

# BIOMASS HEATING SYSTEM (WOOD PELLET BOILERS)

## NORTH SLAVE CORRECTIONAL FACILITY YELLOWKNIFE, NT

### PROJECT REPORT

#### Background

The heating plant supplying the North Slave Correction Facility (NSCF) consisted of two oil-fired boilers with a total capacity of 2880 kW. When the facility was designed, it was decided that two boilers would be sufficient to meet the required peak heating and ventilation loads at a winter temperature of -45°C.

The first winter of operation proved that the existing plant could maintain the facility comfort requirements in winter, but with no spare capacity whatsoever. Therefore, the plant did not have any backup in case of a boiler failure. In the event of failure, the facility would have had to shut down service areas.

Because of this lack of spare capacity, the Department of Public Works and Services (PWS) proposed that a third boiler, similar to the existing ones, should be added as a backup. A budget of \$225,000 was established for the third boiler, to be in place and operational before the 2006/07 heating season.

In the winter of 2005/06, a local Yellowknife company, Arctic Green Energy (AGE), began to promote the use of biomass wood pellet boilers for space heating in large buildings.

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

#### What is Biomass Heating?

Biomass is plant material or animal waste, which has fuel value and may be burnt to produce power or heat. The most common biomass for heat is wood, such as logs or chips or, more recently, pellets.

Using biomass pellets as a fuel is said to be “carbon neutral”, and is, therefore, a renewable energy source. It is a major energy source for some European countries, such as Austria, Sweden, and Denmark. In these countries, biomass is considered a promising energy resource, because it can be easily converted to a wide range of products.

Wood pellets burn the cleanest of any solid fuel. They have higher energy content and lower moisture content per unit weight than wood or wood chips, so they burn efficiently and produce very little creosote, ash and nitrous oxides. Wood pellets are produced from clean, bark-free, ground, dried and compressed waste wood, free of additives.

Heating with pellets is economical at the current price of heating oil. Boilers are available in dual pellet/oil-fired models, making them ideal candidates for use in new buildings.

**Department of Justice  
Department of Public Works and Services**

### Wood Biomass Energy is:

- **Renewable**
- **Clean**
- **Economical**



## The Arctic Green Energy Proposal

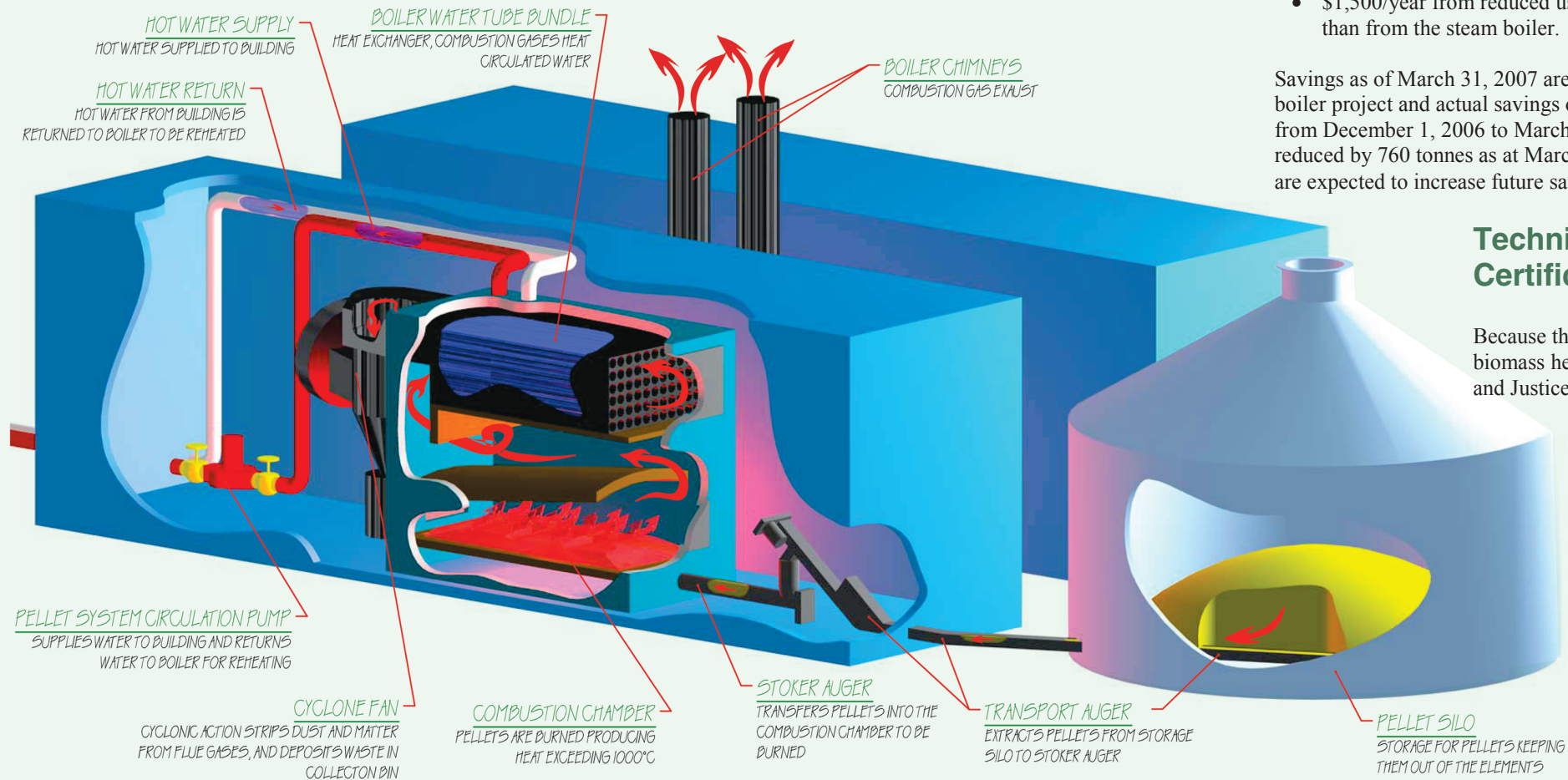
In April 2006, PWS and the Department of Justice received a proposal from Arctic Green Energy (AGE), a northern company in Yellowknife, to provide a wood pellet boiler installation for the NSCF instead of the third oil-fired boiler being planned.

