

# BIOMASS HEATING SYSTEM

## Wood Pellet Boilers



NORTH SLAVE CORRECTIONAL FACILITY (NSCF)  
YELLOWKNIFE, NT

January 1, 2007 – December 31, 2007

### SYSTEM PERFORMANCE REPORT

### Background

The original heating plant supplying the NSCF consisted of two oil-fired boilers with a total capacity of 2880 kW. The size was established during the design for the facility, and was based on the criteria that the two boilers would be sufficient to meet the required peak heating and ventilation loads at a winter design temperature of -45°C.

The first winter of operation proved that the existing plant could maintain the facility comfort requirements at winter design temperatures with one ventilation system heat recovery device out of service, but with no spare capacity whatsoever. Therefore, the plant did not have any backup in case of a boiler failure or loss of two or more heat recovery devices, which meant that, in the event of failure, the facility would have had to institute a phased shutdown of service areas.

Because of this lack of spare capacity, the Department of Public Works and Services (PW&S) proposed to the Department of Justice (DOJ) that a third boiler, similar to those existing, be provided as a backup. The proposal was accepted, and a budget of \$225,000 was established for provision of a third boiler, to be in place and operational prior to the 2006/07 heating season.

Helping to develop energy projects using sustainable biomass resources for environmental benefit and local economic development

### Contract for Heating with Biomass

In April 2006, PW&S and DOJ received a proposal from Arctic Green Energy (AGE), a northern company located in Yellowknife, to provide a wood pellet boiler installation for the North Slave Correctional Facility in lieu of the third oil-fired boiler originally planned to be installed as backup for the existing heating plant.

Under the resulting contract, AGE installed a wood pellet boiler system at no cost to the GNWT to act as the prime “base load” supply, which would provide 90% of the annual heat requirements of the facility. The existing oil-fired boilers would cover the shortfall encountered during the peak winter loads and would provide 100% emergency backup in the event of a failure with the wood pellet system.

AGE acts as an “Energy Service Provider”, billing the GNWT for heat supplied to the facility as read by installed BTU meters. The system includes the provision of a storage silo sized to contain an adequate quantity of wood pellets for one month of required output in winter conditions, which enables the system to continue to operate during ferry/ice road closures.

AGE provides this heat at a cost that fluctuates with the price of oil. The savings due to the difference between the price of oil and wood pellets is shared between Arctic Green Energy and the GNWT.

### Environmental Recognition for the Project

The installation of the wood pellet heating system qualified AGE for an \$80,000 incentive payment from the Renewable Energy Deployment Initiative (REDI) program. AGE also received an Environmental Excellence Award from the Northwest Territories Association of Professional Engineers, Geophysicists and Geologists (NAPEGG) in recognition of the initiative.

