Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

House 5 – Aboriginal Cultural House

Attention:

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Prepared by:

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- ASHRAE Level 1 Study -

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1.1 Overview and Facility Use

The Aboriginal Cultural Centre is also known as the Gathering House. The facility, located on Thompson Rivers University Campus in Kamloops, British Columbia, was originally constructed in 1945. A single storey addition to the building was made in 2009, which serves as a computer room and gathering space. The gross conditioned square footage of the building is approximately 258 m^2 (2,777 ft^2). The original building has two levels and a basement. The main and upper levels house offices, and a small kitchen on the ground floor. The basement is a computer room and a common area.

1.1.1 Physical condition and window type

The original building appears to be well maintained. The windows are double paned. The building insulation contains asbestos so there are no plans to upgrade the insulation in this building. The building will likely be torn down in the near future. Because of this, no insulation upgrades for considered for this facility.

1.2 Mechanical Systems

1.2.1 Ventilation

The following major ventilation systems exist in the building:

- A gas fired furnace, F-1, provides ventilation to the addition via grilles and diffusers.
- One exhaust fan serves the bathrooms in both the existing and addition buildings.
- Another gas fired furnace provides ventilation to the original house.

1.2.2 Cooling

A reversible heat pump provides heating and cooling to the addition through a coil in furnace F-1.

A cooling only condensing unit provides cooling to the original house via a DX coil in the furnace for that building.

1.2.3 Heating

The following major heating systems exist in the addition:

- A heat recovery ventilator (HRV-1) preheats outdoor air for the addition furnace, F-1.
- A reversible heat pump, located outside, provides the first stage of heating for furnace F-1.
- A gas fired furnace (F-1) provides supplemental heating.

A gas fired furnace provides heating to the original house.

1.2.4 Domestic Hot Water

A single gas fired domestic hot water tank provides heating for both spaces and is located in the basement of the original house.

1.3 Lighting System

Linear LEDs provides most of the lighting for the facility. CFLs provide lighting to the rest of the house. TRU is in the process of replacing all lighting on campus with LEDs.

1.4 Control Equipment

One programmable thermostat controls heating and cooling in the original house. Another programmable thermostat controls the addition.

1.5 Energy Analysis

1.5.1 Energy Use Profile

The electricity data provided for this facility seems unreasonably low based on the equipment in the building. As such, the electricity consumption for this building was simulated based on the building's equipment inventory and estimated operational hours. This is presented in Figure 1. Electricity usage is assumed higher in the summer during cooling season.

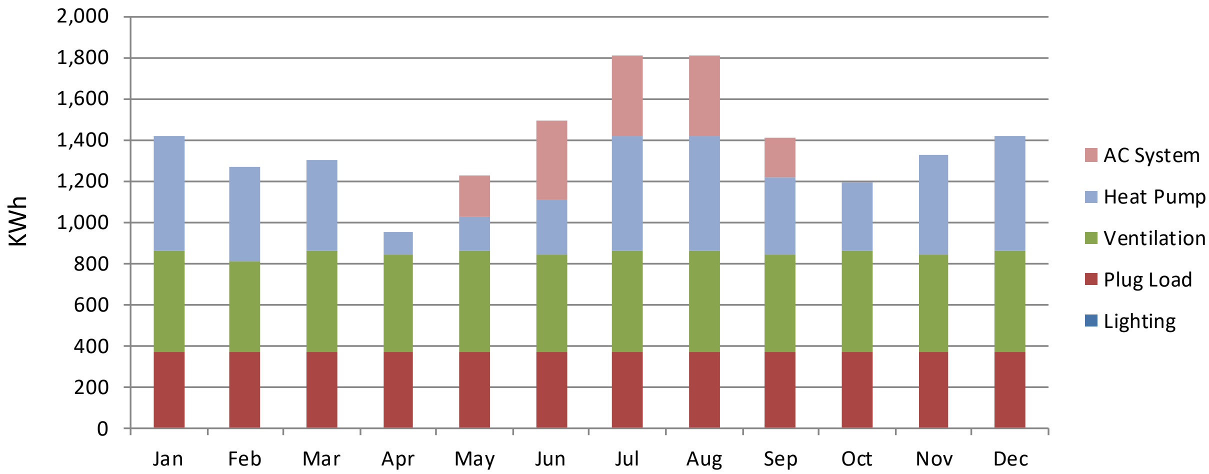

Figure 1: Monthly Electricity Consumption

No gas consumption data was available for this building. Figure 2 presents the building's simulated gas consumption based on estimated equipment usage profiles. Gas usage is higher during heating season.

