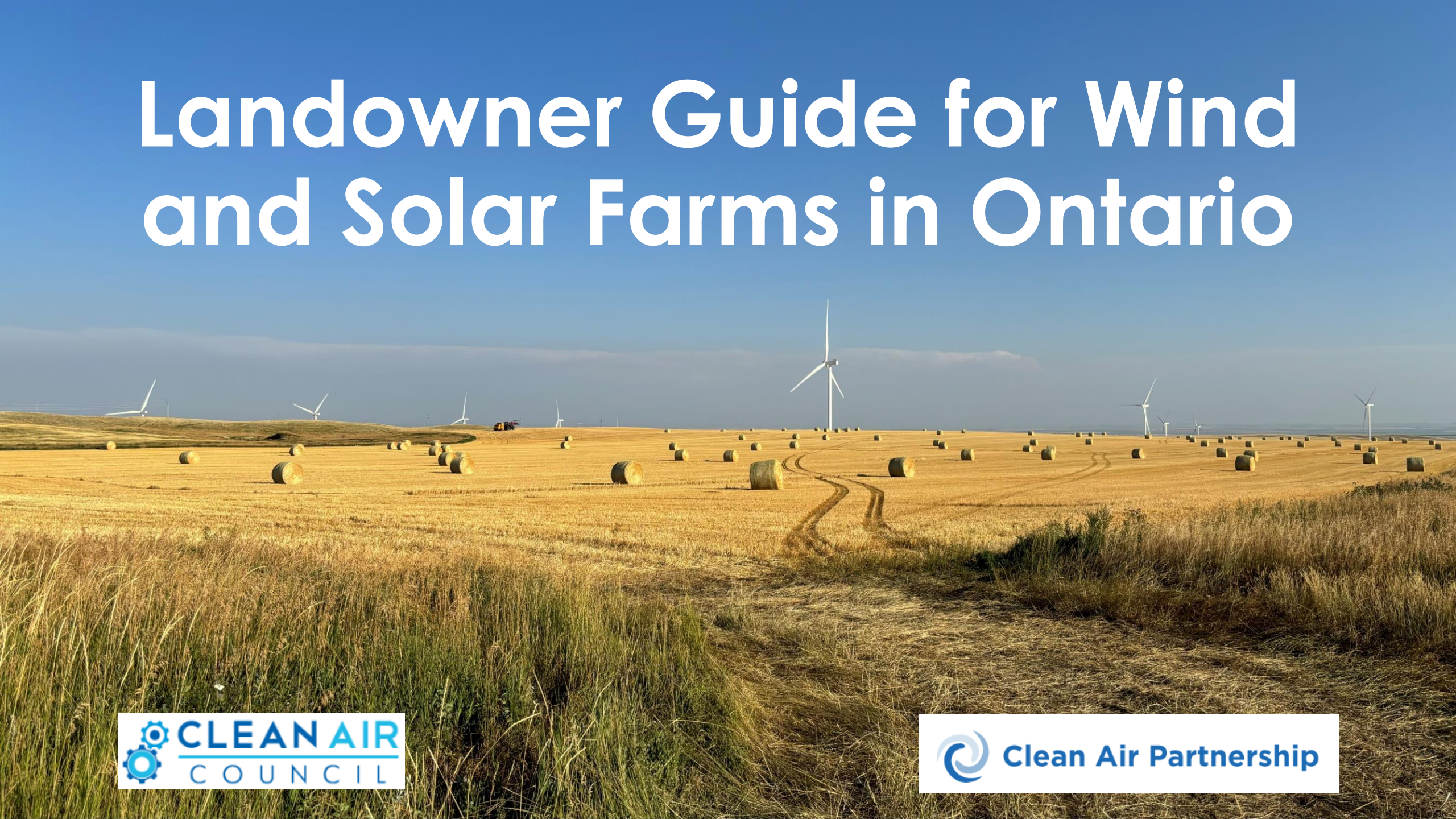
Landowner Guide for Wind and Solar Farms in Ontario



CLEAN AIR COUNCIL

Clean Air Partnership

Purpose of Landowner Guide

Help understand utility-scale renewable energy development

- Renewable energy growth
- Renewable technology basics
- Energy impacts
- Type of benefits and royalties
- Project development timelines
- Ontario permitting processes
- Questions to ask developers

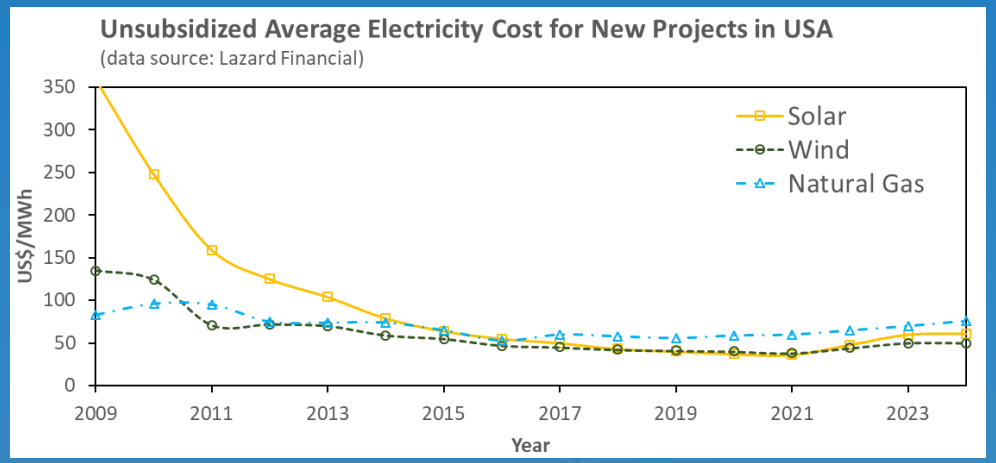
These slides act as a summary of the Landowners Guide document.

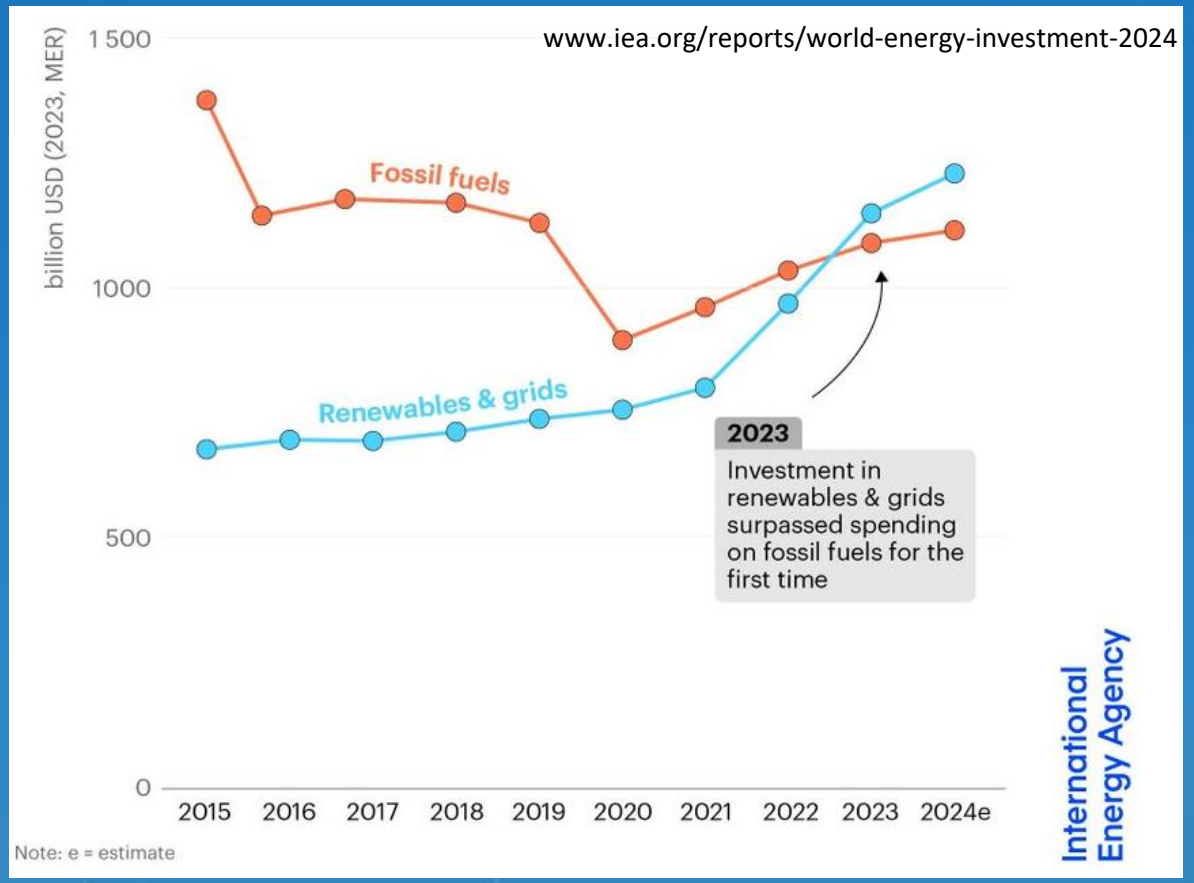
PART ONE – BACKGROUND

- Why wind and solar are growing
- Basic operating principles
- Major components and commercial layout

Renewable Energy is Growing Fast!

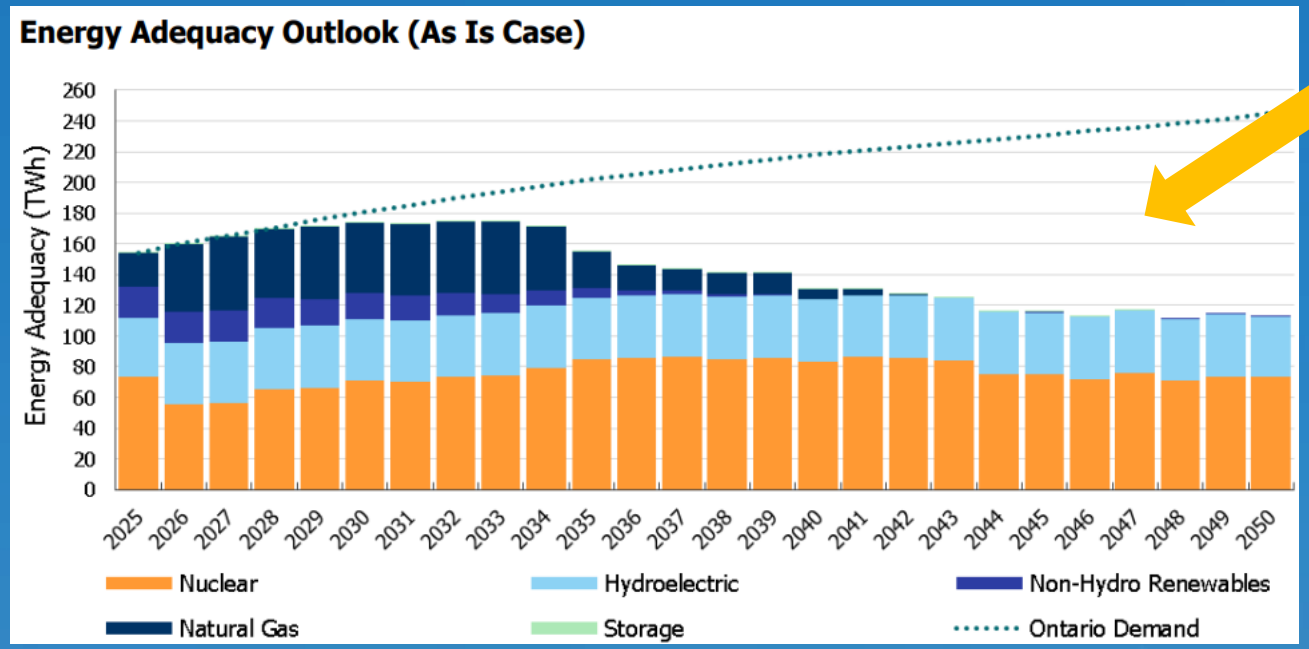
Wind and solar are being built around the world because they have become low cost, and have low life-cycle GHG emissions.





