



INFRASTRUCTURE
GOVERNMENT OF THE NORTHWEST TERRITORIES

ENERGY INITIATIVES REPORT

2017 – 2018

If you would like this information in another official language, call us.

English

Si vous voulez ces informations dans une autre langue officielle, contactez-nous.

French

Kīspin ki nitawih̄tīn ē nīh̄yawih̄k ōma ācimōwin, tipwāsinān.

Cree

Tłıchq̄ yatı k'èè. Dı wegodı newq̄ dè, gots'ō gonede.

Tłıchq̄

ʔerih̄t'ıs Dēne Sųłıné yatı t'a huts'elkēr xa beyáyatı theᓗ ᓗat'e, nuwe ts'ēn yóftı.

Chipewyan

Edı gondı dehgáh got'ıe zhatıé k'éé edat'éh enahddhę nıde naxets'ę edahıı.

South Slavey

K'áhshó got'ıne xədə k'é hederı ᓗedjhtl'é yerıııwę nıde dúle.

North Slavey

Jii gwandak izhii ginjik vat'atr'ijāhch'uu zhit yınohthan jı', diıts'at ginohkhıı.

Gwich'in

Uvanittuaq ilitchurisukupku Inuvialuktun, ququaqłuta.

Inuvialuktun

Ċ^bdċ ııı^{sb}bΔ^c ʌ^cʌJΔ^{rc} Δ^obııċ^cı^{sb}ı^cı^b, ı^cē^cı^oı^c ı^cı^bc^cı^oı^cı^c.

Inuktitut

Hapkua titıqqat pijumagupkit Inuinnaqtun, uvaptınnut hivajarłutit.

Inuinnaqtun

Aboriginal Languages Secretariat: 867-767-9346 ext. 71037

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MINISTER'S MESSAGE



It has been an active and productive year for the various departments and agencies that deliver energy programs and services in the Northwest Territories. Their initiatives supported communities, residents and Indigenous governments to invest in activities that reduce energy costs and our environmental footprint. While this work was ongoing, the Government of the Northwest Territories (GNWT) also finalized long-term strategies to address our energy systems, climate change and our petroleum resources. This policy framework helped the GNWT and the Government of Canada to align our objectives to sign long-term bilateral agreements that will provide funding for future energy infrastructure and programs that support NWT communities, business and industry.

The GNWT leads by example when it comes to energy conservation and efficiency. We invested \$3.8 million this year into optimizing GNWT building systems, and our energy conservation and efficiency programs designed to help NWT residents, businesses and industry save energy and money were fully subscribed.

We continued to support biomass heating projects across the territory, study wind resource potential in the High Arctic, and work toward connecting our hydroelectricity systems. These initiatives are critical in the transition to a lower-carbon economy

The GNWT's *2030 Energy Strategy* and *Climate Change Strategic Framework* were developed this year using the feedback we received from communities, Indigenous governments and other stakeholders across all regions. This was an essential process, as there are no one-size-fits-all energy solutions. By reaching out to communities, and striving to understand each community's priorities, we foster local participation, find local solutions, and build practical supporting infrastructure.

Over the next three years we will invest approximately \$180 million to support implementation of the *2030 Energy Strategy* through a three-year *Energy Action Plan*. Most of this funding will be invested in building renewable energy projects in remote diesel-communities and supporting energy efficiency. By helping communities reduce their reliance on fossil fuels, we will be doing our part to help fulfill Canada's international commitments to reduce greenhouse gas (GHG) emissions, while stabilizing the cost of energy in the NWT.

When we take a collaborative approach to energy with communities, Indigenous governments, business and industry, and get support from our federal partners, we can move forward with a clear vision for clean growth, do our part to address climate change, and make our energy systems more efficient, secure and sustainable.

Mahsi,

The Honourable Wally Schumann

Minister of Infrastructure

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EXECUTIVE SUMMARY

The eighth edition of the INF Energy Initiatives Report is an overview of the GNWT's energy programs and activities over the past year. Along with its energy conservation and efficiency initiatives, the development of a long-term strategy to address energy in the NWT was a core focus for the Department of Infrastructure (INF) in 2017/18. Highlights from energy-related activities in 2017/18 include:

- 28 energy efficiency projects on various GNWT facilities.
- A reduction of 10,338 tonnes of GHG emissions from energy investments in GNWT assets, representing a 23.8% reduction in annual emissions.
- The new addition to the École Allain St-Cyr School was underway with 100% biomass heating scheduled for completion in the fall of 2018.
- East Three School in Inuvik was the first GNWT asset in the Beaufort Delta to install biomass, with a 950-kW boiler.
- Fifty-five wood stoves were delivered to the NWT as part of the Arctic Energy Alliance's Community Wood Stove Project.
- Colville Lake produced 20.3% of their power from solar energy and their battery energy storage system, displacing 134,441 kWh of diesel-generated energy.
- Enhanced snow surveys were conducted in the Snare basin to improve snow water equivalent estimates in the Snare River watershed.
- Work was undertaken to further understand the potential of the Taltson River. Technical studies, market evaluations and a business case are being developed to help support a proposal for future funding.
- The GNWT held a Traditional Knowledge and Land Use Workshop with Gwich'in and Inuvialuit elders, land users and youth in Inuvik to solicit local participation in the Inuvik High Point Wind Project.
- A 30-metre wind monitoring tower with heated sensors was installed in Sachs Harbour. The tower is powered by a remote hybrid renewable energy system—being used for the first time—using solar panels, small wind turbines and a diesel generator to charge its batteries throughout the year.
- Drafting of the *2030 Energy Strategy* and the accompanying 2018 – 2021 *Energy Action Plan* was completed during the 2017 – 2018 fiscal year, after analyzing feedback collected during the previous year's public engagement sessions. Both documents were released in May.
- Supplemental teaching materials focused on northern energy were developed for the Northwest Territories Experiential Science Curriculum at the high school level. Lesson plans were designed to help teachers and students better understand energy issues in the North.

Looking ahead to the coming year, the GNWT will begin implementing projects and programs identified in the *2018 – 2021 Energy Action Plan*.

Work on the Inuvik Wind Project including community engagement, federal funding applications, geotechnical and environmental work to prepare for a regulatory application will continue.

The GNWT will continue negotiating with Environment and Climate Change Canada (ECCC) to secure funding for programs that will help communities, governments and industry lower their greenhouse gas emissions, through ECCC's Low Carbon Economy Leadership Fund.

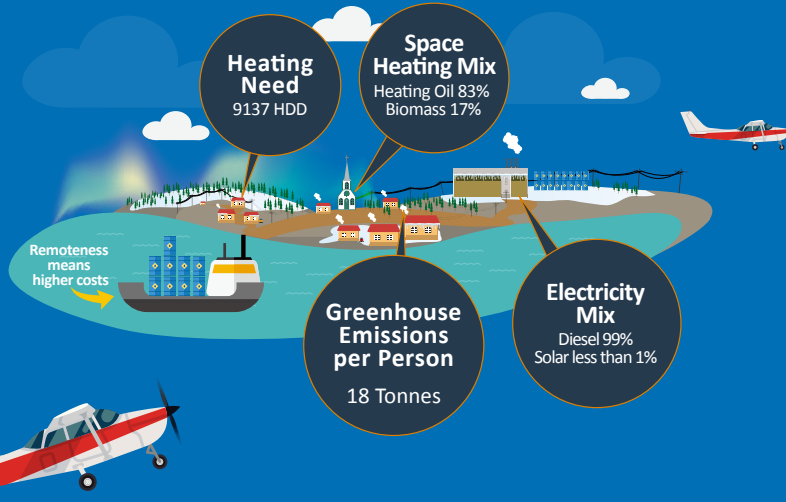
Continued development of transportation corridors throughout the territory will lay the foundation for new energy opportunities.

This year's work promises to reveal exciting and transformative energy opportunities going forward.

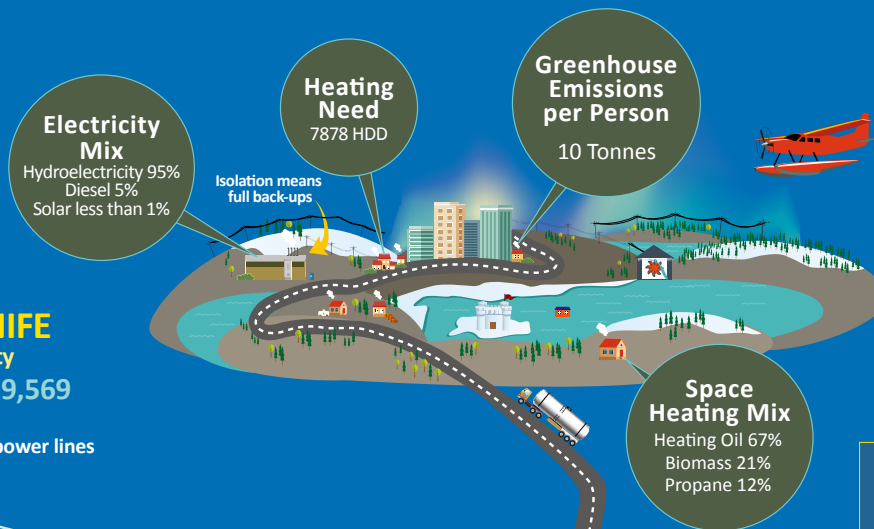
COMMUNITY ENERGY USE

How does yours compare?

