Vuntut Gwitchin First Nation Community Energy Baseline Study

Prepared for:

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ABSTRACT

A Community Energy Baseline (CEB) Study was carried out for the Vuntut Gwitchin First Nation (VGFN) in Old Crow, Yukon during the summer of 2005. The 2004 fiscal year was used as the base year for quantifying energy usage and subsequent greenhouse gas emissions. The goals of the CEB were: to examine the energy supply and demand; detail the sources and consumption; determine GHG emissions; and the financial cost of energy to the VGFN community, including both administrative and residential sectors.

To determine an emissions benchmark, energy use findings were used to calculate greenhouse gas emissions from the VGFN during the 2004 fiscal year. The calculated total amount of energy utilized by the VGFN in 2004 was 24,100 GJ which resulted in the emission of 3,249 tonnes of neutral (biomass or wood) and non-neutral greenhouse gas emissions (CO_2 equivalent). The administrative sector used 17% of all energy within the community and emitted 15% of the greenhouse gases. The residential sector utilized 83% of the energy and emitted 85% of the greenhouse gases.

The majority of energy use was relatively evenly split between the electrical, heating and transportation sectors. Diesel electrical generation was the leading contributor to greenhouse gas emissions. In addition to investigating the VGFN community, the entire community of Old Crow was also found to have utilized 33,687 GJ of energy and emitted 4,389 tonnes of eCO_2.

ACKNOWLEDGEMENTS

The authors would like to thank all of the staff at the Vuntut Gwitchin First Nation Administrative office for their assistance in the data collection for this project. Lyle Charlie served as the Local Research Assistant for this project and provided valuable local knowledge of the community. We wish to also express our appreciation to the VGFN citizens that allowed us to come into their homes and survey them, as well as several VGFN Staff members who assisted us in gathering the necessary information. The ANCAP Steering Committee Members and Pathfinder (Sean Mackinnon) were also very helpful with providing information and the necessary contacts for this project. Sean also assisted in the development of Section 1.1 of this report as well as the summary poster. Sean MacKinnon as well as Melissa Valja (VGFN) reviewed a draft version of this report and provided helpful feedback. Yukon Electrical Company Limited (Phil Borgel) provided energy use information for the community of Old Crow as well as records of electricity consumption within the company (Susan Borud).

STATEMENT OF LIMITATIONS

This document has been prepared by EDI Environmental Dynamics Inc. for the exclusive use and benefit of the Vuntut Gwitchin First Nation and ANCAP. All associated data including surveys, survey results and reports (electronic or otherwise) are the property of the First Nation.

This document represents our best professional judgement based on the information available at the time of its completion and as appropriate for the project scope of work. There are a variety of methods and formulas that can be used to calculate energy consumption and greenhouse gas emissions; this report uses methods that were thought to be the most appropriate for this project. No warranty, expressed or implied, is made.

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1.0 INTRODUCTION

With the intention of helping Canada meet the objectives of the Kyoto Protocol, the Department of Indian Affairs and Northern Development (DIAND) in collaboration with Natural Resources Canada (NRCan), developed the Aboriginal and Northern Community Action Plan (ANCAP) initiative. The ANCAP is intended to provide funding and support for energy related projects focusing on reducing greenhouse gas emissions through promotion of: renewable energy initiatives; energy efficient design and planning; and sustainable development. The Yukon Region ANCAP Committee is the steering body for ANCAP in the Yukon and is composed of representatives from regional First Nations, DIAND, a 'Pathfinder' as well as other invitees (ANCAP 2005).

A Community Energy Baseline (CEB) study is necessary for each First Nation to become eligible for ANCAP funding of future projects. The CEB studies will act as a starting point to gauge the success of future greenhouse gas emissions reduction and energy conservation strategies. In the summer of 2005 CEB studies were initiated by the ANCAP Committee for the six following First Nation communities: Kluane First Nation (Burwash Landing, YT), First Nation of the Na Cho Nyak Dun (Mayo, YT), Ross River Dena Council (Ross River, YT), Selkirk First Nation (Pelly Crossing, YT), Ta'an Kwach'an Council (Whitehorse, YT) and Vuntut Gwichin First Nation (Old Crow, YT). This report presents the findings from the Vuntut Gwitchin First Nation CEB.

The Village of Old Crow is a remote community[1] located approximately 1,000 km north of Whitehorse, YT, (Figure 1) in the heart of the 65,000 km^2 Traditional Territory of the Vuntut Gwitchin First Nation. The community essentially exists only as a First Nation settlement (i.e. all the infrastructure and other people are there to service the First Nation). The CEB study was carried out in Old Crow to investigate the sources and impacts of energy use by the VGFN during the 2004 fiscal year (April 2004 – March 2005). Through the collection of energy use information, it was possible to calculate the greenhouse gas (GHG) emissions from the various energy types used within the community. In addition, the costs of energy used by the First Nation were also compiled. These results provide a baseline of information necessary for the improvement of energy efficiency and conservation systems within the community and will also be valuable when considering renewable or alternative energy sources. The following are the objectives of the VGFN CEB as listed by ANCAP (2005a):

- Identification of energy sources and rates of consumption within the community.
- Identification of specific energy demands within the community.
- Calculation of GHG emissions resulting from the consumption of various types of energy within the community.
- Calculation of costs related to energy usage within the community.
- Raising awareness of energy related issues within the community.
- Capacity building with First Nations members within the community.
- Beginning to develop an understanding of energy related issues (GHG emissions, energy consumption, etc) within the community.

[1] Old Crow is generally only accessible by airplane.

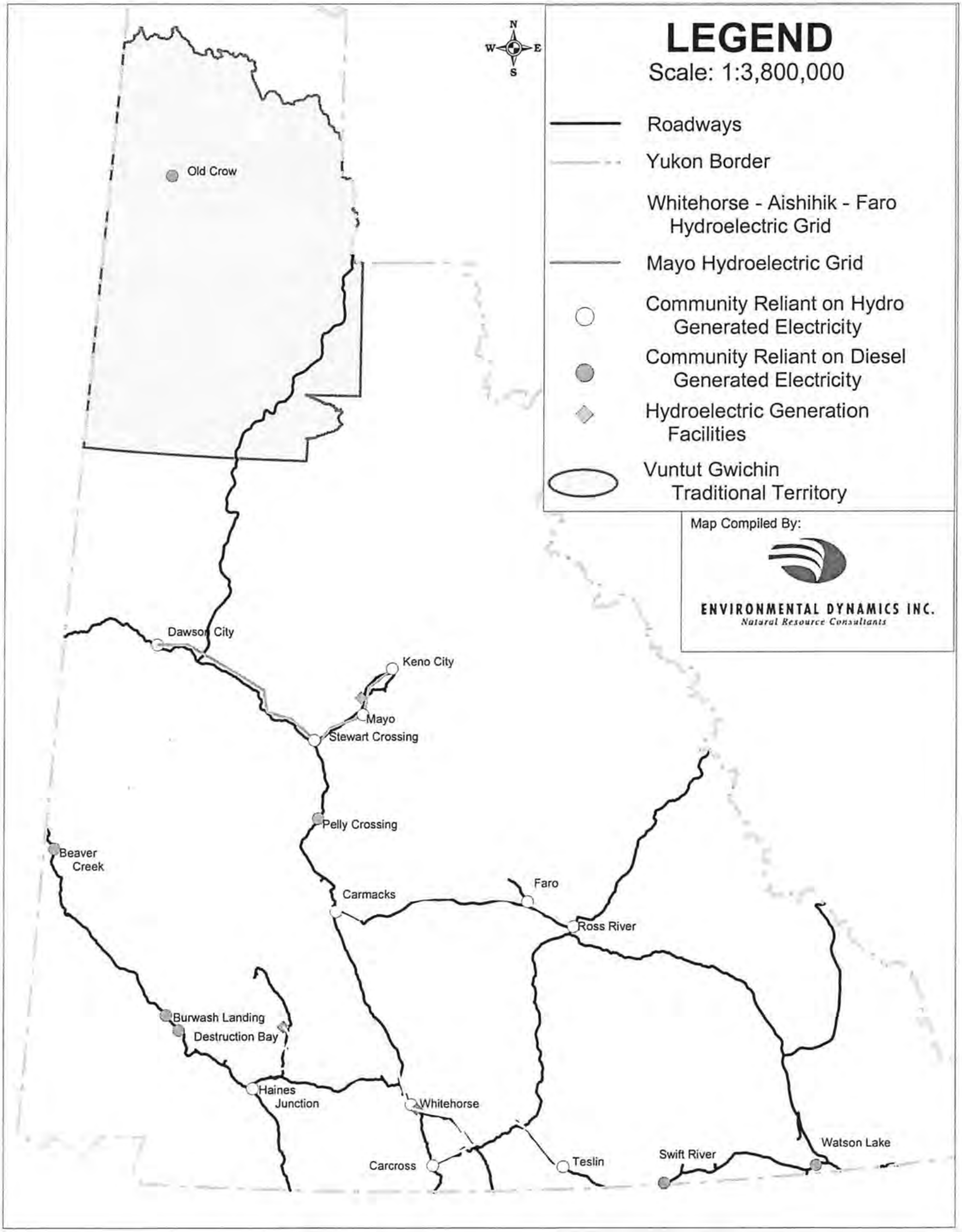


Figure 1. Map of the Vuntut Gwichin Traditional Territory within the Yukon Territory.

1.1 Understanding Energy

Before an understanding of energy usage within the community can be obtained, a brief understanding of what energy is and how it works is required. Work, power and energy are terms which can be used when describing what members of the KFN utilize for day to day tasks such as transportation and home heating. Work occurs when a force is applied through a distance such as propelling a car. Energy is the capacity to do work, such as how far your vehicle can drive on a tank of fuel. Power is the measure of work done per time; for example, power is required to drive from Whitehorse to Burwash Landing. More power is required to get there faster. Work as well as energy are measured in Joules whereas power is measured in Watts.

Electrically speaking a certain number of Watts (Watts = Volts x Amps) are drawn from the electrical system to meet the demand of your electrical devices. Supplying this demand over a period of time ends up being measured in Watt-seconds or Joules (J). Watt-seconds and Joules can be converted to the more common units of: kilowatt hours (kWh), kilojoules (kJ), or gigajoules (GJ). In order to begin to understand how much energy is being used, there must be an understanding of how much energy does 1 GJ equal. For example, one GJ will:

- Light a 60 watt light bulb, 24 hours a day for 192 days.
- Light a 15 watt compact fluorescent light bulb (same amount of light as an incandescent 60 watt bulb) 24 hours a day for 772 days.
- Run your television, 24 hours a day for 38 days.
- Propel a 2005 Toyota Matrix for 365 km[2] in the city.
- Propel a 2005 Dodge Caravan (Minivan) for 240 km[1] in the city.
- Propel a 2005 Toyota 4Runner 4x4 for 214 km[1] in the city.
- Propel a 2005 Ford F150 4x4 for 167 km[1] in the city.
- 1 GJ costs you: $38.78 (gas) [2]
  $32.55 (electricity – plus riders, taxes and customer charges)

There are inefficiencies every time energy is converted from one form to another. When diesel (or wind or water) is used to generate electricity there are "losses" in the system. When electricity is used to cool a building there are losses, where a home is heated with firewood, not all of the energy within the log comes out as heat. Often energy losses are in the form of heat or incomplete combustion. Combustion engines (diesel generators, cars, truck, etc.) are particularly inefficient. Most combustion engines are only 25 - 40% efficient. In contrast, a large hydro generator may be 90% or more efficient. Some forms of renewable energy are not very efficient, such as photo-voltaic (solar) panels. However, the fuel for these panels (the sun) is free; therefore, this must be taken into account.

Choosing energy efficient devices that are suitable to your task is very important. If a Toyota Matrix will serve your purpose, but you drive a Ford F150 4x4, you will end up releasing more than twice as many emissions and have to pay twice as much to travel the same distance. Similarly if you use a 60W incandescent light bulb where a 15W compact fluorescent bulb will do, you will pay four times the amount in power (plus you will have to replace it more often). For electrical devices, any diesel generation on

[1] Natural Resources Canada. 2005b.
[2] Based on a price of $1.50/L.

your distribution system, (includes the hydro grid at times) will also release more emissions due to the excessive electrical demand of the inefficient devices. Furthermore, if your energy comes from an inefficient or unsustainable source (fossil fuels) and you have the potential for sustainable energy (wind, hydro, solar, earth energy, etc..); it may be worth considering switching.

