Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

Clock Tower

Attention:

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May 25, 2022

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- ASHRAE Level 1 Study -

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1. Background Description of Facility, Hardware and Systems

1.1 Overview and Facility Use

The Clock Tower building was built in 1989. The building is 4 stories with a gross floor area of 2,975 m^2. The building gets its name from the clock tower, an architectural feature incorporated in the building. The building consists of mainly of offices and a theatre space.

1.1.1 Physical condition and window type

The original building appears to be well maintained. Building windows and doors are double-paned and are typically constructed in aluminum frame with the majority of windows being inoperable.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation for the building is provided by the following systems:

- F-1 provides conditioned air to the 1st and 2nd floors via variable air volume diffusers (VAVs). It is original to the building, but was retrofitted in 2021.
- F-2 provides conditioned air to the 3rd and 4th floors via VAVs. It is original to the building, but was retrofitted in 2021.
- RTU-1 provides conditioned air to the theatre via constant volume diffusers.
- The fan coil unit (FCU) on the 2nd floor serves room CT 209 and CT 210.

1.2.2 Cooling

One packaged air-cooled Trane chiller (CH-1) and four pumps (P-6, P-7, P-8, P-10) provide chilled water to the following:

- AHU cooling coils
- Fan coil unit cooling coils

1.2.3 Heating

Building heating water is generated using two Thermal Solutions natural gas boilers. They serve the following systems. Boilers are 88% efficient.

- AHU heating coils
- VAV reheat coils (not all VAVs have these)
- Fan coil unit heating coils
- Radiation panels in the 2nd floor offices

Additionally, the rooftop unit serving the theatre (RTU-1) has gas fired heating. During the site visit it was noted that some areas of the building were very cold and tenants all brought electric heaters. There were issues with blowing the breakers.

This building is going to be connected to the district energy plant as part of the first phase of connections. The district energy plant will provide all heating water and domestic hot water (DHW) in the building.

1.2.4 Domestic Hot Water

Domestic Hot Water (DHW) at the facility is generated by three “A.O Smith” 1.5kW electric domestic hot water heaters.

This building is going to be connected to the district energy plant as part of the first phase of connections. The district energy plant will provide all heating water and domestic hot water (DHW) in the building.

1.3 Lighting System

All lighting was upgraded to LED in 2016.

1.4 Control Equipment

The BAS was upgraded from Siemens to Automated Logic as part of the Fortis Bundle A Cycle 1 Implementation in 2021. The terminal equipment controllers (TECs) are all very old Siemens devices. They will be upgraded in 2022.

The reheat coils of the 3rd floor FCUs are controlled using local digital thermostats.

2. Energy Analysis

2.1.1 Energy Use Profile

Figure 1 presents the building’s electrical consumption since 2017. Data from May 2020 onwards was neglected from the baseline calculation as it was significantly below average. This is likely due to the reduced operation during COVID. It should be noted that more recent data is available in IoTORQ, however, this data was noted to be significantly below previous years and was deemed to be unreliable. We suspect there is a scaling issue with this data.

