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PUBLIC WORKS AND SERVICES
GOVERNMENT OF THE NORTHWEST TERRITORIES

ENERGY CONSERVATION INITIATIVES REPORT

2015-2016

Government of
Northwest Territories

Kīspin ki nitawihtīn ā nīhīyawihk ōma ācimōwin, tipwēsinēn.

Cree

ʔerihtł’ís dëne súłiné yati t’a huts’elkër xa beyéyati theʔą ʔat’e, nuwe ts’ën yółti.

Chipewyan

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

English

Si vous voulez ces renseignements en français, contactez-nous.

Français

Jii gwandak izhii ginjìk vat’atr’ijąhch’uu zhìt yinohthan jì’, diits’àt ginohknìi.

Gwich’in

Hapkua titiqqat pijumagupkit Inuinnaqtun, uvaptinnut hivajarlutit.

Inuinnaqtun

ᑕᒃᔪᐊ ᑎᑎᖅᑲᕐ ᐱᓕᒍᐱᑦ ᐃᓄᒃᑎᑕᖅᓯᒪᓕᑎᒃ, ᐅᐸᑦᑎᓐᓄᕐ ᐅᖅᑲᓕ ᓴᓐᓂᑐᑎᑦ.

Inuktitut

UVANITTUAQ ILITCHURISUKUPKU INUVIALUKTUN, QUQUAQLUTA.

Inuvialuktun

K’éhshó got’ı̨ne xədə k’é hederi ʔedı̨htl’é yeriniwę nídé dúle.

North Slavey

Edi gondı dehgéh got’ı̨e zhatié k’ę́ę́ edatł’éh enahddhę nide.

South Slavey

Tłı̨chǫ yati k’ èè dè wegodìı wek’èhoı̨zǫ nę̀ę̀wǫ dè, gots’ǫ̀ goahde.

Tłı̨chǫ

1-855-846-9601

MINISTER'S MESSAGE

In the NWT, energy needs are driven by a relatively small and widely dispersed population. In many regions we lack the public infrastructure that much of Canada enjoys; the network of roads and transmission lines that spread costs and provide opportunities for more affordable energy. As a result, energy costs are a substantial component of the cost of living for residents, and of the operating budgets for governments, communities and businesses.

The challenges of northern life also bring opportunity. The Department of Public Works and Services (PWS) operates and maintains over 800 building assets within our 33 communities and plays a leadership role in energy conservation and efficiency. In 2015-2016, 26 energy efficiency projects reduced our GNWT wide electricity and heating consumption by 4% and 8% respectively. In addition to direct investment in our assets, the Arctic Energy Alliance administered over $3 million in energy efficiency programs for the general public to reduce energy use and to increase renewable energy production, one building at a time.

Renewable energy is a growing proportion of our energy mix. Biomass boilers accounted for 18% of GNWT heating needs and will grow to 24% by the end of the year. Hydropower is the single largest source of renewable energy in the NWT. The North Slave Resiliency Study confirmed that our hydro system typically has surplus renewable energy but that we need to invest in aging infrastructure, enhance water monitoring and plan for low water events. In the 25 communities of our thermal zone, solar power systems are being successfully installed across the north, most recently in Wrigley and Fort Liard. Although not yet economic in the north, solar is proven technology that can displace diesel while inviting northerners to engage in a discussion about our energy situation.

We are also learning through innovation by adapting proven technologies to work in a northern context. The first hybrid solar diesel plant in Canada is regularly silencing the diesel plant in Colville Lake. Cleaner burning natural gas is displacing diesel in Inuvik and has achieved $1.7 million in savings thanks to the northernmost liquefied natural gas (LNG) storage facility in Canada.

For 2016/17 we will see more northern innovation along with a continued focus on energy conservation investments in projects across the north such as LED lighting, building retrofits, biomass and solar. A variable speed generator will be tested in Aklavik to improve plant efficiency. Work will also commence on the feasibility of LNG in Tuktoyaktuk and megawatt scale wind in Inuvik. Community engagement on a new energy plan and climate change framework will get underway later this year with a view to releasing new strategies in 2017.

While cost of living and sustainability issues cannot be addressed overnight, I am looking forward to building on work completed to date. I am pleased to present the *2015/16 PWS Energy Conservation Initiatives Report*.

The Honourable Caroline Cochrane
Minister of Public Works and Services

CONTENTS

EXECUTIVE SUMMARY

Energy conservation and efficiency remained a core focus for the Department of Public Works and Services (PWS) in 2015/16. This sixth edition of the *PWS Energy Conservation Initiatives Report* includes highlights for the GNWT's energy programs and activities over the past year.

Highlights from completed energy related activities in 2015/2016 include:

- 26 energy efficiency projects on various GNWT facilities
- A reduction of 8,847 tonnes of GHG emissions from energy investments in GNWT assets, representing a 20% reduction in annual emissions
- Electricity and heating fuel consumption was reduced by 4% and 8% respectively
- LED streetlight conversions in 8 more NWT communities
- 6 new biomass boiler installations, bringing the total number to 28 GNWT wide
- 69 kilowatts (kW) of new solar in Wrigley and Fort Liard, raising the total to 695 kW of local connected solar in the NWT
- The 136 kW Colville Lake hybrid solar and battery project, the first of its kind in Canada, will test the benefits of integrating lithium batteries and large scale solar in a remote diesel community
- Liquefied Natural Gas (LNG) supply resulted in fuel savings worth $664,000 in 2015/16 and a total of $1.7 Million since the project started in February 2014
- Annual greenhouse gas emission reductions of 2,257 tonnes from LNG displacing diesel in Inuvik

A number of other initiatives were undertaken to address specific energy issues that emerged. In response to the low water levels on the Snare hydroelectric system, PWS worked with hydro experts to investigate system resiliency and low water management options. The North Slave Resiliency Report made a number of recommendations that the GNWT has adopted.

Looking ahead to the coming year, $3.8 Million will be directed to energy retrofits and alternative energy projects including LED lighting, building retrofits, biomass and solar across the GNWT. Five biomass boilers are included in new construction projects across the NWT including the Stanton Territorial Hospital, which is well underway. Effective envelope design, ventilation heat recovery, efficient lighting, use of day lighting and operation and maintenance standards are all included in the new facility which will serve the entire NWT.

In terms of emerging technologies, a variable speed generator to improve diesel efficiency and integrate higher levels of solar energy in remote diesel communities will be tested in Aklavik. The feasibility of LNG to displace diesel power generation will be investigated in Tuktoyaktuk. Planing, design and feasibility work will continue for a proposed wind project in Inuvik.

On the policy and communications side, a new Energy Plan will be developed in conjunction with a NWT Climate Change Framework. Public engagement on the development of both the Energy Plan and Climate Change Framework will commence in the fall of 2016.

INTRODUCTION

The NWT is home to 44,291 people spread across 33 communities and a vast land area of 1.35 million square kilometres. Public infrastructure such as roads and transmission lines to connect communities are limited. Fossil fuels remain the primary source of energy for power, heating and transportation, in our remote communities.

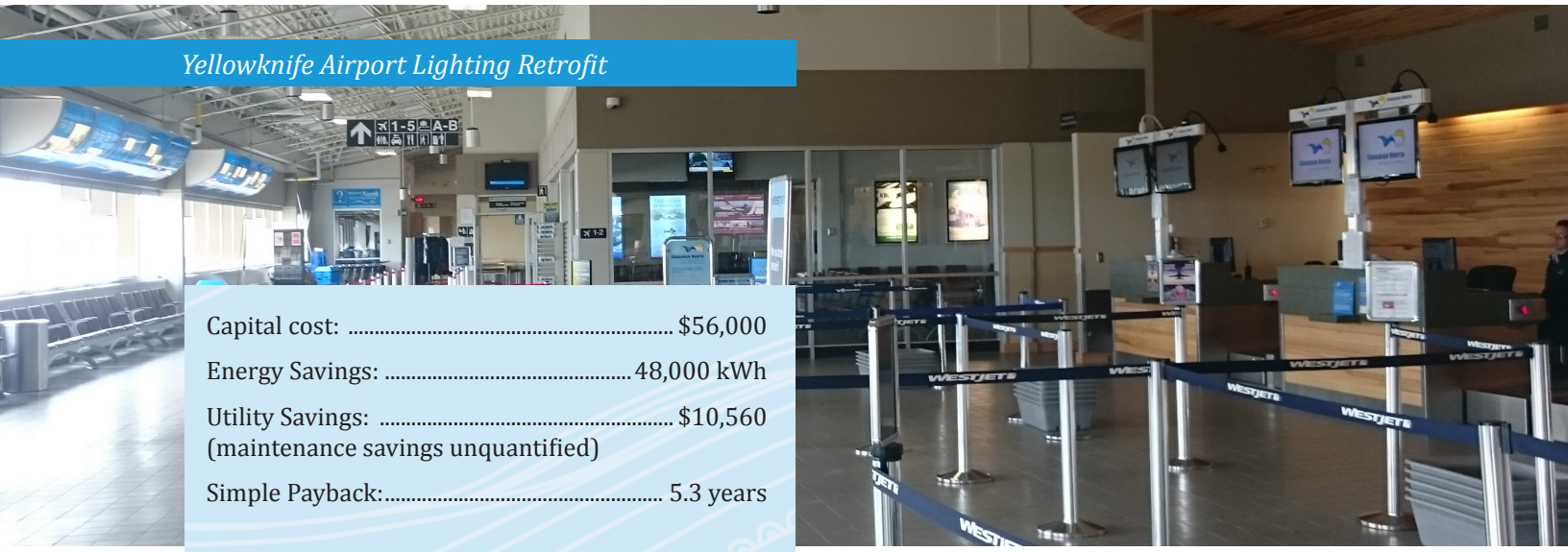
Effective April 1, 2015, GNWT energy functions were consolidated within the Department of Public Works and Services. PWS now funds the Arctic Energy Alliance to support communities and residents in managing their own energy use and leads in the investigation and development of alternative energy solutions across the NWT. This ensures a coherent and territory-wide approach to the energy challenges we face.

Energy in the NWT is expensive. Substantial financial and human resources are needed to materially improve the energy situation in the NWT. However, residents, businesses, communities and governments can make effective choices that will help to improve our energy situation over time.

Energy conservation and efficiency investments have proven to be a cost effective option to reduce energy consumption and the environmental impact of our energy use. Emerging renewable energy technologies continue to make inroads and are a small but growing proportion of our energy portfolio.

This Energy Report provides a high level review of the current energy situation in the NWT, and highlights the key energy activities undertaken by the GNWT. Activities include leading by example to reduce our energy use, and funding programs and services that support communities and residents to reduce their energy use. As well, a summary of the results of key strategic investments in renewable and alternative energy technologies is provided, along with highlights of work to be done in the coming year.

Yellowknife Airport Lighting Retrofit



Capital cost: $56,000

Energy Savings: ..... 48,000 kWh

Utility Savings: $10,560
(maintenance savings unquantified)

Simple Payback:..... 5.3 years

In 2015/2016, PWS replaced the existing 400W metal halide fixtures in the Yellowknife Airport Terminal Building. In addition to the maintenance savings from the longer life (75,000+ hours) of these LED fixtures, the power requirements have been reduced by half. Further savings will be realized through the summer and shoulder months as daylight sensors have been utilized to dim these fixtures, while still maintaining a minimum level of lumination.

ENERGY IN THE NORTHWEST TERRITORIES

The resource development sector accounted for over 50% of energy use in the territory in 2014. Mining developments created significant variability in total NWT energy use over the last 10 years. Commercial, Institutional and public sector energy use has been trending downward.

In the NWT, our challenge is to provide reliable, affordable and environmentally friendly energy options for our communities. The vast distances between communities adds to the cost of transportation of goods, and adversely affects the cost of living. The lack of all-season road access to many communities makes air travel a significant factor in the high proportion of transportation related energy use.