1.2 Background

The VGFN owns and operates 4 administrative buildings within the community of Old Crow including a main administration building, community hall, safe house and youth centre. As well, the first Nation owns three other buildings, one leased to the North Yukon Renewable Resource Council, one leased to the Northern Store, and one that is not in use (Vuntut Development Corp. Office).

The Vuntut Gwitchin First Nation also owns approximately 123 residential units (of various sizes and ages). The majority of tenants living in these housing units are responsible for the payment of utility (heating fuel and electricity) bills. However, the First Nation pays the utility bills to varying degrees for a number of Elders and individuals on social assistance.

Electricity is supplied to VGFN buildings and Old Crow via an isolated (off-grid) diesel generating station located within the community. This facility is operated by the Yukon Electrical Company.

2.0 METHODOLOGY

The sections below outline the methodology used to calculate the energy use, subsequent greenhouse gas emissions and costs associated with energy usage by the VGFN during the 2004 fiscal year.

2.1 Development of Core Surveys

A survey form was created in order to collect information from buildings and associated vehicles/equipment pertaining to the type of energy consumed, the amount of energy used, the amount of waste generated and the costs of energy usage. The survey forms also included a brief inspection of energy efficiency within the building being surveyed. The survey form used can be found in Appendix 1.

2.2 Data Collection

A researcher visited the community in order to gather the required information and promote energy efficiency in the community. A local research assistant assisted the researcher with the collection of information. In addition, First Nation staff assisted by providing data on energy consumption and costs as well as general knowledge of the community.

Data was collected for all First Nation owned buildings and equipment and a representative sample of 10 VGFN residences. The residences surveyed were of varying sizes, ages and potential levels of energy use. First Nations staff assisted in the identification of potential residential survey candidates. The results from these houses were projected to estimate the total energy use, greenhouse gas emissions and costs resulting from energy usage from the 123 VGFN homes.
Within the administrative sector, records of heating fuel, firewood, electricity and vehicle fuel were gathered from records held by the First Nation. This differed within the residential sector, where records

of electricity were obtained from the distributor (Yukon Electrical Co). Due to a lack of records of residential vehicle fuel and firewood usage, these statistics were estimated with the assistance of the resident. Within both sectors, the quantification of the amount of waste (i.e.-garbage, compost and recyclables) was obtained through surveying those individuals responsible for cleaning of the buildings. A number of visual observations were conducted within the buildings surveyed to assess the general energy efficiency of the buildings such as window type and presence of an insulating blanket on the water heater.

2.3 Calculations

The data collected as outlined in Section 2.2 was used to calculate the energy and greenhouse gas emissions. For ease of understanding, the amount of energy consumed was converted to common units using conversion factors with Canada's Greenhouse Gas Inventory 1990 – 2001 (Environment Canada Greenhouse Gas Division 2003). This standard unit, gigajoules (GJ), was derived for the various fuel types using the conversion factors in Table 1.

Table 1. Energy conversion rates[1].

Fuel Type	Units	Energy Per Unit (GJ)
Diesel	1 L	.03868
Gasoline	1 L	.03466
Electricity	1 kWh	0.0036
Softwood (i.e.-spruce)	1 cord	18.7

A Microsoft Excel spreadsheet was developed to calculate the greenhouse gas emissions produced based on the data collected from the survey forms. Only those greenhouse gas emissions resulting from the direct usage of energy were included in the calculation spreadsheet. For example, the fuel used by an aircraft to transport heating fuel to Old Crow was not included in the calculations. The efficiency of the aircraft would not be the responsibility of the VGFN and the subsequent greenhouse gas emissions should be attributed to the fuel company itself.

There are three different types of greenhouse gases, Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). By volume CO_2 is the main greenhouse gas emitted to the atmosphere and it is used as the baseline for rating the impact of other gases on the environment. Methane and nitrous oxide each have a different global warming potential (Table 2) when compared to CO_2. For example, nitrous oxide is generally emitted in relatively small amounts (see Table 3); however, this gas has a very high global warming potential equivalent to 310 times that of carbon dioxide. These global warming potentials are all taken into account in order to gain a standardized figure of GHG emissions and is referred to as a carbon dioxide equivalent ($eC0_2$). As such, the spreadsheet was designed to convert the amount of each GHG emitted into eCO_2 which assists with understanding the results of this project.

[1] Environment Canada Greenhouse Gas Division. 2003.

Table 2. Standard global warming potential for each of the greenhouse gases produced from the burning of fuels[1].

Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310

Greenhouse gas emissions were calculated from the volumes of fuels consumed. Table 3 outlines the GHG emissions factors used in the spreadsheet from the burning of fossil fuels.

Table 3. Emission factors for the burning of fossil fuels[2].

Fuel Type	CO_2 (kg/L)	CH_4 (kg/L)	N_20 (kg/L)
Diesel	2.73	0.00012	0.0001
Gasoline	2.36	0.00025	0.00026

The general unit of measure for firewood is a cord; however, as different species of trees have different densities, GHG emissions must be calculated based upon the weight of the wood. In addition, the emissions are also related to the type of woodstove used due to capacity and burning potential of the stove. As such, the spreadsheet contained different columns for each wood and stove type. The related formulas are presented in tables 4 and 5.

Table 4. Density of common wood fuel types in the Yukon[3].

Fuel Type	Fuel Density (kg/m^3)	Volume of One Cord (m^3)	Weight of One Cord (kg)
Spruce	450	3.456	1555.2
Pine	350	3.456	1209.6
Aspen & Poplar	420	3.456	1451.52
Birch	670	3.456	2315.52

Table 5. Emission factors for the burning of wood (average of wood types[2].

Type of Stove	CO_2 (kg/kg fuel)	CH_4 (kg/kg fuel)	N_20 (kg/kg fuel)
Wood in conventional wood stove	1.5	0.015	0.00016
Wood in stove with advanced technology	1.5	0.0069	0.00016

The amount of waste (i.e. garbage) generated also plays a significant role in greenhouse gas emissions. When calculating greenhouse gas emissions from waste there are three different types of waste to be taken into consideration; mixed garbage, composted material and recycled material. Each type must be separately quantified as each type of waste has a different emission factor (Table 6). The amount of waste generated by each building surveyed was quantified in terms of weekly amounts and extrapolated to include the entire fiscal year of 2004. The spreadsheet used the emission factors in Table 6 to calculate the total emission based on waste composition.

[1] VCR Inc. 2004.
[2] Environment Canada Greenhouse Gas Division. 2003.
[3] SI Metric Units Website. 2005.

Table 6. Emission factors for the disposal of waste.

Type of Waste	Standard Units[1]	eCO_2 / kg	eCO_2 / standard unit (kg)
Mixed Garbage[2]	Typical curb side garbage bag = 7 kg	3	21
Compost material[3]	Typical curb side garbage bag = 10 kg	2	20
Recycled material[3]	Typical curb side garbage bag = 6 kg	1	6

In order to assess greenhouse gas emissions resulting from the use of electricity in Old Crow, the efficiency of the off grid diesel generating station was determined. The Yukon Electrical Company Limited provided data on electricity use and diesel consumption that assisted in determining the efficiency (L/kWh). A total of 1.8 GWh of diesel generated electricity was utilized in Old Crow during 2004[4] (Borgel pers. comm. 2005). A total of 610,000 L of diesel fuel was used to generate electricity in the community during 2004. Using this figure, the generator's efficiency was calculated to be 0.2876 L/kWh. In order to put the amount of electricity used into perspective, comparisons can be made with other First Nations. For example, the Selkirk First Nation (Pelly Crossing) utilized 2.2 GWh of diesel generated electricity.

2.4 Determination of Energy Costs

In the case of records being used to quantify energy usage, the cost of energy was also collected in the same manner. This was done in the case of the administrative sector where accurate records were in place for both energy usage and the associated costs. Quantification of costs related to energy within the residential sector required estimations in many cases. In order to best quantify the cost of firewood as an energy source, a standard rate was used. Through consultation with community members, the cost of firewood within the community of Old Crow was determined to be $300/ cord. In the case of residential transportation fuel costs, the overall cost was calculated using an average fuel price in Old Crow ($1.50/ L) and the volume of fuel used.

2.5 Assumptions

The calculations of the GHG emissions generated by the VGFN were based on the following assumptions.

- All information provided to the surveyor was accurate to the knowledge of the person being surveyed.
- The ten residences surveyed were a representative sample of all 123 households in the VGFN community.
- The standard units (i.e.-garbage bags) used for waste were (on average) equal to those in Table 6.
- The composition of the bags of waste (i.e.-garbage and recycling) was of a mixed variety.
- All garbage is land filled and not burned[2].

[1] A typical curbside garbage bag has a capacity of 56 L.
[2] Alward, R. 2005.
[3] Environment Canada. 2005.
[4] Data was available only for the 2004 calendar year, so this data was used for this calculation.

2.6 Neutral / Non-neutral Greenhouse Gas Emissions

The burning of biomass (wood) has been referred to as a partially neutral greenhouse gas emission (Environment Canada 2003) and as a totally neutral emission (Natural Resources Canada 2002). The concept of neutral emissions is such that wood is referred to as being a carbon neutral fuel source because as trees grow they recycle CO_2 in order to build their structure. This concept is only said to be true if the cutting of wood is carried out in a sustainable fashion (NRCAN 2002) and with little forestry activity in the Old Crow region this may very well be a true assumption[1].

3.0 RESULTS

Typically, Community Energy Baseline Studies conducted in the Yukon have only focused on the infrastructure and energy directly attributable to the First Nation and its members that live in the community. Old Crow is unique in the Yukon as it is a remote First Nation community all of the infrastructure and energy consumed is to service the First Nation. As such, the results of this report first focus on all of the energy consumed in the community of Old Crow (Section 3.1) before describing the energy use by the First Nation itself (Sections 3.2-3.6). For example, buildings that are not owned or operated by the First Nation such as the Health Centre, RCMP, the airport and the school are included in Section 3.1 only.

3.1 Energy Use by the Entire Community of Old Crow

An overall estimate of energy usage, cost and subsequent greenhouse gas emissions was made due to the fact that Old Crow is almost completely composed of VGFN citizens or others servicing those citizens (i.e.-RCMP, nurses, etc). The entire community used an estimated 33,687 GJ of energy at a cost of $1,076,605 (Figure 2). As a result of this energy usage, 4,390 tonnes of eCO_2 were emitted (Figure 3). It should be noted that 35% (1,547 tonnes eCO_2) were neutral emissions resulting from the burning of firewood (Figure 3).

[1] The rate of uptake for the average tree in Canada is approximately 10.19 kg CO_2 tree yr (Tree Canada Foundation 2005). Therefore, the amount of CO_2 given off by the VGFN during 2004 would require 134,439 trees one year to recycle and put into their growth. To put the rate of biological uptake into perspective, assume a conservative estimate of 1000 trees / ha in the Old Crow region. With approximately 135,000 trees required to uptake the emissions by the VGFN in 2004, it can be calculated that 135 hectares of forest are required. Given the small population of and vast amount of forested area in the Old Crow region this amount of wood harvest was deemed to be sustainable.

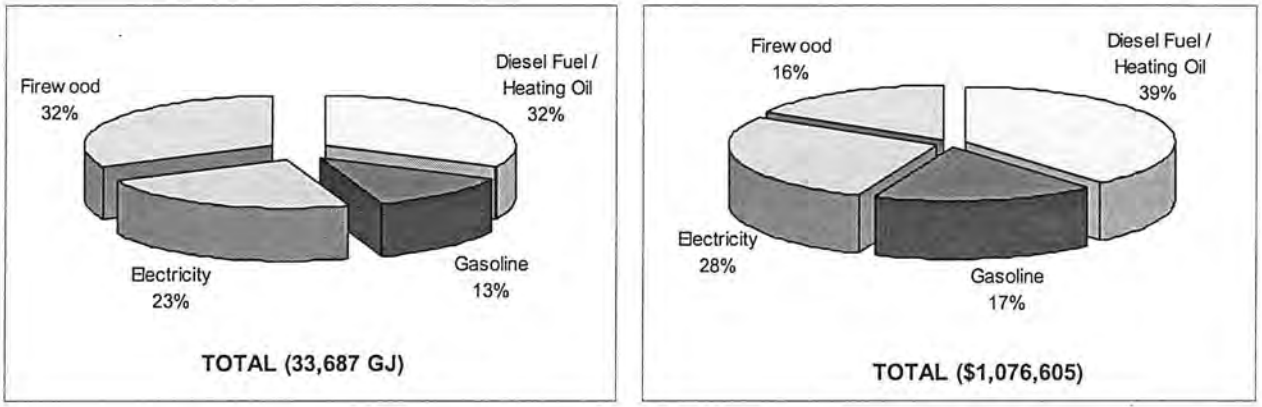


Figure 2. Energy use (left) and associated costs (right) by the community of Old Crow.

