Community Energy and Emissions Inventory

A Kluane First Nation-Yukon Research Centre Partnership Project

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Executive Summary

A community-based approach to inventorying energy and greenhouse gas emissions was developed and carried out by Kluane First Nation (KFN) and the Yukon Research Centre (YRC) in 2011/2012. Residents and commercial and government operators in Burwash Landing, Destruction Bay, and Silver City were interviewed about the types of energy they depend on—including how much it costs them, and how much they used in 2011—and the associated greenhouse gas emissions were derived. Consideration was given to stationary energy (electricity and heat generation), transport energy (on and off-road vehicle use), and waste sectors. Views on energy concerns and success stories were also solicited to provide insight into the inventory as well as future directions that could be taken with local energy production and consumption. In addition, building characteristics, such as mode of heating, quality of insulation, etc., were gathered so the communities may effectively monitor and interpret changes to energy consumption and emissions over time. This approach to understanding energy use and emissions at the community scale is unique in that it draws upon the strengths of both quantitative and qualitative research methodologies to illuminate current and potential energy states.

Acknowledgements

Instrumental in coordinating and carrying out numerous aspects of this project were KFN staff Colin Wright and Janice Dickson. The local research review committee, comprised of Sandra Johnson, JP Pinard, Janice Dickson, and Colin Wright, was also key in that it ensured the needs and interests of the communities were met. And without the willingness of community members from Burwash Landing, Destruction Bay, and Silver City to share household information and perspectives on energy consumption, the project itself would not have been possible.

Many other agencies/organizations played a role in the successful completion of this work, including: Local Governments for Sustainability (ICLEI), the Climate Change Secretariat (Yukon Government), Department of Community Services (Yukon Government), Property Management Division (Yukon Government) Yukon Electrical Company Ltd., Yukon Energy, Yukon Bureau of Statistics (Yukon Government), the Energy Solutions Center (Yukon Government), and the University of Alaska Anchorage's Institute of Social and Economic Research.

Glossary

CO_2e	Carbon dioxide equivalent
ICLEI	Local Governments for Sustainability
IEAP	International Local Government GHG Emissions Analysis Protocol
KFN	Kluane First Nation
KLR	Kluane Lake Region
GHG	Greenhouse gas
GWP	Global warming potential
GJ	Gigajoules
YRC	Yukon Research Centre
YG	Yukon Government

Introduction

Climate change is one of the most significant of contemporary concerns and stressors facing aboriginal and northern communities across Canada. This may be attributed to the fact that climate changes are being experienced most intensely in Arctic regions – annual average temperatures, for example, have increased at almost twice the rate as other regions of the planet in recent decades (Hassol 2004). And, an acceleration of trends such as rising average temperatures, melting of glaciers and sea ice, and rising permafrost temperatures is expected, due to ongoing increases in concentrations of greenhouse gases (GHG) in the earth's atmosphere (Hassol 2004). These trends are having profound impacts on arctic environments and societies, such as increasing fires, vegetation and species shifts, wetland changes, declining food security, human health concerns, increasing access to resources, and enhanced agriculture and forestry opportunities (Hassol 2004).

Concurrent with climate change impacts are community responses to them. Arctic peoples have long depended on and adapted to their changing environments (Huntington and Fox 2004); in the contemporary context of global climate change—in which the rate of change is rapid—Arctic peoples continue to adapt with an increasing role for resource management and institutional governance to play (Nuttall *et al.* 2008).

Management of energy resources, with a focus on energy conservation and the development of renewable energy, is just one example of how northern and indigenous peoples are adapting to climate change, the reduction of GHG emissions being the central point. A useful planning tool in this context is energy use and greenhouse gas emissions inventorying at a community scale.

The general purpose of an inventory of this nature is to identify where energy is being used and emissions created in order to track progress in reducing energy consumption and emissions, set emissions targets, make comparisons with other jurisdictions (Community Energy Association 2008) and identify areas of concern,

opportunity, and action (Pembina Institute 2008). Many governments around the world have engaged in community energy and emissions inventorying to inform decision-making as well as to support legislated targets for reducing emissions.

Although a number of energy use and GHG emissions monitoring efforts are underway in the Yukon—such as those by the Climate Change Secretariat to support the reduction of greenhouse gas emissions in Yukon Government operations and those by the Yukon Energy Corporation and the Yukon Electrical Company to support electricity conservation in Yukon communities—very little work has been done to make energy use/emissions information available at the community scale.

Project Goals and Objectives

In the fall of 2011, the Yukon Research Centre and Kluane First Nation partnered to develop and pilot an approach to energy and greenhouse gas emissions inventorying to support energy-related decision making in Burwash Landing, Destruction Bay, and Silver City, and Yukon communities, more broadly. Specific project objectives were to:

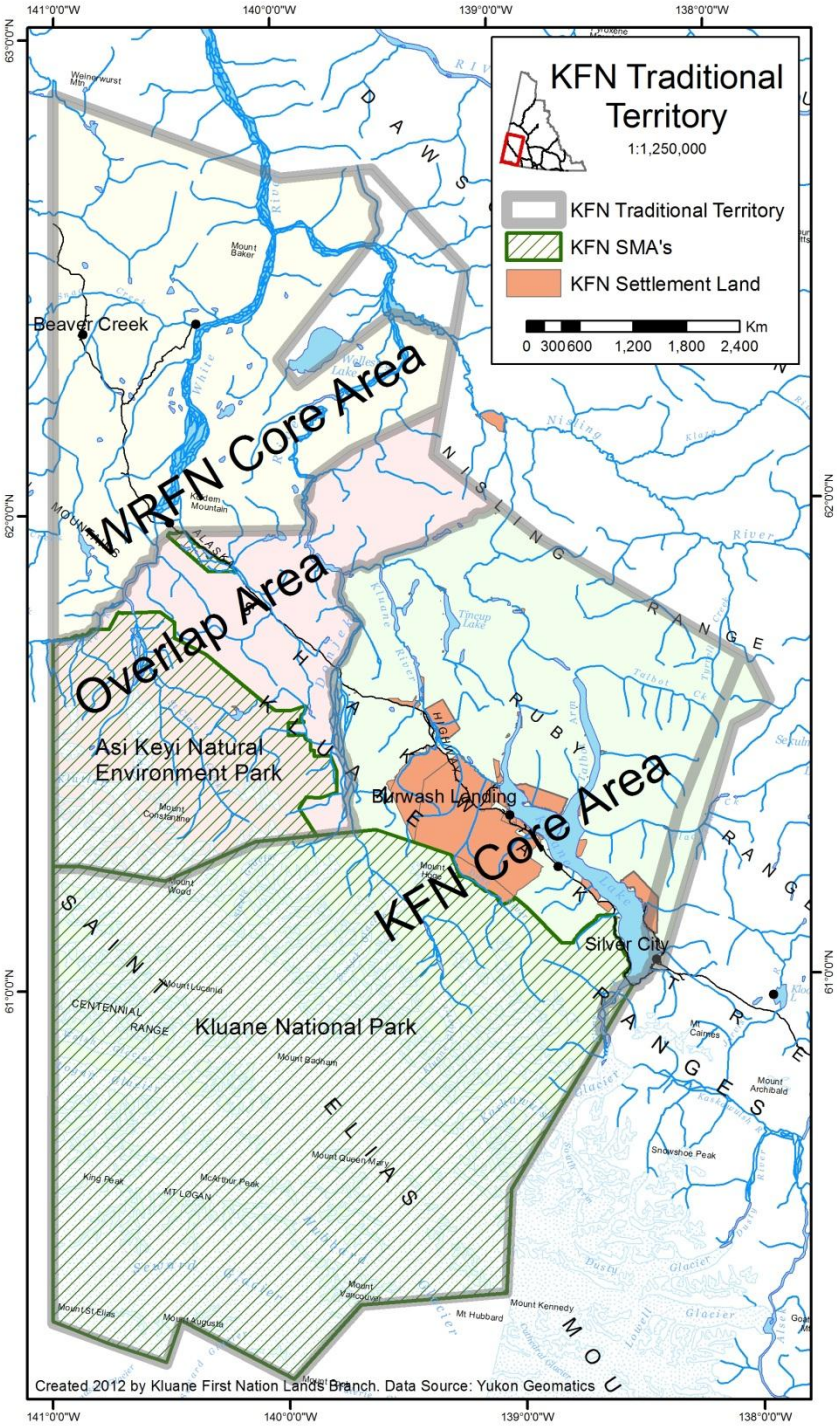
- Develop a community-based approach to energy and greenhouse gas emissions inventorying
- Conduct the inventory (i.e. establish a comprehensive baseline of information on the types of energy people rely on, how much they use, how much it costs them, and the associated greenhouse gas emissions) in Burwash Landing, Destruction Bay, and Silver City
- Understand more about community perspectives on energy success stories and concerns to provide insight into inventory results as well as future directions that could be taken with local energy production and consumption
- Inform alternative energy projects underway in Burwash Landing and Destruction Bay
- Identify opportunities for reducing energy consumption and greenhouse gas emissions.

Project Partners

The Kluane First Nation

The Kluane First Nation is located in Burwash Landing, which is situated on the shores of Kluane Lake in southwest Yukon, an area known for its vast river valleys, impressive mountains, and boreal flora and fauna (McClellan 2001). Figure 1 shows Kluane First Nation's traditional territory. Members of Kluane First Nation are Southern Tutchone, the First Nations of southwest Yukon that share a common Athabascan dialect (McClellen 2001).

Figure 1. KFN Traditional Territory



Source: KFN Lands Branch

KFN has developed and maintained a system of sustainable living that has allowed for the nourishment of their land and people since time immemorial. Their government structure ensures the survival of culture, language, spirituality

and physical well-being through laws that show great respect for the land and the water. KFN has inherited the right of self-governance from their elders, medicine people, spirits, and from their mothers and fathers. KFN people consider themselves progressive and forward looking with the knowledge of their ancestors, the pride of their heritage and the strength of their culture. They also have the responsibility to ensure that activities within their Traditional Territory respect their rights, titles and interests and do not compromise the current and future prosperity of their citizens. – *Kluane First Nation Government, 2012.*

In terms of energy, Kluane First Nation has long been interested in finding sustainable solutions. Since 1991 they have identified their commitment to demand side energy management, water conservation and reduction of waste water volumes, energy efficiency improvement of buildings, reduction of the use of harmful building materials and products, and finding sustainable alternatives to burning diesel fuel for electricity generation (Kluane First Nation and Hedmann & Associates 1991).

The Yukon Research Centre

The Yukon Research Centre is located in Whitehorse, Yukon, and is part of Yukon College. It was established in 2009, under the direction of the Yukon Territorial Government, with the broad maxim to take innovative steps to address climate change and build the Yukon knowledge economy. The YRC's approach to facilitating these objectives involves a collaborative, multi-disciplinary approach of traditional knowledge, social, natural, and physical sciences.

Supporting research with First Nations, developing alternative energy technologies, and reducing the dependency on fossil fuels are examples of some of the YRC's more targeted goals. This partnership project with Kluane First Nation demonstrates our commitment to these goals.

Principles that guide the YRC's work are:

- Our research will address northern issues and opportunities in an ethical, objective and relevant manner
- Our research will be conducted in a collaborative manner with our partners, building upon each other's strengths and capabilities by combining science with First Nations Traditional Knowledge and with respect for their culture
- Our research will be conducted in the north, addressing the needs of Yukoners and engaging them in the process; it will demonstrate positive benefits for the North, benefits which will be effectively communicated to the Yukon and its communities in order to improve living conditions
- Our research will be both applied and basic, providing quality information for informed decision making
- Our research will be financially sustainable, yielding social, economic and environmental benefits by engaging in multidisciplinary approaches to research and development.

The Yukon Research Center's year-round greenhouse. Photo credits from L to R: Treharne Drury; www.archbould.com.

Methods

An Inventory Framework

After project goals were identified, a framework for conducting the energy and greenhouse gas emissions inventory was selected. The Local Governments for Sustainability International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP) was chosen, after reviewing several frameworks—such as British Columbia's Community Energy and Emissions Inventory, the Climate Registry, and the Arctic Energy Alliance's Community Energy Planning Toolkit—because the community is taken as the unit of focus (as opposed to the corporation, as with the Climate Registry), as well as units within the community, including residents, commercial and government operators, thereby assigning control over energy consumption and emissions. This structure was seen as important, because of the way in which it can foster the identification of group-specific actions and opportunities to reduce energy consumption and GHG emissions over time.

Guiding Principles

The Local Government Greenhouse Gas Emissions Analysis Protocol follows principles consistent with those used in the finance sector to ensure accurate accounting and reporting[1], which are:

Relevance: The GHG inventory shall appropriately reflect the greenhouse gas emissions of the local government or the community within the local government area and should be organized to reflect the areas over which local governments exert control and hold responsibility in order to serve the decision-making needs of users.

Completeness: All GHG emission sources and activities within the chosen inventory boundary shall be accounted for. Any specific exclusion should be disclosed.

Consistency: Consistent methodologies to allow for meaningful comparisons of emissions over time shall be used. Any changes to the data, inventory boundary methods or any relevant factors in the time series, shall be disclosed.

Transparency: All relevant issues shall be addressed in a factual and coherent manner to provide a clear audit trail, should auditing be required. Any relevant assumptions shall be disclosed and include appropriate references to the accounting calculation methodologies and data sources used, which may include this Protocol and any relevant Supplements.

Accuracy: The quantification of GHG emissions should not be systematically over or under the actual emissions. Accuracy should be sufficient to enable users to make decisions with reasonable assurance as to the integrity of the reported information.
-ICLEI, 2009, p. 6

Scope

Following the IEAP, this inventory is comprised of separate analyses of the energy consumption and emissions generated by local governments (KFN and Yukon Government) and those associated with the communities (Destruction Bay, Burwash Landing, and Silver City) as a whole over the course of one year. Destruction Bay and Burwash Landing were considered one community for the purposes of this study, because they share the same electricity generation station.

Government operations and community inventories were divided into sectors consistent with international standards for classifying GHG emissions and reflective of government operations and community activities. Based on government operations, community activities, and resources available for the

[1] These principles have previously been modified by the WRI/WBCSD GHG Protocol Initiative to apply to the accounting and reporting of greenhouse gas emissions followed in the IEAP.

project, stationary energy, transport energy, and waste sectors were considered (fugitive emissions, industrial processes, agriculture, land use, land use change, and forestry were not).

Spatial/Political Boundaries

For local governments, the analyses included energy used and emissions arising from the use of all significant assets and services, no matter where those emissions occurred (ICLEI 2009).

Sources of emissions considered for Yukon Government (YG) and KFN Government sectors were:

- Owned and operated buildings and facilities
    - Purchased electricity and fuels associated with heating/powering buildings (stationary energy)
- Travel serving the needs of staff, regardless of whether or not travel originated from the community
    - Fuels associated with the operation/maintenance of owned and operated on and off-road vehicles including boats (transport energy)
    - Air travel serving the needs of staff regardless of whether or not travel originated from the community (transport energy).

For the communities (including residential and commercial sectors), energy used and GHG emissions associated with activities occurring within the local government's geopolitical boundary were considered (ICLEI 2009). Emissions sources included:

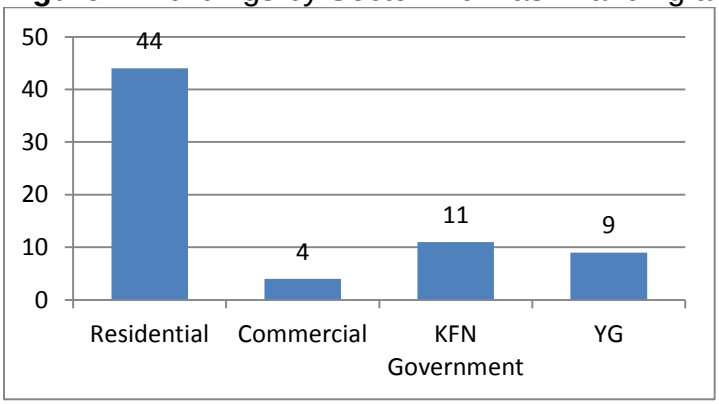
- Water and wastewater treatment
- Waste
- Street lighting and traffic signals (stationary energy)
- Homes and buildings occupied by residents and commercial operators
    - Purchased electricity and fuels associated with heating/powering buildings—including chainsaw fuel purchased for gathering cords of wood—such as homes, garages, greenhouses, etc. (stationary energy)
- Travel serving the needs of residents and commercial operators, regardless of whether or not travel originated from the community
    - Fuels associated with the operation/maintenance of owned and operated on and off-road vehicles (transport energy)
    - Air travel serving the needs of community members regardless of whether or not travel originated from the community (transport energy).

