



Thompson Rivers University ASHRAE Level 1 Energy Study

Energy Study for:

BC Centre for Open Learning

Attention:

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BC Centre for Open Learning - ASHRAE Level 1 Study -

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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

The BC Center for Open Learning, located on Thompson Rivers University Campus in Kamloops, British Columbia, was originally constructed in 2007. The gross conditioned square footage of the building is 3,837 m² (41,301 ft²). This four-level building houses a data center on Level 1 as well as offices and common staff kitchen spaces on each level.

1.1.1 Physical condition and window type

The original building appears to be well maintained. The windows are double paned.

1.2 Mechanical Systems

1.2.1 Ventilation

The following major ventilation systems exist in this building:

- One Make-up air unit (MUA-1), located on the roof, delivers fresh air to all four levels of the building. The MUA has a heat pipe recovers heat from the exhaust stream and uses it to pre-heat the supply air. All exhaust air from the building is collected into this exhaust air duct so it can be used as a heat recovery source.
- Approximately 55 water source heat pumps recirculate and condition air in the individual zones.

1.2.2 Cooling

The following major cooling systems exist in this building:

- MUA-1 is equipped with a direct expansion cooling coil
- One cooling tower provides cooling for the heat pump loop
- There is a dedicated AC unit for the data centre on level 1. The condensing unit is located on the roof.

1.2.3 Heating

The following major heating systems exist in this building:

- MUA-1 is equipped with gas fired heating.
- Two non-condensing gas fired boilers provide heating to a primary heating loop which serves two secondary heating loops. These boilers were installed in 2007.
 - The first secondary loop circulates through the force flow heaters, radiant ceiling panels, and baseboard radiation.
 - The other secondary heating loop supplies a heat exchanger for the heat pump loop.

This building is planned to be in the first phase of connection to the district energy system. This means that all heating water and domestic hot water for the building will come directly from the district energy plant.

1.2.4 Domestic Hot Water

There is one gas fired domestic hot water (DHW) tank located in the penthouse. Based on the documentation provided, this unit is original to the building.

This building is planned to be in the first phase of connection to the district energy system. This means that all heating water and domestic hot water for the building will come directly from the district energy plant.

1.3 Lighting System

According to conversations with facilities staff, all lighting in this building has been upgraded to LED.

1.4 Control Equipment

An Automated Logic building automation system (BAS) controls all major building systems except DHW.

1.5 Energy Analysis

1.5.1 Energy Use Profile

Figure 1 presents the building's electrical consumption since 2018. Baseline electricity consumption was calculated based on consumption from 2018 through May 2021, which is the most recent data available for this facility. The decrease in electricity consumption since May 2021 is likely due to the reduced operation during COVID. This data along with the outliers in 2019 were excluded from the baseline calculation. The data center in this building likely accounts for a significant amount of this electricity consumption.

