University of Alberta Future Energy Systems

Nova Scotia Energy Market Profile

Measuring the Costs and Benefits of Energy Transitions

Sonak Patel and Elizabeth Dowdell
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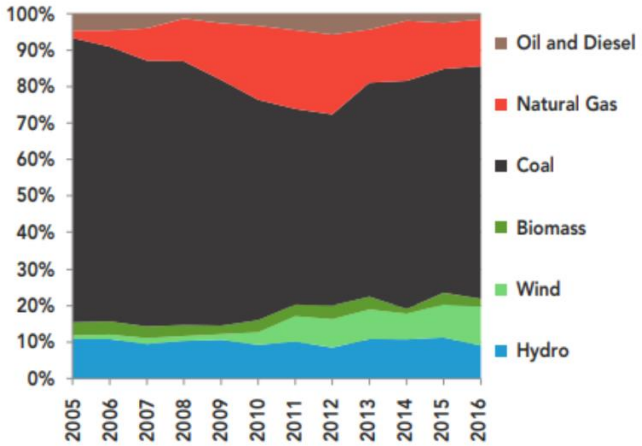
Context

Nova Scotia has a total generating capacity of 2,987 MW, the majority of which comes from coal. Nova Scotia Power is the corporation responsible for the generation and distribution of energy in the province (NEB, 2018). The following represents the energy portfolio of Nova Scotia in 2016 (NEB, 2017):

- Coal: 1,252 MW
- Wind: 515 MW
- Natural Gas: 482 MW
- Hydro: 388 MW
- Oil and Diesel: 222 MW
- Biomass: 128 MW



Electricity Generation By Source in Nova Scotia
Source: NEB, 2017

Average Consumption

Nova Scotia has an annual electricity consumption per capita of 10.6 MWh, 30% less than the national average. In the last 13 years, Nova Scotia has seen energy demand fall by 10%. Nova Scotia is a net importer of energy from New Brunswick and will purchase power from Newfoundland and Labrador's Muskrat Falls Hydro facility (currently in development) via the Maritime Link Project (NEB, 2018).

Nova Scotia Demographics

- **Population:** 923,598 (0.2% increase from 2011)
- **Average Age:** 43.5
- **Working Age (15-64):** 605,950
- **Private Dwellings:** 458,568
- **Private Dwellings Occupied by Usual Residents:** 401,990

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

Electricity Market

As per the *Public Utilities Act,* the Nova Scotia Utility and Review Board regulates power utilities. Nova Scotia Power Incorporation (NSPI) is a vertically integrated utility responsible for generation, transmission, and distribution of electricity in the province. Several municipalities (Antigonish, Berwick, Canso, Lunenburg, Mahone Bay, and Riverport) have their own distribution and buy energy from NSPI and other generators (Nova Scotia's Electricity Systems, 2014).

Nova Scotia operates a wholesale electricity market, allowing generators to sell energy to NSPI or the six municipalities above. Under the *Electricity Reform Act* (2013), final consumers are able to purchase energy directly from renewable providers, bypassing NSPI and utilities (Nova Scotia Electricity Systems, 2014).

Community Feed-In Tariffs (COMFIT)

The Nova Scotia Community Feed-In Tariff (COMFIT) was intended to encourage renewable energy generation by providing a guaranteed rate per kWh for projects that sell to the provincial grid and to broaden the ownership of renewable generation to include community investment. This program was in operation for 5 years between 2011 and 2016, providing 150 MW of renewable community-owned projects (Nova Scotia Department of Energy and Mines, nd).

Solar for Community Buildings Pilot Program

In the *Electricity Plan: Our Electricity Future*, the Province introduced a new solar energy program. The Solar Electricity for Community Buildings Program is in a pilot stage, intended to allow community participation in solar energy generation. The Program allows municipalities, Mi'kmaq Bands, Academic Institutions, and Non-Profits to make proposals for the sale of energy, with the lowest bids being awarded a 20 year power purchase agreement. Generators must not exceed 75 kW and must not involve the clearing of forested or agricultural land (The Solar Electricity for Community Buildings Pilot Program, nd).