Data on the above emissions came from a variety of sources:

- Electricity consumption data was supplied by the Yukon Electrical Company Limited

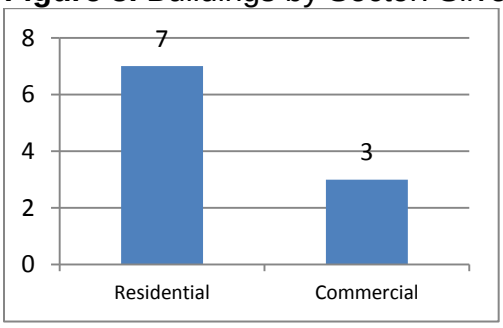
- The Property Management Division, YG, provided fuel/electricity consumption data on YG buildings, vehicles, and septic/lagoon facilities in Burwash Landing and Destruction Bay
- The Climate Change Secretariat, YG, supplied waste data for Destruction Bay and Burwash Landing
- The remaining information was gathered through surveys. Figures 2 and 3 show the number of homes/buildings surveyed in each community and government sector.

Figure 2. Buildings by Sector: Burwash Landing and Destruction Bay



Residential households were defined as private dwellings occupied by usual residents[2]; results from the 44 sampled were projected across the 65 total in Destruction Bay and Burwash Landing (Statistics Canada 2006) to estimate total energy use. Households with home-based businesses were included in the residential category. Results were not projected across commercial operations (4 out of 8 were sampled), because there was a great deal of variation in the nature of the operations. All KFN Government and YG buildings were surveyed[3].

Figure 3. Buildings by Sector: Silver City



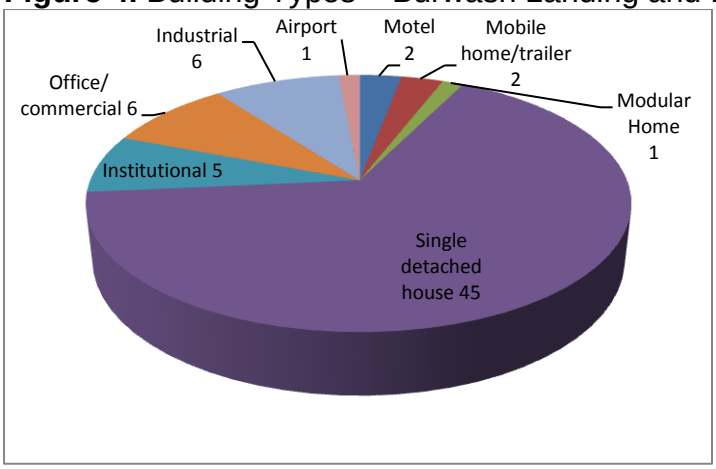
[2] A separate set of living quarters which has a private entrance either directly from outside or from a common hall, lobby, vestibule, or stairway leading to the outside, and in which a person or a group of persons live *permanently* (Statistics Canada, 2006). Permanent rather than temporary residents were the target in this study, because their ability to participate in energy use/emissions reductions over time was anticipated to be greater than that of temporary residents.

[3] Energy consumption associated with street lights, and upper and lower septic in Destruction Bay and Burwash Landing was also captured, though not shown in figure 2.

In Silver City, households with home-based businesses were also included in the residential category. All residents and commercial operators were surveyed.

Figure 4 shows the range of building types encountered in Burwash Landing and Destruction Bay.

Figure 4. Building Types – Burwash Landing and Destruction Bay



Clockwise from upper left: Talbot Arm Motel, Destruction Bay; Jacquot Hall, Burwash Landing, Sedata Business Centre, Burwash Landing; YG Maintenance Compound, Destruction Bay. Photos by Lisa Christensen.

Accuracy of the Data

KFN data on fuel consumption for stationary and transport energy purposes was sourced from records maintained by the Finance Department. YG data came from records maintained by the Property Management Division. The remaining stationary and transportation energy data, in the residential and commercial sectors, was sourced from a combination of financial records maintained by participants and memory recall, the majority being the latter.

Year

The inventory year selected was 2011, as it was the year for which accurate records across YG and KFN Governments were held for emissions sources included in the study. In addition, 2011 was the most recent year in memory for participants, which was important for optimizing recall ability.

Gases

Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6). As PFCs, HFCs, and SF_6 emissions are considered relatively insignificant for community-level emissions analyses (IEAP 2009; BC Community Energy and Emissions Inventory 2010) only CO_2, CH_4, and N_2O were considered in this study. The 3 main sources of GHG emissions were:

- Emissions, from the burning of fossil fuels, such as diesel, gasoline, and propane
- Emissions from the production of electricity from diesel generated electricity
- The decomposition of biomass to GHGs in landfills and wastewater treatment facilities.

To track GHG emissions, individual gases are converted to carbon dioxide equivalent (CO_2e) to calculate a single number that represents the total amount of GHGs being released. CO_2e is the standard unit that allows amounts of GHGs of different strengths to be added together based on each gas's impact on climate change (ICLEI, 2009). For example, one unit of N_2O is 310 times more potent than carbon dioxide as a global warming gas, which means that one unit of N_2O is equivalent to 310 units of CO_2e (ICLEI, 2009). This conversion factor is known as the gas's global warming potential. Global warming potentials (GWPs) for common gases are shown in Table 1.

Table 1. GWPs from the IPCC Second Assessment Report (ICLEI 2009, p.10)

Gas	GWP
Carbon Dioxide (CO2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
HFC-23	11,700
HFC – 125	2,800
HFC – 134a	1,300
HFC – 143a	3,800
HFC – 152a	140
HFC – 227ea	2,900
HFC – 236fa	6,300
HFC – 43-10mee	1,300
Perfluoromethane (CF_4)	6,500
Perfluoroethane (C_2F_6)	9,200
C_3F_8	7,000
C_4F_{10}	7,000
C_5F_{12}	7,500
C_6F_{14}	7,400
Sulfur Hexafluoride (SF_6)	23,900

In order to make practical sense of emissions, they are usually expressed in terms of emissions/energy used: C02e/gigajoule, for example. To convert energy usage into emissions, the following equation (ICLEI 2009) is used:

Fuel consumed (measurement of energy use) x emissions factor=emissions

Emissions factors from Environment Canada's National Inventory Report (1990-2009) were used to calculate emissions in this study.

Adding Depth to the Inventory

Perspectives on the State of Energy

Another key aspect of this project was gathering community perspectives on the state of energy so that insight could be gained into the inventory itself as well as future directions that could be taken with energy production and consumption. 52 people were interviewed in total: 2 from the commercial sector and 50 from the residential sector. These groups were combined in the analysis to protect anonymity. Questions asked on the state of energy were those listed in table 2:

Table 2. State of Energy Questions

1. What kinds of energy success stories are you aware of in your community?
2. Do you have any concerns about energy in your community, now or into the future?
3. How do you think these concerns could be best addressed?

Energy Use Indicators

Information on basic building characteristics—such as home insulation values, heating mode, window types, number of appliances etc.—was also gathered via the survey, so that the reasons underlying energy consumption could be better understood. Questions on these characteristics may be found in the survey instrument (Appendix 2), sections 1 through 3.

How Information was Gathered, Summarized and Verified

Information on energy and emissions was gathered using in-person, structured interviews in which a specific set of questions was used to guide the interview process. Of the interviews conducted in person (a small handful were mailed in) the average length was 50 minutes; the shortest interview took 20 minutes and the longest 94 minutes. Topics covered during the interviews included general and detailed building characteristics, the type and amount of fuel consumed for heating buildings and transportation purposes (including the cost of such fuels), and perceptions of the state of energy. Separate survey instruments were created for the residential sector and government/commercial sectors; these may be found in Appendix 2.

Informed consent forms, reviewed prior to the interviews, had two purposes, 1) to obtain participant permission to participate in the study, and 2) to communicate the intent of the project, how the information would be used, as well as how confidentiality/anonymity would be addressed (informed consent forms may be found in Appendix 3). To check suitability of the instrument in terms of content and duration, two pilot interviews were carried out with residents of Burwash Landing. Janice Dickson and Lisa Christensen organized and conducted project interviews.

Janice is from Burwash Landing, where both of her parents were born. After graduating from F.H. Collins in Whitehorse, she took the Environmental Officer Training Program at Yukon College and pursued work as a finance officer, environmental officer, and health coordinator with the KFN. When she isn't working, or contributing her time to the Dan Keyi Renewable Resource Council, she likes to hunt and fish and spend time with her daughter, Pascale.

Colin Wright

Lisa is from Whitehorse, Yukon, a place she has called home since 2002. She currently works at the Yukon Research Centre and has a background in rural sociology and environmental and conservation sciences. Lisa enjoys working on community-based projects and likes to spend as much time as possible in Yukon woods and rivers with family and friends.

Lisa Christensen

All interviews were conducted in English, and responses written on survey forms in pen. Completed surveys were returned to respondents at their request then entered anonymously into an access database stored in a secure electronic folder with both KFN and the YRC (with the exception of Silver City data, as the KFN has no governance associations with Silver City residents). Original data forms, containing participant names and addresses, were destroyed. Data from Destruction Bay and Burwash Landing will not be released for future purposes without the express permission of the YRC and KFN; to release Silver City data for future purposes, permission from the YRC and residents must be sought.

Quantitative data in the access database was summarized by producing excel summary reports. Microsoft Word was used to analyze qualitative data through a process of searching for patterns and themes. Statements of relationships in the data were proposed with this approach, which allowed data to be grouped into categories and themes—this technique is commonly used in qualitative research (Merriam 1988).

A selection of summarized findings (overall energy consumption totals for each community and all qualitative findings) was presented back to participants at a workshop held on May 31, 2012 for verification purposes. Participation over the course of the 3-hour workshop ranged from 10-14 people. The following actions were taken in response to workshop feedback:

- Verification of the diesel fuel consumption totals in Silver City

- Greater emphasis on the health/quality of life benefits of wood as an energy source.

Lisa Christensen

Community-Based Approach

A key aspect of this project was the community-based approach taken. This approach is described herein, beginning with how the project was conceptualized, how it took shape and was maintained, and how it concluded.

Community-based research—which is sometimes referred to as action research, participatory research, or participatory action research—is collaborative research involving community members that aims to address a community problem or effect social change (Strand 2003). This project may be categorized in this way, because it was initiated on the basis of a shared interest in energy management by the YRC and KFN. That is, the YRC wanted to create an energy and emissions inventory tool for Yukon communities, and KFN wanted to utilize the tool to support their energy initiatives. Discussions between the First Nations Initiatives Department at Yukon College and KFN's Lands Branch catalyzed the project's beginnings and project coordination and communication were maintained by KFN's Environment Officer, Colin Wright, and one of the YRC's researchers, Lisa Christensen. For other governments, institutions, or individuals looking to establish such partnerships, First Nations Government Chief and Council meetings or City Council meetings may be useful starting points.

Following establishment of the partnership in the fall of 2011, research on related projects was carried out to gather existing data and avoid duplication of efforts. The Yukon Energy Partners' meetings, at which information is shared quarterly among those involved in energy work, was an excellent place to cover that ground. Relevant data discovered included Yukon Government's internal GHG emissions inventory, the Kluane First Nation Community Energy Baseline Study from 2005, and Yukon Electrical Company Ltd. and Yukon Energy's Conservation Potential Review from 2010.

At the same time that preliminary research was gathered, an energy and emissions inventorying tool (i.e. a questionnaire) was drafted and sent to various agencies for review, including the Climate Change Secretariat, the Institute of

Social and Economic Research (University of Alaska Anchorage), and the local research review committee, which was appointed to guide the research process. A diverse committee membership was sought, including elders, youth, and those with an interest in or experience with energy, but because many initiatives were underway in the community at the time, we were limited to selecting those simply interested in and willing to participate. Beyond discussing suitability of the questionnaire, other critical aspects of the project were discussed, including:

- How best can the inventory serve the community?
- Are there other local groups the project should be reviewed with?
- What is already known about energy consumption?
- What should the scope of data collection be?
- What sources of emissions need to be considered?
- How will the gathered information be stored, how will it be used, and who will have access to it?
- What final products should be put forward from this work?

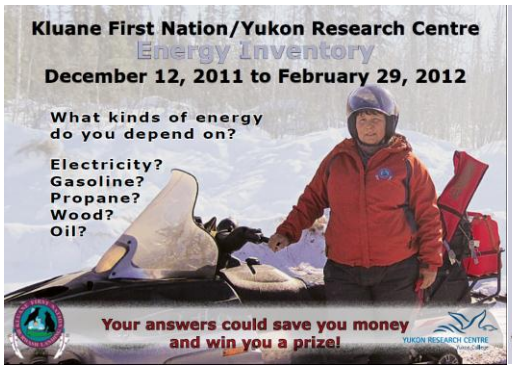
Once the questionnaire was finalized, an informed consent form, designed to be used in conjunction with the questionnaire, was created. Before interviews were undertaken, it was determined whether or not a research permit was required under the Yukon Scientists and Explorer's Act (no permit was required).

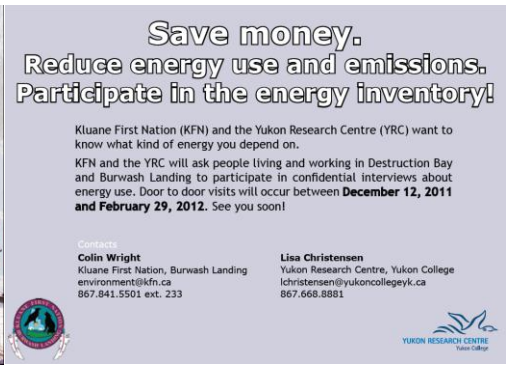
Mid-way through the interviews, another local research review committee meeting was held to assess interview progress, plan the workshop at which results would be shared and verified with participants, and discuss format of the final report and other items. Once interviews were completed, data were then analyzed, summarized and presented to participants at the workshop. Feedback from the workshop was then worked into the final report, and the report was proofed by both partners.

In terms of outreach with the community over the course of the project, a shared approach was taken. That is, all outreach materials were co-developed and approved by each project partner. The schedule of communications was as follows:

Pre-interviews

1) Distribute project postcard to all community members to communicate the details of the project





2) Media release of project information (and subsequent CBC radio interview) to raise community awareness of project – see Appendix 1 for the media release
3) Host a community open house

Post-interviews

4) Distribute workshop invitation letters to all project participants
5) Host a community workshop at which project results are verified and shared
6) Mail final reports and completed surveys, if requested, to participants
7) Media release of project results

The YRC-KFN partnership was maintained for nearly one year, and was viewed by both parties with a high level of regard. The community and institutional benefits that flowed from the partnership and the project, more broadly, are elaborated on in the section, “Project Benefits.”

Findings

This section presents the information that was gathered on energy types communities in the Kluane Lake Region (KLR) depend on, how much they use, how much it costs them, the associated GHG emissions, as well as community perspectives on energy concerns and success stories. Results are organized and presented according to the major themes identified in community perspectives, with numerical data on energy consumption, emissions, and building characteristics incorporated throughout to bring greater depth and context to the meanings people attached to their energy experiences. For the complete results on energy consumption and GHG emissions, refer to Appendices 4 and 5.

Dissatisfaction with Diesel and the Desire for Renewables

Even though diesel and heating oil are strongly relied upon by both communities (see box 1) 32 out of 52 respondents expressed dissatisfaction with using the fuels for heat and electricity generation. Reasons were numerous including that diesel is a fossil fuel, which impacts air quality, human health (see box 2) and climate when combusted; there are noise disturbances associated with operation of the diesel generator; diesel-generated electricity is inconsistent and hazardous as demonstrated by frequent power surges and the damage they impose on household appliances; and because diesel is imported into the region there is an inherent risk of fuel interruption. In addition, the cost of diesel is ever rising (see figure 39), which can exacerbate conditions of poverty and/or cause out-migration to areas with less expensive energy. And furthermore, there are concerns that as Burwash Landing expands, there may not be enough electricity to go around: when the Copper Joe subdivision was built, for example, the grid was pushed to operate on the edge, as one participant pointed out.

Box 1. Diesel fuel consumption and emissions in Destruction Bay/Burwash Landing and Silver City

Across both communities and all community sectors—with the exception of the residential sector in Burwash Landing/Destruction Bay (refer to Appendix 4 to view stationary energy consumption in the residential, commercial, and government sectors in each community)—heating oil, a type of diesel, and diesel fuel dominate the stationary energy category. Figures 6 and 27 illustrate this point.

Figure 6. Total Stationary Energy Consumed, Burwash Landing/Destruction Bay

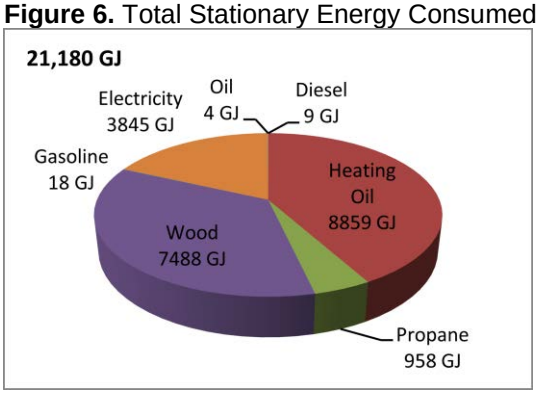
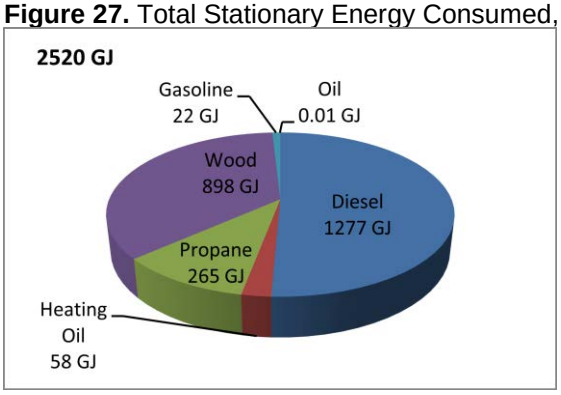


Figure 27. Total Stationary Energy Consumed, Silver City



And, after air travel, diesel/heating oil comprise the largest source of greenhouse gas emissions in both communities (see table 3).

