# The Economic Impacts of the Wind Energy Sector in Ontario 2011-2018

May 27, 2011

Prepared by ClearSky Advisors Inc.



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# 1 Executive Summary

## 1.1 Key Highlights

The wind energy sector in Ontario will generate a significant amount of both electricity and economic activity over the course of 2011 through 2018. Specifically, during this timeframe, the sector is expected to:

- Install over 5.6 GW of wind energy capacity, bringing Ontario's total wind energy capacity to 7.1 GW by 2018;
- Create 80,328 job years (Person-Years of Employment or PYE);
- Attract $16.4billion of private investments of which $8.5billion will be invested locally in Ontario; this investment is entirely private investment, and is only to be paid back upon the production of power over the lifespan of the turbines; and
- Contribute more than $1.1billion of revenue to local Ontario municipalities and landowners in the form of taxes and lease payments over the 20-year lifespan of projects installed in 2011 - 2018.

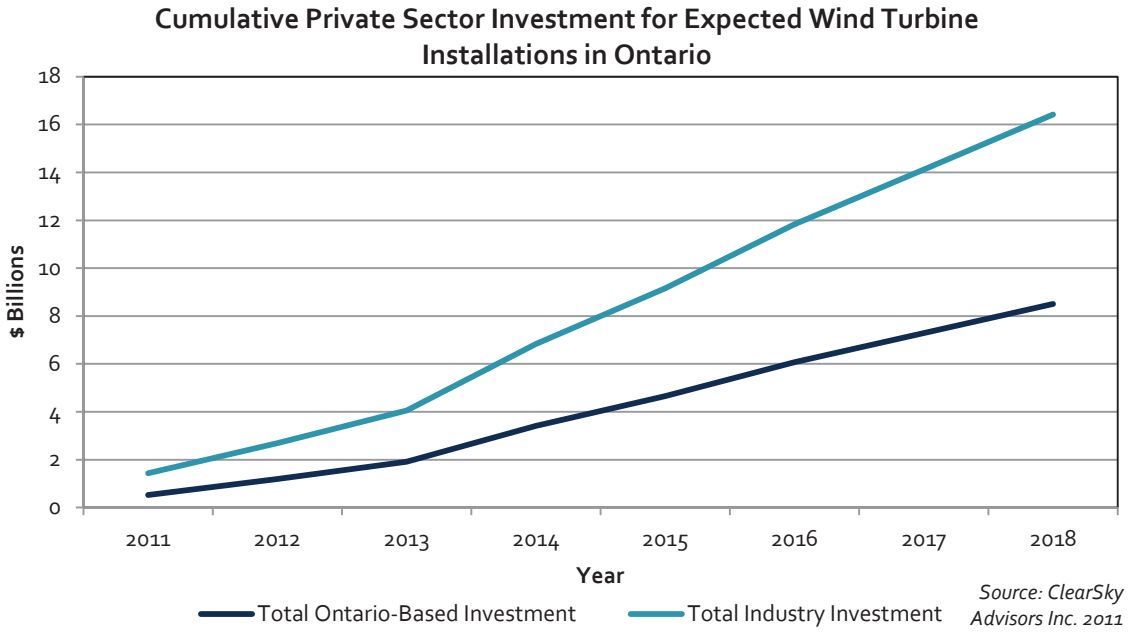



Figure 1.1: Cumulative Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

Of the over 5.6 GW of wind energy capacity installed from 2011 to 2018:

- On average 709 MW will be installed per year; and
- The market will have a capacity for up to 900 – 1,000 MW of installations per year.

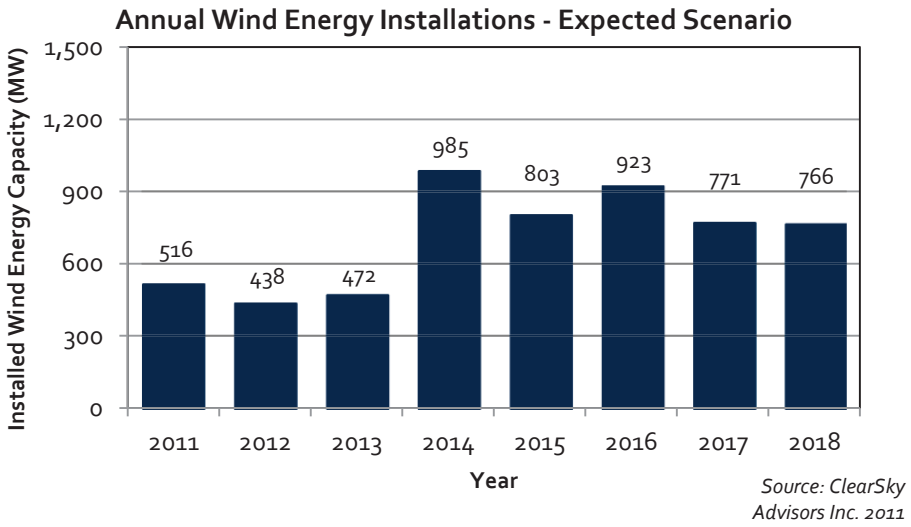



Figure 1.2: Annual Wind Energy Installations in Ontario (in MW), Expected Scenario (2011-2018)

The $1.1billion of revenue to local Ontario municipalities will be paid out over the 20-year lifespan of projects and will consist of:

- Over $1billion in lease payments paid to landowners
- Over $145million in taxation paid to local municipalities

The 80,328 PYE corresponds to 14.1 PYE per MW of nameplate capacity, split between:

- 10.5 PYE per MW in the construction phase; and
- 3.6 PYE per MW for ongoing operations and maintenance.

Note: These figures are ONLY for the projects forecast for installation in 2011 through 2018. The actual number of jobs is likely to be higher because no jobs are included for export, pre-contract development, or any ongoing installations after 2018. Furthermore, we have only considered direct and indirect jobs and not induced jobs. Therefore, these numbers are conservative for all years. The drop-off in employment after 2017 would only occur if exports and continued project awards beyond 2018 did not materialize.

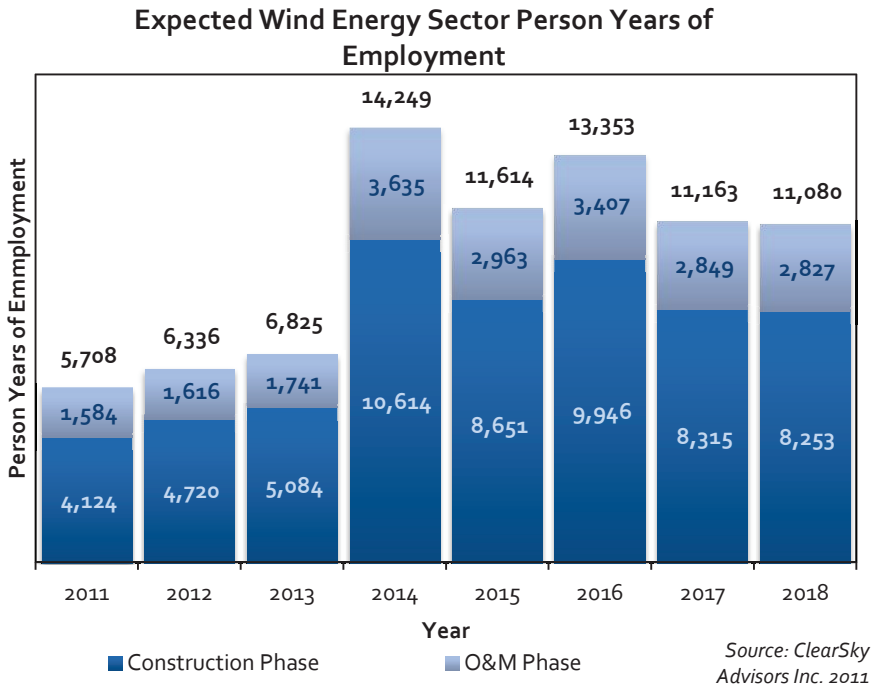



Figure 1.3: Person Years of Employment Created by the Wind Energy Sector in Ontario, Expected Scenario 2011-2018

To illustrate, for a sample 100 MW nameplate capacity wind energy generation project installed in Ontario:

Table 1.1: Summary of 100 MW Project Sample Costs, Benefits, and Employment

| 100 MW Project Sample Costs, Benefits, and Employment | | |
|---|---|---|
| **Expected Cost** | *Total Lifetime Cost (in 2011 $)* | $337,530,679 |
| | *Total 20 Year O&M Cost* | $68,501,669 |
| | *Total Expected Installation Cost* | $269,029,010 |
| **20 Year Economic Benefits to Landowners and Municipalities** | *Total 20 Year Economic Benefits* | $41,271,945 |
| | *20 Year Lease Payments* | $38,668,407 |
| | *20 Year Tax Payments* | $2,603,538 |
| **Expected PYE** | *Total* | 1,416 |
| | *Construction Phase* | 1,052 |
| | *O&M Phase* | 363 |

*Source: ClearSky Advisors 2011*

## 1.2 Methodology for Data Collection and Analysis

Primary data was collected through interviews with a wide range of industry stakeholders. In total, ClearSky Advisors conducted 43in-depth interviews to develop a comprehensive understanding of the economics of the wind energy sector in Ontario. Occasionally, the in-depth interviews would be complemented by emails to ensure that all necessary details were obtained from the interviewees. Overall, we interviewed:

- Large and small project developers, representing over 92% of the MW volume of connected projects and contracts offered to date;
- Leading independent engineering, construction, and consulting firms; and
- Manufacturers (both at the OEM and Tier 1 level), representing over 99% of the installed wind capacity in the province of Ontario.

The high rate of participation by interviewees in this study means that we are very comfortable that the data collected is representative of the current wind industry in Ontario.

In conjunction with the in-depth interviews, research from secondary resources was conducted to further inform interviews, cross-check interview findings, compare Ontario-based findings in a global perspective, and generally to enhance the understanding of the intricacies of the economics of the Ontario wind energy sector. Notable examples of secondary sources include:

- Publications by the Ontario Power Authority (OPA) including Ontario's Long-Term Energy Plan (LTEP), Integrated Power System Plan (IPSP) and quarterly updates;
- Peer-reviewed studies from academic sources and publications; and
- Statements and plans by the Ministry of Energy, IESO, and OPG.

Forecasts for job creation and ratepayer impact were generated through a ClearSky Advisors model that incorporates established and recognized 3rd party tools (Jobs and Economic Development Impact Model-W1.10.2)[1] with in-house modelling. Inputs for the model were taken from ClearSky Advisors' market modeling as well as trusted 3rd party sources. In particular, economic multipliers specific to Ontario were obtained from Statistics Canada, job creation data was taken from peer reviewed publications, and price data was taken from sources such as the Ontario Power Authority, Ontario's Ministry of Energy and Moody`s Investment Service. Cost data for fossil fuels includes environmental and health externalities where they have been quantified by either peer reviewed publications or government data. Given the controversy around including externalities, we have used conservative and verifiable estimates and identified where we have used them wherever possible. Additional costs for nuclear (including waste management and insurance) are not included.

Job creation outcomes are tailored to reflect domestic content requirements in the province and other characteristics of Ontario's Feed-in Tariff program. Person-years of employment (PYE) include only direct and indirect jobs (induced jobs would be additional to figures reported here).

[1] National Renewable Energy Laboratory (NREL), Jobs and Economic Development Impact (JEDI) Model.

# 2 Introduction

## 2.1 Background

The purpose of this study is to provide an understanding of the economic impact of Ontario's wind energy industry for the period 2011 – 2018. Specifically, the report considers the wind industry within the context of and parameters laid out by the Ontario Government in the Long Term Energy Plan (LTEP) that was released in November 2010. In the LTEP, the Ontario Government covers both demand for and supply of energy for the period 2011 to 2030, including the supply mix, conservation plans and the transmission system.

Based on the targets laid out in the LTEP, the wind energy industry is entering a period of strong growth. By 2018, the Ontario Government is targeting a wind energy generation capacity of 7.1 GW, a number that amounts to an almost five-fold increase from the capacity of 1,428 MW which was in-service at the end of 2010[2].

This study is concerned with quantifying the economic impacts of this growth from 2011 to 2018 on the Ontario economy and for a range of different stakeholders including:

- Wind energy project developers;
- Wind energy equipment design, supply and manufacturing firms;
- Construction and transportation firms;
- Job seekers;
- Municipalities and landowners that host wind farms; and
- Equity and debt providers.

The study was commissioned by the Canadian Wind Energy Association (CanWEA) and has been conducted by ClearSky Advisors on an independent basis. Our mandate has been to produce facts, analysis, and forecasts but not to offer any recommendations.

## 2.2 Scope

There are three primary areas of focus for this report:

1. Ontario wind energy market economics from 2011-2018
2. Ontario wind energy market labour forecast from 2011-2018
3. Job multipliers for both the construction and operations phases of wind energy projects in Ontario

Specifically, this report examines the following:

1. Ontario wind energy generation market economics from 2011-2018
    - Annual and total forecast (in MWh) for the Ontario electricity market;
    - Annual and total forecast (both in MW and dollar value) for the wind energy market in Ontario, including both the construction and operations phases;

[2] Ontario Power Authority. (2010). Progress Report on Electricity Supply, 4th Quarter 2010.

- Analysis of the market opportunity for each major service and supply segment during the construction phase as identified in the Ontario Power Authority's domestic content grid;
- Forecast for the annual and total value of the operations and maintenance market to support wind energy generation during the operations phase;
- Forecast for the share of the market to be captured by the Ontario supply and value chain; and
- Forecast for the dollar value of benefits to landowners and communities in Ontario.