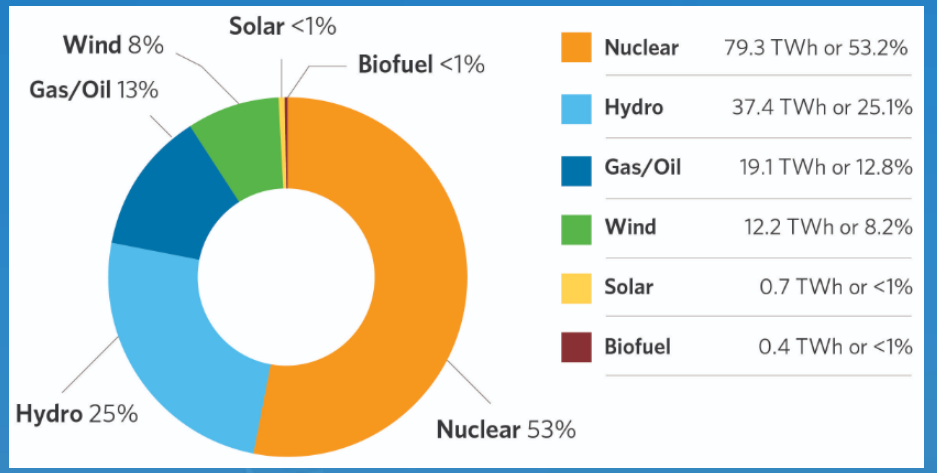
Wind + Solar Supply About 10% Energy in Ontario

Growing demand, and low costs will likely mean growth for both wind and solar in Ontario in coming decades.



New Ontario supply required

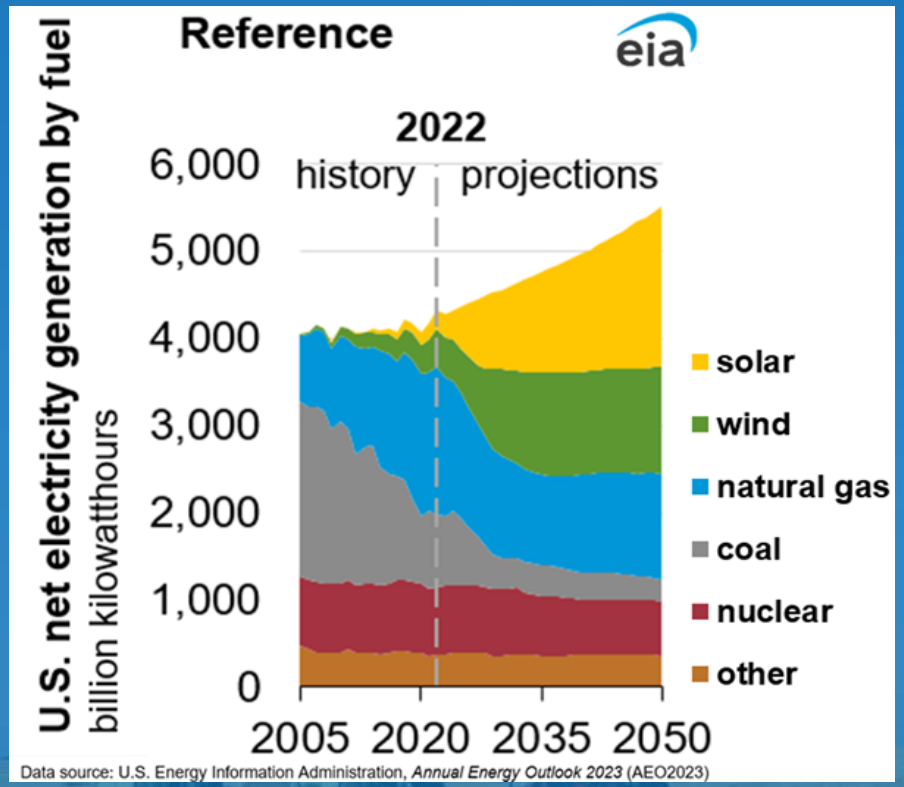
Source: IESO (2024) Annual Planning Outlook

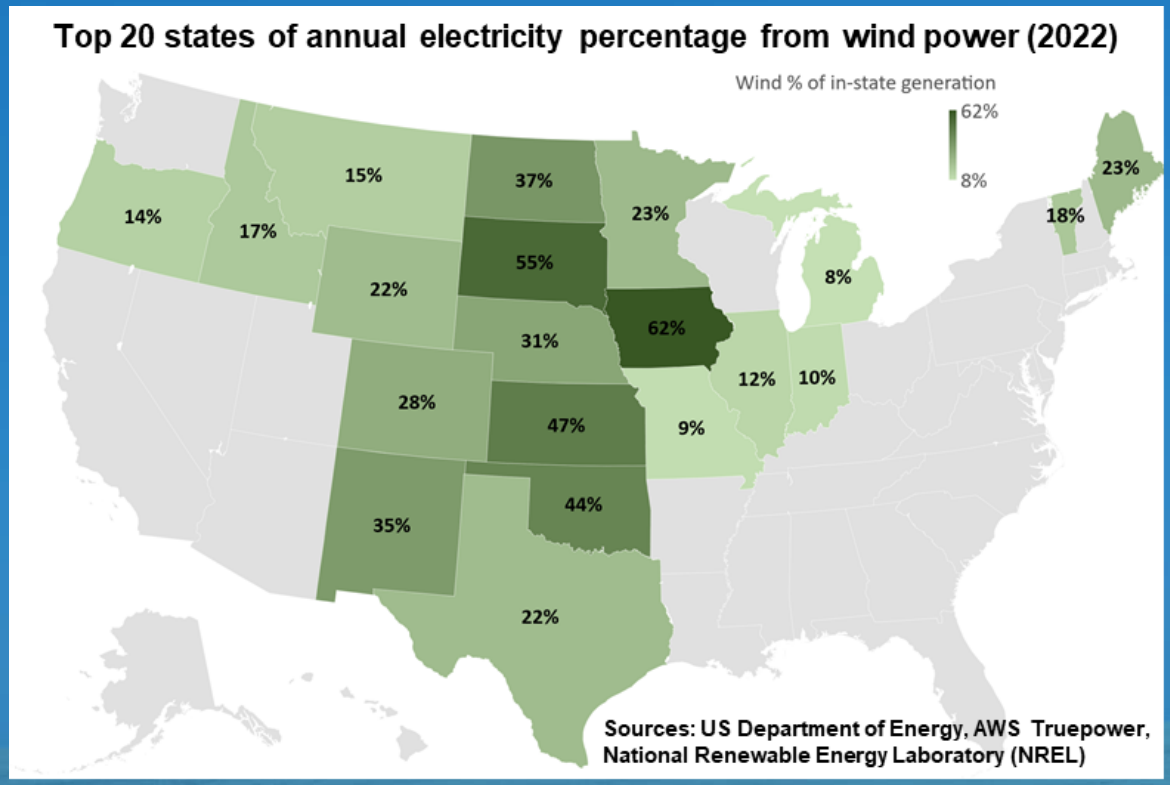


Source: IESO (2024) Supply Overview, Transmission Connected Generation

Ontario Is Not Alone

Renewable energy has recently overtaken both nuclear and coal electricity generation in the United States.





Renewable Energy Basics

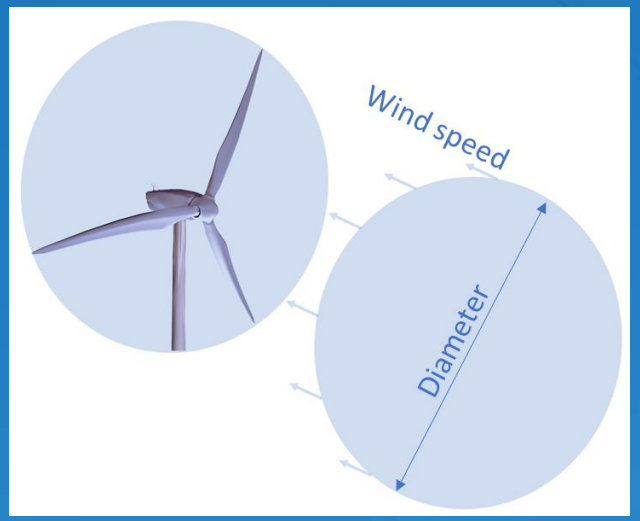
Working principles of wind and solar

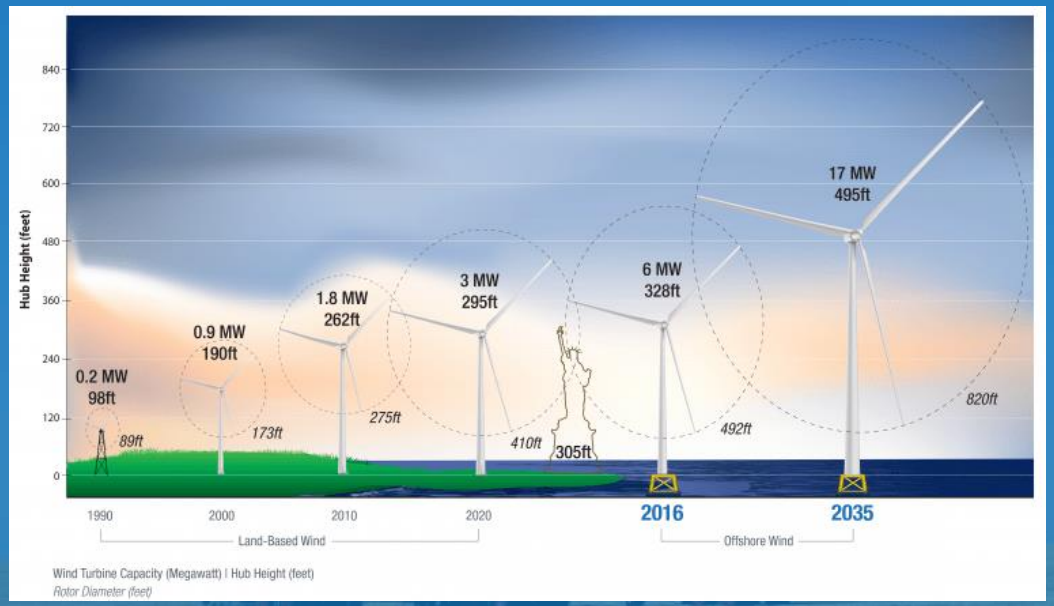
- Basic design features
- Size and layout

Why Are Wind Turbines So Large?

