

Case study of retrofit from natural gas to wood pellet heating

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Introduction

The awareness of biomass heating systems has greatly increased in the recent years. Many residential and industrial owners find themselves in a situation when their current heating system brings them more difficulties than advantages. Maybe the biggest difficulty that stands in their way is the rising price of fossil fuels. In addition, there are other concerns involving protection of environment that can lead to measures like carbon tax.

On the other hand, biomass represents a cleaner alternative to fossil fuels like natural gas. This case study shows what implications are there for businesses considering a retrofit from a fossil fuel heating system to a biomass heating system. This case specifically shows conversion from a natural gas to a wood pellet heating system.

Facility Name	Maintenance Building (MB) of Jack Garland Airport
Location	60 Terminal Street, North Bay, Ontario
Operations Description	The maintenance building at the Jack Garland Airport serves as maintenance for airport vehicles. Local city buses and hospital vehicles are maintained here as well. The maintenance building also provides garage spaces.
Site Size (m²)	67,056 m x 24,384 m = 1643 m ²
Type	Industrial complex
Heating Requirements	Heating system for indoor heating
Current System Description	<p>Technology used:</p> <p>2 natural gas boilers (Volcano 40 HP)</p> <ul style="list-style-type: none">• Boilers heat up water, which is then distributed by a system of pipes to heating units.• Technology used for the heating units is hot air heating. All together there are 10 hot air radiators (space heaters) installed in the MB.• There is an existing infrastructure of pipes in the building. <p>Photo 1. Volcano 40 HP (vintage 1989)</p> 

Table 1. Natural gas consumption (m³) at the maintenance building for 2009 and 2010.

Natural gas consumption in m ³ (60 Terminal Street, North Bay, ON)		
	2010	2009
Jan	7878	2718
Feb	6654	7107
Mar	4640	6356
Apr	2117	4306
May	131	562
Jun	125	47
Jul	111	0
Aug	114	0
Sep	209	0
Oct	579	924
Nov	2629	1914
Dec	6393	4092
Average total annual consumption of natural gas: 29803 m³		

Projected System Description

Technology requirements:

1 wood pellet boiler with power of 150 kW

- To illustrate the technology suitable for the case study situation, wood pellet boilers from  were researched.
- The most suitable technology would be:
PYROT® KRT-150 Maximum boiler output: 150kW [512MBH]
- Possible fuels: wood brickets, off cuts, wood chips, wood pellets
- For dry wood fuels with water content < 35%
- Fuel consumption of this boiler at full load will be approximately **35kg/hr.**
- Estimated price for the wood boiler and equipment is in the range of **\$130000 CAD to \$180000 CAD**
- Includes installation assistance and start up assistance.

Other important part of the projected system is storage for the fuel. In this case, wood pellets are used, so the proposed solution is a **pellet silo**. The pellet silo will be located outside the boiler room.

- Additional infrastructure is needed to transport the fuel to the boiler
- Estimated price for watertight grain silo that can be used as a pellet silo is **between \$15000 CAD and \$20000 CAD.**
- Replacement of old boilers with new biomass boilers includes **cost of installation.** The installation includes replacement, installation of new boilers and pipes.

- Viessmann does not provide removal and installation service of their products but only provides installation assistance and start-up assistance.

Photo 2. PYROT® KRT-150



Photo 3. Example of pellet silo.



	<p>Fuel used:</p> <p><i>Energy content: 18.6 GJ / 1 ton of wood pellets</i> (Gildale Farms, 2011).</p> <p>Cost of 1 ton of wood pellets:</p> <ul style="list-style-type: none"> • Around \$150 - \$245 CAD (Gildale Farms, 2011) • \$250 CAD (BioSynergy Pellets, 2011) <p>Two suppliers of wood pellets were considered:</p> <ul style="list-style-type: none"> • Gildale Farms - Wood Fuel Pellets and Bedding Pellets in Sudbury, Ontario • BioSynergy Pellets in Walkerton, Ontario
<p>Conversion Economics</p>	<p>Calculations for price of energy: comparison between natural gas and wood pellets</p> <p>The average annual consumption of natural gas in MB was used as a reference point to calculate the average amount of consumed energy. 29803 m³ of natural gas represents 1102.711 GJ/year.</p> <p>Natural gas: 1 m³ of natural gas has energy value of 0.037 GJ. [Tran, 2002] 1 m³ of natural gas costs \$0.31 CAD. [Energyshop, 2011] (Regulated Union Gas Northern Ontario Rates, price includes gas supply, transportation to supplier, delivery, monthly consumer charge)</p> <p>So the average total annual cost of heating in the MB is (29803 m³ * 0.31 CAD) = \$9329.07 CAD. Cost of energy for natural gas: \$9329.07 CAD / 1102.711 GJ = \$8.46 CAD / 1 GJ from natural gas.</p> <p>Wood pellets: Energy content: 18.6 GJ / 1 ton of wood pellets (Gildale Farms) Cost of 1 ton of wood pellets:</p> <ul style="list-style-type: none"> • \$150 - \$245 CAD (Gildale Farms) • \$250 CAD (BioSynergy Pellets) <p>Amount of wood pellets necessary to cover annual energy consumption of heating system is 1102.711 / 18.6 = 59.28 tons of wood pellets.</p> <p>59.28 tons of wood pellets cost:</p> <ul style="list-style-type: none"> • Gildale Farms wood pellets: \$150 CAD/t – \$8892 CAD/year • BioSynergy wood pellets: \$250 CAD/t – \$14820 CAD/year <p>Cost of energy for wood pellets:</p> <ul style="list-style-type: none"> • Gildale Farms wood pellets: \$8.06 CAD/1 GJ from wood pellets. • BioSynergy wood pellets: \$13.43 CAD/1 GJ from wood pellets.

