modern utility scale wind turbine technology originated in Europe and has improved over the past two decades to the point that these large turbines are considered a commercially proven, investment grade product. Globally, the large wind turbine industry has experienced annual growth rates of 20-25% over the past several years and this has attracted interest from major corporations, such as GE, Seimens, and Samsung. Growth in North America has also been strong. The Canadian Wind Energy Association believes that wind energy could potentially supply up to 20% of Canada's electricity requirements. With this potential for growth, the manufacturing of large wind turbines for the North American market has begun to move here from Europe as markets are becoming more stable.




Utility scale wind development can be pursued with either corporate or community-based business models. While most wind projects in Ontario are corporately owned, a number of government programs have made a number of community-based and cooperative initiatives feasible. As of April 2011, the Ontario Power Authority (OPA) had executed over 50 wind energy contracts, which has resulted in the development of over 2,000 MW of wind energy. In the most recent Ontario Minister of Energy's *Supply Mix Directive* to the OPA, the Minister calls for 10,700 MW of renewable energy generation (excluding hydroelectric) of which the majority will come from utility scale wind projects.

## Participants

Ontario is beginning to establish a foothold in the wind turbine manufacturing and service industries. In general, the utility scale wind industry is dominated by a few very large firms while the majority of companies have less than 10 employees and focus their activity on operations and technical work. A 2008 survey of Canadian wind industry organizations found that 53% of companies have less than $1 million in annual revenue.

Manufacturing and assembly of the turbines makes up approximately 70-75% of the total cost of a large wind project. The remaining costs come from engineering, site service, construction, and maintenance. As domestic content requirements for wind projects rise it will be necessary to establish a stable and predictable environment that is capable of supporting a wind turbine supply chain and is also within striking distance of large US markets. Utility scale wind turbine manufacturing also requires heavy industry capabilities such as forging, casting, and machine components weighing five tonnes and up. Manufacturing these large parts and coordinating it within the overall supply chain requires regional expertise in engineering and logistics. Because several main components of wind turbines are so large, there are significant advantages to locating manufacturing facilities near potential wind farm sites.

With the increasing capacity in Ontario for wind power generation, there are new opportunities for local manufacturers to supply large turbine components – tower sections, rotor blades, nacelle assemblies, and covers. The high cost of transporting these parts, coupled with government pressure to create local manufacturing jobs, further supports the establishment of local manufacturing centres. Other business opportunities could develop from the need for engineering, construction, and ongoing services.

## *Green Energy and Green Economy Act*

The *Green Energy and Green Economy Act (GEA*) established a Feed-In-Tariff (FIT) for electricity produced from wind and other renewable energy sources. The FIT prices are intended to provide investors a reasonable financial return over a 20-year period, support the development of renewable energy generation, and create jobs in Ontario.

The program is divided into two streams – FIT and microFIT. The FIT program is for renewable energy projects that generate more than 10 kW. Small projects (less than 10kW) fall into the microFIT stream, which aims to encourage small businesses and homeowners to engage in renewable energy projects. Both the FIT and microFIT programs offer 20-year fixed-price contracts at 13.5 cents/kWh for electricity generated from on-shore wind projects. Off-shore wind projects have a feed-in-tariff of 19.0 cents/kWh; however, in 2011 a moratorium was placed on the development of off-shore wind projects due to a lack of scientific data on the effects of wind turbines on fresh water resources.

**Pricing and Uptake**

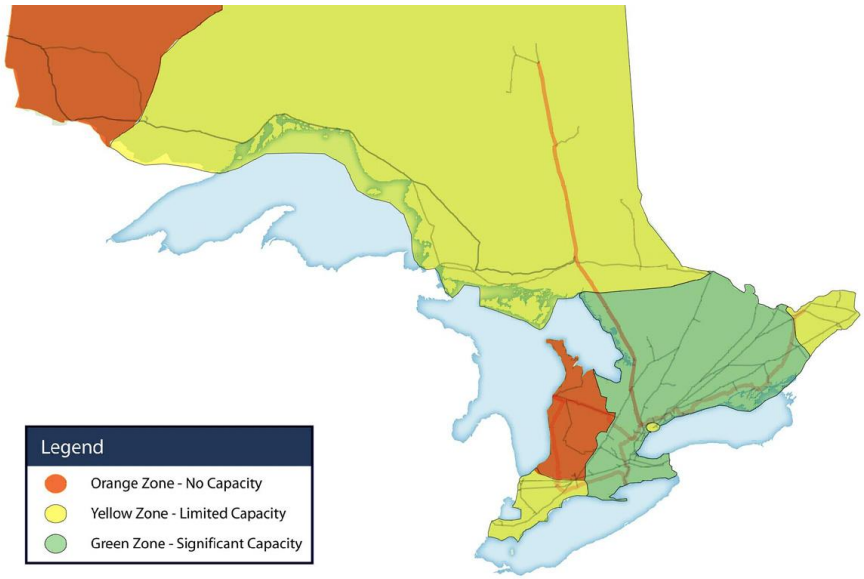
Some participants in the wind industry see the *GEA* as having a pro-solar bias. This stems from the discrepancy in FIT and microFIT prices between wind and solar. Regardless of size, wind projects receive a price of 13.5 cents/kWh while solar projects can receive a price as high as 80.2 cents/kWh. At this point, only large scale wind projects have had success under the *GEA*. As of April 1, 2011, the FIT program has received 260 applications for wind projects. Of these applications, 61 contracts have been offered, 56 contracts executed, and one project is in commercial operation.

