2018 Greenhouse Gas Inventory Report and Action Plan

hydro One

Remote Communities

EXECUTIVE SUMMARY

Hydro One Remote Communities Inc. (Remotes) released 72,221 tonnes of carbon dioxide equivalent (tCO_2e) from January 1, 2018 to December 31, 2018 (i.e., reporting period). Direct GHG emissions accounted for 72.77% of reported emissions. Energy indirect emissions accounted for 0.01% of the reported emissions. Other indirect GHG emissions accounted for the remaining 27.23% of the reported emissions.

Remotes released 52,554 tCO_2e of direct GHG emissions for the 2018 reporting year of which 52,372 tCO_2e was associated with diesel electricity generation. Since the base year, Remotes increased its direct emissions for diesel electricity generation by 115.30% due to a 179.22% increase in electricity demand. However, Remotes reduced its gross emission intensity by 23.16% in 2018 compared to 1990 as a result of directed actions to reduce GHG emissions.

Remotes achieved a net emission intensity of 0.000747 tCO_2e / kWh in 2018. Renewable Energy Technology (RET) generation and the renewable energy innovation diesel emission reduction (REINDEER) program saved 469,742 L of diesel fuel thereby preventing 1,319 tCO_2e in 2018.

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1 INTRODUCTION

Hydro One Remote Communities Inc. (Remotes) believes that the CleanStart™ Registry is an important initiative to focus efforts on greenhouse gas (GHG) emission reductions with the goal of meeting GHG reduction targets and reducing the effects of global warming. Since 2011, Remotes has voluntarily submitted an annual GHG Inventory Report and Action Plan (herein referred to as the 'report') to the CleanStart™ Registry in support of these goals.

The following report details the greenhouse gas (GHG) emissions inventory for the operations of Remotes during the reporting period of January 1, 2018 to December 31, 2018. This inventory lists the sources of GHG emissions and the quantity of emissions released from each source during the reporting period. Remotes do not have or use GHG emission removal technologies, but rather directed actions to reduce GHG emissions have been implemented. Remotes will use the data from this report to disclose its emissions to CSA's CleanStart™ Registry.

Hydro One Networks Inc. is the agent to Remotes and is responsible for the completion of Remotes' GHG inventory and reporting in accordance with *CAN/CSA-ISO Standard 14064-1-06 Greenhouse Gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.* In addition, the World Resource Institute (WRI)/World Business Council for Sustainable Development (WBCSD) Standard: *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standards* and CAN/CSA-ISO Standard 14064-3-06 *Greenhouse Gases - Part 3: Specification with guidance for the validation of greenhouse gas assertions* documents were used as additional resources. An independent third party will be engaged to provide verification of this report.

Remotes released 72,221 tonnes of carbon dioxide equivalent (tCO_2e) for the 2018 reporting year. Direct GHG emissions account for 72.77% of reported emissions. Energy indirect emissions account for 0.01% of the reported emissions. Other indirect GHG emissions account for the remaining 27.23% of the reported emissions. Please refer to **Section 5** and **Appendix A** for the detailed GHG inventory.

2 GENERAL

2.1 Organizational Profile

Remotes a subsidiary of Hydro One Inc. is based in Thunder Bay, Ontario. Remotes generate and distribute electricity to remote communities in Northern Ontario that are not connected to the province's electricity grid. Remotes currently operate 19 diesel generating stations in northern Ontario, as depicted in Figure 1.0.

The electricity that Remotes produces is primarily generated by diesel generators, with some community loads supplemented by mini-hydroelectric plants and/or wind turbines and solar panel generation (i.e., Renewable Energy Technology (RET) Generation).

2.2 Remotes' Baseline Recalculation Policy

Remotes use 1990 as the base year for evaluating GHG emissions. In order to accurately track progress toward GHG reduction targets, Remotes will adjust the base year emissions inventory to account for significant changes, such as structural or methodology changes, if the changes drive a significant increase or decrease in direct emissions associated with electricity generation. Remotes may also choose to recalculate the baseline if significant structural changes occur such as the discovery of a significant error, a change in organizational boundary, or a change in operational control.

Figure 1: Hydro One Remote Communities' Service Territory

3 GHG INVENTORY DESIGN AND DEVELOPMENT

3.1 Organizational Boundaries

Organizational boundaries are used to determine how GHG emissions are accounted. Organizations can choose to account their GHG emissions based on three different boundary conceptions: equity share, financial control or operational control.

Remotes have consolidated and report its GHG emissions and reductions over which it has financial and operational control. This includes emissions generated from production of electricity by diesel generating stations (DGS) at each remote community it serves, the emissions from burning of natural gas at the Thunder Bay Service Centre, renewable energy technology (RET) electricity generation, emissions from Remotes-owned fleet vehicles, transport emissions associated with diesel fuel deliveries by road and air, and imported electricity used at the Thunder Bay Service Centre. Remotes does not own or operate any SF_6 electrical equipment used for transmission and/or distribution of electricity.

3.2 Operational Boundaries

Operational boundaries are identified to define the GHG emissions and offsets associated with the organization's operations. GHG emissions are categorized as direct emissions, energy indirect emissions and other indirect emissions, as defined below:

Direct GHG emissions:
GHG emissions from GHG sources owned or controlled by the organization.

Energy Indirect GHG emissions:
GHG emissions generated from the imported electricity, heat, or steam consumed by the organization.

Other Indirect GHG emissions:
GHG emissions, other than energy indirect emissions, which is a consequence of an organization's activities, but arises from greenhouse gas sources that are owned or controlled by other organizations.

3.2.1 Direct GHG emissions for Remotes

Direct GHG emissions released from Remotes' sources are a result of generator diesel combustion, fleet transportation and natural gas consumption.

Generators within the 19 generating stations burn diesel fuel for the production of electricity, directly emitting GHGs to the atmosphere. Fuel consumption is determined through Remotes' Fuel Management Program (FMP) as well as end-of-year fuel inventories at each generating station. Natural gas, purchased from Union Gas, is used to operate Remotes' head office in Thunder Bay. These emissions are based on purchase receipts.

Direct emissions from Remotes-owned fleet vehicles are determined using information provided by Automotive Resources International (ARI) fleet card purchases (i.e., fuel consumed by various classes of vehicles).

3.2.2 Energy indirect GHG emissions for Remotes

Indirect GHG emissions from the operation of Remotes' head office in Thunder Bay result from imported electricity and are included in the GHG inventory. Estimates are based on receipts from the purchase of electrical energy from Thunder Bay Hydro.

3.2.3 Other indirect GHG emissions for Remotes

This report accounts for other indirect GHG emissions which are based on the transportation of purchased primary material by air and road, as well as staff transport by third party airlines. Estimates are based on published emission factors, flight data and aircraft fuel economies provided by third party airlines.

3.3 Historical Emissions

The base year quantification of 1990 was chosen to evaluate GHG emissions. Refer to **Tables 3-1, 3-2 and 3-3** as well as **Figures 2 and 3** for summaries of direct GHG emissions and gross emission intensities relating to electricity generation from the base year to the current reporting period. Please note that historical gross emission intensities are provided instead of net emission intensities since net emission intensities have only been tracked since 2003. See **Table 5-4** and **Figure 6** for net emission performance for 2003-2018.

