# Recent Developments in Renewable Energy in Remote Aboriginal Communities, Ontario, Canada

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Northern Ontario's 25 remote aboriginal communities are looking to introduce renewable electricity sources into their diesel-powered systems. This paper reviews community electrical systems, past renewable electricity projects, as well as available renewable resources, generation alternatives, and supportive targets and policies for community owned renewable electricity generation in Northern Ontario. Communities are transforming their electrical systems by introducing renewable electricity into their electrical systems and participating directly in the proposed transmission line that would connect 21 of the 25 communities to the provincial grid. Renewable projects are financially supported by federal and provincial programs and take the form of small scale applications under "behind the meter" agreements, or community scale projects under power purchase agreements with HORCI, the utility that services 15 remote communities. Under the long-term option of the interconnection to the provincial grid, communities are expected to be supplied with low carbon, reliable and affordable electricity, and to be able to participate in the development of larger scale community owned renewable electricity generation assets. The model of increased aboriginal community decision making authority is used to increase their socioeconomic benefits and self-sufficiency and may serve as a valuable model for other community assets and service delivery in the future.

**Keywords:** Ontario, remote aboriginal communities, indigenous communities, renewable electricity, community ownership, transmission line, energy transition

## Introduction

Ontario's 25 remote aboriginal[1] communities are highly dependent on diesel for electricity generation and are looking to introduce renewable electricity sources into their electrical systems. Diesel generated electricity is responsible for direct (combustion) and indirect (e.g. transport, including delivery by airplane in some cases) greenhouse gas emissions, fuel spills and fuel tank leakages during transportation and storage, as well as limitations to economic development due to imposed load restrictions (AANDC, 2012b). Although some of Ontario's early utility owned renewable electricity projects experienced performance issues (Weis & Ilinca, 2008), there is renewed interest in hydroelectricity, wind, solar and biomass cogeneration

[1]The term aboriginal community is used in this paper. It is recognized that some communities prefer the term indigenous community while others prefer aboriginal community and that both are used in the literature.

applications to address emission, cost, reliability and self-sufficiency issues. Community ownership or partnership is encouraged to build local capacity and to increase local socio-economic benefits. The next sections of this paper provide an overview of Ontario's remote aboriginal communities, the capacity and type of current electricity generation systems, electricity price and rate structures, future demand expectations, renewable resource availability, as well as policies, plans, and existing and future projects to support renewable electricity generation in the remote communities.

**Population**

There are 37 remote communities in Ontario, of which 25 are aboriginal communities with a population of approximately 15,000[2]. The communities are isolated and accessed only by winter roads and air, while the community of Fort Severn is additionally accessed by barge[3, 4] (OPA, 2014). There are only two communities with a population over 1,200 and 11 communities have a population between 300 and 800 (Table 1). Most of the communities are members of the Nishnawbe Aski Nation (NAN), a political territorial organization representing 49 northern Ontario First Nation communities with an estimated total membership (on and off reserve) of around 45,000 (NAN, 2014). The communities are also grouped by Tribal Council (Windigo First Nations Council, Wabun Tribal Council, Shibogama First Nations Council, Mushkegowuk Council, Matawa First Nations, Keewaytinook Okimakanak, and Independent First Nations Alliance) based on certain regional, ethnic or linguistic characteristics (NAN, 2014).

**Electricity system**

Northern Ontario's remote communities are serviced by Hydro One Remote Communities Inc. (HORCI), and Independent Power Authorities (IPAs) (Table 1 and Figure 1). HORCI, a Hydro One subsidiary company, distributes electricity to 21 remote communities in Northern Ontario, of which 15 are aboriginal communities (Hydro One, 2013; Service Ontario, 2013). HORCI services 3,332 customers and generates electricity from 18 generation stations using 55 generators, two hydroelectric stations (in Deer Lake and Sultan), and four wind demonstration projects (two in Kasabonika Lake FN, one in Fort Severn and one in Big Trout Lake) (Hydro One, 2012; COGUA, 2013; HORCI, 2012).