Table 3. Energy and eC02 Emissions by Source

Energy Source	Total eC02 (t) Silver City	Total eC02 (t) Destruction Bay and Burwash Landing
Heating Oil	**4.1**	**634.2**
Gasoline (stationary)	1.5	1.2
Gasoline (mobile)	39.7	709.3
Gasoline (mobile, aviation)	Unknown (type of fuel unknown)	N/A
Diesel (stationary)	**97.9**	**1461.1**
Diesel (mobile)	**8.5**	**59.7**
Spruce Wood	18.7	156.4
Propane (stationary)	16.1	58.3
Propane (mobile)	N/A	1
Oil	0.04	0.3
Air Travel	3680.4	64,169.1
Waste	Data unavailable	2.6
TOTAL	3,867.2	67,253.3

Box 2. Diesel and Human Health

In June of 2012, the International Agency for Research on Cancer (IARC), part of the World Health Organization, concluded that diesel exhaust is carcinogenic to humans and a cause of lung cancer. This conclusion arose from review of some of the most influential epidemiological studies assessing cancer risks associated with occupational exposure among non-metal miners, railroad workers, trucking industry workers, as well as other occupational groups in Canada, the USA, and Europe. – *International Agency for Research on Cancer (2012)*

Participant statements below capture these concerns.

"Oil is costly for people here – it is $1500-$1600 to fill up an oil tank. If you burned straight oil, you couldn't afford it." *Burwash Landing resident*

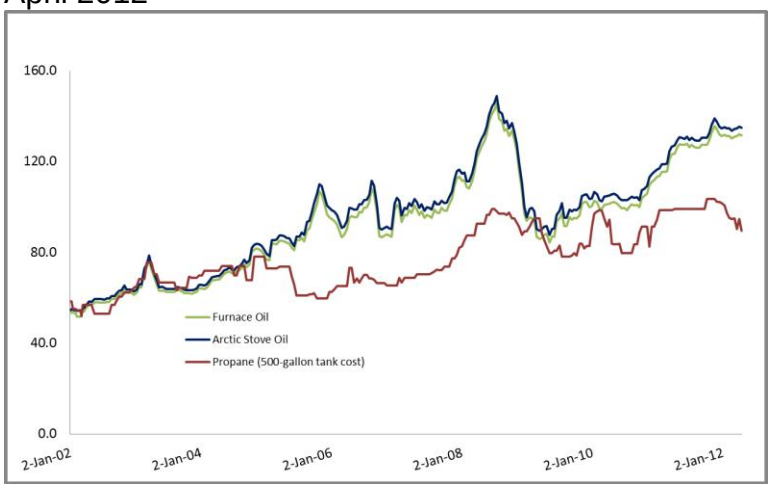
"We're getting to the point where it's too expensive to live here. Since 1999, costs have tripled to run the generator and propane." *Silver City resident and commercial operator*

"What I pay here [for electricity] in 1 month is what I pay in 3 months in BC." *Burwash Landing resident*

"What happens to people with a low income? The cost of oil can put you in poverty" *Burwash Landing resident.*

"Why are we talking about a diesel generator in 2012? An alternative should have been found 10 years ago." *Burwash Landing resident.*

Figure 39. Average Whitehorse Residential Heating Fuel Prices, January 2002-April 2012[4]



Source: Yukon Bureau of Statistics (2012).

[4] Many residents in Silver City, Burwash Landing, and Destruction Bay purchase furnace oil in Whitehorse. The price has increased from 53.1 cents per liter in 2002 to 131.5 cents per liter in 2012—an increase of 248%.

Concerns over the use of diesel are not new. In 1991, Kluane First Nation (and Hedmann and Associates) produced a Community Conservation Strategy that requested re-evaluation of diesel-powered electricity generation:

> The Yukon Energy Corporation[5] must re-evaluate electrical generation using diesel fuel. Burning diesel fuel may not be appropriate or viable when environmental costs are included in the evaluation of alternatives…The Yukon Energy Corporation must assess alternatives to using diesel for electrical generation which are the least harmful to the environment and which are sustainable. Examples of sustainable options are wind generated electricity and micro-hydro projects (p. 34-45)

In this study, 35 respondents named renewable energy as the desired mode—and currently utilized mode in some cases—of electricity and heat generation over diesel, although there seemed to be variation on which alternative was perceived as best. Perspectives on renewable energy are shared below.

Solar

Several participants said they would be interested in exploring solar panels as a source of electricity during the summer months at the very least. Specific experimental interests included use of solar panels in bush camp settings and for heating hot water tanks.

Currently, solar panels are being used with success by two Silver City residents and the Parks Canada Visitor Centre at Sheep Mountain. Two commercial operators had considered solar but felt that the supply would be insufficient. Kluane First Nation is in the process of developing a 4.7 kilowatt photovoltaic array on the roof of 11 Southwick Street, a garage belonging to the KFN Government.

Wind

Wind was named by a number of respondents from each community as a promising form of renewable energy, and one Kluane First Nation is currently exploring. Due to inconsistency, however—which seems to be of least concern in the Slims River Valley—a few participants were skeptical of its reliability.

Slims River Valley.
L Christensen.

[5] Yukon Energy Corporation was the original operator of the electrical generation station in Destruction Bay; the Yukon Electrical Company is the current operator.

Another person highlighted bird mortality as a potential issue. There were a couple of suggestions for ways in which to trial and experiment with wind power: test wind power on the streetlights in Burwash Landing prior to implementing full infrastructure; and plane de-icing systems, which have been in existence since the 1940s, could offer some insight into turbine-icing issues.

Box 3. Wind Turbines in the Yukon

Wind turbines have had a long presence in the Yukon energy picture. A wind generator powered lights in the Old Crow General Store in the 1950s and isolated homesteads across the territory used wind turbines to charge battery banks for home electrical systems (Yukon Development Corporation, 2001). The photo below shows a turbine in use at Jack Hayden's homestead on the south side of Kluane Lake in 1942.

Yukon Archives, R.A. Carter fonds, #1520,

A modern counterpart to the Hayden homestead, is Parks Canada's Visitor Centre at Sheep Mountain. Parks Canada contributed the following anecdote on the turbine in operation at the Centre:

The wind turbine at Sheep Mountain was installed in 1996-1997 after the facility was moved from its former location. The original unit was a wind seeker 1500 watt. It has functioned quite well over the years with annual routine maintenance from Oscars Electric in Whitehorse. One of the original problems we encountered with this unit was the bearings burning out on a regular basis due to the high concentration of airborne silt from the Slims Valley. Regular bearing replacement has mitigated this problem over the years. This unit has contributed to the overall energy requirements of the Visitor Centre: my estimate is that is has produced 55-70% of the overall needs. A small array of solar panels (mostly a trickle charge) and a propane generator serve as back-up to the wind system. The wind turbine is now in need of replacement, which we are currently planning for. - *Sean Fitzgerald, Parks Canada, Haines Junction, Yukon.*

Parks Canada Visitor Centre at Sheep Mountain awaiting turbine replacement. L Christensen.

Geothermal

Geothermal was another renewable energy type mentioned as a possibility in the region – and many respondents are aware and proud of the fact that Kluane First Nation drilled a test well in July, 2012.

Bioenergy

Of all the renewable energy forms discussed in the interviews, bioenergy garnered the most attention: 22 respondents out of 52 named woodstoves and wood chip boilers that provide heat to homes, KFN admin buildings and the Talbot Arms Motel (they also heat hot water with their wood chip boiler) as renewable energy success stories. The figures below illustrate how reliant the KFN, commercial, and residential sectors in Destruction Bay/Burwash Landing as well as the residential sector in Silver City are on wood for heating purposes.

Figure 10. Total Stationary Energy Consumed, KFN, Burwash Landing/Destruction Bay

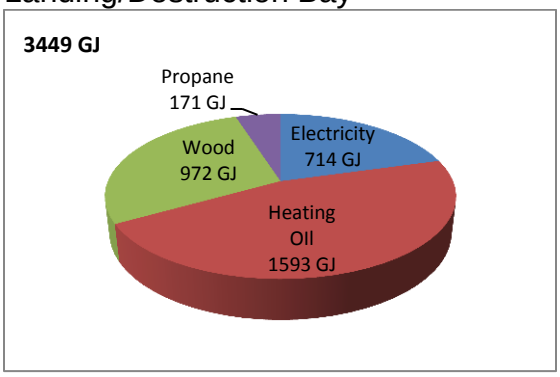


Figure 18. Total Stationary Energy Consumed, Commercial Sector, Burwash Landing/Destruction Bay (GJ)

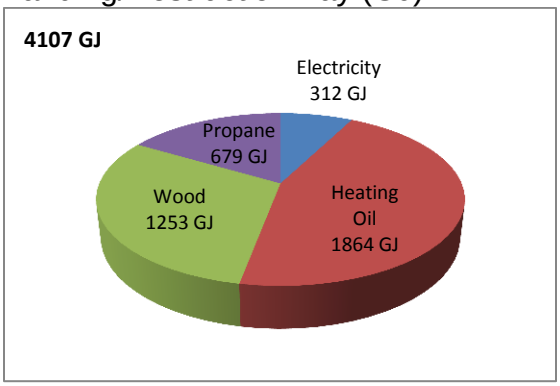


Figure 22. Total Stationary Energy Consumed, Residential Sector, Burwash Landing/Destruction Bay

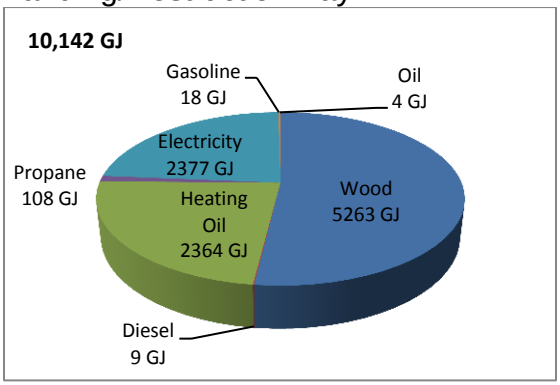
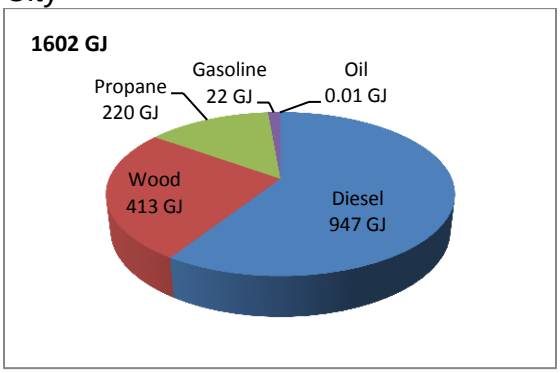


Figure 35. Total Stationary Energy Consumed (GJ), Residential Sector, Silver City



Some of the benefits of wood heat extolled by survey respondents include:

- *Good for business*: The wood chip boiler at Talbot Arm, for example, paid for itself in 3 years and has put $20-30,000 into the local economy since installation 10 years ago. Cutting down on energy costs has increased the success of this business. Between the boilers at Talbot Arm and KFN, and woodstoves among residents, woodcutters in the KLR are kept busy.

KFN's wood chip boiler.
JP Pinard.

Box 4 illustrates the amount of money that stays in the local economy as a result of using wood for heating purposes.

Box 4. Wood is Good for the Local Economy

Wood is the second most relied upon stationary fuel for KFN, the Talbot Arms Motel, and residents in Silver City, and the most utilized stationary fuel for Burwash Landing/Destruction Bay residents. Wood is a local resource that is harvested and used by local people, which means it forms an important part of the local economy as illustrated by figures 11, 19, and 23.

Figure 11. Total Cost Stationary Energy ($), KFN, Burwash Landing/Destruction Bay

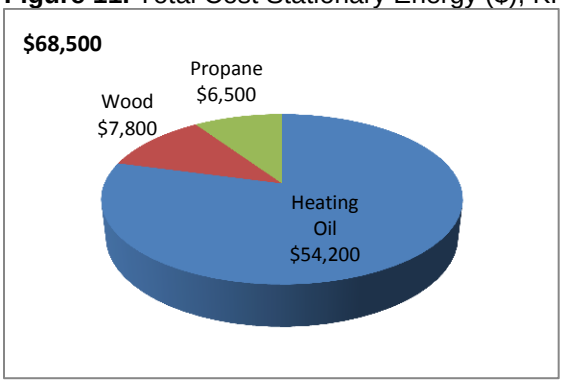


Figure 19. Total Cost Stationary Energy ($), Commercial Sector, Burwash Landing/Destruction Bay

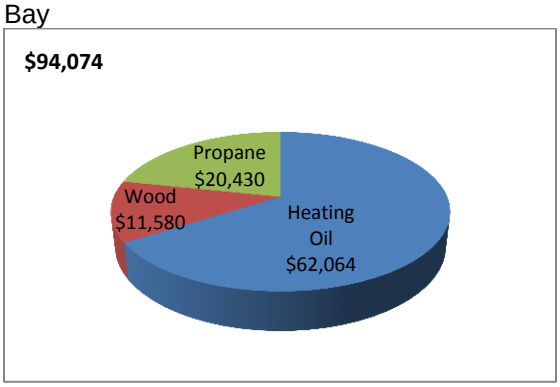
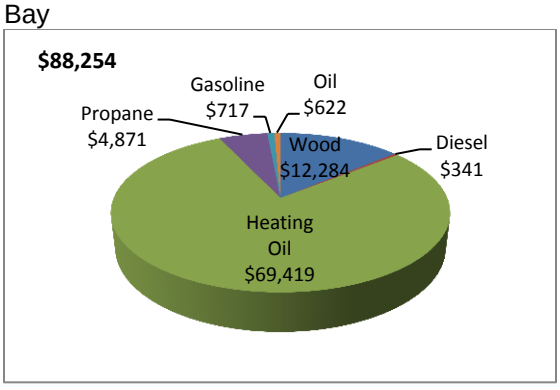


Figure 23. Total Cost Stationary Energy ($), Residential Sector, Burwash Landing/Destruction Bay



- *Good for families*: "A lot of people burn wood. 95% of this community burns wood, it's good on your pocketbook. Oil is costly for people here. $1500-1600 to fill up a tank. If you burned straight oil you couldn't afford it." – *Burwash Landing Resident*
- *Local renewable resource.* Burning wood cuts down on the need for diesel fuel consumption.

Most of the wood harvested by people from Destruction Bay and Burwash Landing comes from burns in the region, like this one. www.archbould.com.

- *Traditional.* "It is remarkable that people still burn wood. Through tradition, I cut and burn wood from age 9. Elders like wood heat, it's better. The furnace is noisy and it doesn't heat up the floor." – *Burwash Landing Resident*
- *Establishes relationships between people, energy, and their environment.* "You can see and fill wood – someone comes and fills up the diesel generator." It also facilitates community relationships – people help each other by going out in groups to gather wood, and provide wood to family members and friends. Moreover, there are recreational values associated with gathering wood.

Box 5. Did you know…

Survey respondents in Destruction Bay and Burwash Landing spent 762 hours gathering wood in 2011. Their counterparts in Silver City spent 220 hours. These hours represent valuable time spent cultivating a sense of well-being and autonomy over energy production.

Box 6. Energy Return on Energy Invested for Various Fuels

Noteworthy, is the energy return on energy invested (EROEI) for various fuels, which sheds light upon the environmental and financial costs of energy. John Gulland prepared the following for the Fuelwood Project in Ontario (2007).
Assumptions:

- Hardwood fuel: 30000 megajoule (MJ/cord)[6]
- 1 litre of gasoline: 43.2 MJ
- Average round trip for fuel delivery: 50km
- Fuel consumption of pick-up truck: 15 mpg=16L/100km
- Two round trips per cord=16L
- Chainsaw fuel per cord: 2L
- Log splitter fuel per cord: 4L

Total fossil fuel consumption: 22 x 43.2=950 MJ/cord
Calculation: 30000/950=32
Energy return on energy invested 32:1
An EROEI of 32:1 may not be worst case for fuelwood, but it is close for rural areas; some people probably produce firewood at an EROI of 30 to 40:1.

For comparison, below are the estimated EROEIs for various energy sources

- Oil 100:1 to 8:1 depending on age, type and location of oil field*
- Oil Sands 2:1
- Biodiesel 3:1
- Coal 9:1
- Natural Gas 8:1 to 10:1
- Hydroelectric 10:1
- Ethanol 0.8:1 to 1.8:1*
- Hydrogen 0.5:1
- Nuclear 4:1
- Solar PV 1:7 to 10:1*
- Wind 18:1
- Wood 30:1 (wood chips, bark for industrial use)

*The wide range in EROEI for these sources reflects the relative energy intensity of facility construction, extraction, refining transmission and maintenance.

