Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

House 9 - Welcome Centre

Attention:

Natalie Yao

Energy Specialist

Thompson Rivers University

Prepared by:

SES Consulting Inc.

Suite 410 – 55 Water Street
Vancouver, BC V6B 1A1
Tel: 604.568.1800
www.sesconsulting.com

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- ASHRAE Level 1 Study -

Table of Contents

List of Figures

List of Tables

1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

House 9, housing the Welcome Centre, was constructed in 1945. It has 2 floors and a gross floor area of 273 m^2 (2,937 ft^2). It contains an open seating area, meeting room, computer room, offices, and a small kitchen.

1.1.1 Physical condition and window type

The original building appears to be well maintained. The windows are double paned. Based on conversations with operators, the insulation in the houses contains asbestos and these buildings are likely to be torn down in the near future. As such, no insulation upgrades were considered for this facility.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation is supplied by two furnaces, located in the basement. The building space is split into four control zones, with vents located in the 1st and 2nd floor. Each furnace supplies an upper and a lower zone for half of the building.

1.2.2 Cooling

Cooling is provided by two direct expansion (DX) cooling coils, located in the building's furnaces, with two external condensing units.

1.2.3 Heating

The natural gas furnaces provide heating to the building's occupied spaces on the 1st and 2nd floor, each serving one side of the building.

1.2.4 Domestic Hot Water

Domestic hot water (DHW) is provided by a single natural gas tank-type heater, located in the basement. This unit was installed in 2015.

1.3 Lighting System

The majority of the 1st floor, approximately 50% of the occupied space, including the computer room, seating area, kitchen, and bathrooms, are illuminated by halogen bulbs. The 2nd floor, approximately 50% of the building space, is illuminated by TLEDs. TRU is currently in the process of replacing all lighting on campus with LED.

1.4 Control Equipment

The gas furnaces and DX cooling coils are controlled by four programmable Trane thermostats. Each thermostat controls one of four zones; two on the 1st floor, and two on the 2nd floor.

1.5 Energy Analysis

1.5.1 Energy Use Profile

Energy metering is not available for this facility. Figure 1 presents the building's simulated electrical consumption based on estimated equipment use. Electricity usage is higher in the summer, during cooling season.