IPAs, established in the 1970s, are community owned and operated utilities servicing 11 northern Ontario remote aboriginal communities (Hydro One, 2012; OEB, 2008). IPAs currently operate 10 stations and 34 generators[5], and service 1,462 customers (1,287 residential, 52 general service and 113 governmental customers) (OEB, 2008). IPA communities' members mention certain

[2] 2011 National Household Survey. Released November 13, 2013.http://www12.statcan.gc.ca/nhs-enm/2011/ref/no13reserves/table-tableau.cfm?Lang=E&CSD_UID=3560085 (accessed January 31, 2014).
[3] http://www.mndm.gov.on.ca/en/northern-development/transportation-support/northern-ontario-winter-roads
[4] http://www.hydroone.com/OurCommitment/RemoteCommunities/Pages/home.aspx
[5] The communities of Keewaywin and Koocheching are served by the diesel plant in Keewaywin.

benefits from running their own power systems, namely local control (which directly affects rate settings according to community needs), support for members facing poverty issues, opportunities for local job creation, and a source of community pride (NAN, 2014a; OEB, 2008).

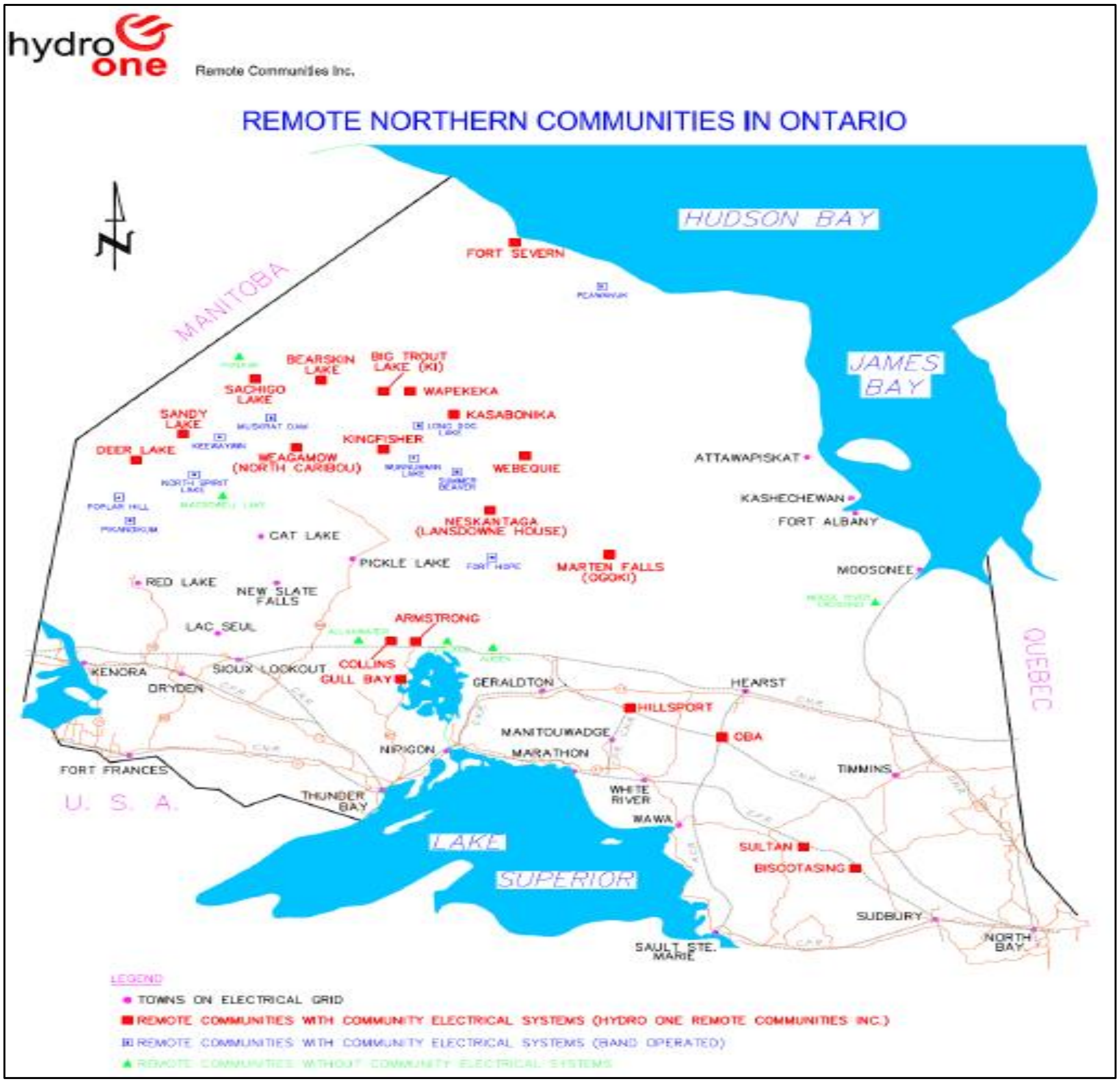
**Table 1: Remote aboriginal communities, Ontario**

