



PRELIMINARY RESULTS



THE MANUFACTURE AND USE OF WASTE CARDBOARD FUEL PELLETS IN INUVIK, NT

FEASIBILITY STUDY

WASTE CARDBOARD QUANTITY

LOCATION	EST. TOTAL CARDBOARD ⁱ
INUVIK	273kg per day
COMMUNITIES TOTALⁱⁱ	208kg per day

TEST CARDBOARD COLLECTION PROGRAM

LOCATION	DIVERTABLE CARDBOARD
STANTON'S DISTRIBUTING	22kg per day
INUVIK HOSPITAL	18kgs per day

The test collection program achieved a 15% diversion rate from only 3 contributors. Processed waste cardboard contained less than 1% by weight non-fiber materialⁱⁱⁱ.

ADDITIONAL BIOMASS SOURCES

Supply expansion opportunities include backhauled waste cardboard from surrounding communities (estimated at 208kg per day) and locally harvested biomass.

PELLET MANUFACTURING

High durability cardboard pellets can be achieved using conventional pelletizing machines with the addition of additives such as vegetable oil or lignin powder^{iv}.

There are several pellet mill suppliers offering pellet mills that suit the scale of the proposed project^v.

BOILER SUITABILITY

Mixed pellet fuels with 5% cardboard pellet content can be burned in most commercial boilers from Viessmann, Hargassner, and Okofen [1] [2] [3].

Pellet certification testing can be done through BBRG^{vi} and PCU Deutschland^{vii}.

KEY PARTNERS

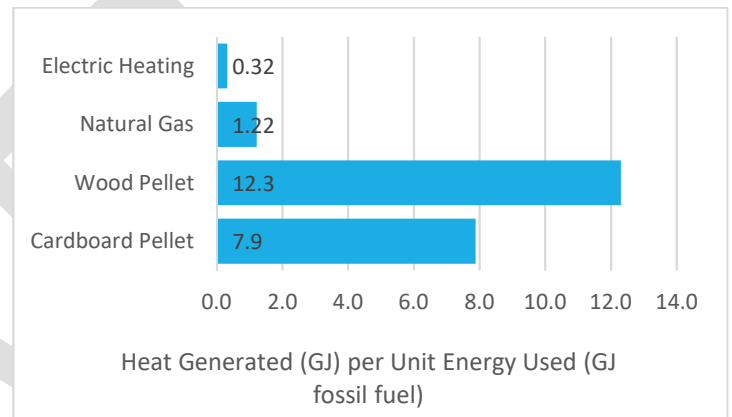
Local industry partner, Delta Enterprises is a large wood pellet importer in Inuvik and has shown interest in taking on cardboard pellet manufacturing in Inuvik.

COMBUSTION EMISSIONS REGULATION

Coming NWT Air Regulations do not regulate gas emission composition^{viii}.

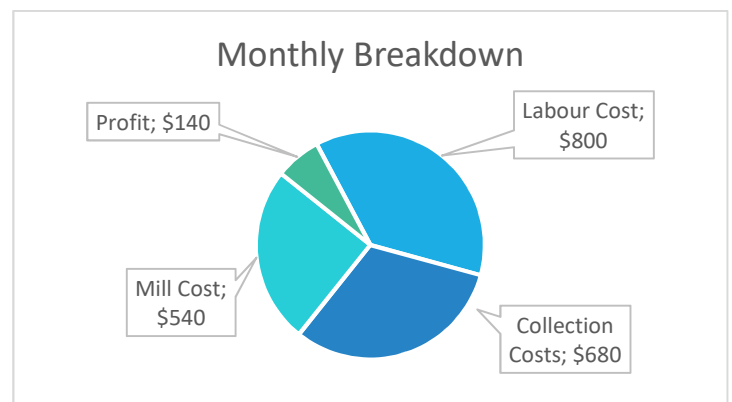
FOSSIL FUEL DIVERSION

Locally sourced fuel pellets provide an order of magnitude return on heating energy over the imported fossil fuels consumed in their production. The space heating ratio in the graph below describes this relationship.



BUSINESS CASE ANALYSIS^{ix}

An initial investment of \$140,000^x could generate up to \$9,800 of profit annually (depending on the cardboard collection method) and create part-time employment. This assumes 60%^{xi} of the cardboard in Inuvik is diverted into this program and the resultant fuel pellets retail at \$450 per tonne^{xii}.



POSSIBLE FUNDING PATHWAYS

- WRRI: Waste Reduction and Recycling Initiative.
- Northern REACHE Program.
- Promoting Clean Energy for Remote Communities (NRCan)
- CREP: Community Renewable Energy Program.

CONTACTS

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REFERENCES

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- [2] Hargessner, "Hargessner Heating Technologies for Biomass," 2017. [Online]. Available: <http://www.hargessner.ca/en/>. [Accessed 11 09 2017].
- [3] Viessmann, "Vitoflex 300-RF Installation and Service Instructions," 03 2017. [Online]. Available: <https://www.viessmann.ca/>. [Accessed 08 09 2017].
- [4] Y. Ma, M. Hummel, M. Maattanen, A. Sarkilahti, A. Harlin and H. Sixta, "Upcycling of waste paper and cardboard to textiles," Royal Society of Chemistry (Accessed 6th Sept 2017), 22nd July 2015.
- [5] I. Shield and C. Whittaker, "Factors affecting wood, energy grass and straw pellet durability - A review," Department of Agro-Ecology, Rothamsted Research. (Accessed Sept 6th 2017), Hertfordshire, 2017.
- [6] Ferguson Simek Clark, "Sewage and Solid Waste Management Site Operations and Maintenance Manual," Yellowknife, 2000.
- [7] Government of the Northwest Territories, "Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites," Ferguson Simek Clark Engineers & Architects, Yellowknife, 2003.

ⁱ These values were calculated using average daily refuse mass and composition data from the *Sewage and Solid Waste Management Site Operations and Maintenance Manual* [6] along with the *Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT* [7].

ⁱⁱ Communities include those accessible by road, i.e. Aklavik, Fort McPherson, Tsiigehtchic, and Tuktoyaktuk.

ⁱⁱⁱ During the test waste cardboard collection program, cardboard was manually processed to remove all tape and labels. The time that this required (35-50kg per hour), along with the weight of the removed material (<1%wt) was recorded.

^{iv} Cardboard produced by the Kraft process has lignin content too low (10%) [4] for high durability pellets (25%) [5].

^v Suppliers contacted include Lawson Mills, Gemco Energy Machinery, California Pellet Mills and Riverside Pellet Mills, all of which produce pellet mills with throughputs in the range of 100-120 kg per hour.

^{vi} BBRG is the University of British Columbia Biomass and Bio-energy Research Group.

^{vii} PCU Deutschland is the governing agency that overlooks ENplus pellet certification for Canada.

^{viii} *Environment and Natural Resources* does require that boilers and fuel types be declared but there are no restrictions on emission gas composition.

^{ix} This business model assumes that the operation is taken on by an existing industrial partner, and so costs associated with building rent and heating are not included in the analysis.

^x \$80,000 is based on the purchasing of the pellet mill and shredder from Lawson Mills, supporting material from ULine, and installing 3 phase electrical power.

^{xi} The cardboard diversion fraction describes the quantity of cardboard successfully diverted as a fraction of the total theoretical cardboard quantity available.

^{xii} The price of \$450 per tonne was determined using a price per unit energy equivalence with the current wood pellets available in Inuvik.