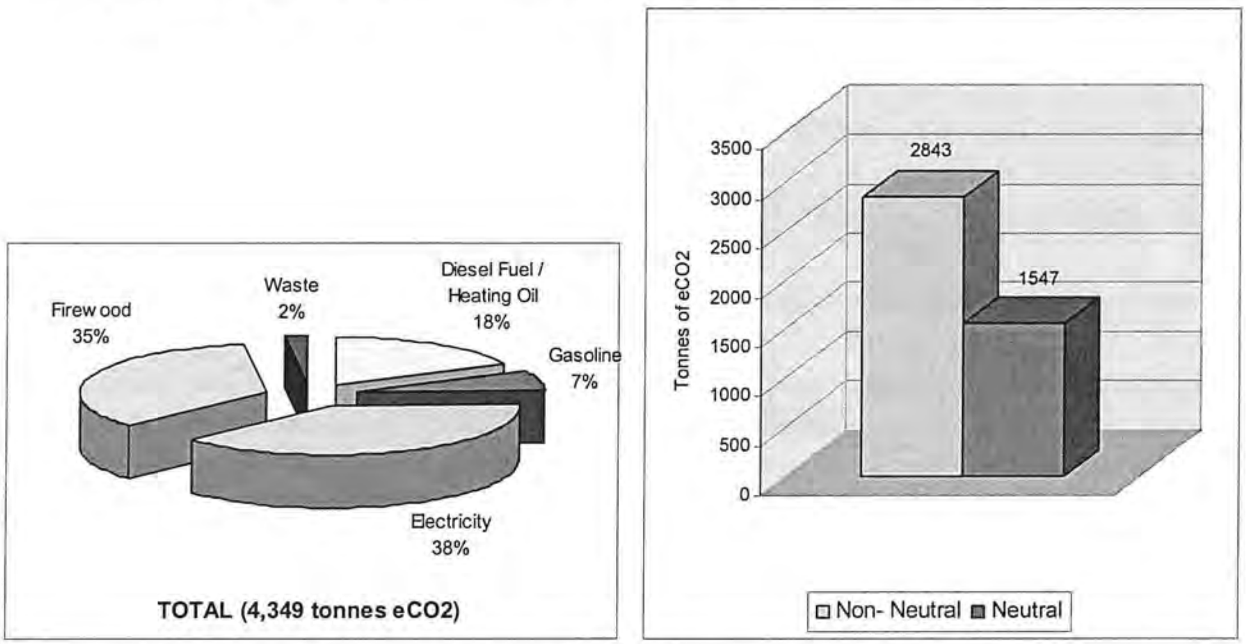


Figure 3. Greenhouse gases emitted by the community of Old Crow.

3.2 Energy Flow within the VGFN Community

A comprehensive graphic representation of the VGFN[1] community energy flow (and impact) determined by the VGFN Community Energy Baseline study can be found in the below Sankey diagram (Figure 4).

[1] This does not include the infrastructure not owned or operated by VGFN.

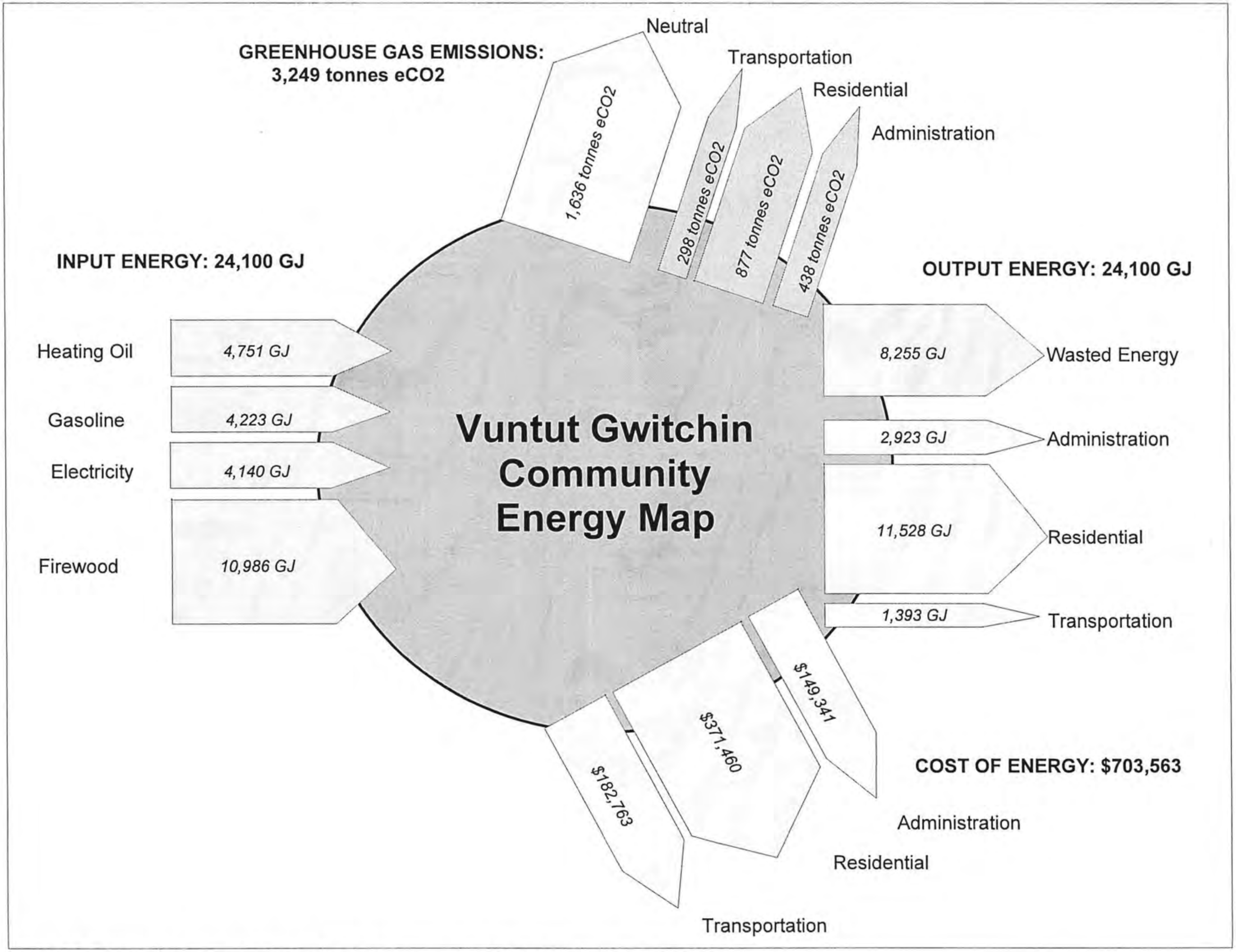


Figure 2. Sankey diagram showing flow of energy used in the community of Old Crow.

3.3 Energy Use by the VGFN Community

The results of this CEB estimate a total of 24,100 GJ of energy were used by the VGFN community during the 2004 fiscal year (Figure 5). The amount of energy utilized by the residential sector of the VGFN was significantly higher than that of the administrative sector. A total of 4,055 GJ were consumed by the administrative sector and 20,045 GJ by the residential sector. The residential sector utilized energy sources from neutral sources (i.e.-firewood) in much greater quantities than that of the administrative sector. The relative proportion of energy sources utilized by the administrative and residential sectors differ considerably (Figure 6). Heating is responsible for the majority of energy usage in both sectors; however, the fuel types utilized differ considerably. The administrative sector relies on heating oil for 56% of energy used whereas the residential sector relies upon firewood for 55% of the energy demand.

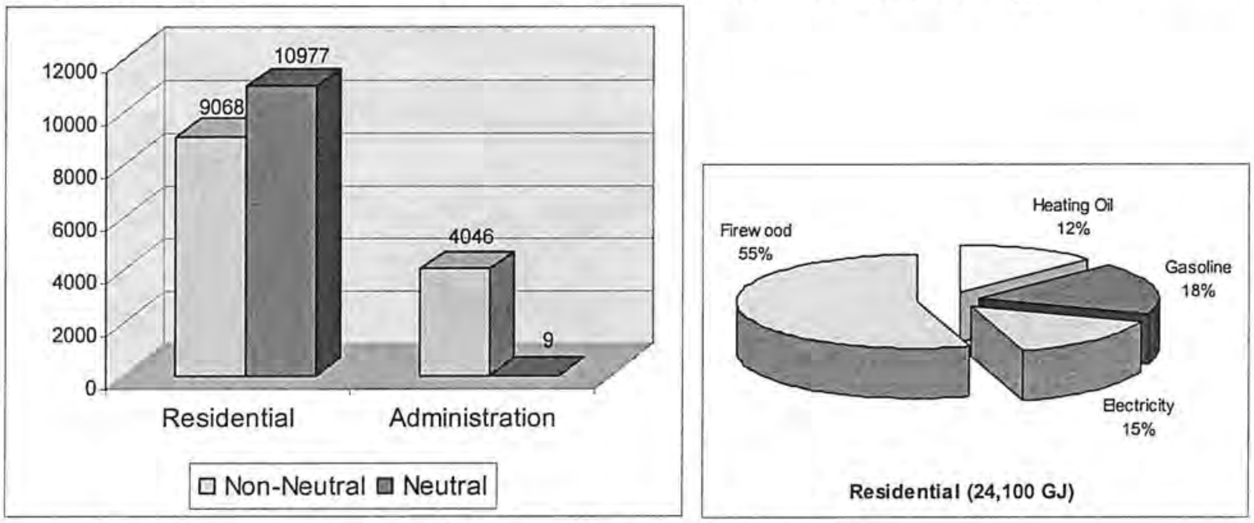


Figure 5. Energy use by the VGFN community during the 2004 fiscal year.

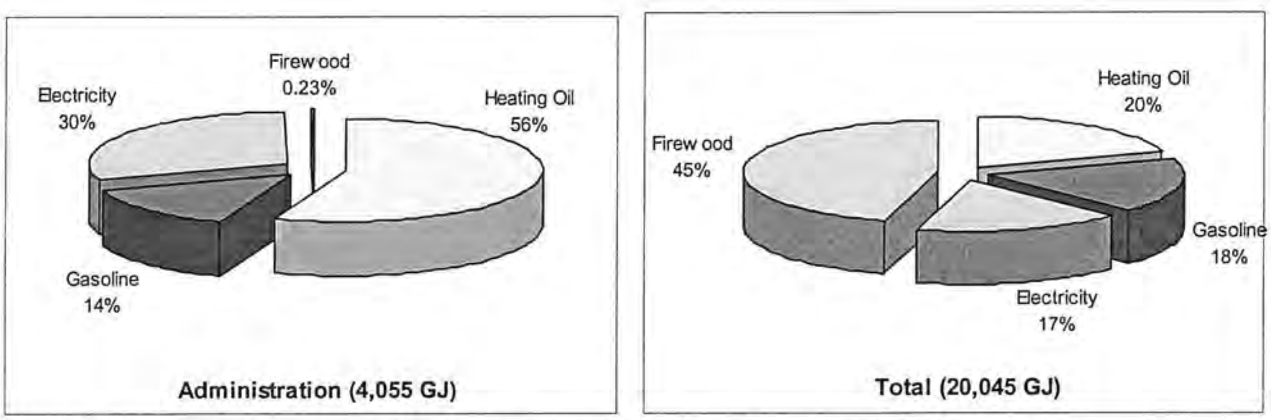
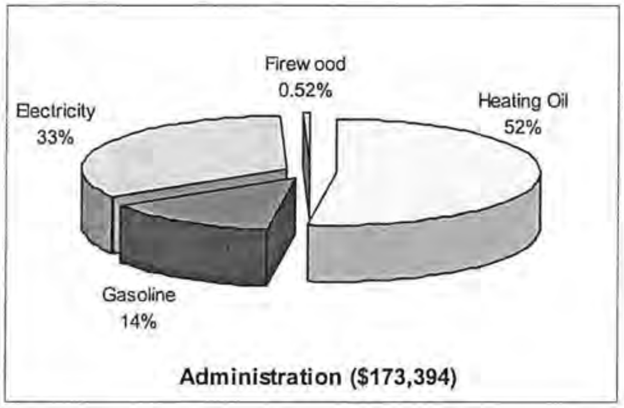


Figure 6. Total energy use by administrative (left) and residential (right) buildings, vehicles and equipment of the VGFN community.