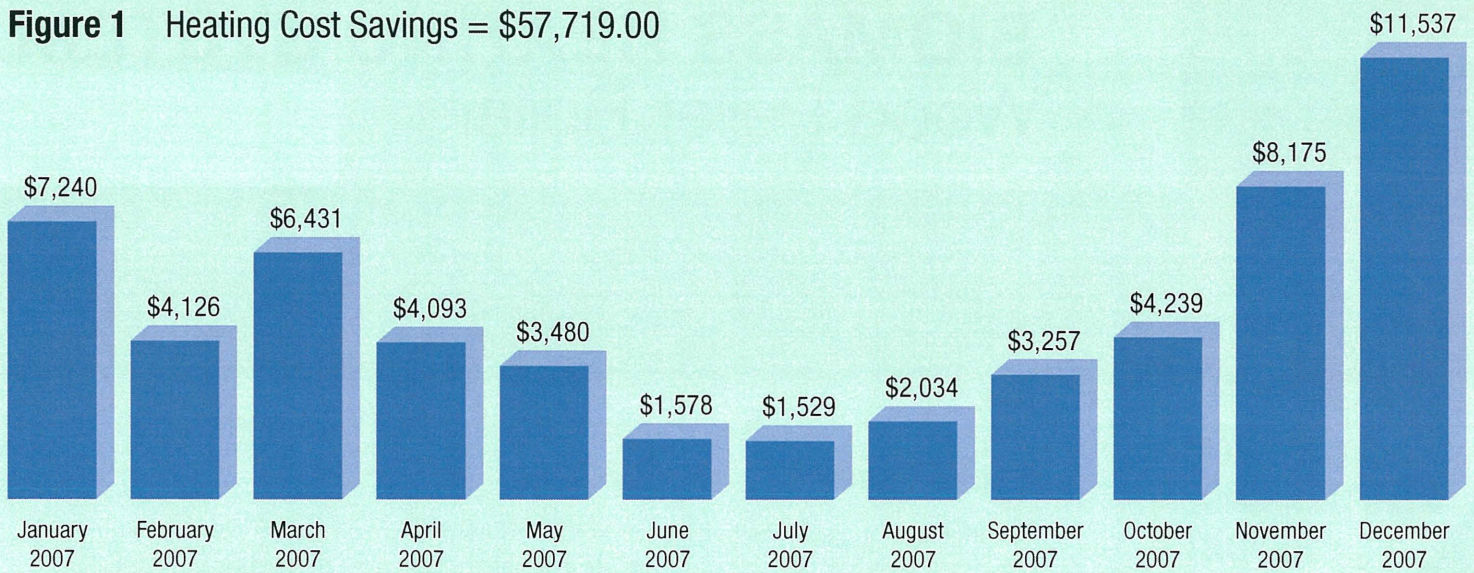
### Wood Pellets



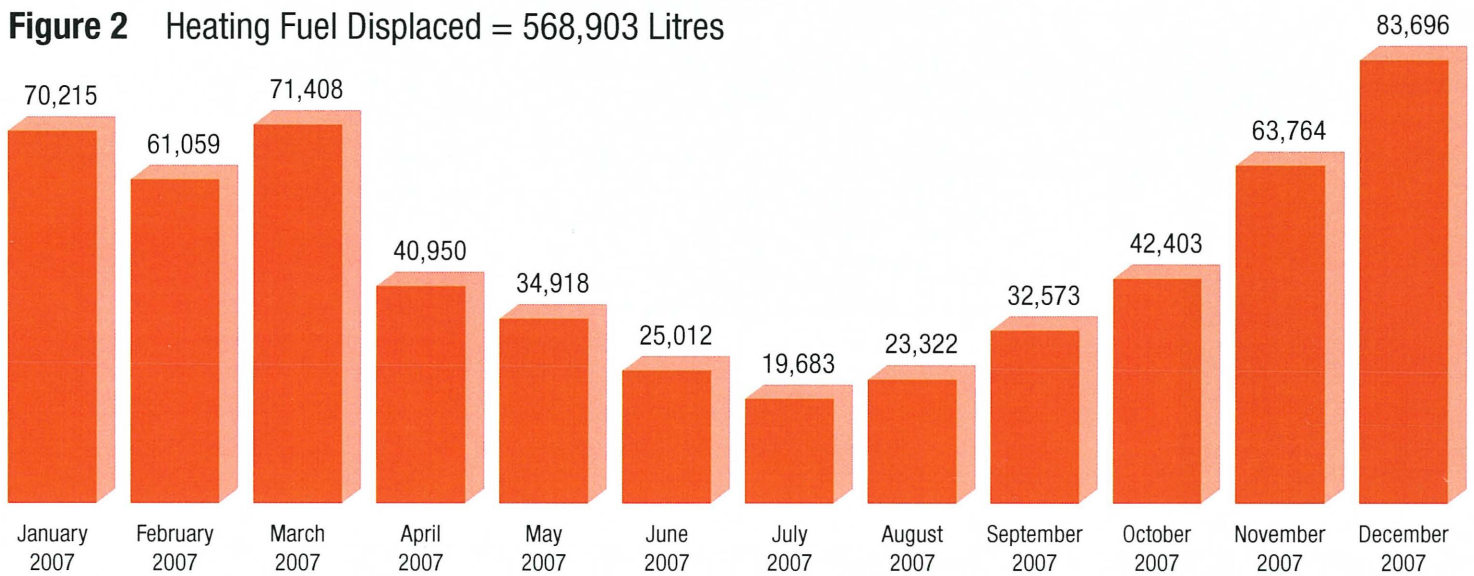
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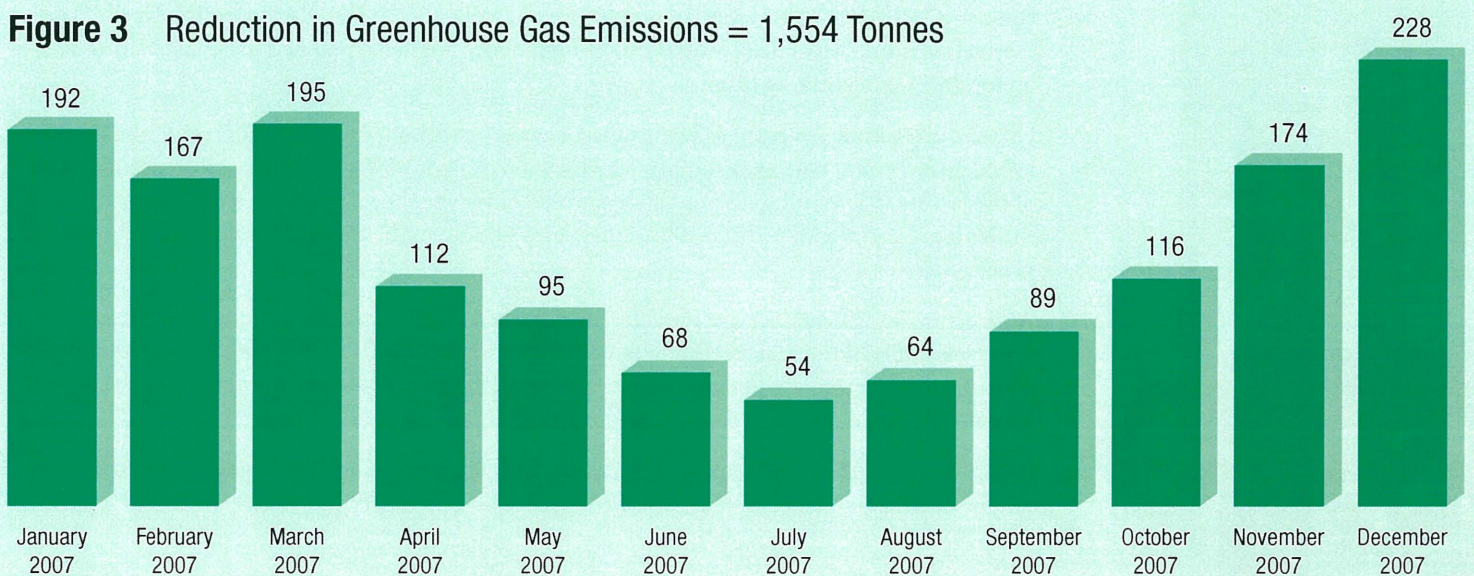
**Figure 1** Heating Cost Savings = \$57,719.00