The following equations gives the maximum power available in the wind:

$$P_{wind} = \frac{1}{2}(\text{air density})\frac{\pi}{4}(\text{diameter})^2(\text{wind speed})^3$$

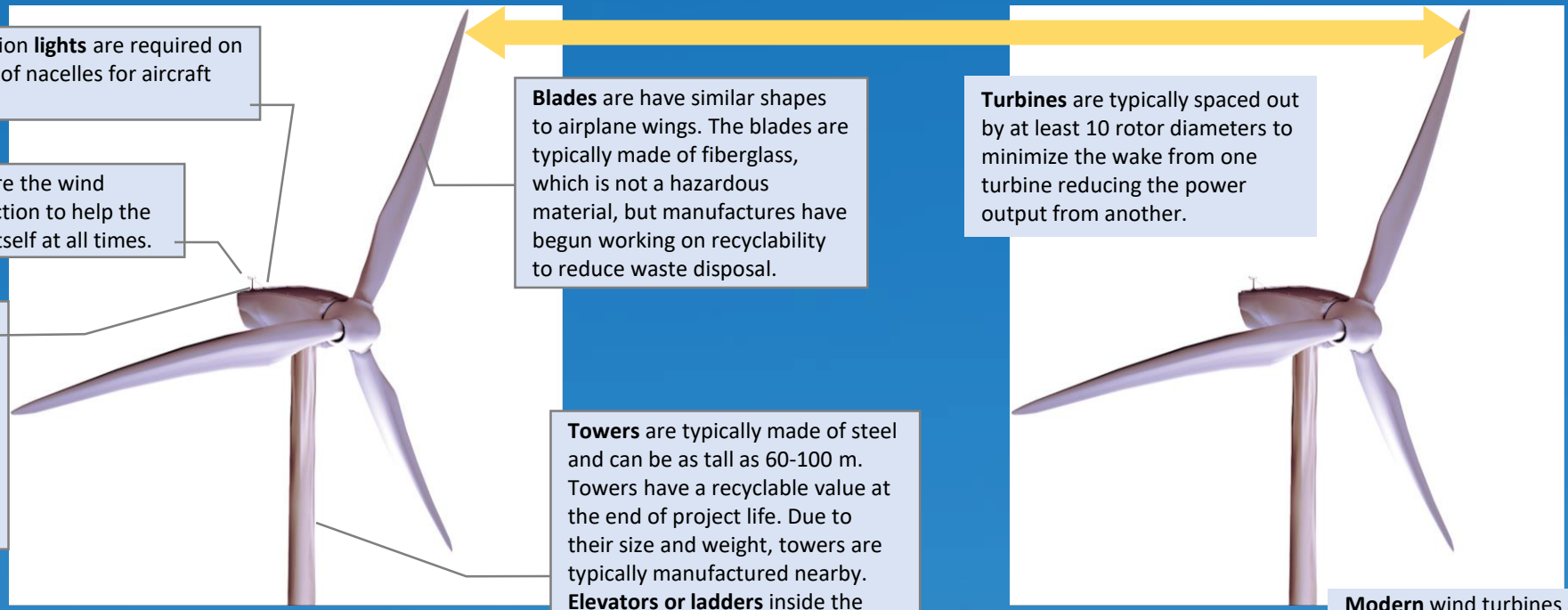




Size and **wind speed** are very important

- Taller turbines can hold larger rotors and harvest stronger winds that tend to be at higher altitudes.
- Larger turbines lower costs, and mean fewer are required.

Components of a Wind Turbine



Navigation **lights** are required on the top of nacelles for aircraft safety.

Sensors measure the wind speed and direction to help the turbine orient itself at all times.

The **nacelle** houses the main components of the electrical machinery. Nacelle or **'hub height'** is of commonly used to reference how tall wind turbines are off the ground, not including their blades.

Blades are have similar shapes to airplane wings. The blades are typically made of fiberglass, which is not a hazardous material, but manufactures have begun working on recyclability to reduce waste disposal.

Towers are typically made of steel and can be as tall as 60-100 m. Towers have a recyclable value at the end of project life. Due to their size and weight, towers are typically manufactured nearby. **Elevators or ladders** inside the tower allow workers to reach the nacelle for routine maintenance which is typically a 2-4 times per year for each turbine.

Turbines are typically spaced out by at least 10 rotor diameters to minimize the wake from one turbine reducing the power output from another.

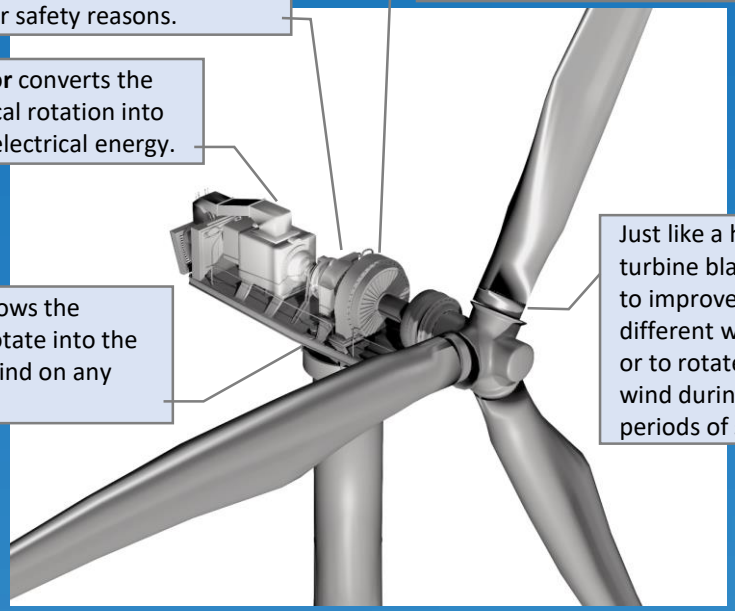
Modern wind turbines are often rated anywhere between 3-6 MW. A typical 150 MW wind farm might need 30-50 large turbines and can generate the equivalent amount of electricity consumed by over 55,000 Ontario homes.

Components of a Wind Turbine

Brake allows rotor to be stopped for maintenance or safety reasons.

Gear box increases the shaft speed so the generator rotates much faster than the blades do.

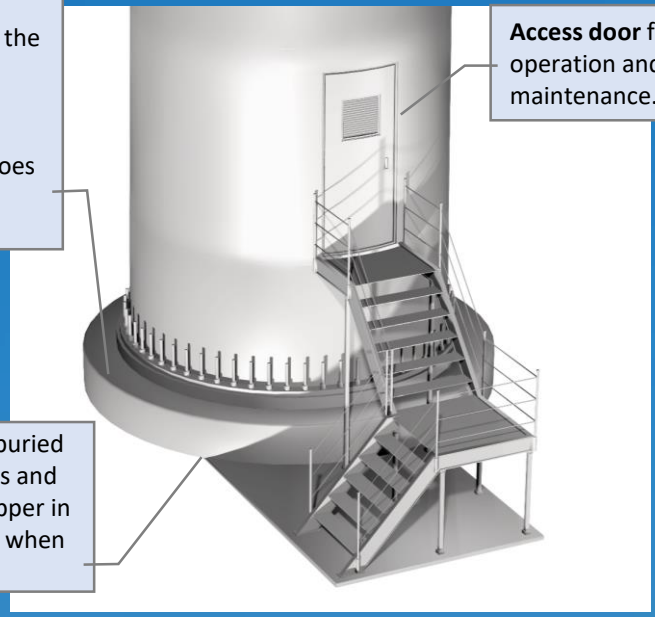
Generator converts the mechanical rotation into 3-phase electrical energy.



Just like a helicopter, turbine blades can **pitch** to improve efficiency in different wind speeds, or to rotate out of the wind during storms or periods of shutdown.

Yaw ring allows the nacelle to rotate into the prevailing wind on any given day.

The **foundation** is made of cement with steel rebar and buried below ground. When the find farm is decommissioned, typically the top several meters are removed so land can be farmed again. The cement that remains is inert and does not pose long term contamination hazards.

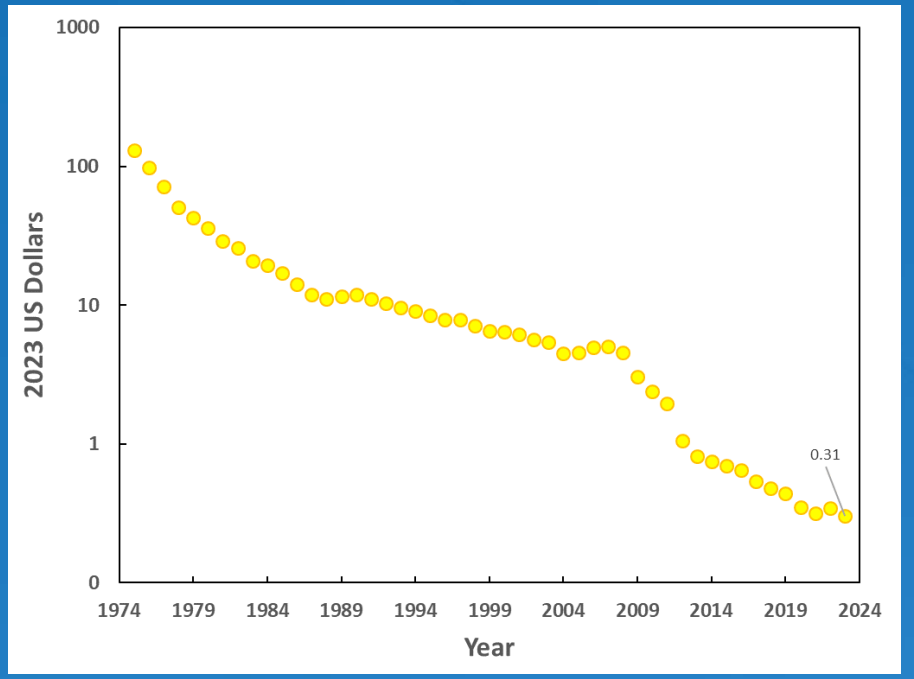


Access door for routine operation and maintenance.

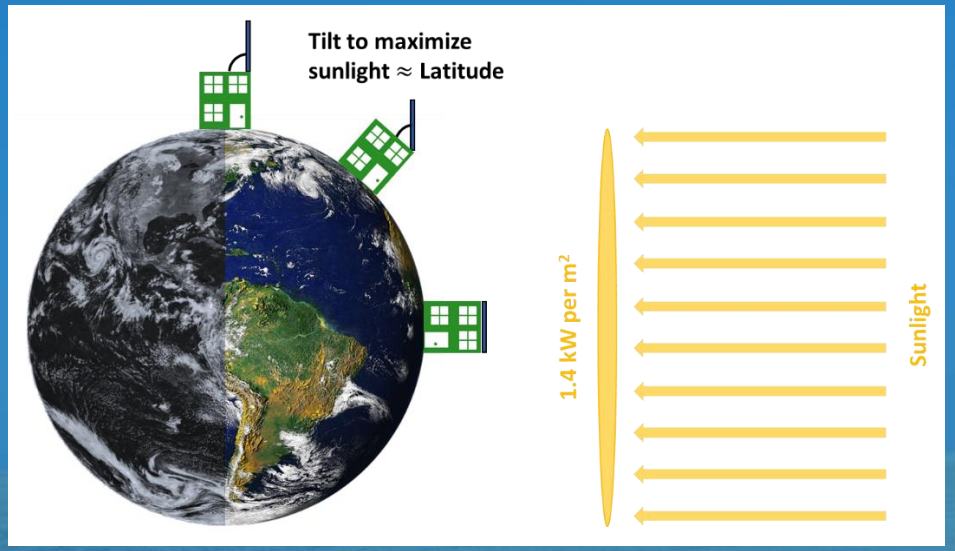
The **wires** are typically buried underneath the turbines and cannot be seen. The copper in the wires is salvageable when the project ends.

Solar PV

- Solar photovoltaics (often called PV), have gone from being the some of the most expensive electricity 20 years ago, to being one of the lowest cost today.
- Solar resource depends on how directly the sunlight hits the panels, as well as how cloudy the region is on average.

