# PUBLIC WORKS AND SERVICES
# ENERGY CONSERVATION PROJECTS
## Annual Report 2012-2013


Prepared By

Design and Technical Services
Public Works and Services
Government of the Northwest Territories
April 2013

Northwest Territories

# Minister's Message

With our extreme northern environment; energy conservation, efficiency and management are important elements in controlling costs and supporting effective and efficient program delivery in all communities of the Northwest Territories (NWT). The Government of the Northwest Territories (GNWT) supports a wide variety of energy initiatives through its 2007 Energy Plan as well as the NWT Biomass Energy Strategy and the NWT Greenhouse Gas Strategy.

On behalf of the GNWT, the Department of Public Works and Services has implemented numerous energy efficiency and alternative energy activities to help manage our energy needs for public buildings over the past five years. Our investments in energy efficiency and alternative energy is reducing our dependence on fossil fuels, lowering our operating costs and helping us meet our greenhouse gas emission reduction goals.

With 33% of the total energy use for public buildings managed by Public Works and Services already provided from renewable energy, the Government of the Northwest territories reduced the consumption of fossil fuels for space heating by over 2.5 million litres in 2012/13 alone.

Through our energy investments, by the end of 2013/14 the GNWT's total reduction in fossil fuel consumption for space heating our buildings is expected to exceed 13.5 million litres with a corresponding decrease in greenhouse gas emissions of over 36,000 tonnes.

Over the past three years, the GNWT's investment in energy improvements and alternative energy projects such as biomass for space heating have generated savings of over $3.3 million. With the completion of projects currently in progress, the GNWT is on track to meet 30% of its total space heating load for PWS-managed assets through biomass energy. As a result of the success of these investments, the Government is now able to reinvest proven operational savings from our energy initiatives to fund future energy conservation and alternative energy projects across the NWT.

Working with our partners in industry and other levels of government the GNWT has become a leader in the development and implementation of cost effective biomass energy solutions for public infrastructure and looks forward to building upon the success of our energy strategies and investments in expanding our use of renewable energy and managing our overall  energy needs.

The Honourable

Glen Abernethy

Minister of Public Works and Services

# Table of Contents

# Overview

The Government of the Northwest Territories (GNWT) continues to expand its activities in support of the visions and goals of the NWT Energy Plan, the NWT Greenhouse Gas Strategy and the NWT Biomass Strategy. The GNWT is committed to the responsible use of energy and to the reduction and mitigation of the effects of its energy use on the environment.

On behalf of the GNWT, Public Works and Services (PWS) engages in various activities and strategies for energy management. These include:

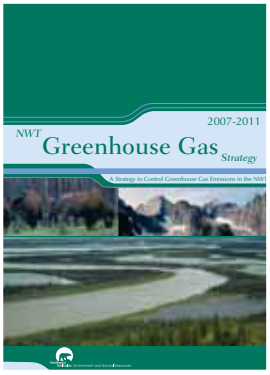
- Use of renewable energy sources such as biomass hydro electricity and solar
- Use of energy audits and energy-efficiency retrofits on existing buildings
- Design and construction of new and retrofitted facilities to higher energy efficiency standards
- Tracking of actual energy consumption and reinvestment of these savings into other energy conservation and alternative energy projects
- Scheduling and performance of adequate and appropriate maintenance
- Ongoing development and utilization of Good Building Practice for Northern Facilities
- Commissioning of construction projects to optimize occupant comfort, energy consumption and building operation
- Promotion of public awareness of energy use and conservation
- Optimizing energy efficient operations of existing infrastructure

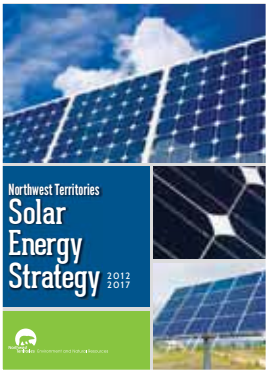
The main focus in planning energy conservation and efficiency projects is to reduce the use of imported heating oil and reduce operation costs. In the 2012-2013 fiscal year:

- Four new biomass boilers were commissioned, one electric boiler powered from excess hydroelectricity was commissioned
- The East Three School in Inuvik was commissioned
- Energy modelling for the new Hay River Health Centre was completed
- Five energy audits and ten thermal scans were completed
- Many energy retrofits of GNWT facilities were completed.

The cumulative savings from all energy management projects since 2007 are equivalent to displacing 9,968,372 litres of heating oil, representing a total greenhouse gas emission reduction of 27,213 tonnes. In 2012-2013, the use of renewable energy in PWS-managed assets increased by 2.4%, to a total of 33%, when compared to 2011-2012.

This report provides a summary of the 2012-2013 successes in energy management. A description of each energy project or initiative is provided, including the amount of fossil fuel displaced and the corresponding reduction in greenhouse gas emissions.


# Energy Savings Projects

Public Works and Services operates and maintains the GNWTs building assets, which range from office buildings, schools, correctional facilities and research laboratories, to garages, water treatment plants and petroleum tank farms. Buildings should provide a comfortable surrounding for employees, and an appropriate environment for the processes and activities occurring inside them, while operating efficiently with little to no energy waste. Good energy management saves energy, reduces utility bills, reduces greenhouse gas emissions, extends building and equipment life, and reduces risks associated with energy supply price spikes.

Over the last five years, the PWS has completed many energy-saving projects, including the installation of biomass heating plants, electric boilers, the addition of heat recovery technology, lighting retrofits and other initiatives. These projects have helped lower utility costs, energy consumption and greenhouse gas emissions.

GNWT assets maintained by PWS consumed the equivalent of 161,896 MWh for heating and electricity in 2012-2013 (Figure 1). PWS energy related activities focus on reducing these annual consumption figures and increasing the percentage of renewable and reducing greenhouse gas emissions.

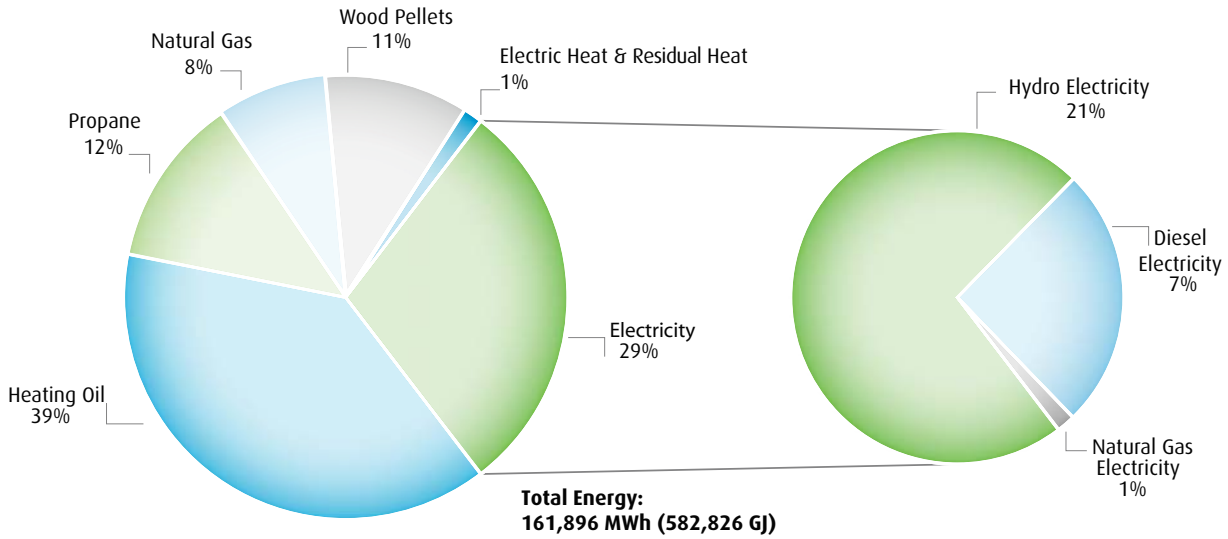



**Figure 1: 2012-2013 Energy Use Breakdown of PWS Maintained Assets (161,896 MWh)**

In 2012-2013, 33% of the total energy consumed by GNWT assets was from a renewable resource. Wood pellets account for 11% of total energy consumed which directly contributes to the reduction of imported heating oil.

# Biomass

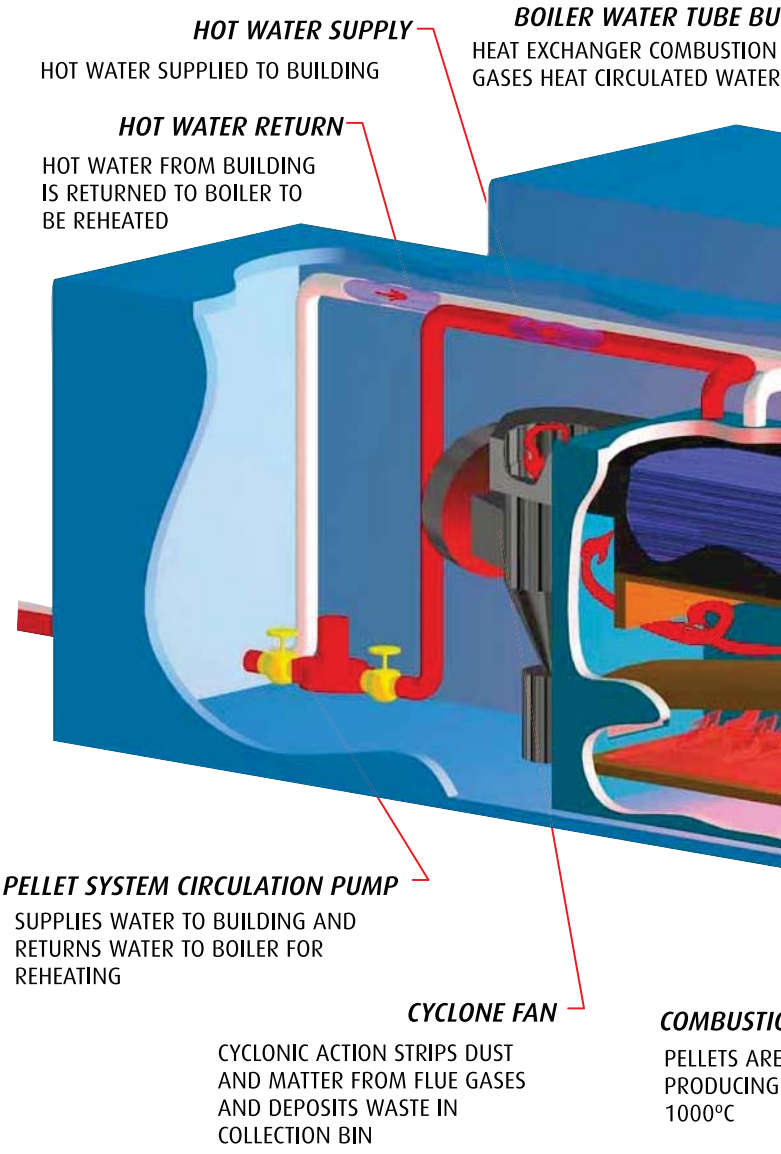
Since 2007, the GNWT has been installing wood pellet boilers in public buildings. The relative low cost of wood pellet heat, when compared to fossil fuels, and the reduction of greenhouse gas emissions through their use directly supports the NWT's Energy Plan, Greenhouse Gas Strategy and Biomass Energy Strategy.