| Nr | Community name | Other name | Population 2011[6] | Diesel plant capacity kW[7] | Annual energy demand (2011) MWh[8] | Member-ship | Utility |
|---|---|---|---|---|---|---|---|
| 1 | Bearskin Lake FN | | 400 | 825 | 2,826 | NAN | HORCI |
| 2 | Deer Lake FN | | 722 | 825 | 5,018 | NAN | HORCI |
| 3 | Fort Severn FN | | 477 | 550 | 2,420 | NAN | HORCI |
| 4 | Kasabonika Lake FN | | 890 | 825 | 4,114 | NAN | HORCI |
| 5 | Kingfisher Lake FN | | 415 | 825 | 2,370 | NAN | HORCI |
| 6 | Marten Falls | Ogoki Post | 234 | 610 | 1,438 | NAN | HORCI |
| 7 | Neskantaga FN | Lansdowne | 240 | 705 | 1,795 | NAN | HORCI |
| 8 | North Caribou Lake FN | Weagamow, Round Lake | 810 | 825 | 4,480 | NAN | HORCI |
| 9 | Sachigo Lake FN | | 420 | 550 | 2,847 | NAN | HORCI |
| 10 | Sandy Lake FN | | 1,954 | 3,250 | 11,290 | NAN | HORCI |
| 11 | Wapekeka FN | Angling Lake | 371 | 550 | 2,535 | NAN | HORCI |
| 12 | Webequie FN | | 670 | 825 | 2,737 | NAN | HORCI |
| 13 | Whitesand FN | Armstrong | 262 | 1,400 | 4,104 | Other First Nation | HORCI |
| 14 | Kiashke Zaaging Anishinaabek FN | Gull Bay, Gull River | 218 | 550 | 1,282 | Other First Nation | HORCI |
| 15 | Kitchenuhmaykoosib Inninuwug FN | Big Trout Lake | 971 | 2,600 | 6,059 | Other First Nation | HORCI |
| 16 | Kee-Way-Win FN | Niska | 337 | 350 | 2,364 | NAN | IPAs |
| 17 | North Spirit Lake FN | | 275 | 420 | 2,085 | NAN | IPAs |
| 18 | Wawakapewin FN | Long Dog | 22 | 55 | n/a | NAN | IPAs |
| 19 | Pikangikum FN | | 2,280 | 1,250 | 5,033 | NAN | IPAs |
| 20 | Poplar Hill FN | | 495 | 600 | 2,189 | NAN | IPAs |
| 21 | Muskrat Dam Lake FN | | 267 | 650 | 2,116 | NAN | IPAs |
| 22 | Nibinamik FN | Summer Beaver | 335 | 705 | 1,996 | NAN | IPAs |
| 23 | Weenusk FN | Peawanuck, Winisk | 234 | 400 | 2,249 | NAN | IPAs |
| 24 | Wunnumin Lake FN | | 516 | 1,115 | 2,213 | NAN | IPAs |
| 25 | Eabametoong FN | Fort Hope, Ebanetoong | 1,085 | 1,565 | 3,400 | NAN | IPAs |
| | **Total** | | **14,900** | **22,825** | **78,960** | | |

*Source: AANDC and NRCan (2011); (HORCI, 2012); OEB (2008).*

[6] See also: http://pse5-esd5.aadnc-aandc.gc.ca/fnp/Main/Search/FNPopulation.aspx?BAND_NUMBER=540&lang=eng.
[7] According to AANDC and NRCan (2011) and OEB (2008).
[8] According to AANDC and NRCan (2011), unless otherwise noticed.

**Figure 1: Remote communities of Northern Ontario and their electricity providers**




*Source: HORCI (2012, p.7).*

## Electricity rates

Electricity rates in HORCI's communities are differentiated between the Standard-A and the non-Standard-A rate. Residential and commercial customers pay the Non-Standard-A subsidized rates, which are equivalent to customers who are connected to the main Ontario grid. Federal, provincial and community buildings pay the Standard-A rate, which equals the cost of electricity generation in the remote communities (0.92 $/kWh in 2013), and is applicable to all accounts paid directly or indirectly out of federal and/or provincial government funding. Electricity costs in IPAs are estimated to be approximately 2% higher than HORCI electricity costs, due to the lack of economies of scale in fuel purchasing and equipment maintenance (OPA, 2010; OEB, 2008). HORCI's residential customers' rates are subsidized mainly by AANDC and Ontario's Rural or Remote Rate Protection (RRRP) funding mechanism. IPAs receive subsidies from

AANDC to support residential consumers but rates are significantly higher for general service and governmental accounts (see Table 2), due to the lack of the RRRP subsidy, since IPAs are not licenced by the Ontario Energy Board (OEB, 2008).