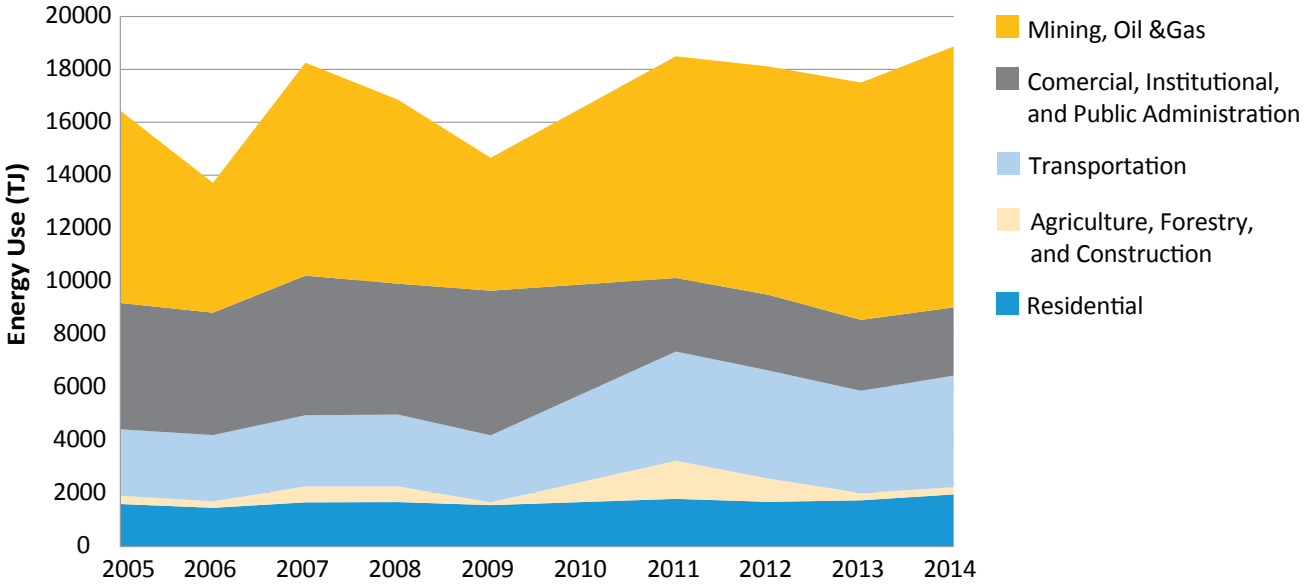


Figure 1 – Total Energy Use Trend by Sector in the NWT

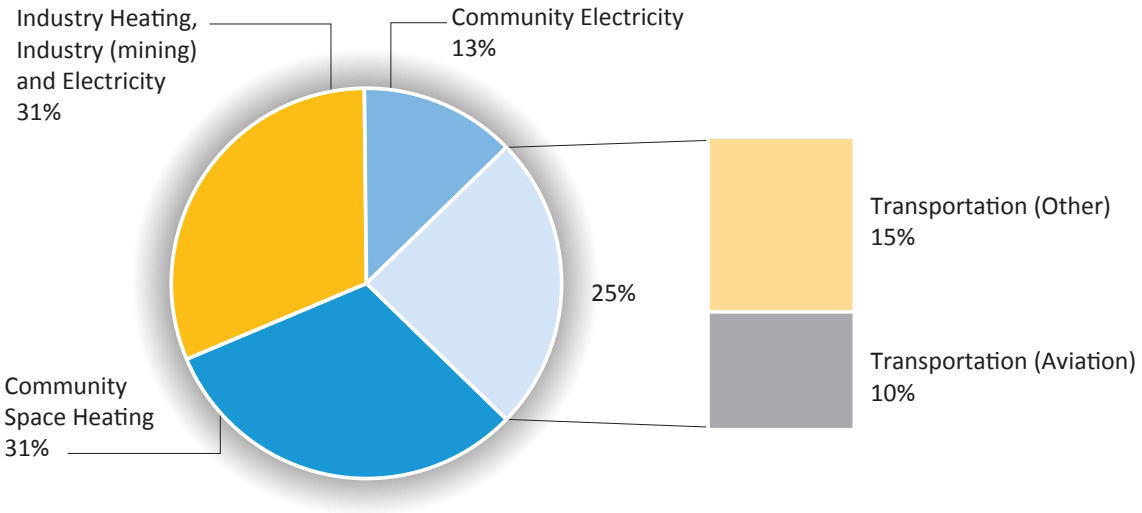


Figure 2 – 2015 Energy Use by Sector

POWER GENERATION

The NWT's electrical system is remote and is not connected to the North American electrical grid. Of 33 communities in the NWT, 23 rely on diesel and 2 rely on natural gas for power generation. In the southern NWT, hydropower is the main source of electricity. The 30 megawatt (MW) Snare Hydro System that serves the communities of Yellowknife, Behchokǫ̀, Dettah and N'Dilo, was built through a partnership between the federal government and the gold mining industry of the 1940's. The 18 MW Taltson Hydro facility, built in the 1960's, relied on a partnership between the Cominco Mine and the federal government to serve the Town of Pine Point and surrounding communities. These critical hydro systems remain in place today.

In a typical year, hydro power accounts for about 75% of the total electrical energy consumed in communities across the NWT, all combined. 2014/15 was not a typical year, as low water levels in the Snare Hydro system and repairs to the Snare Falls 7 MW turbine required a heavy reliance on diesel fuel. The turbine is expected to be back in normal operation in 2016/17.

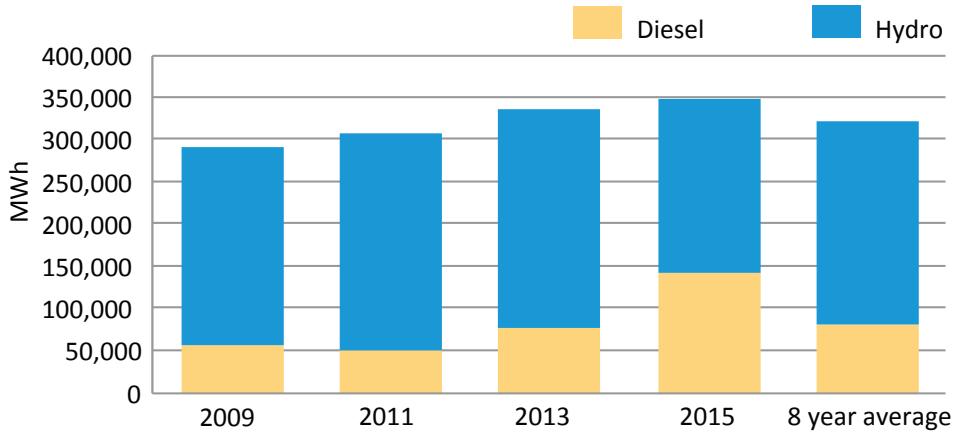


Figure 3 – Electricity Generated by Energy Source

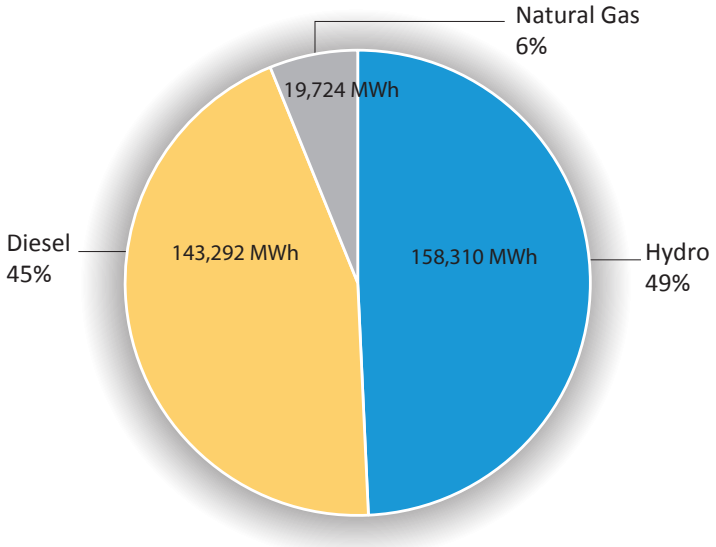


Figure 4 – 2014/2015 Electricity Generated by Energy Source in NWT Communities

NWT HEATING

Heating oil is the main energy source for space heating in the NWT. Heating typically accounts for the highest proportion of energy use in communities. The proportion of energy used in 16 remote NWT communities for transportation, power generation and heating is presented in Figure 5. PWS Fuel Services Division (FSD) manages the purchase, transport and storage of petroleum products in communities that are not served by the private sector.

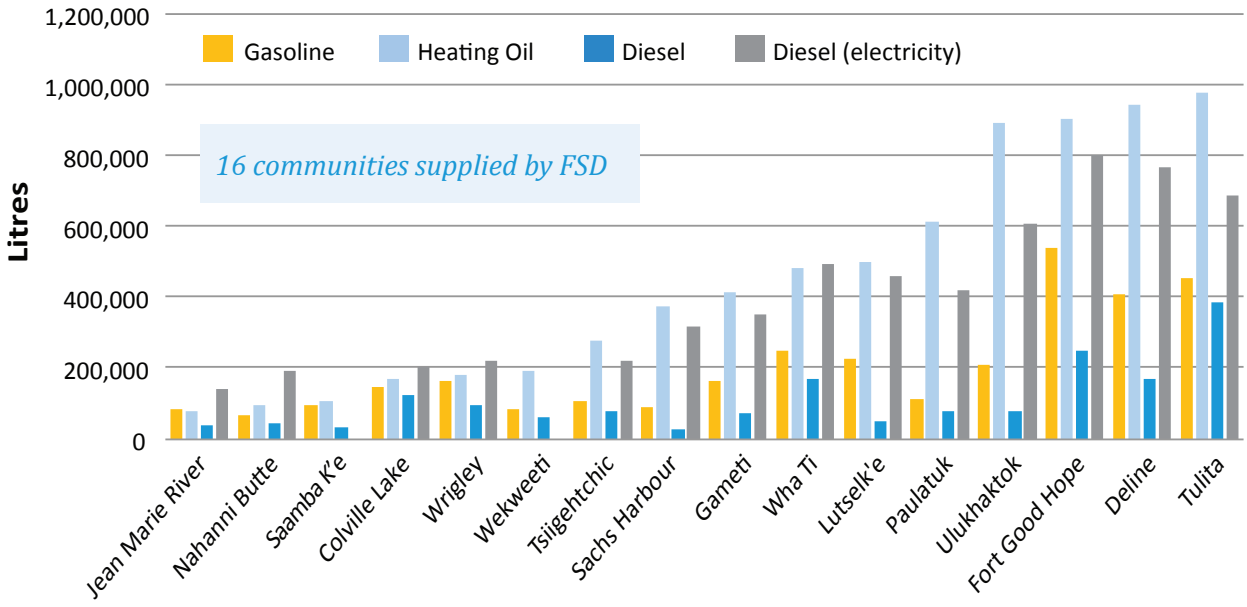


Figure 5 – 2015 Community Fuel Use by Type in 16 Fuel Services Communities

ENERGY CONSERVATION AND EFFICIENCY

The GNWT devotes a significant portion of annual energy investments on improving energy efficiency. Investments in energy efficiency and conservation measures, such as building envelope improvements, heating appliances and lighting upgrades have produced significant operational savings for residents, communities and government.

Northwest Territories Power Corporation

LIGHT-EMITTING DIODE (LED) STREETLIGHT CONVERSION PROJECT

The Northwest Territories Power Corporation (NTPC) completed a LED streetlight conversion project through a $400,000 contribution agreement from PWS. The project converted all remaining high pressure sodium (HPS) streetlights within NTPC communities to LED streetlights, except for Fort Smith. Fort Smith will be completed over the next two years. LED's are 40-80% more efficient than traditional high pressure sodium (HPS) street lights, and last 5 times longer. LED streetlights were installed in the following communities in 2015/16:

Fort Liard
Nahanni Butte
Ulukhaktok
Sachs Harbour
Aklavik
Tsiigehtchic
Wrigley
Fort McPherson

NTPC LED Street Light Conversions

Arctic Energy Alliance Programs

The Arctic Energy Alliance (AEA) is the lead not-for-profit organization helping communities, consumers, producers, regulators and policymakers to work together to reduce the cost and environmental impacts of energy usage in the Northwest Territories (NWT). This year marks 19 years of service to the residents of the NWT.