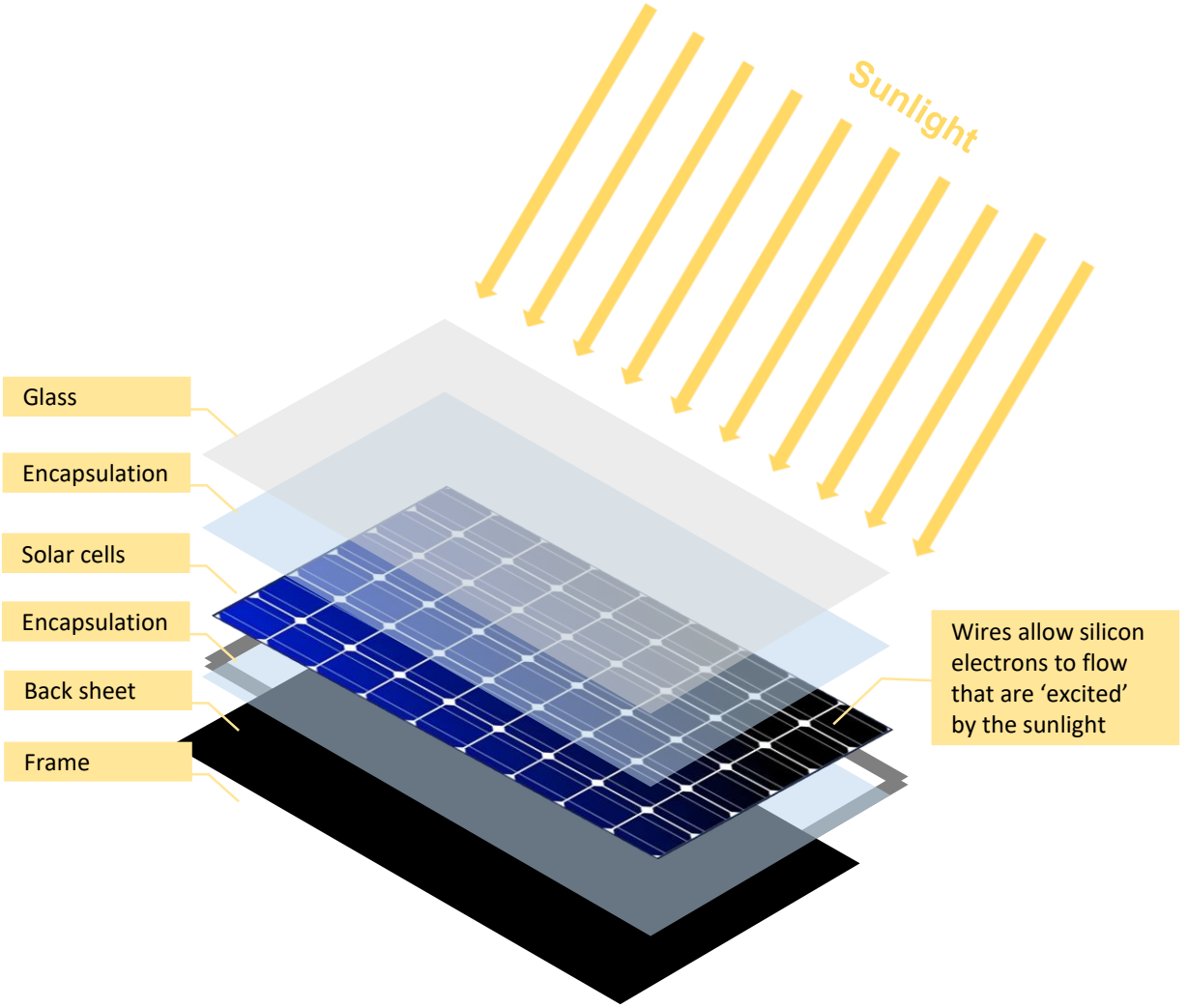


Solar module costs have fallen by over 90% since the mid-1970s (data source: Our World In Data, 2024)



Solar Modules

- Solar cells are primarily made of silicon (one of the most abundant materials on Earth), and convert sunlight directly in DC electricity.
- Typical commercial solar modules are 500 – 700 W and around 2 m long and 1 m wide.
- Solar is so low cost to manufacture, commercial modules often have cells on the back side to capture reflected light! These are called bifacial modules.



Components of a solar module

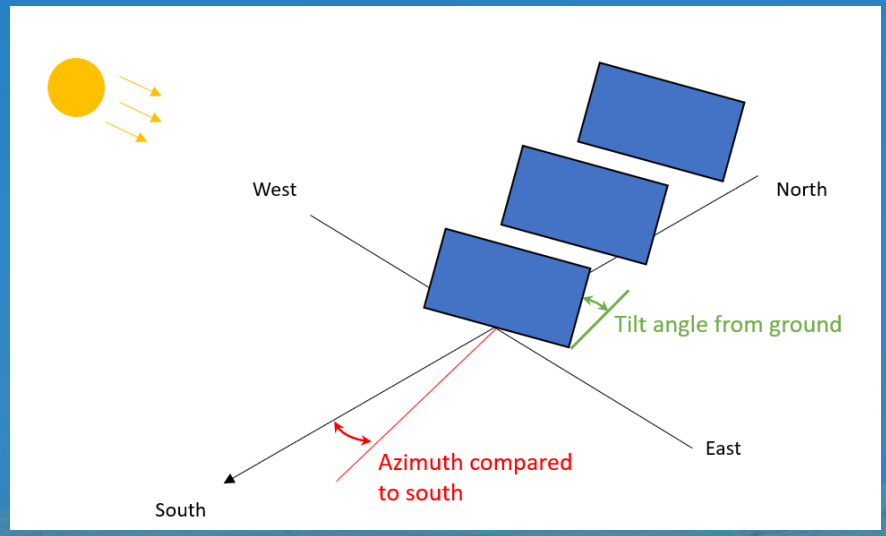
Solar Farm Layout

Solar modules can be mounted in a fixed position (above), or can be built to track the sun every day.

28 modules are shown in the image above, of a solar farm under construction. A 100 MW solar farm might require as many as 200,000.

Solar rows are tilted at angles to maximize sunlight throughout the year, and spaced to minimize shadows from one row to the next.

4-7 acres of land is typical per MW for commercial solar farms.

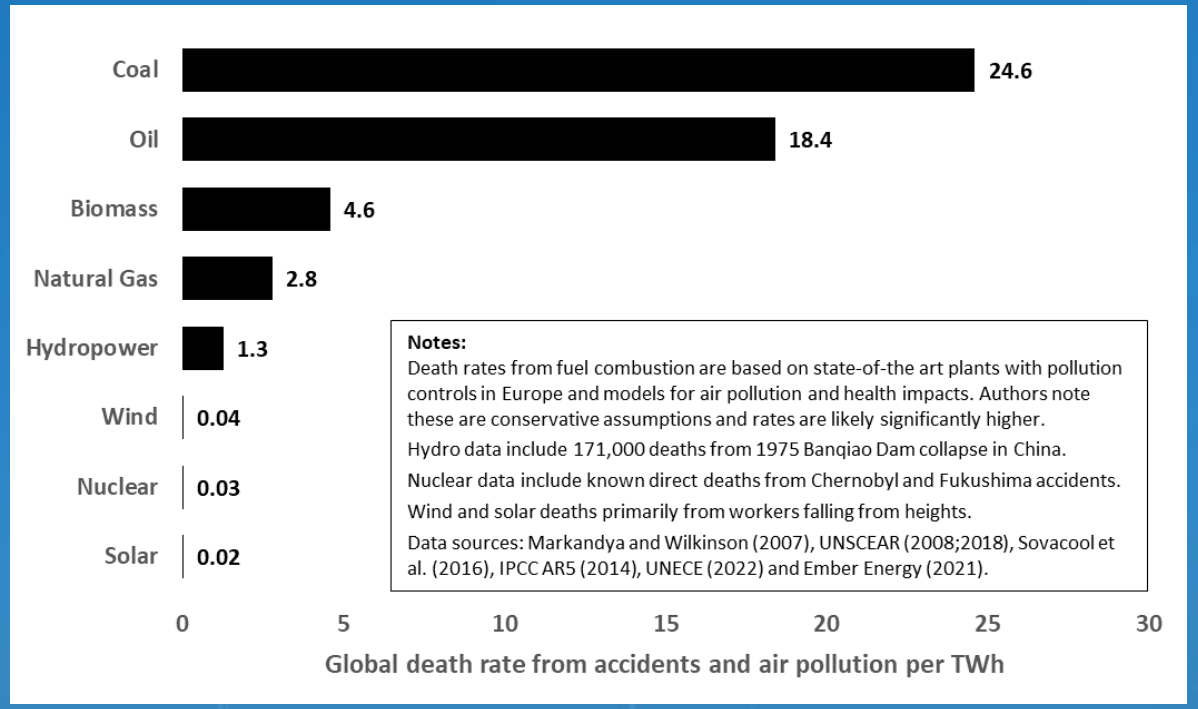


Impacts of Electricity Generation Choices

All energy has some impact on the environment, but some are much larger than others, and/or have differing trade-offs

Impacts include:

- air and water pollution,
- greenhouse gas emissions,
- water consumption,
- habitat loss and,
- mining and disposal-related damages resulting from the required materials and fuels.



Materials Recycling

- Steel, aluminum and other metals that go into solar and plants can be recycled.
- Wind turbine blades are made of fiberglass composites and are not currently recyclable, but manufacturers have started developing recyclable options for future projects.
- Both wind and solar have concrete foundations which does not pose soil or water contamination concerns, but enough needs to be removed at end of project life to returned land to its original working capacity.

What happens to old wind turbine blades?

As the first commercial wind turbines came online in the mid to late nineties, they are now coming to the end of their operational lives and facing decommission, posing the question about what happens to their waste materials.

There are some misconceptions that wind turbines have a harmful impact on the environment because some components, such as their blades, cannot be recycled.

While it's partially true that some can't be recycled, manufacturers and operators are going to great lengths to ensure they are ultimately as sustainable as possible; finding ways to either recycle, reuse or rebuild them using recyclable materials in the future.

What are wind turbine blades made of?

Around 96% of a wind turbine is made from recyclable materials. Their outer shell, shafts, gearing and electrical components are typically made from steel, copper, aluminium, other precious metals and recyclable plastics.[1]

There are more than 8,000 parts to one wind turbine and they can have an operational lifespan of up to 25 years (most last around 20-25 years).[2] They can mostly be recycled at the end of this working life and have increasingly been made from reused materials that have already been recycled.

How Solar Panels are Recycled

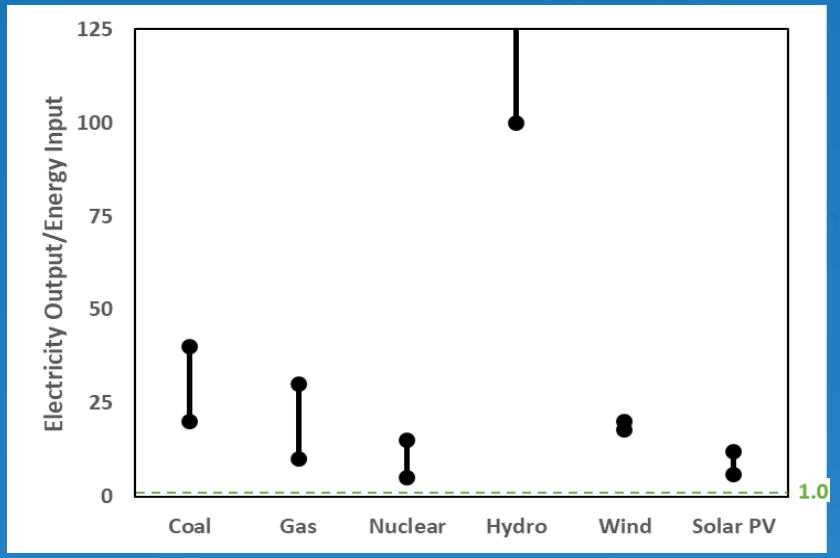
Recycling Overview

Crystalline-silicon solar technology represents most of the solar panel market share. This type of panel is constructed with an aluminum frame, glass, copper wire, polymer layers and a backsheet, silicon solar cells, and a plastic junction box. The polymer layers seal the panel from exposure to weather but can make recycling and panel disassembling difficult, as high temperatures are often required to loosen the adhesive.

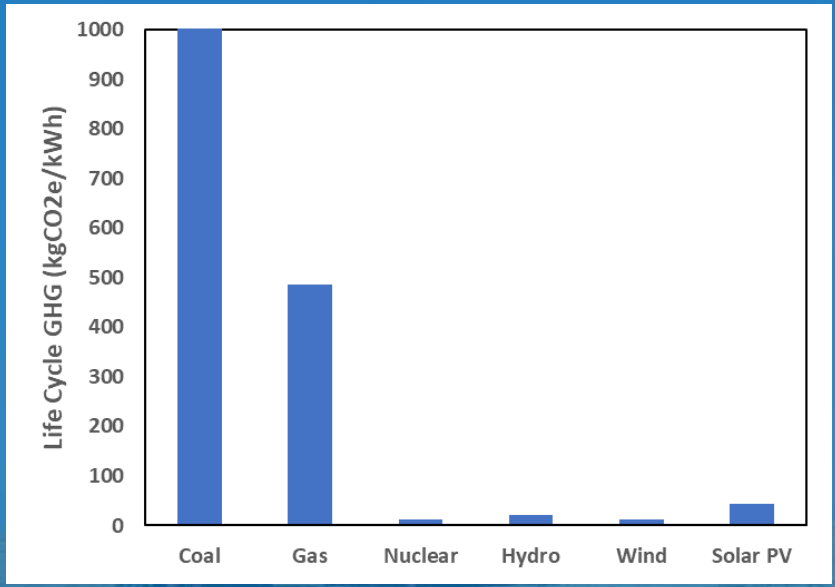
Many of these components can be recycled. Glass composes most of the weight of a solar panel (about 75 percent), and glass recycling is already a well-established industry. Other materials that are easily recyclable include the aluminum frame, copper wire, and plastic junction box.