Wood in the form of natural fire wood compares favourably with other fuels regarding the amount of net energy realized after processing and transportation. This bodes well for a degree of price stability for fuelwood in the future. Price stability is not likely for the fossil fuels because as the easily accessible deposits are consumed the EROEI rises dramatically, as does the retail price.

Hydro

Hydropower was also named as a good candidate for alternative energy; some described it as “a clean and efficient way to heat a home.” Run of the river was outlined by participants as a possibility deserving of some attention as well as micro-hydro on Christmas Creek in Silver City and the Duke River near Burwash Landing[7].

[6] In the Yukon, most people burn softwood for heating purposes. 1 cord of softwood contains 18700 MJ. Using the above calculation, this works out to an EROEI of 20:1.
[7] A review of small scale hydro options in Destruction Bay and Burwash Landing (New ERA Engineering Corporation 2004, p.2) indicated that the Duke River site would not be feasible “due to concerns with high turbidity, bed load, braided channels, flow variations, presence of salmon and required physical layout of the project.”

Despite the optimism associated with hydro power, several participants said that no harm should be incurred to the land as a result of hydro development and that benefits must flow from local resources to local people. Local sentiments toward Yukon Energy's proposed Gladstone diversion project—which would divert water from the Gladstone Lakes into the Sekulmun-Aishihik Lake system to produce up to an additional 18 gigawatt hours of electricity annually (Yukon Energy 2010)—illustrate these concerns:

"The Gladstone is ridiculous. It would just produce more power for the Minto Mine. We wouldn't receive any benefits and it would change the Gladstone Valley forever." *Burwash Landing resident*

"How will the Gladstone affect the area here? It will only benefit Whitehorse." *Destruction Bay resident*

"We won't benefit on this side and it won't be good for Kluane. The fish go up the river there…It's also a caribou area. The dam would ruin everything. Just like what happened to Aishihik Lake." *Burwash Landing resident*

Fostering Renewable Energy Production

Barriers that should be considered when planning for renewable energy were identified in project interviews as well, and these are described below.

Cost of initial capital and storage systems (for wind and solar, for e.g.) was one identified barrier, which can be especially pertinent to those phasing out commercial operations or retiring. If the payback period on the investment is too long, there is little incentive for individuals to consider wind/solar alternatives. Cost is also relevant to communities considering renewable energy infrastructure: one participant from Destruction Bay recalled the discovery of geothermal in Haines Junction, "because of the degree to which community taxes would have increased, Haines Junction residents declined the opportunity."

www.archbould.com

Another mentioned barrier was the maintenance of such systems. Maintenance requires local expertise, which is not necessarily available when needed. And finally, it is becoming increasingly difficult for noncommercial wood cutters to

obtain permits. A Burwash Landing wood cutter elaborates: “in the Haines Junction area, there are ample commercial permits for operators with lots of equipment, whereas single truck operators have no permits.”

Energy Conservation Concerns and the KLR Energy Guide

In addition to diesel, several interviewees identified energy conservation as a major concern in homes and buildings and when it comes to transportation. Homes and buildings are not as energy efficient as they could be, many homes have not been built to adequate standards (i.e. they require better windows, more insulation, vapor barriers, and insulation for the skirting on houses without basements), and a number of them are large and demand substantial energy to heat. Moreover, interviewees said several hot water tanks are located in arctic entry ways, which are not typically insulated or heated. A selection of building characteristics from KFN buildings and houses in Destruction Bay and Burwash Landing in tables 4-10 show the extent to which such energy efficiency improvements could be made[8].

Table 4. Building Insulation Values & Vapour Barrier Presence (for those known)

	Ceiling insulation	*Exterior Insulation*	*Presence of Vapour Barrier*
KFN admin/other buildings (11)	7 (4@R 40, R12, R8, R28)	6 (3@R28, R8, R12, R20)	5
KFN houses (34)	12 (11@ R40, R20)	12 (10@R20, R12.7, R22)	12

Table 5. Window Types (for buildings with windows)

	All Single Pane Windows	*All Double Pane Windows*	*All Triple Pane Windows*
KFN admin/other buildings	0	6	1
KFN houses	2	24	5 (1 household put plastic over double pane windows to give them triple pane value)

*Several residents said their double pane windows are either leaky or broken.

[8] Building characteristics of Kluane First Nation-maintained homes and buildings are exhibited here, because they may be used to strengthen KFN requests for energy efficiency improvement funding through the Federal Gas Tax Fund.

Table 6. Door Seal Condition (for those known)

	Door Seal Absent	*Poor Door Seal*	*Good Door Seal*
KFN admin/other buildings (7)		5	2
KFN houses (34)	13	18	2

*Condition of door seal at 1 household unknown

Table 7. Primary Heat Source

Primary Heat Source							
	W-F Boiler	*Wood stove*	*O-F Boiler*	*E Baseboard*	*O-F Furnace*	*Boiler*	*O-F Furnace + Woodstove*
KFN admin/ other buildings (8)	3	1	1	1	2		
KFN housing (34)		20	5	1	6	1	1

*Note: 16/32 residents with woodstoves said they had difficulty maintaining a consistent temperature in their home, which could indicate an inappropriately sized woodstove for the home size.

Table 8. Type of Hot Water Heater

Hot Water Heater Type					
	Electricity	*Propane/gas*	*Boiler*	*On Demand*	*Boiler*
KFN admin/other Buildings (3)	2	1			
KFN housing (34)	33	1			

*Note: Hot water tanks in all KFN admin/other buildings are insulated and kept at 140F. 7/34 KFN homes have insulated hot water tanks and the temperature setting (for those known) is 120F at 5 homes, 140F at 12 homes, and 128, 131, 77, and 160F at remaining homes.

Table 9. Number of Appliances

	Total Count; Range	*Average*
KFN admin/other buildings (7)	124; 4-39	18
KFN housing (33)	449; 4-24	14

Table 10. Use of Power Bar to turn Appliances On/Off

Power Bar Used to Turn Appliances On and Off		
	Yes	*No*
KFN admin/other buildings	N/A	N/A
KFN housing (33)	11	22

*Note: there was no available information on this question for KFN admin/other buildings

Beyond improving the R value of windows and insulation, installing vapour barriers, and moving arctic entry ways into heated spaces, data show that many door seals could use replacement, more wood stoves could be installed in homes, hot water tank temperatures could be turned down to 131F (and more tanks could be insulated), and a greater number of appliances could be turned on and off automatically with power bars to conserve energy.

In addition, with nearly 100% of KFN's hot water tanks heated with electricity, which is generated from diesel—the largest source of emissions in the community, excluding that associated with air travel (see table 3)—KFN may wish to consider exploring other hot water heating options, such as solar, to reduce emissions. When the City of Saskatoon, Saskatchewan, found out that municipally owned buildings comprised the largest proportion of the city's emissions for instance, they decided to focus on reducing emissions associated with these facilities; solar hot water heating at the city's two public swimming pools was subsequently explored and installed with partial funding from Natural Resources Canada (Partners for Climate Protection, 2012).

Interview participants also explained that there should be greater awareness around turning lights out, closing windows, and turning down the heat, especially in public/commercial buildings that go unoccupied for 15 hours a day. One Silver City resident said that improving awareness could be achieved by increasing personal responsibility for energy use, "If every individual was responsible for their own power use, we would start paying attention."

Beyond energy expended on buildings for heating and electricity, there was also concern over the amount currently allocated to acquiring food. With the closing of the grocery store in Haines Junction in fall 2011, residents in the KLR now have no choice but to travel to Whitehorse for food and supplies. Re-establishing public transportation in some form, would be helpful in this regard, as the next two quotes suggest.

"In the 1970s, my mom used to take the bus into Whitehorse for groceries. The Greyhound ran 2 times per week back then. I have to go to Whitehorse for groceries now." *Silver City resident*

“The biggest expenditure on fossil fuels by far, that I have, is transportation. Many of us out in the communities spend a lot of time and energy on that road to and from town. It would be really awesome if there was a bus that regularly ran into and out of town. Even better would be to combine with the mail delivery, which is 3 times a week. If the mailman took passengers or if there was enough buy in, run a mail passenger van between Whitehorse and Beaver Creek 3 times a week. The guy does it anyway…Anyway, we need a bus. I would certainly use it.” *Silver City resident*

Box 7. Transportation Costs in Burwash Landing/Destruction Bay and Silver City

Between Burwash Landing, Destruction Bay, and Silver City, residents, commercial, and government operators spent $481,420 on transportation fuel in 2011 (this includes fuel for on and off-road vehicle use).

Figure 9. Total Cost Transportation Energy ($), Destruction Bay/Burwash Landing

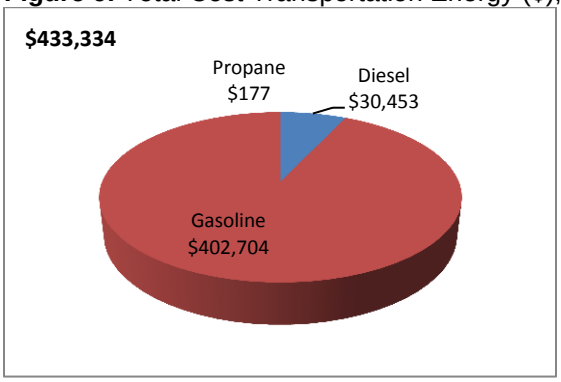
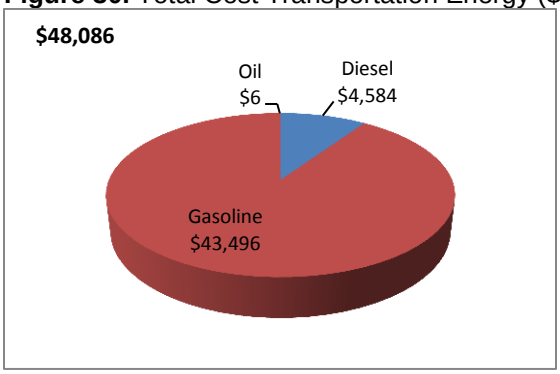


Figure 30. Total Cost Transportation Energy ($), Silver City



So how might community members go about addressing some of these concerns about energy conservation? In the interviews, a variety of ideas were recorded—these ideas were organized into an energy guide to foster information sharing in and across KLR communities.

YOUR HOME/BUSINESS

build small. Build to suit your space requirements to minimize heating costs. *Silver City*

orientation. Ensure entry ways do not face the prevailing wind directions to minimize heat loss. *Burwash Landing*

insulate to code. The Energy Solutions Centre in Whitehorse has many resources on the topic, http://www.energy.gov.yk.ca/

install 3 pane windows. If this isn't an option, cover windows with plastic to add an additional pane's worth of insulation. *Burwash Landing*

wire your home so lights & appliances can be turned off easily when you're not at home. *Burwash Landing*

use low flow shower heads & toilets, change your bulbs to energy savers. One Burwash Landing resident has reduced his bills from $100 to $78 per month by doing so.

insulate your hot water tank. *Burwash Landing*

heat your hot water tank with wood. *Talbot Arm Motel, Destruction Bay*

try on-demand hot water heating. *Silver City*

consider a greenhouse. Growing your own food is more nutritious & reduces diesel used for bringing groceries up the highway. *Destruction Bay*

consider solar if you run your own generator as it is considerably cheaper than running a generator. *Silver City*

build a small fridge in the floor. try it if you have minimal refrigeration needs. *Silver City*

heat with a wood chip boiler or woodstove to save money, utilize local resources, and employ local people. *KLR residents*

YOUR HABITS

set your hot water tank to 55 degrees celcius. The factory setting for most tanks is well above 55 degrees.

put your hot water tank on a timer. One home in Silver City heats their tank for 4 hours a night, which is sufficient to meet the household's hot water needs for the day.

turn off the breaker switch for your hot water tank at the electrical panel if you leave home for more than 24 hours. *Burwash Landing*

turn off your water pump if you plan to leave home for extended periods. *Burwash Landing*

cook on your woodstove when appropriate, when simmering soups, for e.g. *KLR residents*

unplug and store your freezer outside in the winter time. *Silver City*

cover windows in the winter with window quilts, a modern take on the castle tradition of hanging heavy drapes or tapestries in the windows to insulate against the cold. *Destruction Bay*

don't heat unused spaces. Many KLR residents do this, especially with garages.

limit household appliances. "We use the energy we need. We don't have a dryer. We hang laundry outside in the summer time and inside in the winter." We also limit our electric devices, such as fry pans, etc." *Silver City*

turn off septic heat trace in the summertime. It's just a breaker switch. *Burwash Landing*

use task lighting. It helps with efficiency. *Silver City*

"Because life is so expensive here, we need to share our ideas on how to save money on energy." – *Destruction Bay resident*

turn the lights out when not in use. The lights out project at the school in Destruction Bay was a good reminder to one parent in Burwash Landing to maintain this habit. Post reminder signs at the switches. *Burwash Landing*

turn the heat down when you're not home or out of the office. *KLR residents*

use an electric kettle instead of a stovetop one to reduce electricity consumption. *Destruction Bay*

GETTING AROUND

walk, snowshoe, or canoe. Residents are proud of the fact that human-powered transportation is commonplace in the KLR.

drive the speed limit and save one quarter on your fuel bills. *Burwash Landing*

plug in your car for 2 hours at a time when the temperature plunges below minus 20.

don't idle your vehicle. *Burwash Landing*

carpool. *Burwash Landing*

drive a fuel efficient vehicle if you can.

drive different vehicles for different purposes. For e.g. drive a small car for trips to town, a truck for hauling wood, and a 4WD vehicle for winter. *Silver City*

HOW TO GET HELP WITH ENERGY COSTS

if you live in a rural area outside of a municipality with no access to power the Yukon government's Rural Electrification Program provides financing and other support for rural Yukoners to get access to power services. Power services eligible for this support include stand-alone renewable energy technologies, such as solar/photo-voltaic, wind and micro-hydro projects. For more information call the Yukon Community Services Department at (867) 667-5268 or email assessment.taxation@gov.yk.ca

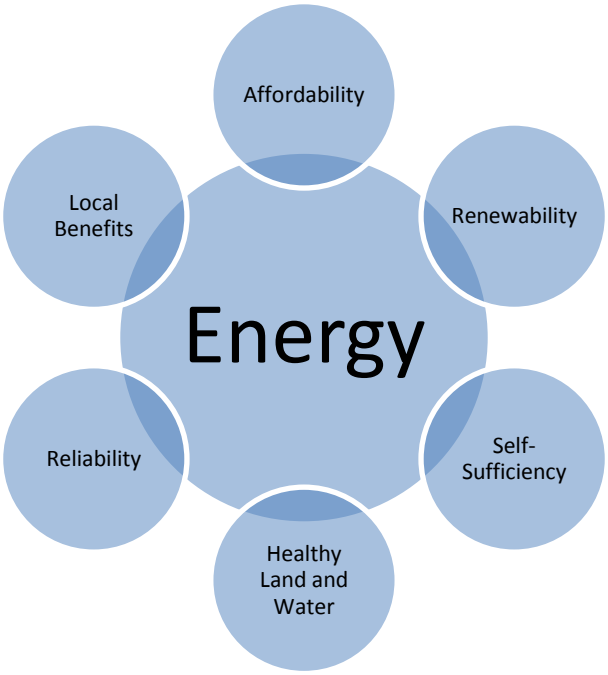
if you are a KFN elder contact the KFN Governance Department to discuss the Elders Benefit Package, which includes a subsidy of $1500 annually for the purchase of heating fuel. Call (867) 841-5501.

"Because life is so expensive here, we need to share our ideas on how to save money on energy." – *Destruction Bay resident*

Energy Values

Although creating a set of values and principles around energy consumption and production was not part of the original project objectives, they were clearly evident in the results. Energy values distilled from project results are: affordability, renewability, self-sufficiency, healthy land and water, reliability, and local benefits. These values are depicted in figure 40.

Figure 40. Energy Values in the KLR



The only value not covered in the discussion thus far is self-sufficiency. When participants talked about self-sufficiency, they referred to a desire to see either the community or individuals produce energy. The following quotes show the two different scales at which this value was expressed:

"I want to see our community become energy self-sufficient in terms of energy production." *Destruction Bay resident*

"The band should build hydropower at the Duke River. The First Nation has to be self-sufficient." *Burwash Landing resident*

"For me, the goal is to be 80-90% off grid. Each house could have their own wind mills. In the old days, they had their own mills [at the Champagne Road House]. What's the big deal, we're just a little village. It would be nice to get off the grid, then you're more self sufficient." *Burwash Landing resident*

"I wouldn't mind having my own wind farm, independent of the grid." *Burwash Landing resident*

Already, through a number of energy initiatives, such as the geothermal and wind projects, the use of wood stoves, wood chip boilers, and solar panels in homes and commercial buildings, community members are demonstrating their commitment to upholding the value of self-sufficiency.