**Table 2: Electricity rates in Ontario's remote communities**

| Rates type | HORCI electricity rates for 2013 | IPAs electricity rates |
|---|---|---|
| Non-Standard-A | Energy charge first 1000 kWh….......0.08 $/kWh<br>Energy charge next 1500 kWh….......0.11 $/kWh<br>Energy charge all additional kWh ....0.17 $/kWh | Residential…. 0.18 $/kWh -0.25 $/kWh<br>Business……. 0.18 $/kWh-0.90 $/kWh<br>Government…0.90 $/kWh-1.90 $/kWh |
| Non-Standard-A General Service | Energy charge first 1000 kWh….......0.08 $/kWh<br>Energy charge next 1500 kWh….......0.11 $/kWh<br>Energy charge all additional kWh ...0.17 $/kWh | |
| Standard-A Residential | Energy charge first 250 kWh…0.56-0.84 $/kWh<br>Energy charge all additional….0.64-0.92 $/kWh | |
| Standard-A General service | \|Energy charge………………....0.64-0.92 $/kWh | |

*Source: Hydro One (2012, p.748)*; *OEB(2008).*

### Future power requirements and plans

Electricity generation in the HORCI operated communities increased at an average 2% annually from approximately 24,500,000 kWh in 1990 to approximately 59,000,000 kWh in 2011, due to population, dwelling and community building increases (HORCI, 2012). Similarly, electricity generation for the IPA communities increased an average of 2% annually between 2004 and 2011 (OEB, 2008). Future electricity load is forecast to increase due to community population growth and new resource development projects within Nishnawbe Aski Nation territory connected with the discovery of significant deposits of nickel and copper in the Ring of Fire area (Burkhardt, Rosenbluth, & Boan, n.d.; NRCan, September 2012). Under these resource development projections, OPA (2010) and OPA (2014) anticipate a load increase from 18 MW to 85 MW and generation needs from 84,000 MWh to 394,000 MWh between 2013 and 2053 (Table 3).

**Table 3: Forecast peak demand for Ontario's 25 remote aboriginal communities**

| Description | Forecast Peak Load for the 25 remote communities | | | | |
|---|---|---|---|---|---|
| | 2013 | 2023 | 2033 | 2043 | 2053 |
| Peak Load (MW) | 18 | 27 | 38 | 57 | 85 |
| Energy consumption (MWh) | 84,000 | 122,000 | 179,500 | 266,000 | 394,000 |

*Source: OPA (2010, p.23).*

Additionally, Ontario's 25-year economic plan for Northern Ontario (Ministry of Infrastructure, 2011) identifies renewable energy generation as an emerging priority economic sector. Ontario's Long Term Energy Plan targets 20,000 MW of renewable energy generation by 2025, or approximately half of the provincial installed capacity, with 10,700 MW being wind, solar and bioenergy, and 9,300 MW being hydroelectric power (OME, 2013). Provincial targets for electricity generation also call for increased participation by aboriginal communities in clean electricity generation based on local resources, to address pressing socioeconomic and environmental issues (OME, 2013; AECOM, 2012).

