

## Canadian Agriculture at a Glance

# Canada's farms integrate renewable energy production and technologies toward a future of sustainable and efficient agriculture

by Zong Jia Chen and Allyson Jewitt

Release date: May 17, 2023



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Published by authority of the Minister responsible for Statistics Canada

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# Canadian Agriculture at a Glance



## Canada's farms integrate renewable energy production and technologies toward a future of sustainable and efficient agriculture

by Zong Jia Chen and Allyson Jewitt

Under the backdrop of climate change and national and global commitments to combat its causes and effects, farms in Canada are increasingly transitioning toward sustainable practices. Data from the 2021 Census of Agriculture show an increased number of farms reporting renewable energy production and the use of select technologies on farms.

Renewable energy production not only gives Canada's farmers the opportunity to add a sustainable practice to their operations, but also provides them with a source of revenue for energy sales to the grid and a way to save on future energy costs.

In addition to renewable energy production, Canada's farms have been relying on other types of technology that can help decrease labour costs, improve accuracy and efficiency of farm processes, and increase competitiveness in the global trade market.

This article first examines how the use of renewable energy production on farms has evolved since the previous census. It then explores technology adoption and the development of technology use on farms between 2015 and 2020.

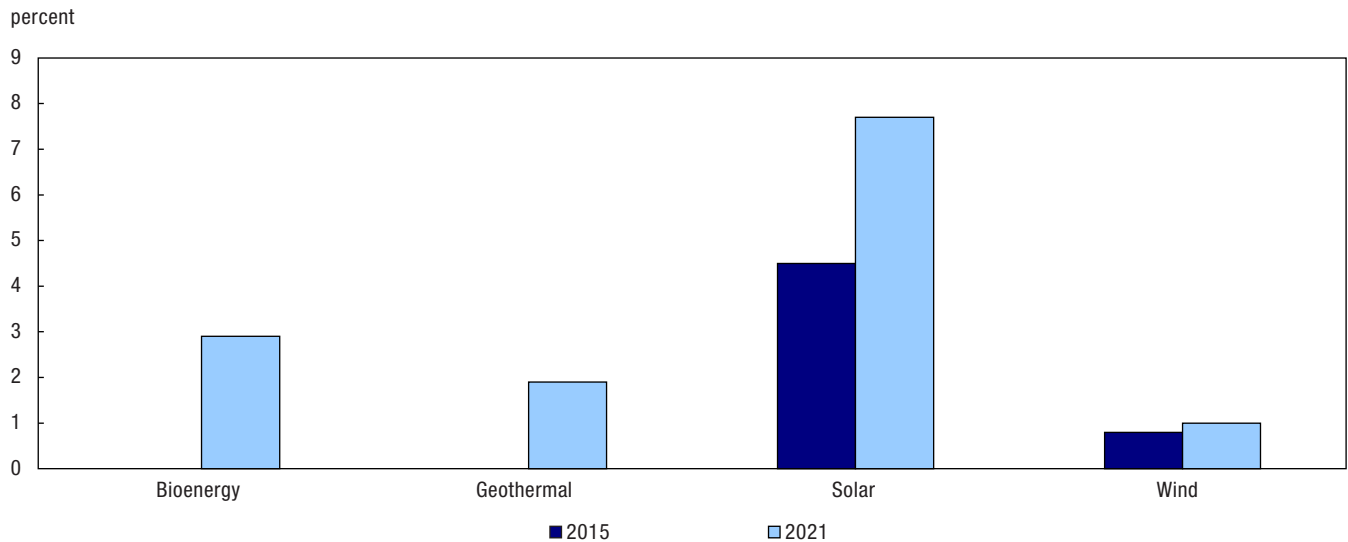
### Renewable energy production rates on farms in Canada has doubled from the previous census

In 2021, there were 22,576 farms that reported at least one form of renewable energy production. They accounted for 11.9% of farms in Canada, more than doubling the rate reported in the previous Census of Agriculture (5.3%).