FORT GOOD HOPE
 Thermal Community (Diesel)
 Population: 516
 Not connected by roads
 Not connected by power lines



YELLOWKNIFE
 Hydro Community
 Population: 19,569
 Connected by road
 Not connected by power lines



Electricity Mix
 Sources of energy used to power buildings

Space Heating Mix
 Sources of energy used to heat buildings

Heating Need
 Heating Degree Days (HDD) measure how cold a region is. An average house would use about half a litre of oil per HDD

Greenhouse Emissions per Person
 The amount of greenhouse gas emitted by a community, divided by its population

60th Parallel

Power lines end

EDMONTON
 Grid-Connected Community
 Population: 932,546
 Connected by roads
 Connected by power lines



NWTenergy.ca

INTRODUCTION

The *2017 – 2018 Energy Initiatives Report* is a high-level review of the Territory's current energy situation and key initiatives undertaken by the GNWT and its partners over the past year. A summary of the results of key strategic investments in renewable and alternative energy technologies is also provided, along with a look ahead to initiatives slated for the coming year.

The GNWT's tradition of supporting energy conservation and efficiency reached a milestone, as the Capital Asset Retrofit Fund (CARF), completed its tenth year. We have learned much from the work done in the early years of CARE, and have developed new best practices that currently guide our work to optimize building systems to reduce energy consumption, operating costs, and greenhouse gas emissions. Normalizing these standards for GNWT assets provides an example for residents and industry to follow.

Many were inspired to improve their own energy efficiency this year, as evidenced by the interest and uptake in GNWT-funded energy conservation and efficiency programs for residents and businesses—administered by the Arctic Energy Alliance. This trend bodes well for a united effort between government, communities and industry to conserve energy, save money, and encourage clean economic growth.

To improve our energy systems, we need to use all the tools at our disposal going forward. Engagement with local communities, governments and other stakeholders is essential to finding energy solutions that truly work.

The NWT has a wealth of Traditional Knowledge (TK) to help ensure successful projects, as demonstrated at our TK and land use workshops in Inuvik. We must also incorporate emerging technologies, like the Remote Hybrid Renewable Energy System we are testing in Sachs Harbour, or our study of the latest submarine cable technology for Taltson hydroelectricity expansion. Traditional Knowledge and emerging technologies applied together will help to address our uniquely northern energy issues by drawing from the past and embracing the future.

As communities across the North experience the effects of climate change, it is in our interests to join the world in the transition to a lower carbon economy. It is also in our interests to advocate for communities that need support to make this transition, and ensure that they get it.

In 2017 – 2018, the Department of Infrastructure took the feedback it received from communities, Indigenous governments, and other stakeholders the previous year to develop and craft the GNWT's *2030 Energy Strategy*. The Strategy sets out the GNWT's long-term approach to supporting an energy system that provides reliable, affordable and sustainable energy, as well as doing our part to reduce Canada's greenhouse gas emissions. The Strategy is supplemented with a three-year rolling *Energy Action Plan* that will be implemented in partnership with the Northwest Territories Power Corporation, the Arctic Energy Alliance, the NWT Housing Corporation, and NWT communities.

For the first time, the GNWT and Infrastructure Canada have signed a ten-year funding agreement that will direct significant resources at the energy infrastructure needed to reduce GHG emissions and stabilize the cost of energy in our remote communities.

ENERGY SNAPSHOT

ENERGY USE

Energy use in the NWT is very different than it is in the rest of Canada. A few large mines and petroleum production comprise the territories' main energy consumers, whereas communities use less than 50% of energy produced. Providing reliable and affordable energy to the NWT's many small, isolated communities

remains a constant challenge. Northerners are now turning to alternative energy sources to supplement petroleum products, such as wood for heating and solar panels for electricity. This helps reduce energy costs and environmental impacts.

Figure 1: 2016 NWT Energy Use by Sector

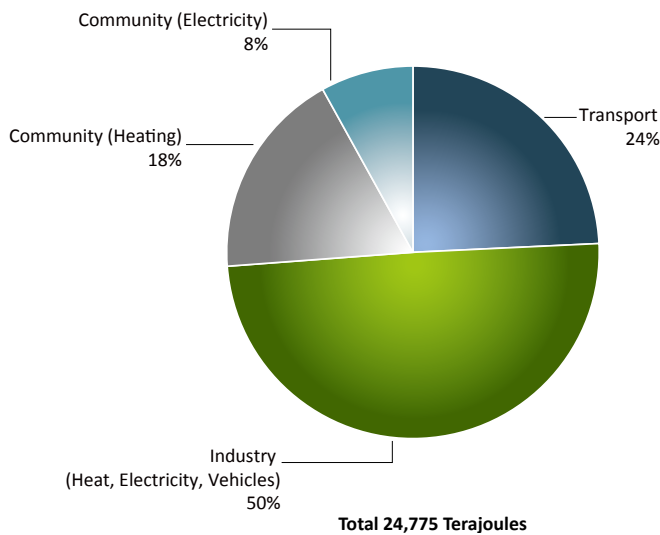


Figure 2: 2016 NWT Energy Use by Sector, Excluding Industry

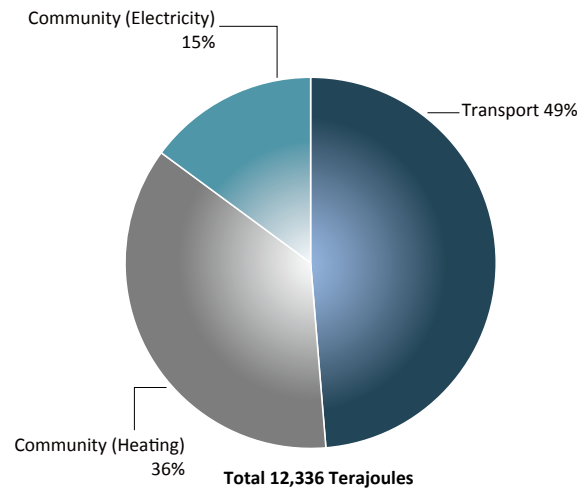
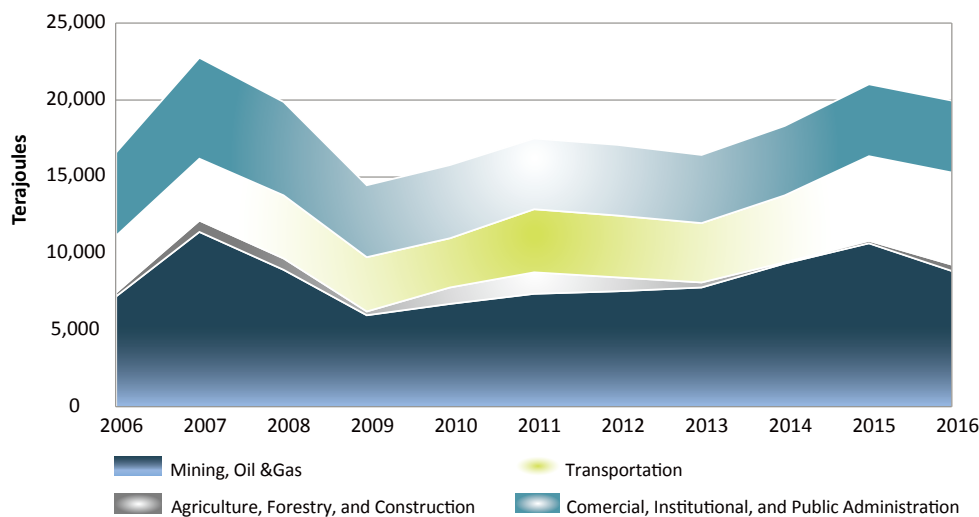


Figure 3: Total Energy Used in the NWT



DID YOU KNOW?

One terajoule equals approximately 27,000 litres of oil or 3,000 bags of wood pellets—enough to heat an average home for five years.

POWER GENERATION

Most of the power generated for NWT communities comes from hydroelectric facilities, where the energy of flowing rivers is transformed into electricity. Communities not connected to our hydroelectric grid use diesel generators or natural gas to produce electricity. The territories' mines also use diesel generators to produce most of their electricity,

with the exception of one diamond mine that incorporates an on-site wind farm. Unlike most of Canada, the NWT is not connected to the North American electrical grid. Without access to electricity from the North American grid, each community must have its own sources of backup power, which greatly increases the cost of providing electricity.

Figure 4: Electricity Generation Trends

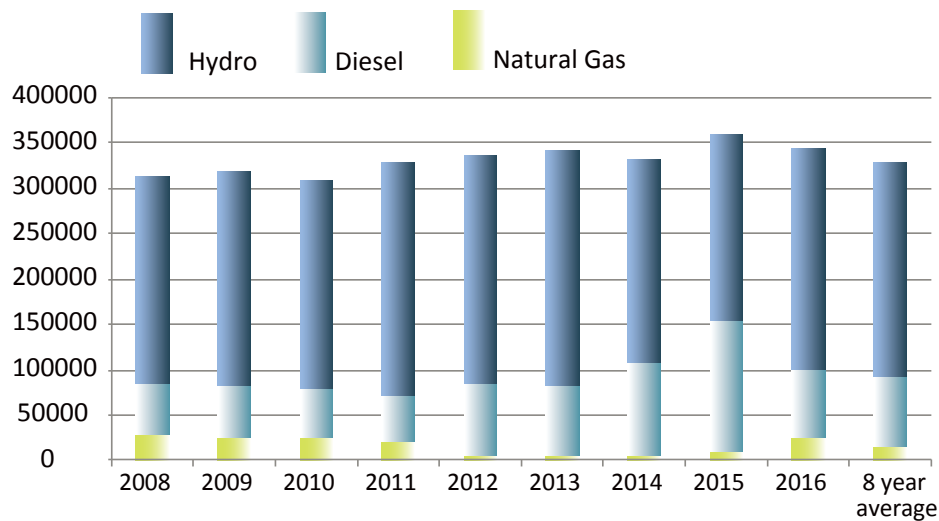
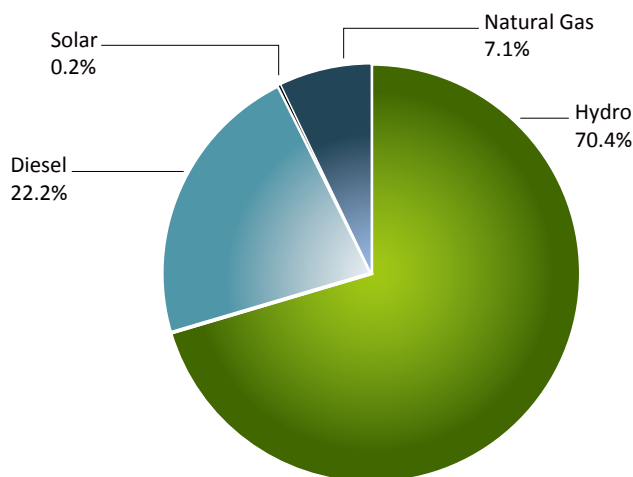


Figure 5: Electricity Sources in NWT Communities



DID YOU KNOW?