With a budget of $3,142,500 in 2015-16, AEA delivered its energy programs on behalf of the GNWT. Highlights from four of AEA's most popular programs are summarized below.

1. The **Energy Efficiency Incentive Program (EEIP)** is a rebate program designed to assist homeowners and consumers in the purchase of new, more efficient models of products such as fridges, washers and dryers along with heating systems including wood stoves, pellet stoves and oil boilers. LED lighting was added to the program in 2015-16.

EEIP Results

Hydro & Non-Hydro	Number of rebates
Hydro communities	89
Non-Hydro communities	371
TOTAL	460

2. The **Commercial Energy Conservation and Efficiency Program (CECEP)** provides rebates for energy upgrades in commercial buildings. Eligible upgrades include heating and controls, air sealing, lighting, ventilation, hot water and low flow devices.

CECEP Results

Metrics	CECEP
Total number of rebates	17
Estimated annual savings	$243,000

3. The **Alternative Energy Technologies Program (AETP)** provide rebates for renewable energy sources such as solar, wind, and wood pellet heating for residents and businesses. Eligible applicants receive one-third of project costs up to $5000 and businesses receive one-third of projects costs up to $15,000.

AETP Results

Metric	AETP Commercial	AETP Residential
Total no. of rebates	14	29
Number of rebates in Yellowknife	3	10
Number of rebates outside Yellowknife	11	19
Total rebate $	$139,609	$108,708
Estimated annual savings	$46,522	$27,970

4 The **Community Renewable Energy Program (CREP)**, provided funding to community and aboriginal governments solar, wind and biomass heating projects. Successful applicants receive up to one-half (50%) of the project cost, up to $21,000.

CREP Summary

Project Type	Location	Installed kW	Rebate Amount
Photovoltaic (PV) & Wind	Fort Providence		13,801
Photovoltaic (PV)	Aklavik	3	17,169
Photovoltaic (PV)	Sachs Harbour	15	21,000
Photovoltaic (PV)	Yellowknife	25	11,025
Photovoltaic (PV) & Wind	Fort Simpson	0.56	9,576
Photovoltaic (PV)	Inuvik	5	5,664
Other	Yellowknife		21,000
TOTAL			99,235

Detail on programs that AEA delivers is provided in Appendix A. For more information on the rebate programs and services that the Arctic Energy Alliance provides, please visit their website at: http://aea.nt.ca/.

Public Works and Services

UTILITY TRACKING AND REPORTING

Since 2010, PWS has managed and tracked the utility budget for all GNWT-owned assets[1] in order to assess overall energy performance. By tracking utility data, PWS can effectively monitor and report on GNWT facilities energy use, greenhouse gas emissions and utility expenditure data.

Utility data collected throughout the year also allows for the benchmarking of facility energy use for different types of buildings such as health centres, schools and office buildings. Metrics such as kWh/m^2 and $/$m^2$ normalize data to aid in the identification of buildings that are running less efficiently. The benchmarking of facilities helps guide the process for energy retrofitting GNWT facilities in future fiscal years. This work has helped reduce the energy intensity of GNWT Schools by 15% since 2006/07.

ENERGY EFFICIENCY TARGETS

All new GNWT buildings must be designed to perform 10% better than a facility constructed to the National Energy Code of Canada for Buildings 2011. Depending on the size of the project this is confirmed through a full energy modelling workshop or energy modelling report during the schematic design and/or the design development of the project.

Energy modelling workshops are used by PWS staff to design the most energy efficient and cost effective building. Designers, contractors, user groups and staff all contribute to optimal energy efficient design. Life cycle costing is used to determine the value of each energy efficiency measure such as the use of biomass technology, levels of envelope insulation, ventilation systems, and lighting efficiency etc. Even the positioning of the building on the lot is considered in the overall design and energy efficiency of a facility.

The National Energy Code of Canada for Buildings 2015 has been released and is being reviewed by PWS for consideration as a performance target for the design of new GNWT facilities.

The mid-life envelope upgrade of the Echo Dene School was completed in 2015/2016 to address the aged building envelope. It included the renewal of the buildings air barrier, upgraded insulation to Good Building Practice levels, replacing the aged and damaged cladding and window replacement.

Echo Dene School, Fort Liard **BEFORE**

Echo Dene School, Fort Liard **AFTER**

Capital cost:	$974,000
Energy Savings:	57,000 kWh
Utility Savings:	$7,500
Extended life to envelope:	25 years

[1] Excludes Yellowknife school board utilities

GNWT Energy Usage and Utility Tracking

In 2015/2016, the cost of heat and power for GNWT facilities totalled $29,061,000. As shown in Figure 6, the largest utility cost to the GNWT is electricity at 62% of the total budget, followed by heating oil at 18% and propane at 8%.

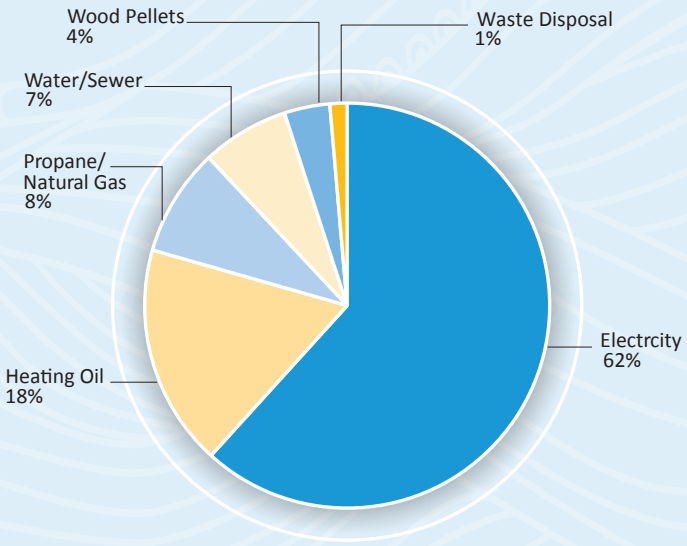


Figure 6 – 2015/2016 utility cost breakdown, total utility expenditures of $29,061,000

While the GNWT's $29,061,000 utility expenditures are dominated by the cost of electricity, greenhouse gas emissions and energy usage are led by the burning of fossil fuels for heating purposes as seen in Figure 7. In 2015/2016, approximately 33,511 tonnes of greenhouse gas emissions (GHGs) were released as a result of burning fossil fuels for heat and electricity generation for GNWT assets.

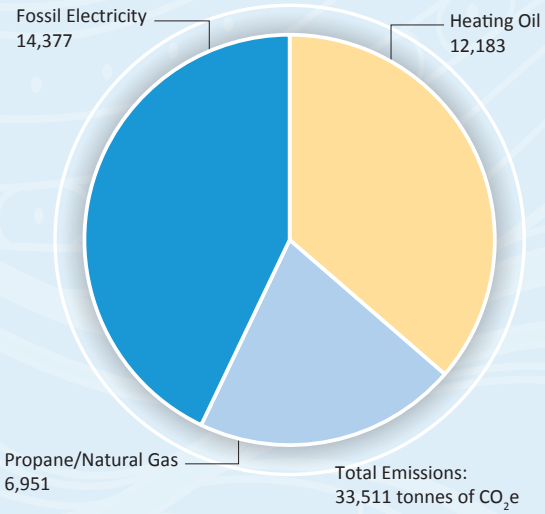


Figure 7 – Annual Greenhouse Gas Emissions from GNWT facilities in 2015/2016

Energy use for GNWT facilities, in 2015/2016, was the lowest it has been in the past five years. Warmer weather, energy efficiency upgrades and the smart operation of facilities all contribute to this lower energy usage. Shown in Figure 8, overall energy usage is approximately 10% less than the average usage over the past five years.

In 2015/2016, 30% of the GNWT's total energy used was from a renewable source. Continued use of biomass boiler technology and the return of water in the Snare hydro system mean a return to increased use of renewables in the coming fiscal years.

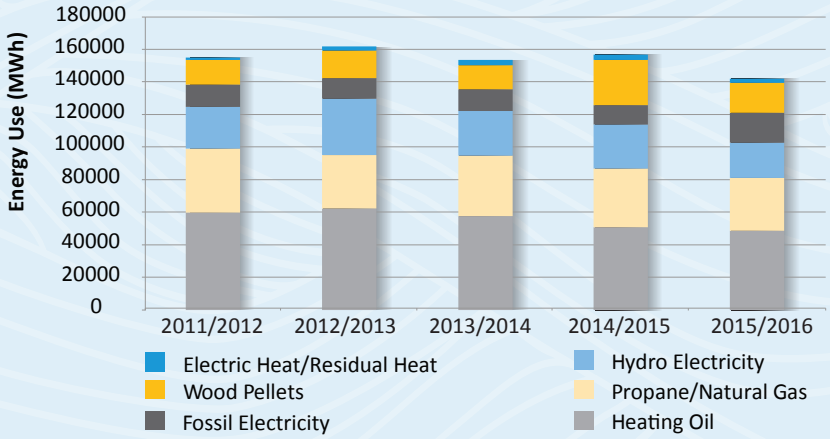


Figure 8 – Energy use comparison between fiscal years

In 2015/16, space heating for GNWT facilities totaled 101,000 MWh. Of this total space heating amount, 20% was provided by renewable hydro and biomass energy. With the addition of new biomass boilers in 2015/2016 and 2016/2017, it is anticipated that biomass will contribute to 24% of the total space heating requirements of GNWT assets.

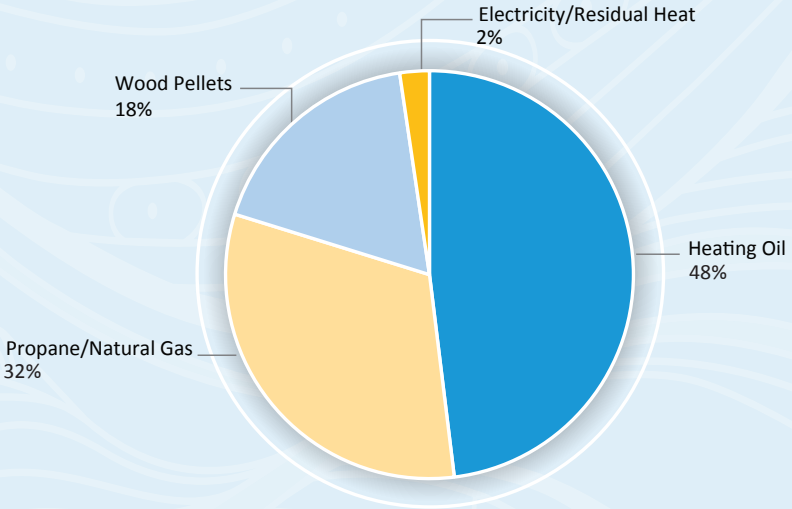


Figure 9 – 2915-16 space heating breakdown for GNWT assets

GOOD BUILDING PRACTICES FOR NORTHERN FACILITIES

The expertise of northern designers and builders from the private and the public sector have contributed to the creation of the PWS Good Building Practices for Northern Facilities (GBP) Guidelines, which guide the design of northern facilities that are reliable, maintainable and energy efficient. These guidelines are to be followed for all new builds and major retrofit projects of government facilities, to ensure the longevity and energy efficiency of the infrastructure.

DESIGN AND CONSTRUCTION OF NEW GNWT BUILDINGS

An important component of PWS' 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 buildings. PWS uses many tools to achieve building designs that are reliable and energy efficient.