3.4 Cost of Energy by the VGFN Community

An estimated $703,565 was spent by the VGFN community on energy within the 2004 fiscal year. Of this, 25% ($173,394) was spent by the administrative sector and 75% ($530,171) by the residential sector (see Figure 7 and Table 7).



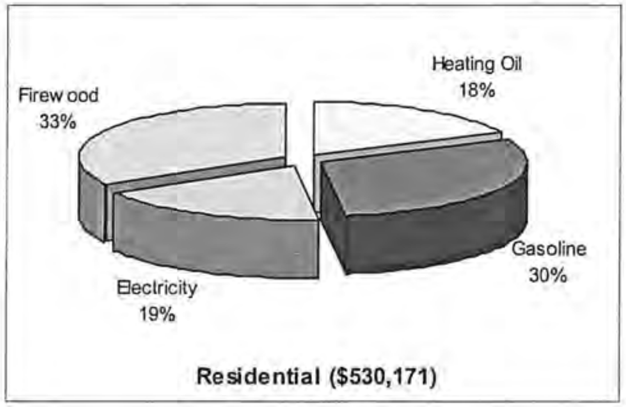


Figure 7. Cost of energy by the administrative (left) and residential (right) sectors of the VFGN community.

Table 7. Cost of energy by the administrative and residential sectors of the VGFN community.

Energy Type	Cost of Energy		
	Administrative	Residential	Total
Heating Oil	$90,785	$96,272	$187,057
Firewood	$900	$176,100	$177,000
Electricity	$57,656	$99,088	$156,744
Gasoline	$24,053	$158,711	$182,764
TOTAL	$173,393	$530,170	$703,565

3.5 Greenhouse Gas Emissions by the VGFN Community

A total of 485 tonnes of greenhouse gases were emitted by the administrative sector (Figure 8) compared to 2,764 tonnes by the residential sector. The residential sector had a larger portion (59%) of neutral emissions that the administrative sector (2%). Emissions from heating (i.e. firewood) were responsible for a much greater portion of neutral emissions in the residential than from the administrative sector (figure 8 and 9). The majority of the administrative sector's emissions were a result of electricity generation. A complete summary of greenhouse gas emissions can be found in Appendix 2.

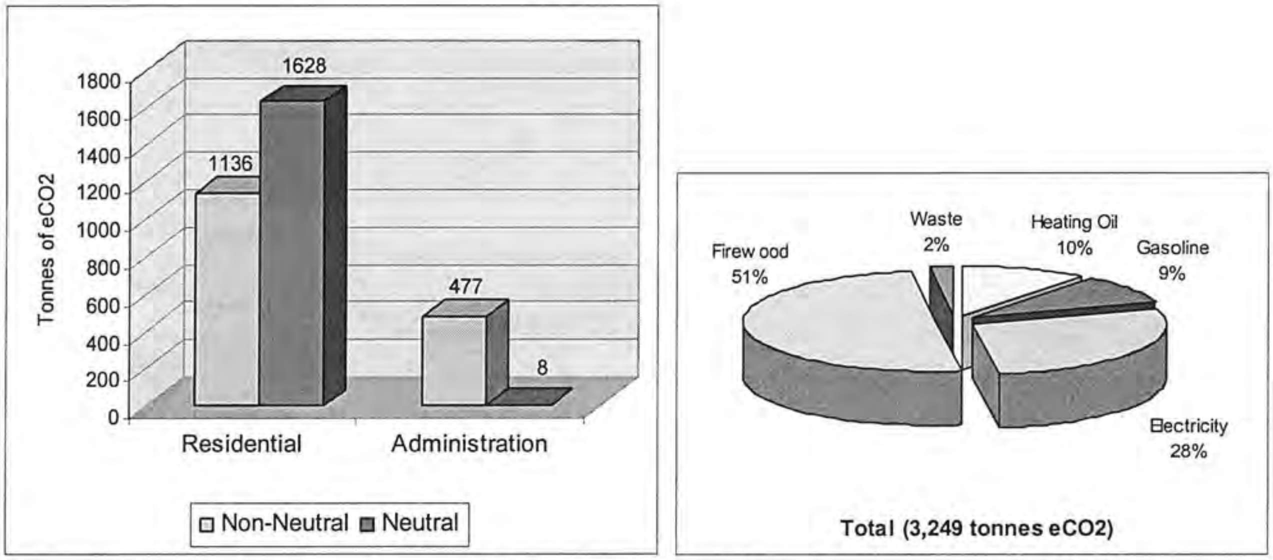


Figure 8. Neutral and non-neutral emissions from residential and administrative sectors of the VGFN community.

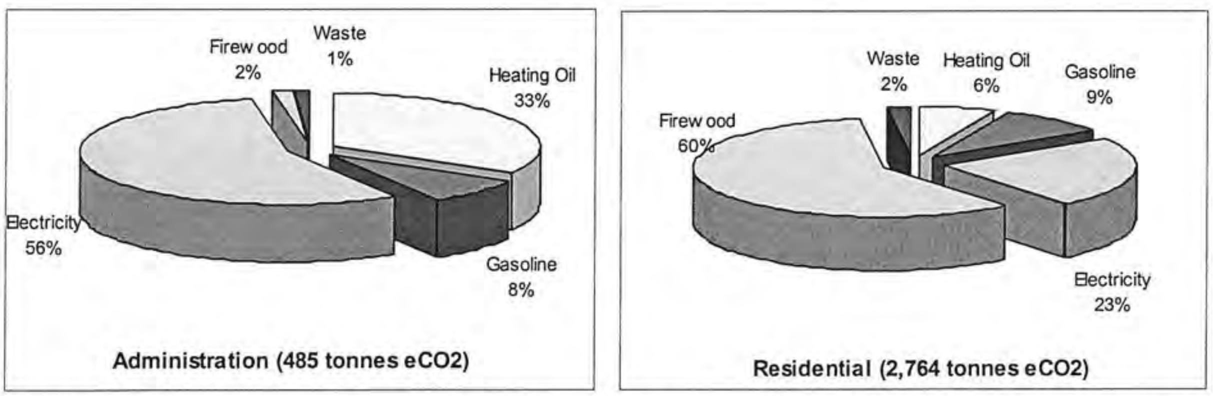


Figure 9. Total greenhouse gas emissions (including neutral) from administrative and residential sectors of the VGFN community.

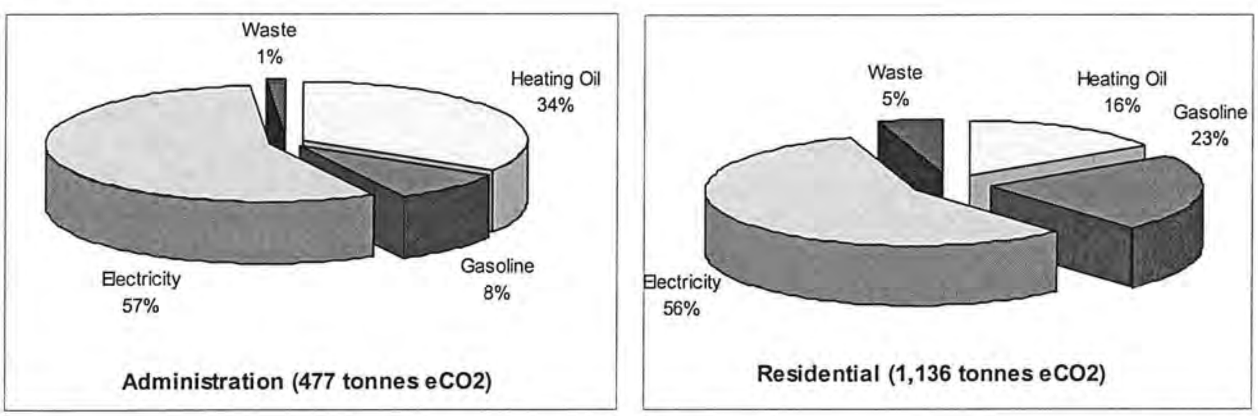


Figure 10. Total greenhouse gas emissions (excluding neutral) from administrative and residential sectors of the VGFN community.

3.5.1 Neutral Greenhouse Gas Emissions by the VGFN Community

For the purpose of this survey, greenhouse gas emissions resulting from the burning of wood were included in the total calculations. However, it should be noted that the burning of firewood was responsible for a total of 1,635 tonnes of eCO_2, and accounted for 50% of total emissions. The amount of CO_2 emitted by wood burning was 1,370 tonnes and does not include CH_4 and N_2O emitted. It is important to distinguish between the gases being emitted from the burning of wood because sources believe that the neutral emissions account only for CO_2 emitted (Environment Canada Greenhouse Gas Division, 2003).

Emissions resulting from the burning of firewood and composting of waste were considered to be neutral greenhouse gas emissions. All neutral emissions within the VGFN community were a result of burning firewood as a heat source.

3.5.2 Administration Buildings

A small number of buildings are responsible for the majority of the greenhouse gas emissions in the administrative sector (Figure 11). Two buildings (Administration Building and Northern Store) were responsible for the greatest portion (76%) of total emissions.

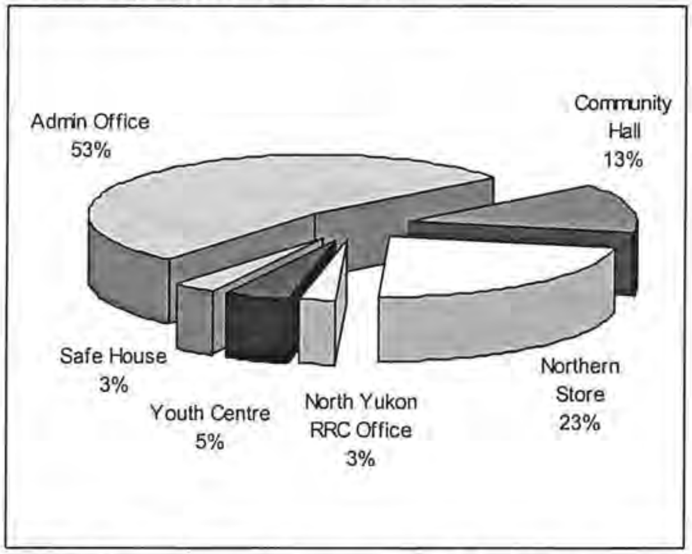


Figure 11. Sources of greenhouse gas (non-neutral and neutral) emissions from VGFN administrative buildings.

3.6 Energy Efficiency

A brief assessment of energy efficiency was conducted within each building surveyed. The vast majority of buildings surveyed had at least minimal energy efficient items such as double paned windows and weather stripping present. A smaller proportion had additional energy efficient items such as fluorescent lighting and covered windows in place (during winter months). Overall, most buildings could be made more energy efficient with a minimal amount of effort. Examples of simple methods which could increase energy efficiency include items such as compact fluorescent light bulbs, water heater insulating blankets and window coverings during the winter months. A very positive energy efficient item which was frequently encountered in the community were EPA rated woodstoves. These energy efficient items burn less firewood and reduce the amount of waste energy given off.

Due to the lack of roadways in the community, vehicles are used for travelling short distances and energy usage for transportation is not as big of a concern as in other communities. Within the VFGN community, there was found to be a mixture of both four stroke (most outboard boat motors, all ATVs) and two stroke engines (some outboard boat motors, most snowmobiles). The economic viability of lower fuel consumption makes them more desirable in terms of transportation.