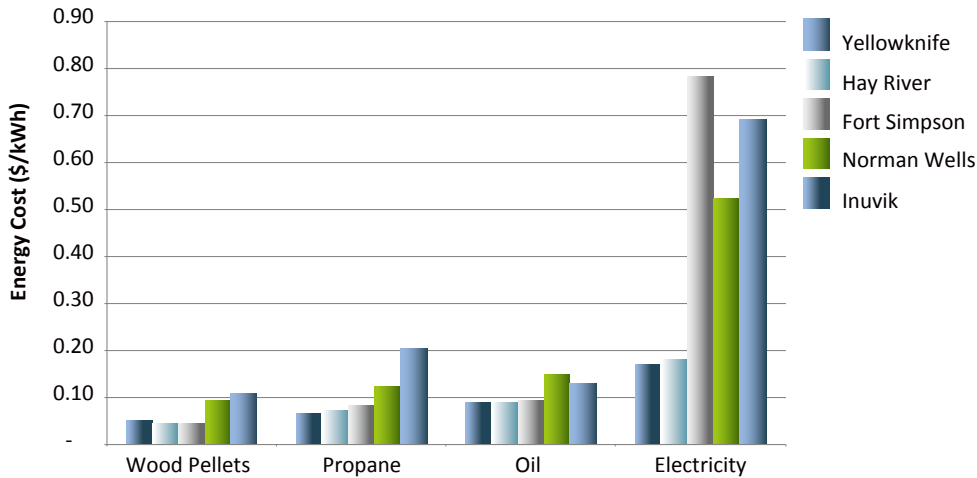
2015 received lower than normal rainfall and hydroelectric production was reduced compared to other years. Back-up diesel was relied on more than normal in 2014 and 2015 to make up the energy shortfall. 2016 and 2017 water levels are increasing and hydro production is returning to normal.

ENERGY PRICES

Electricity remains the most expensive energy source in the NWT, especially in diesel communities. Wood pellets compete favourably against fossil fuels for heating, as heating

oil and propane prices in the last six years have fluctuated by as much as 30% and 50% respectively, while the bulk price of wood pellets has remained 44% cheaper on average.

Figure 6: Energy Prices by Community

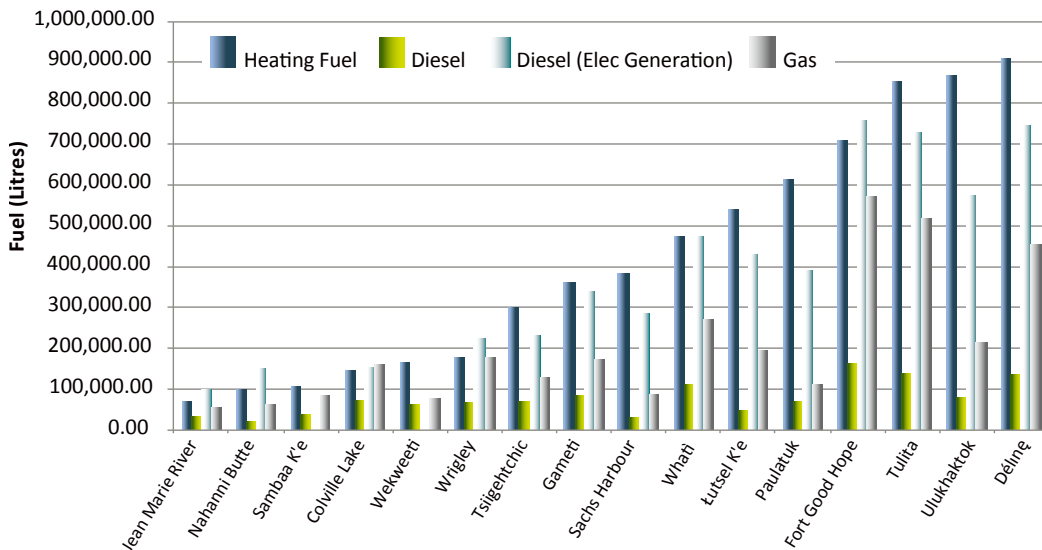


FUEL DELIVERED BY THE GNWT

The Department of Infrastructure’s Fuel Services division manages the purchase, transport and storage of bulk petroleum products for 16 NWT

communities not serviced by the private sector. Local contractors distribute these petroleum products to their communities.

Figure 7: Fuel (by type) delivered to Petroleum Products Program (PPP) communities in 2017 – 2018





New, efficient wood stoves, ready for delivery to Behchokò.

ENERGY CONSERVATION AND EFFICIENCY

ARCTIC ENERGY ALLIANCE (AEA)

The AEA administers programs and projects funded by the Department of Infrastructure that help Northerners reduce their energy use and adopt renewable energy technologies, thereby reducing their greenhouse gas emissions and saving them money.

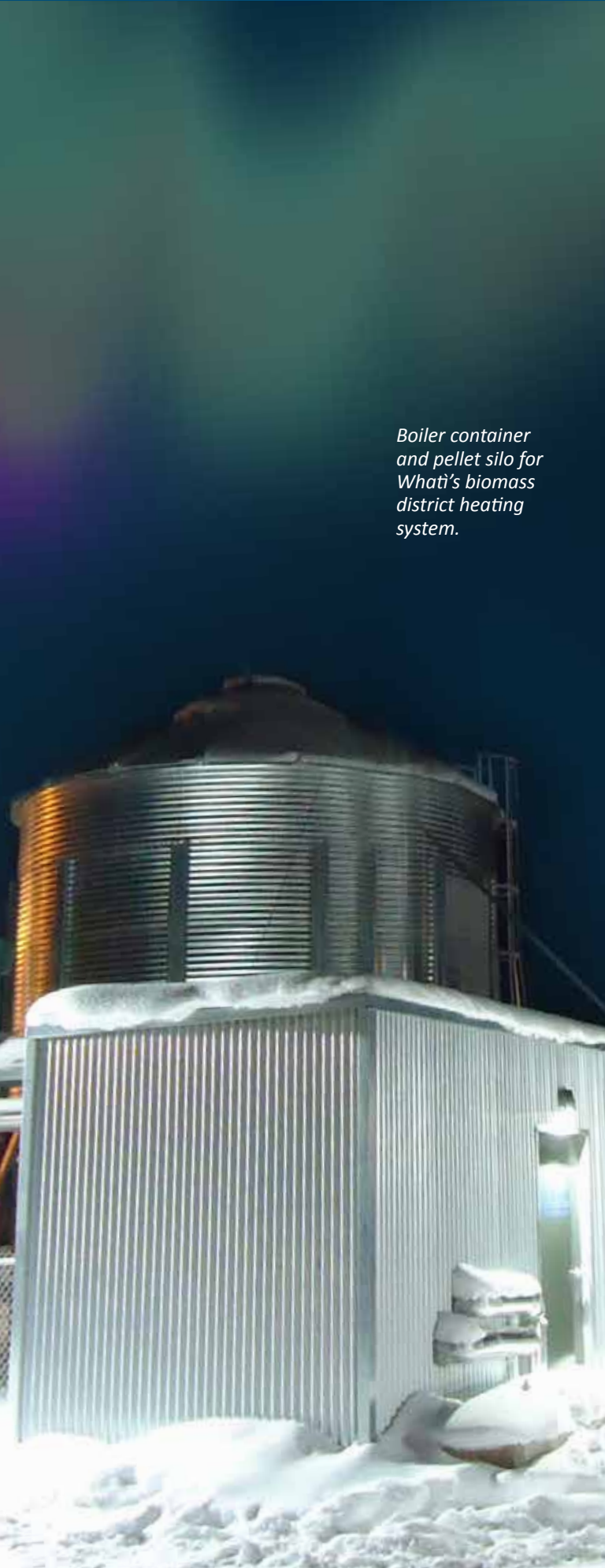
2017 – 2018 HIGHLIGHTS

COMMUNITY WOOD STOVE PROJECT

In 2017/18, the AEA helped coordinate the installation of nine stoves in Fort Good Hope and 20 in Colville Lake. In March, a total of 55 stoves were delivered to Behchokò, Whatì, Gameti, Wekweètì and Délı̄në, to be installed in 2018/19.

The AEA also holds Burn-it-Smart sessions in communities that receive new stoves, to ensure that residents are aware of how to use their stoves efficiently and safely.

As a result of this project, a resident of Fort Good Hope received his Wood Energy Technology Transfer (WETT) Canada certification to properly install and inspect wood stoves according to national codes, and can now perform these services for local communities.



Boiler container and pellet silo for Whatì's biomass district heating system.

WHATÌ DISTRICT HEATING SYSTEM

Under the Biomass Energy Program, the AEA provides Northerners with accessible technical advice on existing or potential biomass heating or electricity co-generation (heat and power) projects.

Since 2015/16, the AEA has been helping the Community Government of Whatì plan and build a district heating system based around a biomass boiler. The boiler burns wood pellets to heat three community government buildings and the GNWT-owned health centre.