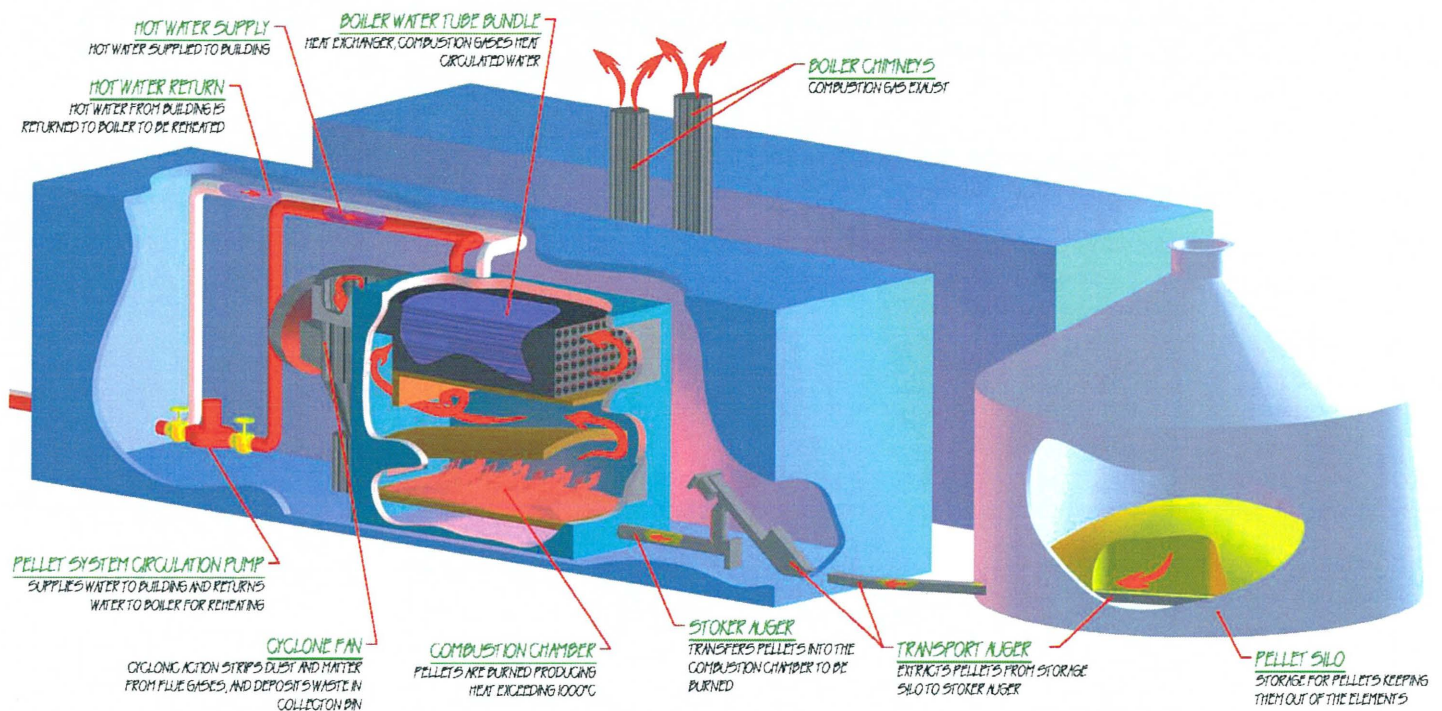
**Figure 2** Heating Fuel Displaced = 568,903 Litres