2. Ontario wind energy generation market labour forecast from 2011-2018:
    - Annual direct and indirect employment during both the construction and operations phases; and
    - Employment breakdown by supply and value chain segments.
3. Job multipliers for the construction and operations phases of wind energy generation in Ontario

# 3 Market Forecast

The wind energy sector in Ontario is expected to grow significantly from 2011-2018. Specifically, the market is expected to:

- Install an additional 5.6 GW of wind energy capacity by 2018, bringing Ontario's total wind energy capacity to 7.1 GW by 2018.
- Provide 3.11% of the required electricity in Ontario in 2011, increasing to 10.99% by 2018.

While the past decade has seen growth for the wind industry in Ontario, the LTEP targets continued capacity growth through 2018, as shown in Figure 3.1.

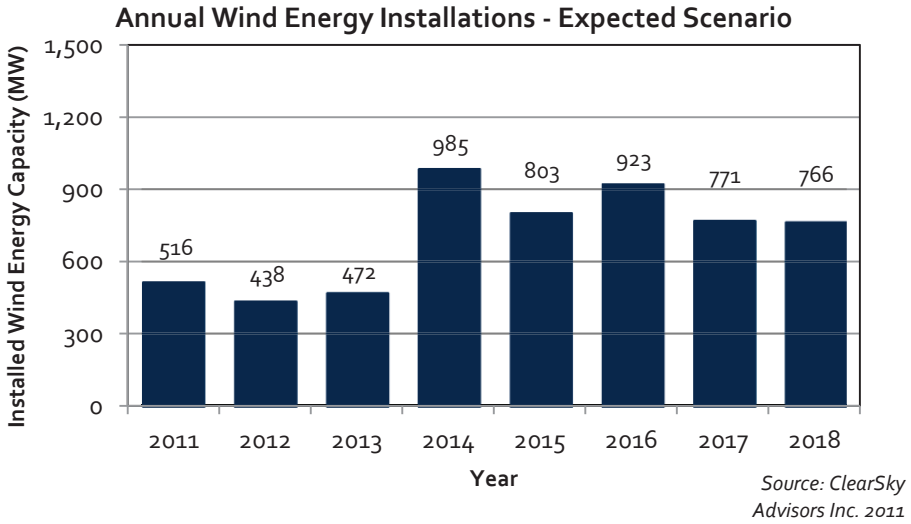



Figure 3.1: Expected Ontario Annual Wind Energy Installations Forecast From 2011-2018 (in MW)

Ontario's energy market is driven by the province's energy procurement policy, as implemented by the Ontario Power Authority (OPA). For wind energy specifically, the procurement policy has been implemented through a series of programs since 2003, beginning with Renewable Energy Supply (RES) I-III, followed by the Renewable Energy Standard Offer Program (RESOP) and finally the current Feed-In Tariff Program (FIT) which was launched in October 2009.

## 3.1 Market Overview

### 3.1.1 Ontario Electricity Market Forecast

Ontario's Long-Term Energy Plan (LTEP) clearly outlines that the years 2011 through 2018 will be a period of change in the energy supply mix in Ontario.

- There is significant investment planned into transmission and energy conservation in Ontario.
- Electricity demand is anticipated to grow at a CAGR of 0.46%[3] from 2010 through 2018.

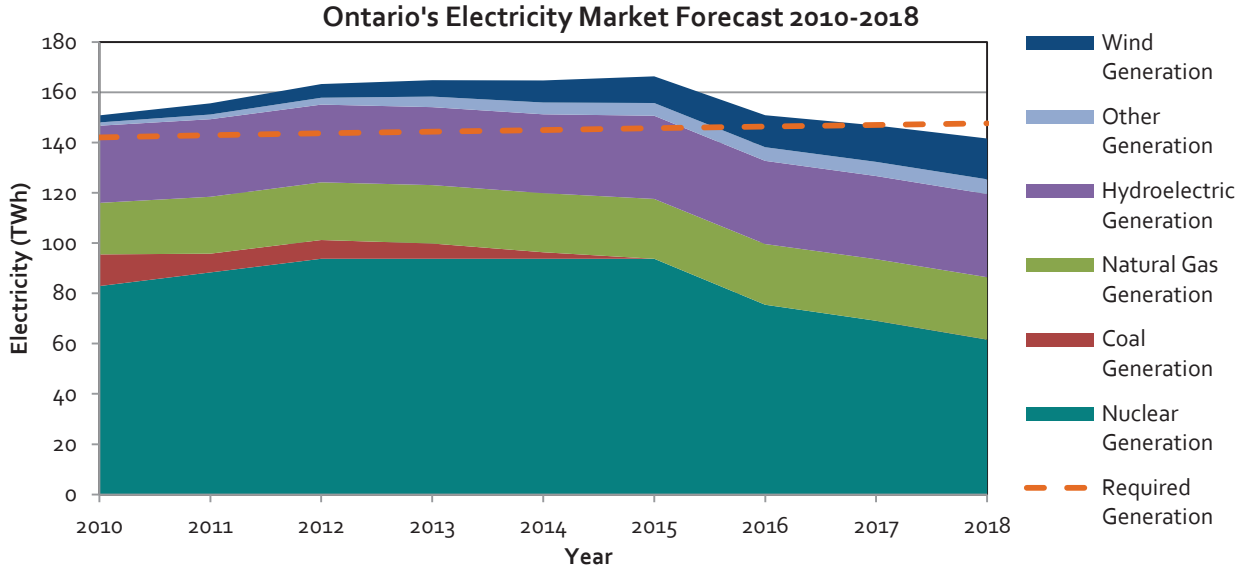
[3] Ontario Power Authority. (2010). Ontario's Long Term Energy Plan 2010-2030; Independent Electricity System Operator (IESO). 2010. 18 Month Outlook From December 2010 to May 2012 http://www.ieso.ca/imoweb/pubs/marketReports/18Month_ODF_2010dec.pdf; and Ontario Power Authority. (2011). IPSP Planning and Consultation Overview.

- Coal-fired generation will be phased out in the province by 2014.
- By 2025, 10,000 MW of existing nuclear generation capacity will be refurbished.

From 2011 to 2018, it is anticipated that total electricity demand in Ontario will increase from 142.4 TWh to 147.6 TWh, though by 2018, with an additional 17.8 TWh offset by energy conservation in Ontario.

As the province aims to phase out coal by 2014, wind energy generation will increasingly become an important part of the energy supply mix. In 2011, wind is anticipated to provide 3% of the required electricity in Ontario, increasing to just under 11% by 2018[4].




*Sources: ClearSky Advisors Inc. 2011; OPA, IPSP Planning and Consultation Overview 2011; OPA, Ontario's Long Term Energy Plan 2010; IESO, 18 Month Outlook December 2010*

Figure 3.2: Ontario's Electricity Market Forecast

### 3.1.2 Implications of Long Term Energy Plan for Renewable Energy Capacity and Generation

Ontario's LTEP outlines that 10,700 MW of renewable energy generation capacity (including wind, solar, and biomass) is to come online by 2018 in the province of Ontario. This capacity is expected to yield an annual electricity generation of 24.96 TWh, where:

- 78% is anticipated to come from wind energy;
- 12% is anticipated to come from solar PV; and
- 10% is anticipated to come from biomass sources.

[4] Generation is calculated as the difference between gross demand and energy conservation.

### 3.1.3 Wind Energy Capacity in Ontario: Existing, Contracted, and Targeted

By 2018, the LTEP targets over 7 GW of installed wind energy generation capacity in Ontario. Table 3.1 illustrates that while the pace of development has been significant in the past, the next several years will require a high pace of project awards if the province is to meet the LTEP target.

Table 3.1: Wind Energy Generation Contracts in Ontario: Existing, Contracted, and Targeted

| Wind Energy Capacity in Ontario: Existing, Contracted, and Targeted | | | | | | | |
|---|---|---|---|---|---|---|---|
| | RES Program | RESOP Program | On-Shore FIT Program | Samsung & KEPCO | Total | Target | Additional Required |
| Existing installed capacity (MW)* | 1,233.1 | 193.8 | 0.8 | - | 1,427.7 | N/A | N/A |
| Contracts under development (MW)* | 276.3 | 131.5 | 1,228.8 | 2,000 | 3,636.6 | N/A | N/A |
| Total (MW) | 1,509.4 | 325.3 | 1,229.6 | 2,000 | 5,064.3 | 7,101.2 | 2,036.9 |

** As of December 31st, 2010[5].*

*Sources: ClearSky Advisors 2011; OPA,* Progress Report on Electricity Supply, 4th Quarter 2010

Table 3.2: Expected Wind Energy Generation Capacity Installations in Ontario by Program Type, 2011-2018

| Expected Wind Energy Generation Capacity Installations in Ontario by Program Type, 2011-2018 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| RES | 132 | - | - | - | - | - | - | - | 132 |
| RESOP | 276 | - | - | - | - | - | - | - | 276 |
| On-Shore FIT | 109 | 38 | 72 | 585 | 403 | 523 | 771 | 766 | 3,266 |
| Samsung & KEPCO | - | 400 | 400 | 400 | 400 | 400 | - | - | 2,000 |

*Sources: ClearSky Advisors 2011; OPA,* Progress Report on Electricity Supply, 4th Quarter 2010

#### *3.1.3.1 Wind Energy in Ontario: Pre-contract Development*

Currently, there are more than enough FIT applications for wind energy projects awaiting approval by the OPA to satisfy the targets of the LTEP.

- The LTEP calls for 7.1 GW of installed wind energy capacity;
- As of Dec 31st, 2010, 1,428 MW of wind energy capacity are installed in the province; and
- This leaves a requirement of 5.6 GW of additional capacity to be installed.

[5] Ontario Power Authority. (2010). Progress Report on Electricity Supply, 4th Quarter 2010.

Consider the above facts in light of the wind pipeline in the on-shore FIT program and Samsung and Korea Electric Power Corporation (KEPCO) agreement as of Q4, 2010:

- 0.8 MW of FIT projects already connected in the province;
- 1,229 MW of FIT projects with contracts awarded and were under development;
- 2,000 MW of projects under development by the Samsung and KEPCO; and
- 5,153 MW of FIT project applications awaiting the economic connection test (ECT).
- In total, the above numbers represent over 8.3 GW of potential wind energy capacity, from just the FIT program and the Samsung & KEPCO agreements– far surpassing the 5.6 GW of additional capacity required to meet the LTEP targets for wind energy.

It is not impossible for new project applications to be submitted, accepted, constructed, and connected during the forecast period. After all, it is highly unlikely that all of the contracted and applied-for projects will come to fruition for a variety of reasons. For example, some projects will not find financing, while others are not located where there is likely to be an economic connection to the grid. However, the chances of new project applications making it through to construction at this point are much lower than just two years ago. As such, developers we interviewed have confirmed that their pre-contract development activity will be greatly reduced over the near term.

## 3.2 Supply of Wind Energy Equipment

Compared to other renewable energy sources, the wind industry enjoys a relatively mature supply chain at the global level. However, as part of the province's FIT program, an increasing amount of the equipment must be made in Ontario. For FIT projects with a commercial operation date (COD) before December 31, 2011, the level of domestic content as defined by the OPA is 25% while for FIT projects with a later COD, the level of domestic content is 50%. Projects under development by Samsung must adhere to domestic content requirements similar to those under the FIT program. In short, this increase in domestic content requirements means that a wind supply chain will need to be significantly augmented in Ontario.

For this report, the supply chain for the wind energy sector is broken down into the construction phase and the operations and maintenance phase. The construction phase is further divided into equipment and balance of plant.

Table 3.3: Breakdown of Total Installed System Cost for a Wind Turbine in Ontario (by Percent)

| Breakdown of Total Installed System Cost for Wind Turbines in Ontario[6] | |
|---|---|
| **Component** | **Percent of Total Installed System Cost** |
| **Nacelle** | 40% |
| **Blades** | 9% |
| **Towers** | 12% |
| **Transportation** | 10% |
| **Balance of Plant (BOP)** | 29%* |
| *General Materials* | 52% of BOP |
| *Labour* | 33% of BOP |
| *Development* | 15% of BOP |

* *In Ontario, the BOP for wind turbine installations can range between 20-40%.*

*Source: ClearSky Advisors 2011*

The equipment portion of the construction phase is broken down into 4 components; nacelle, blades, towers, and balance of plant.

### 3.2.1 Nacelle

For wind turbines installed in Ontario, on average, the nacelle accounts for 40% of the total installed system cost. For this report, the nacelle is defined as including (where applicable):

- Nacelle frame and shell;
- Pitch system;
- Yaw system;
- Hub (and hub casing);
- Gearbox;

[6] From the interviews we conducted the average wind turbine in Ontario ranged from 2-2.3 MW.

- Generator and brake;
- Heat exchanger;
- Drive shaft; and
- Power converter.

### 3.2.2 Blades

Blades installed on wind turbines in Ontario account on average for 9% of the total installed system cost. For the purpose of this report, blades are defined as cast/moulded wind turbine blades.

### 3.2.3 Towers

On average, wind turbine towers installed in Ontario account for 12% of the total installed system cost. For the purpose of this report, towers are defined as (where applicable):

- Materials for wind turbine towers (typically either steel or concrete); and
- Manufacturing/forming of materials into wind turbine towers.

### 3.2.4 Transportation

Transportation of the nacelle, towers, and blades from manufacturers to the installation site accounts for 10% of the total installed system cost for wind turbines built in Ontario.

### 3.2.5 Balance of Plant

Balance of plant (BOP) accounts for an average of 29% of total installed system cost for wind turbines installed in Ontario. For the purpose of this report, the balance of plant is defined as:

- General materials and equipment (52% of the BOP cost), including:
    - Construction (roads, bulldozers, cranes, etc.);
    - Transformers;
    - Control panels and electronics (such as cables and wiring); and
    - HV electrical systems.
- Labour (33% of the BOP cost), including:
    - Foundation;
    - Tower erection;
    - Electrical; and
    - Management/supervision.
- Development (15% of the BOP cost), including:
    - Interconnection;
    - Legal consulting; and
    - Engineering.