The AEA helped the community to secure funding, and acted as a coordinator between the community government and the contractor.

The boiler was fired up for the first time in March 2017. In the winter of 2017/18, the contractor conducted some small repairs and held training sessions for community government staff on operating and maintaining the boiler. The system is now fully operational and the community government expects to connect additional buildings in the future.

The system is projected to save the community government 100 tonnes of greenhouse gases, 38,000 litres of diesel and \$40,000 annually.



Michael Goodwin of the AEA presents David LeBlanc with a rebate cheque for building a home with an energy-efficiency score of at least 85 out of 100.

ENERGY RATING SERVICES SUPPORT PROGRAM

One of the AEA's most well-known programs, the Energy Rating Services Support Program provides homeowners across the NWT with access to affordable home energy evaluations using the EnerGuide Rating System, under license from Natural Resources Canada to improve their energy efficiency. The following are just two highlights from those evaluations.

In 2017/18, the AEA completed more than 140 home energy evaluations in six communities across the NWT, including Yellowknife's newest Habitat for Humanity home—which scored 84 out of a possible 100 on the EnerGuide Rating System scale—and was the first recipient of AEA's Energy Efficiency Incentive Program rebate for homes that score 85 or above.



Morgan Ranseth, J.C. Ouelette-Landry and their daughter place the EnerGuide home evaluation label on their new home.



Aklavik VSG Unit

NORTHWEST TERRITORIES POWER CORPORATION (NTPC)

VARIABLE SPEED GENERATOR (VSG) WITH SOLAR

The sun doesn't always shine, and the wind doesn't always blow. The intermittent nature of renewable energy is one of the factors limiting its integration into our current system. Fixed-speed generators are reliable when run on traditional fuel, but can only integrate so much renewable energy without becoming susceptible to power outages.

NTPC began testing one possible solution to this challenge in the community of Aklavik, where a variable-speed generator (VSG) has been commissioned. The VSG integrates with a 55kW solar photovoltaic (PV) project that has already been built by the GNWT in Aklavik.



*Mark Horton, Mike Ocko, Andrew Burns,
Benedict Nleya*

A one-year pilot project is underway that will assess performance of the 590 kW VSG relative to the expected 80,000 litre reduction in diesel consumption and enhanced system stability. Variable-speed systems absorb input fluctuations by changing their speed and creating a smoother power output. They maintain high efficiency at all operating speeds and—after AC to DC conversion—allow a greater capacity of solar energy to be installed.

INUVIK HEAT RECOVERY

NTPC is installing an Exhaust Gas Heat Recovery Unit (EGRU) on the power plant's second natural gas-fired generator. An EGRU on one generator currently provides heat to NTPC's power plant and the Town's water treatment plant (WTP), but this arrangement is insufficient at times and must be supplemented by gas-fired boilers in the winter.

The new EGRU will:

- Reduce the need to run the plant's backup natural gas-fired boilers—which generate heat to vaporize the natural gas that powers the generators and boilers.
- Reduce operating costs and natural gas consumption, while increasing overall efficiency.
- Maximize waste heat recovered with an improved control system.
- Meet growing heating needs of the recently upgraded WTP.
- Feed new loads, including two nearby GNWT buildings that only require funding to design and install energy transfer stations and piping.

Funding from the Government of Canada (Indigenous and Northern Affairs' REACHE Program) allowed this project to proceed a year ahead of schedule.

Exhaust Gas Heat Recovery Unit in Inuvik





DEPARTMENT OF INFRASTRUCTURE (INF)

CENTRE FOR MINING AND INDUSTRY TRAINING (CMIT)

Energy metering has been installed at the College and Mining Training Institute in Fort Smith. Meters are installed on the heating systems to quantify and optimize the performance of the wood pellet boiler systems.

The digital meters calculate the BTUs/kWhs output by each of the oil boilers and wood pellet boilers. These meters are integrated into the heating control systems to anticipate the need for heat, and initiate the slower ramping up of the wood pellet boilers.

The benefits of this include maximizing the use of the wood pellet boilers and in turn, minimizing the use of oil and reducing GHG emissions.



Maintaining the load on the Wood Pellet Boilers is integral to realizing the savings and reduction of GHG emissions.



ÉCOLE ALLAIN ST-CYR SCHOOL

The heating system for the new addition to the École Allain St-Cyr School was designed for 100% biomass with a connection to the William McDonald School for optimization. With LED lighting and high RSI-value insulation for wall and roof assemblies, the new addition exceeds the minimum requirements of the National Energy Code and the Good Building Practices for Northern Facilities by more than 10%.

The system will save 115,000 litres of diesel and reduce GHG emissions by 306 tonnes per year.

ŁUTSEL K'E SCHOOL

The Łutsel K'e Dene School received an envelope upgrade to improve energy performance and GHG reductions. Additional insulation was added to reduce building energy costs. The envelope upgrade will see annual fuel and electricity savings of approximately \$3,000.

The upgrade was funded by the Capital Asset Retrofit Fund (CARF). The project was delivered as part of an addition and retrofit to the existing school to include new classrooms and learning space.

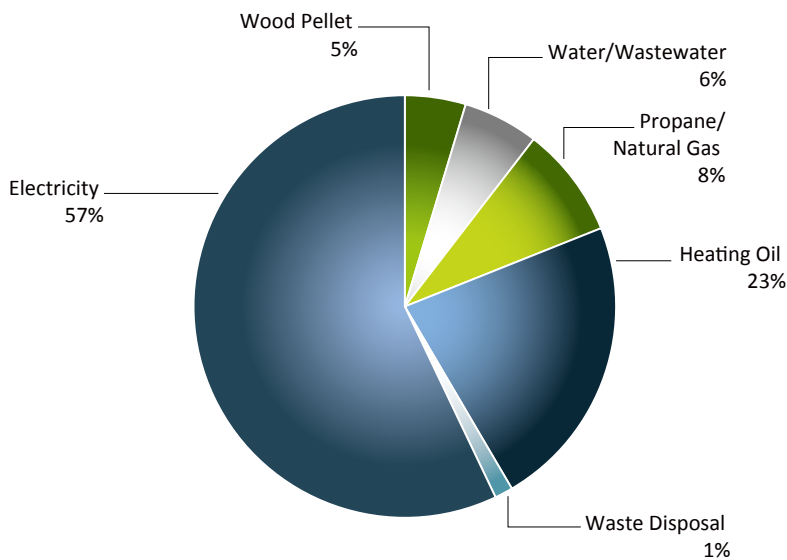


TRACKING GNWT ENERGY USE AND UTILITY COSTS

GNWT UTILITY COSTS

In 2017/18 the cost of heat and power for GNWT Facilities totaled \$30.3 Million dollars. Figure 8 below shows the largest utility cost to the GNWT being electricity followed by heating cost making up a total of 80% of total expenditures. It should be noted that wood pellet expenditures increased from 3 to 5% in 2017/18 versus the previous year.

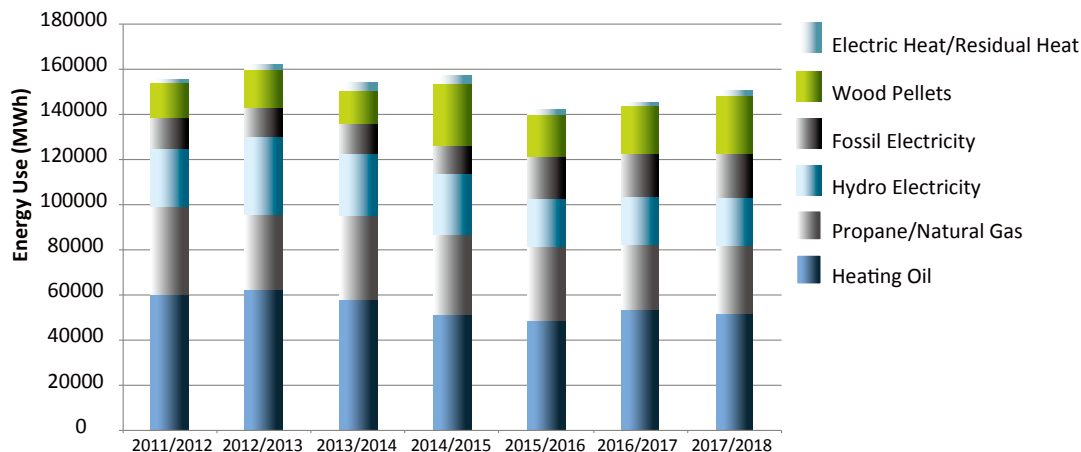
Figure 8: 2017/2018 GNWT Utility Expenditures



GNWT ENERGY USE TRENDS

Energy use by the GNWT rose by approximately four percent in 2017 – 2018, but fossil electricity and heating oil use went down. Weather patterns and the addition of large GNWT assets recent years contributed to the rise in energy use. Increased water levels should further reduce fossil electricity in the coming years.

