Thompson Rivers University
ASHRAE Level 1 Energy Study

Energy Study for:

Culinary Arts

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

May 25, 2022

Culinary Arts
- 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

The Culinary Arts building was constructed in 1970 with the additions completed in 1983. It a three storey building that consists of the Culinary Arts Training Centre (classrooms, bakery, kitchen, offices and dining room) and the Meat Cutting Department. The gross building floor area is 20,864 ft^2.

1.1.1 Physical condition and window type

The original building appears to well maintained. The windows are double glazed.

1.2 Mechanical Systems

1.2.1 Ventilation

Ventilation is supplied by the following units.

- AHU F-6 is a mixed air, dual duct unit with a constant volume supply fan (SF) and return fan (RF). It has a heating water pre-heat coil as well as a heating water coil in the hot duct and a chilled water coil in the cold duct. It serves the bakery, lounge, classrooms and offices on the first floor. This unit is being rebuilt in the summer of 2022 and a variable speed drive (VSD) is being installed if feasible.
- AHU F-13 is a 100% outdoor air (OA), dual duct unit with a constant volume SF. It has a heating water pre-heat coil as well as a heating water coil in the hot duct and a chilled water coil in the cold duct. It serves the cafeteria, alumni dining room, and kitchen on the second floor. This unit is being rebuilt in the summer of 2022 and a variable speed drive (VSD) is being installed if feasible.
- RTU-1 is a mixed air unit with gas heating and direct expansion (DX) cooling. It has constant volume SF. It serves the alumni dining room. This unit was replaced in 2013.
- MAU-1 is a 100% OA unit with gas fired heating and a single constant volume SF. It serves the kitchen and was replaced in 2016.
- The Meat Cutting RTU is a mixed air unit with gas fired heating, DX cooling and a constant volume SF. This unit serves the entire meat cutting area and was replaced in 2006. This unit is not on BAS.

1.2.2 Cooling

Chiller CH-1 provides chilled water (CHW) to the cooling coils in the cold ducts of AHU F-6 and AHU F-13. RTU-1 and the Meat Cutting RTU have DX cooling coils. There is also a dedicated condensing unit on the meat cutting roof that serves the walk-in coolers and freezer.

1.2.3 Heating

Condensing natural gas boilers B-5 and B-6 supply heating water to the following systems.

- AHU F-6 preheat coil and hot deck heating coil
- AHU F-13 preheat coil and hot deck heating coil
- Cafeteria reheat coils in the north/south zone ducting (there is one reheat coil per duct)
- Hot water radiant panels in cafeteria, dining room and perimeter classrooms

RTU-1 and MUA-1 both have internal natural gas burners to provide heating.

This building is going to be connected to the district energy plant as part of the Phase 1 connection plan The district energy plant will provide all heating water and domestic hot water (DHW) in the building.

1.2.4 Domestic Hot Water

The main building has 2 natural gas domestic hot water (DHW) heaters that serve the main building. They take preheated solar DHW and output DHW for the building DHW loop and kitchen dishwasher.

The meat cutting area has 2 natural gas DHW heaters. They are new as of 2016. They provide DHW for the meat cutting room.

This building is going to be connected to the district energy plant as part of the Phase 1 connection plan The district energy plant will provide all heating water and domestic hot water (DHW) in the building.

1.2.5 Lighting System

The building is 100% LED.

1.3 Control Equipment

The facility has a Johnson Controls BAS. All ventilation, heating water, chilled water and DHW serving the main building are on BAS. The meat cutting RTU, unit cooler and DHW tanks are not on BAS. SES is currently implementing a control upgrade on this building, part of which entails bringing the meat cutting DHW system onto BAS.

2. Energy Analysis

2.1.1 Energy Use Profile

Figure 1 presents the building's electrical consumption since 2018. The Fortis energy conservation measures for this building were split up into two parts with only two of the seven measures being implemented in 2021. The remaining measures are currently in the process of being implemented. There is no energy data from after the implementation of the first measures so all data from 2018 onwards was used to calculate the baseline electricity use. Although there was a slight decrease in energy use due to COVID, it was not significant enough to require that the data be removed from the baseline calculation.