Table A.2 in the appendix shows how the supply chain classifications match the OPA's domestic content grid.

## 3.3 Pricing

Though relatively new in North America, particularly in Ontario, electricity generation from wind turbines is a mature technology with well-established global manufacturers and developers. For the purposes of this report, we have assumed that the rate of innovation and cost-reduction will only slightly outpace inflation, thus leaving equipment costs essentially flat over the forecast period.

The installation cost of wind turbines has been fairly well insulated against inflation. Variation in total system price and O&M cost of wind turbines in Ontario depends primarily on the following factors:

- Wind regime conditions;
- Choice of turbine technology;
- Project specific geography (Crown land, location of interconnection, road access, etc.);
- Topology/geo-morphology (type of soil/rock on which the project is built, the slope/grade of the land on which the project is built, etc.);
- Project implementation schedule; and
- First Nations agreements.

Table 3.4: Wind Turbine Installation and Service Pricing in Ontario

| Wind Turbine Installation and Service Pricing in Ontario (in Real 2011 $CAD) | | | | |
|---|---|---|---|---|
| | | Average Price ($/MW) | High Price ($/MW)* | Low Price ($/MW) |
| Total All-In Installed Cost | *Pre-50% Domestic Content Requirements (2011)* | $2,630,000 | $3,430,000 | $2,110,000 |
| | *Post-50% Domestic Content Requirements (2012-2018)* | $2,690,000 | $3,500,000 | $2,110,000 |
| Annual Operations & Maintenance Cost | | $34,300 | $40,600 | $20,800 |

* *Projects at the high end of the price range would only be financially viable in very unique circumstances.*

*Source: ClearSky Advisors 2011*

ClearSky Advisors has reported an average value, high-price, and low-price for total installation and O&M wind turbine system costs for pre- and post-50% domestic content requirements to reflect the variability of these factors. This is shown above in Table 3.4. Turbine prices are expected to increase due to domestic content requirements. Our research has found, however, that the reported ranges for all-in system costs and O&M costs have more to do with the variable nature of balance of plant costs (20-40% of the total installed cost) and the aforementioned project-specific location characteristics in Ontario and less to do with impact of changing domestic content requirements on turbine costs. Projects at the high end of the price range would only be financially viable in very unique circumstances.

As the OPA's mandated 50% domestic content requirement for wind turbines installed in Ontario comes into effect after January 1st, 2012, we expect an increase of just over 2% to the all-in installed system cost. In terms of O&M costs, the accumulated 20-year costs are anticipated to stay around 20% of the total lifetime cost (all-in installed price plus 20-year O&M costs), irrespective of the domestic content requirements.

## 3.4 Wind Energy Sector Installed Capacity Forecast Scenarios

The potential market outcomes for the wind energy sector over the next few years are based on three pairs of wind energy demand and supply scenarios, with the assumptions for each outlined in Table 3.5.

Table 3.5: Wind Energy Sector in Ontario Scenario Assumptions

| Wind Energy Sector in Ontario Installed Capacity Forecast Scenario Assumptions | | | |
|---|---|---|---|
| **Assumption** | **High Market Forecast** | **Expected Market Forecast** | **Low Market Forecast** |
| **Political Support** | High | Steady | Low |
| **Transmission Capacity** | Aggressive Additions | Steady Additions | Minor Additions |
| **Project Delays*** | Few | Some | Significant |
| **Project Cancellations** | Few | Some | Significant |

*These delays include the February, 2011 offer from the OPA for a 1-year extension on commercial operation date (COD) for FIT contract holders.

*Source: ClearSky Advisors 2011*

Factors that were considered to contribute positively or negatively to the assumptions listed above include:

- Environmental benefits;
- Environmental concerns;
- Increased awareness of the cost of traditional energy sources;
- Perceived causes of the increase in the cost of electricity to ratepayers;
- Community support;
- Community opposition; and
- Contracting and permitting processes.

1. Expected Market Forecast – The Expected Scenario reflects a situation where government policy supports the targets laid out in the LTEP. The Expected Scenario is mostly based on information garnered from the interviews with developers of wind generation projects in the province as well as related research and analysis of the targets set out in the LTEP in conjunction with planned transmission expansions and upgrades.
2. High Market Forecast – The High Scenario is based upon expedited transmission expansions and increases in either a) the target itself, or b) the relative proportion of wind included in the LTEP target of 10,700 MW of renewable energy generation to be installed in Ontario by 2018.
3. Low Market Forecast –The Low Scenario is predominantly based upon assumptions around delays to the current transmission expansion plans, coupled with a loss of political will to continue with the growth of the wind energy generation sector in Ontario.

Table 3.6: Installed Wind Capacity to be Built in Ontario, 2011-2018

| Annual Installed Wind Capacity in Ontario (MW) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Installed Capacity From 2011-2018 | Total Installed Capacity by 2018 |
| Expected Scenario | 516 | 438 | 472 | 985 | 803 | 923 | 771 | 766 | 5,673 | 7,101 |
| High Scenario | 653 | 456 | 660 | 1,111 | 976 | 1,015 | 1,059 | 1,010 | 6,939 | 8,366 |
| Low Scenario | 386 | 384 | 283 | 516 | 248 | 311 | 152 | - | 2,280 | 3,708 |

*Source: ClearSky Advisors 2011*

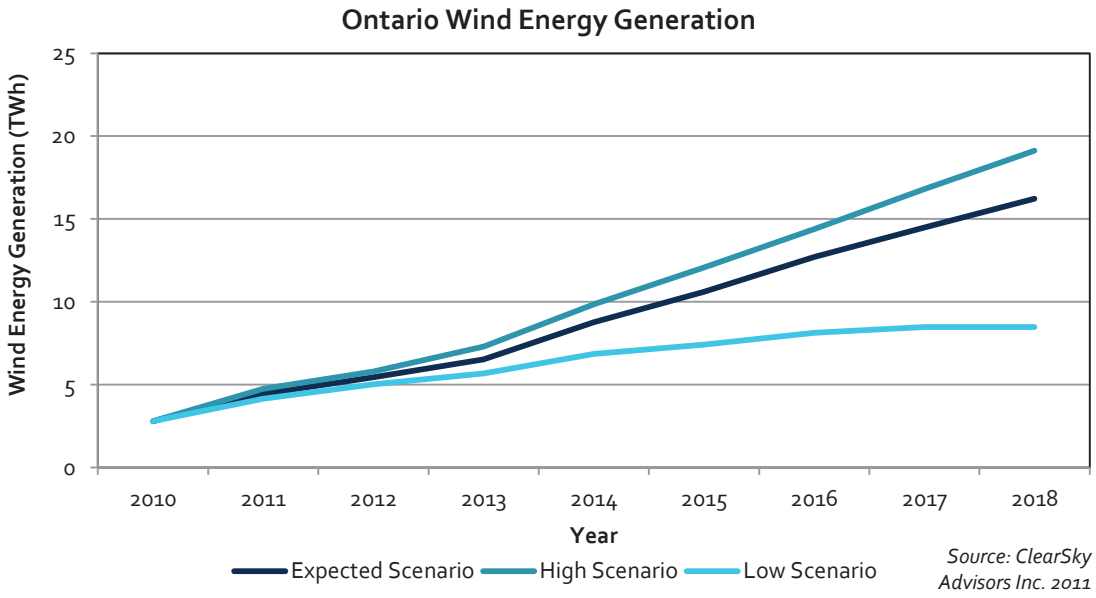



Figure 3.3: Ontario Wind Energy Generation (in TWh)

It is important to note that the Expected Case and High Case only slightly differ between the present and 2014. This reflects the assumption that wind energy capacity is currently being added to the grid essentially as fast as the grid can allow for. It also reflects the fact that wind energy takes approximately 3 to 4 years to develop from inception to connection. The remaining time is spent on activities such as development, contracting, permitting, etc.

As was outlined above, we considered many factors in developing our three market scenarios. However, as a result of the interviews we conducted it was apparent that political support and the availability of transmission were the two factors that had the biggest impact on the wind energy sector in Ontario.

### 3.4.1 High Scenario Overview:

Assumptions used in the creation of the high scenario include:

- Strong political support for continued procurement of wind energy generation capacity.
- Aggressive transmission additions will facilitate an increase in project awards and installations.
- Potential interruptions to original project schedules:
  - Permitting – few;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – some; and
  - Project cancellations – few.

#### *3.4.1.1 Installation Rate in Ontario*

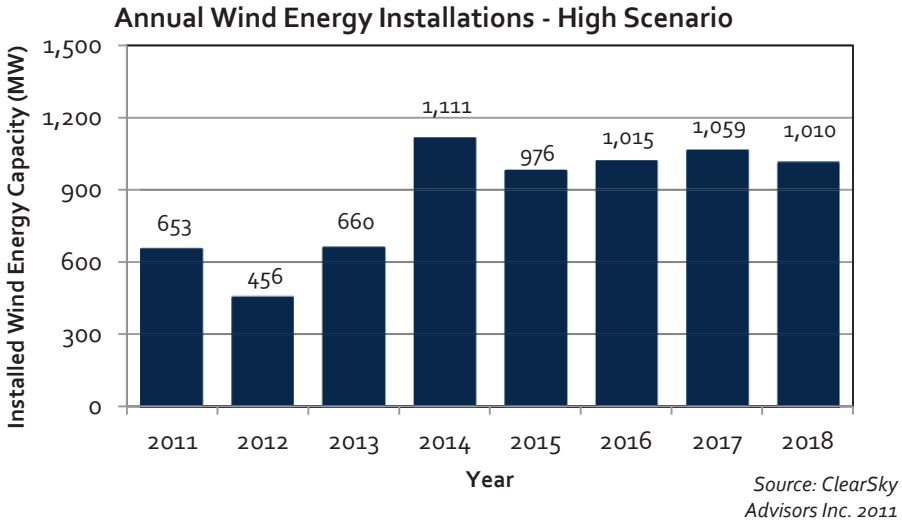



Figure 3.4: Annual Wind Energy Installations in Ontario (in MW), High Scenario (2011-2018)

- Total 2011-2018 installations: 6,939 MW - total cumulative installations by 2018: 8,366 MW.
- Average annual installations: 867 MW - ranging from 456 MW (2012) to 1,111 MW (2014).

#### *3.4.1.2 Trends*

- Annual installations will peak in 2014 and maintain a high level through 2018 due to:
  1. The Bruce to Milton transmission expansion project
  2. East-West tie transmission upgrades
  3. Substantial transmission upgrades in south-western Ontario (2017)
- Market supply capacity for wind turbine installations of 1,100 - 1,200 MW per year:
  - The market may experience potential domestic content supply constraints in 2014-2018 as there will be a near doubling of market volume from 2013 to 2014 and 5 consecutive years approaching market capacity.
  - Most parts of the value and supply chains can stretch beyond 1,200 MW per year, but depending on future market conditions, the supply of domestic-content compliant steel and the availability of skilled labour (especially for electrical and tower erection) could be constraining factors that could cause delays and/or price increases.

### 3.4.2 Expected Scenario Overview:

Assumptions used in the creation of the expected scenario include:

- Steady political support for continued procurement of wind energy generation capacity.
- Several transmission additions and upgrades that will facilitate the growth of the market in line with the LTEP.
- Potential interruptions to original project schedules:
  - Permitting – some;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – some; and
  - Project cancellations – some.

#### *3.4.2.1 Installation Rate in Ontario*

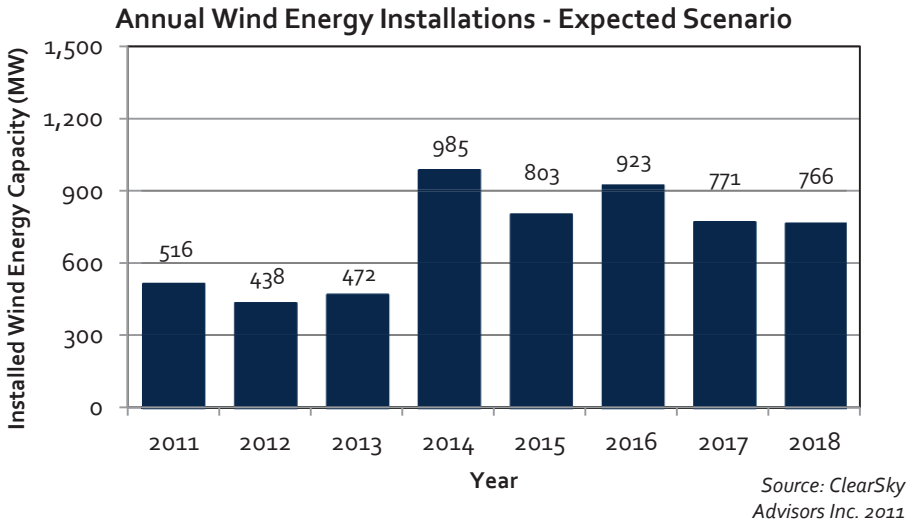



Figure 3.5: Annual Wind Energy Installations in Ontario (in MW), Expected Scenario (2011-2018)

- Total 2011-2018 installations: 5,673 MW - total cumulative installations by 2018: 7,101 MW.
- Average annual installations: 709 MW - ranging from 438 MW (2012) to 985 MW (2014).

#### *3.4.2.2 Trends*

- Annual market volume will peak in 2014 and maintain a high volume until 2018 due to:
  1. The Bruce to Milton transmission expansion project
  2. East-West tie transmission upgrades
  3. Substantial transmission upgrades in south-western Ontario
- Market supply capacity for wind turbine installations of 900 - 1,000 MW per year:
  - The market may potentially experience domestic content supply constraints in 2014-2016 as there will be 3 years in a row of installation volume at nearly market capacity.
  - Most parts of the value and supply chains can stretch beyond 1,000 MW per year, but depending on future market conditions, the supply of domestic-content compliant towers could be constraining factors that could cause delays and/or price increases.