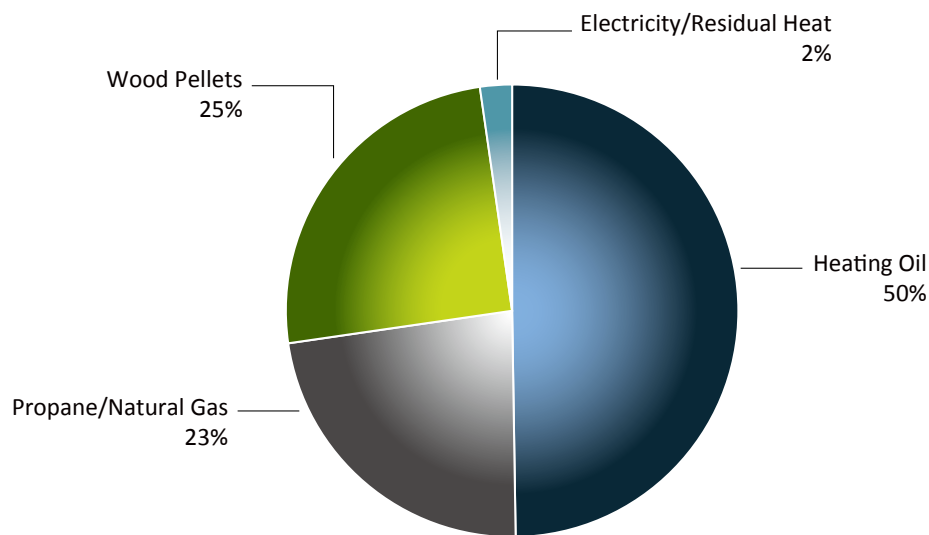
Figure 9: Energy Use Comparison by Year



GNWT SPACE HEATING BY FUEL TYPE

In 2017/18, space heating for GNWT facilities totalled 110,000 MWh. Of this total, 27% was provided by renewable electric heat and biomass energy. This number continues to increase as existing biomass plants are optimized and new ones are installed.

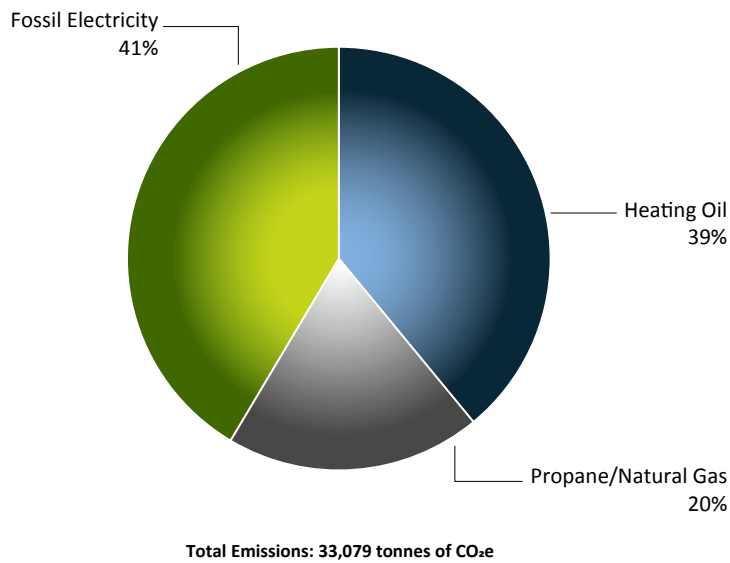
Figure 10: 2017-2018 GNWT Space Heating Energy Sources



GNWT GHG EMISSIONS AND REDUCTIONS

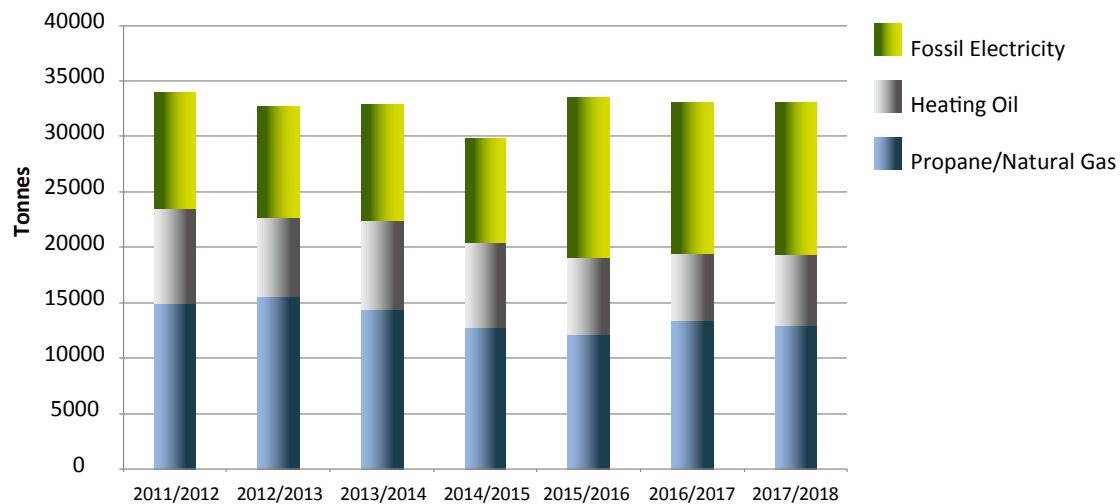
In 2017/18, approximately 33,000 tonnes of greenhouse gas emissions (GHG) were released as a result of burning fossil fuels for heat and electricity generation for GNWT assets. This is a reduction of approximately 2,000 tonnes from the previous year.

Figure 11: GNWT Greenhouse Gas Emissions by Energy Type



GNWT GHG EMISSIONS TRENDS

Figure 12: GNWT Greenhouse Gas Emissions Comparison by Year



BUILDING PRACTICES AND CODES

GOOD BUILDING PRACTICE FOR NORTHERN FACILITIES

The Department of Infrastructure's Good Building Practice for Northern Facilities (GBP) Guidelines ensure that government infrastructure is reliable, maintainable, and energy efficient. Created using the expertise of northern designers and builders from the public and private sector, these guidelines are followed for all new builds and retrofits of GNWT facilities. An updated version of the GBP Guidelines is currently being drafted by INF's Design and Technical Services division to add new technical guidance and incorporate more energy-saving measures. Scheduled to be completed in the 2018/19 fiscal year.

DESIGN AND CONSTRUCTION OF NEW GNWT BUILDINGS

An important component of INF's mission is to provide government departments with safe and reliable facilities that are sustainable and energy efficient. How buildings are designed, constructed and maintained affects the useful life of a building, the life cycle costs of the facility and the comfort level for users of the building. INF uses many tools to achieve appropriate building designs that are reliable and energy efficient.

NATIONAL CODE DEVELOPMENT

INF participates on various national code development committees. This allows the GNWT to represent an important northern perspective to influence national code development, share best practices, and enhance our uptake of energy efficient design standards and techniques as part of the GBP.

INF is currently involved with the following committees/groups:

- The Canadian Standards Association Technical Subcommittee (studying building energy estimation methodology)
- The Public Infrastructure Engineering Vulnerability Committee studying the impact of climate change on northern engineered infrastructure)
- The Building Technology Transfer Forum
- CSA – B365 Code Development
- CSA – Geotechnical Site Investigations for Building Foundations in Permafrost Zones
- Standards Council of Canada – Northern Infrastructure Standardization Initiative

LED lighting retrofits at the Norman Wells Airport

CAPITAL ASSET RETROFIT FUND (CARF)

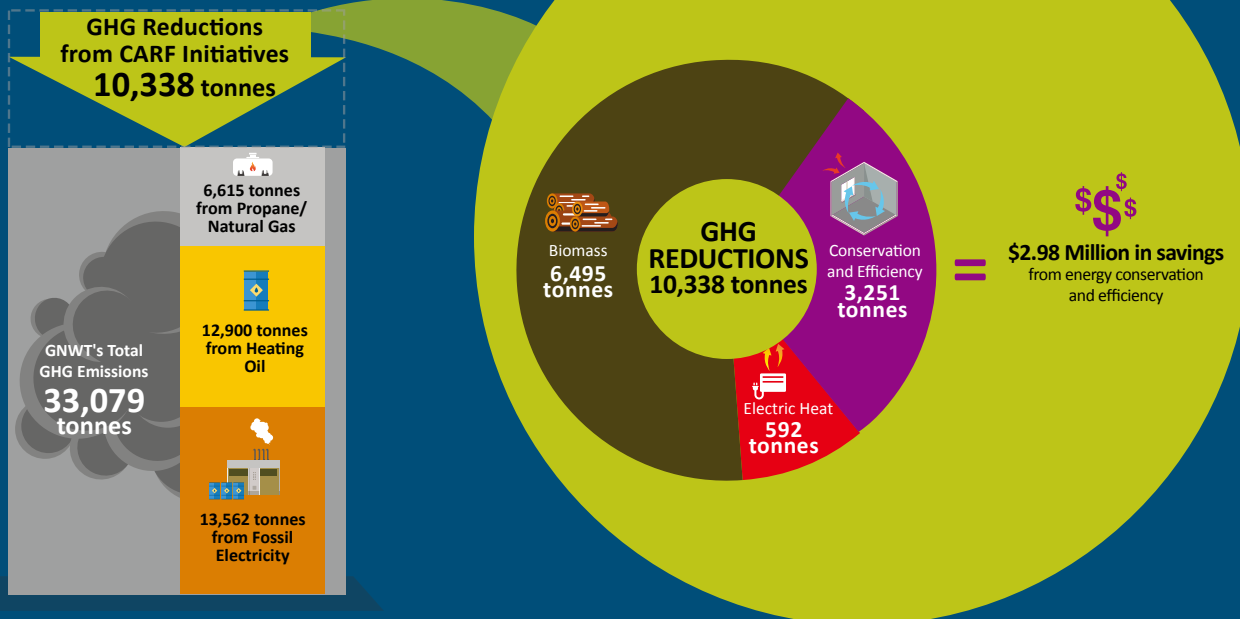
LEADING BY EXAMPLE

The Capital Asset Retrofit Fund provided 3.8 million dollars in 2017 – 18 to optimize building systems through envelope and lighting upgrades, biomass installations, heating control optimizations, efficient water fixtures and aging building retrofits. Now entering its tenth year, CARF continues to reduce energy consumption, operating costs and GHG emissions across the Territory. Projects suitable for CARF funding are identified after annual energy benchmarking and auditing, thermal scanning and feedback from operations and maintenance staff.

2017 – 2018 HIGHLIGHTS

(SEE APPENDIX B FOR A LIST OF COMPLETED PROJECTS.)