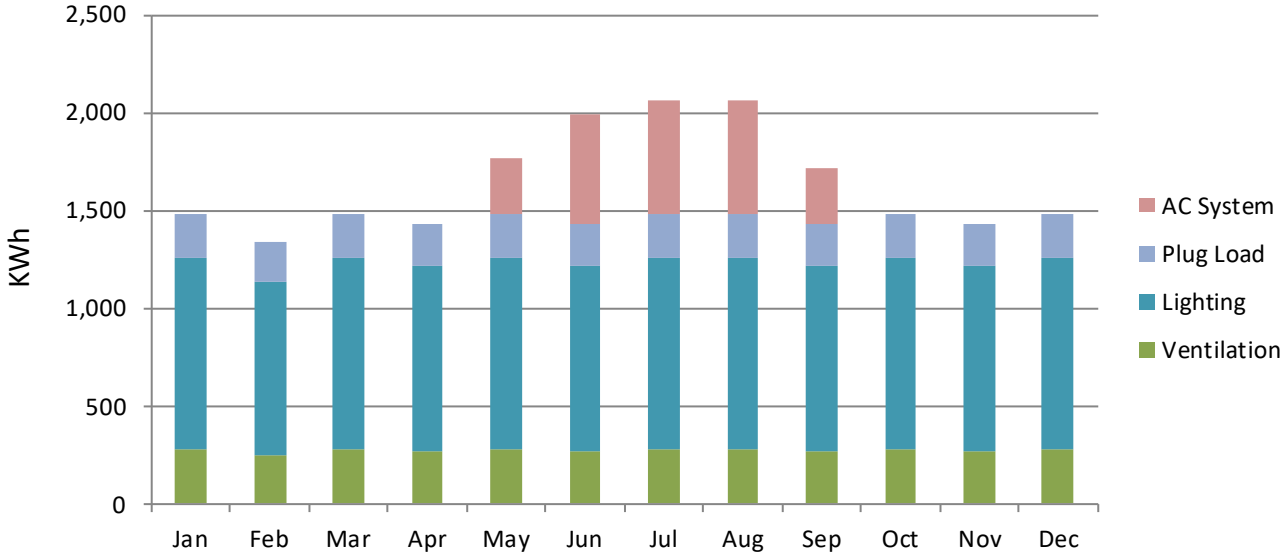

Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's simulated gas consumption. Energy consumption follows a typical heating profile.

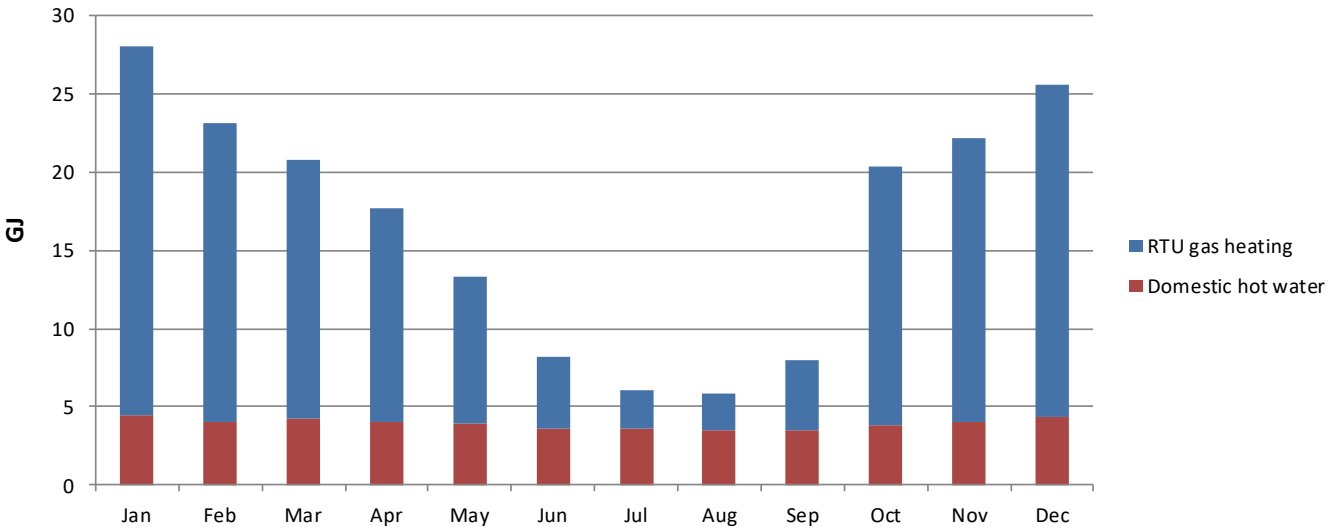

Figure 2: Monthly Gas Consumption

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 9 – Welcome Centre has a baseline Energy Use Intensity (EUI) of 980 MJ/m^2.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	199	730	$2,987	$1.02
Electricity	69	250	$1,208	$0.41
Total	**268**	**980**	**$4,195**	**$1.43**

1.5.3 Energy End Use Breakdown

The energy use is based on estimated operation patterns. The estimated breakdown of electricity consumption by building system is presented in Figure 3. Gas is only used for space heating.