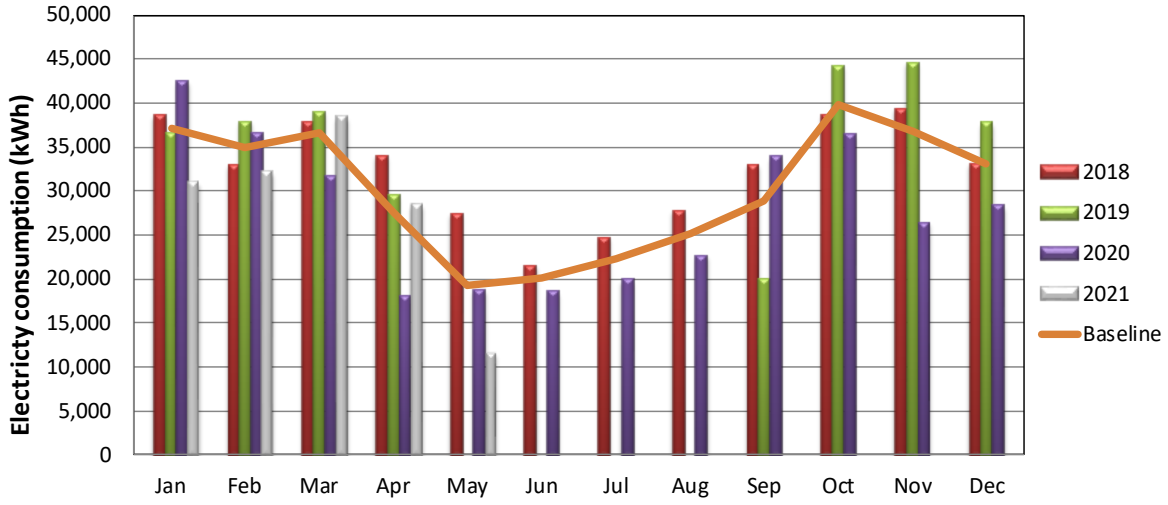

Figure 1: Monthly Electricity Consumption

Figure 2 presents the building's gas consumption from 2018 onwards. The Fortis energy conservation measures for this building were split up into two parts with only two of the seven measures being implemented in 2021. The remaining measures are currently in the process of being implemented. There is no energy data from after the implementation of the first measures so all data from 2018 onwards was used to calculate the baseline gas consumption.

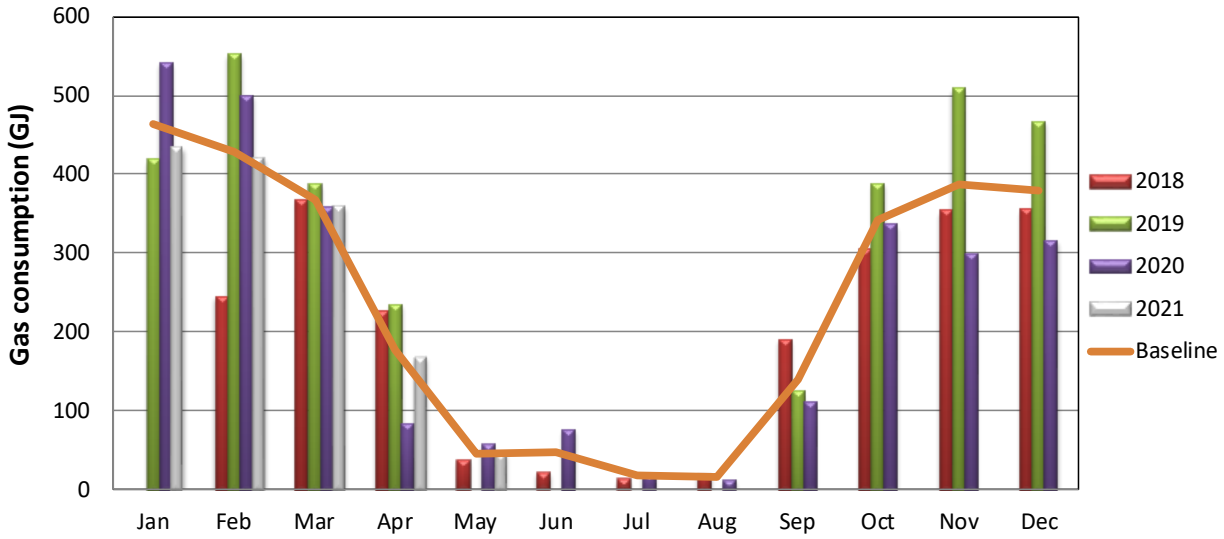

Figure 2: Monthly Gas Consumption

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. Culinary Arts has an Energy Use Intensity (EUI) of 2,122 MJ/m^2.

Table 1: Summary of Baseline Energy Data

Utility	Energy Use (GJ)	EUI (MJ/m2)	Cost ($)	Cost ($/ft2)
Gas	2,814	1,451	$42,211	$2.02
Electricity	1,301	671	$22,877	$1.10
Total	**4,115**	**2,122**	**$65,088**	**$3.12**

2.1.3 Energy End Use Breakdown

The energy use is based on estimated equipment operation profiles. The estimated breakdown of electricity consumption by building system is presented in Figure 3. This breakdown uses the new RTU specifications.