### 3.4.3 Low Scenario Overview:

Assumptions used in the creation of the low scenario include:

- Low political support for continued procurement of wind energy generation capacity:
  - Potential changes to the domestic content rules.
- Minor transmission additions to facilitate additional project awards and installations (by 2018).
- Potential interruptions to original project schedules:
  - Permitting – significant;
  - Construction – few (chiefly due to winter weather);
  - OPA's 1 year extension on COD – significant; and
  - Project cancellations – significant.

#### *3.4.3.1 Installation Rate in Ontario*

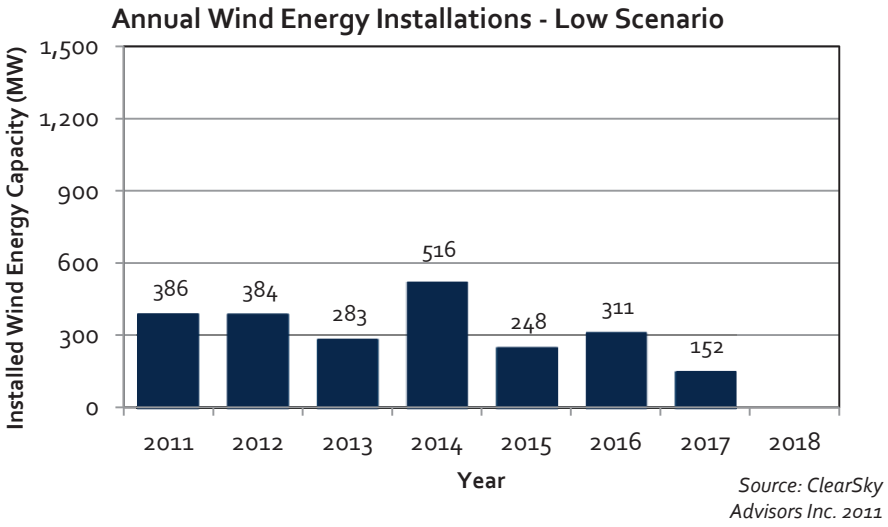



Figure 3.6: Annual Wind Energy Installations in Ontario (in MW), Low Scenario (2011-2018)

- Total 2011-2018 installations: 2,280 MW - total cumulative installations by 2018: 3,708 MW.
- Average annual installations: 285 MW - ranging from 0 MW (2018) to 516 MW (2014).

#### *3.4.3.2 Trends*

- Annual installations will peak in 2014 due to:
  1. The Bruce to Milton transmission expansion project
- Market supply capacity for wind turbine installations of 600 - 700 MW per year:
  - It is unlikely that the market will experience any domestic content supply constraints from 2011-2018.
  - Most parts of the value and supply chains have significant flexibility in terms of scaling production and service up and down. Further, additional supply in the Ontario marketplace could be used to serve other North American markets fairly easily due to the strong transportation infrastructure in Ontario. As such, though the market capacity will be far greater than demand in most years, it is unlikely that there will be a surplus of equipment and/or production capacity that could cause decreases in price.

# 4 Economic Impacts

## 4.1 Overview of Economic Impacts

Investment in the wind energy sector impacts a number of stakeholder groups within the province of Ontario in a variety of ways, including stimulation of local spending, generation of tax revenue, lease payments, job creation, and the development of local expertise and innovation[7]. Based on market activities corresponding with the "expected" scenario laid out in the previous section, the key economic indicators are:

- The wind energy sector will result in 80,328 person years of employment (PYE) from 2011-2018.
- Total private sector investment for wind turbine installations will be more than $16.4billion, of which greater than $8.5billion will be spent locally in Ontario from 2011-2018, shown in Figure 4.1.
- Total private sector benefits paid in Ontario, demonstrated in Table 4.7, as a result of installations in 2011-2018 will surpass $1.1billion (based on and paid over 20-year contracts from the installation date), including:
    - $1.03billion in lease payments to landowners; and
    - $147million in taxation payments to municipalities.

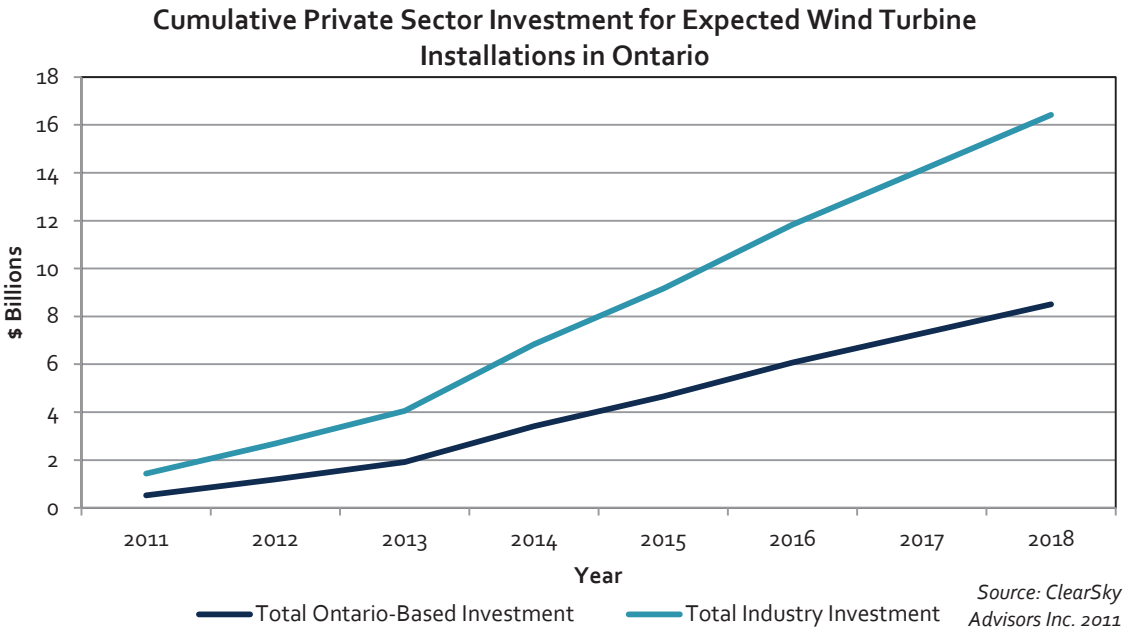



Figure 4.1: Cumulative Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

[7] The analysis in this report does not include the economic or labour impacts associated with the decommissioning, re-powering, and/or refurbishment of wind turbines at the end of their service life. It is likely that a combination of all three options will be employed for wind turbines in Ontario, but at this point in time it is unclear what percentage of turbines will subjected to each end of service life option.

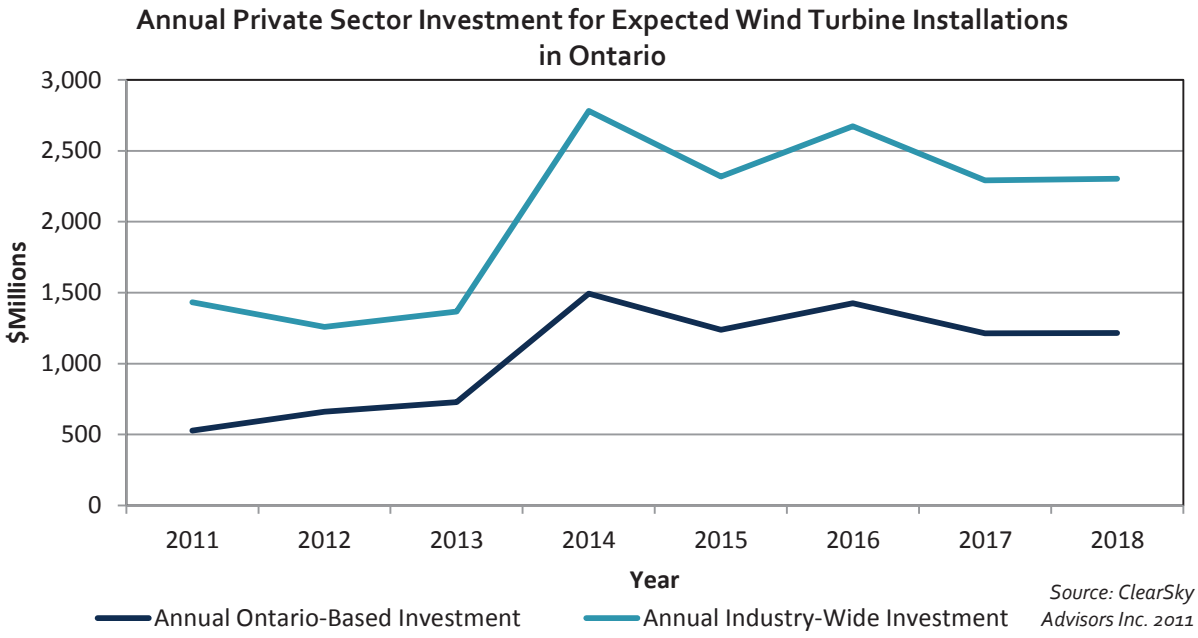



Figure 4.2: Annual Private Sector Investment for Wind Turbine Installations in Ontario, Expected Scenario 2011-2018

## 4.2 Job Creation

When compared to existing traditional energy sources in Ontario, the wind energy sector creates more employment opportunities per unit of energy produced and does so at a lower cost per job. This fact, as demonstrated in the following figures, helps to explain why the province of Ontario and other governments from around the world are including wind energy as a growing part of their energy mix.

In general, when considering jobs created by the wind energy sector, it is useful to make a distinction between pre-connection and post-connection jobs. Post-connection jobs are typically ongoing and include operation and maintenance (O&M) while pre-connection jobs are more variable in nature and include project development, onsite labour, manufacturing, wholesale, and distribution. For the purposes of our study, we have termed pre-connection jobs as "Construction Phase" and have assumed that the pre-connection jobs would be one-time[8]. In order to be sustained on an ongoing basis, these jobs would need to be maintained with export projects and/or additional local market awards.

In order to compare ongoing jobs with one-time jobs, we use a measure called person-years of employment (PYE). As the name suggests, PYE represent one year of employment for one individual (i.e. 40 hours per week for 52 weeks). To illustrate, since Ontario FIT contracts last for 20 years, we equate one O&M job associated with a FIT contract to 20 PYE.

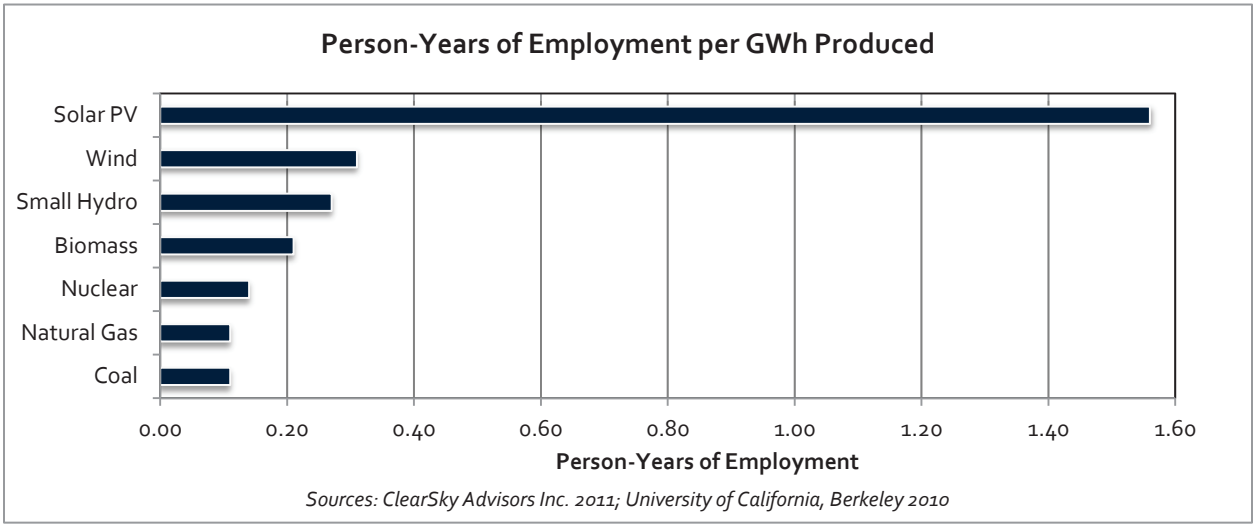



**Figure 4.3: Person Years of Employment per GWh of Generated Energy by Various Technologies Employed in Ontario.**

To compare job creation (in terms of PYE) by various generation technologies, it is most useful to measure the number of PYE created per unit of energy produced (GWh in this case). Figure 4.3 demonstrates PYE per GWh by different technologies used in Ontario for energy generation. Results from a 2010 study published in Energy Policy by Wei et al. that synthesized data across 15 job studies

[8] Re-powering construction phase employment was not taken into consideration as it will appear much later than the scope covered in this report. A continuous wind market will create these jobs and allow for a number of construction phase jobs to be self-sustaining.

were coupled with Ontario-specific conditions (such as wind regime, solar insolation, and FIT contract data) to inform the model used in Figure 4.3[9].