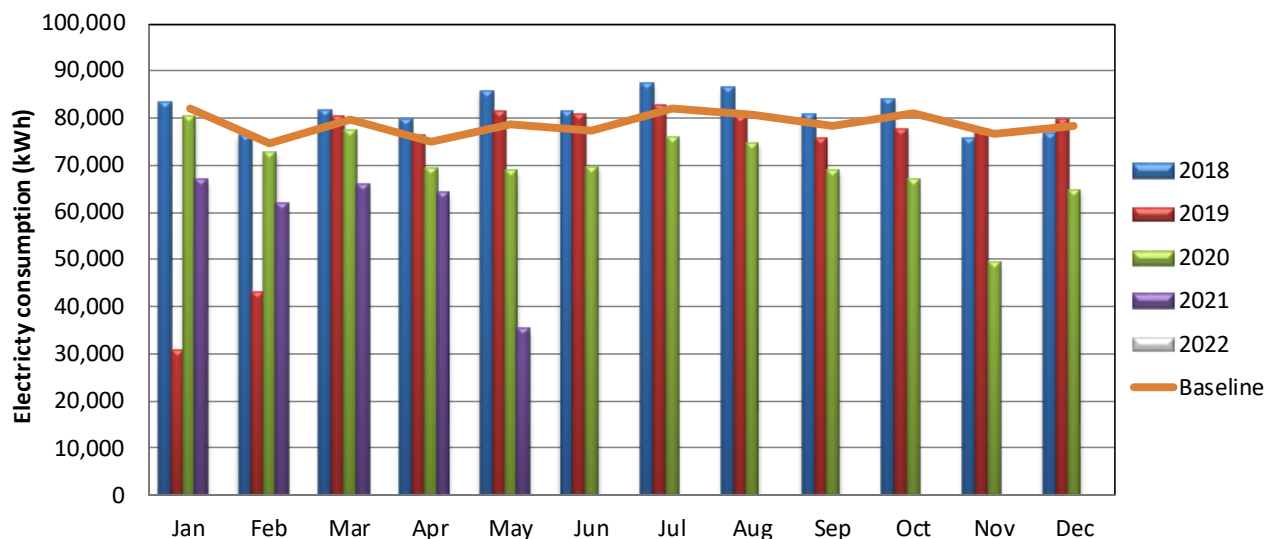


Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's gas consumption since 2018. The data from July 2020 onwards comes from the new energy management system IoTORQ. Based on the gas equipment in the building, it is thought that this data is more accurate than the previous years data from Pulse. However, it seems slightly higher than what makes sense based on trends and equipment inventories. As such the building's gas baseline was estimated using the equipment inventory data and BAS trends of operation. We recommend that the gas metering for this building be confirmed.

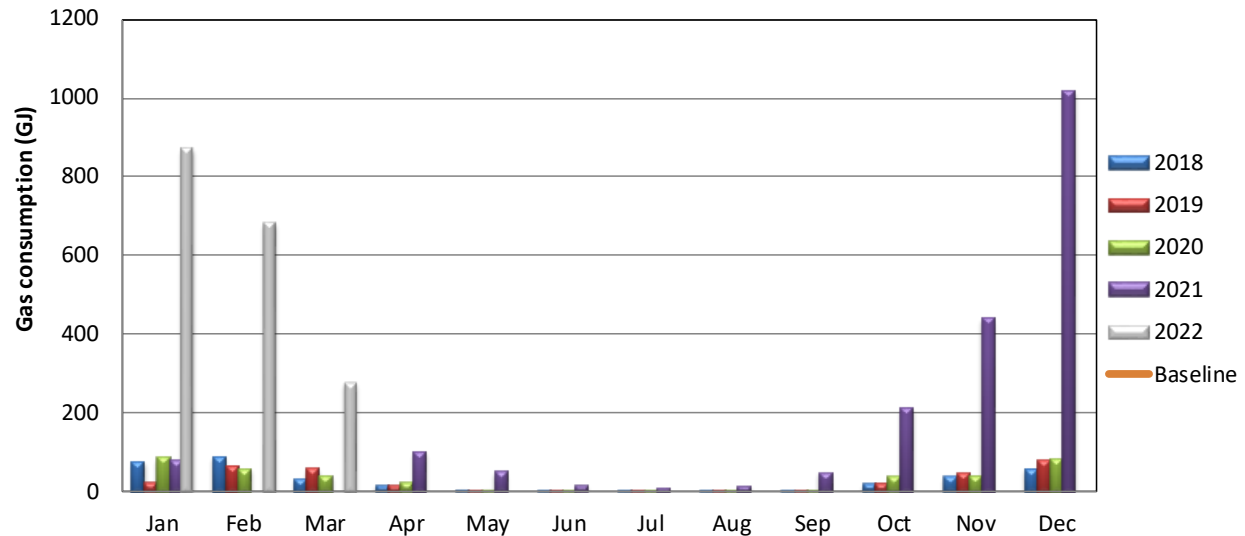


Figure 2: Monthly Gas Consumption

1.5.2 Energy Intensity Analysis

A summary of the baseline energy consumption and the corresponding costs and energy intensity for the facility is presented in Table 1. Open Learning has an Energy Use Intensity (EUI) of 1,313 MJ/m².