Four main types of renewable energy production could be reported in the 2021 Census of Agriculture. Of all farms in Canada, 7.7% reported solar energy production, 2.9% reported bioenergy production, 1.9% reported geothermal energy production and 1.0% reported wind energy production. Bioenergy was further sub-categorized into biofuel (reported by 168 farms), biomass combustion (5,330 farms), biomethane (126 farms) and other biogas (61 farms). Bioenergy options are not mutually exclusive—some farms are producing more than one type of bioenergy (Chart 1).

**Chart 1**

**Proportion of farms reporting renewable energy production by selected type, Canada, 2015 and 2021**



**Note:** The bioenergy and geothermal categories have no comparable historical data.

**Sources:** Statistics Canada, Census of Agriculture, 2016 and 2021 (3438).

## Renewable energy is primarily being used on farms

Over three-quarters (75.7%) of farms in Canada that reported renewable energy production in 2021 used that energy on their farms. Renewable energy can be used to meet a variety of on-farm electrical and heating needs, while providing savings on energy costs over time.

## Solar energy continues to be the most used renewable energy production method

In 2021, 7.7% of farms in Canada reported solar energy production, up from 4.5% in the previous Census of Agriculture. The total number of farms reporting solar energy also increased with 14,587 farms reporting solar energy production, up from 8,658 farms in the previous census.

Solar energy production systems include photovoltaic and thermal systems such as solar panels, solar heating equipment, solar fencing system, and solar water pumps that enhance farm sustainability by reducing water use, pollution, and reliance on fossil fuels.

## Six in ten farms reporting solar energy are located in Ontario and Alberta

In 2021, farms in Ontario accounted for over one-third (36.3%) of the total number of farms in Canada that reported solar energy production. It was followed by Alberta (24.9%).

Most of the increase in solar energy production from the previous census to 2021 was reported in Alberta (+1,865 farms), followed by Saskatchewan (+1,731 farms) and Ontario (+867 farms) (Chart 2).

## Beef and feedlot farms and oilseed and grain farms are the top farm types reporting solar energy

In 2021, 29.7% of farms that reported solar energy production in Canada were classified as beef and feedlot, followed by oilseed and grain farms (27.8%). Solar energy is an appealing option for farms seeking to lower production costs by reducing energy expenses. Additionally, solar energy can provide power to feed mills, electric fences, fans and other electrical requirements on beef and feedlot farms. Moreover, solar energy can be used on oilseed and grain farms

to run an irrigation system or the electrical needs of the whole operation, for example.

## Farms in higher revenue classes are more likely to report solar energy production

More than 1 in 10 (10.3%) farms in the \$2,000,000 and over revenue class reported solar energy production in 2021, followed by farms in the \$1,000,000 to \$1,999,999 revenue class (9.7%). The initial installation of solar systems on a farm can be costly, but there are potential long-term savings. These installation costs depend on the size of the system, the availability of rebates, the type of equipment and the location of the farm.

## The number of farms reporting wind energy production is increasing

In 2021, 1,955 farms in Canada reported wind energy production, up 22.4% from the previous census. Wind turbines convert kinetic energy from the wind into

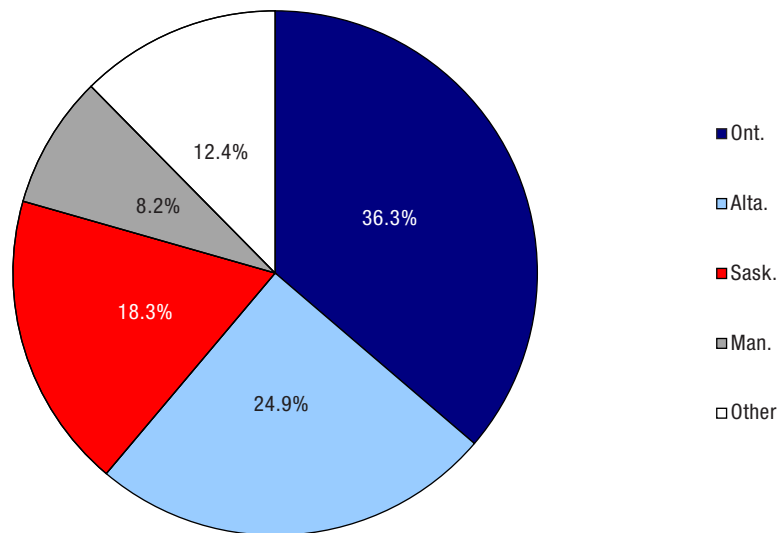
electricity, which could then be stored and used to operate equipment and other electrical requirements on farms.