Remotes released 52,554 tCO_2e of direct GHG emissions for the 2018 reporting year of which 52,372 tCO2e was associated with diesel electricity generation. Since the base year, Remotes increased its direct emissions for electricity generation by 115.30% due to a 179.22% increase in electricity demand. However, Remotes reduced its gross emission intensity by 23.16% in 2018 compared to 1990 as a result of more efficient diesel generation (i.e., more efficient diesel generators).

Remotes achieved a net emission intensity of 0.000747 CO_2e / kWh for 2018. Unlike gross emission intensity which only factors electricity generation GHG emissions by diesel electricity generation (kWh) only, net emission intensity factors electricity generation GHG emissions by total electricity generation (kWh) - i.e., diesel and RET electricity generation combined. Please note for the purposes of this report that neither gross nor net emission intensities include Remotes-owned fleet transportation direct emissions since they have only been tracked since 2015.

Table 3-1: Comparison of Direct GHG Emissions Intensity from Base Year

	Base Year (1990)	Current Reporting Year (2018)
ABSOLUTE EMISSIONS (tCO2e)		
Direct Emissions	24,410	52,554
PRODUCTION (kWh)		
Units of Generator Production (kWh)	24,505,364	68,422,758
Renewable Energy Technology Production (kWh)	–	1,723,178
EMISSION INTENSITY (t CO2e/kWh)		
Gross Emission Intensity (t CO_2e/kWh)	0.000996	0.000765
Net Emission Intensity (t CO_2e/kWh)	–	0.000747

Note: Gross emission intensity only includes direct emissions associated with diesel electricity generation

Table 3-2: Comparison of Direct, Energy Indirect and Other Indirect Emissions Intensity

	Base Year (1990)	Current Reporting Year (2018)
ABSOLUTE EMISSIONS (tCO2e)		
Direct Emissions	24,410	52,554
Energy Indirect	58	5
Other Indirect Emissions	–	19,663
PRODUCTION (kWh)		
Units of Generator Production (kWh)	24,505,364	68,422,758
Renewable Energy Technology Production (kWh)	–	1,723,178
EMISSION INTENSITY (t CO2e/kWh)		
Gross Emission Intensity (t CO_2e/kWh)	0.000998	0.001056
Net Emission Intensity (t CO_2e/kWh)	–	0.001030

Table 3-3: Historical Direct GHG Emissions and Gross Emission Intensities

Year	Diesel Generation (kWh)	GHG Emissions (tCO_2e)	Gross Emission Intensity (tCO_2e/kWh)
1990	24,505,364	24,410	0.000996
1991	28,349,815	28,062	0.000990
1992	31,883,583	29,054	0.000911
1993	37,681,890	35,331	0.000938
1994	41,662,806	38,304	0.000919
1995	46,438,464	43,298	0.000932
1996	51,119,647	45,791	0.000896
1997	51,469,797	47,855	0.000930
1998	49,904,700	44,596	0.000894
1999	52,481,796	45,299	0.000863
2000	60,548,438	49,633	0.000820
2001	58,407,766	47,898	0.000820
2002	57,849,172	44,964	0.000777
2003	58,434,379	45,592	0.000780
2004	52,045,608	40,287	0.000774
2005	52,241,239	39,488	0.000756
2006	51,299,438	40,071	0.000781
2007	53,809,839	41,271	0.000767
2008	54,865,485	43,156	0.000787
2009	55,371,891	42,084	0.000760
2010	54,945,714	41,747	0.000760
2011	56,751,074	43,436	0.000765
2012	59,334,904	45,559	0.000768
2013	62,372,035	48,220	0.000773
2014	63,344,724	49,266	0.000778
2015	61,696,965	49,124	0.000796
2016	63,193,956	48,773	0.000772
2017	64,133,224	46,897	0.000731
2018	68,422,758	52,372	0.000765

Notes:

1. Direct emissions for **Table 3-3** only include emissions from diesel electricity generation
2. Historical gross emission intensities are provided instead of net emission intensities since net emission intensities have only been tracked since 2003. See **Table 5-4** and **Figure 6** for net emission performance for 2003-2018.

Figure 2: Historical Direct GHG Emissions

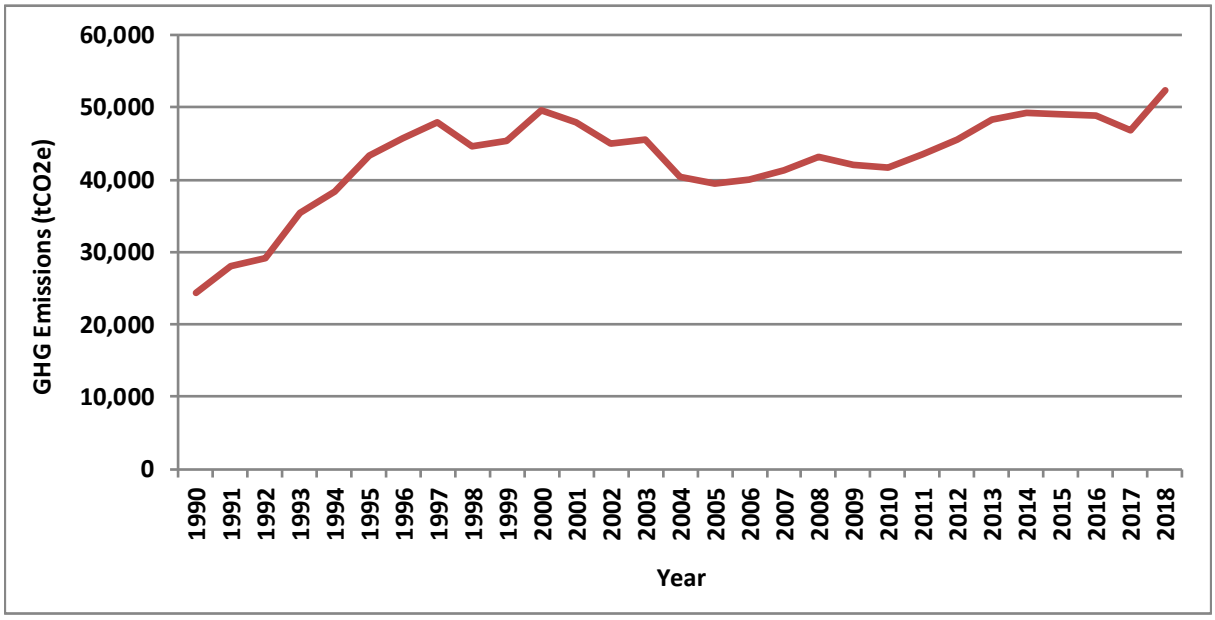
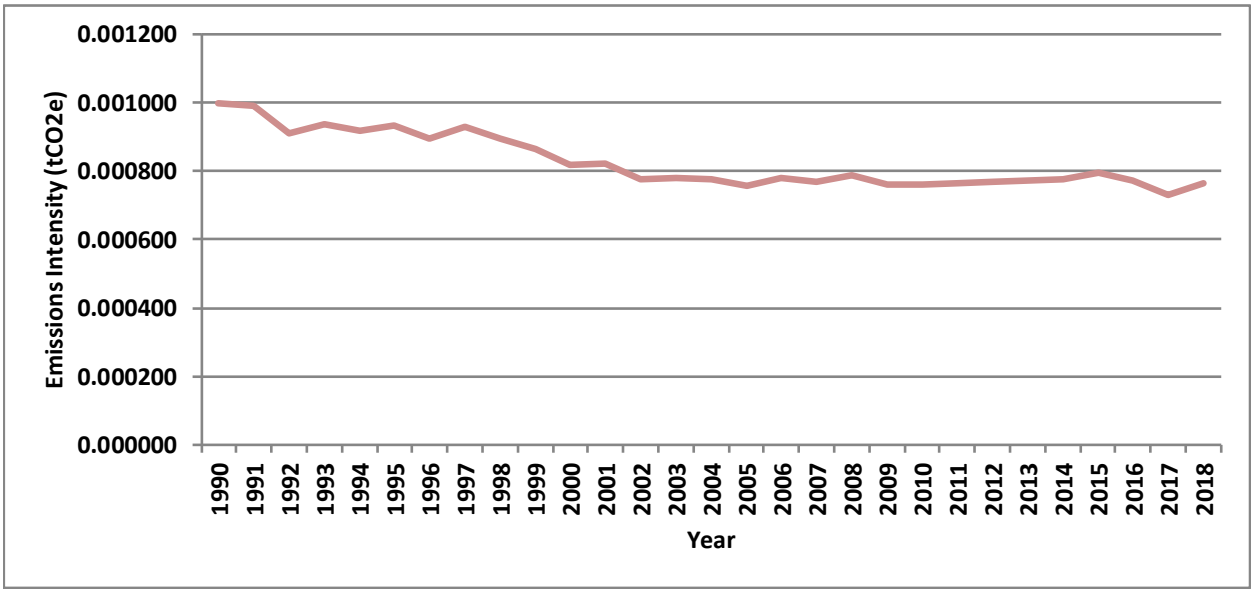