PWS CAPITAL ASSET RETROFIT FUND

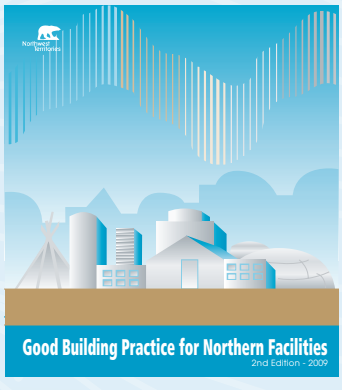
The Capital Asset Retrofit Fund (CARF) program allows for the upgrading of existing GNWT buildings to improve overall energy efficiency. The program helps to reduce energy consumption, operating costs, and greenhouse gas emissions associated with the operation of GNWT buildings. The CARF program has been in operation since 2009/2010.

Annual energy benchmarking and auditing, thermal scanning, and feedback from operation and maintenance staff all contribute to identifying buildings and projects for the CARF program . Typical projects completed under this program include: Envelope upgrades, lighting upgrades, heating control optimizations, installation of efficient water fixtures and re-commissioning of aging building systems.

In 2015/2016, 26 energy efficiency CARF projects were completed. A few highlights include:

- New high bay LED lighting at the Yellowknife airport that uses daylight harvesting technology to reduce electric lighting levels during the day,
- Demand Response Ventilation at the Legislative Assembly building that uses variable frequency drives to slow fan motors when spaces are not in use or minimally occupied,
- Lighting retrofits for the Paulatuk Nursing Station and Residence,
- Upgrading of airport runway lighting in Norman Wells to LED lamps,
- A Phase 2 Energy Retrofit of the Grandfather Ayha School in Deline that included new HVAC controls; and
- An envelope upgrade of the Echo Dene School in Fort Liard.

The detailed list of completed projects can be found in Appendix B.



In general, buildings constructed to the GBP perform 10% better than the National Energy Code of Canada for buildings 2011. The GBP can be found online at http://www.pws.gov.nt.ca/.

NATIONAL CODE DEVELOPMENT

PWS 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.

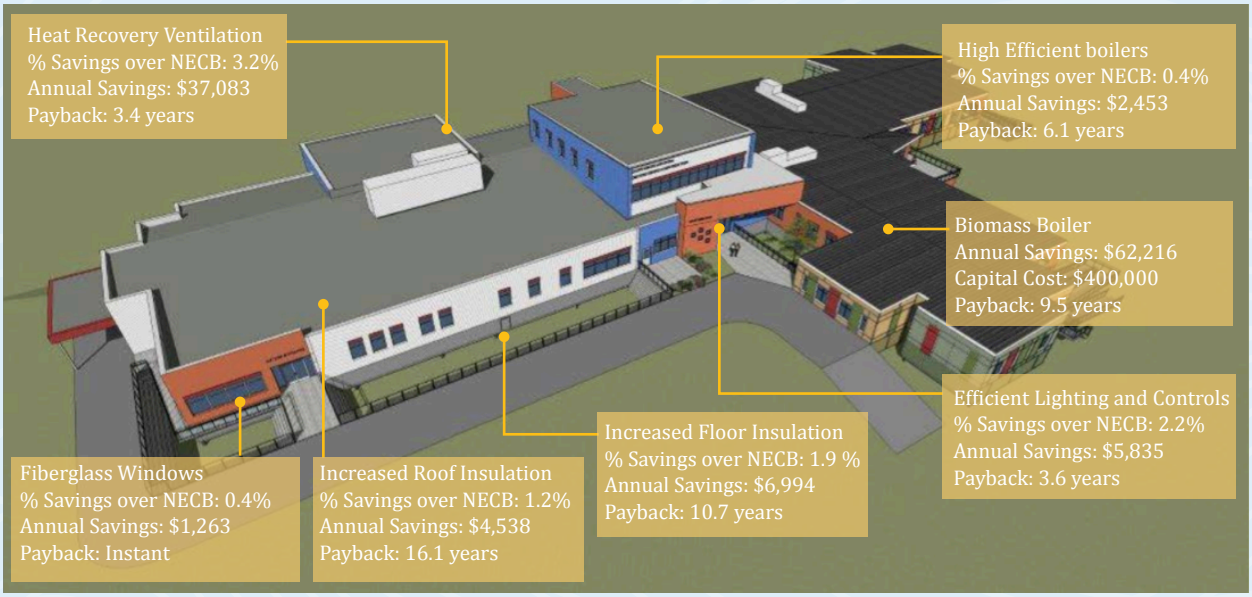
The department is currently involved with the following committees/groups:

- the Canadian Standards Association Technical Subcommittee looking at building energy estimation methodology
- the Public Infrastructure Engineering Vulnerability Committee looking at 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

Sahtu Centre for Health and Social Services and Long term Care

Construction began in 2015/2016 on the new health and long term care centre in Norman Wells. Replacing the existing 33 year old health station, this health centre will provide 24/7 emergency services, social assistance and long term care for residents in the Sahtu region.

The facility will perform 11.1% better than a facility designed to the National Energy Code of Canada for Buildings 2011. Energy efficiency design measures include optimum orientation for solar gain and natural lighting, heat recovery on ventilation, efficient lighting, an effective and durable envelope package and a biomass boiler to provide base load heating for the facility.



A rendered view of the Norman Wells Health and long Term Care Centre produced during the design development phase.

GNWT Energy Efficiency Performance Indicators

Greenhouse gas emission reductions

The reduction of GHG's is a priority of the GNWT's to assist in the global effort to mitigate the impacts of climate change. Through the use of energy efficiency upgrades (CARF), alternate energies (solar, biomass, hydroelectricity) and efficient building design/construction, the GNWT is making significant reductions in its own GHG emissions from building assets. As shown in Figure 10, GHG emission reductions totalled 8,847 tonnes in 2015-2016, representing a 20% total reduction in annual GHG emissions from GNWT assets.

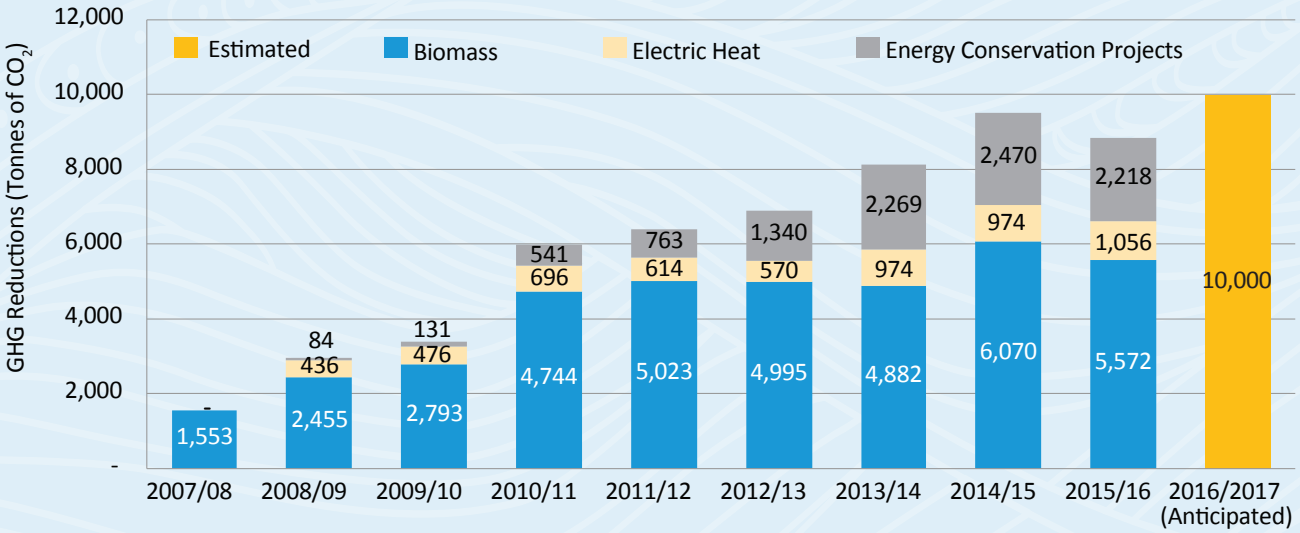


Figure 10 – GHG reductions from different energy conservation project types

Reduced hours of operation from warmer weather and maintenance issues resulted in lower GHG emission reductions than the previous year. New boilers coming online, and addressing operational issues with the current boilers will result in a significant increase in biomass use in 2016/2017.

Energy Reductions

It has been a priority of the GNWT to lead by example in the reduction of energy use. The energy retrofitting of GNWT assets, through the Capital Asset Retrofit Fund, has greatly helped reduce the total energy usage of GNWT assets. Energy efficient upgrades on GNWT assets has helped reduce 1,700 MWh of electricity usage and 8,439 MWh (equivalent to 784,000 L of heating oil) in the 2015/2016 fiscal year. These reductions represent a 4% reduction in the GNWT's overall electricity usage in the NWT and an 8% reduction in total heat energy.

Cost savings

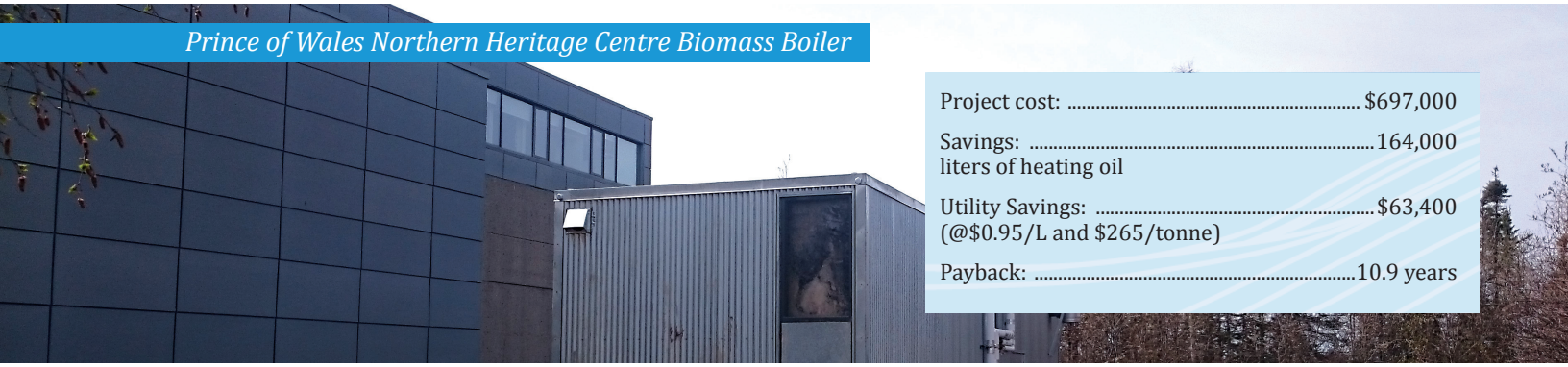
The lower price of heating oil and propane in 2015/2016 reduces the total potential cost savings from energy efficiency projects, but helps the overall GNWT utility budget. In 2015/2016, total utility cost savings was $1.79M from the implementation of energy efficiency and renewable energy technologies.

[1] The cost of propane in Yellowknife in the last 2 years peaked at $1.05/L and hit a low in 2015/2016 of $0.25/L

ALTERNATIVE AND RENEWABLE ENERGY PROJECTS

While energy efficiency and conservation options can reduce costs, the use of alternative and renewable energy can also deliver GHG emission reductions. Many biomass, solar and residual heat projects have been implemented throughout the NWT over the past decade. The following is a list of programs and projects completed in 2015/2016.

Prince of Wales Northern Heritage Centre Biomass Boiler



Project cost:	$697,000
Savings: liters of heating oil	164,000
Utility Savings: (@$0.95/L and $265/tonne)	$63,400
Payback:	10.9 years

A 300 kW wood pellet boiler was installed and commissioned in 2015/2016. This system has an integrated storage system that receives wood pellets pneumatically, eliminating the need for a large exterior pellet silo.