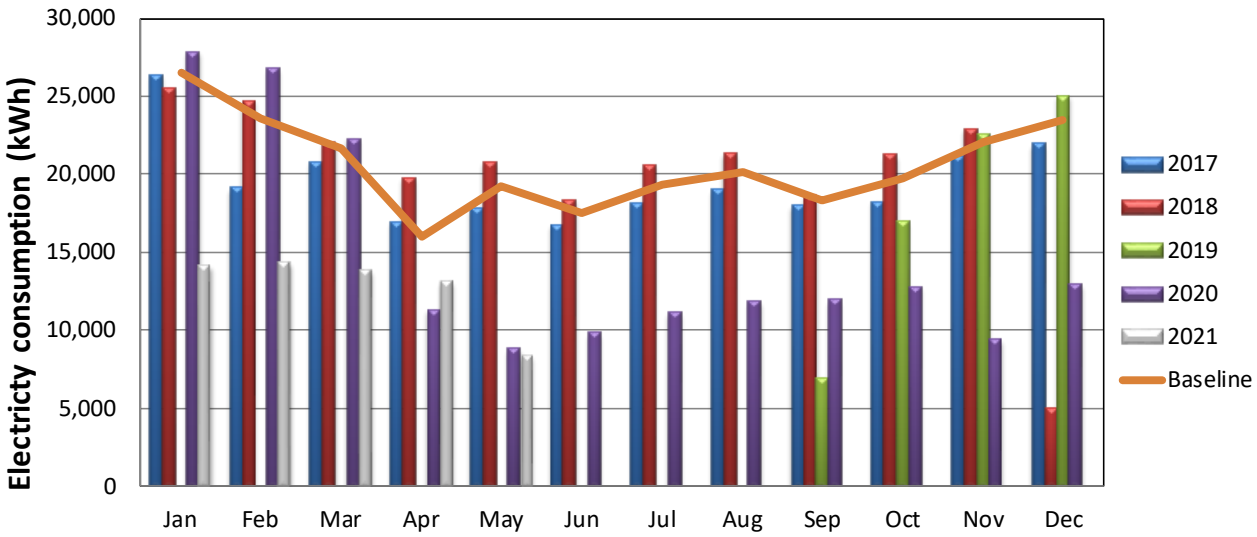

Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's gas consumption since 2017. It appears there is an issue with the gas meter in this building as there are frequent gaps in available data. COVID does not appear to have significantly affected the gas consumption at this building as the 2020 year is nearly identical to the 2018 year. Given the number of missing months in the data, all reliable data from 2017 onwards was used to calculate the baseline energy consumption of this building. It should be noted that more recent data is available in IoTORQ, however, this was noted to be significantly above the previous years and was deemed to be unreliable. We suspect there is a scaling issue with this data.

