NEXUS
BRUCE POWER RESEARCH CENTRE

ENERGY GENERATION & LAND USE REPORT | AUGUST 2025

A growing economy. A crowded landscape.

Energy demand across Canada is projected to soar. By 2050, Ontario expects its electricity demand to increase by 75%, driven by population growth, electrification and new industries (Independent Electricity System Operator, 2024). Meeting this demand will require a major expansion of clean energy infrastructure—one that must be balanced against ecological constraints and competing land uses.

Energy projects do not exist in a vacuum. They must compete for space with housing, agriculture, industry, and more. Economic and population growth drive the need for new housing developments and industrial spaces. Meanwhile, agricultural land faces pressure as growth reduces the acreage available for food production (Statistics Canada, 2024). Land is finite—and increasingly contested.

Different sources of electricity production offer unique advantages, often debated in terms of cost, reliability and carbon emissions. However, one critical factor is often overlooked: how much land each source requires. Solar farms, wind turbines, and nuclear plants have vastly different footprints on the land. Understanding those impacts is essential for informed, long-term planning. A clearer picture of these trade-offs helps support a balanced energy mix—one that leverages the strengths of each clean technology.

This report compares the land-use intensity of three energy sources (nuclear, solar and wind) using real-world data. It analyzes how much land is needed to meet Ontario's current energy needs under each scenario and explores the broader implications for land use and sustainable development.

Top takeaways

1. Ontario's energy and land use demands are accelerating

- Electricity demand in Ontario is projected to increase by 75% by 2050.
- Land available for energy development is under pressure from competing priorities, including housing, agriculture, and ecosystem preservation.

2. Land-use efficiency varies dramatically by energy source

- Nuclear energy is the most land-efficient of the clean energy sources examined.
- To generate **137 TWh** per year (Ontario's average annual electricity demand):

  Nuclear would require 2,551 hectares.

  Solar requires 274,000 hectares—approximately 97 times more land.

  Wind requires 17,810 hectares (footprint) or 1,644,000 hectares (spacing)—up to 580 times more land.

3. Implications for Bruce County and Saugeen Ojibway Nation Territory

- The **Bruce Power** site occupies just 0.2% of Bruce County, or 0.1% of Saugeen Ojibway Nation (SON) Territory.
- Replacing that output with:

  Solar would require 22% of Bruce County land, or 11% of SON Territory.

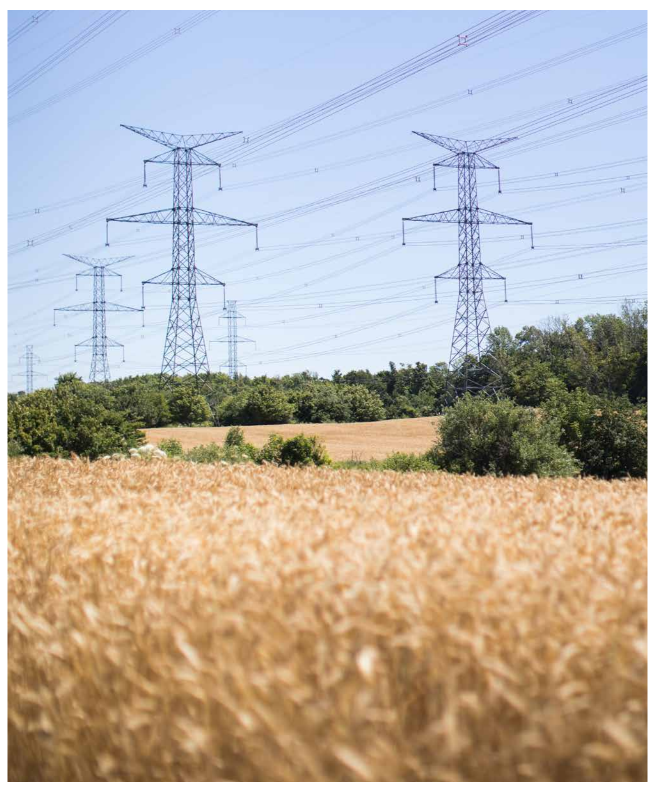
  Wind would require 1.4% to 133% of Bruce County, or 0.7 to 66% of SON Territory (depending on footprint versus turbine spacing).