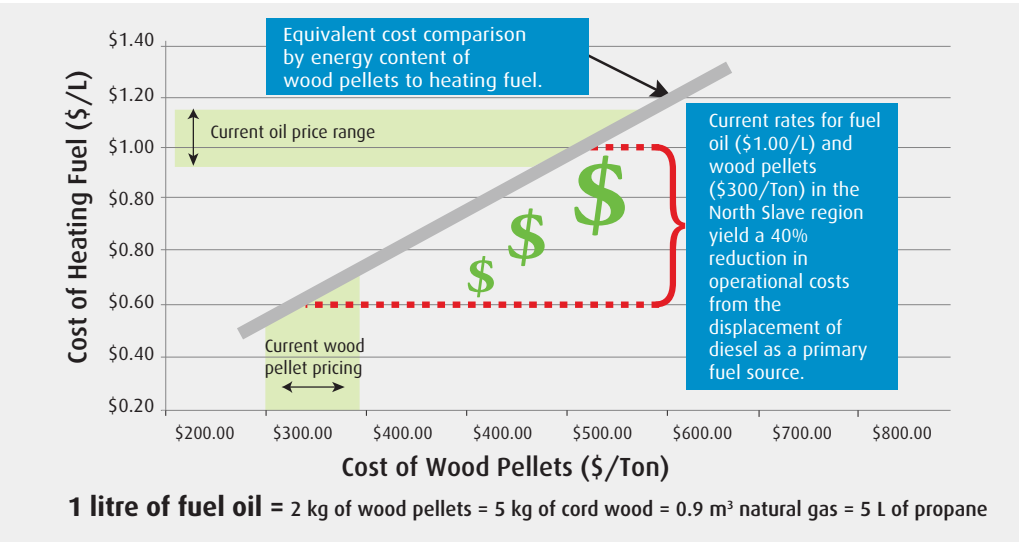
## Biomass Projects

Major public facilities retrofitted to date with biomass heating systems include:

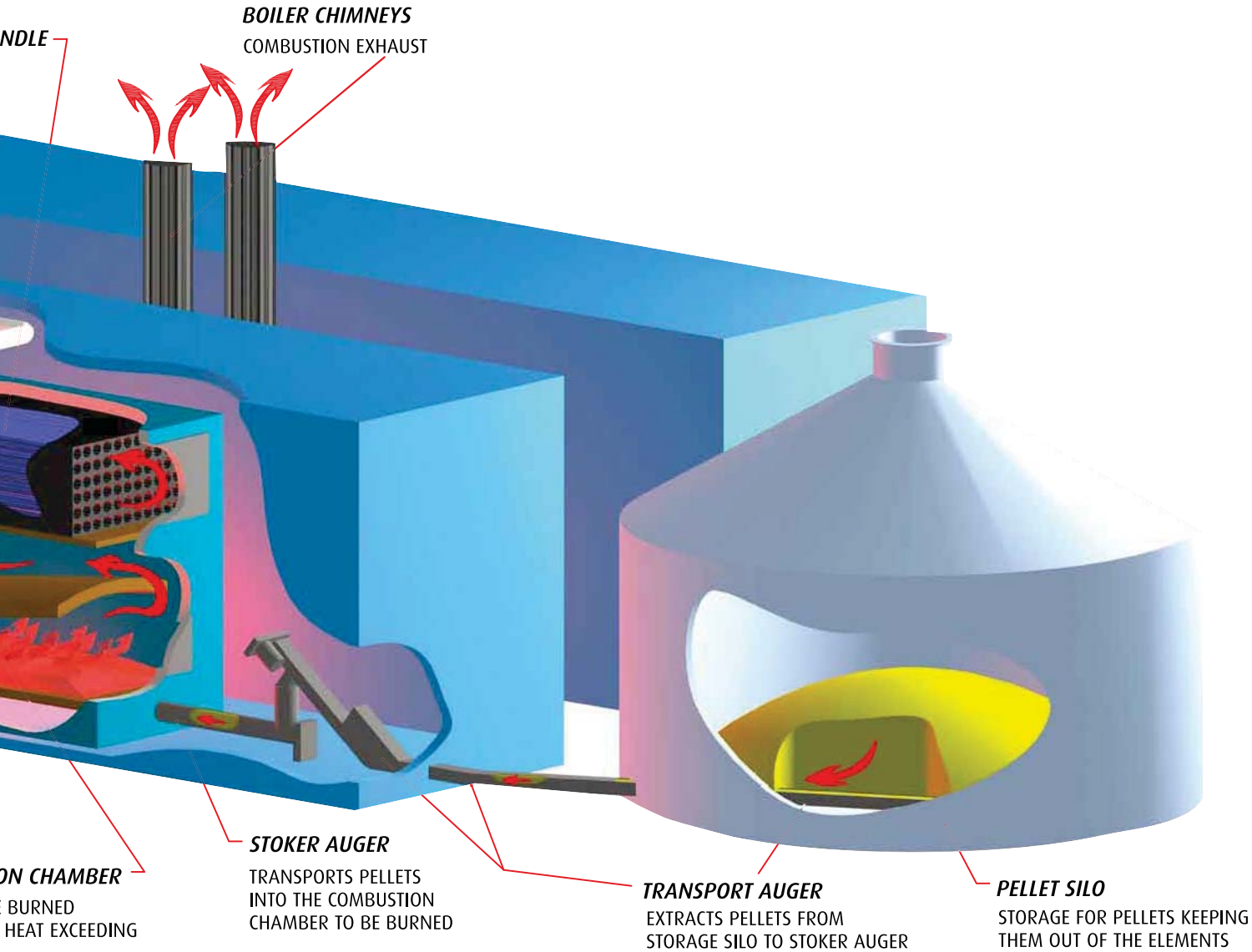
- North Slave Correctional Facility – Yellowknife
- Sir John Franklin High School – Yellowknife
- K'alemi Dene School – Ndilo
- Chief Jimmy Bruneau School – Behchoko
- École St. Joseph School – Yellowknife
- The Legislative Assembly Building - Yellowknife
- Highways Maintenance Garage – Hay River
- PWK School and Recreation Centre – Fort Smith
- Thebacha College – Fort Smith
- Central Heating Plant (Harry Camsell School, Princess Alexandra School, École Boreale, Diamond Jenness Secondary School & Trade Shop) – Hay River
- Health Centre – Fort Smith
- Central Heat Plan (Bompass School, Thomas Simpson School and Recreation Complex) – Fort Simpson
- Airport Combined Services Building – Yellowknife
- Elizabeth Mackenzie School – Behchoko
- Deh Gah School – Fort Providence

## Conceptual Layout of a Typical Biomass Heating System






**1 litre of fuel oil** = 2 kg of wood pellets = 5 kg of cord wood = 0.9 m³ natural gas = 5 L of propane



## North Slave Correctional Facility – Yellowknife (2006)

The biomass boiler installed at the North Slave Correctional Facility in Yellowknife consists of two 750 kW wood pellet boilers, and was commissioned in November of 2006. To the end of the 2012-2013 fiscal year, the wood pellet boilers have displaced approximately 3,400,549 litres of heating oil, resulting in GHG emission reductions of 9,284 tonnes. In 2012-2013, the biomass boiler system displaced approximately 559,806 litres of fuel oil, representing 1,529 tonnes of GHG emission reductions.

The wood pellet boiler installation at the North Slave Correctional Facility was the first of its kind in the Northwest Territories, and one of the first such installations in Canada. The success of this installation proved that biomass technology was economically and technologically viable in the North, and paved the way for future installations of wood pellet boilers.

***North Slave Correctional Facility***

Commissioned: .....2006
Boiler Type: .....Binder
Size: .....2 x 750 kW
Silo Capacity: .....80 Tonnes

## Sir John Franklin High School – Yellowknife (2008)

A 750 kW wood pellet boiler was installed in February of 2008 at the Sir John Franklin High School in Yellowknife. Cumulative savings to the end of the 2012-2013 fiscal year total 1,148,351 litres, representing a 3,135 tonne reduction in GHG emissions.

In 2012-2013, this wood pellet boiler displaced approximately 146,520 litres of fuel oil, resulting in greenhouse gas emission reductions of 400 tonnes.

***Sir John Franklin High School***

Commissioned:.....2008
Boiler Type: .....Binder
Size: .....750 kW
Silo Capacity: .....40 Tonnes

## K'alemi Dene School – Ndilo (2009)

The K'alemi Dene School in Ndilo was designed with three small 23 kW residential wood pellet boilers to serve the heating needs of the school. One of these boilers is capable of offsetting 10,000 litres of fuel oil annually. Two 142 kW oil-fired boilers were also installed to meet peak demands, and provide back up to the wood pellet boilers.

The biomass system was commissioned in September of 2009, and has since been operating with the wood pellet boilers as the primary source of heat. In 2012-2013, the wood pellet boiler system displaced approximately 23,443 litres of fuel oil. This represents a greenhouse gas emission reduction of 64 tonnes. Cumulative savings from this project total 102,747 litres of heating fuel and 281 tonnes of GHG emissions.

***K'alemi Dene School***

Commissioned:.....2009
Boiler Type: .....Bosch
Size: .....3 x 23 kW
Silo Capacity: .....15 Tonnes

## Chief Jimmy Bruneau Regional High School – Behchoko (2009)

A 750 kW boiler was installed at the Chief Jimmy Bruneau Regional High School in 2009 to offset the use of heating oil. In 2012-2013, this biomass boiler installation displaced 175,092 litres of fuel oil, representing a reduction in greenhouse gas emissions of 478 tonnes. Cumulative savings from this project total 619,890 litres of fuel oil, equivalent to reducing GHG emissions by 1,692 tonnes.

***Chief Jimmy Bruneau Regional High School***

Commissioned:.....2009
Boiler Type:.....KOB
Size: .....750 kW
Silo Capacity: .....100 Tonnes

## École St. Joseph School – Yellowknife (2009)

A 540 kW wood pellet boiler was installed at the École St. Joseph School in Yellowknife in October 2009. In 2012-2013, the biomass boiler displaced 88,278 litres of heating oil. This represents a greenhouse gas emission reduction of approximately 241 tonnes. Since commissioning to the end of 2012-2013, cumulative fuel oil reductions total 261,172 litres, equivalent to reducing approximately 713 tonnes of greenhouse gas emissions.

***École St. Joseph School***

Commissioned:.....2009
Boiler Type: .....KOB
Size: .....540 kW
Silo Capacity: .....50 Tonnes

## Legislative Assembly Building – Yellowknife (2010)

The Legislative Assembly Building had a 300 kW wood pellet boiler installed and commissioned in October 2010. Cumulative savings to the end of the 2012-2013 fiscal year total 226,740 litres of fuel oil, equivalent to reducing GHG emissions by 619 tonnes.

In 2012-2013, the biomass boiler displaced 61,172 litres of heating oil. This represents a reduction in greenhouse gas emissions of 167 tonnes. Lower than anticipated savings have meant that PWS continues to assist with optimizing boiler performance.

***Legislative Assembly Building***

Commissioned: .....2010
Boiler Type: .....Binder
Size: .....300 kW
Silo Capacity: .....40 Tonnes

## Highways Maintenance Garage – Hay River (2010)

A 300 kW wood pellet boiler was installed in the 4-bay Highways Maintenance Garage in Hay River in October 2010. In 2012-2013, this biomass boiler displaced 57,142 litres of heating oil, reducing greenhouse gas emissions by 156 tonnes. Cumulative savings from this biomass boiler installation total 208,131 litres of fuel oil and GHG reduction of 568 tonnes.

***Highways Maintenance Garage***

Commissioned: .. 2010
Boiler Type: .....KOB
Size: .....300 kW
Silo Capacity: .....50 Tonnes

## P.W. Kaeser High School and Recreation Centre – Fort Smith (2010)

A 750 kW wood pellet boiler was installed to provide heating for the PWK School and Recreation Centre in Fort Smith and commissioned in October 2010. In 2012-2013, the biomass boiler displaced 167,399 litres of heating oil and reduces greenhouse gas emissions by 457 tonnes. These bring fuel savings to date to 581,282 litres and GHG reductions to 1,587 tonnes.

***PWK High School***

Commissioned:.....2010
Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

## Thebacha College – Fort Smith (2010)

A 750 kW wood pellet boiler was installed in the Thebacha College in Fort Smith in the fall of 2010. In 2012-2013, the biomass boiler displaced 109,890 litres of heating oil, reducing greenhouse gas emissions by 300 tonnes. Cumulative savings to the end the 2012-2013 fiscal year total 420,456 litres and 1,147 tonnes of GHG emissions reductions.

### *Thebacha College*

Commissioned: .....2010
Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

## Central Heating Plant – Hay River (2010)

A 1 MW wood pellet boiler was installed in a central heating plant in Hay River in 2010. The heating plant serves Harry Camsell School, Princess Alexandra School, École Boréale, Diamond Jenness Secondary School and the Trades Shop.

In 2012-2013, the biomass boiler displaced 129,670 litres of heating oil and greenhouse gas emissions were reduced by 354 tonnes. Cumulative savings to date total 584,175 litres of fuel, equal to reducing GHG emissions by 1,595 tonnes. Full savings for the 2013-2014 year are anticipated.

### *Central Heating Plant*

Commissioned: .....2010
Boiler Type: .....KOB
Size: .....1 MW
Silo Capacity: .....50 Tonnes

**Harry Camsell School**

**Princess Alexandra School**

**DJSS Trades Shop**

**Diamond Jenness Secondary School**

**École Boréale School**

## Health Centre – Fort Smith (2012)

A 750 kW wood pellet boiler was installed in the Fort Smith Health Centre in 2010. The installation was commissioned in early 2012, after necessary mid-life retrofits to the Health Centre's heating system were completed. The estimated fuel oil savings will total 200,000 litres annually with GHG emissions expected to be reduced by approximately 546 tonnes.