4.0 DISCUSSION

During the 2004 fiscal year, the most commonly used energy source within the VGFN community was firewood. Wood is used exclusively as a heating fuel. This results almost entirely from the residential sector, where firewood made up 60% of all energy used. The high amount of energy and subsequent greenhouse gas emissions (neutral) resulting from firewood usage is likely a result of the economic feasibility and practicality of this energy source for home heating. This is despite the fact that firewood is expensive ($300/cord) in the community, as the alternative (heating oil) is also very expensive.

In comparison to other energy sources, electricity was used in moderate amounts within the VGFN community. However, emissions from this form of energy also compose a very significant portion of greenhouse gas emissions (over 50% of non-neutral emissions). In terms of greenhouse gas production, the current infrastructure in place to supply Old Crow with electricity is based upon a non-renewable, and therefore also non-neutral, energy source (diesel). When assessing the amount of energy used *and greenhouse gas emissions produced* to generate electricity in Old Crow, one *should* take into account the very high amount of embedded energy *(and asscoiated emissions)* related with this particular use of fossil fuel. In this case, embedded energy would represent the energy required to transport diesel fuel to Old Crow in order to generate electricity. Given the very remote nature and method of fuel transport (aircraft) to Old Crow, there is *likely* a very high amount of embedded energy *and greenhouse gas production* associated with all fossil fuel usage. This embedded energy was not included in the results of this project.

As with most northern communities, heating buildings consumes significant energy and generates significant greenhouse gas emissions. Furnace and building efficiency are important factors that will determine energy use, cost, and greenhouse gas outputs. Assuming firewood results in neutral emissions (i.e. - the assumption is that the wood was harvested in a sustainable fashion, within the growth rate of the harvested forest area) there is still value in increasing the efficiency of woodstoves and buildings that are wood heated. Newer woodstoves with advanced technology / catalytic converters (already quite common in the community) allow for a greater amount of energy (i.e.-heat) to be generated from the same volume of fuel (i.e. less wood required per year). As such, less cost, effort and energy (i.e.-fossil fuels) will be expended in the collection of firewood. These stoves also greatly reduce the amount of potent greenhouse gases (CH_4, N_2O) as well as other air born pollutants.

Household and other waste was found to be a very minor contributor to greenhouse gas emissions within the VGFN community. Waste constituted 2% of emissions in both the administrative and residential sectors. The majority of greenhouse gases emitted by landfilled garbage are a result of the release of methane (CH_4). Studies have shown a large proportion (70%) of typical household waste can be either composted or recycled (Environment Canada 2005). Recycling was found to exist in the VGFN community and is expected to become more common[1]. Composting was found to be virtually non-existent within the community. In addition to directly reducing greenhouse gas emissions, recycling and composting allow for less waste to be placed into landfills, thus increasing the lifespan of the Old Crow landfill. Possible methods for increasing the amount of composted and recycled materials include public education and community collection programs.

The main Administration Building accounted for 53% of all greenhouse gas emissions from non-residential buildings (Figure 11) owned by VGFN. This building is heated through the use of a large boiler fueled by heating oil. The Northern Store also contributes a significant portion (23% of VGFN owned buildings) to emissions within the community, mostly due to electricity usage. This is likely a result of the inefficient and outdated coolers and freezers used in the store. As well, various upgrades to increase energy efficiency of the building could save heating costs and result in reduced greenhouse gas emissions. The other buildings within the VGFN administrative sector contributed to the total greenhouse gas emissions in relatively smaller amounts compared to the administration building.

When assessing the energy efficiency of VGFN residential buildings, the age of the buildings is critical. In general, older residences have little in the form of energy efficient design, or enhancements. During this survey, the residences surveyed were of varying ages which allowed for a sample of various residence types. The presence of energy efficient practices within the administrative and residential buildings surveyed indicates some awareness when it comes to energy efficiency, however, there is room for improvement. Due to the high amount of emissions resulting from electricity generation, the addition of energy efficient items with residential buildings would be a quality starting point in decreasing emissions in the community of Old Crow.

5.0 CONCLUSIONS AND RECOMMENDATIONS

In terms of future projects that could be supported by the ANCAP and/or other incentive programs there are a number of options that may be desirable to the VGFN. ANCAP supports a number of categories of projects: Renewable Energy and Alternative Energy Measures, Communications and Awareness Raising, Capacity Building Measures and Energy Efficiency Measures and Community Energy Mapping. This Community Energy Baseline study represents a 'Community Energy Mapping' type of project that leads appropriately into the other categories supported by ANCAP. A summary poster of the findings of this CEB can be found in Appendix 3.

In order to reduce energy usage and subsequent greenhouse gas emissions within the VGFN community, the focus of future reduction efforts must be placed on those sectors of energy consumption which utilize the largest proportion of energy and emit the highest portion of greenhouse gases. The heating sector accounts for a large proportion of energy usage within the community; therefore, the following suggestions may assist in reducing the amount of energy used within this sector:

- Installation of solar wall or other passive solar device to collect energy generated by the sun and feed the resulting heat into the buildings heating system (i.e. admin building).

[1] A program is being initiated by the local Habitat Steward in which recyclables are collected and sent out by plane, as donated by the local airline (Air North).

- Making buildings less susceptible to heat loss (i.e. insulation, plastic, covering on windows, weather-stripping, retrofitting, etc.)
- Replacement of old woodstoves with EPA approved woodstoves.
- Retrofit or replacement of aging diesel furnaces/heaters with modern high efficiency ones.

As electricity accounts for a significant portion of energy usage in Old Crow, the diesel generating station operated by Yukon Electric is another significant contributor of greenhouse gas emissions. As previously mentioned, more than half of all non-neutral emissions result from electrical consumption. Research into renewable energy sources to replace or offset the current diesel power generation system would represent important first steps towards reducing greenhouse gas emissions. Diesel generation of electricity contributed 1,691 tonnes of eCO_2 from Old Crow as a whole, which includes 915 tonnes resulting solely from the electrical usage of First Nation administration/community buildings. Another issue with the generating station is the amount of waste energy that is lost in the generating process. This is due to the fact that not all energy within the diesel fuel is converted to electricity. Up to 67% of the chemical energy held by the diesel fuel may be "wasted" in the form of heat and sound. A heat recovery system installed to heat the nearby airport or health centre would result in more efficient use of the diesel generation plant and reduced emissions from heating the other buildings.

Various options to eliminate or decrease this significant source of greenhouse gas emissions include small hydro, wind, solar developments, or, ground or water-source earth energy. Perhaps the most realistic alternative source of electricity would be the construction of a wind turbine. However, a feasibility study of wind generation was recently conducted at a site on Crow Mountain (near Old Crow) and it was determined that wind generation was not feasible unless icing conditions during the winter months could be dealt with. However, it is possible that this research did not consider the merits of all currently available wind generation technology, some of which may address the identified icing problems. Should further research lead to a feasible wind generation or other renewable energy option, this would significantly reduce the community's greenhouse gas emissions resulting from electrical consumption.

The promotion of practices, techniques and technologies to reduce the demand for energy at the community level is also important. In the case of the VGFN, projects focused toward reducing consumption of electricity in addition to heating and transportation fuels could prove valuable. Initiatives could include the following projects (i.e. demonstration projects):

- An energy fair which would have a network of clinics and demonstrations focusing on home efficiency (emphasis should be placed on the efficiency of four stroke vs two stroke engines).
- Increasing awareness of the high level impact that all motorized forms of transportation have on the environment.
- Clinics on vehicle maintenance.

A further consideration for VGFN is future development and expansion of the community. At this time, various residential and other developments are planned for the near future to meet the needs of the community. It is advisable that such plans be reviewed to consider the energy efficiency of proposed developments and to identify innovative options where appropriate. Consideration must be given not only to the energy and heating/electrical efficiency of buildings, but also to community design. That is, overall energy demands and resultant greenhouse gas emissions from expanded infrastructure for water and sewer services, electrical consumption, and transportation requirements may or may not increase exponentially depending on the design and layout of future developments. Appropriate community design can minimize increases in future energy use and resultant greenhouse gas emissions, as well as, the financial burden of servicing new and expanded infrastructure.

The possible projects outlined above would increase energy efficiency and reduce greenhouse gas emissions while at the same time reducing the cost of energy to the First Nation, local businesses, and residents. The main goal of carrying out this CEB was to provide a baseline for energy usage and greenhouse gas emissions within the community. From these findings, it is possible to pinpoint appropriate and effective sectors within the community for projects to reduce greenhouse gas emissions and related financial costs.

6.0 REFERENCES

Alward, R. Senior Engineer, RETScreen International. Personal Communication via email. January 6th, 2005.

ANCAP. 2005a. *Terms of Reference: Community Energy Baseline Studies*. Prepared by the ANCAP Committee. July 2005.

ANCAP. 2005b. ANCAP website: http://www.ainc-inac.gc.ca/clc/tp/apd_e.html. Viewed September 2005.

Borgel, P. Supervising Engineer, Yukon Electrical Company Limited. Personal Communication with Pat Tobler (EDI) via email, August 2005.

Environment Canada Greenhouse Gas Division. 2003. Canada's Greenhouse Gas Inventory 1990-2001.

Environment Canada, 2005. One Tonne Challenge Website. Viewed January 27th, 2005. http://climate change.gc.ca/onetonne/calculator/english/index.asp .

Natural Resources Canada. 2002. A Guide To Residential Wood Burning. Her Majesty the Queen in Right of Canada.

Natural Resources Canada. 2004. Canada's Greenhouse Gas Inventory 1990-2002.

SI Metric Units Website. 2005. http://www.simetric.co.uk/si_wood.htm. Viewed January 26, 2005.

Tree Canada Foundation. 2005. Tree Canada Foundation Website: http://www.treecanada.ca/index_e.htm. Viewed January 31, 2005.

VCR Inc. 2004. SME CO_2 Calculation Tool, version 4. Voluntary Challenge Registry Inc.

APPENDIX 1: SURVEY FORMS

Community Energy Baseline Study: Survey Form
(*one survey to be completed for each FIRST NATION building)*

Surveyor(s): __________ __________

Community: __________ Date: __________

Building: __________

\# of occupants (if residential) __________

Part 1 - Energy Efficiency

1 - Energy Efficient Items Within The Building (check all that apply, comment as required)

double paned windows		covered windows (plastic)	
tripled paned windows		weather stripping	
termostat - with timer		additional insulation	
flourescent lighting		other	

2 - Water heater information:

Does it have an insulating blanket (Yes or No)? __________

water heater model & approx age __________

Does the water heater have a thermostat, if so what is it set at? __________

3 - Any comments on energy efficiency in the building (ie-age, appliances drafts, frost around doorways & windows, etc)

Part 2 - Heating

4 - What type of energy is used for heating the building ? (circle or list all that apply)

Oil (diesel) Propane Wood Electric Solar

Other

5 - What type of fuel wood was used during 2004 for heating and how many CORDS were burnt? (1 cord = 4ft x 4ft x 8ft) -- state percentage of each wood type used

Pine % Spruce % Birch% Aspen/Poplar %

Jan	Feb	Mar	Apr	May	Jun
Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**

TOTAL
0

6 - What was the moisture content of the wood used as fuel (list percentage of each)?

Green % Dead % Seasoned %

7 - Does the woodstove used for heating have EPA advanced technology / catalytic controllers?

(yes/no)

(there were no EPA rated woodstoves before the mid 1990s and all stoves have a plate on the backside which states whether or not they are approved)

8 - Notes on woodstove efficiency (include brand and estimated age).

Part 3: Waste

9 - How much waste is generated per week on average (# of average sized garbage bags)?
(average sized bag is a typical curbside bag with a volume of approx 56 litres)

Type of Waste	Bags / wk
Garbage	
Compost	
Recyclables	

Part 5: Transportation & Equipment

10 - On average, how many minutes a day do you idle your vehicle during:			
Summer		Winter	

11 - What type of vehicles and equipment are used and how much fuel was used during 2004?