Land-use intensity of electricity production

We examined three different types of clean energy production facilities: the Bruce Power Nuclear Generating Station, solar (including ground photovoltaic and concentrated solar power) and wind (footprint and spacing).

The data for wind and solar power land use was drawn from Lovering et al.'s 2022 paper "Land-use intensity of electricity production and tomorrow's energy landscape" (Lovering, Swain, Blomqvist, & Hernandez, 2022).

This study collected and calculated the land-use intensity or electricity (LUIE, measured as hectares occupied per terawatt-hour of electricity generated in a given year [ha/TWh/y]) for real-world electricity generation. The lower the LUIE, the more efficient use of space. Data was sourced from published studies, public records, datasets, and original geospatial analysis.



NUCLEAR

The Bruce Power site, including the natural lands around the generator buildings, occupies an area of approximately 838 hectares (2,071 acres) and generates around 45 TWh per year. This translates to a LUIE of 18.6 ha/TWh/yr.

SOLAR

Datasets included operational ground-mounted photovoltaic plants over 20 MW across 18 U.S. states. The area of land use calculations includes the direct area of panels or heliostats, roads established during development, and ancillary facilities (which may include new service roads, power collection systems, operations and maintenance facilities, etc.).

WIND

Land impacts include the footprint area (the land physically covered by turbine pads and access roads) as well as spacing between the turbines. In a majority of cases, the spacing area can support other uses, such as agriculture. However, as turbines require a minimum spacing distance (7–15 times the rotor diameter for optimal performance (Meyers & Meneveau, 2012)), this area remains part of the total land-use footprint.

Comparative land needs to meet energy demand

To compare across technologies, LUIE data from Lovering et al. (2022) was used to calculate the land required to match Bruce Power's output (45 TWh annually) as well as the land required to meet Ontario's average demand of 137 TWh annually (Independent Electricity System Operator, 2023).

The results highlight nuclear's exceptional efficiency in land use compared to solar and wind. Nuclear, and the Bruce Power site, remain one of the most power-dense and efficient uses of land for energy production of the sources explored in this report.

Source	LUIE (ha/TWh/yr)	Land for 45 TWh/yr—Bruce Power output (ha)	Land for 137 TWh/yr—Ontario annual demand (ha)
Bruce Power Nuclear Generating Station	18.6	838	2,551
Solar (ground photovoltaic)	2,000	90,000	274,000
Wind (spacing)	12,000	540,000	1,644,000
Wind (footprint)	130	5,850	17,810

Visualizing land use

Bruce County spans roughly 4,076 square kilometers and lies within the Territory of the Saugeen Ojibway Nation (SON), which encompasses around 8,093 square kilometers. The Bruce Power site occupies just 0.2% of Bruce County and 0.1% of SON Territory while producing 45 TWh annually.

Here is how much land other energy sources require to produce the same output:

Source	Percentage of Bruce County region	Percentage of SON Territory
Bruce Power Nuclear Generating Station	0.2%	0.1%
Solar (ground photovoltaic)	22.1%	11.1%
Wind (spacing)	132.5%	66.7%
Wind (footprint)	1.4%	0.7%

Land use for 45 TWh/year, shown relative to Bruce County and SON Territory

BRUCE POWER NUCLEAR GENERATING STATION

838 ha

0.2% BRUCE COUNTY **0.1%** SON TERRITORY

SOLAR (GROUND PHOTOVOLTAIC)

90,000 ha

22.1% BRUCE COUNTY **11.1%** SON TERRITORY

WIND (SPACING)