**Table 4: Available renewable energy resources in Ontario's remote aboriginal communities**

| Renewable resource | Wind | | Solar | Hydroelectricity [3] | | | | |
|---|---|---|---|---|---|---|---|---|
| Community name | Average wind speed (m/sec) [1] | Average wind speed (m/sec) [2] | Monthly Aver. Normal Radiation (kWh/m²·day) [2] | Size MW | Energy GWh/y | Capacity factor | Capital cost $million | LUEC[9] $/kWh |
| Bearskin Lake FN | 6 | 4.07 | 3.62 | 5.6 | 24.4 | 0.5 | 36 | 0.086 |
| Deer Lake FN | 5.5 | 6.11 | 2.81 | 5.4 | 23.8 | 0.5 | 32 | 0.08 |
| Fort Severn FN | 7 | 5.20 | 3.51 | - | - | - | - | - |
| Kasabonika Lake FN | 5 | 4.0 | 3.79 | 6.9 | 30.4 | 0.5 | 50 | 0.091 |
| Kingfisher Lake FN | 5 | 4.1 | 3.57 | 2.4 | 13.9 | 0.44 | 16 | 0.108 |
| Marten Falls | - | 4.15 | 3.68 | 4.3 | 19 | 0.5 | 24 | 0.078 |
| Neskantaga FN | - | 4.17 | 3.70 | 23 | 114 | 0.56 | 123 | 0.059 |
| North Caribou Lake FN | 5.5 | 4.12 | 3.61 | - | - | - | - | - |
| Sachigo Lake FN | 5.5 | 4.05 | 3.63 | 5.3 | 23.4 | 0.5 | 36 | 0.089 |
| Sandy Lake FN | 5 | 4.03 | 3.59 | 15.5 | 76.1 | 0.56 | 86 | 0.062 |
| Wapekeka FN | 6.5 | 4.10 | 3.61 | 6 | 26.3 | 0.5 | 54 | 0.109 |
| Webequie FN | 5.5 | 4.21 | 3.62 | 23 | 114 | 0.56 | 142 | 0.066 |
| Whitesand FN (Armstrong) | - | 4.23 | 3.60 | - | - | - | - | - |
| Kiashke Zaaging Anishinaabek FN | 6 | 4.42 | 3.81 | 2.2 | 9.5 | 0.5 | 11.5 | 0.083 |
| Kitchenuhmaykoosib Inninuwug FN | 6.5 | 4.10 | 3.61 | 5.5 | 24.1 | 0.5 | 36 | 0.089 |
| Kee-Way-Win FN | 5.5 | 4.05 | 3.59 | 24.1 | 119 | 0.56 | 140 | 0.063 |
| North Spirit Lake FN | 5.5 | 4.07 | 3.60 | 2.6 | 9.9 | 0.44 | 16 | 0.104 |
| Wawakapewin FN | 5 | 4.10 | 3.58 | 4.3 | 18.9 | 0.5 | 37 | 0.109 |
| Pikangikum FN | - | 4.03 | 3.61 | 8.2 | 36.1 | 0.5 | 44 | 0.071 |
| Poplar Hill FN | - | 4.00 | 3.67 | 11.8 | 57.8 | 0.56 | 65 | 0.064 |
| Muskrat Dam Lake FN | - | 4.07 | 3.59 | 38 | 185 | 0.56 | 196 | 0.056 |
| Nibinamik FN | - | 4.16 | 3.64 | 17 | 85.3 | 0.56 | 96 | 0.062 |
| Weenusk FN | 7 | 6.97 | 3.33 | 4.1 | 18 | 0.5 | 22.6 | 0.078 |
| Wunnumin FN | 5.5 | 4.14 | 3.64 | 13.5 | 66.5 | 0.56 | 83 | 0.068 |
| Eabametoong FN | - | 4.20 | 3.67 | 26 | 129 | 0.56 | 141 | 0.059 |

*Source: [1] Weis & Ilinca (2010), [2] NASA surface meteorology and solar energy-available Tables[10]; [3] Hatch, (2013).*

## Availability of renewable energy sources in northern Ontario

A total of 1,500 MW of potential hydroelectricity capacity has been identified for Northern Ontario (SNC Lavalin, 2006), of which approximately 270 MW are in the proximity of 20 of the 25 remote aboriginal communities (NAN, 2014b; Hatch, 2013). Aboriginal communities have also examined the creation of a transmission line in cooperation with industrial proponents to connect communities and future mining projects with the provincial grid, and access 155 MW of hydroelectricity potential that are within 30 km from the proposed Wataynikaneyap transmission line (OWA, 2014b; WP, 2012). These resources can produce renewable electricity at a lower cost than the current diesel plants (Table 4)[11] (OWA, 2014b; Hatch, 2013; WP, 2012). Wind resources of 6-7 m/s are available at Deer Lake FN, Fort Severn FN and Weenusk FN, while the rest of communities have wind speeds of about 4 m/s (at 50 m height), which is considered low for the development of wind projects, under current capital and electricity generation costs (Weis & Ilinca, 2010; Maissan J. , 2006; Weis & Ilinca, 2008; ARI, 2003). Finally, solar resources in

[9] LUEC= Levelized Unit Electricity Cost

[10] https://eosweb.larc.nasa.gov/cgi-bin/sse/grid.cgi?email=skip@larc.nasa.gov

[11] The Levelized Unit Electricity Cost (LUEC) presented does not include transmission costs.

northern Ontario's remote communities are considered sufficient, with average direct solar radiation in the range of 2.81-3.81 kWh/$m^2$.day (Table 4).