**Figure 3** Reduction in Greenhouse Gas Emissions = 1,554 Tonnes



## Biomass Heating System Conceptual Layout (Wood Pellet Boiler System at NSCF)



### Biomass Heating System Performance and Savings

Initial estimates of savings included \$225,000 from the original third boiler that would no longer be needed and \$50,000 in annual heating costs. The reduction in greenhouse gas emissions was estimated to be 1,450 tonnes annually from the lower consumption of diesel fuel.

Savings for the period of January 1, 2007 to December 31, 2007 totaled \$57,719 in reduced fuel cost because of the lower price of wood pellets compared to fuel oil (Figure 1); \$1,000 due to reduced wear and tear on equipment; \$1,200 due to lower power consumption for fans, oil boilers, and pumps; and \$1,500 from the reduced use of chemicals after switching from steam to hot water.

The system has reduced fuel use at the facility by 568,903 litres (Figure 2), thus reducing greenhouse gas emissions by 1,554 tonnes (Figure 3), equivalent to taking 315 cars or light trucks off the road.

### Reasons to Choose Wood Pellet Biomass Heating

The main reasons to choose a wood pellet heating system are the following:

- The cost of wood pellets is lower and more stable than the cost of fossil fuels, resulting in considerable operational savings;
- They are greenhouse gas neutral and are created from waste wood, which makes them an environmentally sustainable choice;
- Pellets are available and the supply is secure; and
- They can be easily stored and used on demand.

**Wood Biomass Energy is:**  
Renewable | Clean | Economical

## Biomass Heating System

The system installed at NSCF consists of two 750kW capacity boilers complete with all necessary controllers and safety devices, each delivered to site pre-piped and complete with all required electrical and control devices, housed in standard shipping containers.

The wood pellets are delivered to a storage silo sized to contain one months supply at winter design conditions, and fed to the combustion chambers by an automatic auger feed system on demand. The system is automatic, controlled by a digital electronic control system equipped with alarms and trending logs that are fed via internet to the operator's computer station. The system is also equipped with an automatic system that removes ash, which is approximately 1% of the pellets burned.

Hot water is fed to the existing building via an insulated utilidor to connect to a heat exchanger within the NSCF Boiler Room. The heat exchanger is, in turn, connected to the existing NSCF heating system primary loop via a circulating pump. Boiler controls are set so that the wood pellet system is always the baseload heat provider. The heat exchanger was provided to maintain a distinct break between the wood pellet system owned and operated by AGE and the NSCF heating system owned and operated by GNWT. Because of the dual ownership of the overall system, cooperation between both parties regarding operational settings and system performance has been critical to attain the desired optimization of heat, and thus savings, provided by the wood pellet system.

A motorized two-way valve is installed on the return line from the NSCF heating system to the heat exchanger. This valve is controlled by temperature sensors so that, if the NSCF return water temperature exceeds the wood pellet system supply water temperature, the valve closes to prevent backflow of heat to the wood pellet system from the NSCF system.

The wood pellet system installation was completed and brought into service on November 30, 2006, and has been operational since that date with no technical or performance issues arising.

## What You Should Consider When Selecting a Biomass Heating System

- Ensure the size of the boiler system will suit your requirements. Oversized or undersized boilers are less efficient and have a shorter lifespan.
- Find out if you can obtain guarantees of a quality constant fuel from your supplier.
- Check that the boiler system complies with local and national pollution limits.
- Since the materials in the hot sections of the boiler are exposed to severe stress, check the quality and temperature limits of the refractory lining, the wall thicknesses, and serviceability of parts.
- Visit some reference units and talk to their owners.
- Check your supplier's experience in the field of biomass combustion.
- CSA/GNWT approval/certificates.

If you require technical assistance in assessing, selecting, designing for installation, or operating biomass pellet boiler systems, please call GNWT PWS Technical Support Services at (867) 920-8088.

## Future Opportunities

PWS will continue to monitor the system in regard to reliability, operational simplicity and economic advantages, and will research and pursue opportunities for the use of wood pellet boilers on other facilities. PWS is currently working with various authorities to promote the use of wood pellet boilers. In 2008/09, PWS will be studying other buildings as possible candidates for biomass boiler installations.