Lifetime Emissions

- Comparing the **total energy required** for all of the inputs (materials, construction, fuels and disposal) compared to the energy the plant generates over its lifetime (right) is a common way to compare different energy sources.



Typical range of energy generated over a power plant's lifetime compared to the energy required to build and operate. Data source: Hall, Lambert, & Balogh (2014)

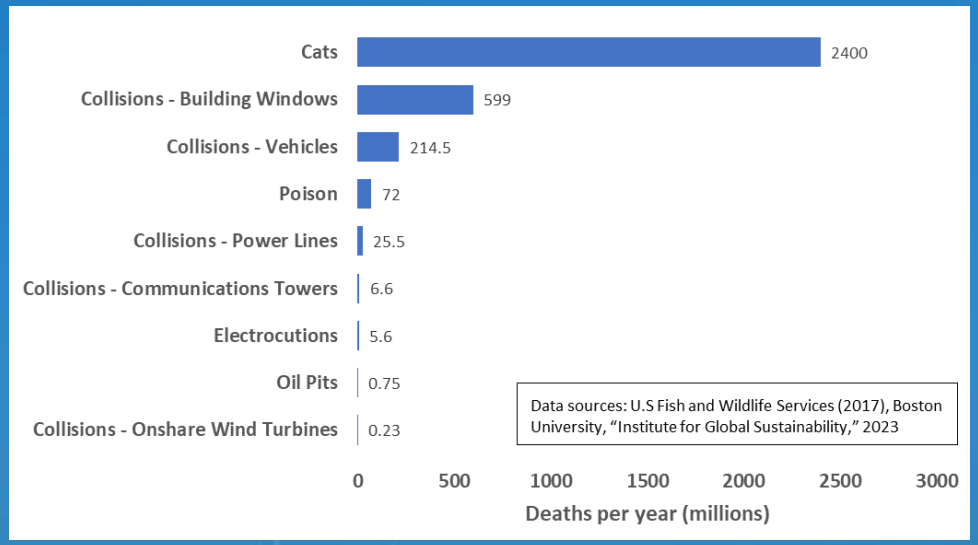


- Similarly, the total **emissions that result** from the 'cradle' to 'grave' of a power plant and all its inputs can be compared the electricity it generates (left).

Typical life-cycle GHG emissions for electricity generation types. Data source: NREL (2021)

Wildlife Impacts

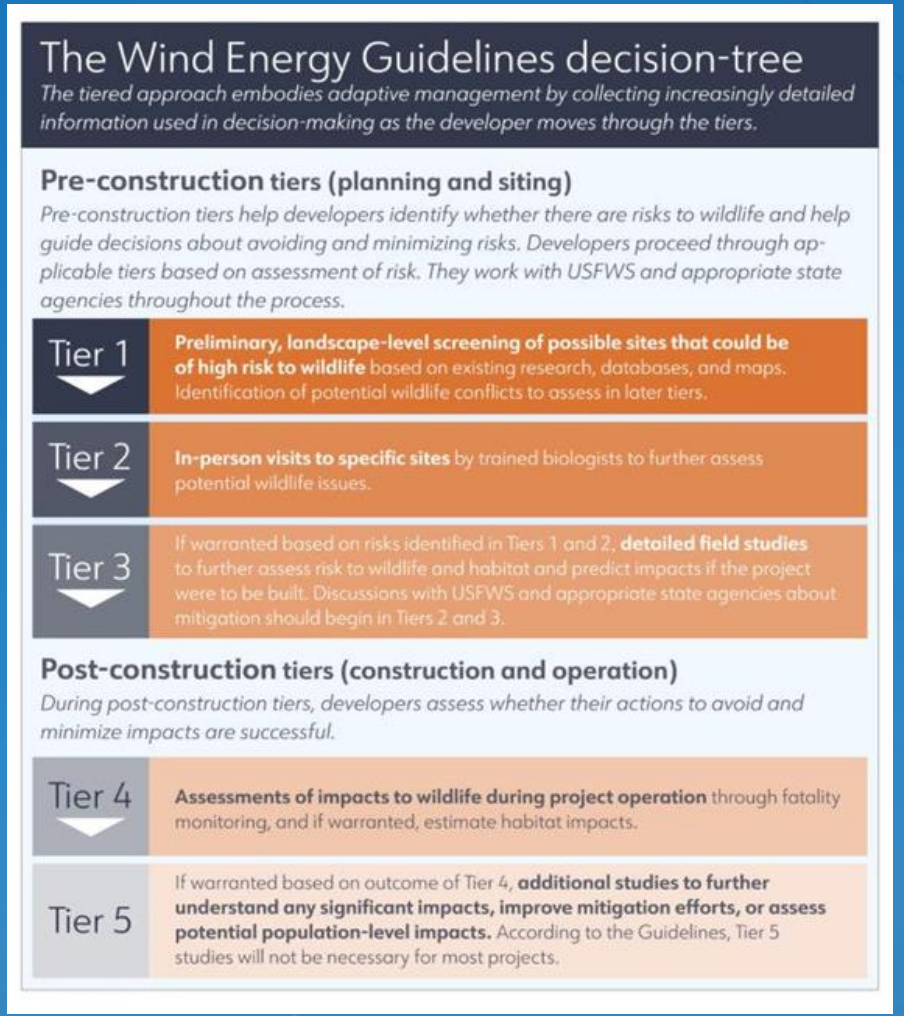
- Conservation societies such as WWF, and the Audubon Society rank climate change as one of the worst risks to wildlife, and have been working to support responsible renewable energy development that minimizes bird and bat impacts in particular
- Bats and Wind Energy Cooperative and the Renewable Energy Wildlife Institute are industry-conservation alliances working to minimize avian impacts
- The government of Ontario has estimated that 4-14 bats/ turbine/year are killed by wind turbines on average



Leading anthropogenic causes of bird mortality in the United States

Wildlife Assessments

- In Ontario, specific environmental approvals required studies both prior to, and post-construction to minimize as well as monitor negative impacts.
- U.S. example is shown on the right →
- Similar steps are taken for solar assessments.

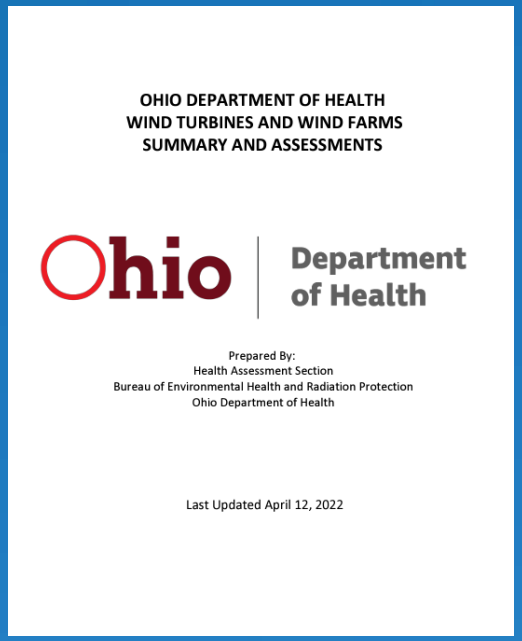


U.S. Fish & Wildlife Service Land-Based Wind Energy Guidelines

Health

"There is no significant body of peer-reviewed, scientific evidence that clearly demonstrates a direct link between adverse physical health effects and exposures to noise (audible, LFN, or infrasound), visual phenomena (shadow flicker), or EMF associated with wind turbine projects."

– Ohio Department of Health



OHIO DEPARTMENT OF HEALTH
WIND TURBINES AND WIND FARMS
SUMMARY AND ASSESSMENTS

Ohio | Department of Health

Prepared By:
Health Assessment Section
Bureau of Environmental Health and Radiation Protection
Ohio Department of Health

Last Updated April 12, 2022

WIND TURBINE NOISE AND HEALTH STUDY:
SUMMARY OF KEY FINDINGS

Canada

WHAT IS THE WIND TURBINE NOISE AND HEALTH STUDY?

Health Canada, in partnership with Statistics Canada, has conducted a study involving communities in Southern Ontario and Prince Edward Island to better understand the impacts of wind turbine noise on health and well-being. A total of 1238 households participated, out of a possible 1570.

The study had three parts:

- An in-person questionnaire, which was given to randomly selected participants living at various distances from the wind turbines;
- A collection of physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate, as well as measures of sleep quality; and
- More than 4000 hours of wind turbine noise measurements conducted by Health Canada to support calculations of wind turbine noise levels at all homes in the study.

The ***Wind Turbine Noise and Health Study*** is a landmark study and the most comprehensive of its kind. Both the methodology used and the results are significant contributions to the global knowledge base and examples of innovative, leading-edge research.

KEY FINDINGS

IT IS IMPORTANT to note that the results from this study do not provide definitive answers on their own and should be considered along with the other research available on the impacts of wind turbine noise on health. Results may also not be applied to other communities as the wind turbine locations in this study were not randomly selected from all possible sites operating in Canada.

*Illness and chronic disease**
No evidence was found to support a link between exposure to wind turbine noise and any of the self-reported illnesses (such as dizziness, tinnitus, migraines) and chronic conditions (such as heart disease, high blood pressure, diabetes).

*Stress**
No association was found between the multiple measures of stress (such as hair cortisol, blood pressure, heart rate, self-reported stress) and exposure to wind turbine noise.

*Sleep**
The results of this study do not support an association between wind turbine noise and self-reported or measured sleep quality.

* While some people reported some of the health conditions above, their existence was not found to change in relation to exposure to wind turbine noise.

Annoyance and quality of life
An association was found between increasing levels of wind turbine noise and individuals reporting to be very or extremely annoyed.

No association was found with any significant changes in reported quality of life, or with overall quality of life and satisfaction with health. This was assessed using the abbreviated version of the World Health Organization's Quality of Life Scale.

Noise
Calculated noise levels were found to be below levels that would be expected to directly affect health (World Health Organization— *Community Noise Guidelines [1999]*). This finding is consistent with self-reported and measured results of the study.

Other Impacts To Be Aware Of

Noise: Sound drops with distance from wind turbines and typically cannot be head above background noise at a distance of 1 km.

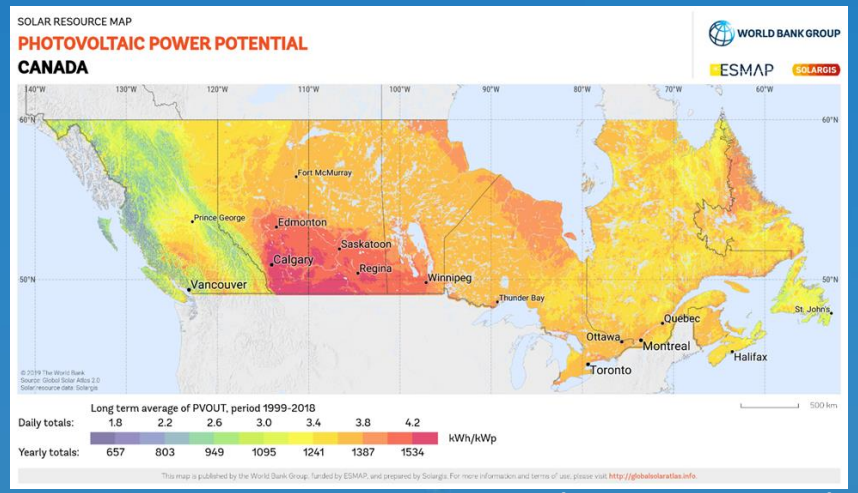
Shadow flicker: Rotating blades' shadows can cause annoyance.

