University of Alberta Future Energy Systems

Manitoba Energy Market Profile

Measuring the Costs and Benefits of Energy Transitions

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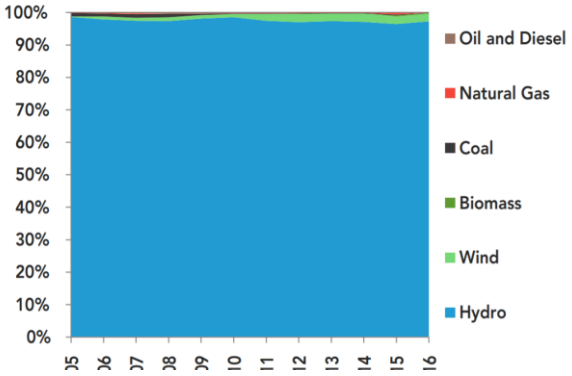
Context

While 87% of total capacity is hydroelectric, hydroelectricity accounted for 97% of generation in 2017 (NEB, nd). Manitoba Hydro, a crown corporation and major energy utility, is responsible for generation, transmission, and distribution in the province (Manitoba Hydro, nd).



Energy Generation by Type Over Time
Source: NEB, 2017

As of 2016, Manitoba's electricity capacity by type is as follows (NEB, 2017):

- Hydro: 5,349 MW
- Natural Gas: 403 MW
- Wind: 258 MW
- Coal: 98 MW
- Biomass: 22 MW
- Oil and Diesel: 5 MW

Average Consumption

In 2015, Manitoba's capita energy consumption was 20.7 MWh. Additionally, Manitoba's average residential energy bill is significantly lower than that of the nation, at $84 per 1,000 kWh compared to $129 per 1,000 kWh (NEB, 2017), the lowest in the country (Government of Manitoba, 2012). Manitoba is a net exporter of electricity (NEB, nd).

Manitoba Demographics

- **Population:** 1,278,365 (5.8% increase from 2011)
- **Average Age:** 39.2
- **Working Age (15-64):** 835,580
- **Private Dwellings:** 539,748
- **Private Dwellings Occupied by Usual Residents:** 489,050

Statistics Canada (2016). Census Profile, 2016 Census.

Micro-Generation

Manitoba Hydro allows the establishment of non-utility generation for personal use and sale to the grid. For electricity sold with a capacity greater than 200 kW, energy sale must be negotiated with a Power Purchase Agreement. Systems can be either load displacement only, which is only intended for personal use, load displacement plus excess to grid, which sells any additional power to the grid, or Independent Power Producers, which only sell energy to the grid. For systems that sell to the grid, the generator must have a bi-directional revenue meter at the generator's expense (Manitoba Hydro, nd*a*).

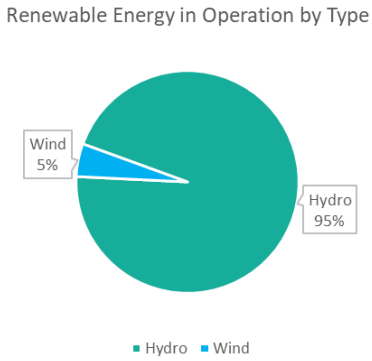
Goals

Manitoba Hydro has met several of their performance goals, including having over 99% of the energy generated in the Province be from renewable sources. Manitoba Hydro is attempting to encouraging energy efficiency through demand-side management. Through their Power Smart program, Manitoba Hydro is attempting to reduce the average energy consumption of Manitoba residents (Government of Manitoba, 2012). Manitoba introduced an emissions tax on coal and petroleum coke in 2012 and eventually banned both energy sources in 2017 (NEB, 2016).

Manitoba Hydro is also in the process of developing the Keeyask Hydroelectric Dam in collaboration with four Indigenous groups. The project will come online in 2021 and provide 695 MW of power. Manitoba Hydro is also in the process of completing the Bipole III transmission line to move energy generated in the north of the province to the south (Manitoba Hydro, 2017).

Renewable projects

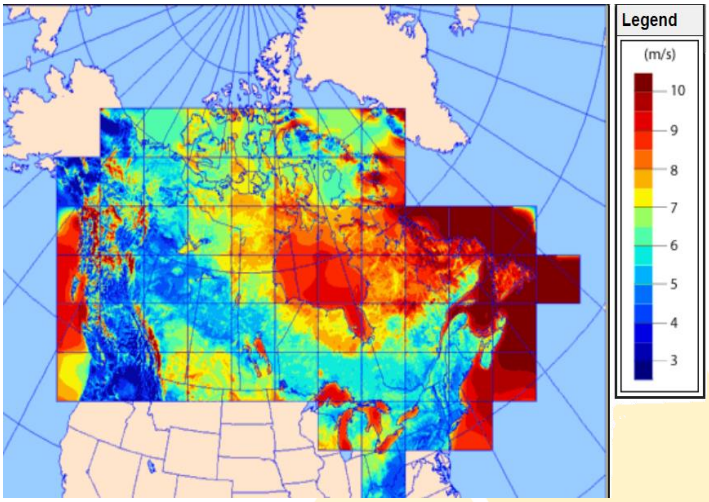
The majority of Manitoba's renewable capacity comes from 15 hydroelectric facilities, the majority of which are owned by Manitoba Hydro or through a limited partnership. At the time of writing, total capacity is 5,394 MW, with a planned increase of 695 MW through the Keeyask Hydroelectric Projects, anticipated to be operational in 2021. There are also two privately owned wind farms.