Biomass

In support of the *Greenhouse Gas Strategy for the Northwest Territories* and the *NWT Biomass Energy Strategy*, the Department of Public Works and Services (PWS) has installed biomass boilers in government facilities since 2007. The use of wood pellets for space heating is considered carbon neutral, and as such, government biomass boilers have made a significant impact in reducing GHG emissions associated with operating GNWT facilities.

GNWT energy funding, CARF and capital funding for new buildings are used to encourage the installation of biomass boilers in existing and new GNWT facilities. The sizing of boilers to meet approximately 50% of the peak load heating requirement of a building can provide 80%-90% of annual heating needs.

In addition to GHG emission reductions and operational savings, the inclusion of biomass boilers in newly completed health centres provides the code mandated secondary heating source.

By 2016, the GNWT had installed 28 biomass boiler systems, all providing lower costs and energy efficient base load heating to government assets. A complete list of these installations can be found in Appendix C.

The following biomass systems were commissioned in the 2015/2016 fiscal year:

- 75 kW boiler, New Health Centre, Fort Providence
- 153 kW boiler, South Mackenzie Correction Centre, Hay River
- 200 kW boiler, Deninu School, Fort Resolution
- 1,200 kW boiler, New Health Centre, Hay River
- 400 kW boiler, Airport Terminal Building, Yellowknife
- 300 kW boiler, Prince of Wales Northern Heritage Centre, Yellowknife

Five projects now in the design and construction phase include biomass boilers for base load heating:

- 200 kW boiler for the Chief Julius School, Fort Good Hope
- 200 kW boiler for the Chief T'selehye School, Tulita
- 400 kW boiler for the New combined Health Centre and Long Term Care Facility, Norman Wells
- A biomass boiler is included in the addition to the Territorial Women's Correction Centre, Fort Smith
- A biomass boiler system is included in the new Stanton Territorial Hospital, Yellowknife

Solar Power

COLVILLE LAKE PILOT PROJECT

The project was initiated by the Northwest Power Corporation (NTPC) as an innovative solution to retire diesel generators that were nearing the end of their economic life. With financial support from the GNWT, NTPC integrated solar PV technology into a new diesel electric plant with energy storage.

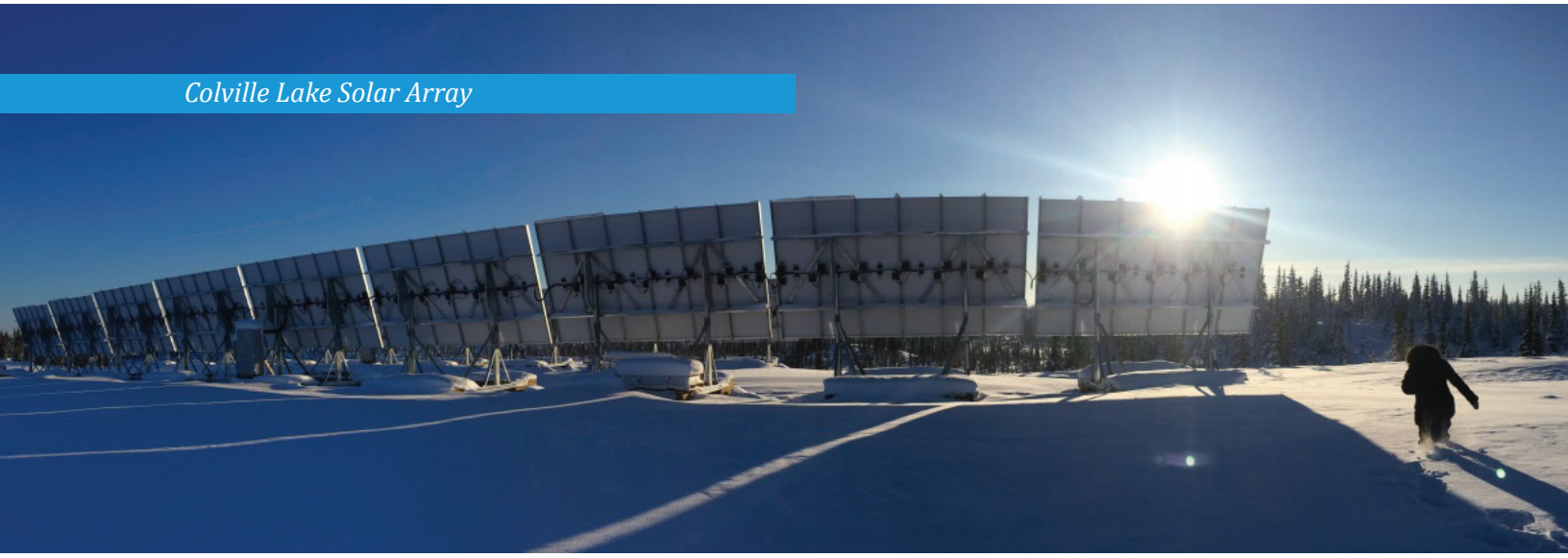
Aerial of Colville Lake Pilot Project

Project Highlights

GNWT Contribution	$1.15 million
Solar PV Batteries/Controllers	$3.2 million
Total Project Costs	$7.9 million
Solar Capacity	136 Kilowatts
Annual Diesel displaced from solar @ $1.17/L	$37,000
Annual diesel efficiency gains and battery savings @ $1.17/L	$79,000
Annual Battery and Solar O &M (Costs)	($42,000)
Total Annual Savings	$74,000
Annual GHG Emission Reduction	270 Tonnes

The solar PV and battery storage components allow the diesel generators to be shut down for extended periods in the summer months and shoulder seasons. The hybrid system has operated since December 2015 and the community has already experienced fewer power outages as a result.

It is common for pilot projects demonstrating new technology to be more expensive than 'business as usual' type projects. The Colville Lake project is no different and the cost to integrate solar PV technology with battery storage into a diesel plant was more than a traditional replacement project. The project cost approximately $7.9 million with $3.2 million to fund the battery and solar components and $4.7 million for the actual replacement and relocation of the diesel generators. The GNWT contributed $1.15 million for solar and battery integration. The combination of new solar, improved energy efficiency and reduced operating and maintenance costs is expected to save up to $74,000 in annual fuel costs and will reduce GHG emissions by 270 tonnes annually.



Colville Lake Solar Array

FORT LIARD

A 39kW solar PV array was successfully built and connected to the NTPC power plant on land near the Fort Liard Airport. The system was brought into service on March 30, 2016, and the energy saved by the project is estimated to reach 39,000 kWh per year. The final cost of the project was $336,803.

Fort Liard PV

WRIGLEY

A 10kW solar PV array was built and connected to the NTPC plant in Wrigley. The energy saved by a 10kW project in Wrigley is estimated to be 10,000 kWh per year. This is equivalent to approximately 3,000 L of diesel, or 8.54 tonnes of CO_2 equivalent saved annually. The cost of the project was $116,637.

The Northwest Territories Housing Corporation (NWTHC) began installing Solar PV on their buildings in 2011. NWTHC now has 98.5 kW of installed capacity in four communities. In 2015/16 a 20 kilowatt ground mounted system was installed at the Fort Liard Seniors Facility. The system will produce 20,000 kWh per year and will offset approximately 6,600 liters of diesel saving 15.6 tonnes of GHG emissions.

	Fort Liard		Wrigley
	Near Airport	Seniors Centre	
Capacity	39 Kilowatts	20 kilowatts	10 Kilowatts
Cost per Watt	$8.64	$9.00	$11.66
Annual Diesel Displaced	11,700 Litres	6,600	3,000 Litres
Annual Savings ($1/L)	11,700	6,600	3,000
Annual GHG Emission Reduction	30 Tonnes	15.6 Tonnes	7.8 Tonnes

Liquefied Natural Gas

Liquefied natural gas (LNG) is natural gas cooled to -162 degrees Celsius. LNG is six hundred times denser than natural gas, which makes it more cost effective to transport. Specialized thermos tanks are used to keep the product cold during transport and storage. The LNG is warmed to become a gas so that it can be used in a gas fired power plant. LNG is safe to transport and compared to diesel power provides a 20% reduction in greenhouse gas emissions produced at the power plant in Inuvik.

INUVIK LNG PROJECT

The Inuvik LNG Project uses LNG to power NTPC's generators in the community. PWS manages the contract for transportation of LNG and relies on a spot supply contract at a liquefaction plant in Delta, British Colombia.

The cost to deliver 106,000 gigajoules (GJ) of LNG to Inuvik was $24.35 per gigajoule (GJ) from April 1, 2015 to March 31, 2016 compared to the price of diesel over that period at $30.59 per GJ.

LNG accounted for approximately 40% of the total power production for the Town of Inuvik with the remainder coming from diesel. The displacement of diesel with LNG provided fuel savings of $664,000 for the Northwest Territories Power Corporation in 2015/16.

The LNG facility began operation in February 2014. Since then, 206,000 GJ of LNG have been delivered to Inuvik, a saving of $1.7 million. Transportation accounts for 60-70% of the landed cost of LNG in Inuvik, and the establishment of a closer LNG supply point with competitively priced product is a near term priority.

FORT SIMPSON LNG FEASIBILITY

Feasibility work was completed to assess the business case and potential to develop a Liquefied Natural Gas (LNG) power generation project in Fort Simpson. Findings indicate that LNG could be a cost-effective alternative to displace diesel, when either diesel costs rise or a closer LNG supply point emerges.