Ice throw: Turbines are typically shut down during and after icing events until the ice falls off the blades, but in rare events ice can be thrown up to 350 m and people and livestock should be kept at safe distances.

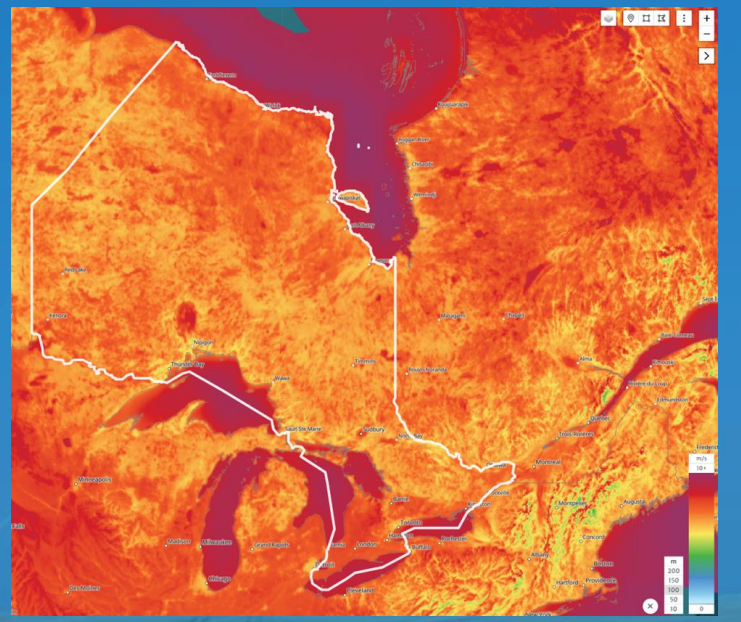
Developers need to provide evidence turbines will be sited far enough away from nearby dwellings to avoid annoyance and risks, as well as models to visualize changes to the landscape after projects are built.

Land Use

- Resource maps are freely available to help identify strong resources.
- Proximity to transmission lines increases desirability.
- Wind: ~125 acres/MW (turbines/road use less than 3%).
- Solar: 1-4 acres/MW.



Photovoltaic energy potential in Canada (source: World Bank)


Wind map of Ontario at 100 m height (source: World Bank)

Agrivoltaics

- Keeping weeds down is important to avoid shadows on solar modules - sometimes animals can be used
- Agrivoltaics Canada suggests there may also be opportunities to increase yields for some crops, protect crops from hail damage and excess sunlight, as well as reduce water consumption

BUSINESS

Solar burgers: How agrivoltaics is marrying food production with green energy

Sun Cycle Farms is an agrivoltaics company, part of a rapidly expanding field that aims to combine solar energy production with agricultural activities.

Updated Dec. 25, 2024 at 7:55 a.m. | Dec. 25, 2024 | 3 min read

Cattle are shown grazing amongst solar panels at an agrivoltaics pilot project conducted by Sun Cycle Farms near Cardston in southern Alberta in this November 2024 handout image.

HO-Sun Cycle Farms/The Canadian Press

By Amanda Stephenson The Canadian Press

Royalties

Landowner payments

Property values

Property taxes

Community benefit agreements

Western University

Scholarship@Western

MPA Major Research Papers | Local Government Program

8-1-2020

Who Has Seen the Wind Benefits? Impacts of Ontario Green Energy Policy on Municipal Community Benefit Agreements from Large Wind Energy Projects

Jason Cole
Western University

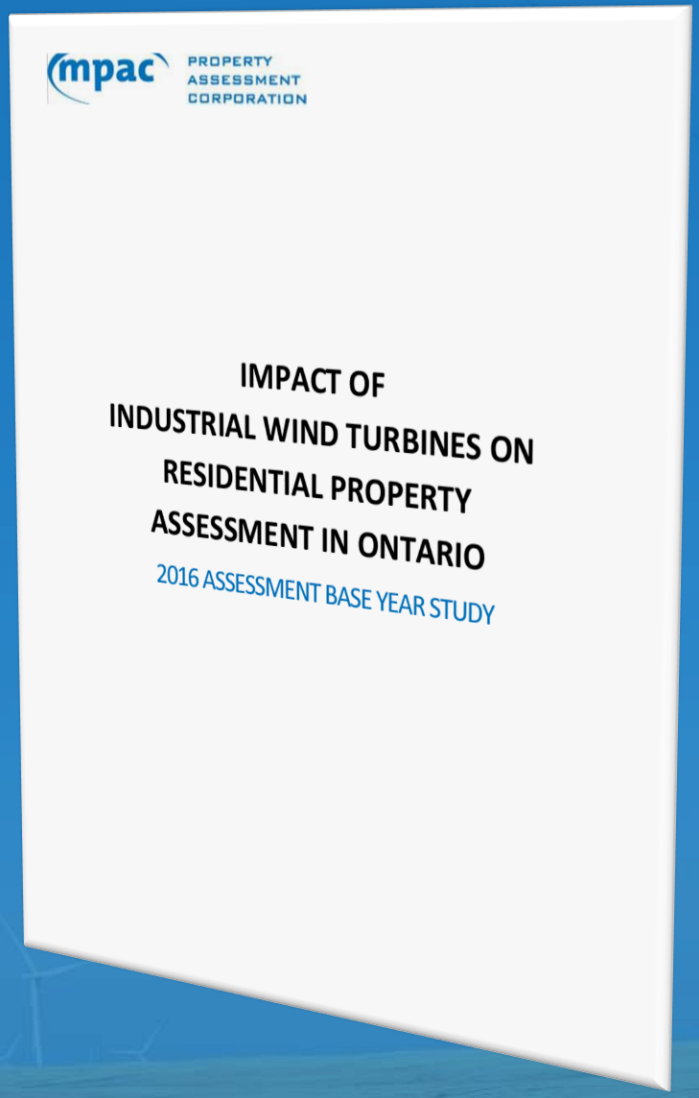
Landowner Payments

- Landowner payments can vary depending on a number of factors including resource quality, land required and the type of contract the developer is able to secure with the government
- Royalties can be fixed, and/or include a portion of the annual revenues
- A University of Wisconsin study reported in the United States annual payments ranged from 7,000 to 14,000 USD (9,500-19,000 CAD) in 2018 per wind turbine
- Seek professional advice before signing land options or leases

Property Values

"Following its review, MPAC concluded that 2016 Current Value Assessments [CVAs] of properties located within proximity of an IWT [Industrial Wind Turbine] are assessed at their current value and are equitably assessed when compared to the assessments of properties that are not in proximity to IWTs.

Therefore, no adjustments are required for 2016 CVAs. This finding is consistent with MPAC's 2008 and 2012 base year IWT reports"



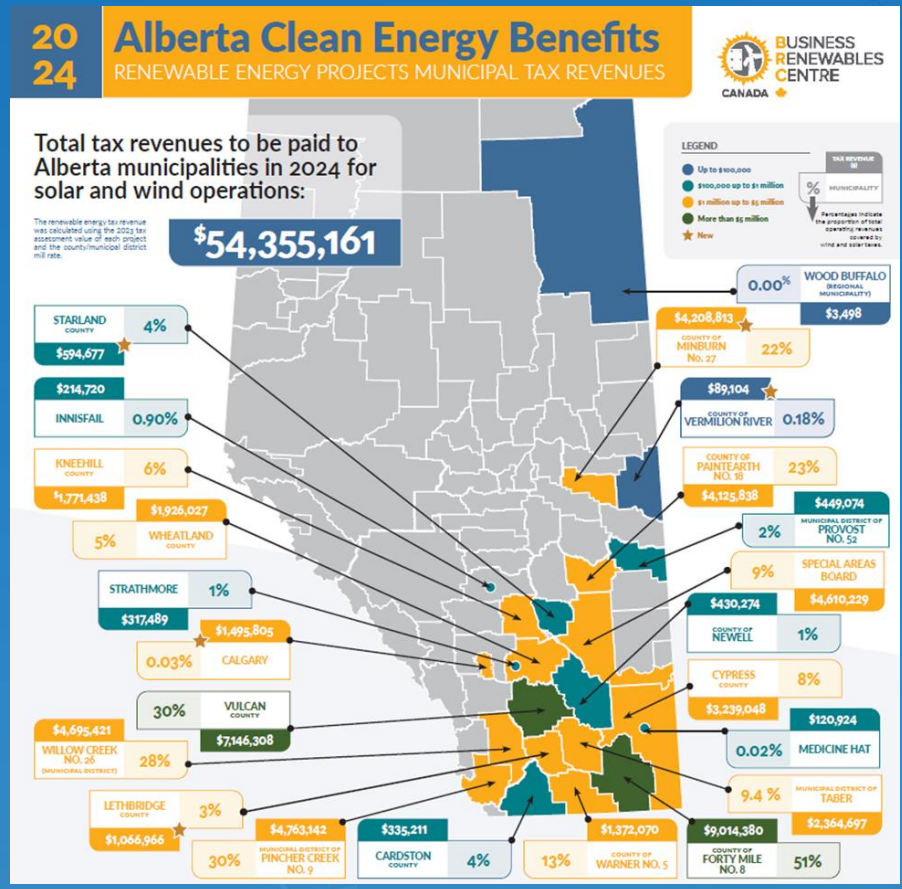
Property Taxes

- While projects bring revenues, be aware of tax implications
- Regulation 282/98 under the Primary Property tax statute states for industrial wind and solar projects:

  "the current value of land that is determined under subsection 19 (5) of the Act continues to be determined under that subsection as if the land was used for farm purposes only. O. Reg. 1/12, s. 3"
- Wind towers are assessed by multiplying $50,460 by the installed capacity in megawatts of the generator attached to the wind turbine tower
- Appeals can be made if assessments are made contrary to the aforementioned values

Community Host Agreements (CHA)

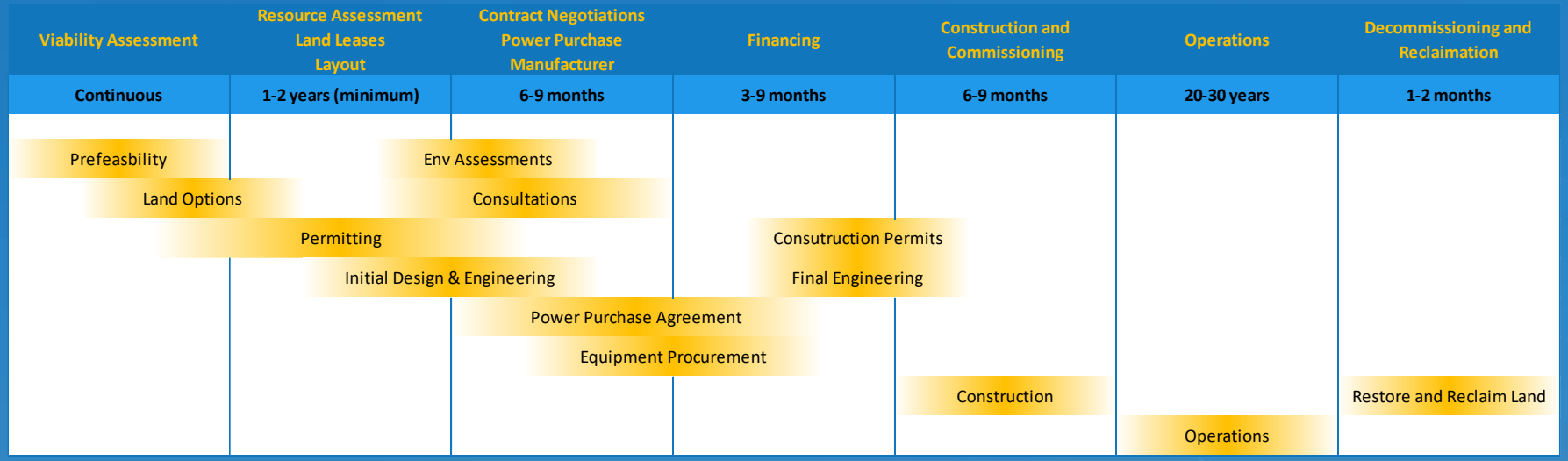
- Developers often agree to provide annual payments to the local community or municipality through a CHA, which can be a lump sum, annual payments or a percentage of revenues
- CHAs can stipulate items such as prioritizing local business and hiring local workers for construction and operational jobs where appropriate