Conclusion

With the aim of supporting energy-related decision making in Burwash Landing, Destruction Bay, and Silver City, the YRC and KFN partnered to develop and pilot a community-based approach to energy and greenhouse gas emissions inventorying. This approach was designed with replication by other communities in mind, and as such, the tools required to conduct the inventory (i.e. the questionnaires, etc.) are provided herein. The strength and uniqueness of the developed approach is that quantitative and qualitative research methodologies are combined to produce a thorough and broad understanding of energy issues and opportunities at the community scale.

In this study, a strong desire to reduce diesel dependency, for electricity and heat generation, was brought to light—despite the fact that diesel is the *most* utilized stationary energy fuel in Destruction Bay/Burwash Landing and Silver City, and, incidentally, the greatest source of greenhouse gas emissions (excluding those associated with community air travel). Wood, on the other hand, a much lauded local source of renewable energy, is the second most relied upon stationary energy fuel and an important contributor to the local economy. Beyond wood, several other sources of renewable energy are used, being explored, and celebrated in the communities, including wind, geothermal, and solar. Building on these and other opportunities highlighted in this report, a number of options for emissions reductions are available for consideration.

Community concerns about energy conservation were also documented in this study, and, paired with the current state of energy efficiency in KFN homes and buildings, a number of opportunities for enhancing energy conservation were highlighted; community members' ideas on how to address concerns about energy conservation also contributed to this list of opportunities.

Thus, through the lens of community perspectives, this energy and emissions inventory provides a strong baseline of information on how people use energy in the KLR and key opportunities for reducing emissions in each of the residential, commercial, and government sectors. It is the hope that this inventory will be useful to people in each of these sectors in a variety of ways, from the day-to-day to policy-driven contexts.

Project Benefits

Benefits that flowed from this research were numerous and multi-scale. For the YRC this work expanded our capacity as well as that of Yukon communities to carry out this work into the future. We also added to our network of professional and community contacts through KFN partnership as well as contact with institutions and agencies involved in energy work in the Yukon, the Circumpolar North, and beyond.

From the KFN's perspective, the partnership provided an opportunity to strengthen understanding of the resources required to keep the community strong. In addition, the project promoted awareness of energy supply, demand and use, and the evaluation of opportunities to improve efficiencies when it comes to energy production and consumption. Strong relationships between scientific communities and small governments, such as the one that developed between the YRC and KFN, also gave KFN the opportunity to build upon their role as stewards for future generations.

At the community level, the residential, commercial, and government sectors now have a greater awareness of the energy types they rely on, the associated financial and environmental costs, and opportunities for reducing emissions. In terms of the costs of energy, a number of residents were informed about the pioneer grant and KFN oil subsidy programs. Energy discussions that took place in the community as a result of the project were also mentioned as useful in terms of contributing to the momentum to move energy ideas forward in the region. In a similar vein, the KLR energy guide will likely foster further discussion and action at the community scale.

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Appendix 1 Media Release

MEDIA RELEASE

For immediate release | December 13, 2011

Yukon Research Centre, Kluane FN team up for energy inventory

Whitehorse –You may know how much fuel your furnace burns in a month- or how much you spend on gas for your car. Now imagine scaling that up to include all the energy used and emissions created by every person, home, business, and vehicle in your community.

That's the job facing researchers at Yukon Research Centre (YRC) and the Kluane First Nation (KFN) in southwest Yukon.

"It's actually a lot more complex than the home energy audit most people are used to hearing about," says Lisa Christensen, the researcher with YRC. "That's why we call it an 'energy use and emissions inventory'."

Working in partnership with the KFN, the inventory will look at the total energy use and emissions generated by the 65 private homes in Destruction Bay and Burwash Landing, as well as all the commercial and government activity taking place in the communities. The study will also try to quantify the emissions associated with land use changes, forestry, the local landfill, and even the sewage system.

The First Nation can then use this information to plan community energy strategies, and measure the success of alternative energy projects or energy conservation efforts.

"The First Nation has a number of renewable energy projects underway and ones they are interested in setting up," says Christensen. "This kind of inventory can inform and support development of those projects by helping to create a picture of how energy use and emissions may be offset."

Similar community energy and emission inventories are done in jurisdictions like British Columbia, but this is the first time one has been done at the community scale in Yukon. The YRC is working closely with the Kluane First Nation in planning and implementing the inventory. Researchers will hire a local person to work on the inventory and establish a local committee guide the project to make sure it meets the needs of the communities.

While the report, due in March, will give the First Nation government valuable information it can use to measure projects and plan for the future, it can also help individuals in their energy conservation efforts, says Christensen.

"I think people these days are well aware of climate change and its impacts, and there is a growing awareness of energy security," she says. "People want to protect their energy security and this is one way of supporting efforts associated with that."

-30-

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Appendix 2 Survey Instruments

KFN-YRC Energy Use and Emissions Inventory
Resident Survey

Building ID:_____
Community:_____
Date: _____Interviewer(s):_____
Interview start time: _____End time:_____ Location:_____

Home - General Characteristics
This first set of questions covers general characteristics of the home you live in.

1. Type of home:
   □ Single-detached house or cabin □ Single detached house/cabin with suite
   □ Suite in a single detached house/cabin □ Duplex □ Four-plex
   □ Row or townhouse Apt/Condo □ Mobile home Other

2. When was this home built? _____(year)

3. # Stories:_____
4. # Rooms (including kitchen, living, bedrooms, bathrooms):_____
5. # Rooms heated in 2011:_____

6. What temperature was the house kept at during the day last year? _____(◦C/◦F)
7. Overnight? _____(◦C/◦F)
8. Is the temperature set-back automatic? □ Yes □ No □ N/A

9. To help us understand energy needs on a per-person basis, can you tell us how many people lived here last year (adults and children)?
   _____
10. How many hours a day would you say the home went unoccupied?_____

11. This home is:
    □ Owned by you or a member of this household
    □ Rented (even if no rent is paid)
    □ KFN housing
    □ Coop
    □ Social housing
    □ Other (specify) _____
    □ Declined to answer

12. Other than power-cost equalization, are your electricity bills subsidized at all?
    □ Yes □ No □ Don't know □ Declined to answer
13. What about your heating bills, are they subsidized?
    □ Yes □ No □ Don't know □ Declined to answer

Home - Detailed Characteristics
The next few questions are about your home and how it was constructed.

14. Total floor space: _____(m^2/ft^2)
15. Is there a heated garage? □ Yes (area: _____ m^2/ft^2) □ No
16. Is there a crawl space? □ Yes (area: _____ m^2/ft^2) □ No

17. Wall construction type:
    □ 2x4 □ 2x6 □ 2x6 enhanced □ R-2000 □ Supergreen
    □ Log □ Other _____
18. Presence of an HRV air exchanger:
    □ Yes □ No
19. Ceiling is insulated:
    □ Yes (type: _____; thickness: _____OR R value:_____) □ No
20. The floor is insulated:
    □ Yes (type:_____ ; thickness: _____OR R value:_____) □ No
21. The exterior walls are insulated:
    □ Yes (type:_____; thickness: _____OR R value:_____) □ No
22. The basement is insulated:
    □ Yes (type:_____; thickness: _____OR R value: _____) □ No
    □ N/A
23. Vapor barrier in place: □ Yes □ No

24. Home's ceiling height: _____(m/ft)

25. # windows _____;# double pane_____# triple pane_____# other_____

Notes (any windows in poor condition, for e.g.*?*):_____
_____
_____

26. # of entry ways, including ones not used:
    _____
27. # of arctic entries (must have 2 doors):
    _____
28. What is the condition of the seals on the doors? □ Good □ Poor □ Absent

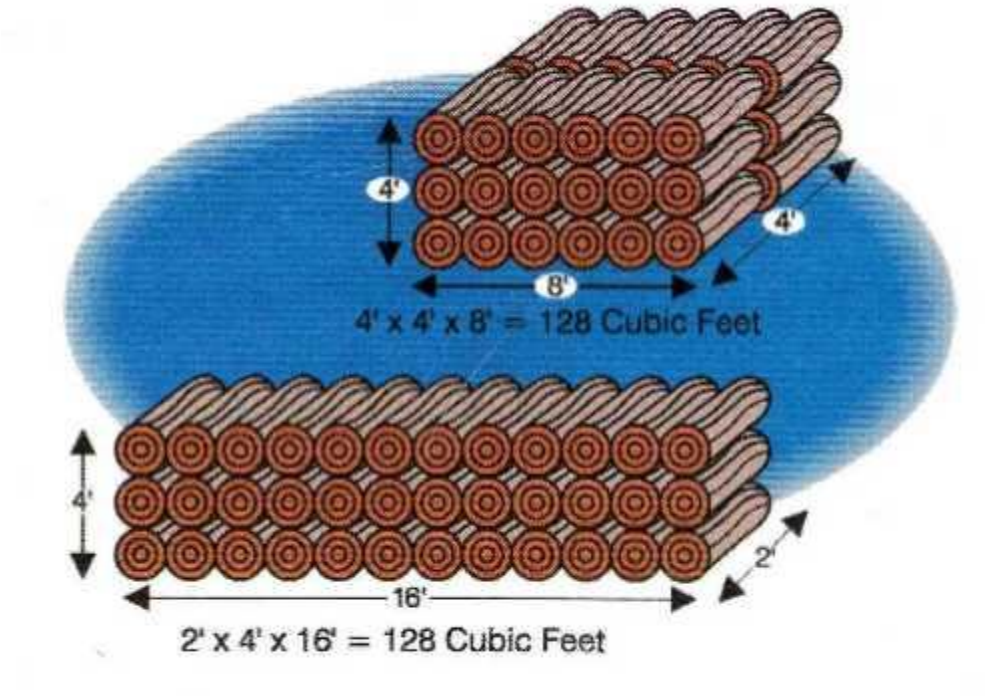
Energy Consumption in the Home
These next questions are about what kind of energy and how much of it is used in your home – so we'll be asking you questions like, "what kind of energy do you use to heat your home?" "How much do you use?" and "How much does it cost you?"

29. Can you tell us all the ways your home was heated in 2011? *Check all that apply*.
- □ Oil-fired furnace (normal/high efficiency burner); year of unit _____(yrs)
- □ Oil-fired boiler (normal/high efficiency burner); year of unit _____(yrs)
- □ Propane-fired furnace (normal/high efficiency); year of unit _____(yrs)
- □ Propane-fired boiler (normal/high efficiency); year of unit _____(yrs)
- □ Wood-fired furnace (normal/high efficiency); year of unit _____(yrs)
- □ Wood-fired boiler (normal/high efficiency); year of unit _____(yrs)
- □ Electric baseboard
- □ Electric fireplace
- □ Woodstove (conventional/advanced tech./catalytic control); model_____
- □ Wood pellet stove; model_____
- □ Heat pump (air source/ground source)
- □ Oil monitor (type _____)
- □ Portable heater (# and type_____)
- □ Propane fireplace
- □ Other (specify)_____

30. Which of these was your primary source of heat?_____

If the participant heated their home with wood (if not skip to #37)…

31. How many cords of wood did you burn in 2011? _____



Source: http://alaska.inetgiant.com/anchorage/addetails/cord-of-wood/2623176

32. What type of fuel wood did you use?
    % Pine_____; type (standing dead/firekill/other _____)
    % Spruce _____; type (standing dead/firekill/other _____)
    % Birch _____; type (standing dead/firekill/other _____)
    % Aspen/Poplar _____; type (standing dead/firekill/other _____)
33. Is it difficult to maintain a consistent temperature with your woodstove? □ Yes□ No
34. If you purchased your wood last year, how much did you spend? _____($)
35. If you got the wood yourself, how much chainsaw fuel (gas and oil) did you use?

	Amount used (L/Gal)	**Dollars Spent (indicate rate per liter for 2011 if recalled OR average YT price in 2011 OR other)**
Chainsaw		
Gas (Reg/Prem)		
Oil		
Truck		
Gas (Reg/Prem)		

36. How much time was spent gathering the wood? _____(Hours)

If the participant used oil for home heating purposes….(if not skip to #40)

37. What is the capacity of your oil tank? _____(L/Gal)
38. How much oil did you use in 2011? _____L/Gal)
39. And what did it cost you? _____($)

40. How is your hot water tank heated?
    □ Boiler □ Wood stove □ Electricity □ Propane/gas □ Oil
    □ Other (specify) _____ □ No hot water tank (on demand) - *skip to #46*.
41. What is its capacity? _____(L/Gal)
42. What year was the unit manufactured? _____
43. What was the temperature set at? _____(◦C/◦F)
44. Did the system have an insulating blanket in 2011? □ Yes □ No

45. What kind of stove do you cook on? *Check all that apply.*
    □ Microwave
    □ Electric
    □ Propane ► Amount used: _____ Cost: _____
    □ Other _____

46. Can you tell us about the appliances you had in 2011? *Fill out table with participant.*

Appliances	**Number**
Washer	
Dryer	
Fridge (can include small freezer)	
Large freezer	
Microwave	
Game system (xbox, for e.g.)	
TV	
Video/DVD player	
Cable/satellite box	
Stereo system	
Desktop computer	
Laptop computer	
Cell phone	
Landline	
Toaster	
Toaster oven	
Coffee maker	
Kettle	
Other	
Other	

47. Do you use a power bar to turn your appliances on and off with? □ Yes □ No
(Indicate systems managed by power bar*:*
_____
_____)

48. Are there other fuels (e.g. kerosene, propane, biofuels, others) you used for home heating or other household purposes (such as a greenhouse) in 2011 that we didn't cover?
Explain (amount and cost _____
_____
_____

Transportation
To get a picture of how much energy is used for transportation purposes, we would now like to ask you about the types of vehicles you had and the associated fuel use in 2011. We're on the homestretch of the interview now.

49. Does anyone in this household own a car or truck *(functioning)*?
□ Yes □ No ►*Go to #52*
▼

If participant recalls amount of fuel consumed or amount spent, fill out the following table:

	Fuel type consumed in (regular gas/ premium gas/diesel)	Amount (liters/gallons)	Dollars spent (indicate rate per liter for 2011 if recalled/average YT price in 2011/other)
Car#1			
Car#2			
Car#3			
Car #4			
Truck#1			
Truck#2			
Truck#3			
Truck#4			

OR if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and the following information:

	Make/ Model	Year	Engine Size (L)	Trans Type (manual or automatic)	Fuel Type (reg. gas/prem.gas/diesel)	Total Km (in 2011)
Car#1						
Car#2						
Car#3						
Car #4						
Truck#1						
Truck#2						
Truck#3						
Truck#4						

50. Do you have an engine block heater for any of your vehicles?
□ Yes □ No► *Go to #52*
▼
51. How was your engine block heater used in 2011?
□ Plugged in for a few hours as needed □ Plugged in all the time □ Timer used

52. Does anyone in this household own a snow machine *(functioning)*?
□ Yes □ No► *Go to #53*
▼

If participant recalls amount of fuel consumed or amount spent, fill out the following table:

	Fuel type consumed (regular gas/ premium gas/diesel)	Amount (liters/gallons)	Dollars spent (indicate rate per liter in 2011 if recalled/average YT price in 2011/other)
SM#1			
SM#2			
SM#3			
SM#4			

OR if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and the following information:

	Make/ Model	Year	Engine Type (2 or 4 stroke)	Fuel Type (reg. gas/prem.gas/diesel)	Total Km (in 2011)
SM#1					
SM#2					
SM#3					
SM #4					

53. Does anyone in this household own an ATV *(functioning)*?

□ Yes □ No ► *Go to #55*

▼

If participant recalls amount of fuel consumed or amount spent, fill out the following table:

	Fuel type consumed (regular gas/ premium gas/diesel)	Amount (liters/gallons)	Dollars spent (indicate rate per liter in 2011 if recalled/average YT price in 2011/other)
ATV#1			
ATV#2			
ATV#3			
ATV#4			

OR if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and the following information:

	Make/ Model	Year	Engine Type (2 or 4 stroke)	Fuel Type (reg gas/prem.gas/diesel)	Total Km (in 2011)
ATV#1					
ATV#2					
ATV#3					
ATV#4					

54. Does anyone in this household own a boat *(functioning)*?

□ Yes □ No ► *Go to #55*

▼

If participant recalls amount of fuel consumed or amount spent, fill out the following table:

	Fuel type consumed (regular gas/ premium gas/diesel)	Amount (liters/gallons)	Dollars spent (indicate rate per liter in 2011 if recalled/average YT price in 2011/other)
BOAT#1			
BOAT#2			
BOAT#3			
BOAT#4			

OR *if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and:*

	Boat type (river or ocean skiff)	Boat length (ft/m)	Hull year built	Outboard HP/Jet HP	Engine yr built	4 stroke or 2 stroke	Fuel Type (reg gas/prem. gas/diesel)	Total Km (in 2011)
BOAT#1								
BOAT#2								
BOAT#3								
BOAT#4								

55. Do you own any other functioning on/off-road vehicles that we didn't cover?
□ Yes □ No ► *Go to #56*

▼

If participant recalls amount of fuel consumed or amount spent, fill out the following table:

#1									
#2									
#3									
#4									

OR *if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and:*

#1									
#2									
#3									
#4									

56. Now we're going to talk about air travel. To the best of your knowledge, can you tell us about all the plane trips made by members of this household in 2011, including the place of departure and arrival, and stopover points, if any? This will help us determine the total distance travelled.