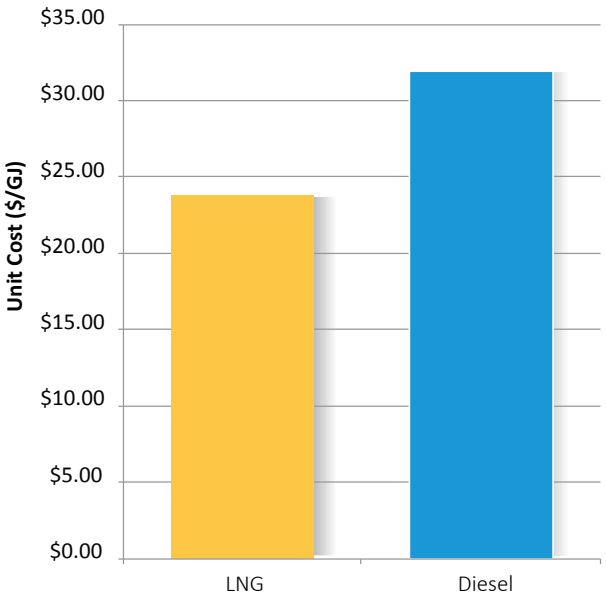


Figure 11 – 2015/2016
Inuvik power generation fuel costs

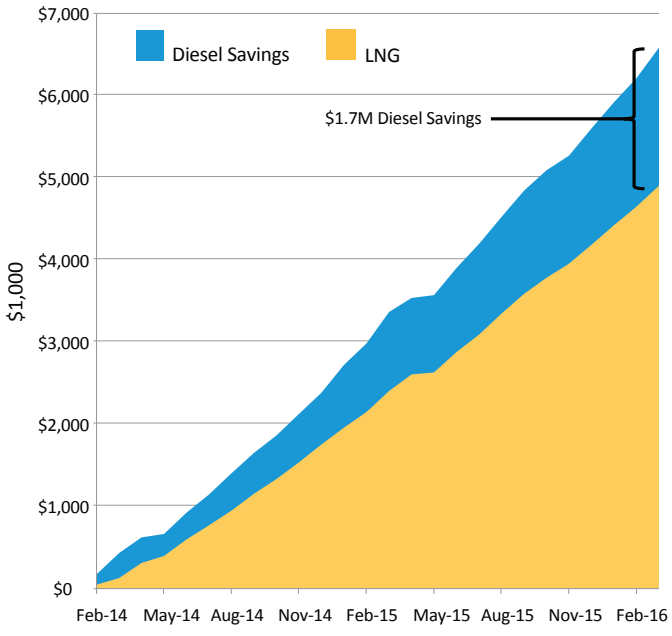


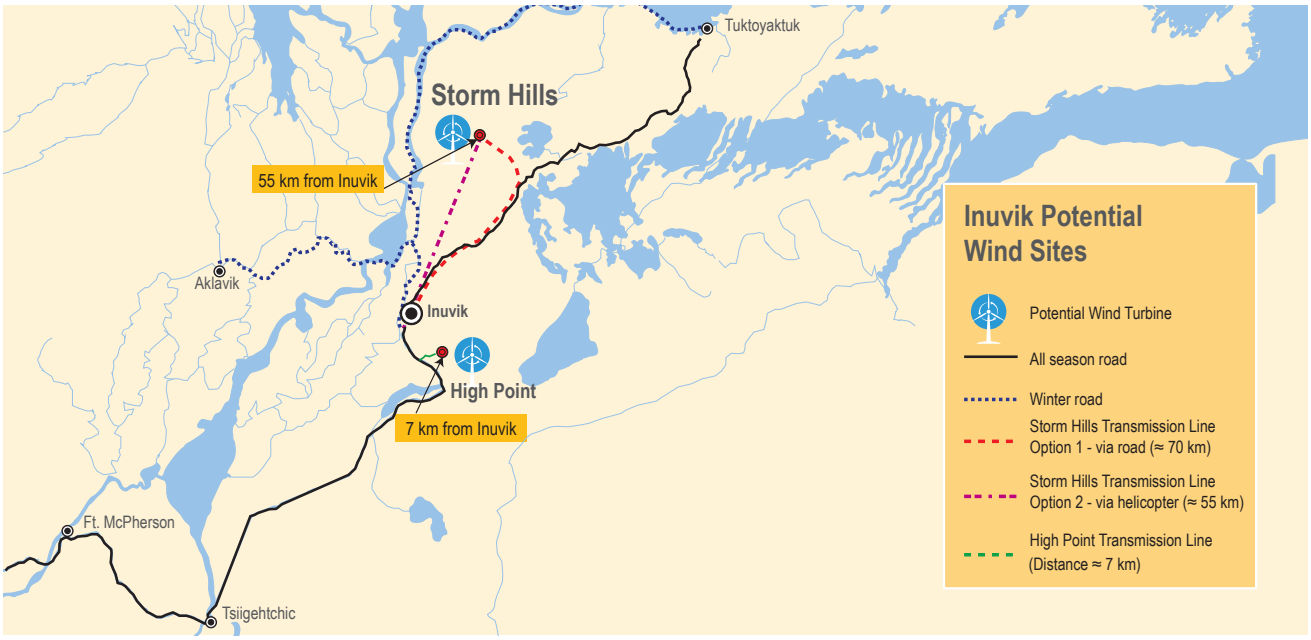
Figure 12 – Cumulative fuel savings over diesel

ENERGY STUDIES AND POLICY INITIATIVES

Energy Plan Next Steps

On November 3-4, 2014, the GNWT hosted the 2014 NWT Energy Charrette in Yellowknife to gain public, community and stakeholder input into ways to make the energy system in the NWT more affordable and sustainable. The Charrette Final Report was released in December 2014, and suggested a number of actions for the GNWT to undertake in the short-term. Short-term actions undertaken in 2015/16 include:

- Consolidating energy functions within the Department of Public Works and Services.
- Continuing to promote energy conservation and efficiency.
- Continuing to focus on alternative and renewable energy.
- Studying ways to improve the resiliency of the North Slave region's electricity system.
- Developing a report on the economics of using surplus power in the Taltson system for electric heating and electric vehicles.



Wind Monitoring

The Department of Public Works and Services (PWS) funded wind monitoring projects in the North Slave and Beaufort Delta regions to determine the wind resources near Yellowknife and Inuvik. Data gathering is ongoing, but preliminary results and project highlights are provided below. Both sites show promise in terms of wind resource potential. Inuvik, as our largest diesel community consumes millions of litres of diesel annually, a portion of which could be displaced by renewable energy. Yellowknife typically has surplus renewable energy and needs to undergo significant demand growth before wind will be of benefit to the Snare system.

INUVIK HIGH POINT

Inuvik is the NWT's largest thermal community which makes it a strong candidate to benefit from potential wind and renewable energy projects. In 2015/16 two sites near the community were investigated for wind energy potential. Storm Hills (55 km from Inuvik) has a proven wind speed of 7.3 metres per (m/s) second which is considered world class. A second site, referred to as High Point, is only 7 kilometres from town and shows promising wind potential. In December 2015, a 50 metre wind tower was installed at the High Point location. The site is producing average wind

speeds of 6.42 m/s however a full two years of data is needed to confirm the quality of the wind resource at the site. A preliminary review of the costs and benefits of each location indicates that high point has the strongest potential to be cost effective and is the focus of work in the coming year.

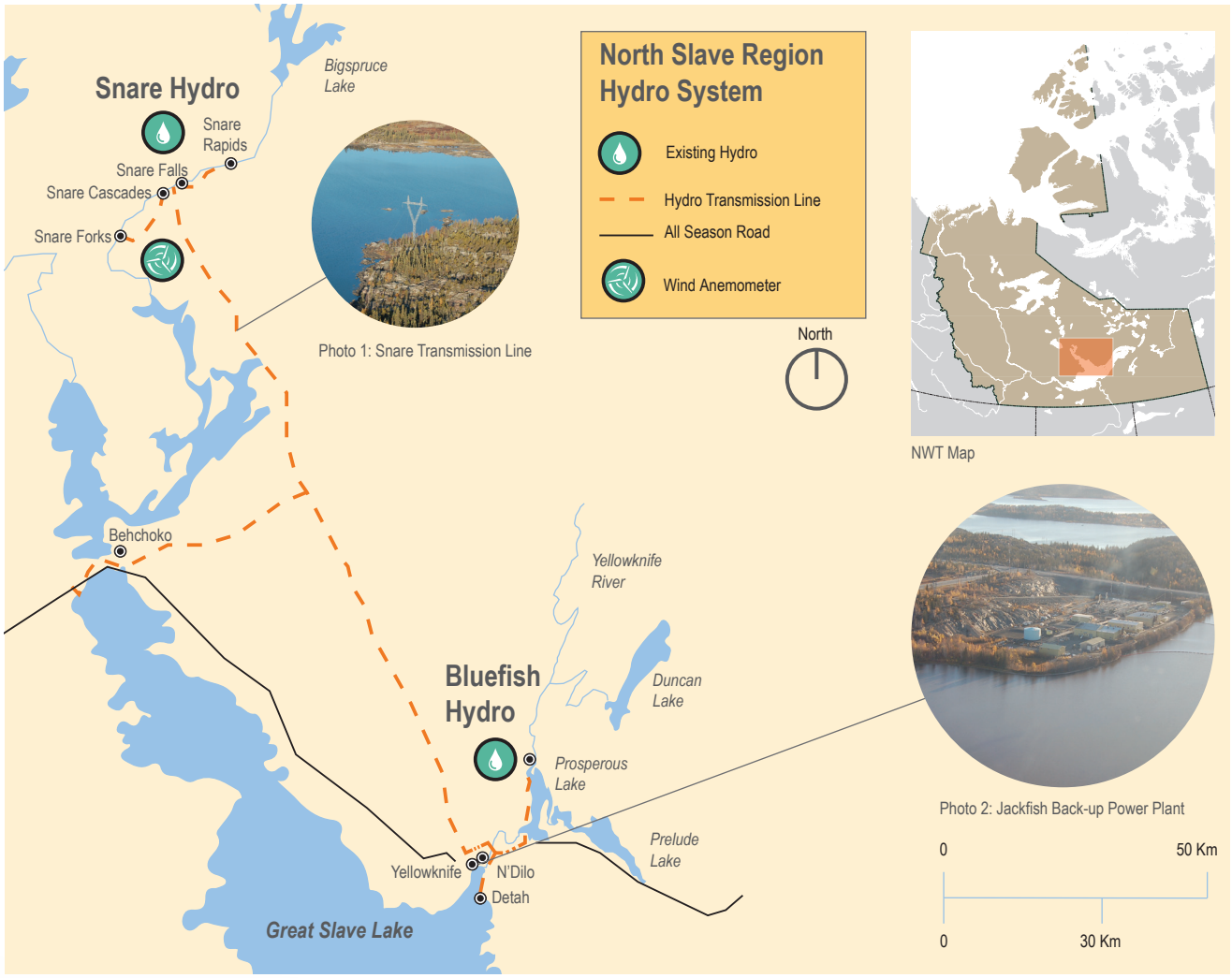
NORTH SLAVE WIND POTENTIAL – SNARE HILLS

In December 2015, wind speed monitors were installed on an existing Northwestel communications tower at CN Hill near the Snare hydro facility. The first three months of wind data show a promising average wind speed of 6.9 m/s at 53 metres height. Wind energy could provide benefits to the Snare system if demand on the system grows significantly, such as from a large mine.

North Slave Hydro System

Hydroelectric plants on the Snare and Yellowknife Rivers supply electricity to Yellowknife, Dettah, N'Dilo, and Behchokǫ̀. Hydropower is used whenever possible because it is a renewable resource that is relatively low-cost to operate.

NWT hydro power is more costly to generate relative to much of Canada. There are a number of reasons for this, including the fact that the North Slave system is aging, very small in relation to the rest of southern Canada where costs can be spread over a larger customer base, is not connected to an all season road and is not connected to a large power grid. Occasional low water conditions increase the costs of our power by adding diesel fuel and diesel engine maintenance costs on top of the fixed costs of the system.



North Slave Resiliency Study

In response to recent low water levels in the North Slave, PWS worked with Manitoba Hydro International (MHI) to look into the resiliency of the hydro system and investigate low water management options. The report concluded that there is an energy surplus in normal water years and that the hydro system is very resilient. A number of recommendations were made to plan for future low water conditions to avoid severe rate changes and to investigate potential improvements to the hydro system.

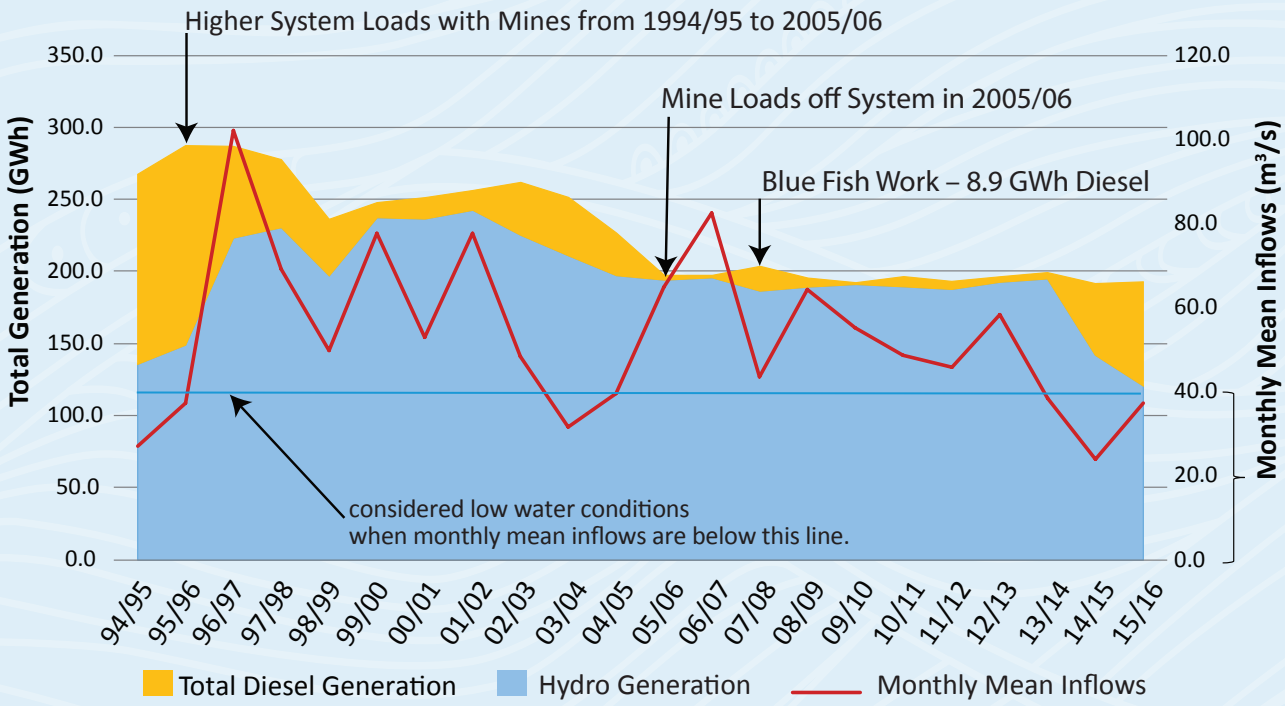


Figure 13 – North Slave Power Generation by Type

Key Findings of the report include:

- Surplus hydro power will be available about 90 percent of the time for at least the next 20 years.
- A significant mining load would need to be connected to the North Slave system for this surplus to disappear.
- Thermal generation such as diesel or possibly LNG is a low cost back-up fuel that would ensure adequate supply during occasional low water conditions.
- Any new power generation, including biomass, wind, solar, or hydro will go unused most of the time and will add unnecessary expense to customers' bills through rate increases.
- Large amounts of back-up generation are needed roughly 10 percent of the time. The back-up generation costs should be managed to avoid rate-shock for customers.