In the 2012-2013 fiscal year, this wood pellet boiler saved the equivalent of 65,567 litres of heating oil, reducing greenhouse gas emissions by 179 tonnes. The Health Centre renovations are ongoing and the wood pellet boiler is only providing heat to a portion of the building. Once the retrofit is complete, full anticipated savings will be met.

***Health Centre***

Commissioned:.....2012
Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

## Central Heating Plant – Fort Simpson (2012)

PWS operates the Central Heating Plant (CHP) in Fort Simpson. The CHP is a low-pressure steam generation facility presently providing heat to three buildings: Fort Simpson Recreation Complex, Bompass Elementary School, and Thomas Simpson School.

An 850 kW low-pressure steam wood pellet boiler was installed inside the CHP in 2012. The system is designed for potential expansion to service future projects like a new PWS workshop and any development that may be located on the old Dehcho Hall Site. Partial savings in 2012-2013 totalled 50,915 litres of heating oil. This represents a reduction of 139 tonnes of greenhouse gas emissions.

***Central Heat Plant***

Commissioned:.....2012
Boiler Type: .....Combustion Experts
Size: .....800 kW
Silo Capacity: .....50 Tonnes

## QUICK FACT

*BY 2015-2016, biomass boilers will have the capacity to provide 30% of total heating load for PWS-managed buildings.*

## Combined Services Building – Yellowknife (2012)

The newly constructed Combined Services Building (Department of Transportation) at the Yellowknife Airport, has had a 540 kW wood pellet boiler installed to offset the use of onsite propane. This wood pellet boiler was first fired in November 2012.

In the four months of operation in 2012-2013, this new wood pellet boiler was able to save the equivalent of 109,157 litres of heating oil, equivalent to reducing 298 tonnes of greenhouse gas emissions.

***Combined Services Building***

Commissioned:.....2012
Boiler Type: .....KOB Pyrot
Size: .....540 kW
Silo Capacity: .....50 Tonnes

## Elizabeth Mackenzie Elementary School – Behchoko (Rae) (2013)

A 540 kW wood pellet boiler was installed at the Elizabeth Mackenzie Elementary School in 2013. Originally the design called for a 300 kW wood pellet boiler, but interest generated by the community of Behchoko and the Northwest Territories Housing Corporation prompted a decision to have a pellet boiler big enough to connect the Community Recreation Complex and a new apartment complex. The boiler was upsized to a 540 kW boiler in order to accommodate the increased heating load of the two facilities.

The GNWT will provide heat to the Recreation Complex and apartment complex when they connect to the system. In the last quarter of 2012-2013, this wood pellet boiler offset heating oil by 63,369 litres, equivalent to reducing greenhouse gas emissions by 173 tonnes.

***Elizabeth Mackenzie School***

Commissioned: .....2013
Boiler Type: .....KOB Pyrot
Size: .....540 kW
Silo Capacity: .....50 Tonnes

## Deh Gah School – Fort Providence (2013)

A 300 kW wood pellet boiler was installed in February 2013 to supplement the school's oil fired boilers. This is the first commercial wood pellet boiler installation in the Town of Fort Providence. The first three months of operation for this wood pellet boiler helped reduce heating oil consumption at the school by 21,978 litres, reducing the greenhouse gas emissions by 60 tonnes.

***Deh Gah School***

Commissioned: .....2013
Boiler Type: .....KOB Pyrot
Size: .....300 kW
Silo Capacity: .....50 Tonnes

# Follow up

Wood pellet boilers are providing substantial operational savings for the GNWT. In 2012-2013, the 15 wood pellet boiler systems in operation displaced the equivalent of 1,829,670 litres of fuel oil, resulting in reductions of approximately 4,995 tonnes of GHG emissions. In some cases these wood pellet boilers are operating more efficiently than existing oil boilers, reducing the total annual heat energy usage of the facilities they serve. Cumulative heating oil displaced by biomass boilers since the installation of the first boiler total 7,898,498 litres (Figure 2).

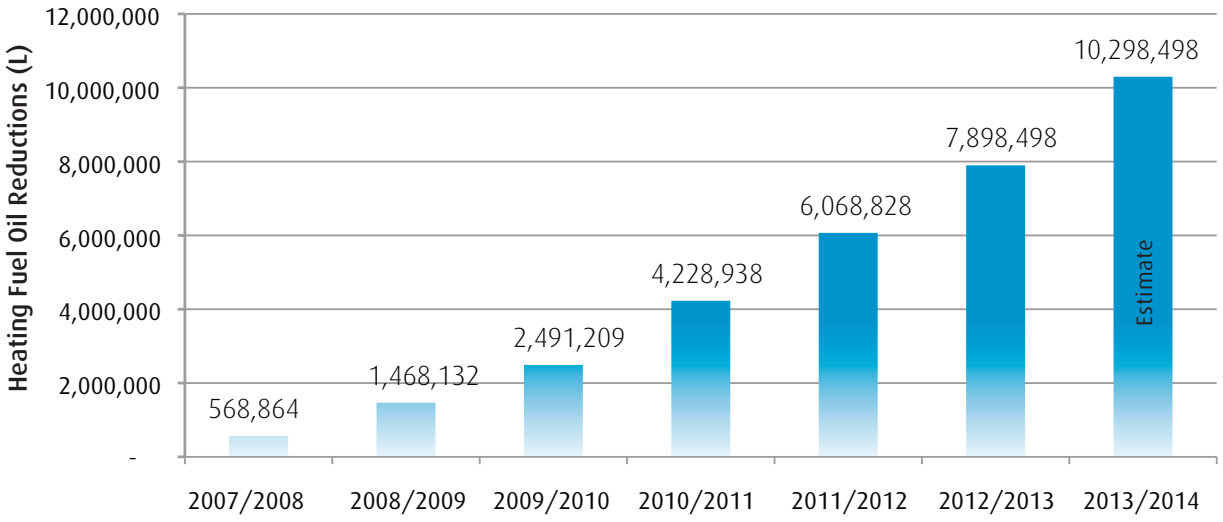



**Figure 2: Cumulative Heating Oil Displaced from the Use of Biomass in GNWT Facilities**

Of all the energy initiatives, biomass boilers are having the largest impact on reducing GHG emissions. Cumulative greenhouse emission reductions total over 21,563 since 2007 (Figure 3).

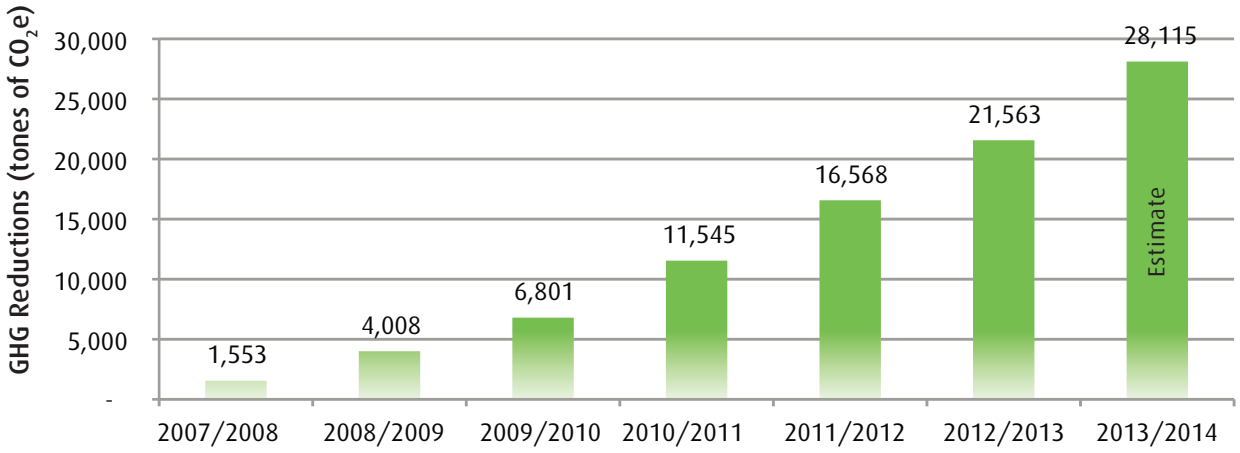



**Figure 3: Cumulative GHG Emissions Reductions from Biomass Boiler Installations**

# Biomass Projects Currently Underway

Past biomass projects have involved the retrofit of existing facilities. In 2012-2013, PWS is designing and constructing new facilities to include biomass boilers. These facilities include the new office building in Yellowknife and the new health centres in Hay River, Norman Wells and Fort Providence.

## New Office Building – Yellowknife

A wood pellet boiler will be connected to service the heating needs of the new office building as well as the existing Stuart Hodgson Building and Laing Building. The total anticipated heating needs of the three office buildings is approximately 323,000 litres of heating oil. The installation of a wood pellet boiler into the office building will displace approximately 275,000 litres of heating oil. Displacing this amount of heating oil equates to reducing greenhouse gas emissions by 751 tonnes.

## New Health Centre – Hay River

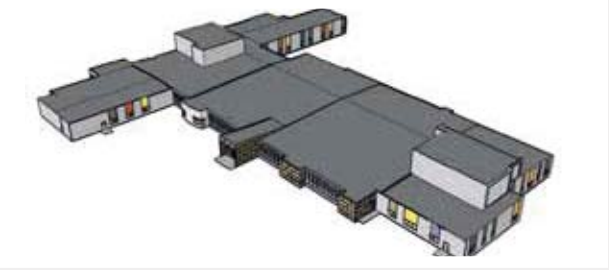
The boiler to be installed in the new Health Centre is currently estimated at 1250 kW with a portion of this capacity providing redundancy back up as required by code. This wood pellet boiler will offset heating oil at the new Health Centre by 244,000 litres annually. Greenhouse gas emissions will be reduced by an estimated 666 tonnes each year.

## New Health Centre – Fort Providence

A wood pellet boiler will be installed in the new Health Centre in Fort Providence. A residential style wood pellet boiler, smaller than 55kW, is currently proposed for the new facility. Although final design and estimates for annual fuel usage are not complete, it is estimated that a small wood pellet boiler in the Health Centre will offset heating fuel by 18,400 litres each year which will offset greenhouse gas emissions by 50 tonnes annually.

## New Health Centre and Long Term Care Facility – Norman Wells

Plans for a wood pellet boiler have been included as part of the design of the new Health Centre and Long Term Care Facility in Norman Wells. It is estimated that this wood pellet boiler could displace approximately 138,000 litres of heating oil, reducing greenhouse gas emissions by 377 tonnes each year. This will be determined after the building goes through the schematic design phase.



Above: Yellowknife – New office building
Top Right: Hay River – New health centre
Bottom Right: Fort Providence – New health centre

# Future Biomass Projects

In 2013-2014, PWS is planning to install biomass boilers into three facilities in Norman Wells, the Mackenzie Mountain School, the Airport Terminal Building and the Airport Combined Services Building.

## Mackenzie Mountain School – Norman Wells

During the mid-life retrofit of the Mackenzie Mountain School, there were considerations made for the inclusion of a wood pellet boiler into the system. This wood pellet boiler would be approximately 220 kW in size and would be housed in a new external boiler building.

A 220 kW wood pellet boiler would offset the use of fuel oil in the school by approximately 64,000 litres of heating oil annually. This would reduce greenhouse gas emissions by approximately 175 tonnes.

## Air Terminal Building – Norman Wells

The air terminal building in Norman Wells has also been identified for a potential wood pellet boiler installation. In anticipation of the switch off of natural gas, this heating system was recently retrofitted to burn heating oil. A 150 kW wood pellet boiler would be installed to supplement heating from the new oil fired system.

## Combined Services Building – Norman Wells

The Combined Services Building has a hydronic heating system which is currently serviced by natural gas boilers. There are also direct fired natural gas overhead radiant heaters for the garage space and direct fired make up air units.

To supplement the heating in this facility, PWS is proposing a 220 kW wood pellet boiler installed in an external boiler building. The system would tie into the existing hydronic network as well as supplement the direct fired radiant heaters by adding a hydronic unit heater for the garage bay.

# Biomass: Lessons Learned

PWS has completed fifteen biomass boiler installations since 2007. Many lessons have been learned from the installation and operation of these wood pellet boilers:

- ***Properly Sized Wood Pellet Boilers:***
  Sizing a wood pellet boiler to operate at peak efficiency during the heating season maximizes annual performance.

- ***Higher quality pellets produce less ash when burned:***
  Varying quality of pellets can produce more ash than expected and diminish efficiency in boiler operation.

- ***Maintenance cannot be overlooked:***
  Wood pellet boilers require additional maintenance when compared to the fossil fuel boilers. Proper maintenance and cleaning is important to ensure efficiency and optimize run time.