Figure 3: Historical Gross Emission Intensities



4 QUANTIFICATION

Remotes has identified and assessed its GHG sources and estimated its GHG emissions using quantification methodologies that minimize uncertainty and yield accurate, consistent and reproducible results.

Since direct measurement is not always practical, Remotes has quantified its diesel, electricity, natural gas, fleet transport and fuel transport emissions using a calculation based on GHG activity multiplied by a GHG emission factor, or:

Activity Data x Emission Factor = GHG Emission

Please refer to **Appendix B** for a summary of the emission factors used.

4.1 Diesel

4.1.1 Activity data for diesel

Activity data for diesel fuel accounts for the volume of fuel combusted, reported in litres (L), and is based on volumetric flow meter data from Remotes' Fuel Management Program (FMP) and well as end-of-year fuel tank inventories.

4.1.2 Emission factors for diesel

The emission factors used for the burning of diesel fuel were taken from Environment Canada's National Inventory Report, 1990-2017, *Part 2*, *Annex 6*, *Table A6-4 Emission Factors for Refined Petroleum Products (Diesel – Refineries and Other)*, and is expressed in grams per litre of fuel (g/L).

4.2 Fleet Transport

4.2.1 Activity data for fleet transport

Activity data for fleet transport emissions was calculated based on total fuel consumption data provided by Hydro One Fleet Services. Fuel is purchased using an Automotive Resources International (ARI) fleet card and is reported monthly to Hydro One Fleet Services. Fuel consumption is reported in litres (L).

4.2.2 Emission factors for fleet transport

The emission factors used for calculating fleet transport emissions were taken from Environment Canada's National Inventory Report, 1990-2017, *Part 2*, *Annex 6*, *Table A6-12: Emission Factors for Energy Mobile Combustion Sources*, and is expressed in grams per litre of fuel (g/L).

4.3 Natural Gas

4.3.1 Activity data for natural gas

Activity data for natural gas usage is based on utility bills from Union Gas and is reported in cubic metres (m^3).

4.3.2 Emission factors for natural gas

Emission factors for burning natural gas in a commercial building were obtained from Environment Canada's National Inventory Report, 1990-2017, *Part 2*, *Annex 6*, *Table A6-1: CO_2 Emission Factors for Natural Gas and Table A6-2: CH_4 and N_2O Emission Factors for Natural Gas.* The emission factors are expressed in grams per cubic metre (g/m^3).

4.4 Electricity

4.4.1 Activity data for electricity

Activity data for electricity consumption is based on utility bills from Thunder Bay Hydro and is reported in kilowatt hours (kWh).

4.4.2 Emission factors for electricity

Electricity emission factors were obtained from Environment Canada's National Inventory Report, 1990-2017, *Part 3*, *Annex 13*, *Table A13-7: Electricity Generation and GHG Emission Details for Ontario.* The emission factors are expressed in grams of carbon dioxide equivalent per kilowatt hour (g CO_2e/kWh).

4.5 Fuel Transport by Road

4.5.1 Activity data for fuel transport by road

Activity data for fuel transport emissions by road were calculated using a combination of measured map distances and actual number of delivery trips made based on fuel deliveries in Remotes' FMP, as reported in litres.

The total distance (km) for each delivery was calculated using the roundtrip distance from the fuel delivery supply location to the remote community. An average fuel economy provided in *Natural Resources Canada: Fuel Efficiency Benchmarking in Canada's Trucking Industry*.

Total fuel consumption (L) = Fuel Economy (L/km) X Distance (km)

4.5.2 Emission factors for fuel transport by road

Emission factors for fuel transport emissions by road were obtained from Environment Canada's National Inventory Report, 1990-2017 *Part 2*, *Annex 6*, *Table A6-12: Emission Factors for Energy Mobile Sources*. Emission factors are expressed in grams per litre (g/L).

4.6 Fuel Transport by Air

4.6.1 Activity data for fuel transport by air

Activity data for fuel transport emissions by air were calculated using a combination of measured map distances, actual number of delivery trips made and the total volume of fuel delivered to each community based on data provided from Remotes' FMP, as reported in litres.

A Radiative Forcing Index (RFI) value for aircraft of 2.7 was used, as obtained from the Intergovernmental Panel on Climate Change (IPCC) *Special Reports: Aviation and the Global Atmosphere, Chapter 6.6.5.*

Each airline provided data that was used to calculate fuel economies in litres/kilometer (L/km) such as: total annual miles flown, hourly burn rates (gallons/hour), and average flight speeds (mph) for their respective aircraft.

Statute miles were converted to kilometers using the following conversion:

1 statute mile = 1.609 km

Based on distance flown (km) and aircraft average fuel economies (L/km) for each vendor, the total volume of Jet A fuel consumed for fuel transport for the year (L) was calculated using the following equation:

Total fuel consumption (L) = Fuel Economy (L/km) X Distance (km)

Note: This report assumes that all fuel purchased from First Nation tank farms was delivered to the First Nation via air transport. Therefore, all fuel purchases from First Nations are accounted for in air fuel transport emissions only.

Based on the volume of fuel (L) purchased from the First Nation, the actual number of trips was calculated using the following equation:

Number of trips = total volume purchased (L) / aircraft fuel transport capacity (L/trip)

4.6.2 Emission factors for fuel transport by air

Emission factors for fuel transport emissions by air were obtained from Environment Canada's National Inventory Report, 1990-2017 *Part 2, Annex 6, Table A6-12: Emission Factors for Energy Mobile Sources*. Emission factors are expressed in grams per litre (g/L).

4.7 Staff Transport by Air

4.7.1 Activity data for staff transport by air

Activity data for staff transport emissions by air was calculated based on information provided by air transport vendors contracted by Hydro One Remote Communities.