WATER GAUGING PROGRAM

PWS contracted the Water Survey of Canada to install a new water (flow and level) monitoring gauge on the Yellowknife River at Quyta Lake North of Bluefish Lake. The gauge will provide new data on the inflows from the upper portion of the Yellowknife River and provide more data for power planning purposes.

Fort Simpson Biomass Combined Heat and Power (CHP)

The GNWT researched the business case of integrating a utility scale biomass CHP solution in the 600 kilowatt to 1.2 Megawatt range that would be tied into the electrical and heating infrastructure system in Fort Simpson. The analysis assumed that the project would tie-in to the existing GNWT district heating system and the NTPC system. Multiple CHP technologies and biomass harvesting options were examined with the most viable option for a project relying on fuel sourced from locally harvested round wood, with onsite chipping at the power generation facility. The findings of this report were not economically favourable. The GNWT will continue to monitor technology advancements in the CHP area but the conditions are not yet suitable for a utility scale biomass CHP solution at this time in Fort Simpson. Work is underway to investigate the potential of smaller scale biomass CHP sized at less than 20kW to meet the heat load of one building with electricity as a by-product.

Using the Taltson Hydro Surplus

In 2015/16, the Northwest Territories Power Corporation (NTPC) expanded the existing electric heat program that serves a number of government buildings in Fort Smith, to offer interruptible electric heat to community governments in the South Slave region including the communities of Fort Smith, Hay River, Hay River Reserve, Enterprise and Fort Resolution. NTPC is negotiating with potential customers at this time.

Beginning in 2008, electricity for heating has been sold to the GNWT for use in three government buildings in Fort Smith (JBT School, Breynat Hall, and the Department of Transportation Highways Four-Bay Maintenance Garage). The Northern Lights Special Care Home and Roman Catholic Church were added in 2013.

This initiative has allowed NTPC to use approximately 14.5 million kWh of renewable hydroelectricity in place of fossil fuel heating in the community.

Energy Data

The creation of a new Energy Information Database will allow for the collection of information related to energy in a single, easy to access, location. The database will:

- Support the development of GNWT departmental policy and programming.
- Streamline the record keeping and updates on relevant energy data and GHG reporting.

The project's development is divided into two main phases:

Phase I	Phase II
• Database architecture design • Scope data sources and availability • Issue request for proposal for database design • Information requests and data collection forms • Build data relationship diagrams	• Integrate and connect information in electronic form • Build reporting capabilities: - NWT GHG Reports - Community Energy Profiles - Energy Conservation Report - Tax Revenue Forecasts

The information will be integrated into a Geomatics Information System (GIS) tool.

Electric Car Pilot Project

In 2015, the Arctic Energy Alliance (AEA) tested an electric vehicle (EV) in Yellowknife. AEA used a data logger to record and monitor the performance of the vehicle in northern conditions. The EV operates on a battery until its capacity drops to a minimum threshold from full charge. From there an internal gasoline engine powers an electric generator to extend the vehicle's range as needed. The GNWT is interested in EV technology in hydro communities. .

The electric vehicle pictured above was operated for a year by the AEA and has since been transferred to the Department of Public Works and Services.

Three factors make electric vehicles challenging to drive in the NWT: the cost of electricity, the cost premium of electric vehicles and long cold winters. At $0.32 per kWh for power and $1.12 per liter for gasoline, electricity is 2.7 times more expensive for the same amount of energy. The manufacturer's suggested retail price (MSRP) for the base 2016 EV model is $38,490, compared to $15,995 for a similarly sized compact car available from the same manufacturer.

The electric vehicle is more efficient than a combustion engine. As well, from the consumer perspective, if the choice is spending $40,000 on an electric car or spending the $40,000 on another gasoline model, the cost of operating an electric car starts to break even after about 100,000 kilometres (accounting for an additional $5,000 for a charging station). While the AEA found that battery performance is impacted by cold weather, from a driving perspective, including trips between Yellowknife and Hay River, overall, the electric vehicle performed well in the winter. For more information, please contact the AEA.

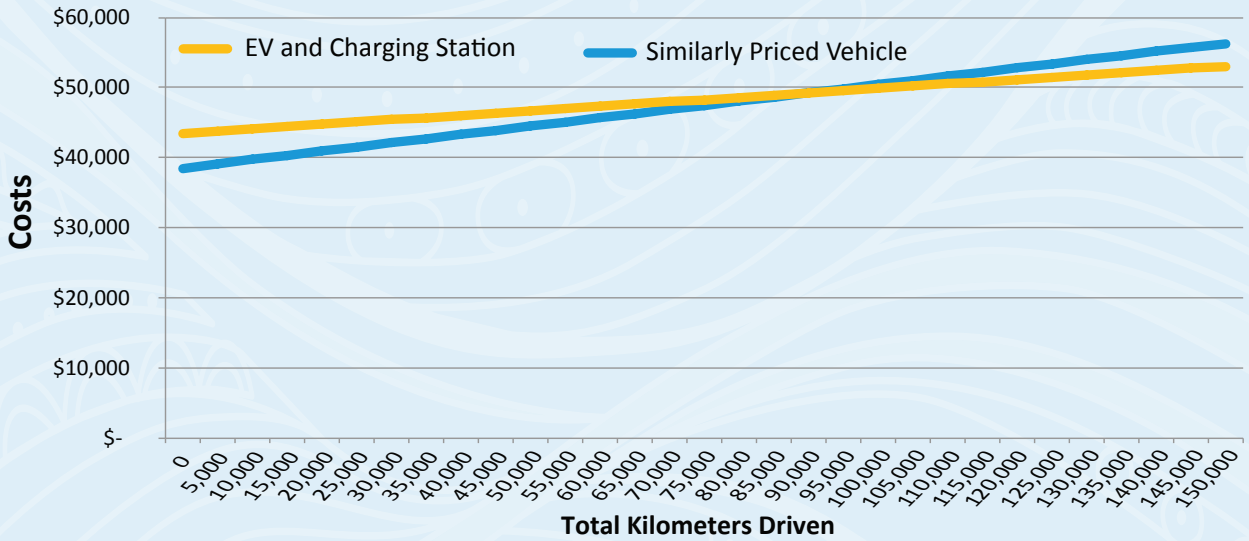


Figure 14 – Cost comparison of common vehicles cost efficiency

A detailed report of this EV is expected to be released by AEA in 2016.

A LOOK AHEAD

In 2016/17, the Department of Public Works and Services (PWS) has a number of initiatives planned as part of its energy activities that align with the priorities and mandate of the 18th Legislative Assembly.

Specific 2016/17 energy initiatives underway now include:

ENERGY EFFICIENCY PROJECTS

PWS will continue to focus on energy efficiency through the Capital Asset Retrofit Fund (CARF). With a budget of $3.8M in 2016/2017, CARF will deliver the following large projects:

- Mid-life retrofitting of the Charles Techto School, Trout Lake and Lutsel K'e Dene School
- Solar PV project in Inuvik and the Dehcho region
- Lighting retrofit projects with operation and maintenance staff in all regions.

BIOMASS PROJECTS

PWS is working to complete the biomass projects at the Chief T'Selehye School in Fort Good Hope and the Chief Albert Wright School in Tulita. These biomass boilers will be capable of displacing 90% of the school's annual heating oil demands.

A new biomass project will be completed at the East 3 School in Inuvik in time for the 2016/17 heating season. This system will be the first biomass boiler installed in GNWT facilities in Inuvik. This 1 MW boiler system will be capable of displacing up to 280,000 liters of propane annually.

NEW CONSTRUCTION – STANTON TERRITORIAL HOSPITAL REPLACEMENT

Visible from almost anywhere in Yellowknife, construction of the replacement for the Stanton Territorial Hospital is well underway. This new facility is being delivered under a performance based "Public Private Partnership" (P3) agreement used for government infrastructure projects elsewhere.

Similar to all GNWT building projects, the new Stanton Territorial Hospital will be 10% more energy efficient than a hospital of its type constructed to the National Energy Building Codes (NEBC) 2011. With the high energy requirements of a hospital, energy efficient design is important to help reduce overall life cycle costs for the facility. Effective building envelope design, ventilation heat recovery, efficient lighting, use of natural light, operation and maintenance standards are all included in this state of the art facility.

Rendering of proposed design of the new Stanton Territorial Hospital.

INUVIK WIND

Inuvik "High Point" has the strongest potential to provide the highest cost benefit ratio for a wind farm in the Inuvik region. Work in the coming year will focus on road and transmission line right of way, geotechnical work and investigation of the most suitable wind farm size (2-5MW range) to tie in with the NTPC power plant.

TUKTOYAKTUK LNG

A feasibility study to examine the location, design, costs and benefits of a small-scale LNG storage, vaporization and gas generation plant that would rely on trucked LNG will be completed in 2016/17. The work will determine whether LNG will be cost competitive to displace diesel in Tuktoyaktuk once the new Inuvik to Tuktoyaktuk highway is complete.

ENERGY INFORMATION AND AWARENESS

With consolidation of the energy functions of government within PWS, energy communications take on a more strategic, focused and coordinated approach to communicate matters related to energy to stakeholder groups and the public. PWS has developed a communications strategy which includes the following objectives:

- Improve knowledge and awareness of how energy is generated, regulated and distributed in the NWT, as well as the associated opportunities and challenges;
- Increase public knowledge and awareness of what the GNWT and its affiliates are doing in the fields of energy conservation and efficiency, energy projects and innovation; and
- Strengthen public awareness of why residents' energy decisions matter and what they can do to reduce their own energy costs and impacts.

NWT HYDROLOGY RESEARCH AND POWER GENERATION

The North Slave Resiliency Study (for further details refer to the North Slave Hydro System section of this report) highlighted the need for more data and information to help to predict the frequency and occurrence of low water conditions in the Snare and Yellowknife river basins.

In 2016/17 PWS will collaborate with other government departments such as the Water Strategy Division and the Cumulative Impacts Monitoring Program at the Department of Environment and Natural Resources, to investigate hydrology in the North Slave region. A number of research initiatives are being developed in partnership with Canadian universities to better prepare for climate change and water related forecasting that may benefit hydro power planning. As an example, PWS will work in partnership with the NTPC and Brock University to establish historical precipitation data in the Snare and Yellowknife basins. Tree core samples of the North Slave region will establish historical precipitation levels in the area. Other work will include a review of snow pack measurement practices and stream flow modeling to help forecast water conditions in future years.