Ontario accounted for over half (53.6%) of the farms in Canada that reported wind energy production in 2021. Similarly, in the previous census, Ontario accounted for 56.9% of the farms in the country that reported wind energy production.

## Geothermal energy is an emerging energy production method

Geothermal energy can be harvested from the heat generated within the Earth. This renewable energy is commonly used as a sustainable method for heating and cooling buildings. In 2021, 1.9% (3,596) of farms in Canada reported geothermal energy production. In 2021, the rate of farms reporting geothermal energy production in Manitoba (4.1%) more than doubled the national average rate (1.9%), followed by Ontario (3.5%).

**Chart 2**  
Proportion of farms reporting solar energy production by province, 2021



**Notes:** Totals may not equal 100% because of rounding. Provinces in the "Other" group include Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec and British Columbia.  
**Source:** Statistics Canada, Census of Agriculture, 2021 (3438).

## Bioenergy is the second most frequently reported type of renewable energy production

Bioenergy is useful on farms because it converts some farm waste into energy, which results in decreased landfill and greenhouse gas emissions. In 2021, 2.9% (5,522) of farms in Canada reported bioenergy production, of which biomass combustion (e.g., burning of organic raw material such as straw and wood) accounted for the vast majority (96.5%).

In 2021, 1,588 farms in Quebec reported bioenergy, accounting for 5.4% of farms in the province. It was the highest rate among provinces and was followed by Prince Edward Island (5.2%).

Aside from renewable energy production, Canada's farms are also turning to technology to implement more efficient and sustainable practices on their operations.

## More than half of farms in Canada report the use of technologies

The Census of Agriculture collected information for eight different types of technologies for the 2020 calendar year. In 2020, 95,713 farms reported at least one type of technology being used on the farm, which accounted for 50.4% of total farms in Canada.

In particular, 32.0% of farms in Canada reported using a soil sample test in 2020. This was followed by automated guidance steering systems (auto-steer) (26.8%), slow-release fertilizer (23.4%), variable-rate input applications (e.g., seed, agrochemical and fertilizer) (16.1%), Geographic Information System (GIS) mapping (13.2%), drones (3.6%), fully robotic milkers (1.2%) and robotic greenhouse equipment (0.2%).

## Large farms help pave the way for the modernization of the agriculture industry

Farms in higher revenue classes were more likely than farms in lower revenue classes to use technology on their farms. In 2020, 86.9% of farms in Canada in the \$1,000,000 to \$1,999,999 revenue class reported at least one type of technology, followed by farms

in the \$500,000 to \$999,999 revenue class (84.3%) and \$2,000,000 and over revenue class (82.6%). Conversely, 20.6% of farms in the \$1 to \$9,999 revenue class reported at least one type of technology use on their farms.

## Farms are turning to precision farming technologies to increase accuracy and yield

Precision farming is an emerging technological approach to agriculture management that measures and analyzes the requirements of specific fields and crops. The 2021 Census of Agriculture collected information on five technologies related to precision farming: GIS mapping, slow-release fertilizer, variable-rate input application, drones and soil sample tests.

GIS mapping is another technology that was reported on farms more frequently in 2020. It allows farmers to collect data (e.g., via sensors attached to farm machinery) that can be used for better planning of crop cultivation to maximize yields. In 2020, 13.2% of farms in Canada reported GIS mapping, up from 8.2% in 2015.