- LED lighting was installed at the Norman Wells Airport.
- INF and the Department of Education are moving forward to install a biomass district heating system at Weledeh/St Patrick’s School.
- Contract awarded to install biomass boiler at École Allain St-Cyr School. Installation will be completed in the fall of 2018.
- INF conducted a performance review of all installed wood pellet boiler capacity of GNWT assets from the beginning of CARF.



CARF PERFORMANCE INDICATORS

GREENHOUSE GAS EMISSIONS REDUCTIONS

To assist global efforts to mitigate the impact of climate change, it is a priority of the GNWT to reduce GHG emissions. Through energy efficiency upgrades, alternate energies (solar, biomass, hydroelectricity) and efficient building design/construction, the GNWT is making significant reductions in GHG emissions from building assets. As shown in Figure 13, GHG emission reductions totaled 10,338 tonnes in 2017/2018, representing a 23.1% total reduction in annual GHG emissions from GNWT assets. Most of the reduction has come from the addition of wood pellet boilers in GNWT facilities and it is our objective to continue to implement and increase the use of biomass where appropriate. As more wood pellet boilers are installed, the focus will shift from retrofitting existing buildings to promoting their success and continuing to integrate them into the design of new capital assets.

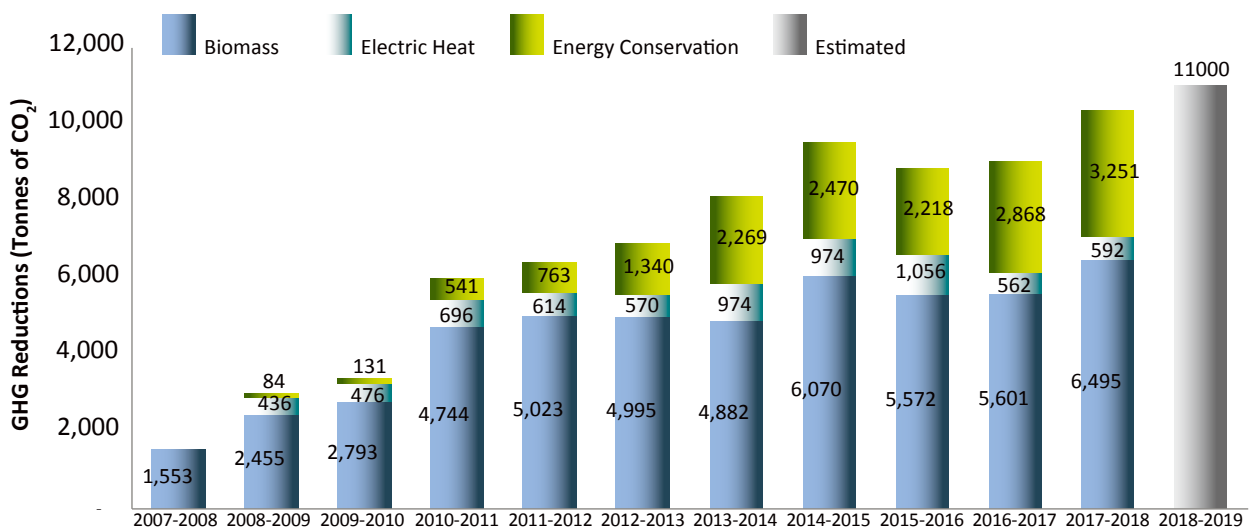
ENERGY REDUCTIONS

The GNWT leads by example when it comes to reducing energy use. Retrofitting existing GNWT assets through CARF-funded energy conservation projects—such as control upgrades, LED lighting retrofits and installation of energy-efficient equipment and appliances—reduces annual electricity and heating use by approximately 15%. These energy conservation projects have also displaced 5.7 million litres of oil since CARF began. Together with biomass, hydroelectric heating and other CARF projects, the GNWT has achieved an overall displacement of approximately 27 million litres of oil since the program's inception. The CARF investment has offset the emission of 73,030 tonnes of GHG, 15,935 of which came from implementing energy conservation measures (shown in yellow on the graph below).

COST SAVINGS

In 2017/2018, total utility cost savings of \$2.98 million resulted from the implementation of energy reduction efforts and CARF projects.

Figure 12: GHG REDUCTIONS TRENDS FROM CARF INITIATIVES





RENEWABLE ENERGY

BIOMASS



BIOMASS IN INUVIK

INUVIK HOSPITAL

A 1250kW wood pellet boiler will be installed at the Inuvik Hospital. It is the GNWT's second biomass installation in the Beaufort Delta, and the largest in Inuvik. The boiler will offset 479,600 litres of fuel or the equivalent of 1,300 tonnes of CO₂ annually and provide savings of approximately \$680,000 annually. Construction will take place late 2018.

EAST THREE SCHOOL (INUVIK)

The East Three School is the first GNWT Asset in the Beaufort Delta to install Biomass. A 950kW wood pellet boiler was installed and operational as of March 2018. Designed to handle 80% of the school's heating load, the boiler will offset 269,750 litres of propane or the equivalent of 410 Tonnes of CO₂ and \$366,850 in savings annually.

WOMEN'S CORRECTIONAL CENTRE (FORT SMITH)

Construction is currently underway to retrofit the Women's Correctional Centre in Fort Smith to add 100% biomass heating, LED lighting, and high insulation values. This building will exceed the 2015 National Energy Code for Buildings (NECB) by more than 10%.



SOLAR

NORMAN WELLS 10-KILOWATT SOLAR GNWT SHOP

As part of this year's construction project, a 10-kilowatt array was added to the INF Shop in Norman Wells. As Department of Infrastructure owns this asset, the project was funded by CARF as a contract change to increase the building's energy efficiency.



Solar array installed on the roof of the Department of Infrastructure Shop in Norman Wells.

Colville Lake

From April 2017 to March 2018

20.3% of the community's power generation provided by solar energy and the battery energy storage system

53% of the community's power generation was provided by solar energy and the battery energy storage system in July 2017

134,441 kWh of diesel-generated electricity was displaced

38,337 litres of diesel fuel was displaced

Diesel generators operated at least **27% less** than in a standard diesel plant



HYDRO

TALTSON – A VISION FOR CLEAN GROWTH

Taltson expansion is an opportunity to foster a clean growth economy by connecting hydro investments that were first made more than 75 years ago. It will improve the NWT’s climate change resilience and provide green power needed to support the next phase of resource development—in ways that are environmentally sustainable and economically transformative.



- 1

Connect legacy hydro to add green capacity.
- 2

Partner to provide clean energy to the resource economy.
- 3

Build an inter-tie to connect the North with southern Canada.



TALTSON HYDROELECTRICITY

The Taltson project was included in the Western Regional Electricity Cooperation and Strategic Infrastructure (RECSI) Study. RECSI is a federal, provincial territorial initiative, funded by NRCan to evaluate and rank the most promising electricity infrastructure projects in Western Canada that would assist the region, particularly Alberta and Saskatchewan to transition to a lower carbon electricity generation portfolio.

The Department of Infrastructure's research into a submarine cable and High Voltage Direct Current (DC) (HVDC) transmission hold early promise to bring estimated interconnection

costs down while eliminating other technical issues associated with long transmission lines. This work is in very early stages, and requires a significant amount of technical work to provide more certainty around project costs. The GNWT is submitting a proposal to the Federal Government to examine emerging technologies, technical viability, transmission line alignment, capital costs and project partners that could lead to a regulatory application. Engagement with indigenous partners will be a key part of this work as well.

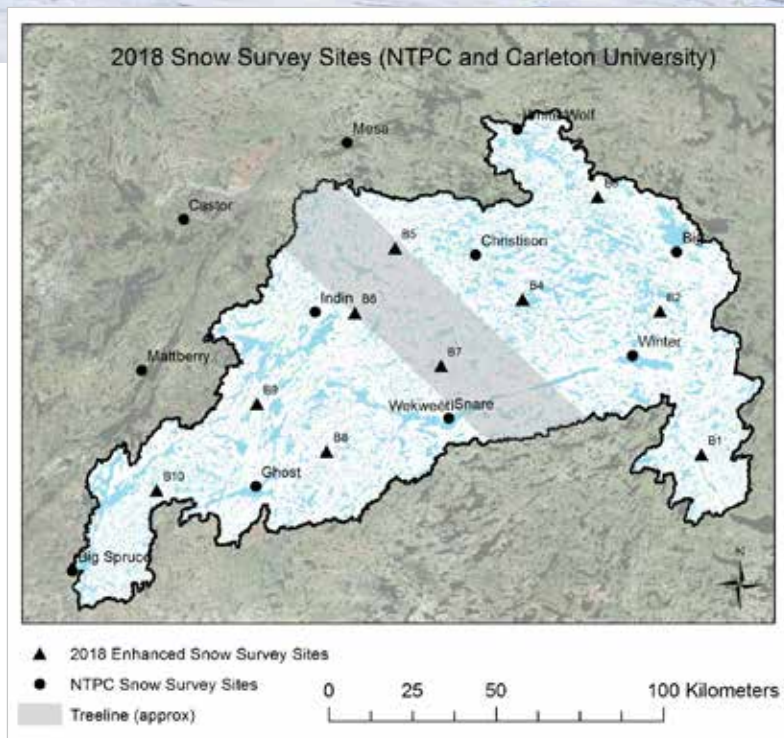


STUDYING SNOW DISTRIBUTION IN THE SNARE BASIN

The Northwest Territories Power Corporation uses a snow water equivalent (SWE) model to forecast water flows. In March 2018, researchers from Carleton University and Wilfrid Laurier University conducted enhanced snow surveys in parallel with the annual NTPC surveys to improve SWE estimates in the Snare River watershed. A twin otter (NTPC), helicopter (Carleton University) and skidoos (Laurier University and Wekweètì residents) were used to access survey sites.