Enhanced Net Metering

This program allows users to connect small renewable projects (under 1 MW) to sell to the grid. Generators are credited for any excess energy that is sold back to the grid at retail rates. Any individual, business, and community group can qualify for the net metering program (Enhanced Net Metering, nd).

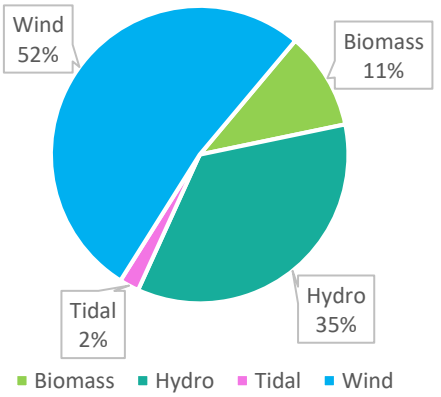
Goals

The Renewable Energy Plan, passed in 2010, provides details on the provincial goal to move away from carbon production in electricity generation. The goal of the province is have 40% of the total capacity be from renewable sources by 2020. To achieve this goal, large and medium-sized projects will be introduced by the NSPI and IPPs and community projects and enhanced net metering will encourage smaller projects. However, the Province has been hesitant to pursue biomass energy, as forest harvesting is a contentious issue (Nova Scotia Department of Energy, 2010).

Renewable projects

Nova Scotia's operational renewable energy capacity sums to 1,117.61 MW. 52.36% of this capacity comes from wind, 35.18% from hydroelectricity, 10.67% from biomass, and 1.79% from tidal. Nova Scotia also has a 4 MW tidal demonstration project in development.

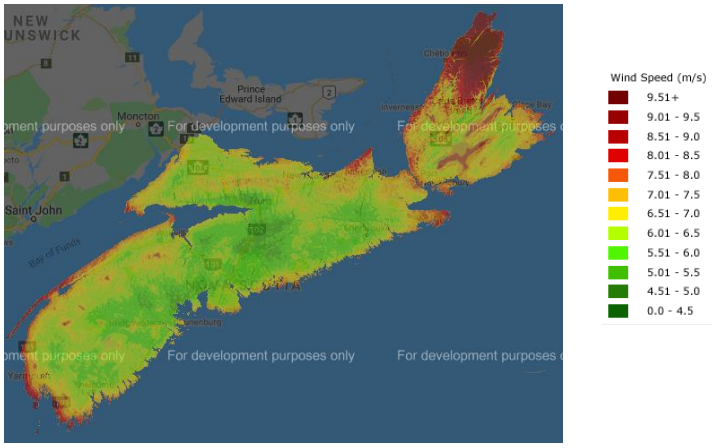
Renewable Projects in Operation by Type



Renewable Potential Summary

Wind

The map below, provided by the Nova Scotia Wind Atlas, shows mean wind speed at 80 metres. Red to orange areas indicate wind speeds exceeding 7 m/s, suitable for commercial development. The most viable areas of Nova Scotia for wind development are on Cape Breton, where speeds exceed 7 m/s.



Mean Wind Speed in Nova Scotia at 80 m Height
Source: http://www.nswindatlas.ca/

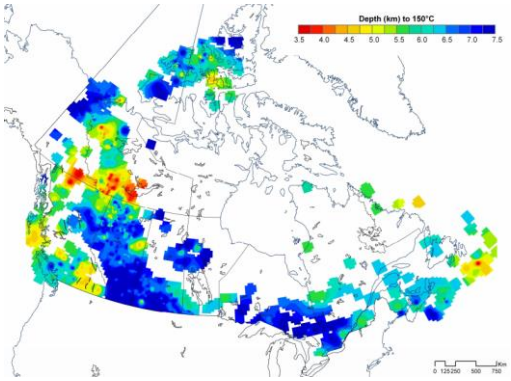
In a 2015 national study by Barrington-Leigh & Ouliaris, wind potentials across the nation were measured to determine the feasible generation. Using GIS, high wind potentials were identified using wind speeds of 7 m/s at a height of 80 m. The study excluded protected lands, inland water bodies, First 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, Nova Scotia could generate 30 TWh per year. Onshore wind energy could account for 62% of Nova Scotia's total energy demand of 49 TWh per year (Barrington-Leigh & Ouliaris, 2015).