- ***Ash in flue gases:***
  Physical particulates are released in the flue gases of these pellet boilers. PWS has included the use of cyclones installations to reduce emissions of fine particulates.

- ***Anticipated vs. Actual Savings:***
  In theory it is possible to supplement up to 90% of the total annual heating load of a facility with a biomass boiler, close monitoring and optimization can help reach these targets.

- ***Moisture control:***
  Ensuring that pellets stay dry is important to ensure that pellets do not freeze and clump up, which can lead to auger jamming and expensive downtime.

- ***Training:***
  Ensuring that staff is properly trained on the boiler equipment will lead to successful operation.

- ***Building integration:***
  Ensuring that building heating controls are properly configured to ensure that wood pellet boilers operate as the primary heat source will increase annual savings.

**Elizabeth Mackenzie Elementary School – Wood Pellet Boiler installation**

# Electric Heat Conversions – Hydro

In 2008 the first two electric boilers were installed and commissioned to use surplus electricity from the Taltson Dam. This surplus electricity is provided by Northwest Territories Power Corporation (NTPC) to heat GNWT buildings in Fort Smith.

Since 2008, four buildings in Fort Smith have taken advantage of this renewable power source including the J.B. Tyrell Elementary School, Breynat Hall, the Department of Transportation Highways Maintenance Garage and the Northern Lights Special Care Home. These electric boilers have provided almost 100% of the total heating needs for each facility since the respective time of commissioning.

**Taltson Hydro Dam**

# Completed Projects

## J.B. Tyrell Elementary School – Fort Smith (2008)

Historical annual heating oil consumption for the J.B. Tyrell Elementary school was approximately 166,208 litres. Based on peak heating requirements for the school, an 810 kW electric hot water boiler was installed to provide 100% of peak demand heating with interruptible electricity. The existing oil-fired boilers remained in service as back up.

Installation of the electric boiler was completed and commissioned in November 2008. In 2012-2013, the electric boiler displaced approximately 86,652 litres of fuel oil, reducing greenhouse gas emissions by 237 tonnes. Since 2008 to the end of 2012-2013, cumulative savings total 455,920 litres, equivalent to reducing GHG emissions by 1,245 tonnes.

***J.B. Tyrell Elementary***

Boiler Type: .....Acme
Size: .....810 kW

## Breynat Hall – Fort Smith (2008)

One 720 kW electric hot water boiler was installed in Breynat Hall to offset heating oil by approximately 132,000 litres a year. This electric boiler is large enough to meet the peak heating demands at the Hall, and was commissioned in November 2008. In 2012-2013, the electric boiler displaced approximately 96,801 litres of fuel oil, reducing greenhouse gas emissions by 264 tonnes. Cumulative savings total 469,568 litres of heating oil, equivalent to reducing GHG emissions by 1,282 tonnes.

***Breynat Hall***

Boiler Type: .....Acme
Size: .....720 kW

## Highways Maintenance Garage – Fort Smith (2009)

One 83 kW electric boiler was installed to service the heating needs of the Highways Maintenance Garage. This boiler is sized to meet the peak heating needs of the garage. The existing oil-fired boilers remain in service as back up in case the interruptible power is shut off.

The electric boiler was installed and commissioned in the winter of 2009–2010. In 2012-2013, the electric boiler displaced approximately 24,088 litres of fuel oil, reducing greenhouse gas emissions by 70 tonnes. Cumulative savings since the date of commissioning total 100,301 litres of fuel oil, equivalent to reducing GHG emissions by 265 tonnes.

***Highways Maintenance Garage***

Boiler Type:..... Acme
Size:.....83 kW

## Northern Lights Special Care Home – Fort Smith (2012)

A project in conjunction with NTPC included the installation of a 400 kW electric boiler to carry 100% of the heating load in the facility. This project was commissioned in February 2013. The electric boiler will help offset approximately 77,000 litres of fuel oil annually, and will reduce GHG emission by approximately 210 tonnes. Savings for this project will be reported in the 2013-2014 annual report.

***Highways Maintenance Garage***

Boiler Type:..... Acme
Size:.....83 kW

# Electric Heat Summary

The collaboration between NTPC and PWS to use hydro electricity from the Taltson Dam has displaced approximately 1,022,584 litres of fuel oil since the commissioning of the first electric boiler project to the end of 2012-2013 (Figure 4).

This represents an offset of greenhouse gas emissions of approximately 2,292 tonnes (Figure 5).

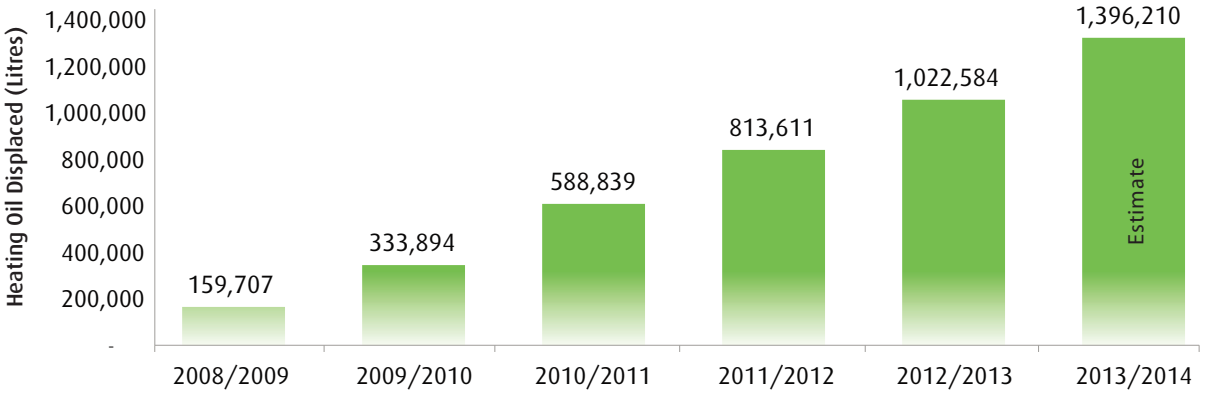



**Figure 4: Cumulative Heating Oil Savings from Electric Heat Conversion Projects in Fort Smith**

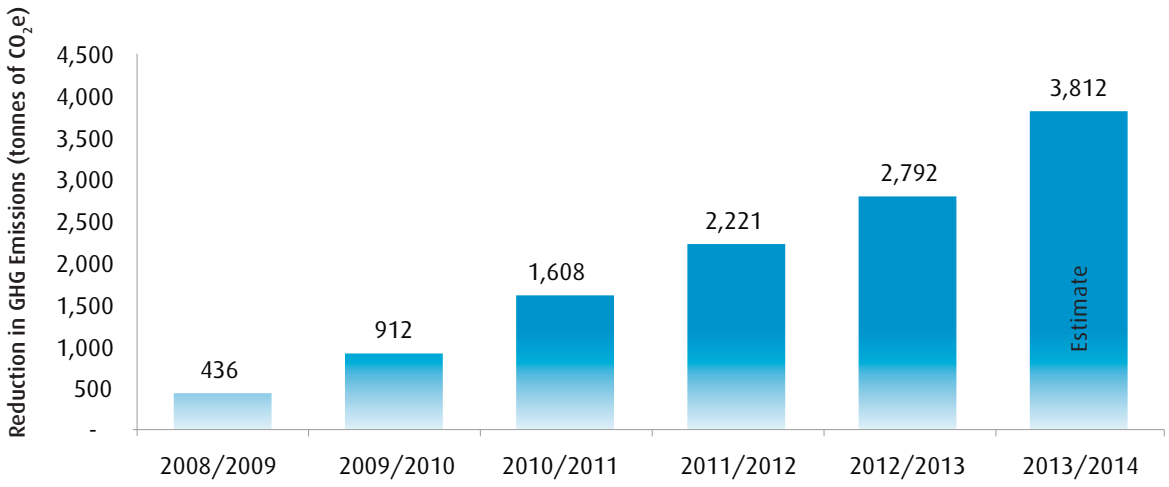



**Figure 5: Cumulative Greenhouse Gas Reductions from the Installation of Electric Boilers in Fort Smith**

# Heat Recovery Projects

Heat recovery is an excellent conservation measure to help reduce heating costs and GHG emissions. Heat energy can be recovered in many ways; in the NWT this has typically been done by recovering the internal heat gain in facilities and heat produced from electricity generators as a by-product.

## Data Centre – Yellowknife

The new GNWT Data Centre in Yellowknife was commissioned in January 2011, and is currently being heated by oil-fired hot water boilers located in the adjacent GNWT Central Warehouse via underground heating mains. Two heat pumps were installed in the mechanical room of the Data Centre to reuse the heat generated from servers and other computer equipment that would otherwise be exhausted outside. Initially, this excess heat will be used to heat the Data Centre's space heating needs.

Ultimately, after a full build out of servers in the Data Centre, the amount of recoverable residual heat will be such that not only will the total heat load of the Data Centre be provided for, but also a portion of the GNWT Central Warehouses.

## Chief Julius School – Fort McPherson

A residual heat recovery system has been installed in the Chief Julius School for many years. The school utilizes heat produced from the NTPC power generation plant in the community to offset its own heating oil boilers. In 2008, NTPC completed a controls upgrade to improve the reliability of the system and increase performance of the residual heat system. In 2012-2013, this residual heat system offset the use of heating oil by 91,053 litres, equivalent to removing 249 tonnes of greenhouse gas emissions.

## Mezi School – Whatì

The Mezi School in Whatì is partially heated by the residual heat from NTPC's power generating plant in the community. Modifications and optimizations to the system have helped increase the amount of residual heat used at the school. In 2012-2013, this residual heat system displaced approximately 30,000 litres of heating oil, representing a 50% reduction in heating oil usage and greenhouse gas emission savings of 85 tonnes. NTPC is looking into improving the performance of this heat recovery system.

## Echo Dene School – Fort Liard

A project to provide residual heat from the NTPC generating plant to various buildings in Fort Liard included the Echo Dene School. This project was completed in 2011 and since then has provided almost 80% of the heating required by the school. In 2012-2013, this residual heat system displaced 43,986 litres of heating oil. This represents a greenhouse gas reduction of 120 tonnes.

## QUICK FACT

*In the 2012-2013 fiscal year, 33% of the total energy used by PWS-managed buildings was from a renewable source.*

# Capital Asset Retrofit Fund (CARF)

The Capital Asset Retrofit Fund (CARF) was established to improve energy efficiency of existing GNWT assets. The program assists the government in reducing building operating costs and greenhouse gas emissions in the Northwest Territories. Without retrofits, these assets will continue to deteriorate, increasing operation and maintenance costs and shortening their overall service life.

This program continues to be an important initiative for the Government of the Northwest Territories. It improves performance and reduces the costs associated with operating government owned infrastructure while supporting the government's objectives in reducing greenhouse gas emissions and our reliance on fossil fuels.

Assessing GNWT facilities to prioritize and target program funding to achieve the greatest return on investment remains pivotal to this programs overall effectiveness. This program, along with other energy conservation initiatives implemented by PWS, has contributed towards the GNWT's goals of displacing fossil fuels and greenhouse gas emissions in the Northwest Territories.

## Process for Selecting Retrofit Projects

**Data Collection**

Utility information is collected through the GNWT Finance System for Accountability and Management (SAM). This system tracks utilities for all GNWT assets managed by PWS.

Occasionally, If data cannot be verified, potential candidate buildings are monitored by the installation of data loggers to ascertain actual energy consumption figures.

**Benchmarking**

Energy benchmarking of like facilities (schools, health centres, offices, etc.) is conducted using the utility information from the SAM system.

**Building Assessment**

High energy use and energy intense buildings are prioritized and selected for a detailed energy audit. Operation and energy performance (kWh/$m^2$, \$/$m^2$...) of the facility is analyzed and used to identify energy management opportunities. Each "measure" is accompanied by energy savings, GHG reductions and a cost/payback analysis.

Technical Status Evaluations (TSE's) and thermal scanning are completed on GNWT assets. These evaluations are a snapshot condition assessment of a facility which identifies operational and code related deficiencies and opportunities for energy conservation.

**Project Prioritization**

Facilities selected for upgrading are placed, by priority, into the CARF Plan for implementation. These energy retrofit projects are sometimes prioritized by region, type of retrofit (innovation), payback and the impact on the environment.

**Develop Scope of Work & Implementation**

All information gathered is analyzed and a detailed scope of work for an energy retrofit is developed. Where possible, this scope of work is developed in conjunction with Deferred Maintenance to achieve better economies of scale and cost savings for project management.