Trip	Departure location	Arrival location	Stopovers
#1			
#2			
#3			
#4			
#5			
#6			
#7			
#8			
#9			
#10			

#11			
#12			
#13			
#14			
#15			
#16			
#17			
#18			
#19			
#20			

57. Do you think this household's energy use in 2011 differed significantly from that of 2010?
Explain:_____
_____
_____
_____
_____

Energy Now and Into the Future
We're almost finished the survey now. There are just three questions left, and they are opinion questions on the state of energy in your community. There are no right or wrong answers here.

58. What kinds of energy success stories are you aware of in your community?

_____
_____
_____
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_____
_____

59. Do you have any concerns about energy in your community, now or into the future?
□ Yes □ No► *Go to #61*
▼
What can you tell us about your concerns? (*Probe: are they financial? Perhaps they're environmental or community-based concerns? Related to energy reliability or security?)*

60. How do you think these concerns could best be addressed?

61. Would you like to make any other comments on what we've discussed?

KFN-YRC Energy Use and Emissions Inventory
Commercial/Government Survey

Building ID:_____
Sector (commercial/industrial/government): _____Community:_____
Date: _____ Interviewer(s):_____
Interview start time: _____End time:_____ Location: _____

Building—General Characteristics
This first set of questions covers general characteristics of the building.

1. Type of building:_____
   _____
   _____

2. When was the building built? _____(year)
   Notes: _____

3. # Stories:_____
4. # Rooms (including all heated spaces):_____
5. # Rooms heated in 2011:_____

6. What temperature was the building kept at during the day in 2011? _____(◦C/◦F)
7. Overnight? _____(◦C/◦F)
8. Is the temperature set-back automatic? □ Yes □ No □ N/A

9. How many people worked here in 2011? _____(# part-time); _____(#full-time)
   Other notes: _____
   _____
   _____
10. How many hours a day would you say the building was unoccupied in 2011?_____

11. This building is:
    □ Owned
    □ Rented (even if no rent is paid)
    □ Other (specify) _____
    □ Declined to answer

12. Other than power-cost equalization, are this building's electricity bills subsidized?
    □ Yes □ No □ Don't know □ Declined to answer

13. What about the heating bills, are they subsidized?
    □ Yes □ No □ Don't know □ Declined to answer

Building—Detailed Characteristics
The next few questions are about the building and how it was constructed.

14. Total floor space: _____(m^2 or ft^2)
15. Is there a crawl space? □ Yes (area: _____m^2/ft^2) □ No

16. Wall construction type:
□ 2x4 □ 2x6 □ 2x6 enhanced □ R-2000 □ Supergreen
□ Other_____

17. Presence of an HRV air exchanger:
□ Yes □ No

18. Ceiling is insulated:
□ Yes (type: _____; thickness: _____OR R value:_____) □ No
19. The floor is insulated:
□ Yes (type:_____; thickness: _____OR R value:_____) □ No
20. The exterior walls are insulated:
□ Yes (type:_____; thickness: _____OR R value:_____) □ No
21. The basement is insulated:
□ Yes (type:_____; thickness: _____OR R value: _____) □ No □ N/A
22. Vapor barrier in place: □ Yes □ No

23. Building's ceiling height: _____(m/ft)

24. # windows _____;# double pane_____# triple pane_____# other_____
Notes (*any windows in poor condition, for e.g.?*):_____
_____
_____

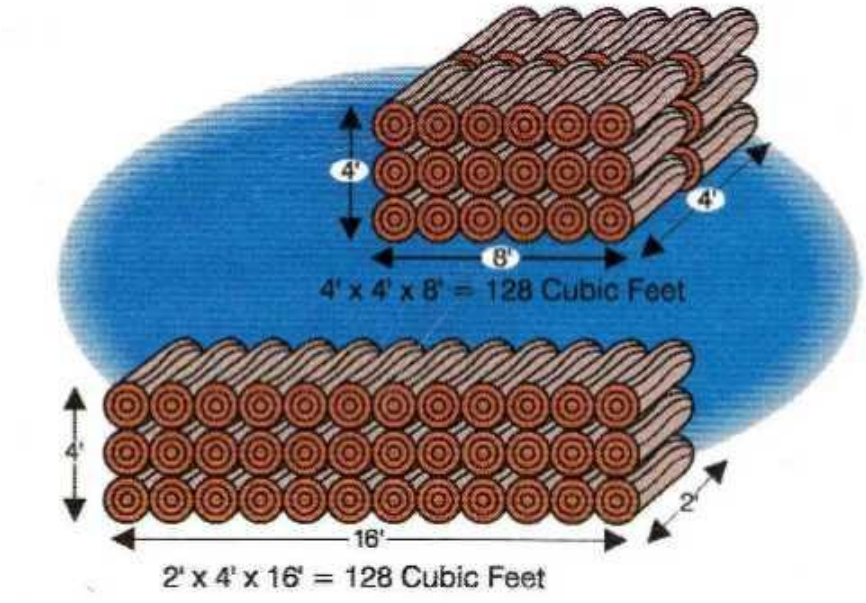
25. # of entry ways, including ones not used: _____
26. # of arctic entries (must have 2 doors): _____
27. What is the condition of the seals on the doors? □ Good □ Poor □ Absent

Energy Consumption in the Building
These next questions are about what kind of energy and how much of it is used in the building – so we'll be asking you questions like, "what kind of energy do you use to heat the building?" "How much is used?" and "How much does it cost?"

28. Can you tell us all the ways the building was heated in 2011? *Check all that apply*.
- □ Oil-fired furnace (normal/high efficiency burner); year of unit _____(yrs)
- □ Oil-fired boiler (normal/high efficiency burner); year of unit _____(yrs)
- □ Propane-fired furnace (normal/high efficiency); year of unit _____(yrs)
- □ Propane-fired boiler (normal/high efficiency); year of unit _____(yrs)
- □ Wood-fired furnace (normal/high efficiency); year of unit _____(yrs)
- □ Wood-fired boiler (normal/high efficiency); year of unit _____(yrs)
- □ Electric baseboard
- □ Electric fireplace
- □ Woodstove (conventional/advanced tech./catalytic control); model_____
- □ Wood pellet stove; model_____
- □ Heat pump (air source/ground source)
- □ Portable heater (# and type_____)
- □ Propane fireplace
- □ Other (specify)_____

29. Which of these was the primary heat source?_____

If the building was heated with wood (if not skip to #36)…
30. How many cords of wood were burned in 2011?_____



Source: http://alaska.inetgiant.com/anchorage/addetails/cord-of-wood/2623176

31. What type of fuel wood was used?
- % Pine____; type (standing dead/firekill/other_____)
- % Spruce ____; type (standing dead/firekill/other_____)
- % Birch ____; type (standing dead/firekill/other_____)
- % Aspen/Poplar ____; type (standing dead/firekill/other_____)

32. Is it difficult to maintain a consistent temperature with the woodstove? □ Yes□ No

33. If the wood was purchased last year, how much was spent? _____($)
34. If you gathered the wood yourself, how much chainsaw fuel (gas and oil) was used?

	Amount used (L/Gal)	**Dollars Spent (indicate rate per liter for 2011 if recalled OR average YT price in 2011 OR other)**
Chainsaw		
Gas (Reg/Prem)		
Oil		
Truck		
Gas (Reg/Prem)		

35. How much time was spent gathering the wood? _____(hours)

If the building was heated with oil…(if not skip to #39)
36. What is the capacity of the oil tank? _____(L/Gal)
37. How much oil was consumed in 2011? _____(L/Gal)
38. And what did it cost? _____($)

39. How is the building's hot water tank heated?
□ Boiler □ Wood stove □ Electricity □ Propane/gas □ Oil
□ Other (specify) _____ □ No hot water tank (on demand) - *skip to #44*.
40. What is its capacity? _____(L/Gal)
41. What year was the unit manufactured? _____
42. What was the temperature set at? _____(◦C/◦F)
43. Did the system have an insulating blanket in 2011? □ Yes □ No

44. Can you tell us about the appliances in the building in 2011?

Appliances	**Number**
Washer	
Dryer	
Fridge (can include small freezer)	
Large freezer	
Microwave	
Game system (xbox, for e.g.)	
TV	
Video/DVD player	
Cable/satellite box	
Stereo system	
Desktop computer	
Laptop computer	
Cell phone	
Landline	
Toaster	
Toaster oven	
Coffee maker	
Other	
Other	

45. Are power bars used to turn appliances on and off with? □ Yes □ No
(Indicate systems managed by power bar*:* _____)
Other notes: _____
_____

46. Are there other fuels (propane, kerosene, others) used for heating the building, or for other purposes that we didn't cover?
Explain (amount and cost):_____
_____
_____
_____
_____
_____
_____

Transportation
To get a picture of how much energy is used for transportation purposes, we would now like to ask you about company vehicles and equipment and the associated fuel use.

47. If fuel consumption records were kept for company vehicles (on and off-road, including heavy equipment) in 2011 fill out the following table:

Vehicle	**Fuel type consumed in (regular gas/ premium gas/diesel)**	**Amount (liters/gallons)**	**Dollars spent (indicate rate per liter for 2011 if recalled/average YT price in 2011/other)**
#1			
#2			
#3			
#4			
#5			
#6			
#7			
#8			
#9			
#10			
#11			
#12			
#13			
#14			
#15			
#16			
#17			
#18			
#19			
#20			

OR if mileage known, calculate fuel consumption with NRCan's energy efficiency ratings and the following information:

Vehicle	Make/ Model	Year	Engine Size (L)	Trans Type (manual or automatic)	Fuel Type (reg. gas/prem.gas/diesel)	Total Km (in 2011)
#1						
#2						
#3						
#4						
#5						
#6						
#7						
#8						
#9						
#10						
#11						
#12						
#13						
#14						
#15						
#16						
#17						
#18						
#19						
#20						

*If snowmachine or ATV, need to know: engine type (2 or 4 stroke); make/model; year; fuel type.

*If boat, need to know: boat type (river or ocean skiff); boat length (ft/m); hull year built; outboard HP/jet HP; engine yr. built; 4 stroke or 2 stroke; fuel type.

48. Is an engine block heater used for any of the vehicles?

□ Yes □ No► *Go to #50*

▼

49. How was your engine block heater used in 2011?

□ Plugged in for a few hours as needed □ Plugged in all the time □ Timer used

50. Now we're going to talk about air travel. Can you tell us about the company plane trips made by yourself and/or staff in 2011, including the place of departure and arrival, and stopover points, if any? This will help us determine the total distance travelled.

Trip	Departure location	Arrival location	Stopovers
#1			
#2			
#3			
#4			
#5			
#6			
#7			
#8			
#9			
#10			
#11			
#12			
#13			
#14			
#15			
#16			
#17			
#18			
#19			
#20			
#21			
#22			
#23			
#24			
#25			
#26			
#27			
#28			
#29			
#30			

51. Do you think this building's energy use in 2011 differed significantly from that of 2010?
Explain:_____
_____
_____
_____
_____

Energy Now and Into the Future
We're almost finished the survey now. There are just three questions left, and they are opinion questions on the state of energy in your community. There are no right or wrong answers here.

52. What kinds of energy success stories are you aware of in your community?

53. Do you have any concerns about energy in your community, now or into the future?
□ Yes □ No
▼
What can you tell us about your concerns? (*Probe: are they financial? Perhaps they're environmental or community-based concerns?)*

54. How do you think these concerns could best be addressed?

55. Would you like to make any other comments on what we've discussed?

Appendix 3 Informed Consent Forms

INFORMED CONSENT FORM – RESIDENTIAL SECTOR

YUKON RESEARCH CENTRE
Yukon College

What is the purpose of this project?

- The Kluane First Nation (KFN) and the Yukon Research Centre (YRC) are conducting an energy use and greenhouse gas emissions inventory in Burwash Landing, Destruction Bay, and Silver City.
- By interviewing residents, and commercial, industrial, and government operators about their energy use, we aim to understand how much energy is used and emissions produced at the community scale to support energy-related decision making and planning in Burwash Landing and Destruction Bay.

What kinds of questions will you be asked?

- During the interview you will be asked questions about the type of home you live in and how it was constructed, what kinds of energy and how much of it you consume in your home and for transportation purposes, and how much it costs you. We'll also ask you a few opinion questions about the state of energy in your community.
- If you do not feel comfortable with certain questions, you have no obligation to answer them. If after the interview is over you decide you do not want your answers used, you have up to two weeks after the time your interview was completed to ask that it be withdrawn from the study and destroyed; you can also decide if you don't want to participate after the interview has begun.
- With your permission, we will record your responses to the questions on our survey form.

Where will your name appear and who will know what you said?
What records are being kept or reports written, and how will they be used?

- All the results from this study will be presented according to residential, commercial, industrial, and government sectors so that energy use and emissions may *not* be associated with specific households, buildings, and/or operations. If participant numbers are low in any one sector, thus posing a risk to anonymity, the participants in that sector will be contacted for guidance on how to present sector data (i.e. by presenting it as is, or by combining it with another sector to protect anonymity).
- However, given others may see us with you or be able to identify your comments in reports and other products from this research, we cannot guarantee anonymity. We will contact you if we wish to use a comment that we think might be sensitive to ask for your permission to use it.

- Following completion of the study, your survey form will be identified with a number. The data from your form will then be entered into a spreadsheet in association with this number - your name and address will not be identified. The original survey form will be destroyed. The spreadsheet will be stored securely with the KFN and the YRC and will not be released for future purposes without permission of the KFN and the YRC.
- Results from the interviews will be compiled into a report on energy use and emissions and other products as identified by the community. Results may also be published in academic journals. Findings will be presented to the community and elsewhere (if we are asked to share our findings) as well as at academic conferences.
- Results from the interviews may be used for a number of community energy planning purposes, such as identifying the required capacities of new energy systems, tracking progress in reducing energy consumption and emissions, setting emissions targets, and identifying other opportunities for action, for example. There is no guarantee, however, that findings from the research will be used in decision making.

Where can you find out more about this project and the people involved?

- Janice Dickson, Community Liaison, Kluane First Nation, 867-841-4274 ext. 227, health.programs@kfn.ca
- Lisa Christensen, Researcher, 867-668-8881, lchristensen@yukoncollege.yk.ca, Yukon Research Centre, Yukon College.

Do you agree to this? _____ **Date** _____
(Signature)

_____
(Printed name)

May we record your responses to the survey questions on our form? □Yes □ No

Would you like us to send you a copy of your completed survey? □ Yes □ No

Would you like us to send you a copy of the final report? □ Yes □ No

Mailing Address: _____

This study was explained by:_____

INFORMED CONSENT FORM – COMMERCIAL/GOV. SECTOR

What is the purpose of this project?

- The Kluane First Nation (KFN) and the Yukon Research Centre (YRC) are conducting an energy use and greenhouse gas emissions inventory in Burwash Landing, Destruction Bay, and Silver City.
- By interviewing residents, and commercial, industrial, and government operators about their energy use, we aim to understand how much energy is used and emissions produced at the community scale to support energy-related decision making and planning in Burwash Landing and Destruction Bay.

What kinds of questions will you be asked?

- During the interview you will be asked questions about the building, how it was constructed, what kinds of energy and how much of it was consumed to heat the building and for transportation purposes associated with the business, as well as how much it cost you. We'll also ask you a few opinion questions about the state of energy in your community.
- If you do not feel comfortable with certain questions, you have no obligation to answer them. If after the interview is over you decide you do not want your answers used, you have up to two weeks after the time your interview was completed to ask that it be withdrawn from the study and destroyed; you can also decide if you don't want to participate after the interview has begun.
- With your permission, we will record your responses to the questions on our survey form.

Where will your name appear and who will know what you said?
What records are being kept or reports written, and how will they be used?

- All the results from this study will be presented according to residential, commercial, industrial, and government sectors so that energy use and emissions may *not* be associated with specific households, buildings, and/or operations. If participant numbers are low in any one sector, thus posing a risk to anonymity, the participants in that sector will be contacted for guidance on how to present sector data (i.e. by presenting it as is, or by combining it with another sector to protect anonymity).
- However, given others may see us with you or be able to identify your comments in reports and other products from this research, we cannot guarantee anonymity. We will contact you if we wish to use a comment that we think might be sensitive to ask for your permission to use it.

- Following completion of the study, your survey form will be identified with a number. The data from your form will then be entered into a spreadsheet in association with this number - your name and address will not be identified. The original survey form will be destroyed. The spreadsheet will be stored securely with the KFN and the YRC and will not be released for future purposes without permission of the KFN and the YRC.
- Results from the interviews will be compiled into a report on energy use and emissions and other products as identified by the community. Results may also be published in academic journals. Findings will be presented to the community and elsewhere (if we are asked to share our findings) as well as at academic conferences.
- Results from the interviews may be used for a number of community energy planning purposes, such as identifying the required capacities of new energy systems, tracking progress in reducing energy consumption and emissions, setting emissions targets, and identifying other opportunities for action, for example. There is no guarantee, however, that findings from the research will be used in decision making.

Where can you find out more about this project and the people involved?

- Janice Dickson, Community Liaison, Kluane First Nation, 867-841-4274 ext. 227, health.programs@kfn.ca
- Lisa Christensen, Researcher, 867-668-8881, lchristensen@yukoncollege.yk.ca, Yukon Research Centre, Yukon College.