Comparison:

Natural gas	Wood pellets
\$8.46 CAD / 1 GJ from natural gas	\$8.06 – \$13.43 CAD/1 GJ from wood pellets

Total estimated cost of the projected system:

Boiler (Installation and start-up assistance) - \$130000 CAD to \$180000 CAD (Kai Menges)

+

Pellet silo – \$15000 CAD to \$20000 CAD (Kai Menges)

+

Old boiler removal – around \$2000 CAD (Whatprice.co.uk, 2011)

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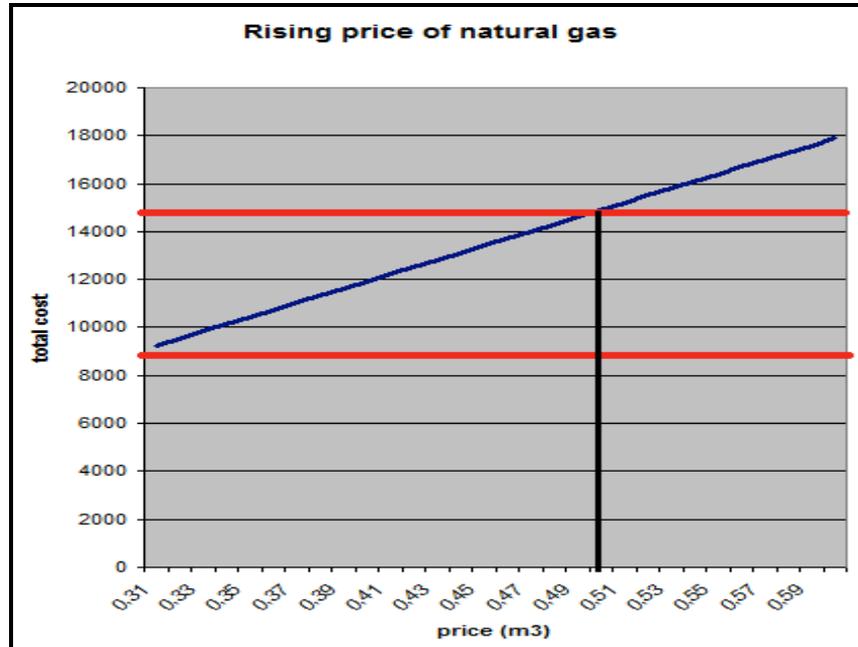
\$147000 – \$202000 CAD

Viability conditions

1. Rising price of fossil fuels

It is assumed that price of fossil fuels will continue to rise in the future. To imagine how this corresponds with the projected situation, a figure is used to determinate threshold price for natural gas. Two red lines represent the cost for wood pellets. The bottom red line represents wood pellets price at \$150/ton and the upper red line represents wood pellets price at \$250/ton. The threshold price for natural gas has to be set up for more than **\$0.51 CAD/m³** to exceed the price of the best quality wood pellets.

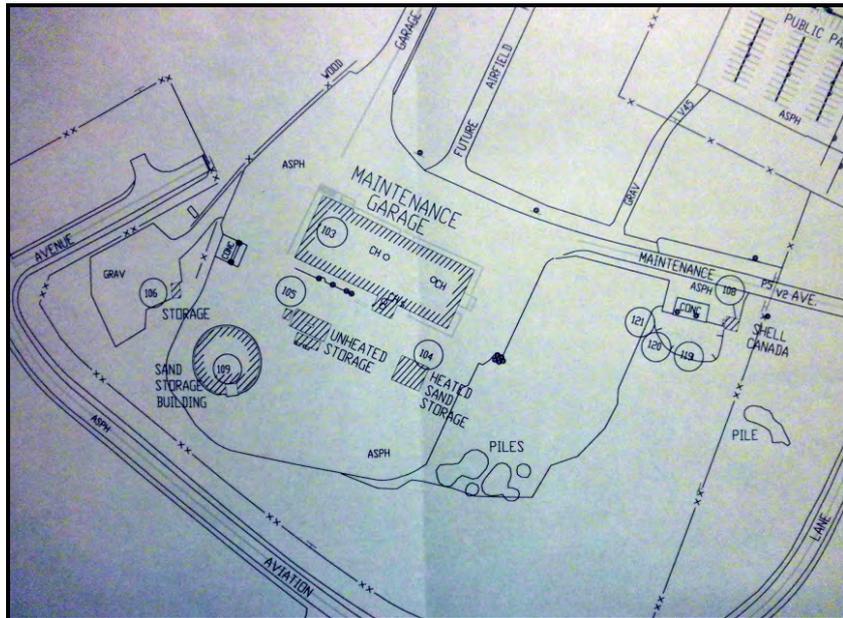
Figure 1. Assumed rising price of natural gas.



2. Introduction of carbon tax

A carbon tax is defined as a tax based on greenhouse gas emissions (GHG) generated from burning fossil fuels. It puts a price on each ton of GHG emitted. Possible introduction of a carbon tax on fossil fuels can raise the price of natural gas. The example of a carbon tax from British Columbia is used to illustrate

Photo 5. Situation of the Maintenance building within the Jack Garland Airport area.



Recommendations

- Application of biomass, specifically wood pellets represent a good opportunity to avoid rising price of fossil fuels in the future.
- The possibility that carbon tax can be introduced poses a threat to another increase of the fossil fuel prices.
- Combination of wood pellets suppliers is recommended.
- Consider application of wood pellet boiler with a back up natural gas boiler.
- Further more detailed research needed.

References

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