Table 1: Baseline Energy Consumption

Utility	Energy Use (GJ)	EUI (MJ/m ²)	Cost (\$)	Cost (\$/ft ²)
Gas	1,639	427	\$16,757	\$0.41
Electricity	3,399	886	\$56,270	\$1.36
Total	5,038	1,313	\$73,027	\$1.77

1.5.3 Energy End Use Breakdown

The estimated breakdown of electricity consumption by building system is presented in Figure 3. The significant plug load in the building is a result of the data centre.

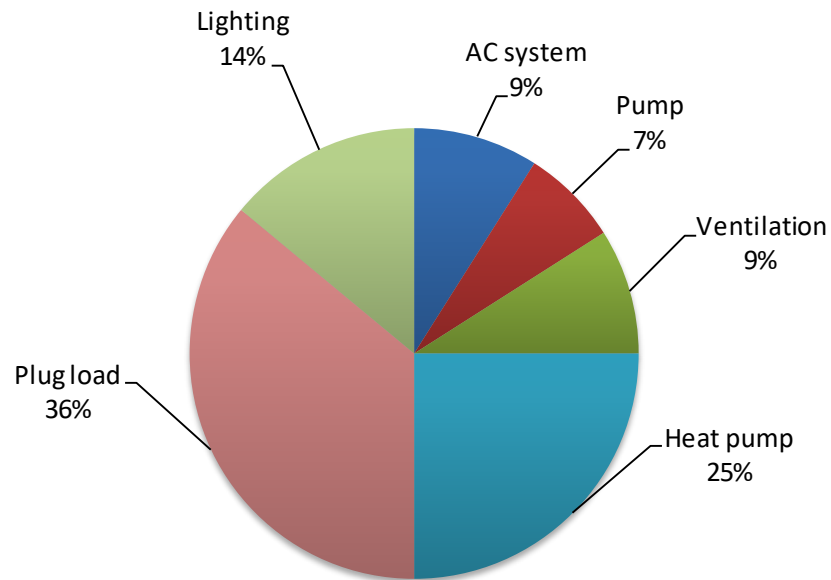


Figure 3: Electricity Consumption

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

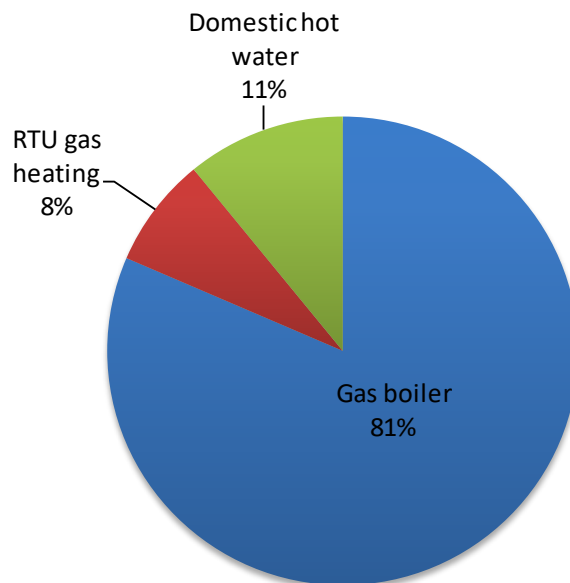


Figure 4: Gas Consumption

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

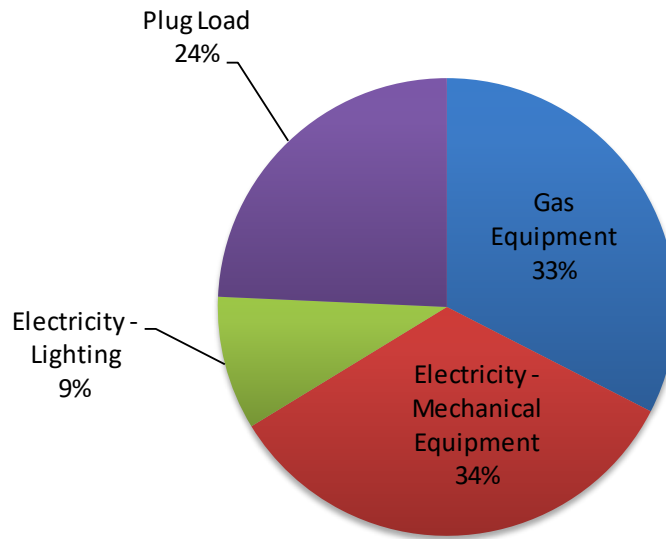


Figure 5: Total Energy Breakdown

2. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at Open Learning. 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 CO₂e / kWh of electricity in BC, and 49.87 kg CO₂e / 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. As some of the measures are mutually exclusive, it doesn't make sense to summarize the savings for all measures. The individual measure savings summaries are presented in Table 3.