Carleton University researchers used this data to test NTPC's snow survey methodology and to provide recommendations for reducing error in SWE estimates required for flow forecasting. The ground-based SWE work is also being used by Laurier researchers to test satellite-based SWE studies.

Carleton University researchers, NTPC and GNWT Water Resources staff visited 20 sites across the Snare River basin (see map), including 10 regularly surveyed locations and 10 new locations added in 2017.



More than 4000 snow depth measurements and 100 SWE measurements were obtained, capturing broad-scale differences in snow accumulation among lakes, wetlands and uplands. Laurier University researchers conducted more detailed surveys in collaboration with Wekweètì residents. The results of both projects will be combined to better understand optimal snow survey design.



Participants at Traditional Knowledge Workshop in Inuvik.

WIND

In 2017/18, INF funded wind-monitoring studies in Inuvik, Sachs Harbour and Norman Wells.

INUVIK WIND

The GNWT is completing a detailed feasibility study for the Inuvik High Point site that will include detailed cost estimates, engineering, geotechnical work, turbine selection, procurement options and environmental baseline data collection. The Inuvik wind project could displace up to 3 million liters of diesel fuel annually and could reduce greenhouse gas emissions by 4 to 7 thousand tonnes annually. The project will require both federal and GNWT funding to be economically feasible without impacting electricity rates in the thermal zone. The project is located within the Gwich'in Settlement Region and the GNWT has engaged extensively with the Gwich'in Tribal Council and other Indigenous governments and stakeholders in Inuvik. The GNWT also held a Traditional Knowledge and land use workshop on March 7-8, 2018 that included Gwich'in and Inuvialuit elders, land users and youth.

The workshop provided valuable information on how people use the area for trapping, hunting, berry picking and other traditional uses.

Next steps for the Inuvik Wind Project include:

- The GNWT will continue to work with the federal government to confirm levels of funding for the project. It is anticipated that this decision will be finalized in the Fall of 2018.
- Complete all parts of the detailed feasibility study, including geotechnical field work.
- Complete environmental baseline programs in the summer/fall of 2018.
- Continue to engage with the Gwich'in Tribal Council.

Government of
Northwest Territories

INUVIK WIND

Exploring Wind Energy in the Beaufort Delta



North

Inuvik

All season road

Airport



- Easily controlled to meet electricity demands.
- Fast response time.
- Considered very reliable for generation.
- Large amounts of fuel can be stored easily.



- Greenhouse gas emissions.
- Requires ongoing cost for imported fuel.
- Local noise and pollution.

Diesel Generators





- No cost for fuel.
- No emissions.
- Available year round.



- Cannot control wind for timing or power.
- Cannot store wind for later use (unless batteries are used)
- Up-front costs are high.

Wind Turbines



Strategically located to minimize noise for residents.

Noise

- Conduct engagement sessions to gain local approval.
- Avoid sites with any known cultural significance.
- Avoid blocking access to any site with known cultural significance.

Cultural



- Turbines have been known to impact birds.
- Will do study to understand and minimize impacts.
- Baseline environmental studies will be completed.

Wildlife



There are strict guidelines on all tall structures around airports. The tower cannot be located on either end of the runway, unless more than 4km away. Due to proximity to runway and height restrictions, towers need to be provided with lighting.

Air Traffic

High Point



Inuvik wind is a local source of renewable energy that can help the Northwest Territories transition to a lower carbon economy.



- A wind project at the High Point site would:
- Diversify Inuvik's electricity system.
 - Displace up to three (3) million litres of diesel fuel annually (approximately 30% of Inuvik's total diesel usage to generate electricity).
 - Reduce greenhouse gas (GHG) emissions by up to 3,800 tonnes per year.



Wind speed at the High Point site is 6.81 metres per second at 74 metres above ground level (hub height).



Topography is relatively flat with a gradual downslope from the proposed site to the highway. Some rock outcrops are in the area. The site is in the zone of continuous permafrost.

For more information visit NWTEnergy.ca



SACHS HARBOUR – REMOTE HYBRID RENEWABLE ENERGY SYSTEM

Recent advances in cold weather wind turbine technology along with NTPC's scheduled plan to replace the Sachs Harbour power plant in 2019 prompted efforts to better quantify the local wind resource and examine the integration of a wind turbine into the community's diesel grid. Following an INF-funded study, the community's leadership approved a nearby site to erect a meteorological tower and a future wind farm.

In March 2018, contractors installed a 30-meter wind monitoring tower with heated sensors. A new remote hybrid renewable energy system—being used for the first time—will power the tower. The system uses solar panels, small wind turbines and a diesel generator to charge batteries throughout the year, providing heat to the sensors and lighting for the top of the tower.

NORMAN WELLS WIND POTENTIAL

Norman Wells' reliance on diesel fuel coupled with improvements in wind technology prompted the GNWT to explore wind as an alternative energy source for the community. Local wind speeds were mapped, and combined with observations made by helicopter (funded by the Norman Wells Land Corporation) to determine the most beneficial size and preferred location for a wind project. The best location is expected to be along the Mackenzie River where the wind is channeled by the shape of the valley. A Met Tower has been purchased, with installation planned for 2018. The Northern REACHE program provided funds for the wind study and tower purchase this year.

ENERGY POLICY

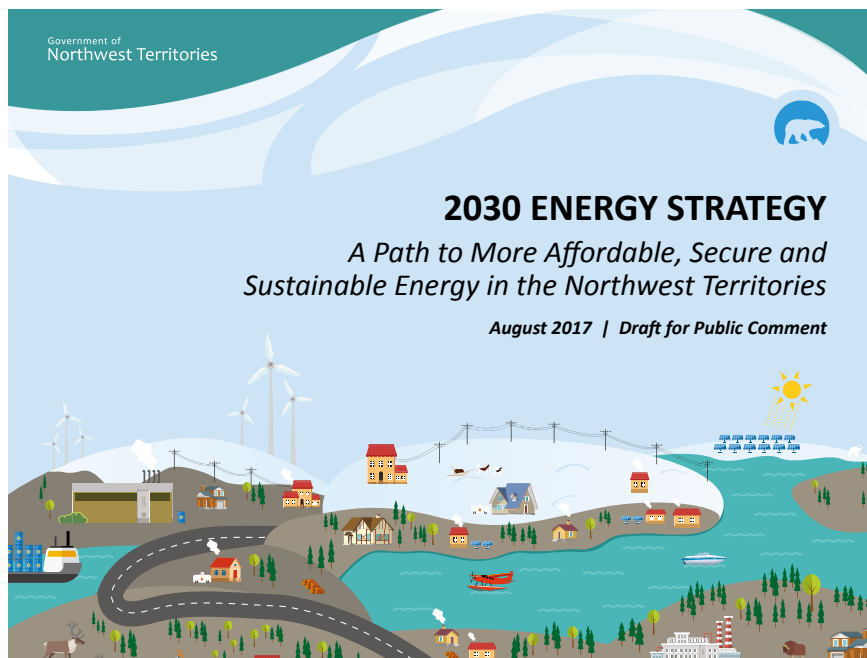
2030 ENERGY STRATEGY

In 2017, GNWT developed the 2030 Energy Strategy to establish the principles to guide the short and long term approach to energy in the NWT. The strategy focuses on affordability, reliability and environment impact of energy and sets greenhouse gas reductions targets for the electricity, heating, and transportation sectors. A draft strategy was released in September 2017 and received comments from Indigenous governments, Community Organizations, Non-government organizations, Industry and the public.

The Strategy identifies six strategic objectives to move towards a lower carbon economy:

1. Work together to find solutions: community engagement, participation and empowerment.
2. Reduce GHG emissions from electricity generation in diesel powered communities by an average of 25%.
3. Reduce GHG emissions from road vehicles by 10% on a per person basis.
4. Increase the share of renewable energy used for space heating to 40%.
5. Increase residential, commercial, and government building energy efficiency by 15%.
6. A longer term vision: develop the NWT's energy potential, address industry emissions, and do our part to meet national climate change objectives.

Addressing climate change is critical, and the strategy promotes energy efficiency and using renewable and alternative energy sources to reduce dependence on fossil fuels. The strategy, along with the Climate Change Strategic Framework, will guide the NWT as we do our part to help meet national greenhouse gas reduction commitments under the Paris Accord and the Pan-Canadian Framework on Clean Growth and Climate Change.



Northern Energy

SUPPLEMENTARY TEACHING MATERIALS

LESSON PLANS FOR EXPERIENTIAL SCIENCE 10, 20, 30



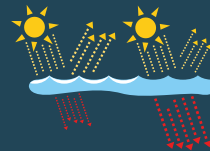
Northern Energy



Renewable Energy



**Wind Power
and Your Community**



**The Albedo Effect
and Feedback Loops**



**Renewable Energy
and GHG Mitigation**



**Calculating Your
Travel GHG's**

SUPPLEMENTARY TEACHING MATERIALS

In support of the 2030 Energy Strategy, supplemental teaching materials were developed for the Northwest Territories Experiential Science Curriculum at the 10, 20 and 30 levels (high school). Six lesson plans were produced, each one designed to help students and teachers become more familiar with energy issues in the North.

Themes addressed in the lesson plans include the effects of energy use on the Earth's climate system, how electricity and heat are currently

produced in the NWT, how renewable energy technologies can reduce our greenhouse gas (GHG) emissions, and how students can calculate their travel emissions and compare them to other types of transportation in the NWT.

The supplemental teaching materials will be available to NWT teachers in the fall of 2018, and will also be hosted on the INF and Arctic Energy Alliance websites.

A LOOK AHEAD

2030 ENERGY STRATEGY – THREE-YEAR ACTION PLAN

The GNWT is currently developing a multi-year energy action plan to implement the Strategy. The plan will include actions and initiatives to meet the six strategic objectives of the Strategy. The Action Plan will be released concurrent with the Energy Strategy in the summer of 2018.