Nova Scotia also has some potential for offshore wind energy as well. Barrington-Leigh & Ouliaris (2015) evaluated the potential for offshore wind across the nation. Offshore wind benefits from higher wind speeds, but is challenged by higher construction costs, higher maintenance costs due to seawater corrosion, and higher transmission costs (Barrington-Leigh & Ouliaris, 2015). Most commercial offshore

wind occurs at shallow depths. When examining feasible lands for offshore wind, areas near the shore and water bodies near population centres or transmission lands were considered feasible. Areas with high potential were off the coast of British Columbia, on the Great Lakes, on the Gulf of St. Lawrence, and Bay of Fundy. High potential sites do not account for shipping lanes and environmentally sensitive areas. Assuming a 50% utilization of high potential areas, it was determined that offshore wind farms in Nova Scotia could produce 21 TWh per year, meeting 43% of the total energy demand in Nova Scotia of 49 TWh per year (Barrington-Leigh & Ouliaris, 2015). Nova Scotia could meet all of their energy demand using on and off shore wind power.

Geothermal

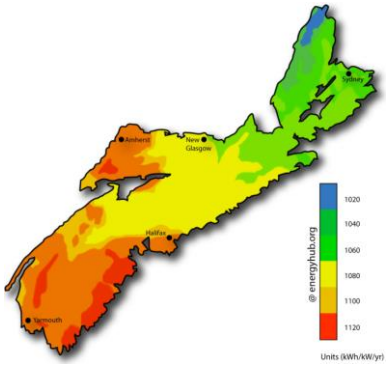
The map to the right shows the depth at which temperatures of 150°C occur, which is considered suitable for electricity generation. Nova Scotia has significant potential due to the number of existing coal mines, which can be converted into geothermal generators. Feasibility is further improved by the proximity of communities to coal mines, reducing transmission costs (Grasby et al., 2012).



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

Solar

Nova Scotia has poor geography for solar energy, due to cloud cover in the province. The areas of the highest potential in Nova Scotia are to the south. From a policy perspective, Nova Scotia supports small scale solar power using the Enhanced Net Metering Program (Solar Panel Power, nd).



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

Hydroelectric

Barrington-Leigh & Ouliaris (2015) used the technical feasibility of hydroelectric resources and assumed a 60% capacity to generation ratio and 60% of feasible sites are developed to determine the feasibility of energy generation from hydroelectric sources. Nova Scotia could produce 27 TWh per year, which could meet 55% of the total 49 TWh per year demand.

Tidal

Tidal energy is still in its infancy, and technology is still in the process of being developed. As such, it is hard to have a realistic estimate of how much energy can be feasibly generated from tidal sources. Barrington-Leigh & Ouliaris (2015) assumed 15% of the tidal potential on the shores of Nova Scotia can be realistically captured. Under this parameter, Nova Scotia could generate 1.64 TWh per year, or 3.32% of the total energy demand of 49 TWh per year.

Wave

Wave energy is another growing technology and is also difficult to determine the true potential of wave powers. Waves are faster further from the shore, but floating wave converters have high transmission and maintenance costs. In an attempt to estimate the wave energy potential of Nova Scotia, Barrington-Leigh & Ouliaris (2015) assumed wave power facilities would have to locate near the coast. Using the 500 km of coastline on the Atlantic Ocean divided amongst the four provinces with Atlantic coasts and assuming a 10% efficiency of conversion between theoretical potential and electricity generated, it was determined that Nova Scotia could generate 5 TWh per year, or 11% of the total 49 TWh per year Nova Scotia Energy Demand (Barrington-Leigh & Ouliaris, 2015).

Biomass

Barrington-Leigh & Ouliaris (2015) used the existing biomass energy generation in Nova Scotia to estimate the bioenergy potential of the province, which was provided as 0.9 TWh per year, 1.9% of the total 49 TWh per year.

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