Under the proposal, AGE would install a system based on design criteria traditionally used in Europe, consisting of a Binder wood pellet boiler system, manufactured in Austria, to act as the prime “base load” supply unit. This would provide heating for the facility based on 50% of the existing boiler plant, or the same capacity as the proposed third boiler. This new system would provide the heating requirements of the facility for 90% of the year. The existing oil-fired boilers would cover the shortfall encountered during the peak winter loads, the remaining 10% of the year, and would provide 100% emergency backup in the event of a system failure with the wood pellet system.

AGE would be responsible for the design, installation, operation and maintenance of the wood pellet system at no cost to the GNWT, and for provision of the pellets from the nearest supplier at La Crete, Alberta. The La Crete plant has been producing high quality pellets for many years, with the vast majority of their product being exported to Europe and Asia.

AGE would act as an “Energy Service Provider”, billing the GNWT for heat supplied to the facility as read by installed British Thermal Unit (BTU) meters. The system includes the provision of a storage silo to contain an adequate supply of wood pellet for one month’s required output in winter conditions. This would enable the system to continue to operate during ferry/ice road outages.

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



## Biomass Heating System Performance and Savings

Initial estimates of savings to be realized were:

- Capital savings of \$225,000 from the original third boiler project;
- \$50,000 annual savings in heating costs for the facility;
- Reduction in greenhouse gas emissions of 1,450 tonnes/year;
- \$500/year savings due to reduced “wear and tear” of equipment; and
- \$1,500/year from reduced use of chemicals from heating domestic hot water rather than from the steam boiler.

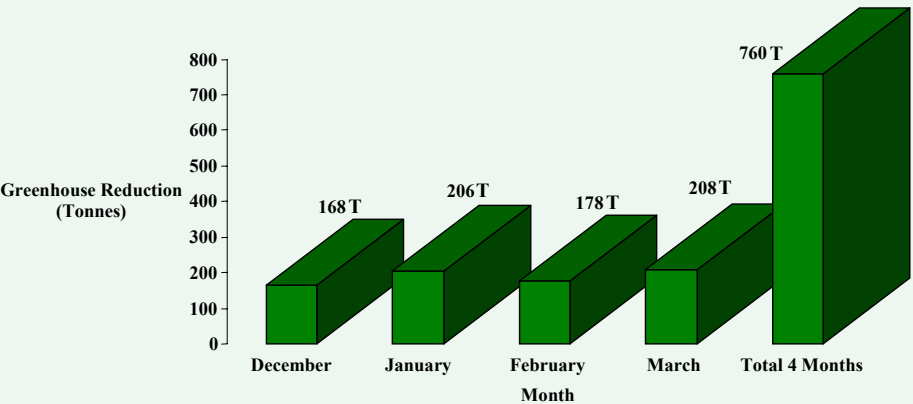
Savings as of March 31, 2007 are capital savings of \$225,000 from the original third boiler project and actual savings of \$18,103 in displaced fuel (260,211 litres) oil costs from December 1, 2006 to March 31, 2007. Greenhouse gas emissions have been reduced by 760 tonnes as at March 31, 2007. Further adjustments to operational settings are expected to increase future savings.