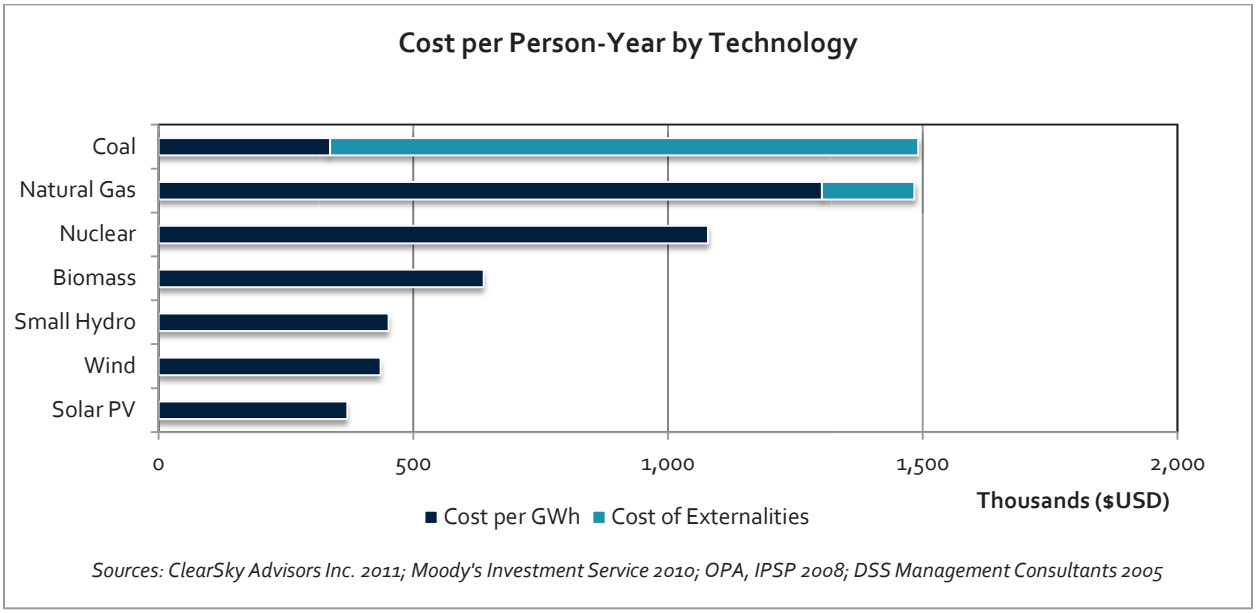



**Figure 4.4: Cost per Person Year of Employment by Various Energy Generating Technologies Used in Ontario**

The cost of job creation can be calculated by comparing PYE per unit of energy with the cost per unit of energy. Our cost calculations have come from current Feed-In Tariff rates, Moody's Investment Service (for nuclear data)[10], and the OPA's integrated power system plan (IPSP) evidence[11]. In order to reflect a more complete and accurate cost to Ontarians, our assumptions for the cost of fossil fuels incorporates conservative estimates (2¢/kWh for natural gas and 12.7¢/kWh for coal)[12] published by the Ontario Ministry of Energy of the cost of health and environmental externalities caused by these types of power generation[13].

[9] Wei, M., Patadia, S., Kammen, D. 2010. Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? Energy Policy. 38: 919-931.
[10] Weis, T., Stensil, S.-P., & Stewart, K. (August, 2010). Renewable is Doable. http://pubs.pembina.org/reports/ontario-green-energy-report-august-web.pdf
[11] Ontario Power Authority. (2007). Methodology and Assumptions for the Cost to Consumer Model. http://www.powerauthority.on.ca/ipsp/Storage/53/4886_G-2-1_Att_1_corrected_071019.pdf; and Ontario Power Authority. (2008). Integrated Power System Plan for the Period 2008-2027. http://www.powerauthority.on.ca/integrated-power-system-plan/g-plan-outcomes
For natural gas pricing the OPA considered several scenarios that fall within a spot-price range from $4.00 to $12.00; as present day prices are close to the low end of that range, we used the OPA's low price case in our cost calculations. Ontario Power Authority. (2008). Integrated Power System Plan for the Period 2008-2027. http://www.powerauthority.on.ca/integrated-power-system-plan/g-plan-outcomes.
[12] DSS Management Consultants Inc., RWDI Air Inc. (2005). Cost Benefit Analysis: Replacing Ontario's Coal Fired Electricity Generation. Toronto, ON: Ontario Ministry of Energy.
[13] Externalities of 18¢/kWh due to coal were reported in a Harvard study. (Reuters. (2011). Coal's hidden costs top $345 billion in U.S.-study.)

#### 4.2.1.1 Total Jobs Created Annually and Total for 2011-2018

Figure 4.5 demonstrates annual job creation in Ontario by the wind energy industry. The number of PYE presented includes both one-time and ongoing jobs. All PYE from permanent jobs are attributed to the year in which the project was installed[14].

The cumulative expected PYE created by the wind energy sector in Ontario from 2011-2018 is shown in Table 4.1. It should be noted that the jobs reported here are solely a result of the LTEP.

- From 2011-2018, 80,328 PYE will be created in Ontario due to the wind energy sector.
- On an annual basis, the number of jobs created varies from a low of 5,708 PYE in 2011 to 14,249 in 2014.

Note: The O&M job numbers listed for each year in Figure 4.5, are created as a result of the projects built that year, but are actually carried out over the 20 year period a project is expected to be in operation. Figure 4.8 illustrates that fact in more detail.

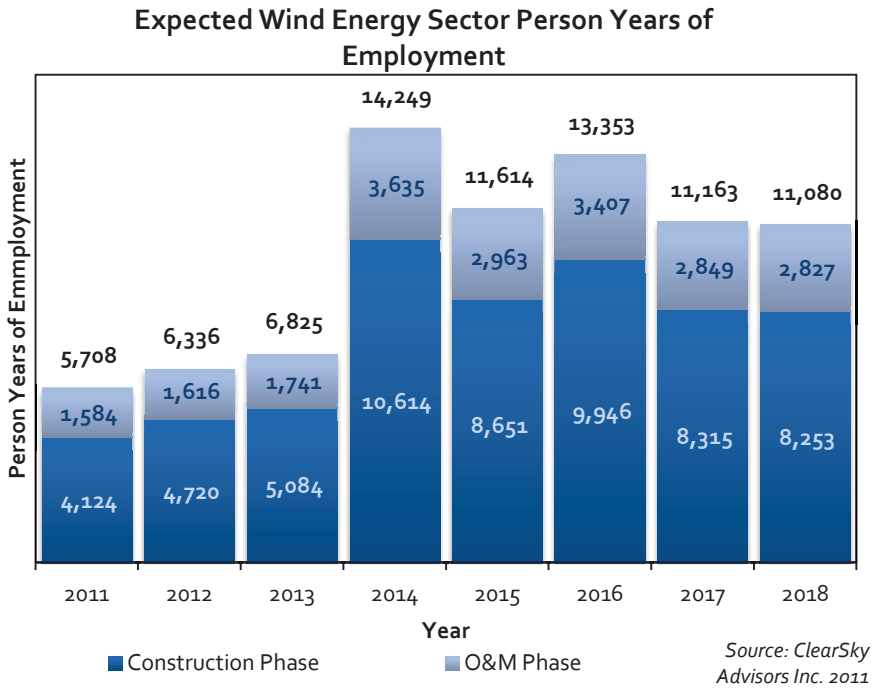



Figure 4.5: Person Years of Employment Created by the Wind Energy Sector in Ontario, Expected Scenario 2011-2018

#### 4.2.1.2 Jobs Creation by Type in Ontario for 2011-2018

Figure 4.6 demonstrates the relative proportion of employment by different types of jobs in Ontario from 2011-2018, due to the wind energy sector.

- 54% of PYE created in Ontario due to the wind energy sector will occur in the construction phase due to labour and manufacturing employment.

[14]Developmental PYE are included in the construction phase as service jobs. As the employment calculations are for only connected projects, any development work in the prospecting phase, as well as any other development, manufacturing, and/or construction work for incomplete projects are not accounted for in our scenarios.

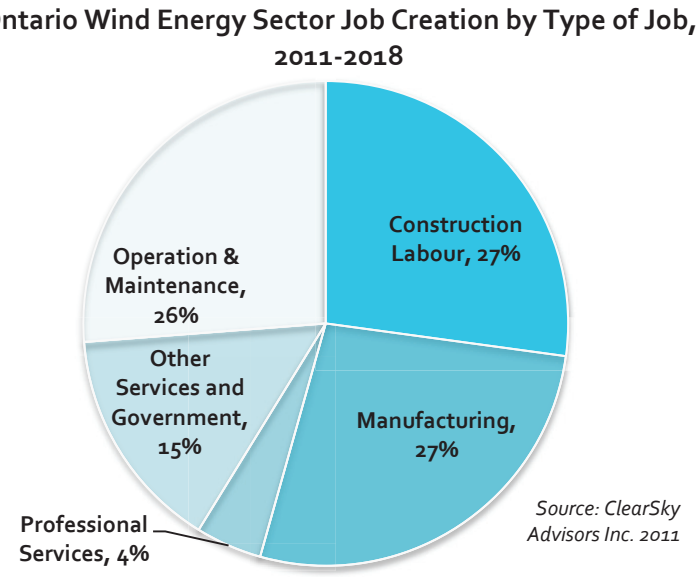



Figure 4.6: Total Ontario Wind Energy Sector Job Creation by Type of Job, Expected Scenario 2011-2018

PYE can be classified into three categories: direct, indirect, and induced.

- Direct PYE are jobs that are created to immediately serve the actual supply chain, such as wind turbine manufacturing and construction.
- Indirect[15] PYE are jobs that have been created to facilitate the creation and maintenance of the supply chain, such as the construction and manufacture of facilities and equipment used in the wind energy generation supply chain.
- Finally, induced PYE are jobs that are created elsewhere in the economy as a result of spending from both direct and indirect workers and firms[16]. Induced PYE were not included in this study so as to be conservative with PYE estimates as well as due to their ambiguous nature. Induced jobs are real, but quantifying them is difficult, so we have focused our analysis on direct and indirect jobs.

Expected PYE creation due to Ontario's Wind Energy Sector from 2011-2018, demonstrated in Table 4.1, will be almost equally split between direct and indirect employment:

- 38,135 direct PYE; and
- 42,193 indirect PYE will be generated in Ontario due to the wind energy sector.

[15] Note: The model assumes (based on inputs and multipliers from Statistics Canada) that a certain percentage of indirect jobs would need to exist in the province to serve the wind energy sector. These jobs are counted in the year in which the installations are complete and not necessarily in the year that they occur.
[16] Estimates of Job Creation from the American Recovery and Reinvestment Act of 2009. http://www.whitehouse.gov/assets/documents/Job-Years_Revised5-8.pdf

Table 4.1: Job Creation (PYE) in the Ontario Wind Energy Sector, 2011-2018

| Wind Energy Sector Job Creation (PYE) in Ontario, 2011-2018 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Direct* | 2,651 | 3,013 | 3,246 | 6,776 | 5,523 | 6,349 | 5,308 | 5,269 | 38,135 |
| | *Indirect* | 3,057 | 3,323 | 3,579 | 7,473 | 6,091 | 7,003 | 5,855 | 5,811 | 42,193 |
| | *Total* | 5,708 | 6,336 | 6,825 | 14,249 | 11,614 | 13,353 | 11,163 | 11,080 | 80,328 |
| High Scenario | *Direct* | 3,349 | 3,138 | 4,540 | 7,643 | 6,714 | 6,985 | 7,285 | 6,947 | 46,602 |
| | *Indirect* | 3,863 | 3,461 | 5,007 | 8,430 | 7,405 | 7,704 | 8,035 | 7,663 | 51,567 |
| | *Total* | 7,212 | 6,598 | 9,548 | 16,073 | 14,120 | 14,689 | 15,319 | 14,610 | 98,169 |
| Low Scenario | *Direct* | 1,979 | 2,642 | 1,950 | 3,549 | 1,710 | 2,138 | 1,069 | - | 15,037 |
| | *Indirect* | 2,282 | 2,914 | 2,150 | 3,914 | 1,885 | 2,359 | 1,155 | - | 16,658 |
| | *Total* | 4,262 | 5,557 | 4,100 | 7,462 | 3,595 | 4,497 | 2,223 | - | 31,695 |

*Source: ClearSky Advisors 2011*

Note: In Table 4.1 all jobs created by an installation in a given year are tied back to that year regardless of when the job actually occurs. See Figure 4.7 for an alternative view of the same data.