(if the total fuel used is not known, gather the other information as a minimum)
(be sure to gather all information on each vehicle as this information is used to estimate emissions)
(note hours of annual use, if mileage is not tracked)

Vehicle / Equipment #1

Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #2

Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #3

Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #4

Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #5

Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #6							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #7							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #8							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #9							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #10							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Vehicle / Equipment #11							
Vehicle / Equipment Type	Make Model	Year	Engine Size	Trans Type	Fuel Type	Total Mileage	2004 Hr / Mileage
Notes on vehicle efficiency:				Amount of Fuel Used in 2004			

Please use the area below for any comments on this bulding:

Community ______________________

Surveyor ______________

Building ______________________

Month	*Type of Fuel*	*Volume Used*	*Cost ($)*
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

APPENDIX 2: SUMMARY OF GREENHOUSE GAS CALCULATION SPREADSHEET

General		***ENERGY USED FOR HEATING & THE RESULTING EMISSIONS***							
	number of (residential only)	Amount of diesel used for heating (L)	Energy (GJ)	Total cost of diesel for heating ($)	GHG Emissions From Diesel (kg)				Amount of propane used for heating (L)
					CO2	CH4	N2O	eCO2	
Admin Office		28600	1106.2	39000	78078.0	3.4	2.9	79036.7	0.0
Community Hall		17350	671.1	28488.7	47365.5	2.1	1.7	47947.1	0.0
Northern Store		3300	127.6	6600	9009.0	0.4	0.3	9119.6	0.0
North Yukon RRC Office		3471	134.3	6942	9475.8	0.4	0.3	9592.2	0.0
Youth Centre		4790	185.3	7866.18	13076.7	0.6	0.5	13237.3	0.0
Safe House		1150	44.5	1888.3	3139.5	0.1	0.1	3178.0	0.0
House #1	2	0	0.0	0	0.0	0.0	0.0	0.0	0.0
House #2	2	150	5.8	225	409.5	0.0	0.0	414.5	0.0
House #3	3	0	0.0	0	0.0	0.0	0.0	0.0	0.0
House #4	2	400	15.5	600	1092.0	0.0	0.0	1105.4	0.0
House #5	2	2600	100.6	3900	7098.0	0.3	0.3	7185.2	0.0
House #6	1	2068	80.0	3102	5645.6	0.2	0.2	5715.0	0.0
House #7	3	0	0.0	0	0.0	0.0	0.0	0.0	0.0
House #8	2	0	0.0	0	0.0	0.0	0.0	0.0	0.0
House #9	5	0	0.0	0	0.0	0.0	0.0	0.0	0.0
House #10	4	0	0.0	0	0.0	0.0	0.0	0.0	0.0
TOTAL Diesel for Yukon Elec.	612000 L		0.0		0.0	0.0	0.0	0.0	
TOTAL VGFN for Old Crow			0.0		0.0	0.0	0.0	0.0	
Total VGFN Diesel Purchase	279907 L		0.0		0.0	0.0	0.0	0.0	
Total VGFN Gas Purchase	121842 L		0.0		0.0	0.0	0.0	0.0	
Total Gas for all VGFN Vehicles	16035 L		0.0		0.0	0.0	0.0	0.0	
Total Gas for 4 VGFN Vehicles	4612 L		1.5						
	215350								
Residential (123)		**64181.4**	**2482.5**	**96272.1**	**175215.2**	**7.7**	**6.4**	**177366.6**	**0.0**
Administrative		**58661**	**2269.00748**	**90785.18**	**160144.53**	**7.03932**	**5.8661**	**162110.847**	**0**
TOTAL		**122842.4**	**4751.5**	**187057.3**	**335359.8**	**14.7**	**12.3**	**339477.4**	**0.0**

General													
	number of (residential only)	Energy (GJ)	Total cost of propane for heating ($)	GHG Emissions From Propane (kg)				Convential Stove				Stove with Ad	
				CO2	CH4	N2O	eCO2	Pine (cords)	Spruce (cords)	Aspen (cords)	Birch (cords)	Pine (cords)	Spruce (cords)
Admin Office		0.0	0.0	0.0	0.0	0.0	0.0						
Community Hall		0.0	0.0	0.0	0.0	0.0	0.0						
Northern Store		0.0	0.0	0.0	0.0	0.0	0.0						
North Yukon RRC Office		0.0	0.0	0.0	0.0	0.0	0.0						
Youth Centre		0.0	0.0	0.0	0.0	0.0	0.0						
Safe House		0.0	0.0	0.0	0.0	0.0	0.0						3
House #1	2	0.0	0.0	0.0	0.0	0.0	0.0		0				5
House #2	2	0.0	0.0	0.0	0.0	0.0	0.0		0				4
House #3	3	0.0	0.0	0.0	0.0	0.0	0.0		5				0
House #4	2	0.0	0.0	0.0	0.0	0.0	0.0		0				5
House #5	2	0.0	0.0	0.0	0.0	0.0	0.0		4				0
House #6	1	0.0	0.0	0.0	0.0	0.0	0.0		0				1.5
House #7	3	0.0	0.0	0.0	0.0	0.0	0.0		7				0
House #8	2	0.0	0.0	0.0	0.0	0.0	0.0		5				0
House #9	5	0.0	0.0	0.0	0.0	0.0	0.0		6				0
House #10	4	0.0	0.0	0.0	0.0	0.0	0.0		0				5
TOTAL Diesel for Yukon Elec.	612000 L	0.0		0.0	0.0	0.0	0.0						
TOTAL VGFN for Old Crow		0.0		0.0	0.0	0.0	0.0						
Total VGFN Diesel Purchase	279907 L	0.0		0.0	0.0	0.0	0.0						
Total VGFN Gas Purchase	121842 L	0.0		0.0	0.0	0.0	0.0						
Total Gas for all VGFN Vehicles	16035 L	0.0		0.0	0.0	0.0	0.0						
Total Gas for 4 VGFN Vehicles	4612 L												
	215350												
Residential (123)		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**332.1**	**0.0**	**0.0**	**0.0**	**252.2**
Administrative		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
TOTAL		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**332.1**	**0.0**	**0.0**	**0.0**	**255.2**

General												
	number of (residential only)	vanced Tech		Energy (GJ)	Cost of firewood collection ($)	GHG Emissions From Wood (kg)				Total cost of heating ($)	Total energy for heating (GJ)	GHG
		Aspen (cords)	Birch (cords)			CO2	CH4	N2O	eCO2			CO2
Admin Office				0.0		0.0	0.0	0.0	0.0	39000.0	1106.2	78078.0
Community Hall				0.0		0.0	0.0	0.0	0.0	28488.7	671.1	47365.5
Northern Store				0.0		0.0	0.0	0.0	0.0	6600.0	127.6	9009.0
North Yukon RRC Office				0.0		0.0	0.0	0.0	0.0	6942.0	134.3	9475.8
Youth Centre				0.0		0.0	0.0	0.0	0.0	7866.2	185.3	13076.7
Safe House				9.2	1200	6998.4	32.2	0.7	7905.9	3088.3	53.7	10137.9
House #1	2			15.3	1500	11664.0	53.7	1.2	13176.4	1500.0	15.3	11664.0
House #2	2			12.2	1200	9331.2	42.9	1.0	10541.1	1425.0	18.0	9740.7
House #3	3			15.3	1500	11664.0	116.6	1.2	14499.1	1500.0	15.3	11664.0
House #4	2			15.3	1500	11664.0	53.7	1.2	13176.4	2100.0	30.8	12756.0
House #5	2			12.2	1200	9331.2	93.3	1.0	11599.3	5100.0	112.8	16429.2
House #6	1			4.6	450	3499.2	16.1	0.4	3952.9	3552.0	84.6	9144.8
House #7	3			21.4	2100	16329.6	163.3	1.7	20298.8	2100.0	21.4	16329.6
House #8	2			15.3	1500	11664.0	116.6	1.2	14499.1	1500.0	15.3	11664.0
House #9	5			18.4	900	13996.8	140.0	1.5	17399.0	900.0	18.4	13996.8
House #10	4			15.3	1500	11664.0	53.7	1.2	13176.4	1500.0	15.3	11664.0
				0.0								
TOTAL Diesel for Yukon Elec.	612000 L			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VGFN for Old Crow				0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L			0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L			0.0								
	215350			0.0								
Residential (123)		**0.0**	**0.0**	**1787.8**	**164205.0**	**1362938.4**	**10453.0**	**145.4**	**1627519.7**	**260477.1**	**4270.3**	**1538153.6**
Administrative		**0**	**0**	**9.18**	**1200**	**6998.4**	**32.19264**	**0.746496**	**7905.8592**	**91985.18**	**2278.18748**	**167142.93**
TOTAL		**0.0**	**0.0**	**1797.0**	**165405.0**	**1369936.8**	**10485.2**	**146.1**	**1635425.5**	**352462.3**	**6548.5**	**1705296.6**

General					***Electricity***						
	number of (residential only)	Emissions From Total Heating (kg)			Amount of electricity used	Total cost of electricity used	Energy	Generator Efficiency	Diesel fuel used	GHG Emissions Fr	
		CH4	N2O	eCO2	(kWh)	($)	(GJ)	(L/kWh)	(L)	CO_2	CH_4
Admin Office		3.4	2.9	79036.7	173248	29452	623.7	0.287631	49831.5	136040.0	6.0
Community Hall		2.1	1.7	47947.1	20124	3421	72.4	0.287631	5788.3	15802.0	0.7
Northern Store		0.4	0.3	9119.6	126000	36688.75	453.6	0.287631	36241.5	98939.3	4.3
North Yukon RRC Office		0.4	0.3	9592.2	4000	23200	14.4	0.287631	1150.5	3140.9	0.1
Youth Centre		0.6	0.5	13237.3	11115	1890	40.0	0.287631	3197.0	8727.9	0.4
Safe House		32.3	0.9	11083.9	4665	793	16.8	0.287631	1341.8	3663.1	0.2
House #1	2	53.7	1.2	13176.4	6988	820.92	25.2	0.287631	2010.0	5487.2	0.2
House #2	2	42.9	1.0	10955.7	7101	822.65	25.6	0.287631	2042.5	5575.9	0.2
House #3	3	116.6	1.2	14499.1	8340	938.91	30.0	0.287631	2398.8	6548.8	0.3
House #4	2	53.7	1.3	14281.8	2835	373.05	10.2	0.287631	815.4	2226.1	0.1
House #5	2	93.6	1.3	18784.5			0.0	0.287631	0.0	0.0	0.0
House #6	1	16.3	0.6	9667.9	5557	678.35	20.0	0.287631	1598.4	4363.5	0.2
House #7	3	163.3	1.7	20298.8	9531	1067.43	34.3	0.287631	2741.4	7484.1	0.3
House #8	2	116.6	1.2	14499.1	9765	1078.65	35.2	0.287631	2808.7	7667.8	0.3
House #9	5	140.0	1.5	17399.0	8881	1020.12	32.0	0.287631	2554.5	6973.7	0.3
House #10	4	53.7	1.2	13176.4	6914	805.09	24.9	0.287631	1988.7	5429.1	0.2
TOTAL Diesel for Yukon Elec.	612000 L	0.0	0.0	0.0			0.0	0.287631	0.0	0.0	0.0
TOTAL VGFN for Old Crow		0.0	0.0	0.0			0.0	0.287631	0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L	0.0	0.0	0.0			0.0	0.287631	0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L	0.0	0.0	0.0			0.0	0.287631	0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L	0.0	0.0	0.0			0.0	0.287631	0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L										
	215350										
Residential (123)		**10460.7**	**151.8**	**1804886.2**	**900797.3**	**103937.3**	**2918.6**	**35.4**	**233187.5**	**636601.9**	**28.0**
Administrative		**39.23196**	**6.612596**	**170016.706**	**339152**	**95444.75**	**1220.9**	**1.725786**	**97550.63**	**266313.217**	**11.7060755**
TOTAL		**10500.0**	**158.4**	**1974902.9**	**1239949.3**	**199382.1**	**4139.5**	**37.1**	**330738.1**	**902915.1**	**39.7**