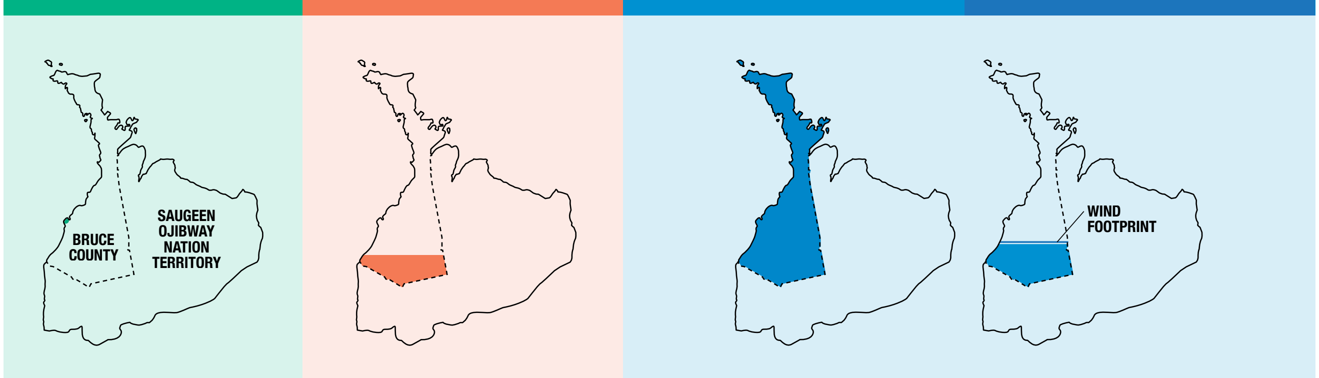
540,000 ha

132.5% BRUCE COUNTY **66.7%** SON TERRITORY

WIND (FOOTPRINT)

5,850 ha

1.4% BRUCE COUNTY **0.7%** SON TERRITORY



Conclusions

Land use is a critical, and often overlooked, dimension of sustainable energy planning. As electricity demand in Ontario rises, land-use conflicts will only intensify. New homes, expanded farms, protected habitats and industrial zones all require space, and energy infrastructure must fit into this already crowded landscape. A sustainable and resilient energy future will depend on a mix of clean technologies, including renewables like wind and solar, which bring important benefits including modularity and scalability. At the same time, this report highlights nuclear energy's unique and often unappreciated advantage: the ability to deliver large-scale power with minimal land disruption.

Among the energy sources examined, nuclear stands out for its exceptional land-use efficiency. The Bruce Power site generates 45 TWh annually while occupying just 0.2% of Bruce County, or 0.1% of SON Territory. By contrast, generating that same output through wind or solar would require vast tracts of land—up to 133% of the county's area, in the case of spacing between wind turbines. Nuclear demonstrates a remarkable ability to meet energy demands without encroaching on natural or agricultural spaces.

As Ontario's electricity needs grow and land pressures mount, prioritizing energy sources with smaller land footprints will be increasingly important for responsible long-term planning. Nuclear energy's proven efficiency makes it a cornerstone of this balanced approach.

References

Independent Electricity System Operator. (2023). 2023 Year in Review. Retrieved from https://www.ieso.ca/corporate-ieso/media/year-end-data

Independent Electricity System Operator. (2024, October 16). 2025 Annual Planning Outlook: Demand Forecast Information Session. Retrieved from https://www.newswire.ca/news-releases/electricity-demand-in-ontario-to-grow-by-75-per-cent-by-2050-849843177.html

Lovering, J., Swain, M., Blomqvist, L., & Hernandez, R. R. (2022). Land-use intensity of electricity production and tomorrow's energy landscape. PLOS ONE, 17(7), 1-17. doi:https://doi.org/10.1371/journal.pone.0270155

Meyers, J., & Meneveau, C. (2012, March). Optimal turbine spacing in fully developed wind farm boundary layers. Wind Energy, 15(2), 305-317. doi:https://doi.org/10.1002/we.469

Statistics Canada. (2024, November 19). Table 32-10-0153-01 Land use, Census of Agriculture historical data. Retrieved from https://doi.org/10.25318/3210015301-eng

NEXUS

BRUCE POWER RESEARCH CENTRE

The **Bruce Power Nexus Research Centre**, is a place of collaboration—a hub where industry leaders, policymakers, scientists and communities come together to find solutions to the most pressing issues of our time. Funded by Bruce Power, our mandate includes: policy research and government engagement; economic and ecosystem development; and environmental and human health research. Our commitment to environmental sustainability and human health will guide our efforts as we work toward fostering a cleaner, healthier future for generations to come.

nii.ca/nexus

NUCLEAR **INNOVATION** INSTITUTE™

The **Nuclear Innovation Institute (NII)** is an independent, not-for-profit organization with a vision of a Canadian landscape that celebrates an innovative nuclear industry as an integral part of the clean energy future. NII's role driving an innovative nuclear voice, skill development and industry advancement supports members and encourages collaborative engagement with communities, industries and governments.

nii.ca