Table 4.2: Net Job Creation (PYE) Difference Between Market Scenarios (Relative to the Expected Scenario), 2011-2018

| Net Difference in Job Creation (PYE) in Ontario Relative to the Expected Scenario, 2011-2018 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | 5,708 | 6,336 | 6,825 | 14,249 | 11,614 | 13,353 | 11,163 | 11,080 | 80,328 |
| High Scenario | 1,504 | 262 | 2,723 | 1,824 | 2,506 | 1,336 | 4,156 | 3,530 | 17,841 |
| Low Scenario | (1,446) | (780) | (2,725) | (6,787) | (8,020) | (8,856) | (8,940) | (11,080) | (48,633) |

*Source: ClearSky Advisors 2011*

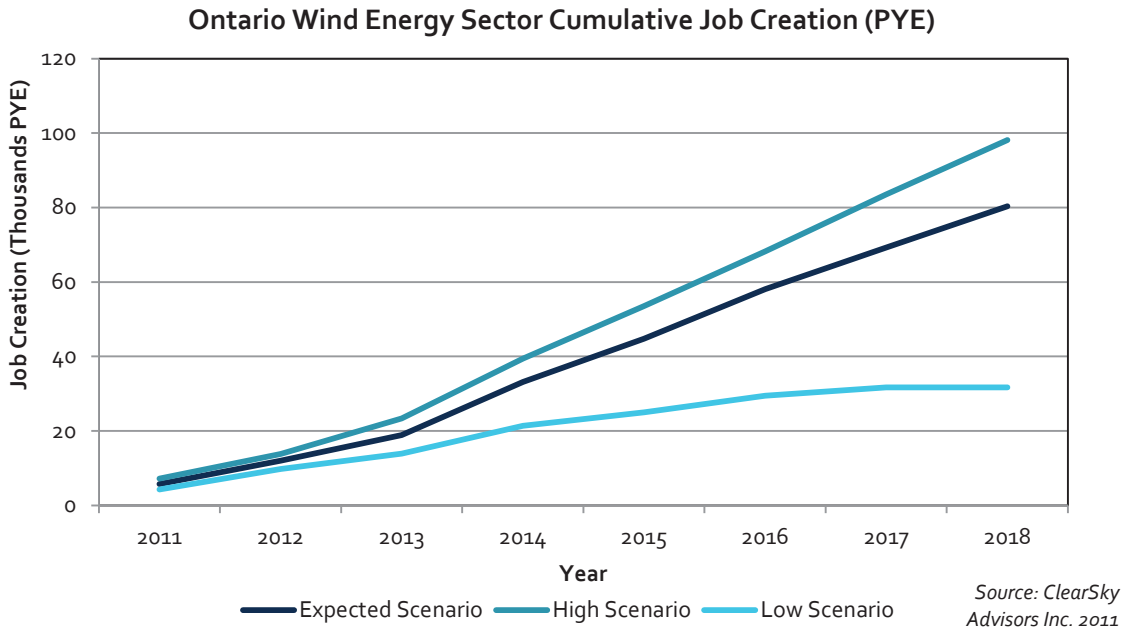



Figure 4.7: Ontario Wind Energy Sector Cumulative Job Creation (in PYE), 2011-2018

Alternatively expected job creation by year and by job type from 2009 to 2038[17] as a result of the wind energy sector in Ontario is shown in Figure 4.8, assuming that:

- Each project is awarded at the beginning of the 1st year;
- Services (developmental and other) take place in years 1 and 2;
- Sufficient lead-time is provided to allow for manufacturing to mainly take place in the 1st and 2nd years;
- Construction is not performed over the winter and is a 2 year process;
    - Foundation and infrastructure work is completed in year 2
    - Turbine erection is completed in year 3
- Each project will be connected and generating at the end of year 3;
- O&M work will begin at the beginning of the 4th year and last for 20 years; and
- Tax payments and lease payments to landowners will begin in year 4 and last for 20 years.

Note: These figures are ONLY for the projects forecast for installation in 2011 through 2018. The actual number of jobs is likely to be higher because no jobs are included for export, pre-contract development, or any ongoing installations after 2018. Furthermore, we have only considered direct and indirect jobs and not induced jobs. Therefore, these numbers are conservative for all years. The drop-off in employment after 2017 would only occur if exports and continued project awards beyond 2018 did not materialize.

[17] For the purposes of this model direct and indirect employment were assumed to occur at the same time. As such, there is no differentiation between these two employment categories in this measure of employment.

- During the forecast window, the number of jobs created varies from a low of 4,761 in 2011 to 9,951 in 2014; and
- 1,031 O&M jobs, ongoing after the end of the forecast window, are expected to be maintained until 2031 when they will slowly decline until a low of 141 in 2038 as wind energy generation projects reach decommissioning and the end of their generation contracts.

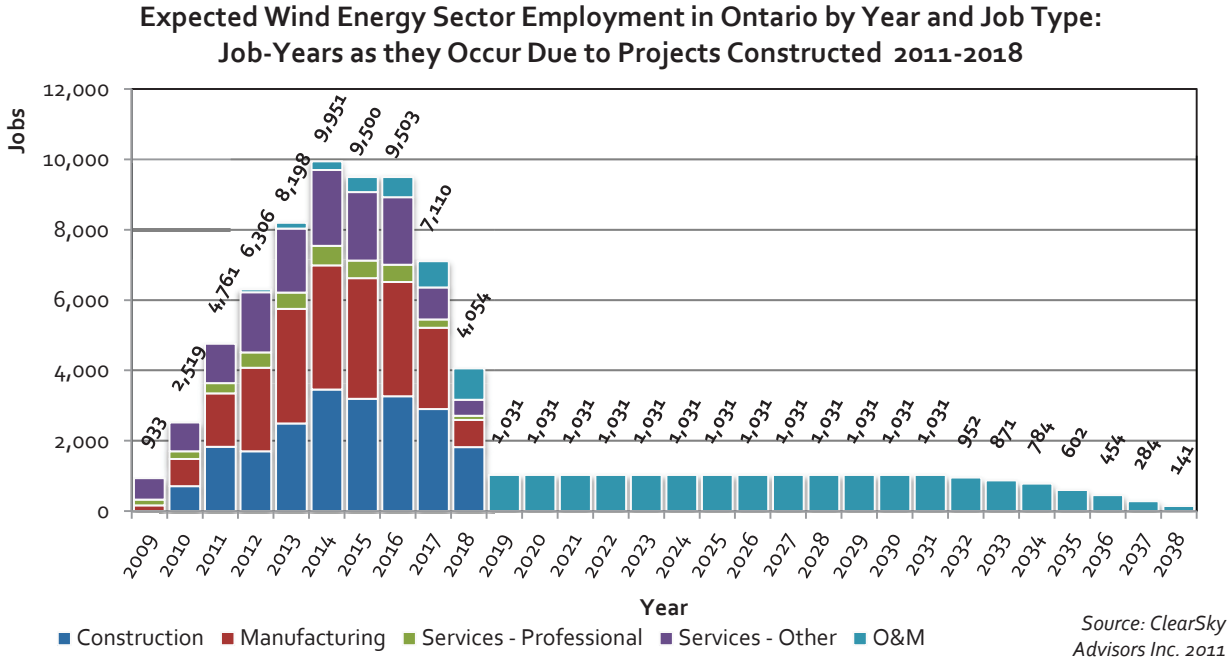



Figure 4.8: Expected Ontario Employment due to Wind Construction 2011-2018: Job Years as They Occur, 2009-2038

### 4.2.2 Jobs Multipliers for Construction & Operation Phases of Wind Energy in Ontario

Based on ClearSky Advisor's Forecast of the Wind Energy Sector in Ontario 2011-2018 (Chapter 3.4) we expect wind energy to have an impact on employment in Ontario in the next several years.

- On average, expected wind energy installations will create 14.1 person-years of employment in Ontario per MW of nameplate capacity:
  - Per average installed wind turbine in Ontario, 30.2 PYE are created in Ontario;
  - During the construction phase, on average, 10.5 PYE per MW of installed wind capacity will be created;
  - During the O&M phase of wind energy, on average over the 20 year contract, 3.6 PYE per MW will be generated in Ontario.

Table 4.3: Summary of Wind Energy Sector Job Creation Studies, in PYE/MW

| Wind Energy Sector Job Creation (PYE) Comparison | | |
|---|---|---|
| **Location** | **PYE/MW** | **Original Source** |
| Ontario | 14.1 PYE/MW | ClearSky Advisors |
| European Union | 21.7 PYE/MW | EWEA |
| California | 12.3 PYE/MW* | CALPIRG |
| Colorado | 5.4 PYE/MW | Colorado State University and The WSARE Program |
| Nevada | 7.7 PYE/MW* | REPP |
| The United States of America | 15.3 PYE/MW* | McKinsey |
| The United States of America | 10.0 PYE/MW* | EPRI |
| Global Average | 13.0 PYE/MW | Wei et al., 2010 |

* *Calculated from Wei et al., 2010.*

*Source: ClearSky Advisors 2011; Wei et al. 2010; EWEA, Wind at Work 2009; Colorado State University Cooperative Extension and the Western Sustainable Agriculture Research and Education (WSARE) Program, Wind Energy in Colorado*

As a comparison, the 14.1 PYE per MW forecasted for Ontario falls within the reported range of 5.4PYE per MW to 21.7 PYE per MW reported for wind energy generation and is slightly higher than the peer-reviewed global average of 13.0 PYE per MW reported by Wei et al. (2010) and shown in Table 4.3[18]. This slightly higher number for Ontario could be explained by the domestic content requirements of the FIT program, which were reflected in our calculations.

[18] Wei, M., Patadia, S., Kammen, D. 2010. Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US? Energy Policy. 38: 919-931; The European Wind Energy Association (EWEA). (2009). Wind at Work, Wind energy and job creation in the UE; Colorado State University Cooperative Extension and the Western Sustainable Agriculture Research and Education (WSARE) Program, Wind Energy in Colorado.

## 4.3 Economic Benefits& Market Value

### 4.3.1 Market Size &Value for Ontario

#### *4.3.1.1 Size of Market Opportunity for Wind Energy Sector Supply Chain in Ontario*

A significant amount of all goods and services purchased by the Ontario wind energy sector will be produced in Ontario. In general, the wind energy sector tends to spend locally on construction, manufacturing, development, operation, and maintenance. Domestic content requirements in the FIT program in Ontario are reinforcing this approach and will drive further local spending on manufacturing and professional services. From 2011-2018, it is anticipated that over $8.5billion will have been captured by the Ontario-based wind energy sector supply chain, as demonstrated in Table 4.4. The investment into the wind energy generation sector is different from many other investments made in public infrastructure in Ontario as it is entirely from the private sector, to be paid back by the rate-payer if, and only if, the wind turbine installations produce power.

Table 4.4: Economic Value of the Ontario-Based Wind Energy Sector Supply and Value Chain ($Millions)

| Economic Value of the Ontario-Based Wind Energy Sector Supply and Value Chain, 2011-2018 ($Millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Ontario-Based* | $528 | $662 | $729 | $1,494 | $1,237 | $1,425 | $1,213 | $1,215 | $8,503 |
| | *Industry-Wide* | $1,433 | $1,260 | $1,367 | $2,781 | $2,318 | $2,673 | $2,293 | $2,303 | $16,427 |
| High Scenario | *Ontario-Based* | $665 | $689 | $1,009 | $1,685 | $1,500 | $1,570 | $1,648 | $1,589 | $10,355 |
| | *Industry-Wide* | $1,797 | $1,314 | $1,885 | $3,136 | $2,806 | $2,947 | $3,100 | $3,003 | $19,988 |
| Low Scenario | *Ontario-Based* | $397 | $581 | $448 | $795 | $406 | $502 | $272 | $49 | $3,451 |
| | *Industry-Wide* | $1,082 | $1,108 | $847 | $1,490 | $779 | $958 | $536 | $127 | $6,928 |

*Source: ClearSky Advisors 2011*

##### 4.3.1.1.1 Market Size for Service & Supply Chain During Construction

The market size of the supply chain serving the construction phase of Ontario's wind energy generation sector, demonstrated in Table 4.5, makes up the vast majority of spending in the industry:

- Most of this spending will be on the wind turbine nacelle (described in Chapter 3.2).
- By 2018, it is expected that almost $8.1billion will be spent on the construction phase Ontario-based service and supply chain, as shown in Table 4.5.

Table 4.5: Economic Value of the Ontario Based Wind Energy Sector Construction Phase Supply Chain ($Millions)

| Economic Value of the Construction Phase Supply Chain, 2011-2018 (Millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Ontario-Based* | $513 | $642 | $692 | $1,444 | $1,177 | $1,354 | $1,132 | $1,123 | $8,077 |
| | *Industry-Wide* | $1,366 | $1,178 | $1,269 | $2,649 | $2,159 | $2,483 | $2,076 | $2,060 | $15,240 |
| High Scenario | *Ontario-Based* | $648 | $669 | $968 | $1,629 | $1,431 | $1,489 | $1,553 | $1,481 | $9,868 |
| | *Industry-Wide* | $1,726 | $1,227 | $1,775 | $2,988 | $2,625 | $2,731 | $2,848 | $2,716 | $18,637 |
| Low Scenario | *Ontario-Based* | $383 | $563 | $416 | $756 | $364 | $456 | $223 | $- | $3,161 |
| | *Industry-Wide* | $1,020 | $1,033 | $762 | $1,387 | $668 | $836 | $409 | $- | $6,116 |

*Source: ClearSky Advisors 2011*

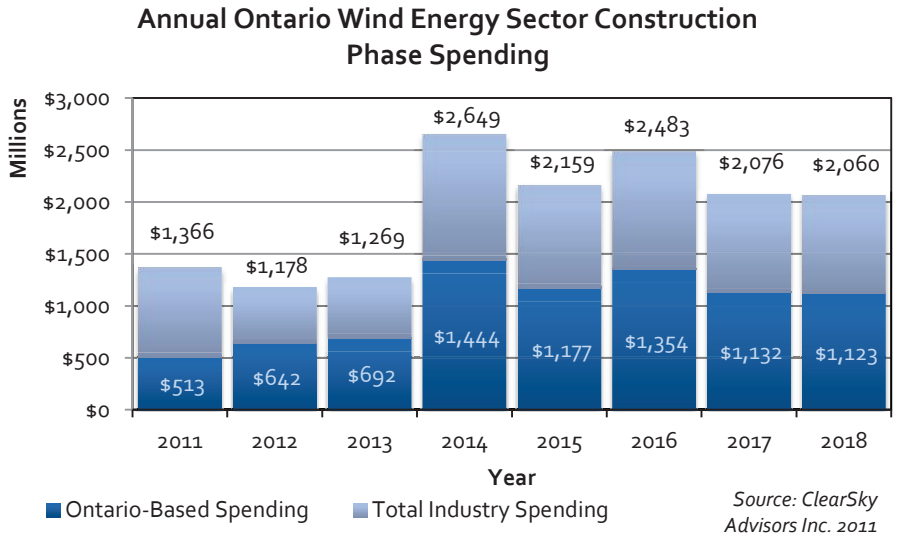



Figure 4.9: Expected Annual Ontario Wind Energy Sector Construction Phase Spending, 2011-2018

#### 4.3.1.1.2 Market Size for Operation & Maintenance in Ontario

The market size of the supply chain serving the O&M phase of Ontario's wind energy sector, shown in Table 4.6, makes up a smaller component of spending in the industry (relative to construction):

- O&M materials spending will far outweigh labour costs;
- By 2018 it is expected that over $1.1billion will be cumulatively spent on O&M services for wind turbine installations in Ontario; and
- It is expected that by 2018 $91.6million will be spent annually in Ontario due to O&M services.