General	number of (residential only)	om Generator (kg)		WASTE # of bags of garbage produced per week (avg)	# of bags of compost produced per week (avg)	# of bags of recylables produced per week (avg)	Total GHGs From Waste (eCO2)			Total GHG emissions
		N_2O	eCO2				Garbage	Composting	Recycling	eCO2
Admin Office		5.0	137710.3	20	0	0	3120.0	0.0	0.0	3120.0
Community Hall		0.6	15996.0	0.25	0	0.125	39.0	0.0	13.0	52.0
Northern Store		3.6	100154.1	15	2	0	2340.0	208.0	0.0	2548.0
North Yukon RRC Office		0.1	3179.5	0.25	0	0.25	39.0	0.0	26.0	65.0
Youth Centre		0.3	8835.0	0.5	0	0.25	78.0	0.0	26.0	104.0
Safe House		0.1	3708.1	1	0	0.25	156.0	0.0	26.0	182.0
House #1	2	0.2	5554.6	0.25	0	0.25	39.0	0.0	26.0	65.0
House #2	2	0.2	5644.4	1	0	0.5	156.0	0.0	52.0	208.0
House #3	3	0.2	6629.2	2	0	1	312.0	0.0	104.0	416.0
House #4	2	0.1	2253.5	2	0	0.5	312.0	0.0	52.0	364.0
House #5	2	0.0	0.0	6	0	1	936.0	0.0	104.0	1040.0
House #6	1	0.2	4417.1	1	0	0.25	156.0	0.0	26.0	182.0
House #7	3	0.3	7575.9	2	0	0.5	312.0	0.0	52.0	364.0
House #8	2	0.3	7761.9	2	0	0	312.0	0.0	0.0	312.0
House #9	5	0.3	7059.3	5	0	1	780.0	0.0	104.0	884.0
House #10	4	0.2	5495.8	4	0	0.75	624.0	0.0	78.0	702.0
TOTAL Diesel for Yukon Elec.	612000 L	0.0	0.0				0.0	0.0	0.0	0.0
TOTAL VGFN for Old Crow		0.0	0.0				0.0	0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L	0.0	0.0				0.0	0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L	0.0	0.0				0.0	0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L	0.0	0.0				0.0	0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L									
	215350									
Residential (123)		**23.3**	**644418.4**	**310.6**	**0.0**	**70.7**	**48449.7**	**0.0**	**7355.4**	**55805.1**
Administrative		**9.75506289**	**269583.114**	**37**	**2**	**0.875**	**5772**	**208**	**91**	**6071**
TOTAL		**33.1**	**914001.5**	**347.6**	**2.0**	**71.6**	**54221.7**	**208.0**	**7446.4**	**61876.1**

General		*ENERGY USED FOR VEHICLES / EQUIPMENT*									
	number of	Gasoline									
		Amount	Energy	Cost	Emissions				Amount	Energy	Cost
	(residential only)	(L)	(GJ)	($)	CO2	CH4	N20	eCO2	(L)	(GJ)	($)
Admin Office		16035	555.8	24052.5	37842.6	4.0	4.2	39219.2		0.0	
Community Hall			0.0		0.0	0.0	0.0	0.0		0.0	
Northern Store			0.0		0.0	0.0	0.0	0.0		0.0	
North Yukon RRC Office			0.0		0.0	0.0	0.0	0.0		0.0	
Youth Centre			0.0		0.0	0.0	0.0	0.0		0.0	
Safe House			0.0		0.0	0.0	0.0	0.0		0.0	
House #1	2	1170	40.6	1755	2761.2	0.3	0.3	2861.6		0.0	
House #2	2	1170	40.6	1755	2761.2	0.3	0.3	2861.6		0.0	
House #3	3	200	6.9	300	472.0	0.1	0.1	489.2		0.0	
House #4	2	0	0.0	0	0.0	0.0	0.0	0.0		0.0	
House #5	2	2250	78.0	3375	5310.0	0.6	0.6	5503.2		0.0	
House #6	1	400	13.9	600	944.0	0.1	0.1	978.3		0.0	
House #7	3	1638	56.8	2457	3865.7	0.4	0.4	4006.3		0.0	
House #8	2	1215	42.1	1823	2867.4	0.3	0.3	2971.7		0.0	
House #9	5	0	0.0	0	0.0	0.0	0.0	0.0		0.0	
House #10	4	0	0.0	0	0.0	0.0	0.0	0.0		0.0	
TOTAL Diesel for Yukon Elec.	612000 L		0.0		0.0	0.0	0.0	0.0		0.0	
TOTAL VGFN for Old Crow			0.0		0.0	0.0	0.0	0.0		0.0	
Total VGFN Diesel Purchase	279907 L		0.0		0.0	0.0	0.0	0.0		0.0	
Total VGFN Gas Purchase	121842 L		0.0		0.0	0.0	0.0	0.0		0.0	
Total Gas for all VGFN Vehicles	16035 L		0.0		0.0	0.0	0.0	0.0		0.0	
Total Gas for 4 VGFN Vehicles	4612 L										
	215350			1.50006217							
Residential (123)		**98928.9**	**3428.9**	**148399.5**	**233472.2**	**24.7**	**25.7**	**241965.3**	**0.0**	**0.0**	**0.0**
Administrative		**16035**	**555.7731**	**24052.5**	**37842.6**	**4.00875**	**4.1691**	**39219.2048**	**0**	**0**	**0**
TOTAL		**114963.9**	**3984.6**	**172452.0**	**271314.8**	**28.7**	**29.9**	**281184.5**	**0.0**	**0.0**	**0.0**

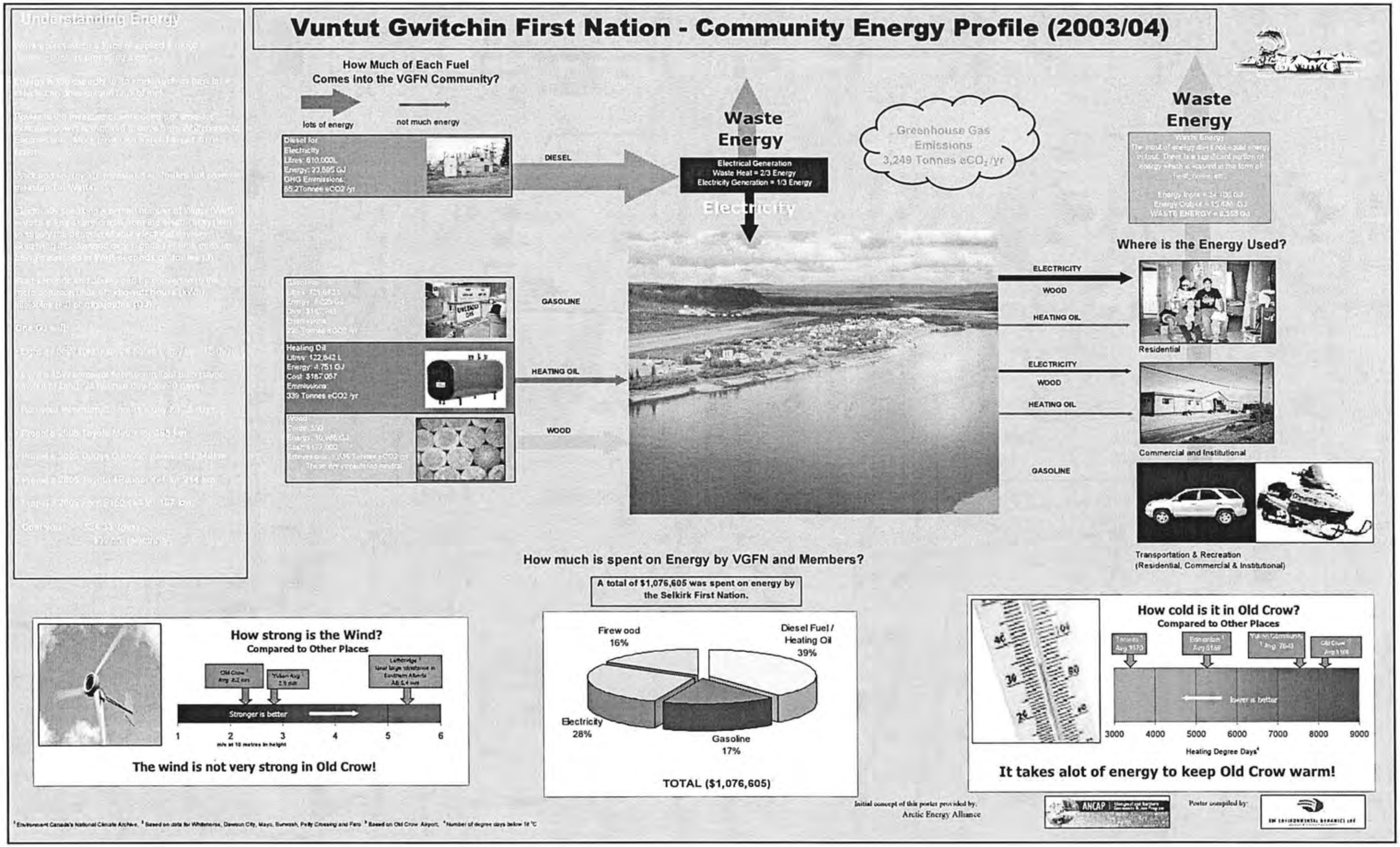
General											
	number of	Diesel				Propane					
		Emissions				Amount	Energy	Cost	Emissions		
	(residential only)	CO_2	CH_4	N20	eCO_2	(L)	(GJ)	($)	CO_2	CH_4	N20
Admin Office		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Community Hall		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Northern Store		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
North Yukon RRC Office		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Youth Centre		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Safe House		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #1	2	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #2	2	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #3	3	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #4	2	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #5	2	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #6	1	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #7	3	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #8	2	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #9	5	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
House #10	4	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
TOTAL Diesel for Yukon Elec.	612000 L	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
TOTAL VGFN for Old Crow		0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L										
	215350										
Residential (123)		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Administrative		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

General	number of (residential only)	eCO2	Total cost ($)	Total energy (GJ)	Total Emissions from vehicles / equipment CO2	CH4	N20	eCO2	SUMMARY Total cost ($)	Total energy (GJ)
Admin Office		0.0	24052.5	555.8	37842.6	4.0	4.2	39219.2	92504.5	2285.7
Community Hall		0.0	0.0	0.0	0.0	0.0	0.0	0.0	31909.7	743.5
Northern Store		0.0	0.0	0.0	0.0	0.0	0.0	0.0	43288.8	581.2
North Yukon RRC Office		0.0	0.0	0.0	0.0	0.0	0.0	0.0	30142.0	148.7
Youth Centre		0.0	0.0	0.0	0.0	0.0	0.0	0.0	9756.2	225.3
Safe House		0.0	0.0	0.0	0.0	0.0	0.0	0.0	3881.3	70.5
House #1	2	0.0	1755.0	40.6	2761.2	0.3	0.3	2861.6	4075.9	81.0
House #2	2	0.0	1755.0	40.6	2761.2	0.3	0.3	2861.6	4002.7	84.2
House #3	3	0.0	300.0	6.9	472.0	0.1	0.1	489.2	2738.9	52.3
House #4	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2473.1	41.0
House #5	2	0.0	3375.0	78.0	5310.0	0.6	0.6	5503.2	8475.0	190.8
House #6	1	0.0	600.0	13.9	944.0	0.1	0.1	978.3	4830.4	118.4
House #7	3	0.0	2457.0	56.8	3865.7	0.4	0.4	4006.3	5624.4	112.5
House #8	2	0.0	1823.0	42.1	2867.4	0.3	0.3	2971.7	4401.7	92.6
House #9	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1920.1	50.3
House #10	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2305.1	40.2
TOTAL Diesel for Yukon Elec.	612000 L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VGFN for Old Crow		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L									
	215350									
Residential (123)		**0.0**	**148399.5**	**3428.9**	**233472.2**	**24.7**	**25.7**	**241965.3**	**502420.2**	**10617.8**
Administrative		**0**	**24052.5**	**555.7731**	**37842.6**	**4.00875**	**4.1691**	**39219.2048**	**211482.43**	**4054.90778**
TOTAL		**0.0**	**172452.0**	**3984.6**	**271314.8**	**28.7**	**29.9**	**281184.5**	**713902.6**	**14672.7**