Renewable Energy Potential

Wind

The feasibility of wind power is based on the average wind speeds in the province. Mean wind speed at a height of 80 m is provided in the map adjacent. Wind speeds are highest in the southern part of the province, consistent with the location of existing wind facilities. Wind energy projects are highly compatible with the existing, predominantly hydroelectric generation portfolio. Because wind is highly intermittent, hydroelectric storage dams can act to fill gaps between supply and demand by acting as firm or spot energy producers.



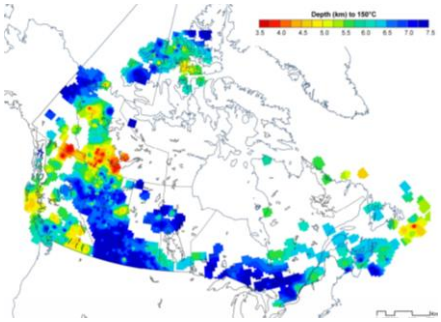
Mean Wind Speed in Canada at 80 m Height
Source: http://www.windatlas.ca/maps-en.php

In a 2015 national study by Barrington-Leigh & Ouliaris, wind potentials across the nation were measured to determine the feasible generation. Using GIS, high wind potentials were identified using wind speeds of 7 m/s at a height of 80 m. The study excluded protected lands, inland water

bodies, First Nations land, and a 5 km buffer around population centres. The remaining lands were then amended to only include lands near transmission lines (Barrington-Leigh & Ouliaris, 2015). Assuming that 25% of the remaining high potential areas are utilised, which accounts for competing land uses, Manitoba could generate 79 TWh per year. Of Alberta's total 2015 energy demand of 70 TWh per year, wind energy could account for 112% of Manitoba's total energy generation (Barrington-Leigh & Ouliaris, 2015). Manitoba could meet all of their energy needs using wind sources.

Geothermal

Geothermal thermal has very limited potential in Manitoba as it primarily lies above the Canadian Shield, which lacks high temperatures near the surface due to the age of the crust (Grasby et al., 2012). The adjacent map provides the depth to reach a temperature of 150°C, suitable for geothermal electricity production. There is very little feasibility for geothermal energy in Manitoba.

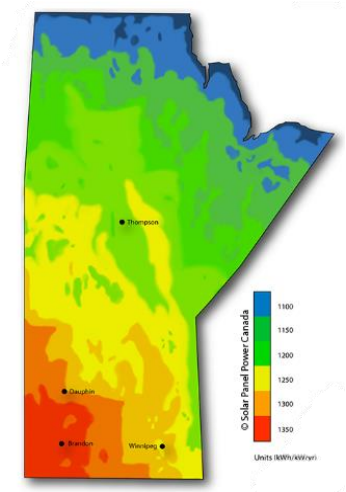


Depths at which temperatures of 150°C occur.
Source: Grasby et al., 2012

Solar

Manitoba has the third highest exposure to sunlight of the Provinces. Potential is significantly higher in the south, as seen in the image adjacent. During a two-year pilot project, Manitoba Hydro provided a solar rebate, which has since been closed. Manitoba does not have any goals to introduce more solar generation (Solar Panel Power, 2018). The lack of rebates and cheap price of energy, which reduces the revenue of excess energy sold to the grid, challenge the feasibility of solar projects.

Barrington-Leigh & Ouliaris (2015) examined the feasibility of utility-scale solar farms in Manitoba. Using the areas that receive the most sunlight and excluding lands that are more feasible for wind development, Manitoba could produce 56 TWh per year of energy from solar farms, meeting 80% of the total energy demand of 70 TWh per year in Manitoba (Barrington-Leigh & Ouliaris, 2015).



Average Annual Solar Energy Generation per kW installed
Source: https://solarpanelpower.ca/solar-power-maps-canada/

Hydroelectric

Using the technical hydroelectrical potential for rivers in the province, and assuming a 60% capacity to generation ratio and assuming 60% of feasible sites are developed, Manitoba could generate 56 TWh per year from hydroelectric sources, meeting 80% of the total energy demand of 70 TWh per year (Barrington-Leigh & Ouliaris, 2015).

Sources

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