Each airline provided total annual miles flown and average fuel economy (L/km) for their respective Pilatus PC-12 aircraft. Note that each airline transports staff via the Pilatus PC-12 aircraft as per contract agreements and health and safety requirements.

Statute miles were converted to kilometers using the following conversion:

1 statute mile = 1.609 km

Based on distance flown (km) and average Pilatus PC-12 average fuel economy (L/km), the total volume of Jet A fuel consumed for the year (L) was calculated using the following equation:

Total fuel consumption (L) = Fuel Economy (L/km) X Distance (km)

4.7.2 Emission factors for staff transport by air

The emission factor used for calculating staff transport emissions by air were taken from Environment Canada's National Inventory Report, 1990-2017, *Part 2*, *Annex 6*, *Table A6-12: Emission Factors for Energy Mobile Combustion Sources*, and is expressed in grams per litre of fuel (g/L).

4.8 Exclusions

4.8.1 Combustion of Biomass

Remotes does not combust biomass. As a result, combustion of biomass is not a source of GHG emission from Remotes operations and therefore is not included as a GHG source.

4.8.2 Fuel Transport by Barge

This report does not include Other Indirect Emissions associated with fuel transport by barge between the Fort Severn port and Manitoba.

5 GHG INVENTORY COMPONENTS

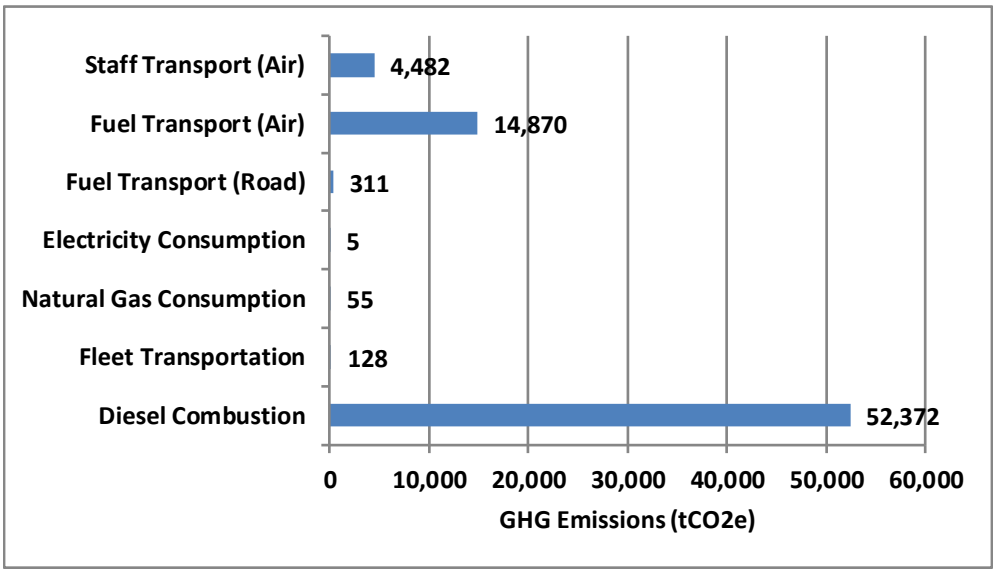
5.1 Emissions

Total emissions from direct, energy indirect and other indirect emission sources for the 2018 reporting year were 72,221 tonnes of CO_2e. Diesel fuel combustion, fleet transportation, energy use including natural gas consumption and electricity use, staff transport by air, and fuel transport by air and road account for Remotes' reported emissions. **Table 5-1** and **Figure 4** summarize emissions by their GHG source. (Refer to **Appendix A** for the complete GHG emissions inventory).

Table 5-1: GHG Emission Source Summary

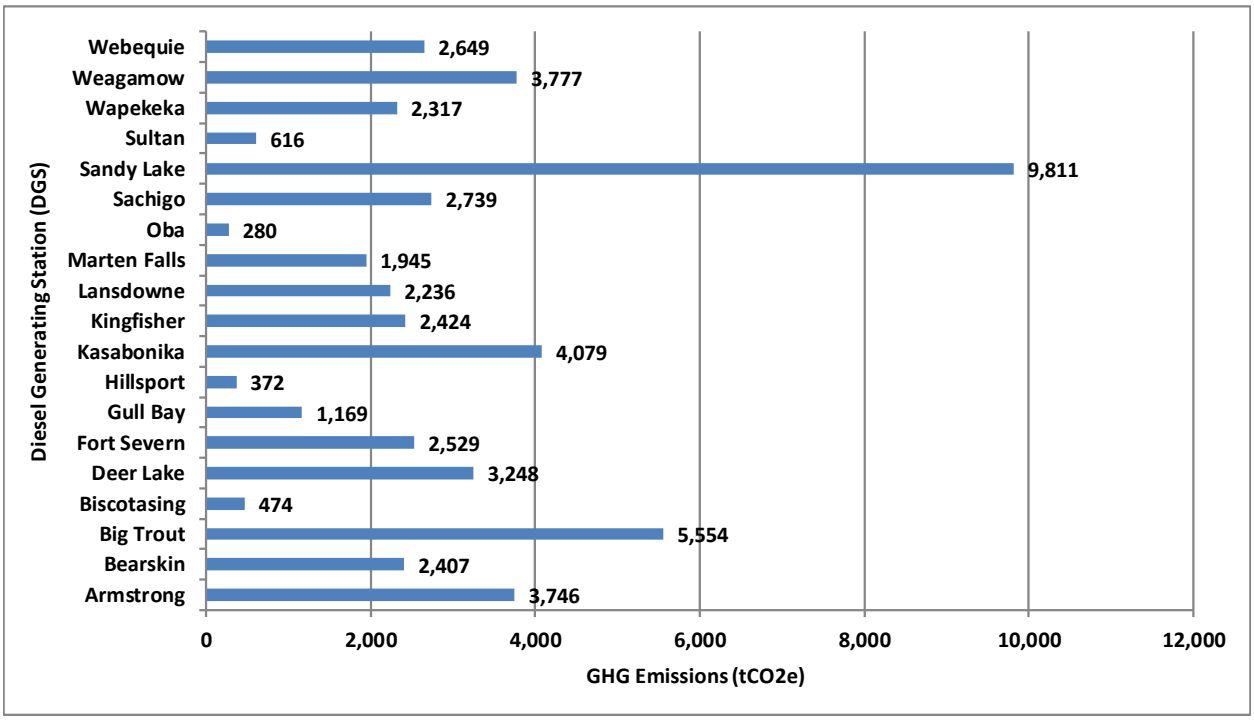
Source	Emissions (t CO2e)	% of Total
DIRECT GHG EMISSIONS		
Diesel Combustion	52,372	72.52%
Fleet Transportation	128	0.18%
Natural Gas Consumption	55	0.08%
ENERGY INDIRECT EMISSIONS		
Electricity Consumption	5	0.01%
OTHER INDIRECT EMISSIONS		
Fuel Transport (Road)	311	0.43%
Fuel Transport (Air)	14,870	20.59%
Staff Transport (Air)	4,482	6.21%
TOTALS	**72,221**	**100.00%**

Figure 4: GHG Emissions by Source



The breakdown of GHG emissions by diesel generating station (DGS) is illustrated in **Table A-1** in **Appendix A** as well as **Figure 4** below. In most cases, emissions reflect the electricity output or demand in the community with the largest stations (i.e., Sandy Lake) responsible for the largest share of emissions.