# Energy Auditing & Benchmarking

Since the fiscal year of 2010-2011, PWS has been responsible for the utility budget for the majority of the GNWTs assets. Since that time, PWS has also been using the governments' financial system to track utility usage of each GNWT asset. This information enables PWS to gather utility information from numerous buildings to assess and compare building energy and cost intensities. This benchmarking enables PWS to compare similar buildings such as schools, health facilities and office buildings to determine which buildings have a larger than average energy intensity.

Energy Usage statistics such as total energy intensity in kWh-$m^2$, utility cost intensity in $-$m^2$, energy intensity normalized by degree days (kWh-1000 HDD-$m^2$) and the total cost of utilities help PWS identify candidates for energy audits and-or upgrades. Buildings with high energy intensities and utility costs are targeted to reduce energy usage. Below displays a cost intensity benchmark for office buildings that was updated with 2011-2012 fiscal year utility information (Figure 6).

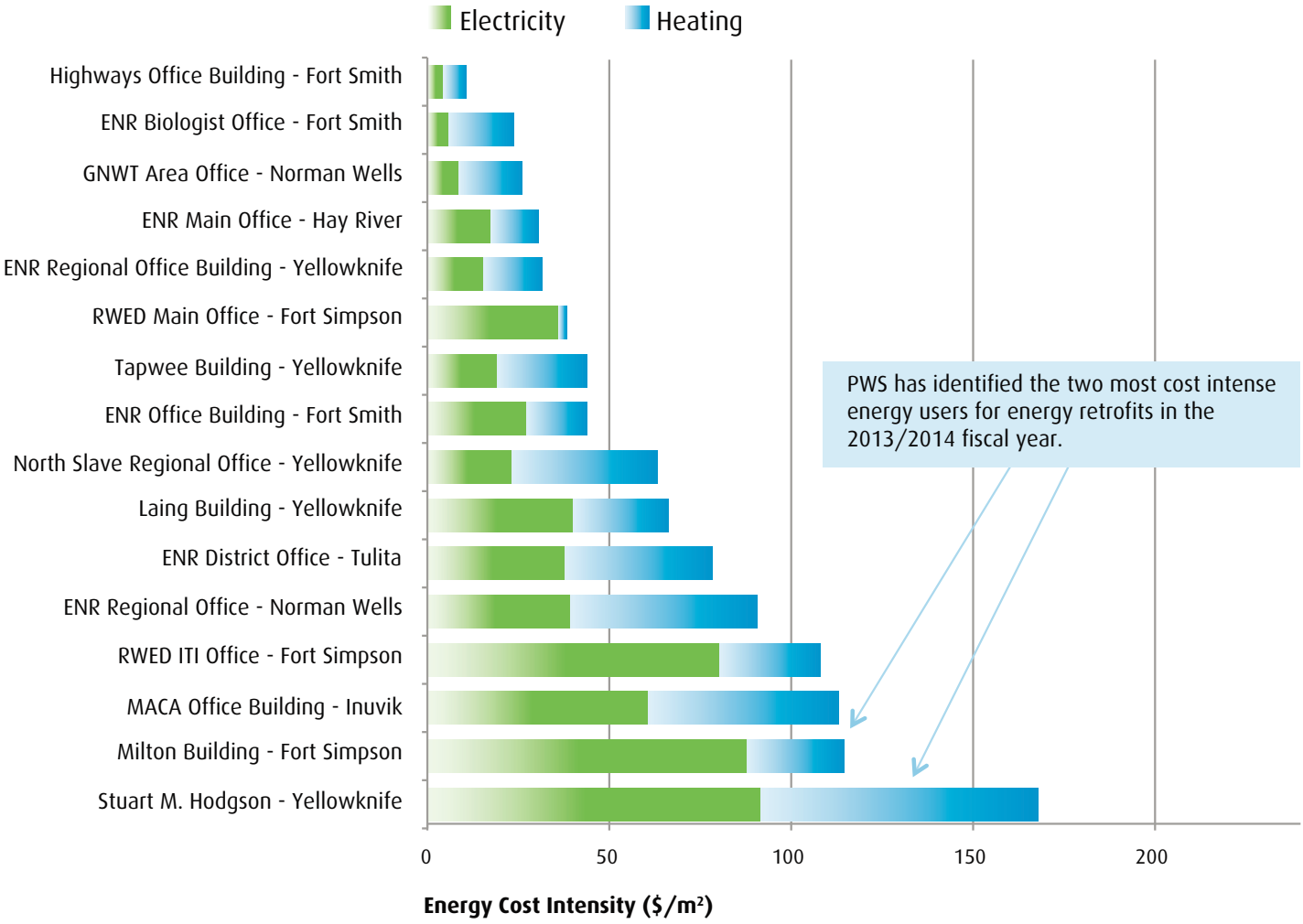
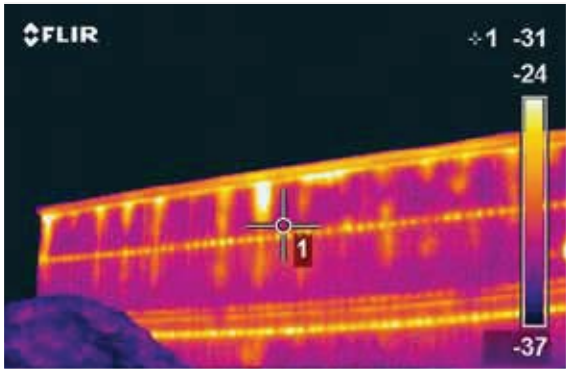



**Figure 6: Cost Intensity breakdown from 2011-2012 Benchmarking of GNWT Office Buildings over 250 $m^2$**

# Thermal Analysis

Infrared thermal scanning surveys are carried out to assess the condition of a buildings envelope and can immediately identify energy saving opportunities. Thermal scanning of a building can also identify issues such as glycol leaks in radiant floor slabs, pinpoint poor electrical connections find leaks in roof and wall assemblies and locate moisture inside a building. Since the implementation of thermal scanning in 2006, over 420 GNWT and municipal buildings have been scanned in almost every community across the NWT. Ten infrared thermal scans surveys were conducted in 2012-2013 in Yellowknife and Whatì.




# Detailed Energy Audits

Detailed Energy audits are conducted on buildings that have been identified by PWS as high energy users. Deliverables from an energy audit include a complete building and system description, a comparison of historical energy usage with weather data, an outline of energy usages by type (i.e. lighting, space heating, domestic water heating, etc.), identification of potential energy saving measures and operating benefits, cost estimates and returns on investments.

PWS has completed 51 energy audits on various GNWT buildings. Energy audits are typically done on larger facilities and in 2011-2012 five facilities were audited in Fort Smith and Yellowknife: PWK High School, Northern Lights Special Care Home and Breynat Hall, Legislative Assembly Building and the Arthur Laing Building.

## QUICK FACT

*Although the average number of heating degree days across the NWT were up in 2012-2013 by 3.4%, PWS-managed assets heat requirements remained relatively constant (decreased by 3%).*

# 2012-2013 CARF Projects

With information gathered from benchmarking, energy auditing, technical status evaluations, deferred maintenance evaluations and maintainer input, PWS puts together a work plan to complete energy retrofits on the assets that would most benefit from this work.

In 2012-2013, a number of energy retrofits were completed in many communities across the NWT. These projects will help to improve the energy efficiency of the assets and in some cases, prolong the useful life of certain equipment. Projects completed in 2012-2013 are detailed on the following pages.

## *Typical Energy Retrofit Measures*

PWS in support of the GNWT energy conservation and energy efficiency initiatives and programs will continue to promote the incorporation of energy-saving practices and technologies into the overall design of new and retrofit projects involving in its facilities. Buildings and assets are designed and operated to minimize operating and maintenance costs, electricity and fossil fuel use, and to minimize greenhouse gas emissions. In addition to the actions listed elsewhere in this report, technologies or methods used to reduce energy use and costs include, but are not limited to, the following:

- Upgrading of building envelopes to achieve air tightness and thermal resistance levels suitable for a "made in the North" standard for our climate.
- Selection of low maintenance and durable cost-efficient equipment and maintenance practices, requiring low future re-investment and having an amply long service life. For example, PWS uses energy-efficient infrared sensors on domestic water faucets.
- Energy-efficient equipment such as condensing boilers, high-efficiency motors, and high efficiency heat exchangers are considered at the design stage.
- The use of variable frequency drives on motors and pumps in ventilation and heating systems for increased efficiency.
- Sizing of equipment such as boilers, pumps, motors, and air conditioners to maximize their efficiency.
- Reducing domestic water usage by selecting low flow fixtures, such as toilets, faucets, and showerheads.
- The use of energy-efficient "Energy Star" appliances.
- The use of heat recovery from exhaust ventilation air to preheat fresh air. Heating loads for fresh air can be considerable, and heat recovery reduces the amount of fuel-fired or electrical air heating required. Heat wheels are used in some of the largest facilities and heat recovery ventilators are sometimes used in small buildings.
- Selection of energy-efficient lamps and lighting systems suited to the application. Most GNWT buildings have been converted to energy-efficient T8 lighting.
- Use of day-lighting in buildings to reduce the need for electric lighting.
- Use of occupancy sensors and photocells to turn off lights or equipment when not needed.
- Sealing of doors and windows to stop air infiltration.
- Ensuring thermostatic and zone valves are located properly and operate correctly.
- Heating and ventilation system set-backs. Heating-cooling levels can be automatically reduced when offices are not in use, such as during nights and weekends. Air-conditioning can be shut off during weekends.
- Use of LED technology to save energy. LED lights are the current standard for exit signs, for example.
- Using Direct Digital Control systems, where suitable, to control equipment schedules and set points and to match the amount of heating and cooling required to the building conditions. The DDC systems can monitor occupancy levels to provide only as much ventilation air as is needed.

## Moose Kerr School – Aklavik

Due to the high cost of utilities at the Aklavik School, an energy audit was completed in 2010. Based on the recommendations of this energy audit, a ventilation optimization and lighting upgrade was completed to help improve the energy efficiency at the school. Total energy related projects will result in the savings of roughly 22,600 litres of heating oil and a greenhouse gas emission reduction of 75 tonnes of CO2e (includes GHG savings from reducing electrical consumption each year). In 2012-2013, the lighting and HVAC retrofit helped reduce greenhouse gas emissions by 22 tonnes, representing a reduction of 8,365 litres of heating oil.

## Regional Hospital – Inuvik

The Regional Hospital in Inuvik is one of the highest energy users in the GNWT. An energy audit completed in 2010 provided numerous energy management opportunities to help reduce the energy use at the hospital. This project was started and was completed in January 2013. It involved the installation of variable frequency drives on a number of pumps and fan motors and a re-balancing and update of HVAC controls. In 2012-2013, this project helped reduce greenhouse gas emissions by 340 tonnes, representing a heating oil reduction of 124,335 litres.

## Helen Kalvak School – Ulukhaktuk

An energy audit completed in 2011 on the Helen Kalvak School recommended several energy management opportunities. In 2012-2013, a project to upgrade the HVAC controls system at the school, implement demand control ventilation and upgrade lighting fixtures was completed. This project is anticipated to save approximately 28 tonnes of GHG emissions while saving 10,300 litres in heating fuel annually.

## Angik School – Paulatuk

Based on an energy audit completed in 2009, a retrofit project at the Angik School was initiated to help increase the energy efficiency at the school. This project included the installation of efficient plumbing fixtures, replacing large pumps and fan motors with premium efficiency motors and replacing incandescent exit lights with LED style. It was completed in 2012-2013, This retrofit will help reduce GHG emissions by 45 tonnes and save 16,864 litres of heating oil annually.

## Deh Gah School – Fort Providence

An energy audit at the Deh Gah School was completed in 2009. This energy audit recommended upgrading the HVAC controls, implementing demand control ventilation and occupancy sensors for lighting. This work was completed in 2012-2013. Including this project and the previous retrofit of the boilers, total GHG reductions of 168 tonnes were realized, representing a reduction of approximately 61,597 litres of heating oil.


## Chief Sunrise School – Hay River Reserve

As part of the deferred maintenance program, the Chief Sunrise School is undergoing a mid-life retrofit. Part of this project included upgrading the HVAC controls to a DDC system. CARF contributed funding towards the upgrade of the heating and ventilation controls. This retrofit is intended to displace approximately 16 tonnes of greenhouse gas emissions annually, equivalent to displacing 5,700 litres of heating oil. Savings will be reported in the 2013-2014 annual report.

## Northern Lights Special Care Home – Fort Smith

A project had been approved to install an electric boiler to supplement the heating load in the Northern Lights Special Care Home with excess power from the Taltson Dam. In an effort to increase the savings potential of this project, CARF provided additional funding to connect the domestic hot water load to this new electric boiler. Adding this change to the project scope will help save an additional 5,500 litres of heating oil and reduce greenhouse gas emissions by another 15 tonnes each year.