There is a lengthy lead time for project development under the *GEA* – an average of three years for wind projects. This is due to what many renewable energy companies see as an onerous amount of paperwork and bureaucracy associated with the FIT program. The process for obtaining a FIT or microFIT contract involves receiving approvals from the Ontario Energy Board (OEB), the Local Distribution Company (LDC), Electrical Safety Authority (ESA), and Independent Electrical System Operator. This list does not include other local permits and public consultation requirements that may exist.

**Transmission Capacity**

Another issue that could potentially limit the growth of the wind industry in Ontario is the capacity restraints of the current electrical grid system. Due to restrictions at some transmission stations in Southern Ontario, many renewable energy projects that were granted conditional contract offers from the Ontario Power Authority (OPA) have not been able to connect. Therefore, the process for applying to the OPA has been revised so that new project proponents must receive confirmation of available transmission capacity from the LDC before submitting an application to the OPA.

The issue of transmission capacity is of particular interest to the wind industry in the Midwestern Ontario region. Currently the province has been divided into three zones based on the amount of available transmission capacity. In the Green Zone there is significant capacity, the Yellow Zone has limited capacity, and the Orange Zone has no capacity. In the Orange Zone, which covers much of Midwestern Ontario, only micro-projects (<10 kW) and farm-based bio-energy generation projects are accepted.




www.powerauthority.on.ca

**Domestic Content Requirements**

In an attempt to drive job creation in the renewable energy sector, the GEA includes domestic content requirements for all renewable energy projects under the FIT program. This means that project developers are required to source a certain percentage of their project costs from Ontario goods and labour at the time they reach commercial operation.

For wind projects greater than 10 kW, the domestic content required will increase from 25% to 50% on January 1, 2012. The OPA has provided a Domestic Content Grid to identify how much each activity of a project's development can contribute. For example, wind turbine blades cast in Ontario and instrumentation within the blades that has been assembled in Ontario is worth 16%, while construction costs and on-site labour performed by individuals who are residents of Ontario is worth 15%. The complete Domestic Content Grid for wind projects can be found on the FIT program website (www.fit.powerauthority.on.ca).

## Other Government Programs

To encourage local ownership of renewable energy projects under the FIT program, the OPA and the Government of Ontario initiated the **Community Energy Partnerships Program (CEPP)**. The grant program assists community power projects with funding support of up to $200,000. This funding opportunity helps cover the early stage soft costs of renewable energy projects. The program is divided into two grants. The first applies to project design and development activities, such as site planning, environmental and regulatory analysis, and business plan development. The second part of the program applies to regulatory approvals, such as renewable energy approval, Electrical Safety Authority (ESA) approval, and project management.

Also administered by the OPA are the **Aboriginal Renewable Energy Fund (AREF)** and the **Municipal Renewable Energy Program (MREP)**. The AREF and MREP will assist Aboriginal communities and municipalities, respectively, in covering a portion of project costs associated with developing a renewable energy project.

The Federal Government provides for a 50% **Capital Cost Allowance (CCA) for Renewable Energy** projects. Corporations can write off the capital cost of a wind turbine system against other revenue resulting in attractive tax consequences. Individuals and businesses can only claim CCA up to the amount of income generated from the wind turbine system. Once the CCA is used, they will have to pay tax on income generated from the system.

## Key Success Factors

In most areas of Ontario there are enough wind resources to support large wind projects with the exception of some inland areas away from the Great Lakes. There is generally enough wind to produce electricity 70 percent of the time and wind tends to blow the strongest in high power demand seasons (winter).

In an effort to create a successful renewable energy program, the Ontario government reviewed programs from other countries to develop the *GEA*. Three key success factors were identified:

i. High investment stability guaranteed by the long-term FIT
ii. An appropriate framework with low administrative and regulatory barriers
iii. Relatively favourable grid access conditions

Judging by the number of initial applications received by the OPA at the 20 year FIT rate of 13.5 cents/kWh, the market is indicating approval for utility scale wind. The Renewable Energy Approval (REA) process has streamlined the environmental and local approval process. The process is clearly defined and there are relatively aggressive timelines for the approval process.