Figure 5: Direct GHG Emissions by Diesel Generating Station



5.2 Target Setting

Remotes began implementing direct emission reduction activities in 1997 as part of Ontario Hydro's (former name of Hydro One) corporate program for renewable energy and have since been using them to set emission intensity targets. In 2016, Remotes extended their target setting for net emission intensity targets for 2016-2020. **See Table 5-2 below**. Net emission intensity targets are higher for 2016-2020 compared to 2008-2015 to realign targets with more realistic actual net emission intensities from recent years.

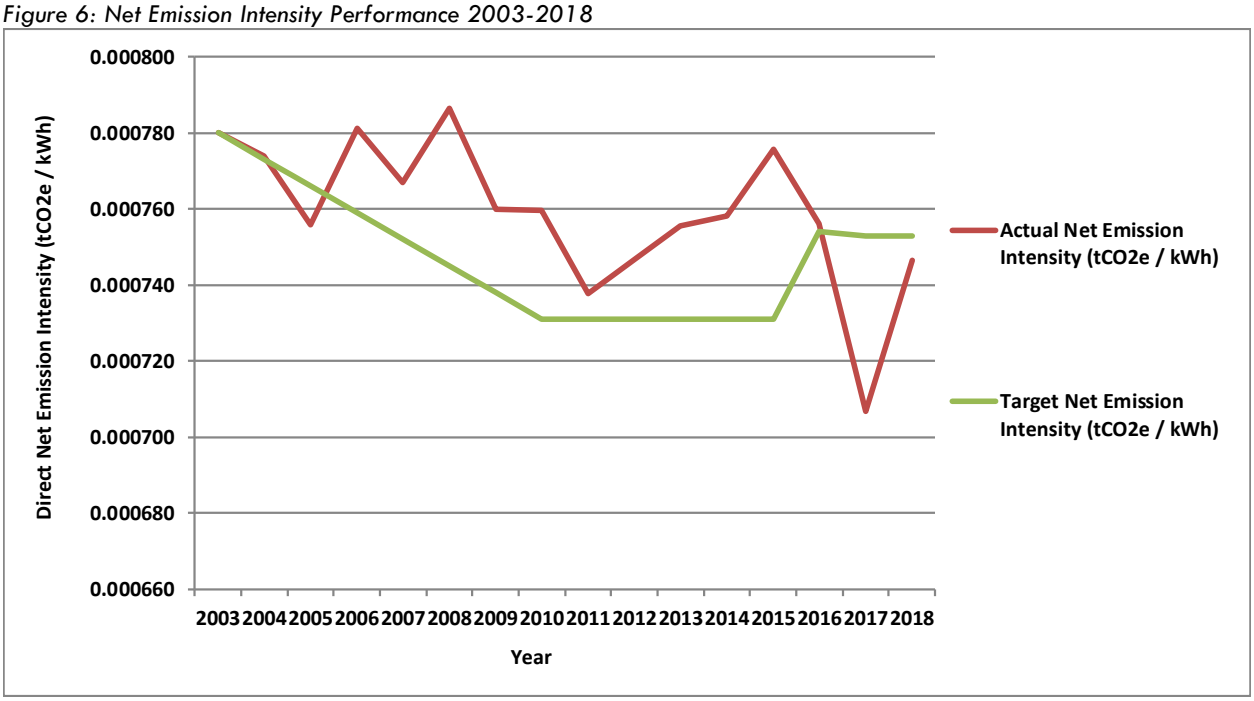
Table 5-2: Net Emission Intensity Targets 2016-2020

Year	Direct Net Emission Intensity (tCO_2e / kWh)
2016	0.000754
2017	0.000753
2018	0.000752
2019	0.000751
2020	0.000750

Remotes have been setting net emission intensity target reductions since 2003. **Table 5-3** and **Figure 6** below demonstrate target versus actual net emission intensity performance from 2003 to 2018. *Table 5-3: Net Emission Intensity Performance 2003-2017*

Year	Actual Direct Net Emission Intensity (tCO_2e / kWh)	Target Direct Net Emission Intensity (tCO2e / kWh)
2003	0.000780	0.000780
2004	0.000774	0.000773
2005	0.000756	0.000766
2006	0.000781	0.000759
2007	0.000767	0.000752
2008	0.000787	0.000745
2009	0.000760	0.000738
2010	0.000760	0.000731
2011	0.000738	0.000731
2012	0.000747	0.000731
2013	0.000756	0.000731
2014	0.000758	0.000731
2015	0.000776	0.000731
2016	0.000756	0.000754
2017	0.000707	0.000753
2018	0.000747	0.000753

Figure 6: Net Emission Intensity Performance 2003-2018



5.3 Directed Actions to Reduce GHG Emissions

Remotes have implemented directed actions to reduce GHG emissions. In 2018, these strategies continued to focus on technological upgrades, renewable energy technology (RET) generation and Renewable Energy Innovation Diesel Emission Reduction (REINDEER) program initiatives.

5.3.1 Technological upgrades

Technological upgrades involve the replacement of older engines with Tier 2 or Tier 3 like-for-like engines (i.e., same prime rating). Although the amount of fuel consumed may not be reduced, fuel efficiencies should improve, thereby reducing net emission intensity.

5.3.2 Renewable Energy Technology (RET)

Remotes operate renewable energy technologies (RET) that impact GHG diesel fuel-burning emissions by preventing their release to the atmosphere. Hydroelectric units operate at Deer Lake (Shoulderblade Falls) and Sultan DGS'. Wind turbine units operate at Big Trout and Kasabonika.

It is estimated that the 2018 RET operations saved 469,742 L of diesel fuel thereby preventing 1,319 tCO_2e of GHG emissions. Refer to **Table A-8** in **Appendix A** for 2018 RET generation data.

5.3.4 Renewable Energy Innovation Diesel Emission Reduction (REINDEER)

Remotes supports customer-based renewable connections in an effort to reduce GHG emissions, fuel usage and provide customer economic benefit. The Renewable Energy Innovation Diesel Emission Reduction (REINDEER) program connects net-metering RET generation as well as well standalone RET generation.

As of December 31, 2018 ten remote communities have solar panel generation installed ranging from 10 to 120kW with a total installed generation capacity of 318.5kW. For the 2017 reporting period the estimated kWh savings annually are approximately 161,600 kWh based on benchmark data received from the Deer Lake School Project, as other customer-based information is not available.

It is estimated that the 2018 REINDEER program saved 69,459 L of diesel fuel thereby preventing 195 tCO_2e of GHG emissions. Refer to **Table A-9** in **Appendix A** for 2018 REINDEER program information.

5.4 Estimation of Uncertainty

Remotes has performed a qualitative estimation of the impact of uncertainties on the accuracy of its GHG inventory. **Table 5-4** below presents the opinions of the level of uncertainty associated with each measured emission source and their emission factors.