**Renewable electricity policies and promotion**

Support for renewable energy projects in Ontario was strengthened with Ontario's Green Energy and Green Economy Act (GEGEA) in 2009. The Act provided financial support for renewable energy projects and access to transmission and distribution for proponents (OME, 2012). The Act was criticized for its high incentives and their subsequent consequences on the global adjustment portion of electricity bill increases and, therefore, its effects on the provincial economy; positive effects of job generation were offset by losses due to the closing of conventional electricity facilities (Auditor General, 2011; Angevine, Murillo, & Pencheva, 2012; Winfield, 2013). Although renewables were blamed for the increases in electricity rates, the larger share of the extra costs in the global adjustment portion of electricity bills were the result of long term contracts with nuclear and gas plants (IESO, 2016). For example, between October 2011 and September 2012 the contribution of nuclear and natural gas contracts to the global adjustment were 42% and 26% respectively versus a contribution of 17% by renewable contracts, including hydroelectric generation (Navigant Cons., 2014).

Within the Green Energy Act, aboriginal participation in on-grid renewable energy projects is possible through the Feed-In-Tariff (FIT) and microFIT programs or through the generation procurement for projects of 500 kW or more, which includes the Hydroelectric Standard Offer Program (HESOP), the Large Renewable Procurement (LRP), and the Combined Heat and Power Standard Offer Program (CHPSOP 2.0) (IESO, 2015). Aboriginal participation is encouraged by providing priority points (when an aboriginal community has greater than a 15% economic interest in the project), while financial assistance is provided through reduced security payments ($ 5/kW regardless of the renewable fuel type), and price adders for addressing increased development costs. Access to capital is facilitated through the Aboriginal Loan Guarantee Program (ALGP), administered by the Ontario Financing Authority (OFA), for transmission projects and wind, solar and hydroelectric generation projects (OFA, 2016). Ontario's Aboriginal Energy Partnerships Program (AEPP), which includes the Aboriginal Renewable Energy Fund (AREF), the Aboriginal Community Energy Plan (ACEP) and the Education and Capacity Building (ECB) Program, address both the financial barrier of high renewable energy initial capital costs and technical support for renewable project development (AEPP, 2016). Implementation of these programs led to aboriginal participation in approximately 240 projects with over 1,000 MW of clean electricity capacity connected to the main grid (OME, 2013).

Besides provincial support, remote communities in Ontario and other provinces and territories benefitted from federal programs that supported capital expenses for renewable electricity generation. Programs launched by the federal government between 2001 and 2016 included the Aboriginal and Northern Climate Change Program (ANCCP), the Aboriginal and Northern

Community Action Program (ANCAP), the ecoENERGY for Aboriginal and Northern Communities Program (EANCP) and the Climate Change Adaptation Program (CCAP), and covered both remote and non-remote aboriginal communities. Additionally, the ANCAP provided funding for community energy planning and capacity building (AANDC, 2014a; AANDC, 2014b; AANDC, 2014d). Finally, at the community level, HORCI supported diesel displacement and emissions reductions through technological upgrades, fuel switching, demand side management, "behind the meter"[12] and "net metering"[13] arrangements, and the Renewable Energy INovation DiEsel Emission Reduction (REINDEER) program, which provided a local FIT tariff for the connection of renewable electricity projects in HORCI serviced communities (HORCI, 2012).

**Renewable electricity generation in remote communities**

The 25 remote aboriginal communities in Northern Ontario are powered by diesel generators and a limited number of renewable electricity projects. There are approximately 23 MW of installed diesel capacity, which generated approximately 79,000 MWh/year in 2011, consumed 22,000,000 liters/year of diesel fuel, and contributed 67,000 tonnes $CO_{2,eq}$/year in $CO_{2,eq}$ emissions[14] (Table 1).

Remote communities in Northern Ontario investigate both participation in renewable electricity generation and direct connection to the provincial grid as means to reduce their dependence on diesel and to improve their socioeconomic conditions using renewable resources. In the case of connection to the provincial grid, and based on the experience from the development of Five Nations Energy Inc.[15], communities anticipate increased electricity reliability, reduced environmental impacts and risks, and socioeconomic benefits, such as new residential sub-divisions, new schools and recreational facilities, and electrically heated homes (Five Nations Energy Inc., 2006). The 21 remote communities participating in the development of the Wataynikaneyap transmission line, expect similar benefits to be associated with the electrification of resource developments in the Ring of Fire area through aboriginally owned renewable electricity generation and transmission (OME, 2013; WP, 2013b; WP, 2012). The ownership model proposed for the transmission line involves using some of the revenue

[12] "On-site, behind the meter": electricity generation connected to consumer's side of the meter that provides power to offset electricity purchased form the utility. Since behind the meter electricity generation offsets retail kWh purchased, the benefit received is superior to a negotiated Power Purchase Agreement. See (Kildegaard & Myers-Kuykindall, 2006).