Table 4.6: O&M Phase Spending due to the Ontario Wind Energy Sector by Segment, 2011-2018

| Economic Value of the O&M Phase Supply Chain, 2011-2018 (Millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Labour* | $6.5 | $7.9 | $9.5 | $12.8 | $15.4 | $18.5 | $21.1 | $23.6 | $115.2 |
| | *Materials* | $60.1 | $73.7 | $88.3 | $118.7 | $143.5 | $172.1 | $195.9 | $219.6 | $1,071.9 |
| | *Total* | $66.6 | $81.6 | $97.7 | $131.5 | $159.0 | $190.6 | $217.0 | $243.2 | $1,187.2 |
| High Scenario | *Labour* | $6.9 | $8.4 | $10.6 | $14.3 | $17.6 | $20.9 | $24.5 | $27.8 | $131.1 |
| | *Materials* | $64.3 | $78.4 | $98.8 | $133.2 | $163.4 | $194.8 | $227.5 | $258.7 | $1,219.2 |
| | *Total* | $71.3 | $86.9 | $109.5 | $147.5 | $180.9 | $215.7 | $252.0 | $286.6 | $1,350.3 |
| Low Scenario | *Labour* | $6.0 | $7.3 | $8.2 | $10.0 | $10.8 | $11.8 | $14.7 | $14.7 | $79.9 |
| | *Materials* | $56.1 | $68.0 | $76.7 | $92.7 | $100.3 | $110.0 | $112.2 | $112.2 | $732.0 |
| | *Total* | $62.1 | $75.3 | $85.0 | $102.6 | $111.1 | $121.8 | $127.0 | $127.0 | $811.9 |

*Source: ClearSky Advisors 2011*

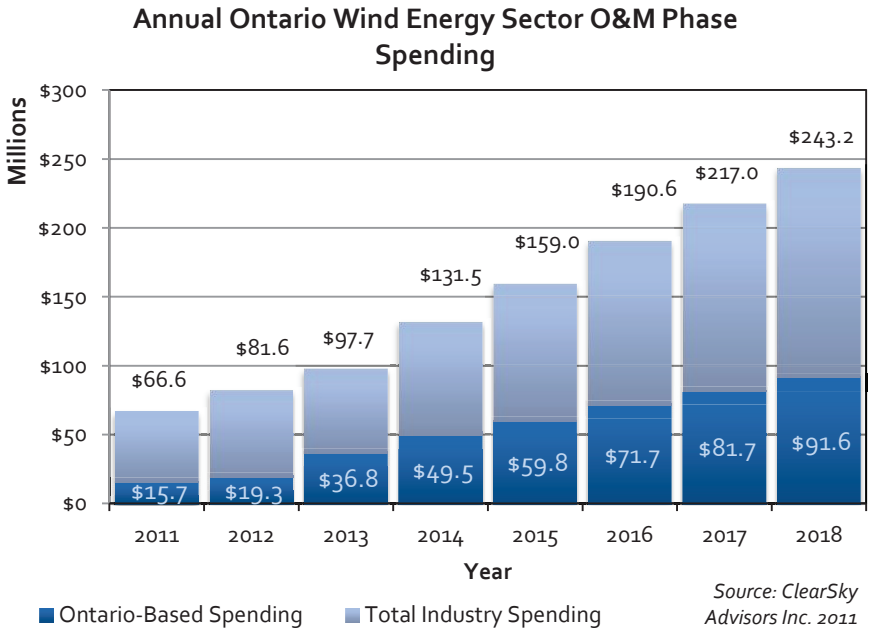



Figure 4.10: Expected Ontario Wind Energy Sector Cumulative O&M Phase Spending, 2011-2018

### 4.3.2 Economic Benefits for Landowners

Landowners with wind turbines on their property will also receive an economic benefit as a result of the wind energy sector in Ontario. Due to the dispersed nature of turbines for wind energy generation projects across many properties, income is distributed to landowners more widely relative to other, non-renewable sources of electricity and therefore a larger number of individuals in the community benefit. On average an annual lease payment of $19,334 is received by landowners for every MW of installed wind energy capacity on their property. Our research indicated that lease payments can range

from under $10,000 to nearly $30,000 per MW. The value of agreed upon lease payments typically is project specific and greatly depends upon:

- Market conditions (i.e. demand for quality sites has increased over time as supply has decreased);
- Wind energy procurement program (i.e. RES, RESOP, FIT, etc.);
- Quality of wind resource;
- Ease of access to the land; and
- Other project specific location characteristics.

From 2011-2018, it is expected that over $313million will be paid to landowners in lease payments due to the wind energy sector in Ontario, as demonstrated in Table 4.7. For wind energy generation capacity installations from 2011-2018, it is expected that over $1billion will be paid in land leases to landowners in Ontario by the end of the 20-year generation contracts[19].

- Total private sector investment, demonstrated in Table 4.7, as a result of installations in 2011-2018, will reach over $1.1billion (based on 20 year contracts):
    - Over $1billion of this total will be through lease payments to landowners

**Table 4.7: Economic Benefits to Landowners and Municipalities**

| Economic Benefits to Landowners and Municipalities from New Wind Turbine Installations (2011-2018) | | | | |
|---|---|---|---|---|
| | | **Lease Payments** | **Municipal Taxation**** | **Total** |
| **Average Annual Payment** | *Per MW* | $19,334* | $1,302 | $20,636 |
| | *Per Turbine* | $41,271 | $2,779 | $44,050 |
| **Expected Scenario** | *Total Payments from 2011-2018* | $313,936,159 | $44,792,293 | $358,728,452 |
| | *20-Year Payments (from 2011-2018 installations)* | $1,027,745,099 | $147,710,917 | $1,175,456,017 |
| **High Scenario** | *Total Payments from 2011-2018* | $357,080,534 | $50,969,381 | $408,049,915 |
| | *20-Year Payments (from 2011-2018 installations)* | $1,256,927,721 | $180,693,145 | $1,437,620,866 |
| **Low Scenario** | *Total Payments from 2011-2018* | $214,691,479 | $30,540,836 | $245,232,314 |
| | *20-Year Payments (from 2011-2018 installations)* | $412,990,330 | $59,071,665 | $472,061,995 |

* *This is an average lease payment value. Our research indicated that lease payments for wind turbine installations can range from under $10,000 to nearly $30,000 per MW.*

** *Minimum municipal taxation payments as calculated based upon the property assessment of wind turbines according to the Municipal Property Assessment Corporation and multiple 2010 municipal tax rates across Ontario.*

*Source: ClearSky Advisors 2011; Statistics Canada 2010*

[19] The economic benefit calculated for landowners does not include any effects on property values.

### 4.3.3 Economic Benefits for Communities

In addition to supporting spending and employment in the province, the wind energy sector will affect municipal tax bases. Minimally, the economic benefit to communities from taxation on expected wind turbine installations will generate over $44million of tax revenue for Ontario municipalities from 2011-2018, as demonstrated in Table 4.7. For expected wind energy generation capacity installations from 2011-2018, nearly $148million of taxation payments will be made to Ontario municipalities by the end of the 20 year generation contracts[20].

The property assessment, for taxation purposes, of wind turbine installations in Ontario is determined by the Municipal Property Assessment Corporation. In Ontario, only the wind turbine tower is subjected to property taxation; meaning that the blades, nacelle, and foundation are exempt. Additionally, the taxable value for a wind turbine tower is fixed at $40,000 per MW of generation capacity. Moreover, it is assumed that each installed turbine requires one acre of land and the land upon which the turbine sits is assessed in the same manner as the immediately surrounding land. Thus, property assessment of wind turbine installations in Ontario is calculated according to:

$$Assessment = (\$40{,}000 \times MW\ of\ Installed\ Capacity) + (\#\ of\ Turbines \times Cost\ of\ Land\ per\ Turbine)$$

Payable municipal property taxes are calculated using the property assessment of the wind turbine installation and the industrial property tax rate in the municipality.

In addition to taxation other municipal benefits have been observed in the province. In some instances the necessary privately funded infrastructure investments (such as roadway improvements) required for wind turbine installations provide opportunities at the community level. These investments are regularly maintained throughout the project lifetime. Additionally, some developers and municipalities agree upon amenity fees to be paid by the developer, which may take a variety of forms, ranging from a percentage of gross revenue to the construction of community centres and arenas. These provide additional benefits, beyond lease payments and municipal taxation, to the entire community as a whole but are difficult to quantify as part of this report.

In many cases the non-taxation benefits to communities can often meet or exceed the taxation benefits to municipalities.

[20] Anticipated Taxation was calculated based upon multiple 2010 municipal tax rates across the province as well as the value of farm land from Statistics Canada (Statistics Canada. (2010). Value of Farm Capital.)

## 4.4 100 MW Project Sample

To illustrate the findings in this report we have created an example of what could be expected for a typical 100 MW nameplate capacity wind energy generation project to be installed in Ontario. For this example we assume:

- The project is awarded at the beginning of year 1;
- Services (developmental and other) take place in years 1 and 2;
- Sufficient lead-time is provided to allow for manufacturing to mainly take place in years 1 and 2;
- Construction is not performed over the winter and is a 2 year process;
    - Foundation and infrastructure work is completed in year 2
    - Turbine erection is completed in year 3
- The project will be connected and generating at the end of year 3;
- O&M work will begin at the beginning of year 4 and last for 20 years; and
- Tax payments and lease payments to landowners will begin in year 4 and last for 20 years.

Table 4.8: Summary of 100 MW Project Sample Costs, Benefits, and Employment

| 100 MW Project Sample Costs, Benefits, and Employment | | |
|---|---|---|
| **Expected Cost** | *Total Lifetime Cost (in 2011 $)* | $337,530,679 |
| | *Total 20 Year O&M Cost* | $68,501,669 |
| | *Total Expected Installation Cost* | $269,029,010 |
| **20 Year Economic Benefits to Landowners and Municipalities** | *Total 20 Year Economic Benefits* | $41,271,945 |
| | *20 Year Lease Payments* | $38,668,407 |
| | *20 Year Tax Payments* | $2,603,538 |
| **Expected PYE** | *Total* | 1,416 |
| | *Construction Phase* | 1,052 |
| | *O&M Phase* | 363 |

*Source: ClearSky Advisors 2011*

- The total lifetime costs to the developer (including all-in installed costs and a 20-year O&M service agreement) would be nearly $338million;
- Over $41million in economic benefits to landowners and municipalities will be realized by the end of the contract; and
- 1,416 PYE will be created over the entire 23 year project timespan.

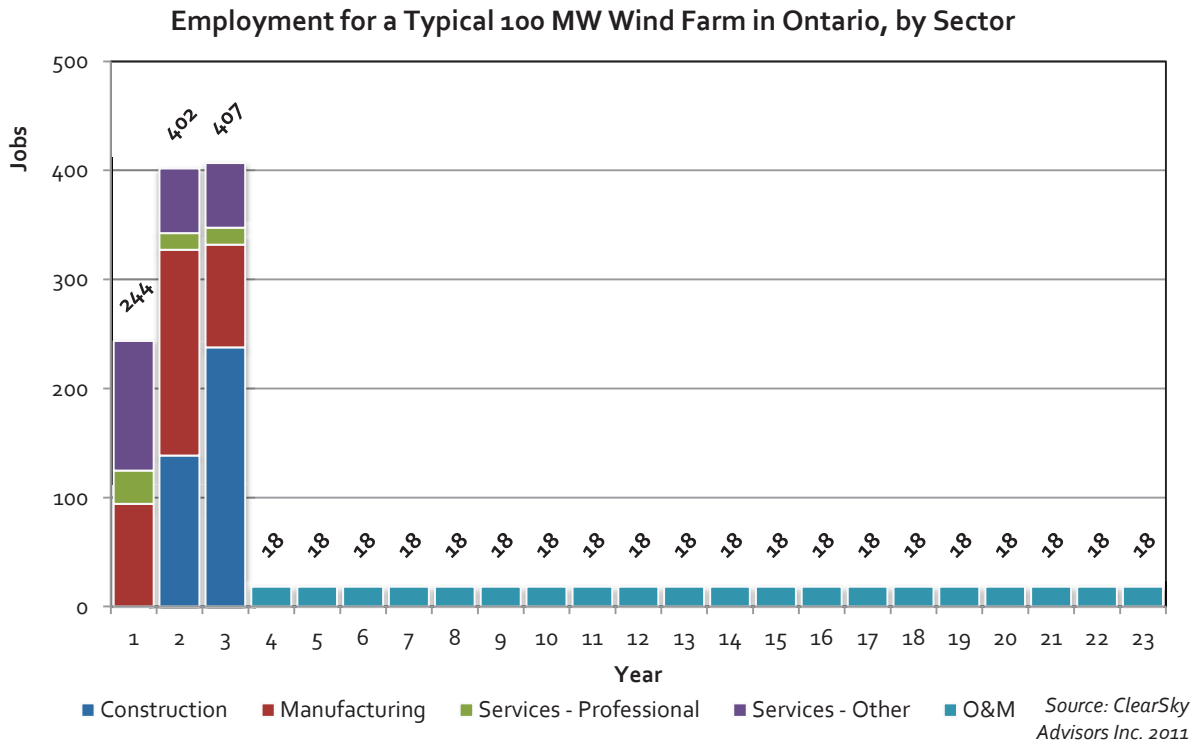



Figure 4.11: Expected Employment by Sector and Time for a Typical 100 MW Wind Farm in Ontario[21]

[21] For the purposes of this model direct and indirect employment were assumed to occur at the same time. As such, there is no differentiation between these two employment categories in this measure of employment.