Nearly one-quarter (23.4%) of farms in Canada in 2020 reported slow-release fertilizer that gradually releases nutrients into the soil. Nearly one-third (31.8%) of farms in Prince Edward Island reported using slow-release fertilizer, followed by Ontario (30.5%).

In 2020, 16.1% of farms in Canada reported variable-rate input application. This type of technology is used by any farm equipment that collects data from sensors or a global positioning system for seeding or applying fertilizers, chemicals, or other inputs at a variable rate. Just over one-fifth (21.9%) of farms in Saskatchewan reported variable-rate input application, followed by Prince Edward Island (20.8%).

In 2020, 3.6% of farms in Canada reported drone technology. Drone technology consists of unmanned aerial vehicles that are used for field scouting and data collection. In 2020, 5.2% of farms in Saskatchewan reported using drones, followed by 4.9% farms in Manitoba.

Soil sample test was one of the new technologies added to the 2021 census and became the most frequently reported technology, with nearly one-third (32.0%) of farms in Canada reporting this technology

in 2020. A soil sample test is a process by which key elements from the soil (e.g., phosphorus, potassium and calcium) are measured to assess their availability to plants and to determine the need for fertilizers or other inputs.

## Oilseed and grain farms are the most likely farm type to report a soil sample test

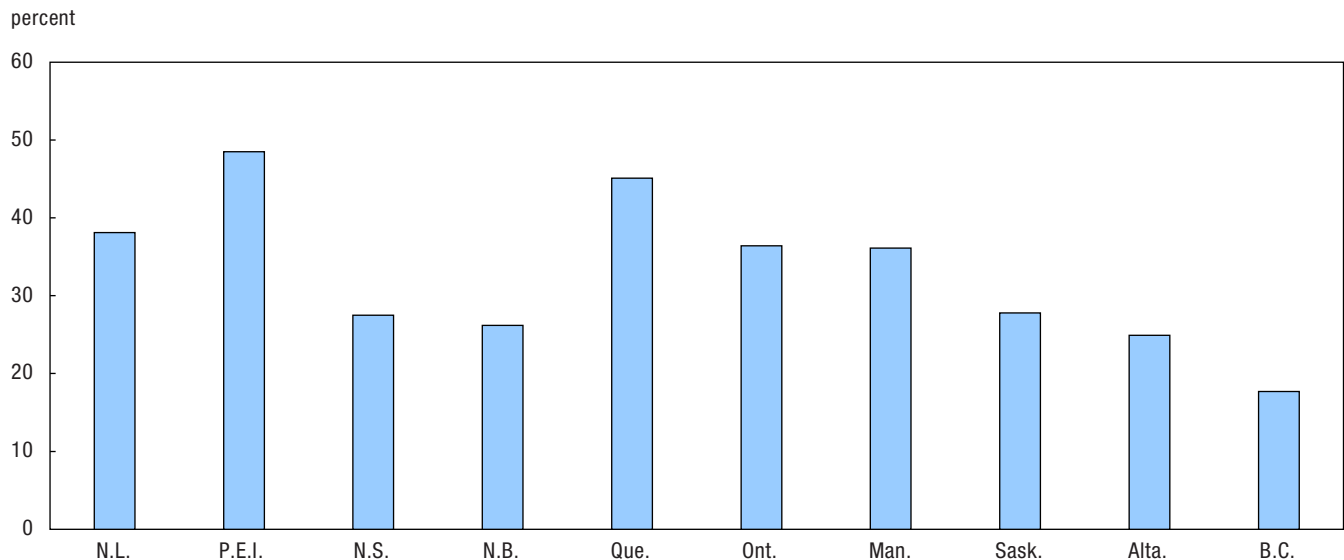
Over half (52.5%) of the 60,687 farms in Canada in 2020 that reported a soil sample test was classified as oilseed and grain, followed by farms classified as dairy cattle and milk production (11.5%).