[13] "Net metering" allows customers that generate their own electricity from renewable electricity technologies to feed excess electricity generated back into Hydro One's distribution system for a credit towards your electricity costs. See: http://www.hydroone.com/Generators/Pages/NetMetering.aspx.

[14] Assuming an average efficiency rate of 3.6 kWh/litre for the diesel engines and an average of 0.00080 tonnes $CO_{2,eq}$/kWh, for direct carbon emissions (emissions resulting from diesel and natural gas combustion only). See HORCI (2012).

[15] Five Nations Energy Inc. is the first aboriginal transmission line established in 2001 that connected three northern Ontario remote communities. The communities of Fort Albany and Kashechewan were connected in 2001 and Attawapiskat in 2003 (Five Nations Energy Inc., 2006).

generated by the transmission line to purchase an increasing equity share in the project from the private partner until it becomes 100% First Nation owned (WP, 2017; NOB, 2016; WP, 2016).

> *"Our people's vision is to own, control and benefit from major infrastructure development in our homelands. Through this partnership, we are changing the landscape of how First Nations can do business into the future. Together we have reached a major milestone towards getting our communities off diesel generation, and improving the socio-economic situation for everyone's benefit."* Margaret Kenequanash, Chair of Wataynikaneyap Power (Ontario Newsroom 2015).

Remote aboriginal communities are also gaining direct experience with small renewable electricity projects. Four of the first wind demonstration projects were installed in the communities of Kasabonika Lake FN, Fort Severn FN, Weenusk FN and Big Trout Lake (Kitchenuhmaykoosib Inninuwug FN) in 1997, and one of the first hybrid hydroelectricity-diesel systems was installed in Deer Lake in 1998 by Hydro One (Ah-You & Leng, 1999). These projects are owned by HORCI and reduce diesel consumption and greenhouse gas emissions in the communities (HORCI, 2012). Deer Lake's 490 kW hydroelectricity plant achieves the highest emissions reductions displacing approximately 36% of community's fuel consumption (HORCI, 2012) and the community examined further upgrades in cooperation with HORCI to improve performance and community benefits. Between 2013 and 2016 there have been 12 community owned solar photovoltaic projects with a total of 338 kW installed in energy intensive community facilities (such as the water and wastewater plant, schools and arenas) in 11 remote communities (Table 5). The projects were developed under a "behind the meter" agreement, and reduce facilities' electricity consumption and, thus, electricity expenses paid from band council and government budgets, therefore allowing funds to be focused on other pressing community needs.

Eight more solar photovoltaic installations on community facilities are planned for Kingfisher Lake FN, Keewaywin FN, North Spirit FN, Wapekeka FN, Wunnumin Lake FN, Eabametoong FN, Sachigo Lake FN, and Webequie FN (Table 5). Furthermore, community scale solar installations under Power Purchase Agreements (PPA) with HORCI are being examined for Kasabonika Lake FN and Fort Severn (MNDM, 2015). Finally, the community of Whitesand FN in planning the generation of electricity and thermal power for community needs through a combined heat and power plant (CHP) plant (Neegan Burnside, 2013), increasing the number of Ontario's remote communities involved in renewable electricity generation to seventeen.