Project development for large wind farms has become a critical factor in determining their success. The typical life cycle of a grid-connected wind farm can be broken down into three phases. The first is the project development phase, which can take between one and three years to complete and contributes approximately $1million to the project's total cost. This phase involves identifying a suitable site, setting up a project team, conducting feasibility studies, and obtaining necessary approvals.

The second phase is construction, which makes up the majority of the project's cost – for a typical wind farm the cost of manufacturing and construction may be in the $50 - $70 million range. This phase lasts approximately one year and includes turbine and tower manufacturing, site construction, transportation and craning, installation, and grid connection. The final phase is power generation, which is expected to

last for at least 20 years. The turbine manufacturer usually offers a "worry free" maintenance contract for the first five years of operation and independent service companies take over the maintenance for the remainder of the wind farm's life. Standard service can include oil change, periodic maintenance, and blade and component repair.

Government programs have provided the impetus for many wind energy developments, but they can also present obstacles to a project's success. In a survey of organizations involved in the wind industry, the FIT program, incentives for renewable power generation, and domestic content requirements were seen as positive government initiatives. However other initiatives, such as trade missions, technology transfer funding, and legislation governing greenhouse gas emissions were viewed as ineffective in helping to establish the wind industry.

A number of other factors are driving the development of the wind industry. These include more environmentally-aware consumers, the perception of wind energy as clean and reliable, and the increasing costs of non-renewable energy sources – whereas the cost of electricity generation is stable over the lifetime of a wind turbine and there are no fluctuating fuel costs.

## Labour Market

It is anticipated that over the next 6 years, 16,000 jobs could be created in construction, installation, operation, and maintenance of renewable energy projects, as well as direct employment in manufacturing. Estimates suggest that utility scale wind requires approximately 10-15 jobs per annual MW of generated electricity. Historical employment data suggests that the majority of employment is in the manufacturing and installation of wind turbines, with approximately one quarter of wind industry employment split between operations and exporting. There is demand for specific skills with special knowledge in the following areas:

**Engineering:** Civil and geotechnical engineers are required for foundation design, tower design, and load and dynamic analysis. Electrical engineers are required for grid impact and power quality studies. Upgrades to the electrical grid are a major need for all forms of renewable power. The necessary upgrades represent a potential investment of up to $2.3 billion over the next several years and would generate significant employment. As such, electrical and power engineers are key fields where skilled labour shortages may exist. Mechanical, electronics, and control engineers are other skilled jobs required by the wind industry.

The University of Western Ontario (UWO), located in the Midwestern Ontario Region, is a global leader in wind engineering. Current research at UWO is focusing on designing transmission and wind turbine towers that can deal with local storm systems, as well as improving the efficiency of wind turbines by reducing model uncertainty. There are opportunities at UWO to deliver training for wind turbine and electrical technicians and certification for new wind and solar products.

**Project Development:** A number of skills and jobs are required related to the project development of wind farms. Legal, financial, and insurance services are three key areas where knowledge is required. Facilitation of public meetings and community consultations are other key skills that are required in the development of large wind projects.

**Manufacturing and Construction:** Employment in heavy industries is required for the manufacturing and assembly of large wind turbine parts. These occupations include machinists, machine fitters, and tooling inspectors. Construction jobs are also required to build access roads for transportation and during the

installation of the turbines. Two specific skill requirements related to the construction of wind farms are excavators and industrial electricians.

**Operations and Maintenance:** While the majority of jobs in the wind industry are in the manufacturing and construction of turbines, a number of skills are needed during the power generating life of a turbine. Process engineering, quality assurance, project management, and specialist technicians are some of the skills likely to be in demand. Labour will also be required for the service, maintenance, and repair of wind turbines throughout their life. St. Lawrence College in Kingston Ontario offers a diploma program for Wind Turbine Technicians. The program provides hands-on experience of the electrical and mechanical aspects of wind turbines. Other skills include fibreglass repair, electronics, instrumentation, and computer applications.

**Research:** A number of studies are required before the installation of a wind farm can begin. As such, growth in the wind industry will create a demand for a number of research and technology skills. During the site selection and environmental assessment stages, geologists and biologists are required. For off-shore projects marine biologists and technology workers with expertise in marine design are required.