## Nearly half of Prince Edward Island farms report a soil sample test

Just under half (48.5%) of the 1,195 farms in Prince Edward Island in 2020 reported a soil sample test. It was the highest rate among provinces, followed by Quebec (45.1%). Limestone applications are particularly important in Prince Edward Island to remedy the negative effects of acidic soils on crop production. Soil testing is a reliable way to estimate the appropriate limestone application level for a crop.

In 2020, 85.9% of dairy cattle and milk farms in Quebec reported a soil sample test. A high rate of soil sample test on dairy farms could be explained by the need to ensure the health and abundance of the pastures used to feed the cows, which depends on a nutritious soil (Chart 3).

**Chart 3**  
Proportion of farms reporting soil sample test in each province, 2020



Sources: Statistics Canada, Census of Agriculture, 2016 and 2021 (3438).

## Auto-steer is becoming more prominent on Canada's farms

Over one-quarter (26.8%) of farms in Canada in 2020 reported using auto-steer, up from just over one-fifth of farms (20.5%) in 2015. Auto-steer technology was the second most frequently reported technology used on farms in Canada in 2020.

In 2020, Saskatchewan continued to have the highest rate of auto-steer reporting in Canada with close to half of its farms (47.6%) reporting this technology. Saskatchewan's highest rate of auto-steer technology can be tied to the fact that this province had the largest number of oilseed and grain farms in Canada, which are more likely to use this type of technology.

## The use of robotic milking technology more than doubled since the previous census

In 2020, 2,197 farms reported robotic milkers, up from 1,063 farms in 2015 in Canada. Robotic milkers help increase the efficiency of dairy production in provinces like Quebec and Ontario, while reducing labour costs. Among farms classified as dairy cattle and milk production in Canada, over one-fifth (20.2%) reported robotic milkers in 2020, up from 8.9% in 2015.

Quebec continued to lead the way in robotic milking technology in 2020, with 902 farms in this province reporting robotic milkers. It was followed by Ontario with 715 farms.

## Note to readers

The Census of Agriculture is conducted every five years.

All estimates presented in this article exclude data from cannabis operations and data from Canada's three territories.

Some data refer to a reference period other than Census Day (i.e., May 11, 2021, for the 2021 census and May 10, 2016 for the 2016 census):

- Financial data refer to the calendar year prior to the census or the last complete accounting (fiscal) year.
- Data on technologies refer to the calendar year prior to the census.
- Renewable energy production data refer to the census calendar year (i.e., 2021) for the 2021 census and to the calendar year prior to the census (i.e., 2015) for the 2016 census.

## Definitions and concepts

### Farm definition

A significant conceptual change has been introduced for the 2021 Census of Agriculture: a "farm" or an "agricultural holding" (i.e., the census farm) now refers to a unit that produces agricultural products and reports revenues or expenses for tax purposes to the Canada Revenue Agency. Before 2021, a "farm" was

defined as an agricultural operation that produced at least one agricultural product intended for sale.

### Farm operating revenues

The Census of Agriculture collects total gross farm operating revenues (i.e., revenues before deducting expenses), in current dollars, for the calendar or accounting year before the census. Farm operating revenues include: operating revenues from all agricultural products sold, program payments and custom work revenues.

The following items are not considered farm operating revenues: sales of forestry products (for example: firewood, pulpwood, logs, fence posts and pilings); sales of capital items (for example: quota, land, machinery); and revenues from the sale of any goods purchased only for retail sales.

### Farm operator

Refers to any person responsible for the management decisions in operating a farm or agricultural operation. Also known as an agricultural operator, farmer, operator or rancher.

### Farm type

The type of farm is established through a procedure that classifies each census farm according to the predominant type of production. This is done by estimating the potential revenues from the inventories of crops and livestock reported on the questionnaire and determining the product or group of products that make up the majority of the estimated receipts. For example, a census farm with total potential revenues of 60% from hogs, 20% from beef cattle and 20% from wheat, would be classified as a hog and pig farm. The farm types presented in this document are derived based on the 2017 North American Industry Classification System classification.