## Table 5: Renewable electricity projects in remote communities, Ontario

| | Community | Hydro MW | Wind kW | Solar kW | Year | Source |
|---|---|---|---|---|---|---|
| **Existing projects** | | | | | | |
| 1 | Bearskin Lake FN | | | | | |
| 2 | Deer Lake FN | 0.49 | | | 1998 | Ah-You & Leng (1999) |
| | | | | 152 | 2014 | WN (2014); HORCI |
| | | | | 10 | 2014 | (2014) |
| 3 | Fort Severn FN | | n.d. | | 1980 | Ah-You & Leng (1999) |
| | | | | 20 | 2015 | See[16] |
| 4 | Kasabonika Lake FN | | 30 | | 1997 | Ah-You & Leng (1999) |
| | | | 30 | | 2013 | |
| | | | | 10 | 2015 | |
| 5 | Kingfisher FN | | | 10 | 2013 | See[17] |
| 6 | Marten Falls FN | | | | | |
| 7 | Neskantaga FN | | | | | |
| 8 | North Caribou Lake FN | | | 18 | 2016 | See[18] |
| 9 | Sachigo Lake FN | | | | | |
| 10 | Sandy Lake FN | | | | | |
| 11 | Wapekeka FN | | | | | |
| 12 | Webequie FN | | | | | |
| 13 | Whitesand FN | | | | | Neegan Burnside ( 2013) |
| 14 | Kiashe Zaaging Anishinabek FN | | | | | |
| 15 | Kitchenuhmaykoosib Inninuwug | | 50 | | 1997 | Ah-You & Leng (1999) |
| 16 | Keewaywin FN | | | 20 | 2015 | See[19]. See also[20] |
| 17 | North Spirit Lake FN | | | 20 | 2015 | See[21] |
| 18 | Wawakapewin FN | | | 18 | 2013 | Enermodal (2013) |
| 19 | Pikangikum FN | | | | | |
| 20 | Poplar Hill FN, | | | 20 | 2015 | See [22] |
| 21 | Muskrat Dam Lake FN | | | 20 | 2015 | |
| 22 | Nibinamik FN | | | | | |
| 23 | Weenusk FN | | n.d. | | 1997 | Ah-You & Leng (1999) |
| | | | | 20 | 2015 | See[23] |
| 24 | Wunnumin Lake FN | | | | | |
| 25 | Eabametoong FN | | | | | |
| | **Total** | **0.49** | **110** | **338** | | |
| **Proposed projects** | | | | | | |
| 1 | Fort Severn FN | | | 300 | | MNDM (2015) |
| 2 | Kasabonika Lake FN | | | 250 | | |
| 3 | Kingfisher FN | | | n.d. | | See[24] n.d.=no data |
| 4 | Wapekeka FN | | | n.d. | | |
| 5 | Wunnumin Lake FN | | | n.d. | | |
| 6 | Weenusk | | | n.d. | | |
| 7 | Keewaywin | | | n.d. | | |
| 8 | Eabametoong FN | | | n.d. | | |
| 9 | Sachigo Lake FN | | | n.d. | | |
| 10 | Webequie FN | | | n.d. | | |
| | **Total** | | | **550** | | |

16 http://www.daigroup.ca/keewaywin.html
17 http://www.shibogama.on.ca/?q=node/103
18 https://www.youtube.com/watch?v=Ypz3Ucb5yas
19 http://www.bullfrogpower.com/wp-content/uploads/2015/09/Day1-Part1-CanadianSolar_09-16-2015.pdf.;
20 http://www.daigroup.ca/keewaywin.html
21 http://www.bullfrogpower.com/wp-content/uploads/2015/09/Day1-Part1-CanadianSolar_09-16-2015.pdf.
22 http://www.daigroup.ca/diesel-offset-solar-projects.html
23 http://www.daigroup.ca/diesel-offset-solar-projects.html
24 EANCP: https://www.aadnc-aandc.gc.ca/eng/1334855478224/1334856305920#sect1

## Conclusion

Remote aboriginal communities in Ontario are transforming their electrical systems by introducing renewable electricity projects and participating in plans for the Wataynikaneyap transmission line that would connect most communities to the provincial grid. While early renewable electricity projects were developed by the local utility (HORCI), recent projects in 11 remote communities were owned by the communities, and concentrated on solar photovoltaic applications connected to energy intensive community facilities. These projects operate under "behind the meter" agreements in cooperation with HORCI, displace diesel fuel, reduce greenhouse gas emissions, and reduce local electricity expenses. Projects were financially supported by federal and provincial programs and eight further solar plants based on this successful deployment model are proposed. These renewable energy projects provide some immediate benefits, but to date the scale is small. Deeper transitions from diesel to renewables are being studied. One long term option that is being planned is the creation of a transmission line that will connect 21 of the 25 remote communities to the provincial grid, supply communities with clean, reliable and affordable electricity, and provide the opportunity for the development of larger scale community owned renewable electricity generation assets. The model of community ownership of assets has been demonstrated with some of the small renewable energy generation projects and is being proposed for the transmission line with multiple First Nations collaborating as partners and co-owners. The model of increased aboriginal community decision making authority is used to increase their socioeconomic benefits and self-sufficiency and may serve as a valuable model for other community assets and service delivery in the future.

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