AKLAVIK – VARIABLE SPEED GENERATOR AND SOLAR POWER

NTPC will install a 600 kW Variable Speed Generator (VSG) in Aklavik, in 2016/17. The VSG is expected to deliver fuel savings of 5-10% annually by improving the efficiency of the existing diesel plant. VSG technology is also expected to increase the potential for renewable energy sources such as wind and solar to be tied into remote diesel plants. PWS will test this new technology by installing a 30-40 kilowatt solar array next to the existing diesel plant. The results of the VSG project will be compared against the costs and benefits of investing in battery storage (such as in Colville Lake) to achieve higher levels of renewable energy in remote communities.

NWT ENERGY STRATEGY

The GNWT is currently developing a new energy plan for the NWT. A public discussion guide outlining the current GNWT approach to energy will be released in the summer of 2016 and public engagement sessions in regional centres will be held in the fall of 2016. These public engagement sessions will be coordinated with the department of ENR, which is developing the Climate Change Strategic Framework. With the relation of energy to GHG emissions and impacts on the environment, it will be important that these two processes are closely coordinated. Both documents will be released in 2017.

APPENDIX A – ARCTIC ENERGY ALLIANCE PROGRAM UPTAKE AND DESCRIPTIONS

AEA Program Results

The table shows results for AEA program uptake (not including the Energy Efficiency Incentive Program)

AEA RESULTS INDICATORS	TOTAL
Total rebates	72
Total rebates in Yellowknife	23
Total rebates outside Yellowknife	49
Total rebate amount	598,801
Average rebate	$51,662
Total capital cost	$3,468,957
Estimated annual savings	$375,492
Estimated annual electricity savings (MWh/year)	56
Estimated annual propane savings	-
Estimated annual oil savings (litres)	122,014
Estimated annual CO_2e savings (tonnes)	375
Total desk-top energy evaluations (includes p-files and yardsticks)	154
Yellowknife desk-top energy evaluations (includes p-files and yardsticks)	112
Outside Yellowknife desk-top energy evaluations (includes p-files and yardsticks)	41
Total on-site energy evaluations (ERS and audits)	179
Yellowknife on-site energy evaluations (ERS and audits) – YK	96
Outside Yellowknife on-site energy evaluations (ERS and audits)	83

ALTERNATIVE ENERGY TECHNOLOGY PROGRAM

The Alternative Energy Technology Program provides funding for renewable energy sources such as solar, wind, and wood pellet heating. Funding is for renewable energy projects for communities, businesses, residents, as well as Aboriginal governments and non-profits.

ENERGY EFFICIENCY INCENTIVE PROGRAM

The Energy Efficiency Incentive Program provides rebates to homeowners who purchase new, more energy efficient models of products and appliances. There is an extensive list of products that are eligible for rebates at various amounts depending on if the applicant lives in thermal versus hydro communities.

COMMUNITY GOVERNMENT BUILDING ENERGY RETROFIT

The Community Government Building Energy Retrofit program assists community governments to conduct action energy efficiency improvements for community government buildings. This program has been very well received and due to the high demand for this Program, not all communities that expressed an interest were able to participate this year.

COMMERCIAL ENERGY CONSERVATION AND EFFICIENCY PROGRAM

The Commercial Energy Conservation and Efficiency program helps businesses make their buildings more energy efficient by providing rebates up to $15,000. This amount is calculated as the lower of 1/3 of renovation costs or 5 times annual energy savings.

BIOMASS PROMOTION AND COMMUNITY ENGAGEMENT

Biomass heating is becoming increasingly popular in the NWT. The Arctic Energy Alliance worked with various clients to encourage the use of biomass, some projects underway include:

- Delivered a biomass / pellet fair in Inuvik this summer.
- Delivering “burn-it-smart” training in the Sahtu.
- Delivering Wood Burning Basics - Traditional & New Technology in the Tłı̨chǫ and Sahtu.

With the help of AEA, the town of Hay River has applied and received an Eco ENERGY grant to conduct a prefeasibility study on using local waste biomass product for water heating at the town’s water treatment plant. AEA is working with Whati and Gameti to advance a biomass district heating project similar to the project in the Tłı̨chǫ region.

ENERGY RATING SERVICE

The Arctic Energy Alliance delivers Energy Rating Services (ERS) for new and existing homes in the NWT. AEA works in partnership with contractors and builders to increase awareness of energy efficiency. The Arctic Energy Alliance performed 150 energy audits and evaluations in 2015-16.

APPENDIX B – LIST OF ENERGY EFFICIENCY PROJECTS

PROJECTS	COMMUNITY	DESCRIPTION
Moose Kerr School	Aklavik	Lighting Retrofit
Air Terminal Building	Aklavik	Lighting Retrofit
Community Learning Centre	Aklavik	Lighting Retrofit
Grandfather Ayha School	Deline	Lighting Retrofit, envelope upgrade
Harry Camsell	Hay River	Lighting Retrofit (Exit Lights)
Health Centre	Fort Good Hope	Lighting Retrofit
Community Learning Centre	Tuktoyuktuk	Lighting Retrofit
Health Centre	Tsiigehtchic	Lighting Retrofit
Health Centre	Fort McPherson	Lighting Retrofit
Health Station	Tuktoyuktuk	Lighting Retrofit
Health Centre	Sachs Harbour	Lighting Retrofit
Deh Gah School	Fort Providence	Boiler Optimization, Gym Lighting, T12->T8
Inuvik Hospital	Inuvik	Controls Optimization
Nurses Residence	Inuvik	Lighting and exterior upgrade
Maintenance Camp	James Creek	Generator Replacement
Mangilaktuk	Tuktoyuktuk	Lighting and Boiler controller
Fort Smith Cyclone Additions	Fort Smith	Add Cyclones to existing WPB (improve emission control)
Stuart Hodgson Building	Yellowknife	Ventilation Upgrade
Thomas Simpson	Fort Simpson	Envelope Upgrade
Thebacha School Retrofit	Fort Smith	Controls Upgrade, Re-Balancing (cooling added though), Envelope (15/16)
Mackenzie Mountain School	Norman Wells	HVAC Retrofit/mid life retrofit
Angik School	Paulatuk	Lighting Upgrade, Efficient Motor Replacement, efficient plumbing fixtures
Chief Sunrise School	Hay River Reserve	DDC Upgrade, Ventilation Upgrade
Helen Kalvak School	Ulukhaktok	DDC Upgrade, Gym Lighting, lighting upgrade, exit lights
Chief Jimmy Bruneau	Edzo	Heating Network Optimization, ventilation optimization
Inuvik School Replacement	Inuvik	Analysis of savings from Replacing the SAM and SH Schools in Inuvik
PWS Warehouse	Yellowknife	Lighting retrofit

PROJECTS	COMMUNITY	DESCRIPTION
NSCF	Yellowknife	Demand control ventilation, Lighting retrofit
Northern Lights Special Care Home	Fort Smith	Lighting retrofit
Bompass School (elec only)	Fort Simpson	DDC Controls
Thomas Simpson School (Elec only)	Fort Simpson	DDC Controls
Breynat Hall	Fort Smith	Small lighting controls
Arthur Laing Scheduling Changes	Yellowknife	Small Recommissioning
Legislative Assembly	Yellowknife	Demand Control Ventilation with VFD's
Health Centre	Gameti	5 kW PV
Airport Terminal Building	Hay River	Controls, Ventilation Upgrade
Sachs Harbour School	Sachs Harbour	Lighting, Envelope Upgrade
Airport Garage	Inuvik	Lighting Retrofit
School Carpentry Shop	Inuvik	Lighting Retrofit
School Auto Shop	Inuvik	Lighting Retrofit
NW airport strip lights	Norman Wells	Runway lights upgrade to LED
Echo Dene	Fort Liard	Envelope Upgrade
Gameti School	Gameti	High Bay (atrium) lighting to LED
Core Rock Building	Yellowknife	Lighting retrofit
Combined Services Building	Norman wells	High Bay LED, exit signs, wall packs
Bristol Warehouse	Yellowknife	Lighting Upgrade
Airport Terminal building	Yellowknife	High bay LED with daylighitng
Chief Julius School	Fort McPherson	High bay LED
mangilaluk school	Tuktoyuktuk	High bay LED
JBT Elementary & Breynat Hall	Fort Smith	800 kW Electric Boiler
DOT Maintenance Garage	Fort Smith	400 kW Electric Boiler
Northern Lights Extended Care	Fort Smith	405 kW ACME Electric Boiler
Steam Heating Plant Upgrades	Ft. Simpson	Boiler Replacement
Central Warehouse	Yellowknife	Boiler upgrades
NSRO	Yellowknife	HVAC Upgrades
Mezi School Waste Heat	Whati	Residual heat from NTPC
Echo Dene School Waste Heat	Fort Liard	Residual heat from NTPC
Chief Julius School Wate Heat	Fort McPherson	Residual heat from NTPC
Diamond Jenness School	Hay River	Mid-life retrofit (HVAC, Lighting, Envelope)

APPENDIX C –
LIST OF COMPLETED GNWT BIOMASS BOILER

FACILITY	LOCATION	DATE COMPLETED	SIZE (KW)	COMMENTS
*North Slave Correctional Facility	Yellowknife	Nov-06	1,500	Purchased Heat
*Sir John Franklin	Yellowknife	Jun-05	750	Purchased Heat
Kalemi Dene School	N'Dilo	Sep-09	69	
Chief Jimmy Bruneau	Behchokǫ̀	Oct-09	750	
PWK School & Recreation Complex	Fort Smith	Oct-10	750	
Highways Maintenance Garage	Hay River	Oct-10	300	
Legislative Assembly Building	Yellowknife	Oct-10	300	
Thebacha College	Fort Smith	Nov-10	750	
Central Heating Plant	Hay River	Nov-10	900	
Health Centre	Fort Smith	Nov-11	750	
St. Josephs Secondary School	Yellowknife	Nov-11	540	
Elizabeth Mackenzie School	Behchokǫ̀	Oct-12	540	
Central Heating Plant	Fort Simpson	Oct-12	823	
Combined Services Building	Yellowknife	Oct-12	540	
Deh Gah School	Fort Providence	Mar-13	300	
*Behchokǫ̀ Longterm Care Facility	Behchokǫ̀	Mar-13	540	Purchased Heat
*Health Centre	Fort McPherson	Sep-14		Purchased Heat
Airport Terminal Building	Norman Wells	Oct-14	159	
Mackenzie Mountain School	Norman Wells	Oct-14	212	
Combined Services Building	Norman Wells	Oct-14	212	
GNWT Office Building	Yellowknife	Dec-14	650	
Health Centre	Fort Providence	Jul-15	75	
Deninu School	Fort Resolution	Oct-15	200	
South Mackenzie Correction Centre	Hay River	Oct-15	212	
Health Centre	Hay River	Nov-15	1,200	
Airport Terminal Building	Yellowknife	Nov-15	400	
Prince of Wales Heritage Museum	Yellowknife	Mar-16	300	

**Boilers are not owned by the GNWT*

APPENDIX D – UTILITY SCALE SOLAR PROJECTS

COMMUNITY	BUILDING	YEAR OF INSTALLATION	CAPACITY INSTALLED ON THIS SITE OR BUILDING(KW)	PROJECT COST	OWNER
Fort Simpson-NTPC	Ground mount @ Airport	2010, 2012 (expansion)	104	$1,070,000	Utility
Hay River-Housing Corp	Wispering Willows Senior Center	2014	60	$250,000	Territorial Government
Lutsel K'e	Ground Mount (IPP)	2014	33	$100,000	Local Government
Colville Lake-NTPC	Utility Solar-Diesel Hybrid (High penetration)	2015	135	$1,150,000	Utility
Fort Liard-Housing Corp	Senior Center -Ground Mount	2015	20	$180,000	Territorial Government
Fort Liard-NTPC	Ground Mount @ Airport	2016	39	$300,000	Utility
Wrigley-NTPC	Ground mount @ Airport	2016	10	$160,000	Utility
Inuvik	PWS Building	2016	20	$200,000	Territorial Government
Inuvik	ARI	2016	25	$200,000	Territorial Government
Aklavik-NTPC	Ground Mount	2016	50	$420,000	Utility
Total			496	$4,030,000	