Table 5-4: Uncertainty Ranking

Activity data	Uncertainty Assessment
Diesel Generator Combustion	**Low Uncertainty** – Diesel consumption is based on the quantity of fuel purchased, as well as fuel tank readings at the end of each year for reconciliation. Minimal loss is expected from storage or generator leakages but the impacts are negligible on fuel combustion data. Fuel data now includes fuel purchased from First Nations. Diesel emission factors are consistent and accurate.
Fleet Transport	**High Uncertainty** - Fleet transport is measured by receipts from ARI (fleet card). ARI service is not available at most remote communities. Also, Remotes receives used fleet vehicles and measuring monthly / annual km is not performed. Annual fleet transport is a best estimate based on available information from ARI.
Electricity Consumption	**Low Uncertainty** – Electricity consumption is based on metered data from Thunder Bay Hydro that is calibrated and verified. The emission factor is based on an annual provincial grid average that includes all of the province's controllable fuel sources (such as coal, natural gas, hydro and nuclear). THe emission factor has not changed since prior to 2008
Natural Gas Consumption	**Low Uncertainty** – Natural gas consumption is based on metered data that is calibrated and verified by Union Gas. Natural gas emission factors are less dependent on location and are almost always standard and accurate, although uncertainty may be derived from fluctuations in measurement equipment.
Fuel Transport	**Low Uncertainty** – Transport distances are measured by mapping techniques using scaled maps. Amount of fuel consumed for transport is based on the measured distances and the quantity of fuel delivered to corporate reservoirs. Fuel data excludes fuel delivered by barge due to unavailability of data (however quantities are low). Transport emission factors from mobile combustion sources are consistent and accurate.
Staff Transport by Air	**Low Uncertainty** – Transport distances are measured by mapping techniques using scaled maps. Amount of fuel consumed for staff air transport is based on measured fuel economies for the Pilatus PC-12 aircraft and total distances travelled per airline per year. Transport emission factors from mobile combustion sources are consistent and accurate.

6 GHG INVENTORY QUALITY MANAGEMENT

6.1 GHG Information Management

Remotes has established roles, responsibilities and authorities for the management of its GHG inventory. This ensures consistency, accuracy, completeness, transparency and conformance with the *CAN/CSA-ISO Standard 14064-1-06 Greenhouse Gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*. **Table 6-1** outlines the core GHG report responsibilities.

Table 6-1: GHG Report Responsibilities

Name	Role	Company	Responsibilities
Kevin Mann	Project Manager	Hydro One Remote Communities Inc.	- To approve and sign the CSA CleanStart™ Registry application form
Lori Rice	Project Coordinator	Hydro One Remote Communities Inc.	- Overall responsibility of the GHG inventory and GHG information management - To plan future emission reduction activities
Adrian Andreacchi	Project Lead	Hydro One Remote Communities Inc.	- To provide required inventory input data (e.g. energy usage, volume of fuel delivered , kW generated, etc.) - To provide information regarding customer demand management initiatives
Vishma Singh	GHG Quantifier	Hydro One Networks Inc.	- To request and analyze activity data, to collect appropriate emission factors and to perform GHG calculations - To produce a report consistent with both the CleanStart™ Registry and CAN/CSA-ISO Standard 14064-1-06 requirements
Dana Lauder	Third Party Verifier	GHD Ltd.	- To verify that Remotes' GHG Inventory Report meets both the CleanStart™ Registry and CAN/CSA-ISO Standard 14064-1-06 requirements - To issue a verification statement

6.2 Document Retention and Record keeping

Remotes keeps copies of all utility bills, fuel receipts, GHG emissions and other important information used to generate the GHG inventory on Remotes' secure server. This process is illustrated on a flowchart outlining the tasks and responsibilities of all personnel and business units involved in greenhouse gas measurement. All fuel data collected from this process is input to the fuel management database system which is audited internally. Remotes utilizes a checks and balance approach in its fuel management methodology to capture any data entry errors. Remotes will also be developing a Fuel Management Program (FMP) user manual to better assist any operator using the system in the near future.

6.3 Organization's Role in Verification Activities

Dana Lauder and Gordon Reusing of GHD Ltd. were contracted to provide independent third party verification as per CAN/CSA-ISO Standard 14064-3-06 requirements. The verification was completed to a reasonable level of assurance.

Remotes prepared for the verification by:

- Engaging an objective third party verifier to provide a reasonable level of assurance;
- Agreeing to verification objectives, scope, materiality and criteria with the verifier;
- Reviewing each section using the CSA Registry checklist; and,
- Using an internal review process for quality control of the inventory and of the report.

CSA Standard reporting declarations is presented in **Appendix C**.

APPENDIX A: 2018 GHG INVENTORY

Table A-1: Direct GHG Emission from Diesel Combustion

Diesel Generating Station (DGS)	Diesel Consumption (L)	Diesel Generation (kWh)	Efficiency (L/kWh)	GHG Emissions (tCO_2e)	Gross Emission Intensity (tCO_2e/kWh)
Armstrong DGS	1,334,075	5,031,121	0.27	3,746	0.000745
Bearskin DGS	857,230	3,086,813	0.28	2,407	0.000780
Big Trout DGS	1,977,998	7,163,773	0.28	5,554	0.000775
Biscotasing DGS	168,674	469,130	0.36	474	0.001010
Deer Lake DGS	1,156,735	5,720,143	0.20	3,248	0.000568
Fort Severn DGS	900,844	3,117,579	0.29	2,529	0.000811
Gull Bay DGS	416,404	1,317,000	0.32	1,169	0.000888
Hillsport DGS	132,348	321,158	0.41	372	0.001157
Kasabonika DGS	1,452,651	5,332,293	0.27	4,079	0.000765
Kingfisher DGS	863,223	3,015,829	0.29	2,424	0.000804
Lansdowne DGS	796,307	2,703,518	0.29	2,236	0.000827
Marten Falls DGS	692,875	2,083,196	0.33	1,945	0.000934
Oba DGS	99,617	258,675	0.39	280	0.001081
Sachigo DGS	975,500	3,574,768	0.27	2,739	0.000766
Sandy Lake DGS	3,494,200	13,483,464	0.26	9,811	0.000728
Sultan DGS	219,379	463,655	0.47	616	0.001329
Wapekeka DGS	825,364	2,728,089	0.30	2,317	0.000849
Weagamow DGS	1,345,325	5,049,268	0.27	3,777	0.000748
Webequie DGS	943,455	3,503,286	0.27	2,649	0.000756
TOTALS	**18,652,205**	**68,422,758**	**0.27**	**52,372**	**0.000765**

Table A-2: Direct Emissions from Fleet Transport

Vehicle Type	Fuel Consumption (L)	GHG Emissions (tCO_2e)
Light Duty Gasoline Truck	4,061	9.66
Heavy Duty Gasoline Vehicle	41,395	97.00
Heavy Duty Diesel Vehicle	7,768	21.03
TOTALS	**53,224**	**127.69**

Table A-3: Direct Emissions from Natural Gas Use at the Thunder Bay Service Centre

Activity	Natural Gas Consumption (m3)	GHG Emissions (tCO2e)
T. Bay SC Natural Gas Consumption	28,757	54.63

Table A-4: Energy Indirect Emissions from Electricity Use at the Thunder Bay Service Centre

Activity	Electricity Consumption (kWh)	GHG Emissions (tCO_2e)
T.Bay SC Electricity Consumption	262,440	4.60

Table A-5: Other Indirect Emissions – Fuel Transport by Road

Note: Fuel deliveries by road to the six permanent road sites (i.e., Armstrong, Biscotasing, Gull Bay, Hillsport, Oba, and Sultan) all originate from Thunder Bay; whereas fly-in have their fuel delivered by winter ice road originating from Pickle Lake (if accessible any given season). Fort Severn is the only fly-in community that receives its diesel via winter ice road from Lundar, Manitoba.