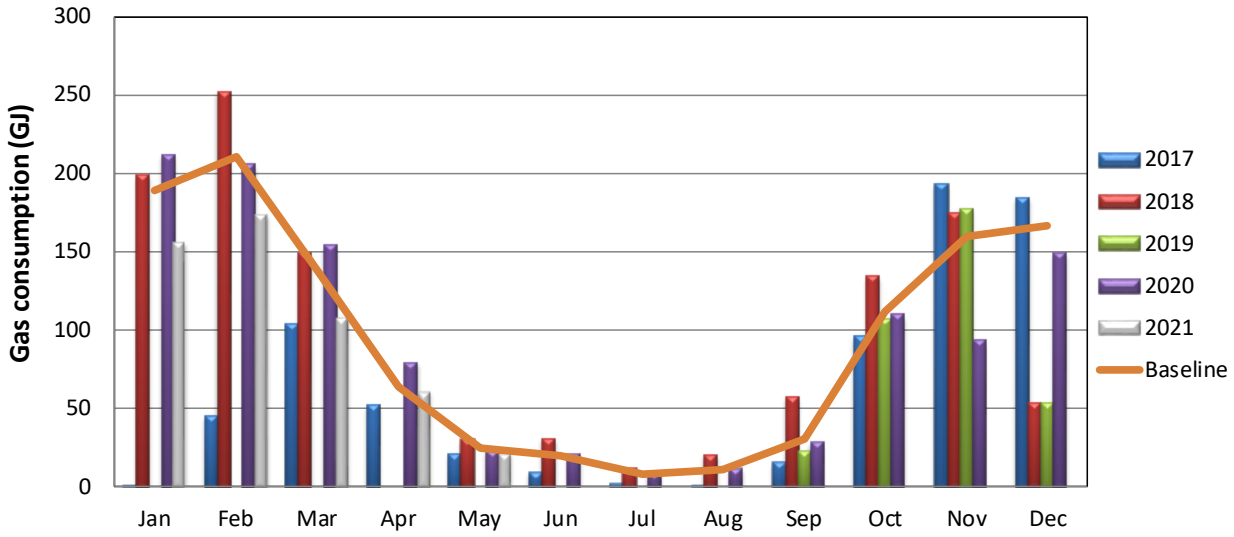

Figure 2: Monthly Gas Consumption

2.1.2 Energy Intensity Analysis

A summary of Baseline Energy consumption and the corresponding costs and energy intensity for the facility is presented in Table 1. The Clock Tower has an Energy Use Intensity (EUI) of 658 MJ/m^2. This is significantly below the average TRU building on campus.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	1,130	368	$16,947	$0.51
Electricity	892	290	$15,681	$0.47
Total	**2,021**	**658**	**$32,628**	**$0.99**

2.1.3 Energy End Use Breakdown

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

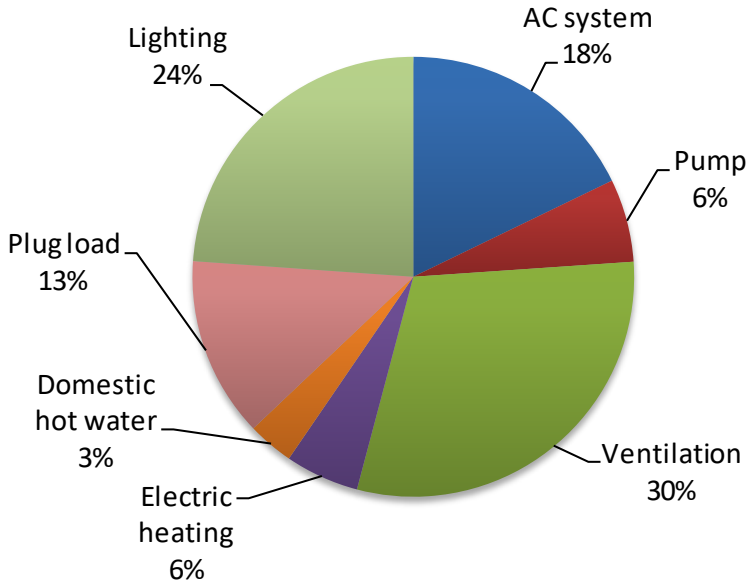

Figure 3: Electricity Consumption

The estimated breakdown of gas consumption by building system is presented in Figure 5.

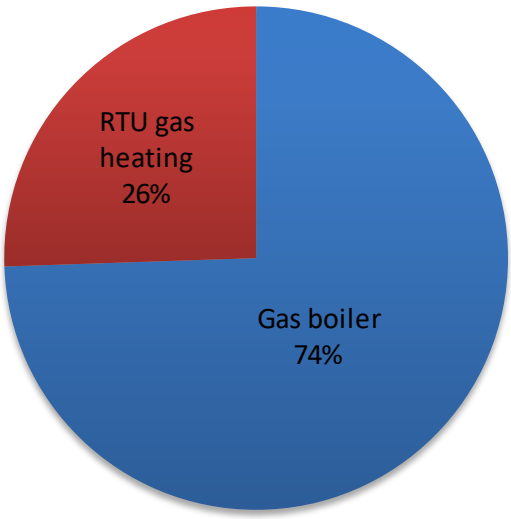

Figure 4: Gas Consumption

The estimated percentage of total energy consumption by building system is presented in Figure 6.