The GNWT, including its partners the federal government, NWT Housing Corporation (NTWHC), the Arctic Energy Alliance (AEA), the NWT Power Corporation (NTPC), as well as residents, business, communities, and industry will make significant investments to implement the 2030 Energy Strategy.

INUVIK WIND

The GNWT will continue to work with the federal government to confirm levels of funding for the Inuvik Wind Project, as well as complete all parts of the detailed feasibility study, geotechnical field work, environmental baseline programs and regulatory processes in the summer/fall of 2018. INF will continue to engage with, and plan to begin road construction in the winter of 2019. The wind turbine could then be installed the following year. INF will continue to engage with key indigenous groups and interest groups in the Beaufort Delta.

INFRASTRUCTURE CANADA AGREEMENTS

In March 2018, the GNWT and Infrastructure Canada signed the Integrated Bilateral Agreement for federal infrastructure funds under the Investing in Canada Plan. The federal government's contribution will provide over \$570 million to the GNWT over the next 10 years under various funding streams of the Investing in Canada Plan. With \$190 million being contributed by the NWT, nearly \$760 million in infrastructure funding in the North will be leveraged through the Agreement. Approximately \$343 million will be available for approved energy projects over those ten years, including approximately \$178 million for initiatives in the *2018 – 2021 Energy Action Plan*.

LOW CARBON ECONOMY LEADERSHIP FUND (LSELF)

The GNWT is applying for up to \$32 million in federal funding under Environment and Climate Change Canada's Low Carbon Economy Leadership Fund. This funding will be invested in community renewable energy projects across the territory, as well as in commercial and industrial projects that lower greenhouse gas emissions. Funding will also bolster programs administered by the Arctic Energy Alliance, support energy upgrades to public housing, and retrofits to our marine fleet that will improve energy efficiency.

APPENDIX A – ARCTIC ENERGY ALLIANCE (AEA)

PROGRAM RESULTS¹

Alternative Energy Technologies Program				
Metric	Commercial	Residential	Community-based	Total
Number of Rebates and Technology Type	2 biomass boilers	1 biomass boiler	3 solar PV	3 biomass boilers
	3 solar PV	22 solar PV	3 total	28 solar PV
	1 other (combination rebate)	1 wind		1 wind
	6 total	24 total		1 other (combination rebate)
				33 total
Communities Receiving Rebates	Fort Smith – 1 Yellowknife and area – 2 Remote locations – 3	Hay River – 1 Inuvik – 1 Yellowknife and area – 22	Inuvik – 1 Tuktoyaktuk – 1 Yellowknife and area – 1	Fort Smith – 1 Hay River – 1 Inuvik – 2 Remote locations – 3 Tuktoyaktuk – 1 Yellowknife and area – 25
Total Rebate Amount	\$55,144	\$80,425	\$57,500	\$193,069

¹Please note that the numbers associated with these results are preliminary, calculated as of April 30, 2018. Although the AEA's fiscal year ends on March 31, in some cases rebates for a given fiscal year may be processed until late summer.

Energy Efficiency Incentive Program		
Region	Number of Rebates	Rebate Amount (\$)
North Slave	361	\$129,731
South Slave	84	\$45,418
Beaufort-Delta	52	\$19,634
Dehcho	21	\$13,433
Tłı̨chǫ	17	\$4,827
Sahtu	7	\$3,485
Point-of-sale LED rebates ²	240	\$2,968
Other	20	\$11,801
Total	802	\$231,297

Commercial Energy Conservation and Efficiency Program	
Metric	Totals
Number of Rebates	21
Rebate Amount	\$126,964
Estimated Annual Energy Savings	\$197,663
Avoided Annual Greenhouse Gas Emissions	118 tonnes
Estimated Simple Payback	2.2 years

Community Government Building Energy Retrofit Program	
Metric	Totals
Building Audits	51 (22 yardstick audits in 4 communities and 29 targeted audits in 5 communities)
Number of Rebates	7
Rebate Amount	\$94,000
Estimated Annual Energy Savings	\$124,000
Avoided Annual Greenhouse Gas Emissions	105 tonnes
Estimated Simple Payback	1.6 years

²Rebates for LED light bulbs as part of a point-of-sale rebate partnership with the North West Company (at Northern and North Mart stores) in communities not using hydroelectricity; not broken down by region.

APPENDIX B – ENERGY EFFICIENCY

FACILITY	LOCATION	DETAILS
Headquarters Various	Yellowknife	Biomass Boiler Optimizations
Headquarters Various	Yellowknife	18/19 Design Services /Auditing
North Slave	Various	O&M Lighting Retrofits
Yellowknife Airport Terminal	Yellowknife	HVAC Controls Upgrades/Optimization for Biomass Boiler
Inuvik Region Various	Inuvik Region	O&M Lighting Retrofits
Chief T'Selehye School	Fort Good Hope	Energy Retrofit based on 15/16 audit
Chief Albert Wright School	Tulita	Energy Retrofit based on 15/16 audit
Angik School	Paulatuk	Energy Retrofit
Inualthuyak School	Sachs Harbour	Energy Retrofit (with deferred maintenance)
Nursing Station	Aklavik	Energy Retrofit
Mangilaluk School	Tuktoyaktuk	Lighting Upgrade and other HVAC upgrades in conjunction with mid-life retrofit
South Slave Various Upgrades	South Slave	O&M Lighting Upgrades
Woodland Manner	Hay River	Upgrades to Woodland Manner in Connection to Biomass
Paul William Kaeser Highschool	Fort Smith	Heat Plant Optimization
Trout Lake School	Trout Lake	Mid-Life Retrofit (HVAC Upgrades, Controls, Lighting)
Various Facilities	Fort Simpson	O&M Lighting Retrofits
Diamond Jenness School	Hay River	Mid-Life Retrofit (HVAC, Lighting, Envelope)
Chief Julius School Waste Heat	Fort McPherson	Residual Heat from NTPC
Echo Dene School Waste Heat	Fort Liard	Residual Heat from NTPC
Mezi School Waste Heat	Whatì	Residual Heat from NTPC
North Slave Regional Office	Yellowknife	HVAC Upgrades
Central Warehouse	Yellowknife	Boiler Upgrades
Steam Heating Plant Upgrades	Fort Simpson	Boiler Replacement
Northern Lights Extended Care	Fort Smith	405 kW ACME Electric Boiler
DOT Maintenance Garage	Fort Smith	400 kW Electric Boiler
Joseph Burr Tyrrell Elementary & Breynat Hall	Fort Smith	800 kW Electric Boiler
Mangilaluk School	Tuktoyuktuk	High Bay LED
Chief Julius School	Fort McPherson	High Bay LED

APPENDIX C – COMPLETED BIOMASS BOILERS

FACILITY	LOCATION	DATE COMPLETED	SIZE (KW)
East Three School	Inuvik	March 2018	950
School	Tulita	March 2017	150
School	Fort Good Hope	March 2017	200
Prince of Wales Northern Heritage Centre	Yellowknife	March 2016	300
Airport Terminal Building	Yellowknife	November 2015	400
Health Centre	Hay River	November 2015	1,200
South Mackenzie Correction Centre	Hay River	October 2015	212
Deninu School	Fort Resolution	October 2015	200
Health Centre	Fort Providence	July 2015	75
GNWT Office Building	Yellowknife	December 2014	650
Combined Services Building	Norman Wells	October 2014	212
Mackenzie Mountain School	Norman Wells	October 2014	212
Airport Terminal Building	Norman Wells	October 2014	159
*Health Centre	Fort McPherson	September 2014	
*Behchok̄ Longterm Care Facility	Behchok̄	March 2013	540
Deh Gah School	Fort Providence	March 2013	300
Combined Services Building	Yellowknife	October 2012	540
Central Heating Plant	Fort Simpson	October 2012	823
Elizabeth Mackenzie School	Behchok̄	October 2012	540
St. Josephs Secondary School	Yellowknife	November 2011	540
Health Centre	Fort Smith	November 2011	750
Central Heating Plant	Hay River	November 2010	900
Thebacha College	Fort Smith	November 2010	750
Legislative Assembly Building	Yellowknife	October 2010	300
Highways Maintenance Garage	Hay River	October 2010	300
Paul William Kaeser School & Recreation Complex	Fort Smith	October 2010	750
Chief Jimmy Bruneau	Behchok̄	October 2009	750
Kalemi Dene School	N'Dilo	September 2009	69
*Sir John Franklin	Yellowknife	June 2005	750
*North Slave Correctional Facility	Yellowknife	November 2006	1,500

(*) purchased biomass heat for these facilities from a third party.

APPENDIX D – UTILITY-SCALE SOLAR PROJECTS

COMMUNITY	BUILDING	YEAR OF INSTALLATION	CAPACITY INSTALLED ON THIS SITE OR BUILDING (kW)	GNWT Contribution (\$)	OWNER
Inuvik - Housing Corporation	17-Unit Apartment Complex	2017	20	\$180,000	Territorial Government
Aklavik-NTPC	Ground Mount	2017	50	\$420,000	Utility
Inuvik	ARI	2017	25	\$200,000	Territorial Government
Inuvik	INF Building	2017	20	\$320,000	Territorial Government
Wrigley-NTPC	Ground Mount @ NTPC	2016	10	\$160,000	Utility
Fort Liard-NTPC	Ground Mount @ Airport	2016	39	\$300,000	Utility
Colville Lake-NTPC	Utility Solar-Diesel Hybrid (High penetration)	2015	136	\$1,150,000	Utility
Łutsel K'e	Ground Mount (IPP)	2014	33	\$100,000 (GNWT Contribution)	Local Government
Hay River-Housing Corp	Whispering Willows Senior's Centre	2014	60	\$250,000	Territorial Government
Fort Simpson-NTPC	Ground Mount @ Airport	2010, 2012 Expansion	104	\$1,070,000	Utility