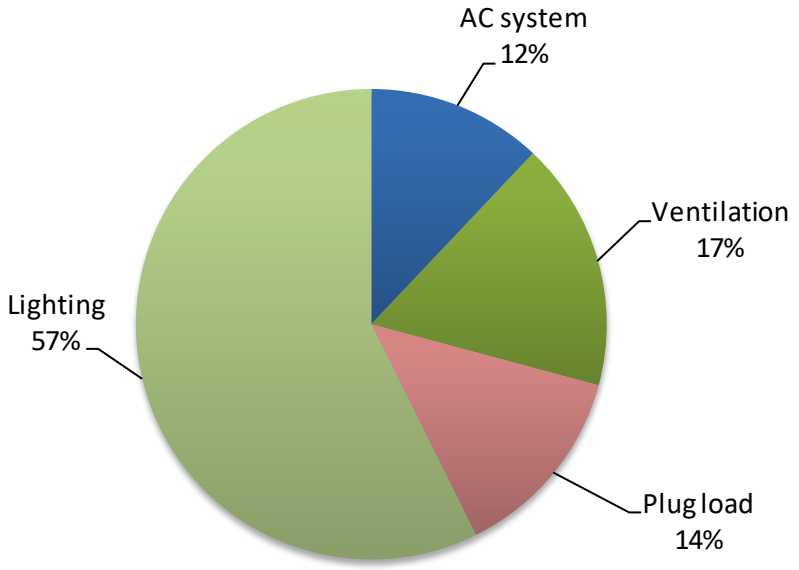

Figure 3: Electricity Consumption

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

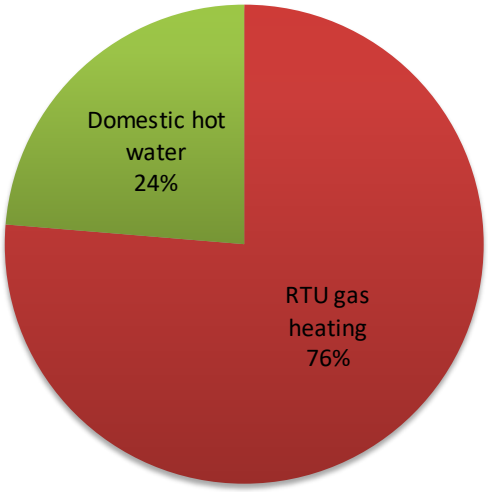

Figure 4: Gas Consumption

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

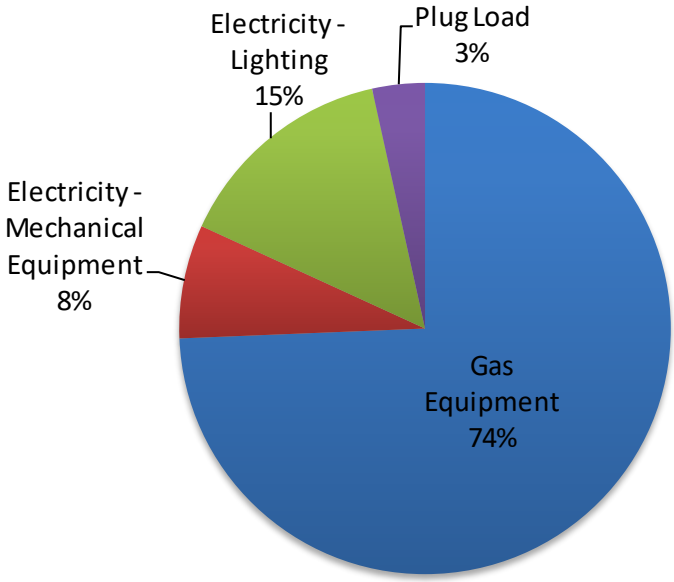

Figure 5: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at House 9 - Welcome Centre. 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	Cost per ft^2
74%	-120%	141%	136%	0.65

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 analysis for these measures does not include any incentives from 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	Heat Pump for Furnaces	$5,000	$6,500	$11,500	3.0	12,600	$1,300	140	(11,400)	6.9
1.2	Renewable Natural Gas				≥ 40		($680)			3.1

2.1.1 Heat Pump for Furnaces

Ventilation is supplied by a two gas furnaces that have direct expansion (DX) cooling coils and external condensing units. 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 units with heat pumps. 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 uses 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.

2.1.2 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 this building, renewable natural gas may be the best option to offset emissions in this 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.