## Regulatory Considerations

Approvals for grid connection are required from:

- Ontario Energy Board
- Local Distribution Company
- Independent Electrical System Operator
- Electrical Safety Authority

Other approvals may be required depending on a variety of conditions such as wind turbine size and location:

- Renewable Energy Approval
- Ministry of Natural Resources
- Ministry of the Environment
- Ministry of Transportation
- Ministry of Culture
- Local Conservation Authority

Consultation may be required from the following sources:

- Public/Community
- Municipalities
- Aboriginal Communities

Federal agency notification and adherence to guidelines may be required from:

- Canadian Broadcast Corporation
- Royal Canadian Mounted Police
- Transport Canada
- Fisheries and Oceans Canada
- Environment Canada
- Parks Canada
- Natural Resources Canada
- Canadian Environmental Assessment Agency

## Social and Environmental Considerations

The utility wind industry currently faces vocal opposition in rural areas[2]. The requirement that turbines be setback 550 metres from residential buildings is the main point of contention. Opponents are concerned about low-frequency noise, the impact on real estate values, and the possible health impacts of living near wind turbines, and believe there has been a lack of transparency and consultation with planners to determine that setback distance.

Public participation has been another major issue that is fuelling the opposition to utility scale wind turbines. A number of recommendations to improve communication in the public consultation process have been made, including considering a context-specific approach to determining turbine setbacks. There is near unanimous agreement that revisions to the community consultation process are required. The establishment of a neutral conflict resolution body could be one method to facilitate dialog between renewable energy stakeholders.

Another suggested action to improve public participation in the wind industry is to provide more opportunities for community-owned projects. This gives community members a greater opportunity to see the benefits of wind power projects and may provide an incentive to undertake more rigorous feasibility studies.

Finally, while wind turbines have a relatively small environmental footprint (compared to other renewable and non-renewable energy sources), a Renewable Energy Approval (REA) is required by the Ministry of Energy for all turbines greater than 3 kW. The REA outlines requirements for turbine specifications, location, and other environmental regulations.

## Risks

Much uncertainty exists around Ontario's FIT program and the *GEA* in general. The threat of policy reversals, continual changes in the FIT program, and poor communication between project proponents, the OPA, and other stakeholders are some of the major concerns of renewable energy companies.

Transmission capacity in rural areas is a major barrier to grid connection and can significantly increase a wind project's cost and development time. The province's Orange Zone for renewable energy, which covers much of Midwestern Ontario, limits the options for utility scale wind projects until improvements to the electrical grid are completed.

Domestic content requirements for wind projects will be increasing in the coming years and meeting these requirements will call for investments in local wind turbine manufacturing and skills training for wind turbine technicians and installers. This issue is compounded by a World Trade Organization challenge posed to Canada by Japan. The challenge argues that the domestic content requirements in the *GEA* have erected unfair trade barriers. This challenge has created uncertainty amongst investors regarding the future of manufacturing in Ontario for renewable energy industries.

The finance and insurance industries do not yet fully understand the renewable energy generation market. This has made it difficult for some companies to obtain project financing and insurance at appropriate rates. In addition, there is further uncertainty related to taxation as rules have not been

[2] Of the 57 chapters of the anti-wind group *Wind Concerns Ontario*, 53 are based in areas with populations under 400,000.

made that deal with questions of farm succession and property tax assessments. There are also questions surrounding how insurance companies will address issues of liability on renewable energy projects. Developing a strong relationship with a financial institution that has some experience with renewable energy financing is an important aspect for any renewable energy company.

## Industry Outlook

Ontario is undertaking an ambitious program of expansion and renewal of the province's transmission facilities. Twenty transmission projects, as well as investments into the distribution network, are underway to ensure there is enough capability for renewable generation resulting from the *GEA* and FIT program. Planning for six core transmission network upgrades are moving forward, including North-South lines from Sudbury to Barrie and Barrie to the Greater Toronto Area, and an East-West line from Nipigon to Wawa. Hydro One is currently adding 1,500 MW of additional transmission capacity between the Bruce and Milton. The projects represent a potential investment of approximately $2.3 billion over the next three years, and are expected to result in up to 20,000 jobs.

As of March 2010, 70 percent of FIT applications, in terms of generating capacity, were related to wind projects. The OPA is continuing to review applications and will give priority to “shovel-ready” projects as more capacity becomes available. However, addressing the issue of growing opposition to wind farms in rural areas may be the most important factor for the wind industry in the short term. Robert Hornung, President of the Canadian Wind Energy Association, suggested as much when he stated that the wind industry must address how to “more effectively engage communities, more effectively engage municipal leaders, [and] work toward making sure discussions at the community level are full, frank, and well-informed”.

In the long term, investments will be needed in marketing, skills training, and research and development. Some of the most advanced wind turbine research in the world is being conducted in Ontario and this innovation will help to establish the region as a major player in the global wind industry.

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