2.1 Energy Conservation Measures

A summary of the analysis for the recommended measures is presented in Table 3. This building is planned to be in the first phase of connection to the district energy plant. If for some reason this connection does not happen, we recommend investigating the following measures:

- Condensing Boiler
- Gas Absorption Heat Pump
- Condensing DHW
- Renewable Natural Gas

The measures presented below are good opportunities regardless of the district energy plant connection. Detailed descriptions for each project are presented below. None of the measures analyzed include incentives provided by Fortis or BC Hydro. In some cases, the incentives provided will significantly reduce costs and overall project paybacks. These should be considered prior to final measure selection.

Table 3: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							\$	GJ	kWh	GHG
1.1	BAS Recommissioning		\$10,000	\$10,000	4.0	7,800	\$1,900	120	1,700	6.0
1.2	Data Center Heat Pump		\$25,000	\$25,000	19.0	(14,800)	\$850	50	800	2.5

2.1.1 BAS Recommissioning

Based on our records, no recommissioning work has been done on this building since it was built in 2007. As such there is likely significant opportunity for optimization. We recommend doing a full recommissioning on the building and specifically looking at the following:

- Heat Pump Loop RCx: Based on other buildings with similar configurations on campus, the heat pump loop systems are rarely operating optimally. We recommend recommissioning the heat pump loop supply water temperature (SWT) control and cycling the terminal heat pumps fan on/off as needed. It was also noted that the cooling tower damper, fan and pump were operating most of the winter to reject heat from the building. This should be investigated as part of the heat pump loop recommissioning.
- MUA RCx: Based on a preliminary review of the BAS, the following optimization opportunities for MUA-1 were identified:
 - the MUA-1 supply air temperature setpoint (SAT SP) is higher than necessary for a system with terminal heating. We recommend recommissioning this control as well as reviewing the variable speed drive (VSD) control to ensure it is responding to CO₂ readings. It is likely the VSD setpoints can be decreased. This should be done cautiously as there will be a minimum flow required when the MUA gas fired heating is operating.
 - The MUA appears to be scheduled, but there does not appear to be an optimal start program for the building. We recommend this be added. The MUA should not be required for optimal start and should be kept off during this period.
 - The gas fired heating of the MUA appears to be coming on at night to maintain a night time setback (NTSB) temperature of ~ 15°C. However, the fan is off during this time. The MUA should not be used for NTSB. The heat pumps should be able to maintain the NTSB temperatures.
- This building contains several common spaces such as breakout rooms and kitchen spaces that would be intermittently occupied throughout the day. Based on the BAS, all spaces are scheduled on from 6:00 am – 5:00 pm. We recommend installing occupancy sensors (OS) in the spaces that are

intermittently occupied throughout the day to setback space temperature and flow setpoints when insufficient occupancy is detected.

- The DHW system is not on BAS. We recommend adding it to the BAS and cycling the recirculation pumps off at night.
- Ensure holiday scheduling is in place for all systems.

2.1.2 Data Centre Heat Pump

There is a single data center on level 1 that is served by both an air source heat pump and a dedicated AC with a rooftop condensing unit. We recommend replacing the air source heat pump with a water source heat pump that is connected to the heat pump loop. The data center requires year-round cooling; which would provide an excellent opportunity to use the waste heat to heat other spaces in the winter months. A detailed design would need to be done to ensure it is feasible to tie the existing heat pump into the heat pump water loop. Although this measure currently has a long payback, it is likely that there would be incentives provided by BC Hydro and/or Fortis BC that would cause this measure to be more attractive. These should be considered prior to final measure selection.

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.