University of Alberta Future Energy Systems

Northwest Territories Energy Market Profile

Measuring the Costs and Benefits of Energy Transitions

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Context

In 2016, the Northwest Territories (NWT) had a total generating capacity of 187 MW. Approximately 75% of NWT's electricity comes from hydroelectric sources, depending on precipitation. In years of low precipitation, diesel is used to replace hydroelectricity (NEB, 2018). NWT has two hydro-based grids that do not connect to each other: the Snare Grid, which is north of Great Slave Lake, and the Taltson Grid, south of Great Slave Lake. There are several remote communities that are not connected to these regional grids (NEB, 2018).

In 2017, the generation capacity of the Northwest Territories Power Corporation is as follows:

- 97.781 MW of Diesel
- 32.715 MW of Hydro
- 5.725 MW of Natural Gas
- 0.290 MW of Solar

Average Consumption

In 2015, NWT users consumed 12.0 MWh per capita, 17% less than the national average. NWT has the second highest electricity costs, at $309 per 1,000 kWh, compared to the national average of $129 per 1,000 kWh. NWT does not trade electricity with other jurisdictions (NEB, 2018).

Northwest Territories Demographics

- **Population:** 41,786 (0.8% increase from 2011)
- **Average Age:** 34.9
- **Working Age (15-64):** 29,690
- **Private Dwellings:** 17,666
- **Private Dwellings Occupied by Usual Residents:** 14,981

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

Northwest Territories Power Corporation

The Northwest Territories Power Corporation (NTPC) is a wholly owned subsidiary of Northwest Territories Hydro, which is owned by the Government of the Northwest Territories (GNWT) under the *Northwest Territories Power Corporation Act*. The NTPC generates and distributes power to communities (Northwest Territories Hydro Corporation, 2017).

Net Metering

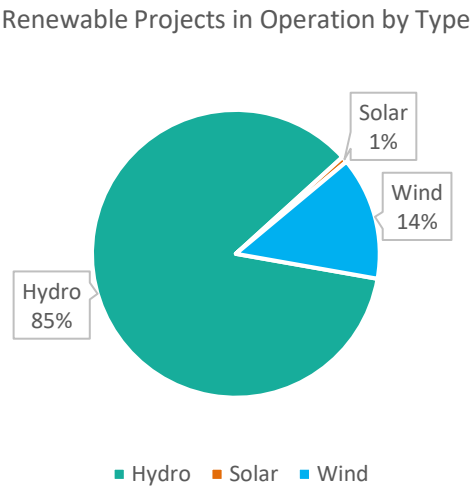
NTPC provides a net metering program that allows consumers to install small renewable energy projects. Net metering producers are credited at the retail rate for excess energy sent to the grid. Any stockpiled credits are cleared on March 31st. Projects cannot exceed a capacity of 5 kW (Things You Should Know, nd).

Goals

Goals for the future are established in the Long Term Vision outlined in the NTPC Annual Report (2017). Goals relating to renewables include having the highest alternative energy implementation per capita and reducing diesel usage by 50% (NTPC, 2017). Diesel usage will be replaced with renewables wherever feasible, by connecting remote communities with the grid and developing solar energy. Specific initiatives include developing a wind plan in Inuvik, using new turbines that can work well in the northern climate, connecting the communities of Fort Providence, Kakisa, and Whati to the grid allowing them to use NWPT hydropower, using Liquefied Natural Gas in Fort Simpson and Tuktoyaktuk (NTPC, 2017).

Renewable projects

As of 2018, the NWT has a total operational renewable capacity of 65.50 MW. The majority (55.85 MW or 85%) of the NWT's electricity comes from hydroelectric sources on the Snare and Yellowknife River. The only wind project in the NWT, the Diavik Diamond Mine's wind turbine produces 9.2 MW of wind energy, amounting to 14% of the renewable energy capacity. One community based solar project added 0.45 MW of capacity, or 0.68%. Other solar projects exist due to the net metering program, but were not inventoried.



Renewable Potential Summary

Hydroelectric

In a 2011 energy report, the GNWT identified the potential for hydro development as 11,000 MW. This was separated into 10 major rivers, with developed, undeveloped, and proposed development, seen below (Northwest Territories Energy, 2011):

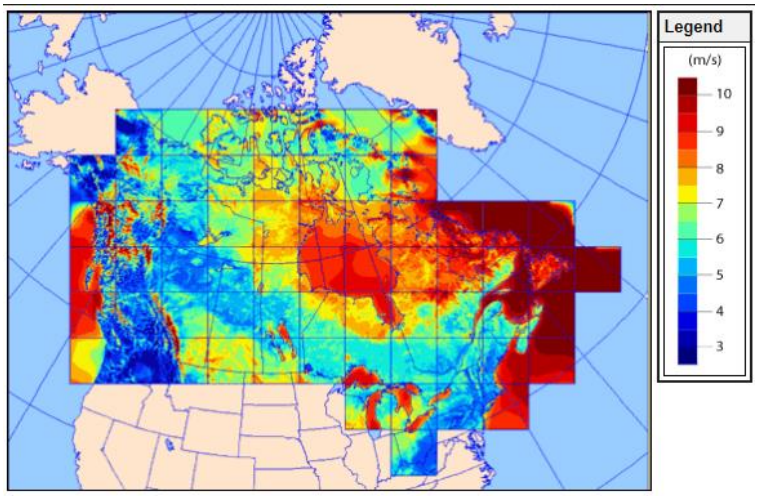
Hydroelectric Development and Potential on rivers in the NWT
Source: https://www.assembly.gov.nt.ca/sites/default/files/11-05-20td36-166.pdf

River	Developed (MW)	Undeveloped Potential (MW)	Proposed Development (MW)
Bear	0	568	0
La Martre	0	27	13
Lockhart	0	269	0
Mackenzie	0	10,450	0
Snare	30	33	0
Snowdrift	0	1	1
Taltson	18	172	56
Yellowknife	7	0	0
Total	55	11,520	69
Slave	0	1,500	0

The origins of the existing hydro plants were often to provide electricity to mine sites. Several additional hydroelectric projects are in various development stages.