# Appendix

Table A.1: Ontario's Electricity Market Forecast by Generation Type, 2010-2018

| Ontario's Electricity Market Forecast 2010-2018 (TWh) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| Total Demand | 148.7 | 150.9 | 152.9 | 154.8 | 156.8 | 158.7 | 160.9 | 163.2 | 165.5 |
| Conservation | 6.7 | 8.0 | 9.2 | 10.5 | 11.7 | 13.0 | 14.6 | 16.2 | 17.8 |
| Nuclear Generation | 82.9 | 88.3 | 93.8 | 93.8 | 93.8 | 93.8 | 75.5 | 69.1 | 61.6 |
| Coal Generation | 12.6 | 7.5 | 7.5 | 6.1 | 2.6 | - | - | - | - |
| Natural Gas Generation | 20.5 | 22.6 | 22.9 | 23.2 | 23.5 | 23.8 | 24.1 | 24.5 | 24.8 |
| Hydro Generation | 30.7 | 30.9 | 30.9 | 31.0 | 31.4 | 33.1 | 33.1 | 33.1 | 33.1 |
| Wind Generation | 2.8 | 4.4 | 5.4 | 6.5 | 8.8 | 10.6 | 12.7 | 14.5 | 16.2 |
| Other Types of Generation | 1.3 | 1.9 | 2.7 | 4.2 | 4.7 | 5.1 | 5.4 | 5.7 | 5.9 |
| Net Export | 8.8 | 12.7 | 19.6 | 20.4 | 19.7 | 20.7 | 4.5 | (0.2) | (6.1) |

*Sources: ClearSky Advisors 2011; OPA, IPSP Planning and Consultation Overview 2011; OPA, Ontario's Long Term Energy Plan 2010; IESO, 18 Month Outlook December 2010*

Table A.2: The OPA's Domestic Content Grid as Classified by Ontario's Wind Energy Sector Supply Chain

| The OPA's Domestic Content Grid[22] | | | |
|---|---|---|---|
| **Designated Activity** | **Description** | **Domestic Content Qualifying Percentage** | **Supply Chain Classification** |
| **1** | Wind turbine blades | 16% | Blades |
| **2** | Pitch system | 3% | Nacelle |
| **3** | Yaw system | 7% | Nacelle |
| **4** | Hub and hub casing | 2% | Nacelle |
| **5** | Gearbox | 11% | Nacelle |
| **6** | Generator and brake | 3% | Nacelle |
| **7** | Heat exchanger | 1% | Nacelle |
| **8** | Drive shaft | 1% | Nacelle |
| **9** | Power converter | 5% | Nacelle |
| **10** | Towers | 4% | Towers |
| **11** | All steel that was formed and shaped into the towers | 9% | Towers |
| **12** | Control panel and electronics | 2% | Electrical |
| **13** | Nacelle frame | 2% | Nacelle |
| **14** | Nacelle shell | 2% | Nacelle |
| **15** | Pad mount or equivalent transformers | 2% | Transformer |
| **16** | Grid connection | 10% | HV Systems |
| **17** | Construction and on-site labour | 15% | Labour |
| **18** | Consulting services | 5% | Developmental |

*Sources: ClearSky Advisors 2011; OPA, Feed-In Tariff Contract 2010*

[22] The official domestic content grid, as part of the Feed-In Tariff contract is available at: http://fit.powerauthority.on.ca/Storage/11202_FIT_Contract_Version_1.4.pdf

Table A.3: Job Creation (PYE) in the Ontario Wind Energy Sector by Employment Segment, Expected Scenario 2011-2018

| Construction Phase | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Construction | *Direct* | 478 | 409 | 441 | 920 | 750 | 862 | 721 | 715 | 5,295 |
| | *Indirect* | 1,448 | 1,241 | 1,337 | 2,791 | 2,275 | 2,616 | 2,187 | 2,170 | 16,066 |
| Manufacturing | *Direct* | 332 | 880 | 948 | 1,979 | 1,613 | 1,855 | 1,551 | 1,539 | 10,696 |
| | *Indirect* | 332 | 881 | 949 | 1,981 | 1,615 | 1,856 | 1,552 | 1,540 | 10,706 |
| Professional Services | *Direct* | 237 | 196 | 211 | 440 | 359 | 412 | 345 | 342 | 2,542 |
| | *Indirect* | 87 | 72 | 78 | 162 | 132 | 152 | 127 | 126 | 935 |
| Other Services and Government | *Direct* | 773 | 665 | 716 | 1,495 | 1,219 | 1,401 | 1,171 | 1,163 | 8,604 |
| | *Indirect* | 436 | 376 | 405 | 845 | 689 | 792 | 662 | 657 | 4,861 |
| **O&M Phase** | | | | | | | | | | |
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Direct | | 831 | 863 | 930 | 1,941 | 1,582 | 1,819 | 1,521 | 1,510 | 10,998 |
| Indirect | | 753 | 753 | 811 | 1,694 | 1,381 | 1,588 | 1,328 | 1,318 | 9,625 |

*Source: ClearSky Advisors 2011*

Table A.4: Job Creation (PYE) in the Ontario Wind Energy Sector by Employment Segment, High Scenario 2011-2018

| Construction Phase | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Construction | *Direct* | 604 | 426 | 616 | 1,038 | 911 | 948 | 989 | 943 | 6,476 |
| | *Indirect* | 1,830 | 1,293 | 1,870 | 3,149 | 2,766 | 2,877 | 3,001 | 2,862 | 19,648 |
| Manufacturing | *Direct* | 419 | 917 | 1,326 | 2,233 | 1,961 | 2,040 | 2,128 | 2,029 | 13,053 |
| | *Indirect* | 420 | 917 | 1,327 | 2,235 | 1,963 | 2,042 | 2,130 | 2,031 | 13,065 |
| Professional Services | *Direct* | 300 | 204 | 295 | 497 | 436 | 454 | 473 | 451 | 3,110 |
| | *Indirect* | 110 | 75 | 108 | 183 | 160 | 167 | 174 | 166 | 1,143 |
| Other Services and Government | *Direct* | 977 | 692 | 1,002 | 1,687 | 1,482 | 1,541 | 1,608 | 1,533 | 10,522 |
| | *Indirect* | 551 | 391 | 566 | 953 | 837 | 871 | 909 | 866 | 5,945 |
| **O&M Phase** | | | | | | | | | | |
| | | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **Total** |
| **Direct** | | 1,050 | 899 | 1,301 | 2,190 | 1,924 | 2,001 | 2,087 | 1,990 | 13,442 |
| **Indirect** | | 952 | 784 | 1,135 | 1,911 | 1,679 | 1,747 | 1,822 | 1,738 | 11,766 |

*Source: ClearSky Advisors 2011*

Table A.5: Job Creation (PYE) in the Ontario Wind Energy Sector by Employment Segment, Low Scenario 2011-2018

| Construction Phase | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Construction | *Direct* | 357 | 359 | 265 | 482 | 232 | 290 | 142 | - | 2,126 |
| | *Indirect* | 1,082 | 1,089 | 803 | 1,462 | 704 | 881 | 431 | - | 6,451 |
| Manufacturing | *Direct* | 248 | 772 | 569 | 1,036 | 499 | 625 | 305 | - | 4,055 |
| | *Indirect* | 248 | 773 | 570 | 1,037 | 500 | 625 | 306 | - | 4,058 |
| Professional Services | *Direct* | 177 | 172 | 127 | 231 | 111 | 139 | 68 | - | 1,024 |
| | *Indirect* | 65 | 63 | 47 | 85 | 41 | 51 | 25 | - | 376 |
| Other Services and Government | *Direct* | 525 | 530 | 391 | 712 | 343 | 429 | 210 | - | 3,141 |
| | *Indirect* | 266 | 269 | 198 | 361 | 174 | 218 | 106 | - | 1,593 |
| **O&M Phase** | | | | | | | | | | |
| | | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **Total** |
| **Direct** | | 620 | 757 | 559 | 1,017 | 491 | 613 | 323 | - | 4,379 |
| **Indirect** | | 562 | 660 | 487 | 887 | 427 | 535 | 263 | - | 3,822 |

*Source: ClearSky Advisors 2011*

Table A.6: Supply Chain Value for the Ontario Wind Energy Sector, 2011-2018

| Wind Energy Sector Supply Chain for Ontario, 2011-2018 ($Millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Construction Phase* | $1,366 | $1,178 | $1,269 | $2,649 | $2,159 | $2,483 | $2,076 | $2,060 | $15,240 |
| | *O&M Phase* | $67 | $82 | $98 | $131 | $159 | $191 | $217 | $243 | $1,187 |
| | *Ontario-Based Total Value* | $528 | $662 | $729 | $1,494 | $1,237 | $1,425 | $1,213 | $1,215 | $8,503 |
| | *Industry-Wide Total Value* | $1,433 | $1,260 | $1,367 | $2,781 | $2,318 | $2,673 | $2,293 | $2,303 | $16,427 |
| High Scenario | *Construction Phase* | $1,726 | $1,227 | $1,775 | $2,988 | $2,625 | $2,731 | $2,848 | $2,716 | $18,637 |
| | *O&M Phase* | $71 | $87 | $109 | $148 | $181 | $216 | $252 | $287 | $1,350 |
| | *Ontario-Based Total Value* | $665 | $689 | $1,009 | $1,685 | $1,500 | $1,570 | $1,648 | $1,589 | $10,355 |
| | *Industry-Wide Total Value* | $1,797 | $1,314 | $1,885 | $3,136 | $2,806 | $2,947 | $3,100 | $3,003 | $19,988 |
| Low Scenario | *Construction Phase* | $1,020 | $1,033 | $762 | $1,387 | $668 | $836 | $409 | - | $6,116 |
| | *O&M Phase* | $62 | $75 | $85 | $103 | $111 | $122 | $127 | $127 | $812 |
| | *Ontario-Based Total Value* | $397 | $581 | $448 | $795 | $406 | $502 | $272 | $49 | $3,451 |
| | *Industry-Wide Total Value* | $1,082 | $1,108 | $847 | $1,490 | $779 | $958 | $536 | $127 | $6,928 |

*Source: ClearSky Advisors 2011*

Table A.7: Total Construction Phase Spending due to the Ontario Wind Energy Sector, Expected Scenario 2011-2018

| Total Ontario Wind Energy Sector Construction Phase Spending, 2011-2018 (Millions) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Equipment** | | | | | | | | | |
| | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **Total** |
| **Nacelle** | $549 | $476 | $513 | $1,070 | $872 | $1,003 | $839 | $832 | $6,154 |
| **Blades** | $121 | $105 | $113 | $236 | $192 | $221 | $185 | $183 | $1,356 |
| **Towers** | $167 | $144 | $155 | $325 | $265 | $304 | $254 | $252 | $1,866 |
| **Transportation** | $135 | $117 | $126 | $262 | $214 | $246 | $205 | $204 | $1,508 |
| **Balance of Plant** | | | | | | | | | |
| | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **Total** |
| **Materials** | $204 | $175 | $188 | $393 | $320 | $368 | $308 | $306 | $2,262 |
| **Labour** | $131 | $112 | $121 | $252 | $205 | $236 | $197 | $196 | $1,448 |
| **Developmental** | $60 | $50 | $54 | $112 | $91 | $105 | $88 | $87 | $646 |

*Source: ClearSky Advisors 2011*

Note: This table represents construction phase spending for projects installed in each given year as indicated above. This spending may not all occur in that year, but would likely occur over the course of 2-3 years prior to commercial operation date (COD).

Table A.8 :Economic Value of the Ontario-Based Wind Energy Sector O&M Phase Supply Chain for 20-Year Generation Contracts ($Millions)

| 20-Year Economic Value of the O&M Phase Supply Chain, 2011-2018 (Millions) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
| Expected Scenario | *Ontario-Based* | $84 | $71 | $122 | $254 | $207 | $238 | $199 | $197 | $1,371 |
| | *Industry-Wide* | $354 | $300 | $323 | $675 | $550 | $632 | $528 | $525 | $3,886 |
| High Scenario | *Ontario-Based* | $106 | $74 | $170 | $286 | $252 | $262 | $273 | $260 | $1,683 |
| | *Industry-Wide* | $447 | $312 | $452 | $761 | $668 | $695 | $725 | $692 | $4,753 |
| Low Scenario | *Ontario-Based* | $62 | $62 | $73 | $133 | $64 | $80 | $40 | - | $515 |
| | *Industry-Wide* | $264 | $263 | $194 | $353 | $170 | $213 | $104 | - | $1,562 |

*Source: ClearSky Advisors 2011*

Note: This table represents the total O&M phase spending for projects installed in each given year as indicated above. This spending will not all occur in that year, but will occur over the course of the 20 year generation contracts. For a more detailed breakdown of likely spending by year see Table A.6.

## About ClearSky Advisors

ClearSky Advisors is an independent research and advisory firm focused on renewable energy markets. The firm was formed by experienced executives and consultants that have worked with many of the world's largest and most respected energy, technology, and manufacturing companies. The founders and principle consultants have been responsible for more than $100M of research activities over the past two decades. Adding to that, our founders and analysts have expertise in strategy development, business planning, project management, quantitative and qualitative research, process design, and research methods.

Through a variety of research and consulting projects in the renewable energy field, ClearSky Advisors has developed specific expertise in the renewable energy markets in general (in Ontario, Germany, and the US) and the Ontario renewable energy market in particular.

ClearSky Advisors' clients include energy sector equipment and materials manufacturers, project developers, EPC providers, investors and governments.