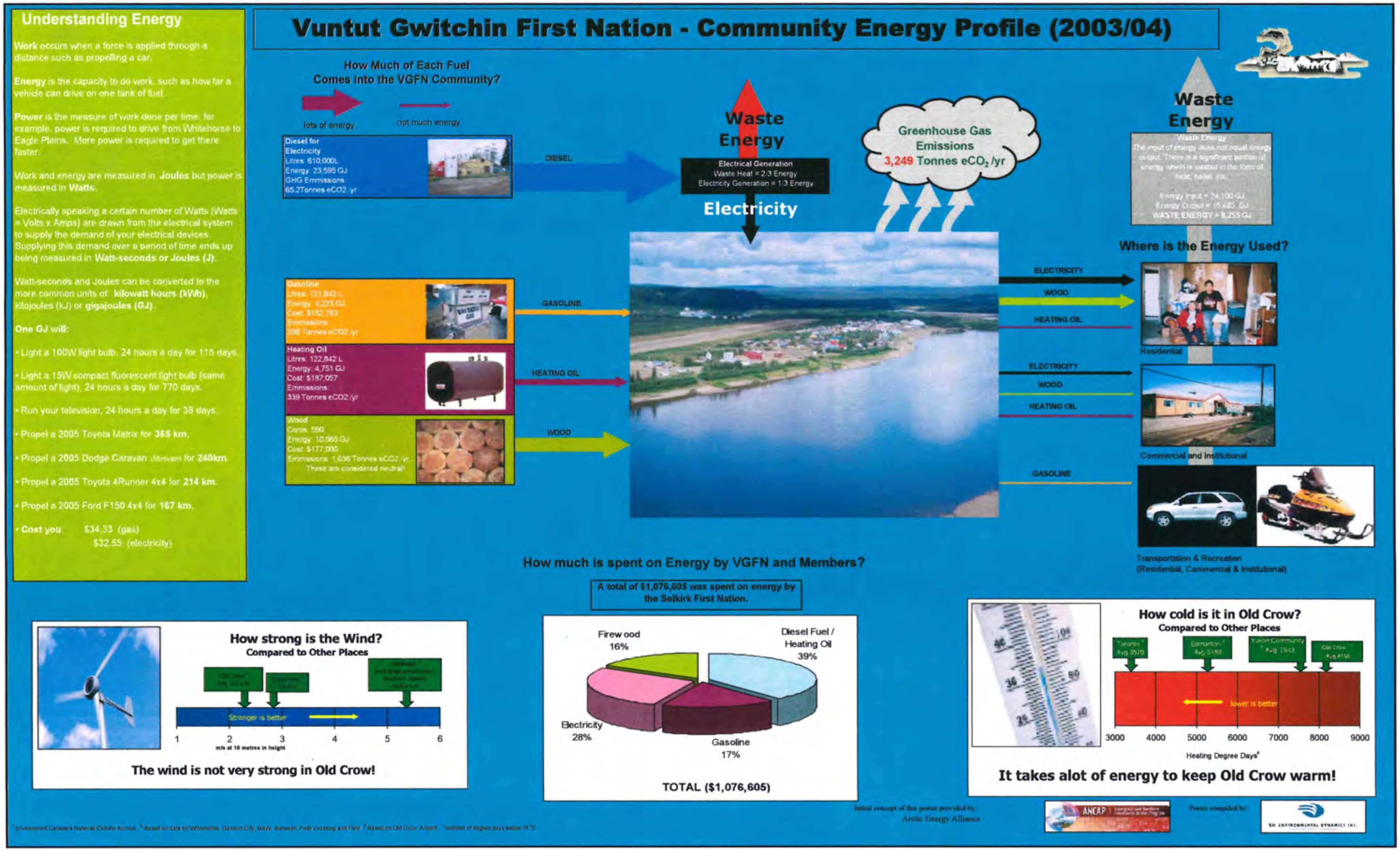
General						
	number of (residential only)	Total GHG Emissions neutral & non-neutral (kg) eCO2	Total GHG Emissions non-neutral (kg) eCO2	Total GHG Emissions neutral (kg) eCO2	Total GHG Emissions neutral & non-neutral (tonnes) eCO2	Total GHG Emissions non-neutral (tonnes) eCO2
Admin Office		259086.2	259086.2	0.0	259.1	259.1
Community Hall		63995.1	63995.1	0.0	64.0	64.0
Northern Store		111821.7	111613.7	208.0	111.8	111.6
North Yukon RRC Office		12836.7	12836.7	0.0	12.8	12.8
Youth Centre		22176.3	22176.3	0.0	22.2	22.2
Safe House		14974.0	7068.1	7905.9	15.0	7.1
House #1	2	21657.7	8481.2	13176.4	21.7	8.5
House #2	2	19669.7	9128.6	10541.1	19.7	9.1
House #3	3	22033.5	7534.4	14499.1	22.0	7.5
House #4	2	16899.3	3722.9	13176.4	16.9	3.7
House #5	2	25327.6	13728.3	11599.3	25.3	13.7
House #6	1	15245.3	11292.4	3952.9	15.2	11.3
House #7	3	32245.0	11946.2	20298.8	32.2	11.9
House #8	2	25544.8	11045.7	14499.1	25.5	11.0
House #9	5	25342.2	7943.3	17399.0	25.3	7.9
House #10	4	19374.2	6197.8	13176.4	19.4	6.2
TOTAL Diesel for Yukon Elec.	612000 L	0.0	0.0	0.0	0.0	0.0
TOTAL VGFN for Old Crow		0.0	0.0	0.0	0.0	0.0
Total VGFN Diesel Purchase	279907 L	0.0	0.0	0.0	0.0	0.0
Total VGFN Gas Purchase	121842 L	0.0	0.0	0.0	0.0	0.0
Total Gas for all VGFN Vehicles	16035 L	0.0	0.0	0.0	0.0	0.0
Total Gas for 4 VGFN Vehicles	4612 L					
	215350					
Residential (123)		**2747074.9**	**1119555.3**	**1627519.7**	**2747.1**	**1119.6**
Administrative		**484890.0247**	**476776.1655**	**8113.8592**	**484.8900247**	**476.7761655**
TOTAL		**3231965.0**	**1596331.5**	**1635633.5**	**3232.0**	**1596.3**

General				
	number of (residential only)	Total GHG Emissions neutral (tonnes) eCO2	Total GHG / Occupant tonnes eCO2 / person	Proportion of emissions neutral (%)
Admin Office		0.0	.	0
Community Hall		0.0	.	0
Northern Store		0.2	.	0.186010337
North Yukon RRC Office		0.0	.	0
Youth Centre		0.0	.	0
Safe House		7.9	.	52.79726258
House #1	2	13.2	10.82882808	60.83960288
House #2	2	10.5	9.834859262	53.59072926
House #3	3	14.5	7.344516312	65.80478543
House #4	2	13.2	8.449653925	77.97024657
House #5	2	11.6	12.66380909	45.79705678
House #6	1	4.0	15.2453439	25.92876636
House #7	3	20.3	10.74834268	62.95166318
House #8	2	14.5	12.77239108	56.75965254
House #9	5	17.4	5.06844634	68.65597207
House #10	4	13.2	4.843547746	68.01023079
TOTAL Diesel for Yukon Elec.	612000 L	0.0	.	.
TOTAL VGFN for Old Crow		0.0	.	.
Total VGFN Diesel Purchase	279907 L	0.0	.	.
Total VGFN Gas Purchase	121842 L	0.0	.	.
Total Gas for all VGFN Vehicles	16035 L	0.0	.	.
Total Gas for 4 VGFN Vehicles	4612 L			
	215350			
Residential (123)		**1627.5**	**1202.9**	**7211.6**
Administrative		**8.1138592**	**0**	**52.98327292**
TOTAL		**1635.6**	**1202.9**	**7264.6**

APPENDIX 3: COMMUNITY ENERGY BASELINE STUDY SUMMARY POSTER



Vuntut Gwitchin First Nation - Community Energy Profile (2003/04)
How Much of Each Fuel Comes Into the VGFN Community?
lots of energy
not much energy
Diesel for Electricity
Litres: 610,000L
Energy: 23,695 GJ
GHG Emmissions:
65.2Tonnes eCO2 /yr
DIESEL
Waste Energy
Electrical Generation
Waste Heat = 2/3 Energy
Electricity Generation = 1/3 Energy
Electricity
Greenhouse Gas Emissions
3,249 Tonnes eCO2/yr
Waste Energy
GASOLINE
Heating Oil
Litres: 122,842 L
Energy: 4,751 GJ
Cost: $187,087
Emmissions:
339 Tonnes eCO2 /yr
HEATING OIL
WOOD
Where is the Energy Used?
ELECTRICITY
WOOD
HEATING OIL
Residential
ELECTRICITY
WOOD
HEATING OIL
Commercial and Institutional
GASOLINE
Transportation & Recreation
(Residential, Commercial & Institutional)
How much is spent on Energy by VGFN and Members?
A total of $1,076,605 was spent on energy by the Selkirk First Nation.
Firewood 16%
Diesel Fuel / Heating Oil 39%
Electricity 28%
Gasoline 17%
TOTAL ($1,076,605)
How strong is the Wind?
Compared to Other Places
Stronger is better
1 2 3 4 5 6
m/s at 10 metres in height
The wind is not very strong in Old Crow!
How cold is it in Old Crow?
Compared to Other Places
3000 4000 5000 6000 7000 8000 9000
Heating Degree Days
It takes alot of energy to keep Old Crow warm!
Initial concept of this poster provided by: Arctic Energy Alliance
ANCAP
Poster compiled by:


Vuntut Gwitchin First Nation - Community Energy Profile (2003/04)
Understanding Energy
Work occurs when a force is applied through a distance such as propelling a car.
Energy is the capacity to do work, such as how far a vehicle can drive on one tank of fuel.
Power is the measure of work done per time, for example, power is required to drive from Whitehorse to Eagle Plains. More power is required to get there faster.
Work and energy are measured in Joules but power is measured in Watts.
Electrically speaking a certain number of Watts (Watts = Volts x Amps) are drawn from the electrical system to supply the demand of your electrical devices. Supplying this demand over a period of time ends up being measured in Watt-seconds or Joules (J).
Watt-seconds and Joules can be converted to the more common units of: kilowatt hours (kWh), kilojoules (kJ) or gigajoules (GJ).
One GJ will:
• Light a 100W light bulb, 24 hours a day for 115 days.
• Light a 15W compact fluorescent light bulb (same amount of light), 24 hours a day for 770 days.
• Run your television, 24 hours a day for 38 days.
• Propel a 2005 Toyota Matrix for 365 km.
• Propel a 2005 Dodge Caravan (Minivan) for 240km.
• Propel a 2005 Toyota 4Runner 4x4 for 214 km.
• Propel a 2005 Ford F150 4x4 for 167 km.
• Cost you: $34.33 (gas)
$32.55 (electricity)
How Much of Each Fuel Comes into the VGFN Community?
lots of energy
not much energy
Diesel for Electricity
Litres: 610,000L
Energy: 23,595 GJ
GHG Emmissions
65.2Tonnes eCO2 /yr
DIESEL
Gasoline
Litres: 131,842 L
Energy: 4,223 GJ
Cost: $182,783
Emmissions
298 Tonnes eCO2 /yr
GASOLINE
Heating Oil
Litres: 122,842 L
Energy: 4,751 GJ
Cost: $187,057
Emmissions
339 Tonnes eCO2 /yr
HEATING OIL
Wood
Cords: 590
Energy: 10,965 GJ
Cost: $177,000
Emmissions: 1,636 Tonnes eCO2 /yr
These are considered neutral!
WOOD
Waste Energy
Electrical Generation
Waste Heat = 2/3 Energy
Electricity Generation = 1/3 Energy
Electricity
Greenhouse Gas Emissions
3,249 Tonnes eCO2 /yr
Waste Energy
Waste Energy
The input of energy does not equal energy output. There is a significant portion of energy which is wasted in the form of heat, noise, etc.
Energy Input = 24,100 GJ
Energy Output = 15,485 GJ
WASTE ENERGY = 8,255 GJ
Where is the Energy Used?
ELECTRICITY
WOOD
HEATING OIL
Residential
ELECTRICITY
WOOD
HEATING OIL
Commercial and Institutional
GASOLINE
Transportation & Recreation
(Residential, Commercial & Institutional)
How much is spent on Energy by VGFN and Members?
A total of $1,076,605 was spent on energy by the Selkirk First Nation.
Firewood 16%
Diesel Fuel / Heating Oil 39%
Electricity 28%
Gasoline 17%
TOTAL ($1,076,605)
How strong is the Wind?
Compared to Other Places
Stronger is better
1
2
3
4
5
6
m/s at 10 metres in height
The wind is not very strong in Old Crow!
How cold is it in Old Crow?
Compared to Other Places
Toronto Avg 3570
Edmonton Avg 5180
Yukon Community Avg 7643
lower is better
3000
4000
5000
6000
7000
8000
9000
Heating Degree Days
It takes alot of energy to keep Old Crow warm!
Initial concept of this poster provided by: Arctic Energy Alliance
ANCAP
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