Wind

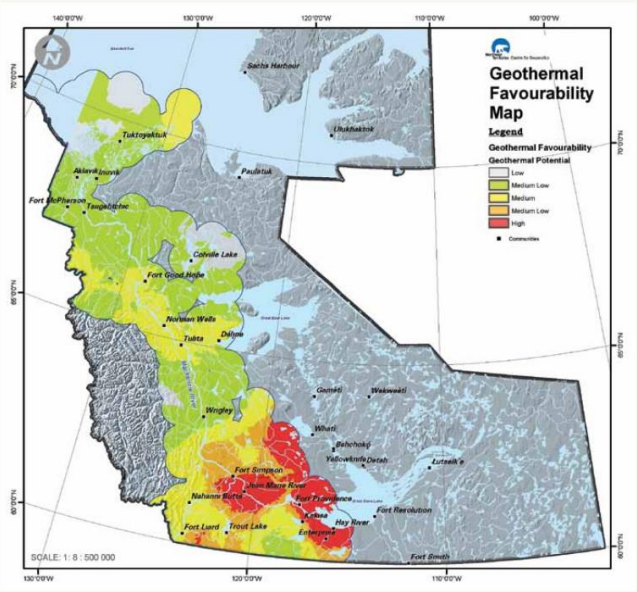
Wind speeds in the NWT are not as high as other parts of the nation, making wind energy less feasible (Northwest Territories Energy, 2011). The product of wind feasibility studies indicate that four communities, Sachs Harbour, Paulatuk, Ulukhaktok, and Inuvik, have wind speeds high enough for feasible wind energy generation (GNWT, 2016). A potential site near the Inuvik airport could provide between 2 and 5 MW (GNWT, 2016). A concern for northern wind farms is the problem of structural ice loading. When ice accrues on turbines, it can decrease performance or an inability to self-start (Pinard & Weis, 2003). Wind turbines must be built of appropriate materials to withstand northern condition (Pinard & Weis, 2003). When conducting an economic analysis, Pinard & Weis (2003) found that high penetration wind portfolios (where wind energy is a significant component of energy generation mix and can act as the sole provider when conditions are favourable) present the best economic case. Mean wind speed at a height of 80 m is provided in the map adjacent.



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

Geothermal

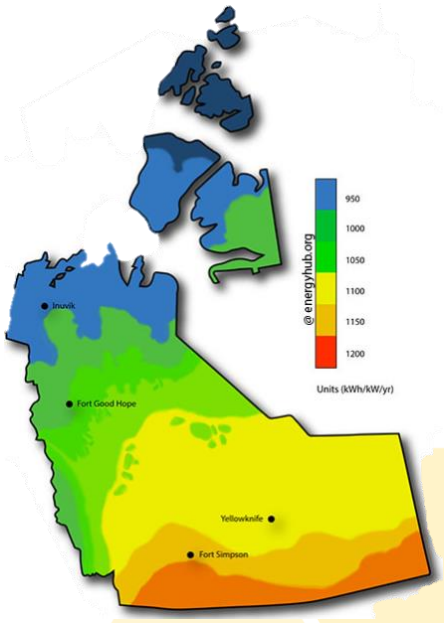
Geothermal energy has significant potential for development in the NWT. Not only does NWT have significant geological favourability, there are also over 1,500 existing wells. Several of them have bottom temperatures of 150°C, suitable for electricity production (Northwest Energy, 2011). The map adjacent shows the geothermal favourability in the NWT, which integrates geological information with infrastructure, communities and grid information (Klump, Stembergh, & Dennett, 2010). The highest geothermal potential exists around the west side of Great Slave Lake, where geothermal energy plants can be connected into the grids. The geothermal gradient at Fort Simpson and Fort Providence is likely enough between 100°C and 180°C at a depth of 2 to 3 km (Klump, Stembergh, & Dennett, 2010). The Mackenzie Corridor, including the communities of Deline, Norman Wells, Tulita, and Fort Good Hope have medium geothermal potential and can be used for heating and possibly energy generation (Klump, Stembergh, & Dennett, 2010).



Geothermal Favourability in the NWT
Source: NWT, 2011

Solar

Solar exposure in the NWT varies greatly, from high in the south to low and infeasible to the north. Fort Simpson is the largest community in the most favourable area (Solar Panel Power, 2018). The GNWT has identified a solar as a component of their energy market and encourages development through the net metering and rebate programs. Solar power can account for approximately 20% of the average power load when integrated into the existing grid. Solar is also being supported for off-grid communities (NWT Environment and Natural Resources, 2012)



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

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Biomass

There are 33.3 million hectares of forested land in the NWT. However, sustainable forestry is challenged by the relatively slow growth of northern trees (Northwest Territories, 2011). There are little waste wood products suitable for biomass, therefore, introducing biomass energy means trees must be cut for the purpose of producing biomass fuel. The NWT currently lacks any biomass electricity generation, but does support a number of actions to encourage biomass heating, by studying the feasibility of biomass energy, and reducing the cost of pellet production (Northwest Territories, 2011). In a report compiled for the NWT, it was determined that harvesting biomass for energy production is sustainable, given the demand for biomass energy would fall below the annual timber yield (Manuilova & Johnston, 2011).

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