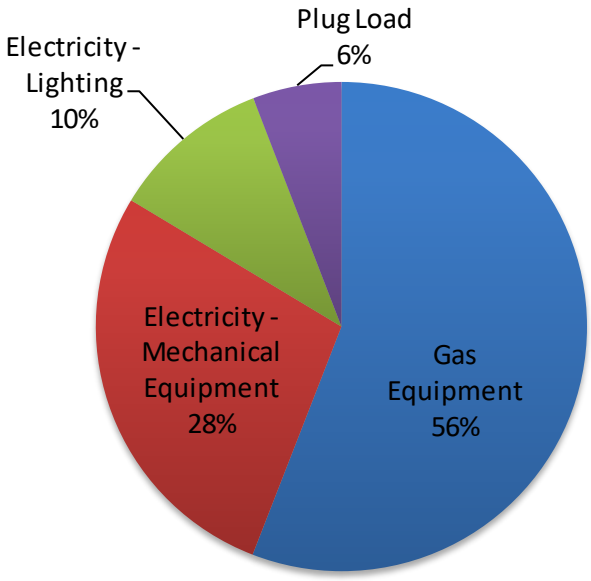

Figure 5: Total Energy Breakdown

3. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at the Clock Tower. 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.

3.1 Energy Conservation Measures

This building is in the first phase of buildings connected to the district energy plant as part. This means that all heating water and domestic hot water (DHW) in the building will now come directly from the district energy plant. As such, no domestic hot water or heating water measures were considered. If for some reason this connection does not happen, we recommend the following measures be investigated:

- Condensing Boiler Upgrade
- Air sourced heat pump for DHW
- Renewable Natural Gas

The measures presented below are the measures that are still relevant if this connection is pursued. A summary of the analysis for the recommended measures is presented in Table 3. Detailed descriptions for each project are presented below. The analysis of these measures does not include incentives from BC Hydro or Fortis BC.

Table 3: Measure Summary

Item	Description	Base Case Cost	Incremental Cost	Total Cost	Effective Payback	NPV	Annual Savings			
							$	GJ	kWh	GHG
1.1	Controls Commissioning		$11,000	$11,000	6.0	2,000	$1,700		25,300	0.2

3.1.1 BAS Commissioning

The Clock Tower was switched from Siemens to Automated Logic during the Fortis Implementation Bundle A Cycle 1 completed in 2021. The building TECs are being upgraded from the old Siemens ones as part of the Bundle A Cycle 2 Fortis implementation. Based on discussions with Automated Logic and TRU operations, a full commissioning of this system has not yet been done. We recommend doing a full commissioning of the building once the Cycle 2 Implementation work is complete. A preliminary BAS review noted the following deficiencies. This was a high-level review as a full BAS review is not within the scope of this project. Many of the other noted deficiencies will be resolved as part of the Cycle 2 upgrade so they were not included on this list.

- AHU graphics missing temperature and damper position minimum setpoint values, occupancy mode, and free cooling mode statuses. These should be added.
- The heating water supply temperature (HWST) was noted to be consistently above the heating water return temperature (HWRT). It is possible these are mislabelled otherwise there may be an issue with the sensor. This should be investigated and remedied.
- Several spaces such as TV02 are equipped with occupancy sensors. These sensors are not visible on the graphics. The status of the occupancy sensors in the spaces along with the associated occupied/unoccupied setpoints should be added to the graphics.
- The SF-2 and SF-1 supply fan commands were turning on/off, but the actual supply fan statuses did not appear to be responding and the fans were noted to be operating 24/7. The schedule of these fans was 6:00 am – 8:00 pm, given that these fans serve offices, it is likely that these schedules are longer than required. This should also be confirmed.
- There appears to be an issue with chiller supply water temperature (SWT) as it was noted to be fluctuating significantly sometimes up to 45°C. This should be investigated and fixed.
- We also recommend that weather predictor programming and outdoor air temperature (OAT) lockouts be added for the boiler heating loop and RTU gas heating/DX cooling. This was observed in the previous Fortis study, but was not implemented as no Fortis incentives were provided.

It should be noted that while we anticipate this measure to have some energy savings, the main purpose of the measure is to ensure the building is functioning as intended after the switchover. Given the complexity of the TRU buildings, we recommend budgeting for a full a commissioning whenever buildings are switched to a new BAS.

4. 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.