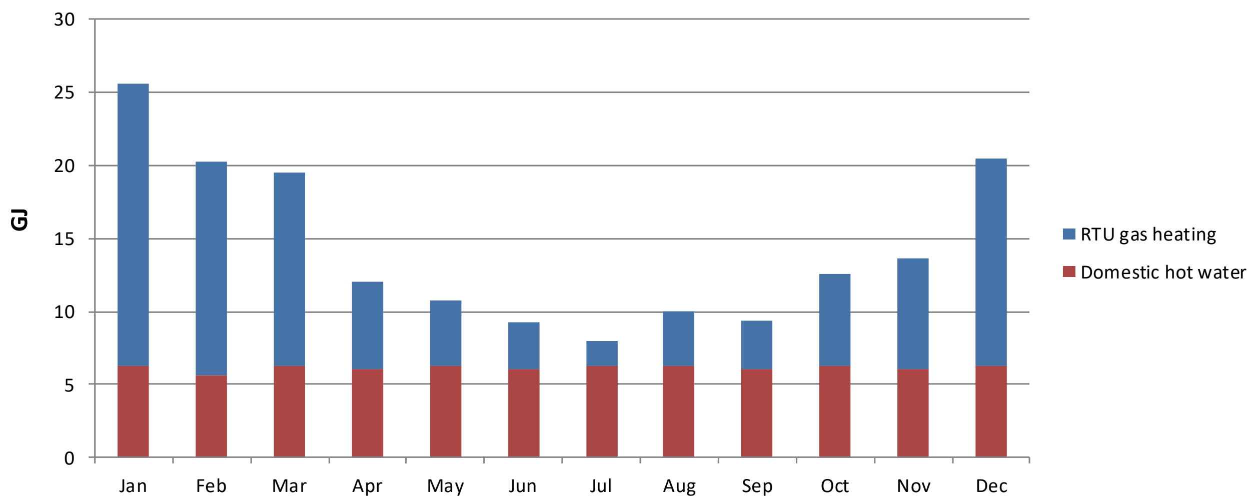

Figure 2: Simulated Monthly Gas Consumption

1.5.2 Energy Intensity Analysis

A summary of Baseline Energy consumption and the corresponding costs and energy intensity for the facility is presented in Table 1. House 5 has an energy use intensity (EUI) of 1,100 MJ/m^2.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	190	700	$2,206	$0.79
Electricity	100	400	$1,759	$0.63
Total	**290**	**1,100**	**$3,965**	**$1.43**

1.5.3 Energy End Use Breakdown

The estimated breakdown of electricity consumption by building system is presented in Figure 3.

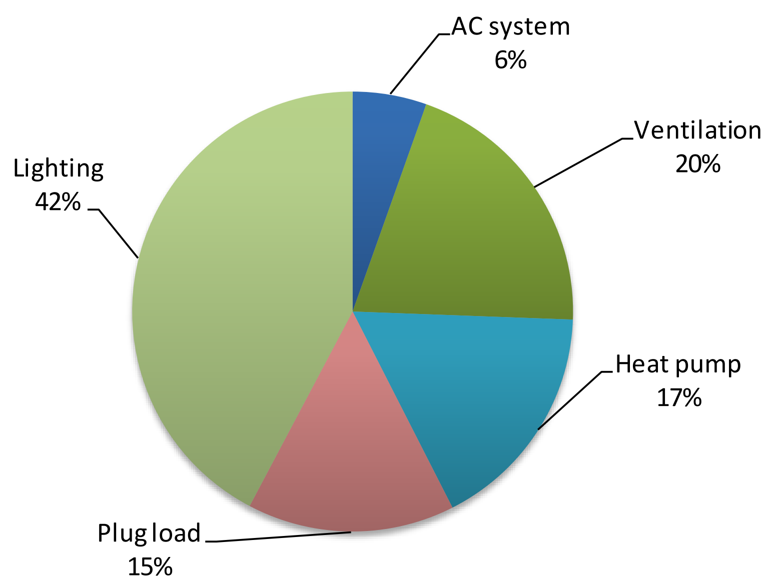

Figure 3: Electricity Consumption

The estimated breakdown of gas consumption by building system is presented in Figure 4.

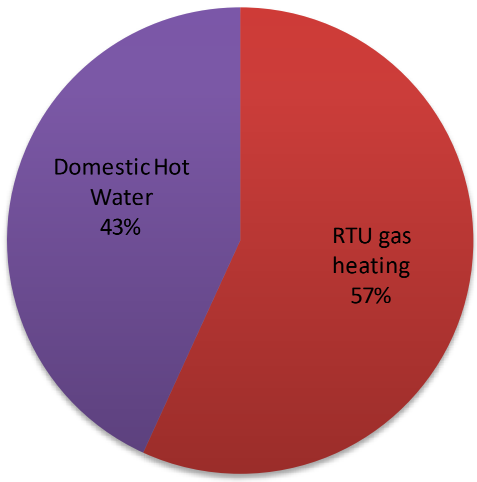

Figure 4: Gas Consumption

The estimated percentage of total energy consumption by building system is presented in Figure 5.