## Chief Jimmy Bruneau School – Behchoko

A ventilation study indicated that the Chief Jimmy Bruneau School was in need of an air handling retrofit to replace old units and bring the ventilation rates up to current code. CARF assisted with the funding of this mid-life retrofit of the ventilation equipment which will yield significant savings when a single air handler is split into two smaller units to properly service the spaces. It is estimated that total energy requirements in the school will be reduced by almost 836 GJ a year. No additional greenhouse gas savings will be realized since this building is on hydroelectricity and the majority of the heating is already provided by a wood pellet boiler.

In addition to the 2012-2013 CARF projects, many retrofits have been completed as part of the CARF program in the past three years. These projects include:

## Nurses Residence – Inuvik

An exterior retrofit was completed on the Nurses Residence in Inuvik. The building was to be re-cladded; CARF assisted with the project by adding funding to increase the level of insulation in the walls. A small lighting retrofit was also included in the project. In 2012-2013, this additional insulation helped reduce heating oil consumption by approximately 500 litres, reducing 1.4 tonnes of greenhouse gas emissions.

## Mackenzie Mountain School – Norman Wells

The school in Norman Wells has undergone a major mid-life retrofit that has been primarily funded by the deferred maintenance program. CARF assisted with the mechanical and plumbing retrofits as it resulted in additional energy and water savings along with the newly installed equipment. In 2012-2013, almost 96,000 litres of heating oil was reduced, resulting in a reduction of 262 tonnes of greenhouse gas emissions.

## Stuart Hodgson Building – Yellowknife

CARF assisted with the optimization of the ventilation equipment at the Stuart Hodgson Building. Zone control with night setbacks, heat recovery and VFDs for better demand control were included as part of the ventilation upgrade. In 2012-2013, this retrofit reduced the need for approximately 250,000 kWh of electricity. This doesn't reduce greenhouse gas savings as the electricity is produced from hydro, but has improved the buildings overall energy efficiency and reduced operating costs.

## Maintenance Camp – James Creek

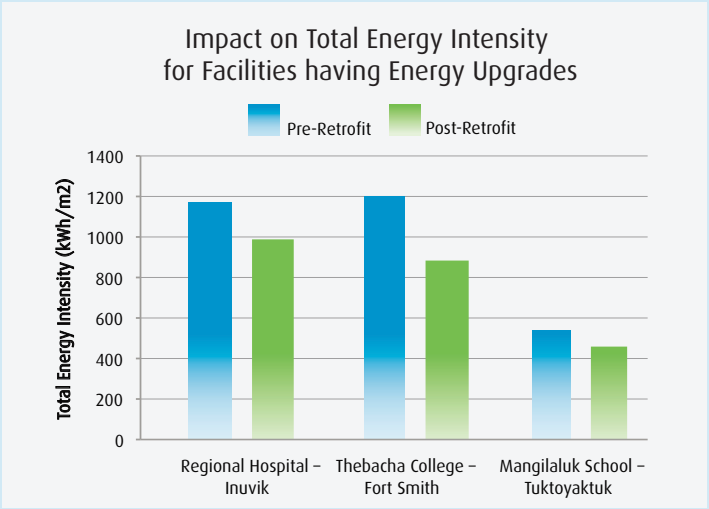
Generators at the James Creek Maintenance Camp were re-sized to better meet the actual demand on the system. This increase in efficiency is expected to offset the use of approximately 9,259 litres of diesel annually, reducing annual greenhouse gas emissions by approximately 25 tonnes a year.

## Thomas Simpson School – Fort Simpson

The Thomas Simpson School was undergoing an upgrade to replace its exterior cladding. CARF funding was added to this project to help increase the level of exterior insulation for the building. In 2012-2013, this exterior retrofit helped save approximately 7,985 litres of heating oil, reducing greenhouse gas emissions by 22 tonnes.

## Thebacha College – Fort Smith

A project to add cooling capacity at the Thebacha College also included the installation of a new HVAC controls package and an upgrade to the existing control system. The upgrades to the HVAC controls will increase efficiency in the building while maintaining occupant comfort. In 2012-2013, approximately 3,802 litres of heating oil was saved, reducing greenhouse gas emissions by 11 tonnes.




### Impact of CARF projects on energy intensity of facilities

Energy retrofits have had a significant impact on the performance of GNWT assets. In some cases, the energy retrofits are producing large reductions in total energy usage, such as the controls upgrade at the Thebacha College.

# EMERGING TECHNOLOGY CASE STUDY – Light Emitting Diode (LED)

The use of LED lighting technology is not new, but in recent years the technology has become more commercially available to use for exterior lighting applications, high bay lighting, standard incandescent, CFL and strip lighting replacements. Benefits of LED lighting include:

- Long life (up to 50,000+ hours)
- Maintenance savings from extended replacement schedules
- Dimmable with instant on/off

Drawbacks of this new technology include:

- High costs of fixtures and components
- Comparable efficiency to HIDs and fluorescents (minimal energy savings from replacements)
- 1:1 retrofits can be difficult due to different lighting levels and throw patterns

## LED Exit Lights

The use of LED technology in exit lights has very common. Retrofits from old incandescent style exit lights to LED type benefit from energy savings as well as longer lamp life. With savings of up to 38W per fixture (compared to an incandescent) and lamp life of over 10 years, it is easy to see why LED's have become the standard for exit sign lighting.

## LED's for New Building Design

PWS has begun to incorporate the use of LED's into the design of new buildings. Typically the rationale for the use of LED fixtures is to save on ongoing maintenance and future energy costs. A few examples of where these fixtures are being utilized include:

- ***GNWT Office Building:***
  PWS is planning to use LED fixtures in the new GNWT office building elevator lobbies, exterior high height lighting and parking area. These areas are being selected to reduce operating costs and future energy savings.
- ***Norman Wells HC/LTC:***
  LED lighting will be used at the new health centre and long term care facility for all exterior lights and select interior lights. The use of LED lights will also allow for motion sensing technology to be used. Again, this installation will reduce maintenance costs for change-outs and the ability to use motion sensors will help reduce energy usage.

*Exit sign at Moose Kerr School has been upgraded to code compliant LED exit light.*

*High bay LED fixtures utilized in the Diamond Jenness Secondary School atrium provide sufficient lighting with longer lamp life.*

## Use of LED Lighting in Existing Buildings

In the last two years, PWS has begun to retrofit certain lighting with LED technology. Typically PWS will consider retrofitting existing light fixtures for exterior lights and high bay lighting due to the impacts on maintenance savings from reducing the number of change outs.

During the midlife retrofit of the Diamond Jenness Secondary School in Hay River, LED fixtures were installed in the atrium of the school. This measure helps reduce ongoing maintenance costs of replacing burnt our fixtures in this high bay area. This midlife retrofit also included the use of LED row lighting at the lower ceiling of the atrium to allow the lights to be manually dimmed for adequate light levels based on the amount of natural light entering from the skylights.

*1 x 4 LED fixtures used around perimeter on 1st and 2nd floor with dimmable control for user adjustment to daylight levels.*

## Energy Efficient Fluorescent Lighting Upgrades – Beaufort Delta & Sahtu Area

Fluorescent lighting retrofits were completed at the following facilities:

- The Moose Kerr School, Aklavik
- Air Terminal Building, Aklavik
- Health Centre, Aklavik
- Community Learning Centre, Aklavik
- Grandfather Ayha School, Deline
- Health Centre, Fort Good Hope
- Community Learning Centre, Tuktoyaktuk
- Health Station, Tuktoyaktuk
- Mangilaluk School, Tuktoyaktuk
- Health Centre, Fort McPherson
- Health Centre, Tsiigehtchic
- Health Centre, Sachs Harbour

This work included an upgrade to more efficient fluorescent lighting and the addition of occupancy sensors in spaces. The work was completed in 2011 and in 2012-2013; approximately 120,000 kWh of diesel produced electricity was reduced. The net reduction in greenhouse gas emissions from these lighting projects was 58 tonnes in 2012-2013.

# Additional Energy Conservation Projects

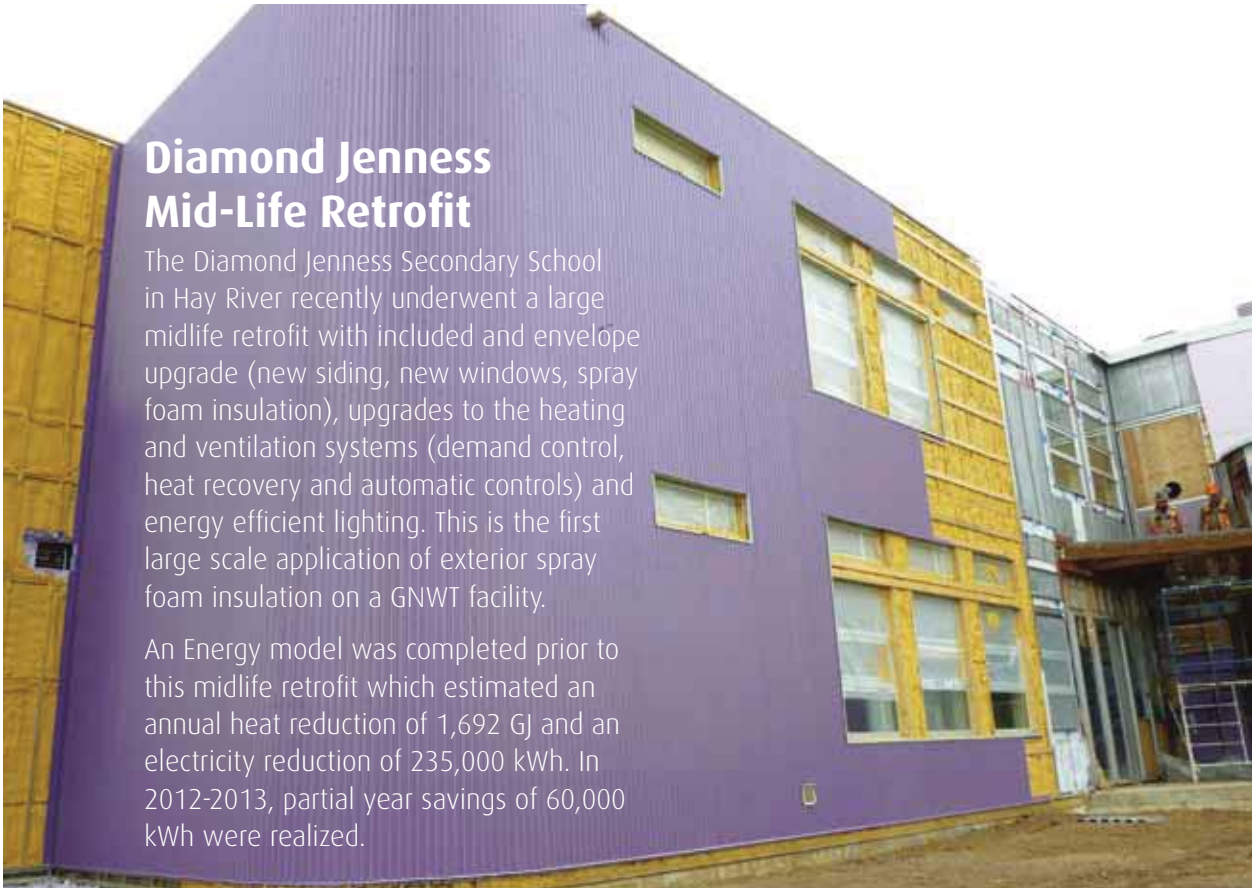
In addition to energy saving projects such as biomass, electric heat and energy retrofits, many projects that PWS undertakes to update-upgrade facilities in need of mid-life retrofits or capital upgrades result in significant energy savings.

Reviews of the central steam plant in Fort Simpson led to the conversion of the aging inefficient high-pressure steam boiler system to a new low-pressure network. Significant savings as a result of this project were realized as overall plant efficiency was increased. In 2012-2013, this conversion displaced approximately 146,300 litres of heating oil, reducing greenhouse gas emissions by 400 tonnes.

Facilities such as the GNWT's Central Warehouse (Yellowknife), North Slave Regional Office (Yellowknife) and the Ndilo Gym were reviewed through Technical Status Evaluations to identify deficiencies in the buildings and to suggest ways to upgrade the facilities. This resulted in replacing the existing central control systems in each of the buildings with direct digital controls.

In 2012-2013, the Central Warehouse energy retrofit project produced 10,051 litres of heating oil savings, equivalent to GHG emission reduction 27 tonnes.