While no Ontario specific data has been compiled, municipal revenues from wind and solar projects in Alberta in 2024 are shown above (Source: Business Renewables Centre)

Project Development

From prefeasibility, to public consultations, environmental assessments, and construction, solar and wind projects can take multiple years to develop



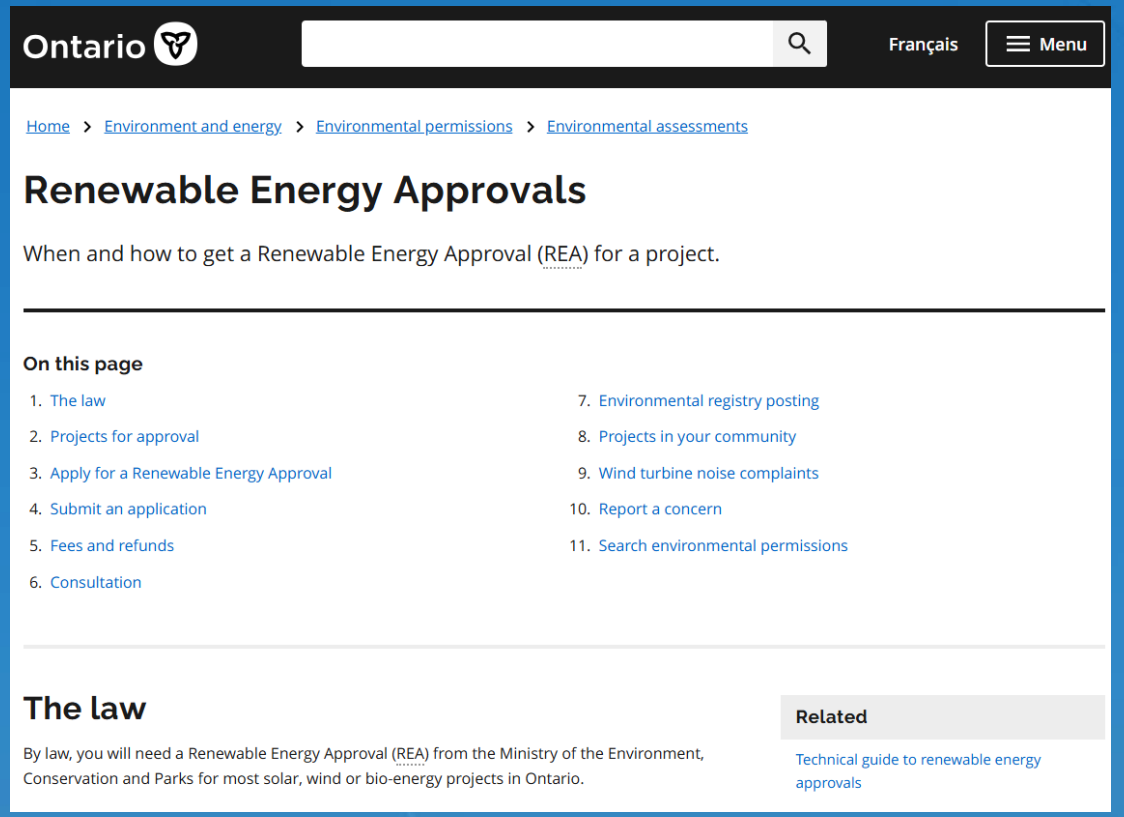
Typical project development timeline. Actual projects may take different time at any step.

Land Options and Resource Assessment

- Once developers have completed initial studies to determine potentially viable locations they will approach landowners with options to secure land for potential projects
- Before a project can be developed on-site resource assessments are often done – particularly for wind energy – which can involve installing monitoring equipment for several years
- Preliminary layout and manufacturer equipment selection is done to model energy generation potential

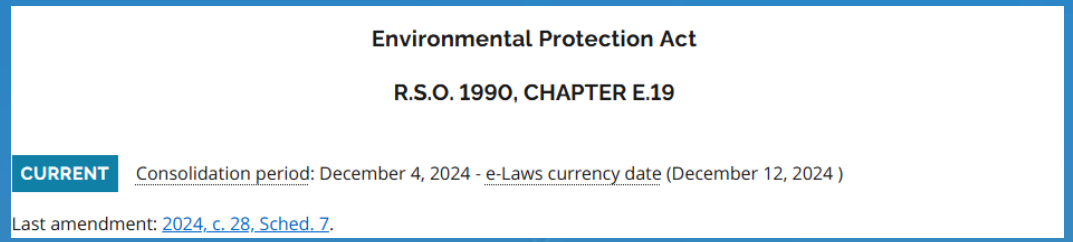
Public Consultations and Impact Assessments

- Starting from land acquisition stages, developers will seek public involvement and community feedback, through meetings and consultations, particularly after environmental assessments and during initial design presentations
- This process is a core feature of the Renewable Energy Approvals (REA) process in Ontario



Permits and Approvals

- Developers must obtain municipal, provincial, and in some cases federal approvals before commencing construction
- Sometimes permits may need to be updated if new equipment is procured as the project develops

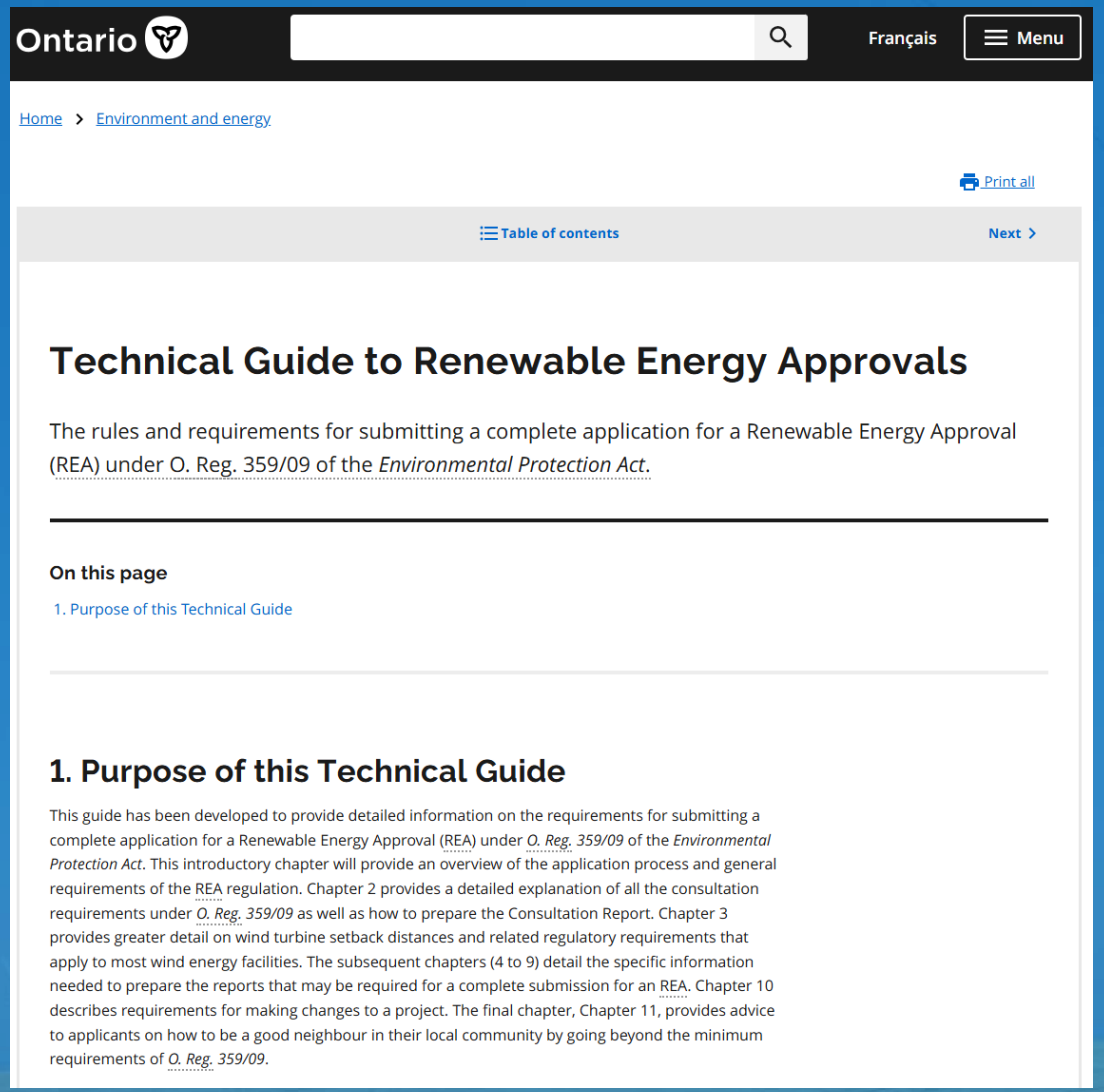


Environmental Protection Act

R.S.O. 1990, CHAPTER E.19

CURRENT Consolidation period: December 4, 2024 - e-Laws currency date (December 12, 2024)

Last amendment: 2024, c. 28, Sched. 7.



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Technical Guide to Renewable Energy Approvals

The rules and requirements for submitting a complete application for a Renewable Energy Approval (REA) under O. Reg. 359/09 of the *Environmental Protection Act*.

On this page

1. Purpose of this Technical Guide

1. Purpose of this Technical Guide

This guide has been developed to provide detailed information on the requirements for submitting a complete application for a Renewable Energy Approval (REA) under *O. Reg. 359/09* of the *Environmental Protection Act*. This introductory chapter will provide an overview of the application process and general requirements of the REA regulation. Chapter 2 provides a detailed explanation of all the consultation requirements under *O. Reg. 359/09* as well as how to prepare the Consultation Report. Chapter 3 provides greater detail on wind turbine setback distances and related regulatory requirements that apply to most wind energy facilities. The subsequent chapters (4 to 9) detail the specific information needed to prepare the reports that may be required for a complete submission for an REA. Chapter 10 describes requirements for making changes to a project. The final chapter, Chapter 11, provides advice to applicants on how to be a good neighbour in their local community by going beyond the minimum requirements of *O. Reg. 359/09*.

Power Purchase Agreement and Detailed Engineering

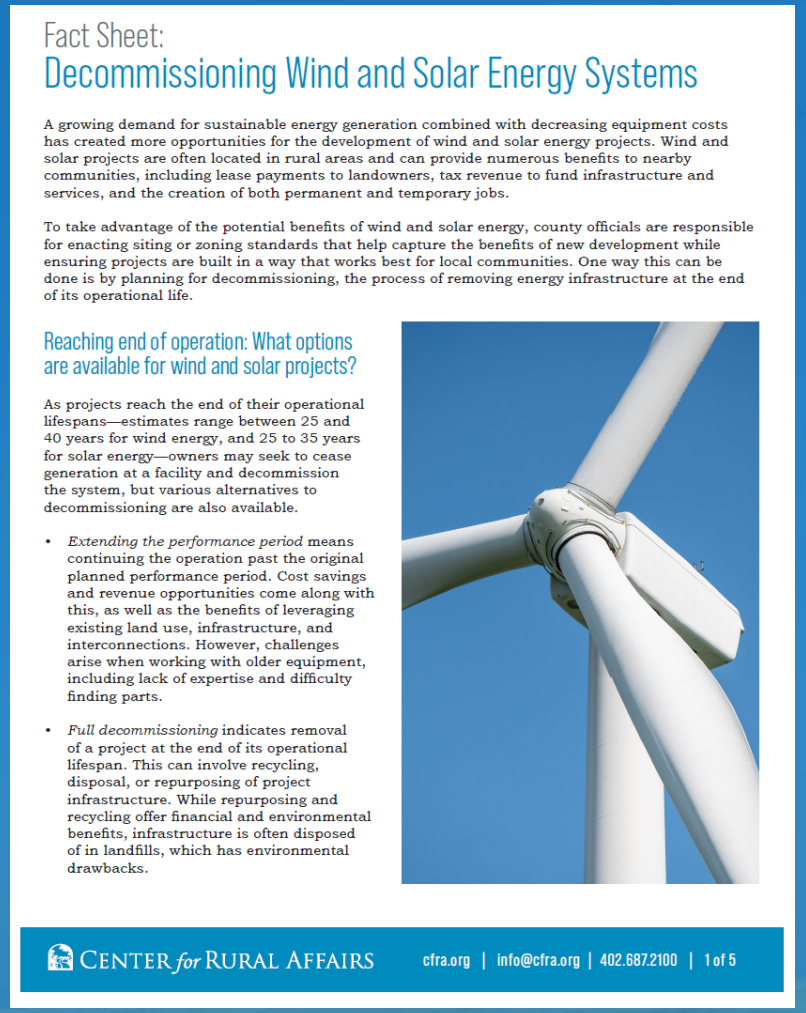
- Securing a buyer for the electricity that is to be generated is an important step
- In Ontario power purchase agreements (PPAs) are typically competitive processes between developers
- Once a PPA has been secured a project can move towards securing financing and the final engineering and design