## Technical Review and Regulatory Certification

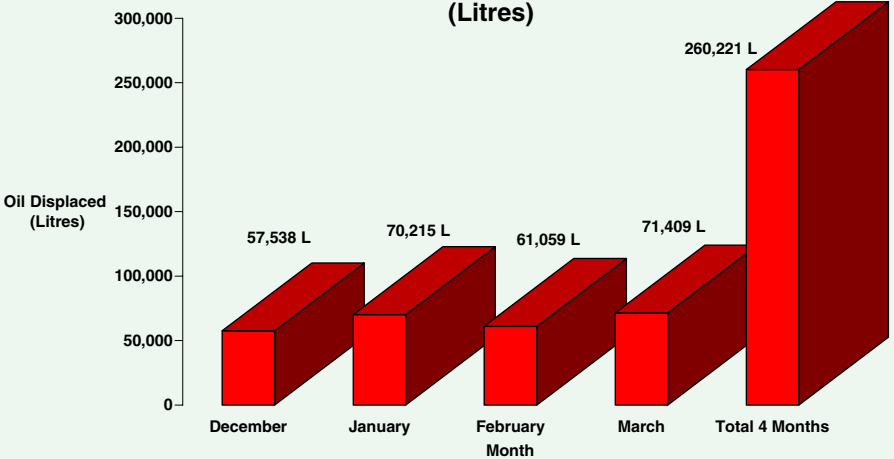
Because this would be one of the first containerized commercial biomass heating systems to be installed in North America, PWS and Justice conducted extensive research into biomass heating systems to evaluate the reliability of the system for our extreme northern environment. Discussions with the Electrical/Mechanical Safety Section of the GNWT established that the designed system would require CSA field certification as a packaged unit once installation was complete. The AGE proposal was accepted, and a contract signed. The contract included the following stipulations:

- 1) System would be supplied, installed, and operated at no cost to the GNWT;
- 2) System to be operational by December 1, 2006;
- 3) AGE would act as an Energy Service Provider at the rates stated in their proposal; and
- 4) Complete wood pellet installation to be CSA Certified.

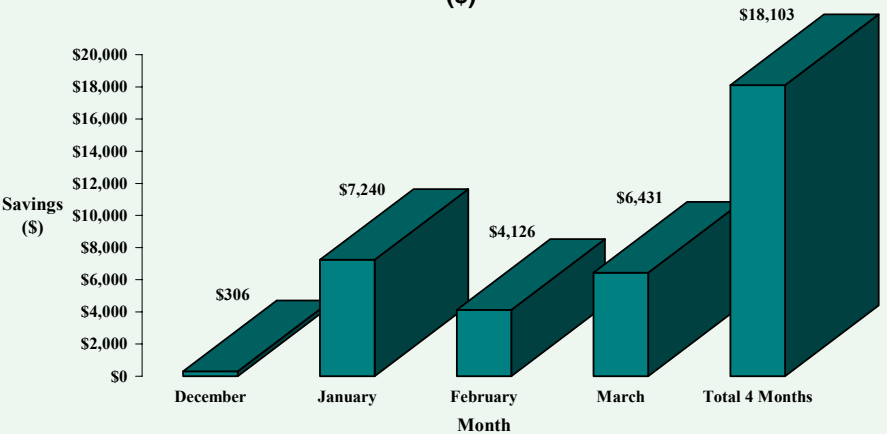
Reduction in Greenhouse Gas Emissions (Tonnes)



Heating Fuel Displaced (Litres)



Heating Cost Savings (\$)





## Biomass Heating System at NSCF – System Components and Operational Sequence

The wood pellets are delivered to a storage silo by “B train.” They are fed to the combustion chambers by an auger-fed system on demand. The system is automatic, controlled by a digital electronic control system equipped with alarms and trending logs that are transmitted to the operator’s computer station. The system is also equipped with an automatic ash removal system. Ash is about 0.3% by volume of the pellets burned.

Heated water is fed to the existing building through an insulated Utilidor connecting to a heat exchanger within the NSCF Boiler Room. The heat exchanger is, in turn, connected to the existing NSCF heating system primary loop by 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 there are two owners of the overall system, cooperation on operational settings and system performance is critical.

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. CSA field certification was obtained in February 2007.

Continuing fine tuning of the overall heating system will improve efficiency and thereby further maximize savings. The system will operate year round to provide domestic hot water to the facility.

## Reasons to Choose Wood Pellet Biomass Heating

The main reasons to choose a wood pellet heating system are

- Lower, stable fuel cost compared to fossil fuels, resulting in considerable operational savings, and a significant reduction in CO<sub>2</sub> emissions.
- Widespread availability of pellets, which contributes to the security of energy supply. They can be stored and used on demand.

## 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 constant fuel quality 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 of biomass pellet boiler systems, please call GNWT PWS Technical Support Services at (867) 920-8088.

## 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.

## Future Opportunities

PWS is monitoring the system over the next year for reliability, operational simplicity and economic advantages. PWS will research and pursue other opportunities for the use of wood pellet boilers on other facilities, whether owned by GNWT, other agencies such as school authorities, municipal authorities, or the private sector.

## Wood Pellets