The North Slave Regional Office energy retrofit displaced 12,726 litres of fuel oil in 2012-2013. This reduction in fuel oil is equivalent to a GHG emission reduction of 35 tonnes.



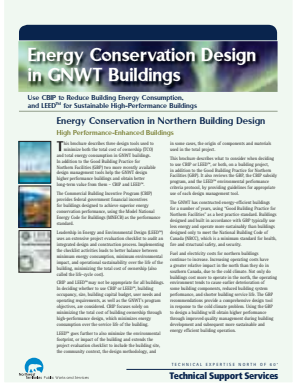
## Diamond Jenness Mid-Life Retrofit

The Diamond Jenness Secondary School in Hay River recently underwent a large midlife retrofit with included and envelope upgrade (new siding, new windows, spray foam insulation), upgrades to the heating and ventilation systems (demand control, heat recovery and automatic controls) and energy efficient lighting. This is the first large scale application of exterior spray foam insulation on a GNWT facility.

An Energy model was completed prior to this midlife retrofit which estimated an annual heat reduction of 1,692 GJ and an electricity reduction of 235,000 kWh. In 2012-2013, partial year savings of 60,000 kWh were realized.

# Initiatives in Energy Efficient Design and Construction

PWS is involved in many areas of energy efficient design and construction. From national code development to commissioning of northern facilities, many of the day to day activities and mandates of PWS have a direct impact on the use of energy and how buildings are designed and constructed in the North.


Energy Conservation Design in GNWT Buildings

Use CBP to Reduce Building Energy Consumption, and LEED® for Sustainable High-Performance Buildings

Energy Conservation in Northern Building Design

High Performance–Enhanced Buildings

Technical Support Services

GNWT facilities are designed for efficiency, reliability and ease of operation. National Code Development

## National Code Development

PWS's technical staff continues to participate in national energy-related code development committees. PWS has one representative on the Building Energy Codes Collaborative.

One staff member serves on the National Research Council Standing Committee for Energy Efficiency in Buildings (SC-EEB), developing the National Energy Code for Buildings (NECB), and provides technical input, with a northern perspective, for the development of the 2015 edition of the NECB. The 2015 NECB will increase the level of energy efficiency above that of the 2011 NECB, based on the terms of reference of the NECB. These include: preparing recommendations for requirements for energy efficiency in the NECB related to: building envelope, water heating, lighting, heating, ventilating and air-conditioning systems, and electrical power. The SC-EEB:

- prepares recommendations to the Canadian Commission on Building and Fire Codes (CCBFC) regarding the technical content of documents within its terms of reference
- is responsible for developing objective-based versions of the requirements within its terms of reference
- advises the CCBFC regarding changes to the scope and application of the NECB and to the SC-EEB matrix
- advises the CCBFC concerning the need for documents ancillary to the NECB and for progeny documents for subjects not within the current scope of the NECB
- advises the CCBFC concerning the need for standards to be referenced by the NECB and identifies needed changes to those standards
- advises the CCBFC on the need for code-related research.

PWS staff also serves on a CSA Technical Subcommittee developing a series of 10 CSA standards on building energy consumption estimation: the CSA C873 series, Building Energy Estimation Methodology. This provides a means for assessing the overall energy efficiency of buildings, without the need to perform hourly computer calculations.

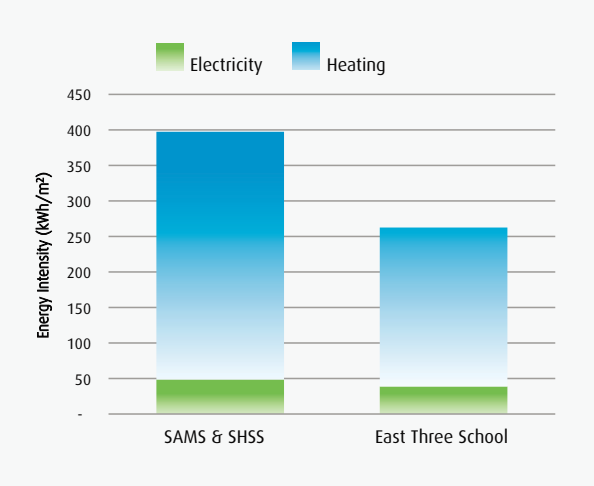
PWS is also involved in the Public Infrastructure Engineering Vulnerability Committee (PIEVC), which studies the impact of climate change on northern engineered infrastructure, and with the Building Technology Transfer Forum (BTTF), which meets to share new technology information across many jurisdictions.

PWS is also participating in the development of an ASHRAE Cold Climate design guide, slated for publication in fall 2014.

# CASE STUDY: Replacement of Schools (Inuvik)

In 2012-2013, the new East Three School was completed. The school is kindergarten to grade 12 and replaces the existing Sir Alexander Mackenzie School (SAMS) and the Samuel Hearne Secondary School (SHSS).

Based on the energy modelling completed, the East Three School will perform substantially better than a base building adhering to the standards of the Model National Energy Code for Buildings (MNECB). Energy efficiency measures that were employed in the design of the new school included the use of heat recovery on ventilation equipment, efficient lighting fixtures and daylight harvesting control, efficient boiler plant, demand control ventilation with the use of variable frequency drives and increased roof and wall insulation levels. The increase in energy efficiency over the combined two schools is shown below.




**Normalized comparison of the energy usage of new East Three School and the combined totals of the two existing schools during the heating season of 2012/2013. 2011-2012 utility data was used for the two existing schools.**

In the first 7 months of operation, the new school was 20% more efficient with electricity usage and 36% more efficient in heating than the two old schools combined. At the current rate for electricity and synthetic natural gas in Inuvik, the reductions in energy consumption have helped the GNWT save approximately $286,000 in operational costs.

*Former Sir Alexander Mackenzie School and Samuel Hearne Secondary School*

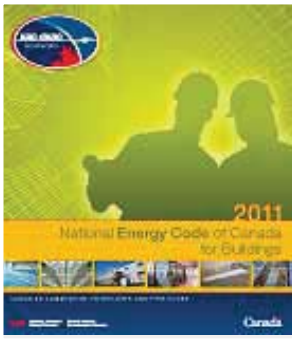
*Recently completed East Three School*

# Energy Modelling

PWS requires that the design for all large facilities follow a review process which in part requires an energy modelling workshop. This energy modelling workshop brings energy modellers, designers, PWS technical staff and the end user together to discuss the intended use of the building and how it can be constructed to perform as efficiently as possible, while still meeting all functional requirements of the end users.

PWS typically requires that the energy performance of new buildings and additions must be 10% more efficient than that of a base building built to the 2011 NECB. In the 2012-2013 fiscal year, energy modelling was conducted on the new Hay River Health Centre.

Typical items that are modelled include various types of insulation, its thickness and application method, heating systems (high temperature, low temperature), boiler plant options (condensing boilers, biomass, geothermal), window glazing, control strategies and a number of other items that all have an effect on the performance of the building. The effect of each individual measure is modelled to determine energy savings and impact on up-front capital costs. The outcome of the energy modelling workshop assists the designers, PWS technical staff and end users in selecting a design that optimizes both energy performance and capital costs.



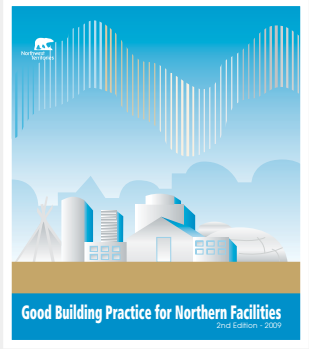

The 2011 NECB is 25% higher efficiency requirements than the MNECB 1997. The 2015 will have improved efficiency standards and will introduce energy use intensities for 10 building types.

# Good Building Practice for Northern Facilities (GBP)

The Third Edition of Good Building Practice for Northern Facilities (GBP) was published in 2011, and is posted on the PWS website. This document is a best practice guide for designing and constructing efficient and reliable buildings in the North. A recent study found that a building built to the GBP performs approximately 10% better than a similar base building built to the NECB 2011.

Since the publishing of the original GBP guideline in 2000, PWS has assisted with the design and construction of over 20 buildings built to the recommendations of the GBP. Additionally, there are five facilities which are currently in design-construction stages utilizing the GPB guidelines, including the Long Term Care Facility in Behchoko, the new Health Centre in Hay River, the new GNWT Office Building in Yellowknife, the new Norman Wells Health Centre and Long Term Care Facility and the Fort Providence Health Centre.

All new and renovated GNWT buildings incorporate the GBP guidelines during their design and construction. PWS has an active role in ensuring that all designers and contractors follow these guidelines by: reviewing drawing submissions at various stages of design completion, conducting site walkthroughs, and follow-up visits during construction, substantial inspection, and commissioning of new facilities.




In general, a building designed to the GBP guidelines will perform 10% better than a building designed to the NECB 2011.

# Performance Verification & Commissioning

The performance verification and commissioning process ensures that the GNWT is provided with a building which meets all design requirements and operates as intended. This ensures a code-compliant, healthy, and comfortable environment for occupants and a building that operates at peak efficiency to reduce energy consumption, operating costs, and greenhouse gas emissions. When building systems function as designed, and operations and maintenance staff is well prepared to operate and maintain the buildings, long lasting efficiency is achieved.

PWS completes functional performance checks to ensure that all equipment is installed and operates in accordance with original design documents. In 2012-2013, PWS was involved with the commissioning of the new East Three School in Inuvik, multiple water treatment facilities, Phases 2 & 3 of the Diamond Jenness School Renovations in Hay River, biomass projects in Yellowknife, Behchoko, Fort Simpson and Fort Providence and various energy retrofit projects in Aklavik, Paulatuk, Ulukhaktuk, Inuvik, Hay River Reserve, Fort Smith and Fort Providence.


Commissioning GNWT Funded Buildings

Building Commissioning Optimizes Building Energy Conservation, Operation And User Satisfaction

What is Building Commissioning?

Building Commissioning Is The Key To Quality Assurance

Commissioning Process

Technical Support Services

Commissioning of GNWT facilities ensures efficient building operation and end user satisfaction.

# Consolidation of Utilities

In 2010–2011, the responsibility for utility payments for all GNWT assets was transferred to PWS.

Utility expenditures for PWS-managed assets totalled $28,793,460 in 2012-2013 (Figure 6).

The utility budget is dominated by electricity costs with over 50% of the total utility budget spent on the purchase of electricity. The purchase of heating oil is the second largest budget item which accounts for approximately a quarter of the annual budget.

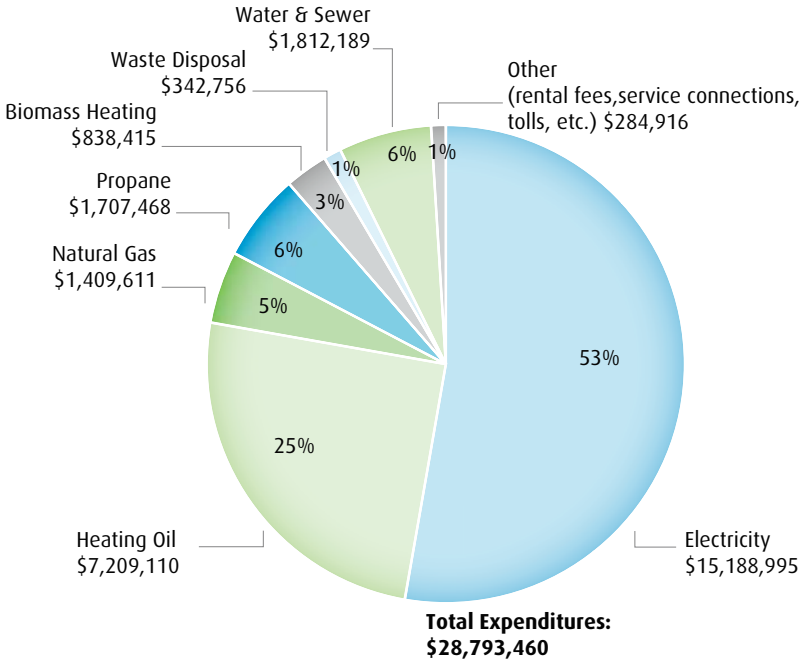



**Figure 6: Utility Expenditures Distribution by Utility Type for 2012-2013**

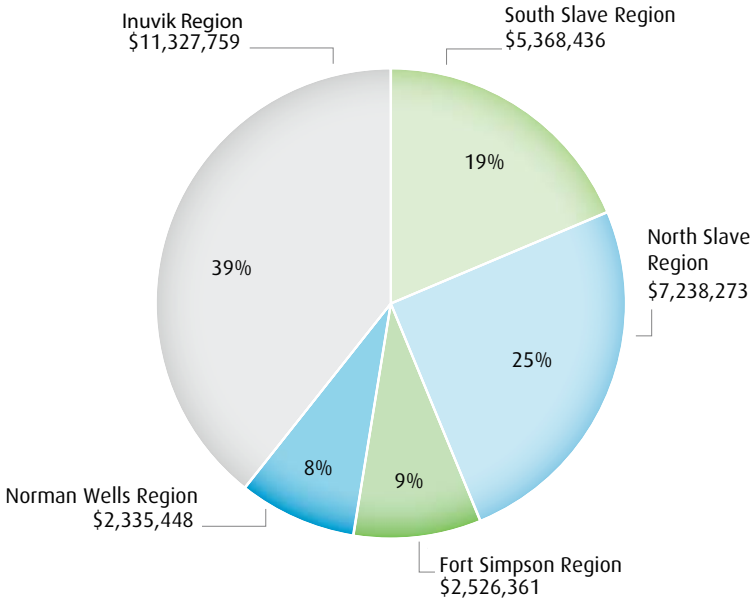



**Figure 7: Utility Expenditure Distribution by Region for 2012-2013**

Utilities can also be tracked by department (Figure 8). Utility budgets for a department are dictated by the programs they provide. The Departments of Health and Social Services and Education, Culture and Employment have the largest budget requirements as they have the largest amount of floor space to effectively provide their respective programs.