Location	Fuel Carriers	Fuel Delivery Origin	Vehicle Type	Distance from Delivery Origin (km)	Delivery Trips (Roundtrip)	Roundtrip Distance (km)	Fuel Consumption (L)	GHG Emissions (tCO_2e)
Armstrong DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	253	28	14,168	5,596	15.15
Bearskin DGS	Cargo North	Pickle Lake	Heavy Duty Diesel	423	14	11,844	4,678	12.67
Big Trout DGS	Wasaya	Pickle Lake	Heavy Duty Diesel	636	43	54,696	21,605	58.49
Biscotasing DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	741	10	14,820	5,854	15.85
Deer Lake DGS	Cargo North	Red Lake	Heavy Duty Diesel	556	13	14,456	5,710	15.46
Fort Severn DGS	Wasaya	Lundar (Manitoba)	Heavy Duty Diesel	1390	5	13,900	5,491	14.86
Gull Bay DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	190	9	3,420	1,351	3.66
Hillsport DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	404	8	6,464	2,553	6.91
Kasabonika DGS	Wasaya	Pickle Lake	Heavy Duty Diesel	556	39	43,368	17,130	46.38
Kingfisher DGS	Wasaya	Pickle Lake	Heavy Duty Diesel	218	20	8,720	3,444	9.33
Lansdowne DGS	Cargo North	Pickle Lake	Heavy Duty Diesel	200	14	5,600	2,212	5.99
Oba DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	563	5	5,630	2,224	6.02
Sachigo DGS	Cargo North	Pickle Lake	Heavy Duty Diesel	419	13	10,894	4,303	11.65
Sandy Lake DGS	Wasaya	Pickle Lake	Heavy Duty Diesel	402	27	21,708	8,575	23.22
Sultan DGS	Wasaya	Thunder Bay	Heavy Duty Diesel	662	14	18,536	7,322	19.82
Wapekeka DGS	Wasaya	Pickle Lake	Heavy Duty Diesel	692	7	9,688	3,827	10.36
Weagamow DGS	Cargo North	Pickle Lake	Heavy Duty Diesel	283	52	29,432	11,626	31.48
Webequie DGS	Cargo North	Pickle Lake	Heavy Duty Diesel	303	5	3,030	1,197	3.24
TOTALS					**326**	**290,374**	**114,698**	**311**

Table A-6: Other Indirect Emissions – Fuel Transport by Air

Location	Fuel Carriers	Aircraft Type	Fuel Delivery Origin	Distance from Delivery Origin (km)	Delivery Trips (Roundtrip)	Roundtrip Distance (km)	Fuel Consumption (L)	GHG Emissions (tCO_2e)
Bearksin DGS	Cargo North	Basler (DC3T)	Pickle Lake	286	21	12,029	17,442	122
Bearksin DGS	Wasaya	Hawker HS 748	Pickle Lake	286	95	54,340	150,522	1,050
Big Trout DGS	Wasaya	Hawker HS 748	Pickle Lake	265	205	108,849	301,511	2,102
Deer Lake DGS	Cargo North	Basler (DC3T)	Red Lake	179	134	47,865	69,404	484
Fort Severn DGS	Wasaya	Hawker HS 748	Pickle Lake	536	104	111,162	307,919	2,147
Kasabonika DGS	Wasaya	Hawker HS 748	Pickle Lake	254	125	63,556	176,049	1,228
Kingfisher DGS	Wasaya	Hawker HS 748	Pickle Lake	177	74	26,195	72,559	506
Lansdowne DGS	Cargo North	Basler (DC3T)	Pickle Lake	179	80	28,576	41,435	289
Marten Falls DGS	Wilderness North	Air Tractor	Nakina	174	179	62,210	64,450	449
Sachigo DGS	Cargo North	Basler (DC3T)	Pickle Lake	302	124	75,096	108,889	759
Sandy Lake DGS	Wasaya	Hawker HS 748	Red Lake	224	398	178,016	493,103	3,438
Wapekeka DGS	Wasaya	Hawker HS 748	Pickle Lake	270	144	77,850	215,644	1,504
Weagamow DGS	Cargo North	Basler (DC3T)	Pickle Lake	183	10	3,669	5,319	37
Webequie DGS	Cargo North	Basler (DC3T)	Pickle Lake	257	145	74,658	108,254	755
TOTALS				**4,193**	**1,838**	**924,068**	**2,132,500**	**14,870**

Notes: Marten Falls also known as Ogoki Post; Wapekeka also known as Angling Lake; Weagamow also known as Round Lake

Table *A-7:* Other Indirect Emissions – Staff Transport by Air

Aircrafty Type	Aircraft Model	Annual Distance (km)	Fuel Consumption (L)	GHG Emissions (tCO_2e)
AirBravo Airlines	Pilatus PC-12	644,083	334,923	2,335
Wasaya Airlines	Pilatus PC-12	305,889	201,886	1,408
NorthStar Airlines	Pilatus PC-12	192,660	105,963	739
TOTALS		**1,142,631**	**642,773**	**4,482**

Table A-8: Renewable Energy Technology (RET) Generation

	Deer Lake DGS Hydel (kWH)	Sultan Hydel (kWh)	Big Trout Wind Turbine (kWh)	Kasabonika Wind Turbine (kWh)	Total RET Generation (kWh)
Generation (kWh)	1,702,306	0	13,362	7,510	**1,723,178**
Fuel Savings (L)	**469,742**				
GHG Reduction (tCO_2e)	**1,319**				

Table A-9: Renewable Energy Innovation Diesel Emission Reduction (REINDEER) Program

Community	Project Description	Generation Capacity (kW)	Connection Date
Armstrong	MNR RET	20	2015
Bearskin	School	21	2016
Deer Lake	School	120	2014
Fort Severn	4 Bay Garage	22	2014
	Roof Tops	40	2016
Kasabonika	Water Treatment Plant	12	2014
Kingfisher	Water Treatment Plant	10	2014
	Store Roof	14	2016
Sachigo	Water Treatment Plant	15	2016
Wapekeka	Water Treatment Plant	18	2014
Weagamow	Water Treatment Plant	17.5	2016
Webequie	Water Treatment Plant	9	2016
TOTALS		**318.5**	
Total Generation (kWh)	**254,800**		
Fuel Savings (L)	**69,459**		
GHG Reduction (tCO_2e)	**195**		

APPENDIX B: EMISSION FACTORS & GLOBAL WARMING POTENTIALS

Global Warming Potentials

Table B-1 summarizes the global warming potential values used for calculating Remotes' carbon dioxide equivalent (CO_2e) emissions.

Table B-1: Global Warming Potentials

Greenhouse Gas	Global Warming Potential (GWP)	Source
CO_2	1	O. Reg. 452/09 Greenhouse Gas Emissions Reporting (Table 1)
CH_4	21	O. Reg. 452/09 Greenhouse Gas Emissions Reporting (Table 1)
N_20	310	O. Reg. 452/09 Greenhouse Gas Emissions Reporting (Table 1)

Emission Factors

Table B-2 summarizes the emission factors used for calculating Remotes' GHG emissions.