Do you agree to this? _____ Date _____
(Signature)

_____
(Printed name)

May we record your responses to the survey questions on our form? □
Yes □ No

Would you like us to send you a copy of your completed survey? □
Yes □ No

Would you like us to send you a copy of the final report? □ Yes □ No

Mailing Address: _____

This study was explained by:_____

Appendix 4 Energy Consumption in the Communities

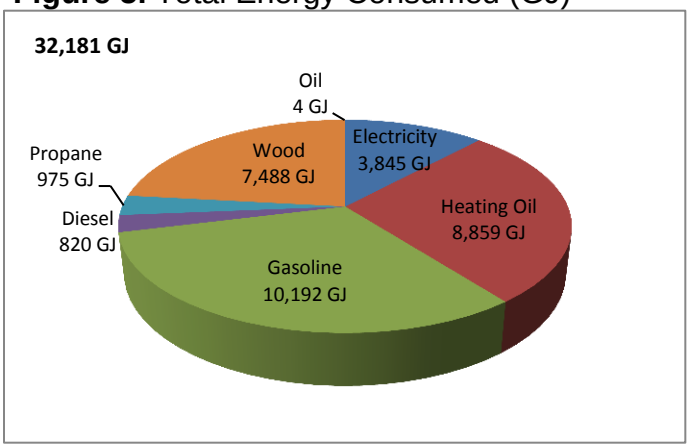
In this appendix results on energy consumption and the associated costs are discussed, beginning with Burwash Landing/Destruction Bay. Overall totals are shared first, followed by totals in stationary and transport energy – these totals are then broken down according to the residential, commercial, and government sectors. The numbers presented here are best estimates, because of the projections made in the residential sector in Burwash Landing and Destruction Bay, and because some participants had to recall to the best of their ability, energy consumption and the associated dollars spent in 2011. Energy, across all types is presented in gigajoules to enable comparisons. Table 11 shows gigajoules converted to barrels of oil equivalent (a unit of energy that represents the energy released by burning one barrel of crude oil), which provides some context for these comparisons.

Table 11. Gigajoules to Barrels of Oil equivalent

Gigajoules	Barrels of Oil Equivalent
1	0.2
5	0.8
10	1.6
50	8.2
100	16.3
500	81.7
1,000	163.5
2,000	326.9
3,000	490.4
4,000	653.8
5,000	817.3
10,000	1634.6
20,000	3269.1
30,000	4903.7
40,000	6824.2

Burwash Landing and Destruction Bay

Figure 5. Total Energy Consumed (GJ)



**Note: Fuel totals were rounded to two decimal points and used to calculate the overall energy total.*

Figure 5 includes electricity used by KFN and YG buildings—including for lagoon heat tape and septic purposes—homes and buildings in the residential and commercial sectors, and streetlights; heating oil used by all sectors for heating homes and buildings; oil used by residents for running chainsaws and maintaining vehicles; propane used by KFN, and the residential and commercial sectors for cooking, heating, and transportation purposes; gasoline and diesel used by all sectors for running generators and chainsaws and for transportation purposes; and wood used by KFN, and the residential and commercial sectors for heating homes and buildings. As the pie chart shows quite clearly, Burwash Landing and Destruction Bay rely most on gasoline, followed by heating oil and wood.

Figures 6 and 8, which show stationary and transportation energy consumption, provide insight into *how* energy was used in 2011; the associated costs are shown in figures 7 and 9.

Figure 6. Total Stationary Energy Consumed (GJ)

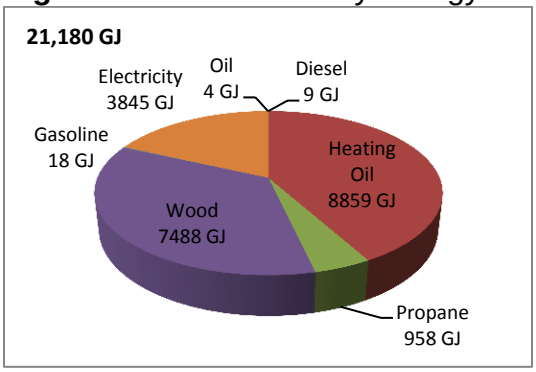
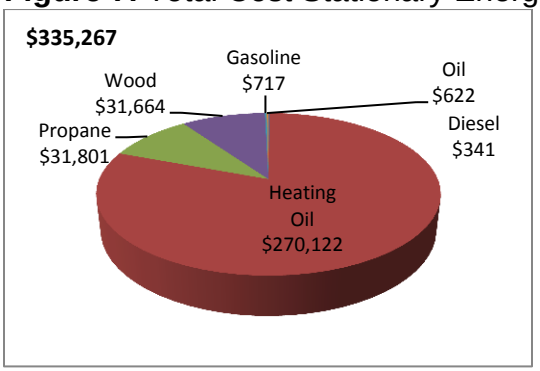


Figure 7. Total Cost Stationary Energy ($)



**Note: electricity is absent from all stationary energy costing figures, because different rates apply to the commercial/government and residential sectors depending on electricity consumption in each billing cycle. As total kilowatt hours were the only data available for 2011, costing data could not be provided.*

Figure 8. Total Transportation Energy Consumed (GJ)

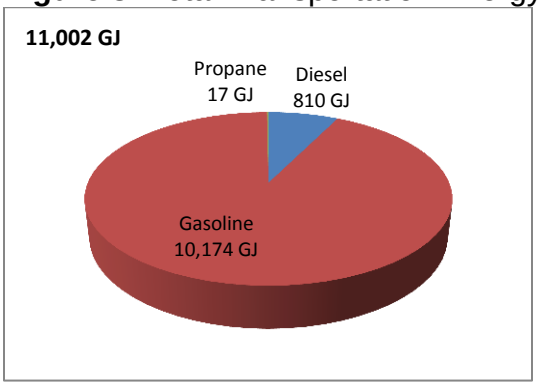
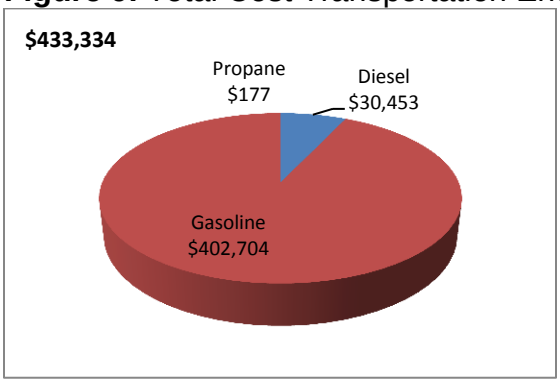


Figure 9. Total Cost Transportation Energy ($)



At first glance, these figures show that twice as much energy was consumed in the stationary energy sector as in the transportation sector in Burwash Landing and Destruction Bay in 2011. And most strikingly, heating oil accounted for the greatest cost in the stationary energy sector—in the absence of electricity costing data, that is—at $270,122. Wood, on the other hand, despite being a key stationary energy fuel source, accounts for a fairly small piece of the costing pie,

because many individuals harvest their own wood. In the transportation sector, gasoline is, by far, the most utilized fuel: $402,704 was spent on gas in 2011.

Next, energy consumption in the stationary and transportation sectors is shown according to user: YG and KFN Governments, commercial operators, and residents

KFN Sector

Figure 10. Total Stationary Energy Consumed (GJ)

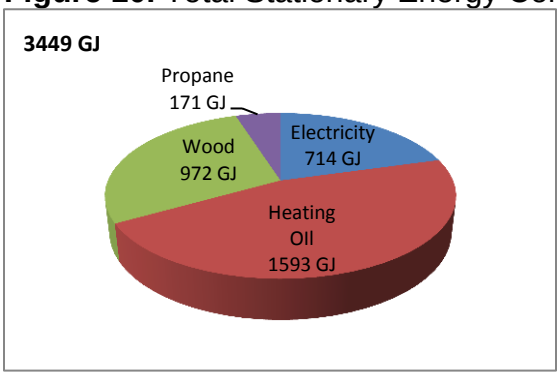


Figure 11. Total Cost Stationary Energy ($)

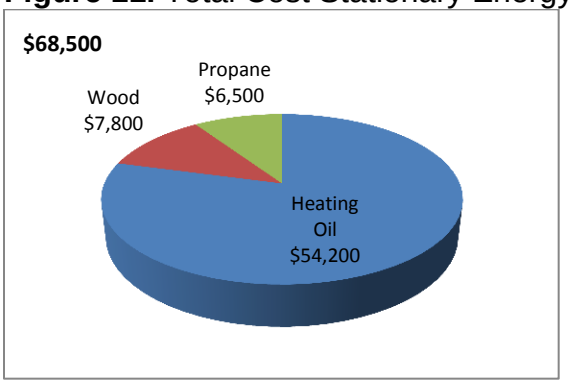


Figure 12. Total Transportation Energy Consumed (GJ)

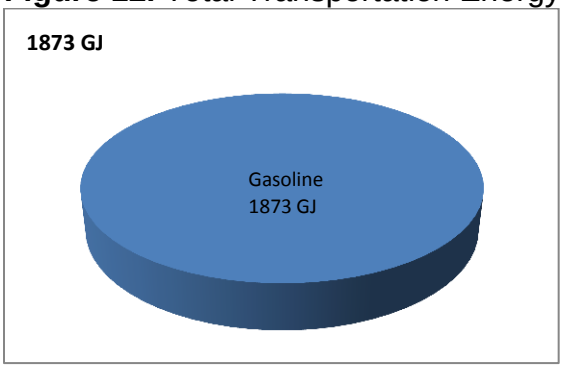
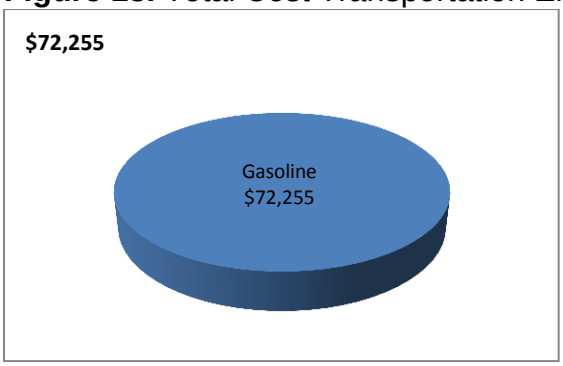


Figure 13. Total Cost Transportation Energy ($)



KFN data are discussed in relation to YG data in the next section.

YG Sector

Figure 14. Total Stationary Energy Consumed (GJ)

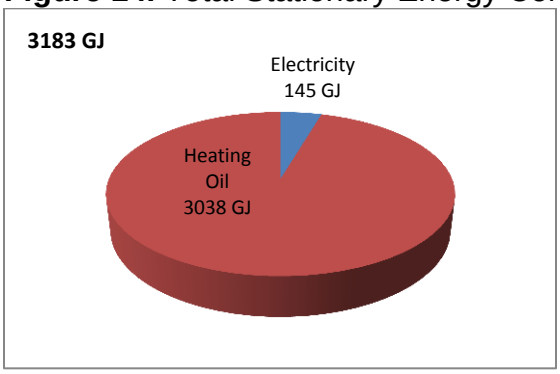


Figure 15. Total Cost Stationary Energy ($)

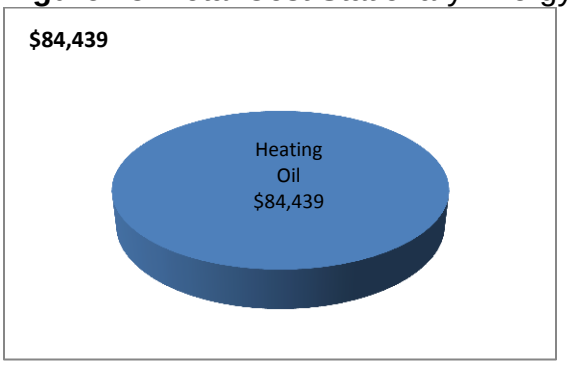


Figure 16. Total Transportation Energy Consumed (GJ)

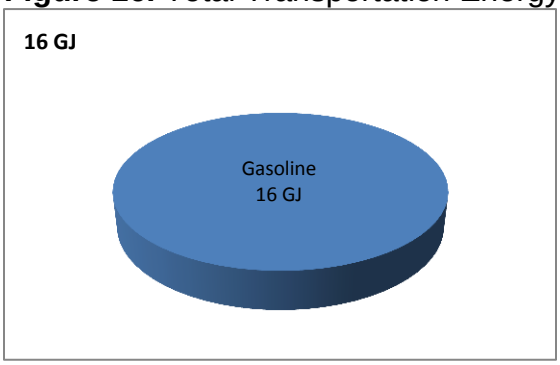
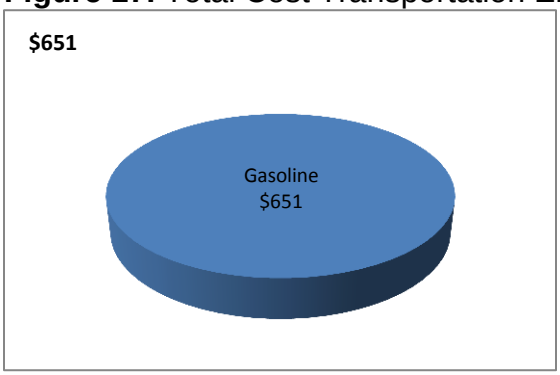


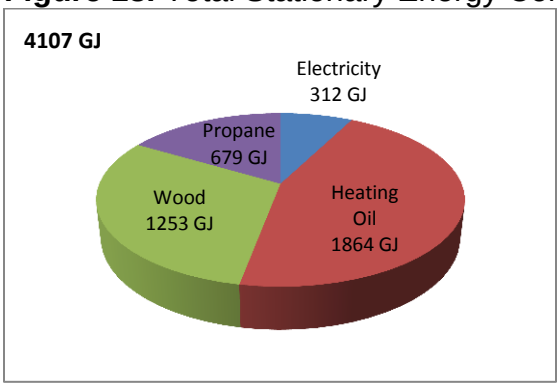
Figure 17. Total Cost Transportation Energy



Between YG and KFN Governments, KFN relies on a combination of heating fuel, wood, electricity, and propane for stationary energy purposes, whereas YG relies almost completely on heating fuel. The data also show that KFN buildings used much more electricity than YG ones in 2011[9]. Moreover, KFN seems to have a much more active vehicle fleet than YG, which again, is likely associated with their large number of staff.

Commercial Sector

Figure 18. Total Stationary Energy Consumed (GJ)



[9] At the data sharing/verification workshop, some participants explained that this may be because KFN has numerous employees that require computers—which draw a significant amount of electricity—whereas YG does not.

Figure 19. Total Cost Stationary Energy ($)

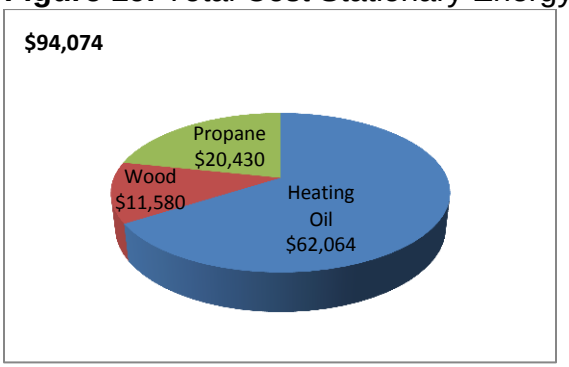


Figure 20. Total Transportation Energy Consumed (GJ)

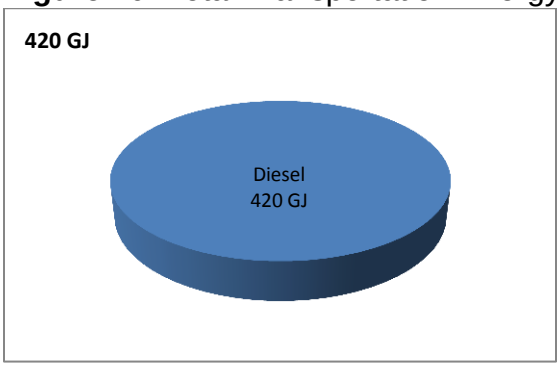
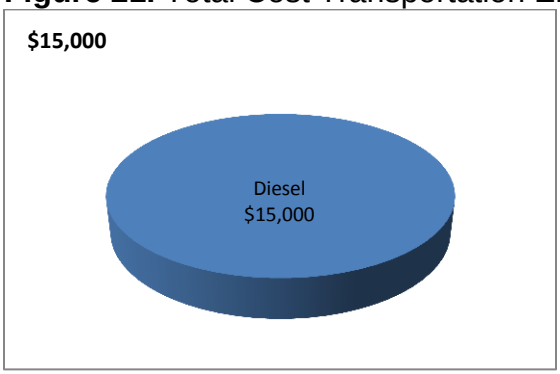


Figure 21. Total Cost Transportation Energy ($)



In the commercial sector, a variety of fuels were utilized for stationary energy purposes in 2011. Diesel was used exclusively as transportation fuel.