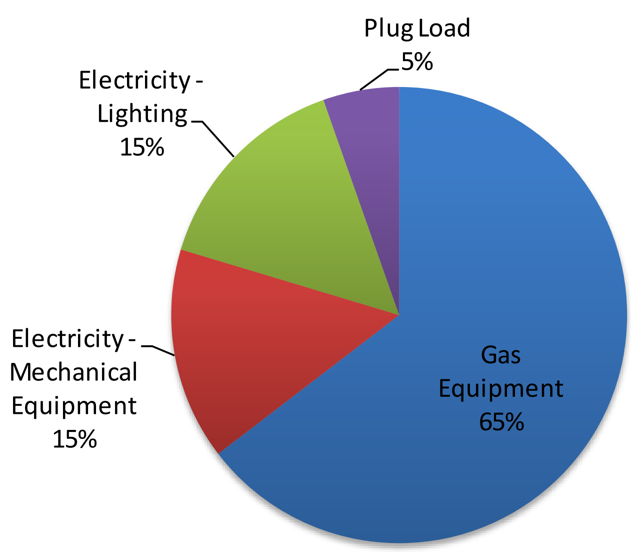

Figure 5: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at House 5. The rate schedules used in this analysis for financial savings estimates are presented in Table 2. The financial savings estimates include goods and services tax (GST) and provincial sales tax (PST). For Greenhouse Gas estimates, we have used emissions factors of 0.010 kg CO_2e / kWh of electricity in BC, and 49.87 kg CO_2e / GJ for gas.

It should be noted that the paybacks for the measures consider the carbon tax escalation provided by the federal government.

Table 2: Rate Schedules

Utility	Rate
Electricity	
Marginal Demand Charge	$12.26 / kW (inc taxes)
Marginal Consumption	$0.063 / kWh (inc taxes)
Gas	
Recent Gas Consumption	$15.00 / GJ (inc taxes)

A number of potential conservation opportunities have been analyzed. A detailed explanation as well as an estimated cost and energy saving potential are summarized for these projects.

If all of the recommended measures are implemented, we estimate the following savings outcomes:

Table 3: Estimated Savings

Energy footprint	Electricity	Natural Gas	Greenhouse gases	EUI (kWh/ft^2)	Cost per ft^2
21%	-18%	42%	41%	6	$ 0.25

2.1 Energy Conservation Measures

A summary of the analysis for the recommended measures is presented in Table 4. Detailed descriptions for each project are presented below. The measure analysis does not include incentives provided by BC Hydro or Fortis BC. Based on conversations with operators, this building is likely to be torn down in the near future so it may not make sense to implement any energy conservation measures on this building.

Table 4: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							$	GJ	kWh	GHG
1.1	Original Furnace Heat Pump	$5,000	$6,500	$11,500	7.0	1,400	$960	60	(5,300)	2.9
1.2	Instantaneous DHW	$3,000	$2,300	$5,300	6.0	1,600	$320	20		1.0
1.3	Renewable Natural Gas				≥ 40		($580)			2.6

2.1.1 Original Furnace Heat Pump

Heating and cooling for the original building is provided by a gas furnace that has a direct expansion (DX) cooling coil and external condensing unit. Given the minimal gas usage in the building, it is unlikely it will be connected to the central plant. As such, we recommend replacing the existing condensing unit with a heat pump. This will allow for efficient heating and cooling of the building. The gas heating can still be used as a backup in the colder winter months. Please note the analysis of this measure using incremental costing as it assumes the heat pump is not installed until the condensing unit is due to be replaced. It does not include the incentives available for heat pumps which will further reduce the payback. It should be noted that the gas furnace itself has also reached the end of its recommended service life, however, given the plans for the building and the minimal gas savings achieved from upgrading the furnace itself, we do not recommend upgrading the furnace unless necessary. If it is upgraded, we recommend installing a high efficiency condensing unit.

A single programmable thermostat controls the supply air temperature for the furnace in the original house, while the building served is divided into at least 2 distinct zones. Often there is a temperature differential between the first and second floor. We recommend installing a second thermostat on the second floor and setting the supply air temperature based on average temperature conditions. This would more appropriately maintain comfortable space temperatures and avoid heating/cooling conflicts. While this is not an energy savings measure, it will result in improved occupant comfort.

2.1.2 Instantaneous DHW

The existing domestic hot water (DHW) tank is standard efficiency natural gas and was replaced in 2009. As it is nearing its recommended service life, we recommend replacing it with an instantaneous high efficiency model. Given the low building DHW usage, this building is a good candidate for an instantaneous DHW heater.

2.1.1 Renewable Natural Gas

FortisBC offers Renewable Natural Gas (RNG), or biomethane, as an alternative to non-renewable natural gas. This presents an easy path to reducing GHG emissions. The cost of RNG is approximately 1.5 times the cost of non-renewable natural gas, however, there is no additional cost for implementing this measure, given that RNG is delivered using existing FortisBC infrastructure. The analysis of this measure assumes the remaining natural gas in the building is converted to RNG however, there are options for converting any portion (5%, 10%, 25%, 50%, 100%) of the total gas consumption to RNG. The cost per tonne would be the same regardless of the portion converted. Given the plans for the building, this measure may be the best option to offset emissions at the facility in the short term.

3. Disclaimer

This document was prepared by SES Consulting Inc. for Thompson Rivers University. The scope was to perform a Level 1 Energy Study at this site. An initial investigation has been performed to estimate the probable costs and savings associated with each project. Further detailed design work will be required for project implementation. Any estimates of probable cost are made on the basis of SES's judgment and experience. SES makes no warranty, express or implied, that cost of the work will not vary from the SES's estimate of probable cost. SES accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.