Site Preparation, Construction and Commissioning

- Municipal, provincial, and in some cases federal approvals must be acquired before commencing construction
- Developers must coordinate with transportation authorities and local municipalities to plan the large-scale movement of equipment
- The site is prepared for construction, including building access roads and laying foundations
- Significant increase in local traffic may potentially cause disruptions during construction
- Once construction is complete the equipment must all be tested before final operations begin

Operations and Decommissioning

- Wind turbines require routine maintenance 2-3 times/year
- Snow and dust removal from solar farms may throughout the year
- Otherwise solar farms generally require less on site maintenance
- Solar tracking systems require regular inspection and maintenance
- Wind and solar equipment can operate for 25-40 years or more
- Owners are responsible for reclaiming the land to agreed upon conditions at the end of project life



Fact Sheet:

Decommissioning Wind and Solar Energy Systems

A growing demand for sustainable energy generation combined with decreasing equipment costs has created more opportunities for the development of wind and solar energy projects. Wind and solar projects are often located in rural areas and can provide numerous benefits to nearby communities, including lease payments to landowners, tax revenue to fund infrastructure and services, and the creation of both permanent and temporary jobs.

To take advantage of the potential benefits of wind and solar energy, county officials are responsible for enacting siting or zoning standards that help capture the benefits of new development while ensuring projects are built in a way that works best for local communities. One way this can be done is by planning for decommissioning, the process of removing energy infrastructure at the end of its operational life.

Reaching end of operation: What options are available for wind and solar projects?

As projects reach the end of their operational lifespans—estimates range between 25 and 40 years for wind energy, and 25 to 35 years for solar energy—owners may seek to cease generation at a facility and decommission the system, but various alternatives to decommissioning are also available.

- *Extending the performance period* means continuing the operation past the original planned performance period. Cost savings and revenue opportunities come along with this, as well as the benefits of leveraging existing land use, infrastructure, and interconnections. However, challenges arise when working with older equipment, including lack of expertise and difficulty finding parts.
- *Full decommissioning* indicates removal of a project at the end of its operational lifespan. This can involve recycling, disposal, or repurposing of project infrastructure. While repurposing and recycling offer financial and environmental benefits, infrastructure is often disposed of in landfills, which has environmental drawbacks.

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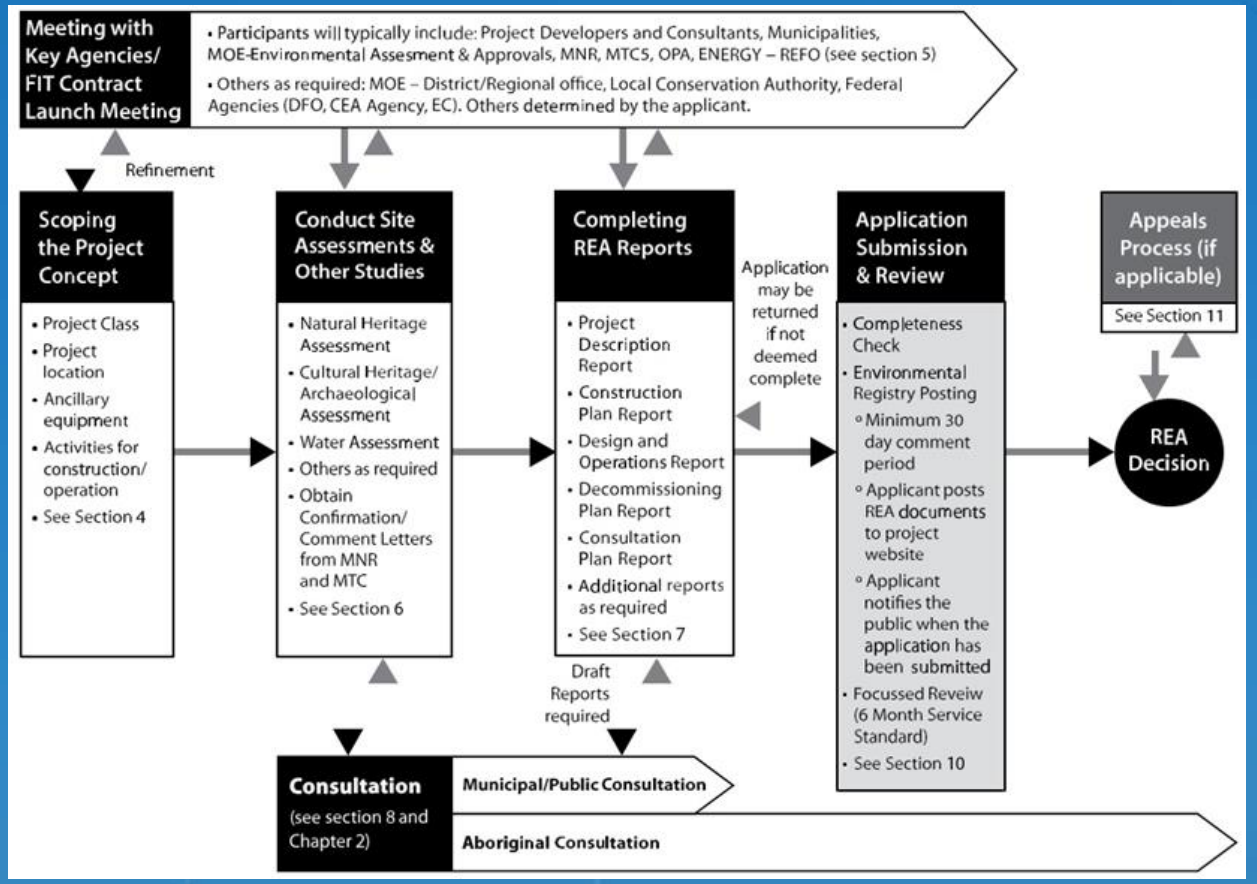
Approvals and Permitting

Ontario projects must receive a Renewable Energy Approval (REA) and in some cases federal environmental impact assessments



Overview of the principle elements of the REA application process

REA

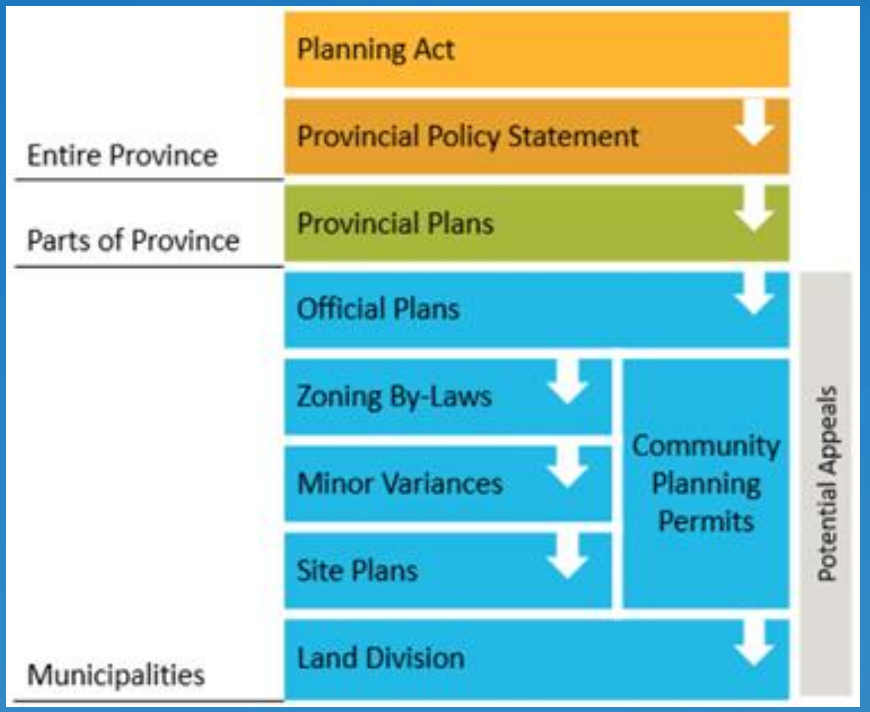
- In 2018 Ontario repealed the 2009 Green Energy Act and restored municipal authority over siting renewable projects in the Planning Act
- Elements of the REA include:
  - Consultation Report
  - Decommissioning Plan Report
  - Design and Operations Report
  - Project Description Report
  - Consultations
  - Protected Properties, Archaeological and Heritage Resources
  - Natural Heritage Assessment
  - Water Impacts
  - Additional Reports as required
  - Prohibitions related to project execution

Federal Environmental Impact Assessment

- Canadian Environmental Assessment Act requires an EIA for projects receiving federal funding or requires federal permits
- Species at Risk Act, the Migratory Birds Convention Act, the Fisheries Act and the Navigable Waters Act may also trigger an EIA led by an independent review panel appointed by the Impact Assessment Agency of Canada

Municipal Role in Project Siting

- Planning authorities are required to submit written confirmation that proposed projects' land use is not prohibited by a zoning by-law or Ministerial Zoning Orders
- IESO requires a Municipal Support Resolution as part of energy procurements



Ontario Ministry of Municipal Affairs and Housing, "Land Use Planning and Agricultural Considerations for Siting Energy Projects," IESO Engagement Session, Toronto, 2024

Questions to Ask Developers

Ontario government has a guidebook aimed at developers on how to ‘be a good neighbour’. This can be useful to review to understand how developers will be approaching landowners, but it is also important to make sure you have your own questions and concerns addressed. The following lists some examples of questions you might want to consider.

The full guidebook includes more questions, although neither are an exhaustive lists – if you have your own, make sure they are answered.

Sample Questions to Ask Developers /1

- What are the financial benefits of hosting a renewable energy project on my property?
- What kind of ongoing communication can I expect?
- How will my land be accessed and affected during normal operations?
- What is the expected duration of the land lease?
- How will the project affect my property taxes, or insurance?
- What are the potential effects on my land use?
- What are the environmental impacts of the project?

Sample Questions to Ask Developers /2

- What is the weed control plan?
- How loud is the project?
- What are the visual impacts?
- What happens if there is damage to my property?
- What is the decommissioning plan?
- What are the safety considerations?
- How much time will I have to review the contract with a lawyer before signing?
- What is the detailed construction schedule?

Protect Your Interests As You Negotiate a Deal

- Set a time and meeting location convenient for you and a friend or partner (always best to have at least two the table during negotiations)
- Meetings do not need to be at your property if you do not wish
- Have all your questions written down. Expect that they all will be answered. Keep track of the ones you are waiting on, and make sure you follow up
- Talk to a lawyer if you sign anything
- Ask for compensation even if you do not have a turbine on your land
- Go to an existing project there is one nearby to gather information and observations
- If you are not happy about anything, ask for it to be improved
- Negotiate early - there can be a lot of flexibility early in the design/planning stage

Additional Resources

- Ontario Federation of Agriculture: Agreements for Renewable Energy Installations on Your Land Fact Sheet
- Ontario Technical Guide to Renewable Energy Approvals
- Ontario Electricity Procurement Announcement (2024)
- Who Has Seen the Wind Benefits? (2020)

Thank You!

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