Residential

In the residential sector in Burwash Landing and Destruction Bay, the data show wood as the most relied upon stationary energy fuel—this was not seen in any of the other sectors. Because most residents harvest wood for themselves and family members and friends, heating oil comes out ahead in the costing data (again, this is in the absence of any costing data associated with electricity). Gasoline comprises the bulk of transportation fuel.

Figure 22. Total Stationary Energy Consumed (GJ)

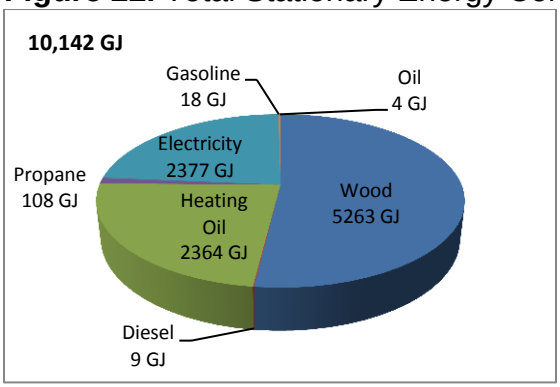


Figure 23. Total Cost Stationary Energy ($)

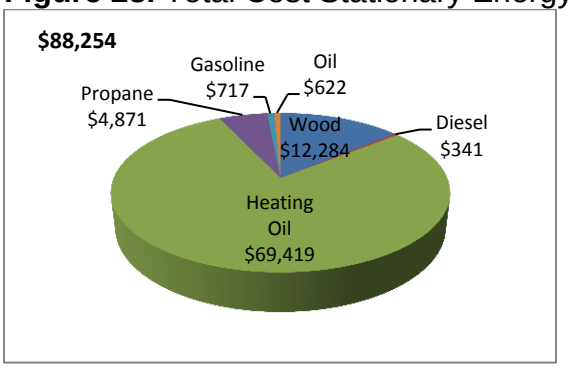


Figure 24. Total Transportation Energy Consumed (GJ)

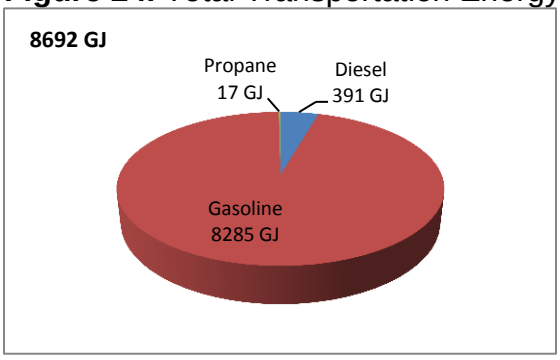
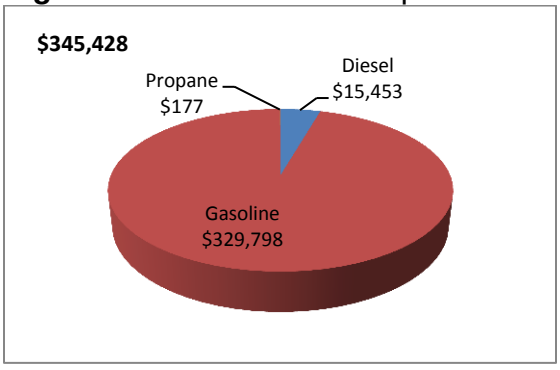


Figure 25. Total Cost Transportation Energy ($)



Silver City

Figure 26. Total Energy Consumed (GJ)

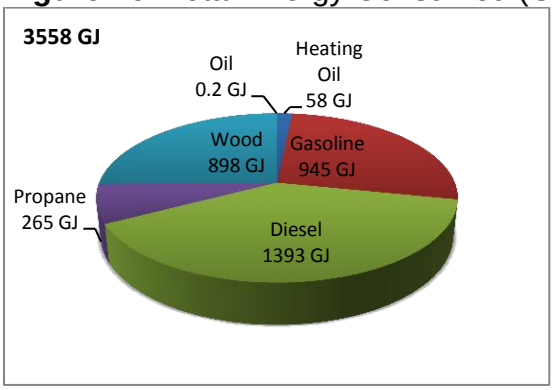


Figure 26 includes oil used by residents for running chainsaws and maintaining vehicles; heating oil used by the commercial sector for heating buildings; propane used by residents and the commercial sector for cooking, heating buildings, and heating water; gasoline and diesel used by residents and commercial operators for running generators and chainsaws and for transportation purposes; and wood used by residents and the commercial sector for heating homes and buildings. Diesel is drawn upon the most, followed by gasoline and wood.

As was the case with Destruction Bay/Burwash Landing, approximately twice as much energy was consumed in the stationary energy sector as in the transportation sector. Diesel generators were used by residents and commercial operators to generate electricity, which accounted for over half of the stationary energy consumption pie and almost three quarters of the costing pie. And wood, the second most important energy type used for heating buildings, was associated with very minimal cost, because many residents and commercial operators harvest their own. Very little heating oil is used by residents and commercial operators in Silver City. Propane, used for cooking, and heating buildings and hot water tanks came in as the third most important stationary energy type. Like Destruction Bay/Burwash Landing, people rely on gasoline in the transportation sector most strongly - $43,496 was spent on gasoline in 2011.

Figure 27. Total Stationary Energy Consumed (GJ)

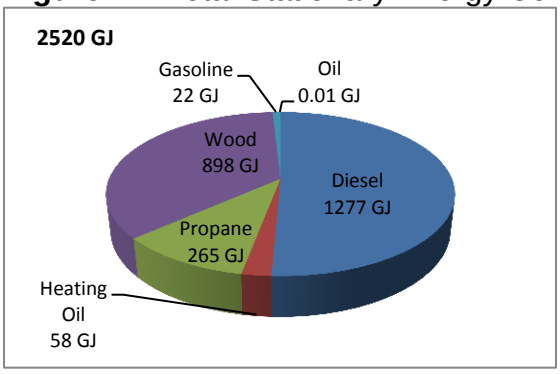


Figure 28. Total Cost Stationary Energy ($)

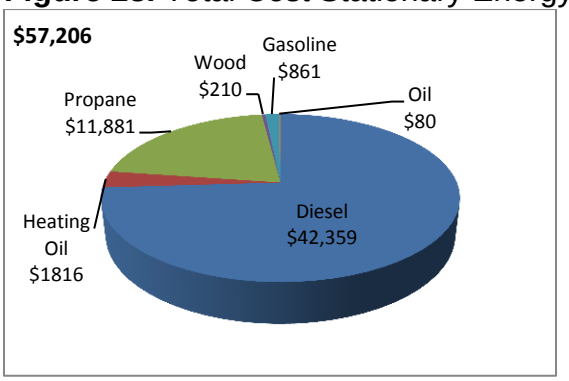


Figure 29. Total Transportation Energy Consumed (GJ)

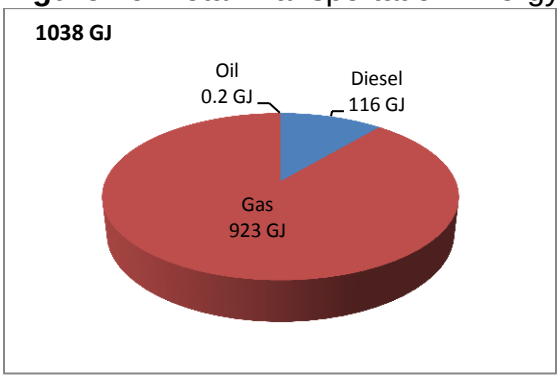
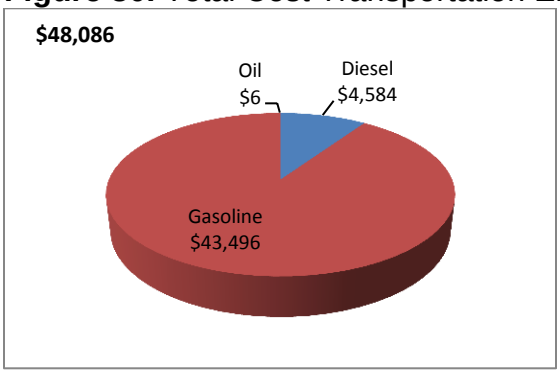


Figure 30. Total Cost Transportation Energy ($)



Commercial

Trends evident in the overall stationary and transportation sectors are similar to those seen with commercial operators – the exception being that heating oil is used more so than wood for heating purposes.

Figure 31. Total Stationary Energy Consumed (GJ)

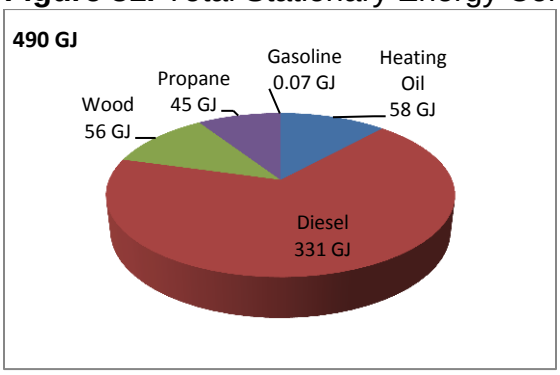


Figure 32. Total Cost Stationary Energy ($)

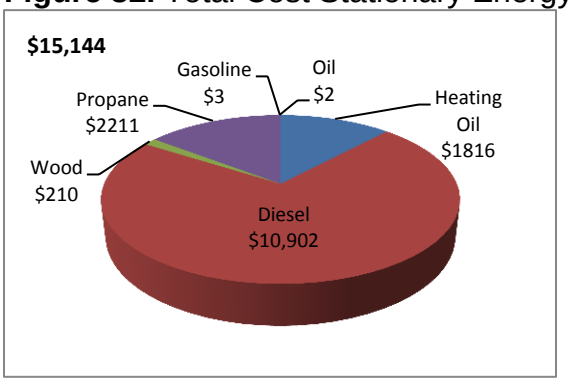


Figure 33. Total Transportation Energy Consumed (GJ)

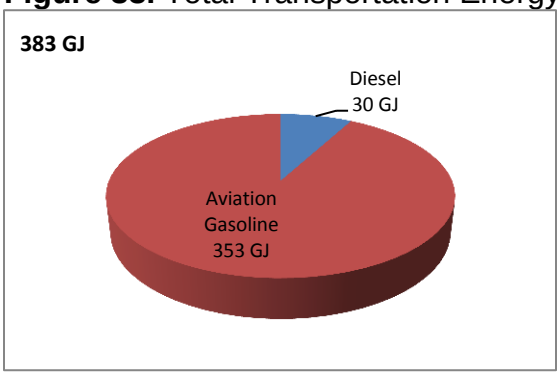
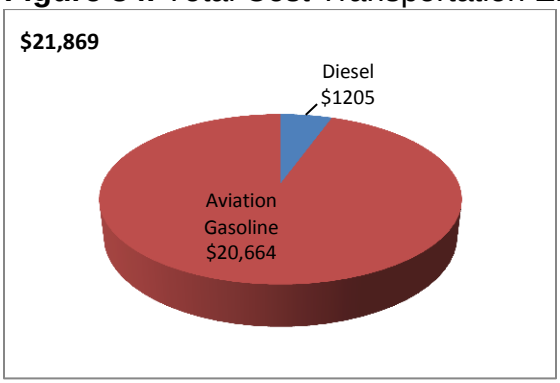


Figure 34. Total Cost Transportation Energy ($)



Residential

Again, the patterns of energy consumption in the stationary and transportation energy sectors for Silver City overall are the same as those for residents (except that residents do not use heating oil for stationary energy purposes).

Figure 35. Total Stationary Energy Consumed (GJ)

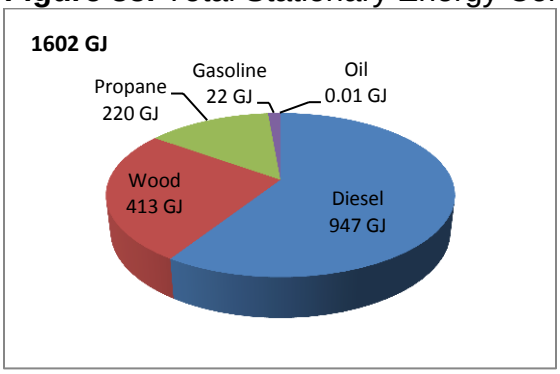


Figure 36. Total Cost Stationary Energy

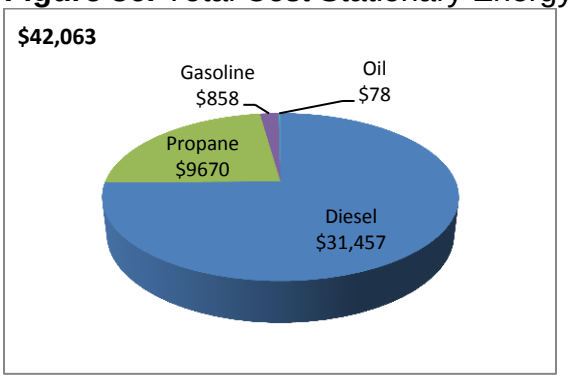


Figure 37. Total Transportation Energy Consumed (GJ)

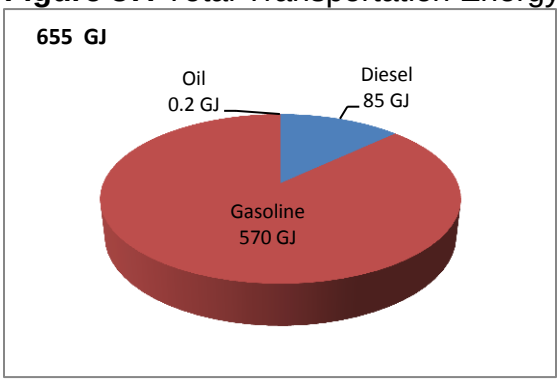
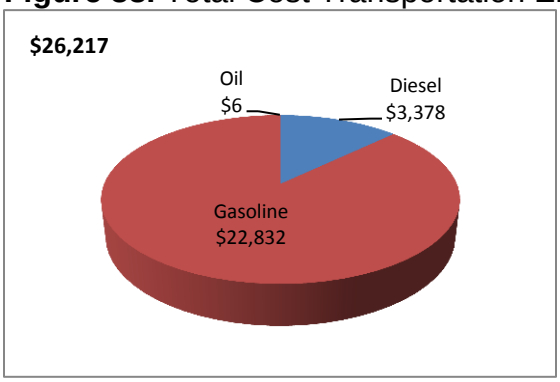


Figure 38. Total Cost Transportation Energy ($)



Appendix 5 Greenhouse Gas Emissions

Greenhouse gas emissions associated with energy consumption in Burwash Landing/Destruction Bay and Silver City are shown in tables 12-15. Emissions associated with air travel and fuels are based on results from the inventory; emissions associated with waste were calculated by Yukon Government's Climate Change Secretariat, using Yukon Bureau of Statistics population statistics, waste generated per person estimates from the Intergovernmental Panel on Climate Change, and waste composition data from the City of Whitehorse.

Emission factors for heating oil, gasoline, diesel, propane, and oil were taken from Environment Canada's National Inventory Report (2009). Emissions factors for air travel were sourced from the International Civil Aviation Organization (http://www2.icao.int/en/carbonoffset/Pages/default.aspx), because emissions are calculated based on actual flight distances rather than short, medium, and long haul flights, which is the case with many other methodologies (such as that used by the Greenhouse Gas Protocol). The emissions factor for spruce wood came from NRCAN's, "A Guide to Residential Wood Heating" (2002). And waste calculations were completed by Yukon Government's Climate Change Secretariat.

Burwash Landing/Destruction Bay

Table 12. Energy and eC0$_2$ Emissions by Source

Energy Source	**Total eC0$_2$ (t)**
Heating Oil	634.2
Gasoline (stationary)	1.2
Gasoline (mobile)	709.3
Diesel (stationary)	1461.1
Diesel (mobile)	59.7
Spruce Wood	156.4
Propane (stationary)	58.3
Propane (mobile)	1
Oil	0.3
Air Travel	64169.1
Waste	2.6
TOTAL	**67,253.3**

Table 13. Energy and eC0$_2$ Emissions by Sector

Sector	**Total eC0$_2$ (t)**
KFN	144.7
Yukon Government	217.5
Residential	287.9
Commercial	200.9
Transportation	64939.1
Community Waste	2.6
Community Diesel for electricity generation	1460.4
TOTAL	**67,253.3**

Silver City

Table 14. Energy and eC0$_2$ Emissions by Source

Energy Source	**Total eC0$_2$ (t)**
Heating Oil	4.1
Gasoline (stationary)	1.5
Gasoline (mobile)	39.7
Gasoline (mobile, aviation)*	N/A
Diesel (stationary)	97.9
Diesel (mobile)	8.5
Spruce Wood	18.7
Propane (stationary)	16.1
Oil	0.04
Air Travel	3680.4
TOTAL	**3,867.2**

***Type of aviation fuel unknown

Table 15. Energy and eC0$_2$ Emissions by Sector

Sector	**Total eC0$_2$ (t)**
Residential	105
Commercial	33.4
Transportation	3728.7
Community Waste	N/A
TOTAL	**3,867.2**

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