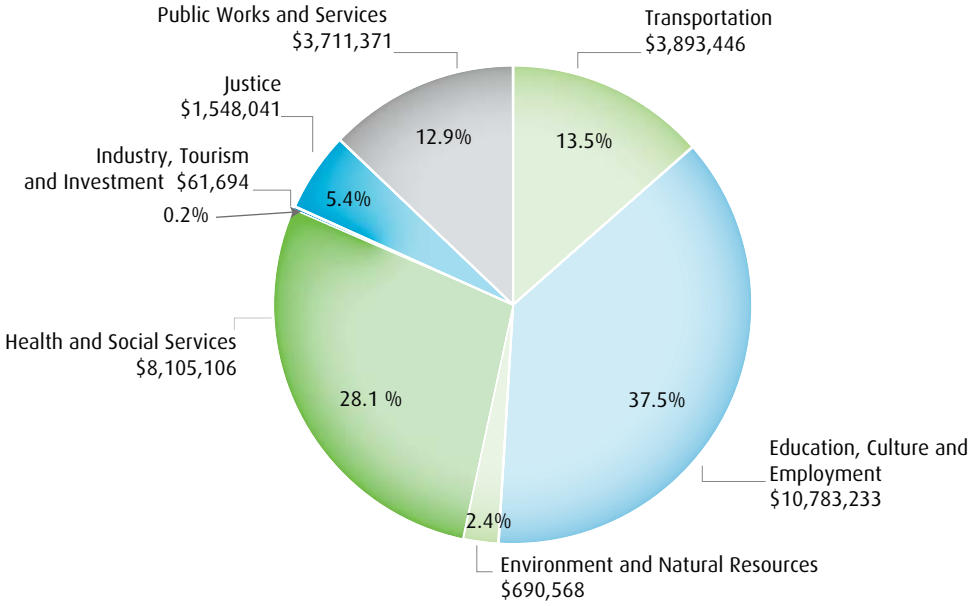



**Figure 8: Utilities Expenditures Distribution by Program for 2012-2013**

Space heating makes up 71% of total energy usage in PWS-managed assets. While heating degree days were higher in 2012-2013 by roughly 3% compared to 2011-2012, actual heating fuel consumptions were lower. The total amount of space heating in 2012-2013 was 412,574 GJ compared to 426,146 GJ in the 2011-2012 fiscal year (Figure 9). Overall heating usage in 2012-2013 decreased by 3% when compared to the usage in 2011-2012. The replacement of old assets with more efficient ones, the retrofitting of existing assets and the ongoing efforts of maintenance staff help to mitigate the increase in energy usage from aging infrastructure.

| Region | Heating Degree Days (18C) | | Increase in |
|---|---|---|---|
| | 2011/2012 | 2012/2013 | HDD |
| Fort Smith | 6684.4 | 7132.2 | 7% |
| Yellowknife | 7570.3 | 8047.8 | 6% |
| Fort Simpson | 7215.1 | 7584.9 | 5% |
| Norman Wells | 8471.8 | 8759.9 | 3% |
| Inuvik | 9454.4 | 9043.5 | -4% |

**Table 1: Comparison of heating degree days from the previous two fiscal years.**

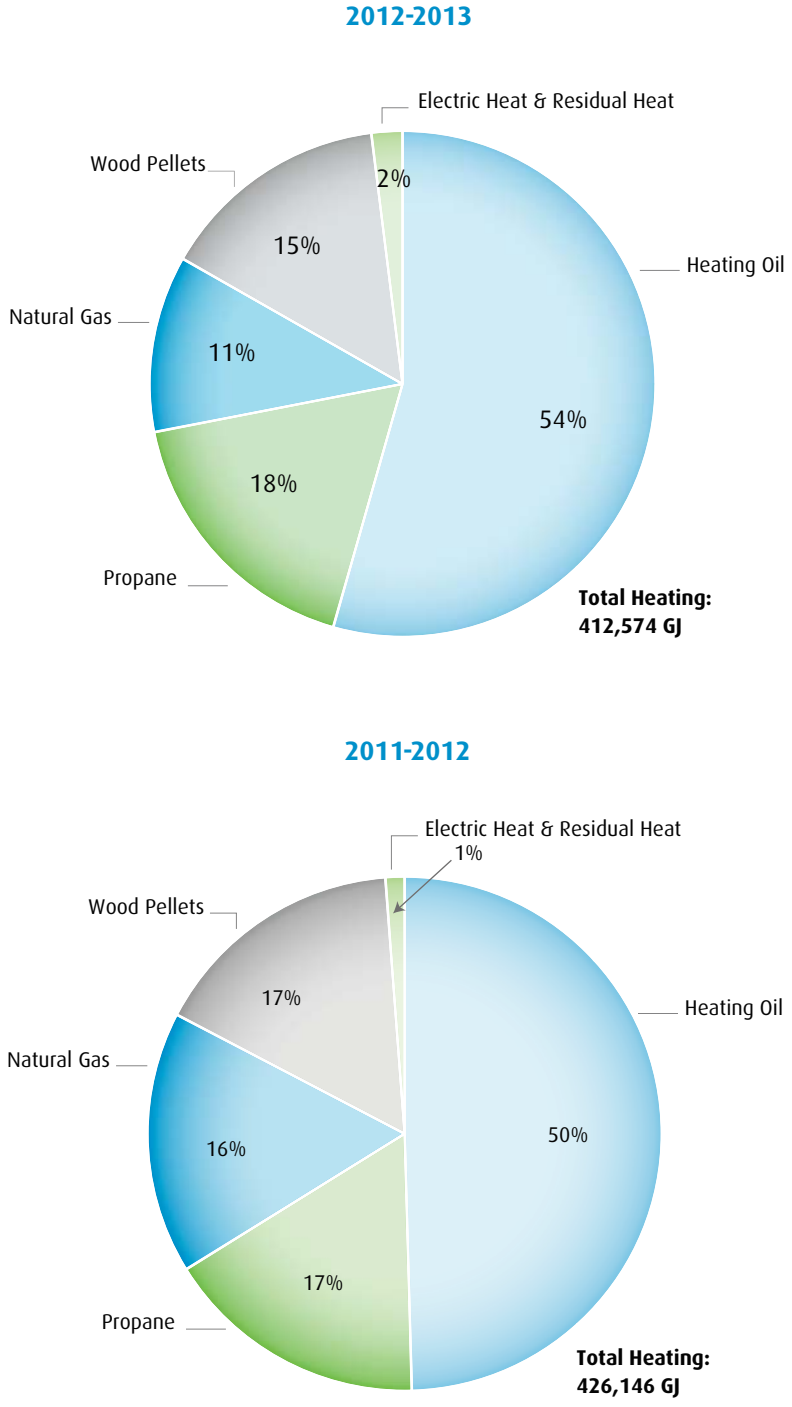



**Figure 9: Space Heat Distribution by Energy Type for PWS-managed Assets for 2012-2013 and 2011-2012**

# Looking Forward

The GNWT continues to support and demonstrate leadership in the areas of energy efficiency, conservation and the development of alternative energy sources. PWS will continue to work with ENR, ITI, NWT Housing Corporation and NTPC to support the GNWT's Energy Plan, the NWT Greenhouse Strategy, the NWT Biomass Energy Strategy and the NWT Solar Energy Strategy

Continued investment in energy efficiency and alternative energy projects is planned for 2013/14 and are projected to further reduce our dependence on fossil fuels and contribute to our greenhouse gas emission reduction goals. PWS estimates that by the end of 2013-2014, cumulative heating oil reductions will total 13.2 million litres (Figure 10). This reduction is equivalent to reducing a total of 36,000 tonnes of greenhouse gas emissions (Figure 11).

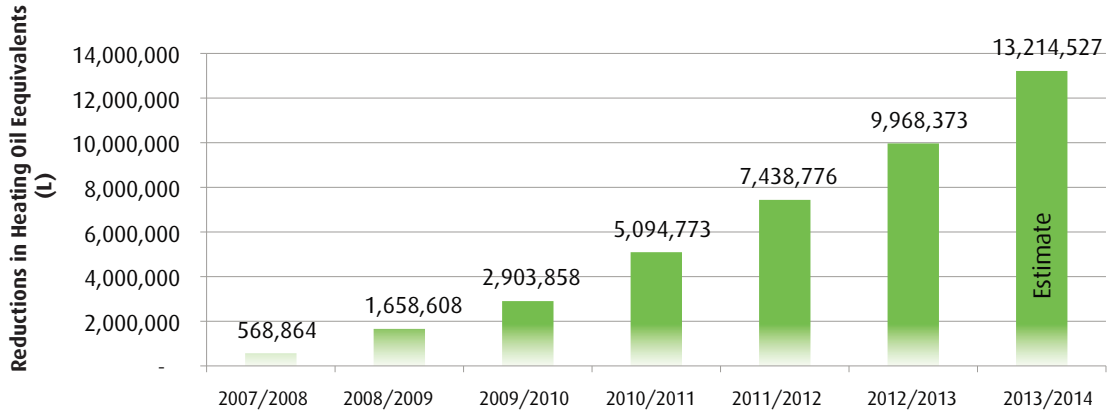



**Figure 10: Cumulative Heating Fuel Displaced from Biomass, Electric Heat and Energy Retrofits**

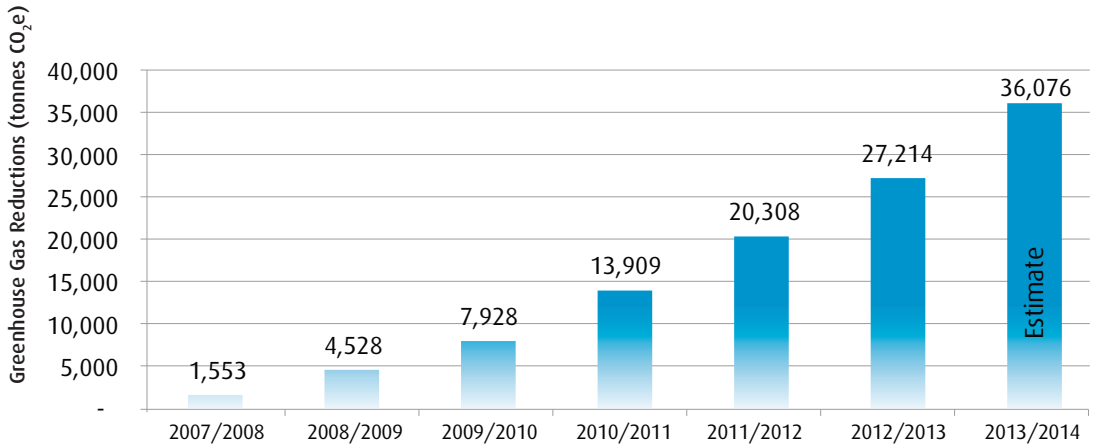



**Figure 11: Total Cumulative Reductions in Greenhouse Gas Emissions from Biomass Heating, Electric Heat and Energy Retrofits**

In addition to the planned energy conservation and efficiency management activities for 2013-2014, PWS, along with other GNWT departments, are committed to increasing their collective knowledge of energy efficiency best practices and emerging technologies. This knowledge is embedded in Public Works and Services "Good Building Practice for Northern Facilities" guidelines and will be invaluable in ensuring energy continues to be a high priority as the GNWT plans for the upgrading and replacement of its public infrastructure in the future.

Printed on recycled paper