Table B-2: Emission Factors

Electricity Generation	Emission Factor	Unit	tCO2e Factor	Source
Diesel CO_2	2681	g/L	0.00281	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-4: Emission Factors for Refined Petroleum Products (Diesel - Refineries and Others)
Diesel CH_4	0.133	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-4: Emission Factors for Refined Petroleum Products (Diesel - Refineries and Others)
Diesel N_2O	0.4	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-4: Emission Factors for Refined Petroleum Products (Diesel - Refineries and Others)

Fleet Transport (Road)	Emission Factor	Unit	tCO2e Factor	Source
Light Duty Gasoline Vehicle (Oxidation Catalyst) CO_2	2307	g/L	0.00238	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Light Duty Gasoline Vehicle (Oxidation Catalyst) CH_4	0.52	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Light Duty Gasoline Vehicle (Oxidation Catalyst) N_2O	0.2	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Light Duty Gasoline Truck (Oxidation Catalyst) CO_2	2307	g/L	0.00238	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Light Duty Gasoline Truck (Oxidation Catalyst) CH_4	0.43	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Light Duty Gasoline Truck (Oxidation Catalyst) N_2O	0.2	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Gasoline Vehicle (Uncontrolled) CO_2	2307	g/L	0.00234	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Gasoline Vehicle (Uncontrolled) CH_4	0.49	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Gasoline Vehicle (Uncontrolled) N_2O	0.084	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Diesel Vehicle (Uncontrolled) CO_2	2681	g/L	0.00271	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Diesel Vehicle (Uncontrolled) CH_4	0.15	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Diesel Vehicle (Uncontrolled) N_2O	0.075	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Heavy Duty Diesel Vehicle Average Fuel Economy	0.395	L/km		Natural Resources Canada: Fuel Efficiency Benchmarking in Canada's Trucking Industry

Natural Gas Consumption	Emission Factor	Unit	tCO2e Factor	Source
Natural Gas CO_2	1888	g/m^3	0.00190	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-1: CO2 Emission Factors for Natural Gas (Ontario)
Natural Gas CH_4	0.037	g/m^3		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-2: CH4 and N2O Emission Factors for Natural Gas (Commercial)
Natural Gas N_2O	0.035	g/m^3		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-2: CH4 and N2O Emission Factors for Natural Gas (Commercial)
Electricity Consumption	**Emission Factor**	**Unit**	**tCO2e Factor**	**Source**
Electricity Generation Intensity CO_2	17	g CO_2e/kWh	0.00002	Canada's National Inventory Report, 1990-2017, Part 3, Annex 13, Table A13-7: Electricity Generation and GHG Emission Details for Ontario
Electricity Generation Intensity CH_4	0.01	g CO_2e/kWh		Canada's National Inventory Report, 1990-2017, Part 3, Annex 13, Table A13-7: Electricity Generation and GHG Emission Details for Ontario
Electricity Generation Intensity NO_2	0.001	g CO_2e/kWh		Canada's National Inventory Report, 1990-2017, Part 3, Annex 13, Table A13-7: Electricity Generation and GHG Emission Details for Ontario
Fuel Transport (Air)	**Emission Factor**	**Unit**	**tCO2e Factor**	**Source**
Aviation Turbo Fuel CO_2	2560	g/L	0.00697	Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Aviation Turbo Fuel CH_4	0.029	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Aviation Turbo Fuel N_20	0.071	g/L		Canada's National Inventory Report, 1990-2017, Part 2, Annex 6, Table A6-13: Emission Factors for Energy Mobile Combustion Sources
Calm Air - ATR72	1.733	L/km		Average fuel economy provided by Calm Air
Wasaya - Hawker Siddeleys HS 748	2.77	L/km		Average fuel economy provided by Wasaya Airlines
Wilderness North - Air Tractor	1.036	L/km		Average fuel economy provided by Wilderness North
Cargo North - Basler (DC3T)	1.45	L/km		Average fuel economy provided by Cargo North
Radiative Forcing Index (RFI) value	2.7			Intergovernmental Panel on Climate Change (IPCC) Special Reports: Aviation and the Global Atmosphere, Chapter 6.6.5

Staff Transport (Air)	Emission Factor	Unit	Source
Air Bravo - Pilatus PC-12	0.52	L/km	Actual average fuel economy for the Pilatus PC-12 provided from Air Bravo
Wasaya - Pilatus PC-12	0.66	L/km	Actual average fuel economy for the Pilatus PC-12 provided from Wasaya
North Star - Pilatus PC-12	0.55	L/km	Actual average fuel economy for the Pilatus PC-12 provided from North Star
Other Factors	**Factor**	**Unit**	**Source**
Mile to Kilometer	1.609	km/mile	www.convertunits.com
kW to kWh Conversion	800	kWh / kW	Remotes estimate based on pilot data from Deer Lake solar project

APPENDIX C: STANDARD REPORTING DECLARATION

Table C-1 provides a summary of the reporting information required by CAN/CSA-ISO Standard 14064-1-06.

Table C-1: Reporting Information

No.	CSA Reporting Requirement	Declaration
A	Description of the reporting organization	See section "2 Organizational Profile"
B	Person responsible	Lori Rice, EHS Coordinator, Hydro One Remote Communities Inc. Tel: 807-474-2829 Email: Lori.Rice@HydroOne.com
C	Reporting period covered	January 1st, 2018 to December 31st, 2018
D	Documentation of organizational boundary.	Financial and operational control approaches
E	Direct GHG emissions, quantified separately for each GHG, in tonnes of CO_2e.	See "Appendix A: GHG Inventory"
F	A description of how CO_2 emissions from the combustion of biomass are treated in the GHG inventory.	Currently, the Renewable Fuels Regulations require petroleum producers and importers to have an average 2% renewable fuel content in diesel fuel, the effects of which have not been measured in this report.
G	If quantified, GHG removals, quantified in tonnes of CO_2e.	Not applicable to this inventory
H	Explanation for the exclusion of any GHG sources or sinks from quantifications.	Due to measurement difficulties, this inventory excludes fuel transport emissions for fuel delivered by barge, employee commuting to Thunder Bay SC, as well as the leakage of refrigerant from air conditioners and other equipment. GHG sinks are not applicable to this inventory.
I	Energy indirect GHG emissions associated with the generation of imported electricity, heat or steam, quantified separately in tonnes of CO_2e.	See "Appendix A: GHG Inventory"
J	The historical base year selected and the base-year GHG inventory.	See section "3.3 Historical Emissions"

K	Explanation of any change to the base year or other historical GHG data, and any recalculation of the base year or other historical GHG inventory.	Not applicable to this inventory
L	Reference to, or description of, quantification methodologies including reasons for their selection.	See section "4 Quantification"
M	Explanation of any change to quantification methodologies previously used.	Not applicable to this inventory
N	Reference to, or documentation of, GHG emission or removal factors used.	See "Appendix B: Emission Factors and Global Warming Potentials"
O	Description of the impact of uncertainties on the accuracy of the GHG emissions and removals data.	Uncertainties in calculations include error margins in emissions factors and measured activity data. Refer to Section "5.4 Estimation of Uncertainty".
P	A statement that the GHG report has been prepared in accordance with ISO Standard 14064-1.	This report has been prepared in accordance with the following standard: CAN/CSA-ISO Standard 14064-1-06 - Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals.
Q	A statement describing whether the GHG inventory, report or assertion has been verified, including the type of verification and level of assurance achieved	Dana Lauder of GHD Ltd. will provide third party verification for this GHG inventory report and will provide a reasonable level of assurance. See Table 6.1 in Section "6.1 GHG Information Management" for more details.