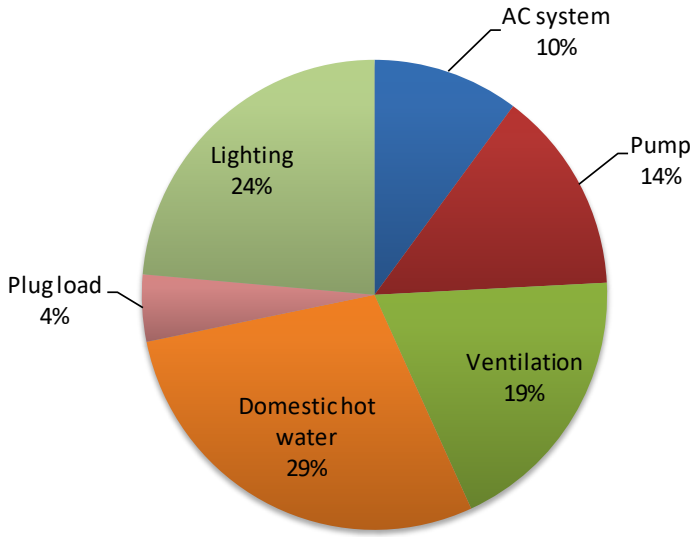

Figure 3: Electricity Consumption

The energy use is based on estimated equipment operation profiles. The estimated breakdown of gas consumption by building system is presented in Figure 4. This breakdown uses the new RTU specifications.

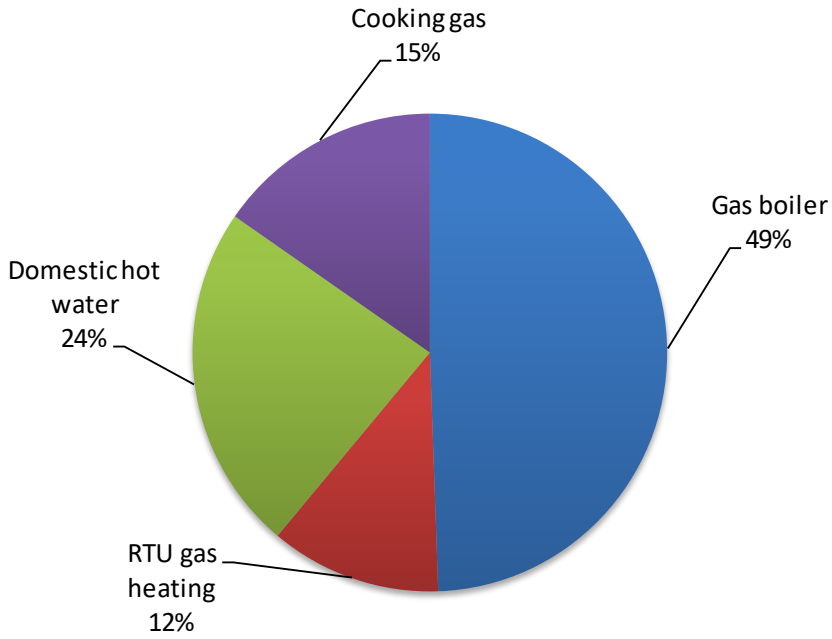

Figure 4: Gas Consumption

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

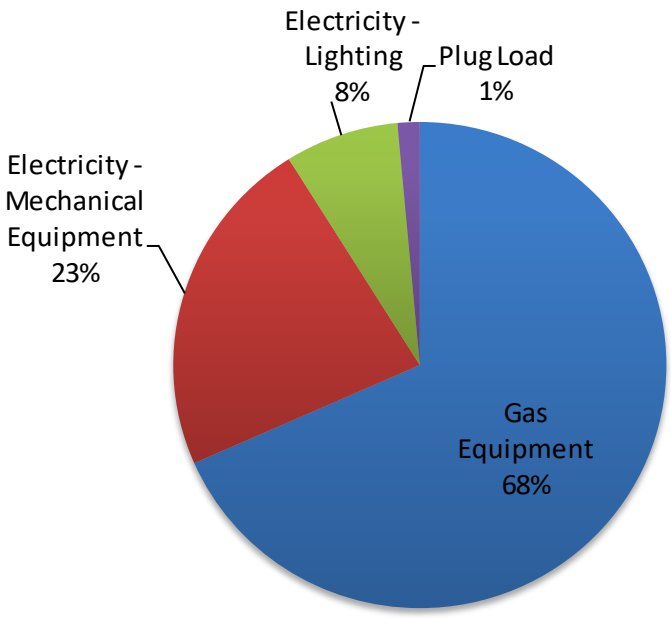

Figure 5: Total Energy Breakdown

3. Conservation Opportunities

The primary objective of this study was to identify and analyse energy conservation opportunities at the Culinary Arts building. 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. Since these measures are mutually exclusive, it does not make sense to present the total savings if all measures are implemented. Please see Table 3 for the individual measure costs and savings.

3.1 Energy Conservation Measures

This building is planned to be in the first phase of buildings connected to the district energy plant. 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
- Condensing DHW
- Heat Recovery Chiller
- Parallel to series heating water piping conversion
- 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 these measures is presented in Table 3. Detailed descriptions for each project are presented below. The analysis for these measures does not include any 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	Meat Cutting RTU High Efficiency	$10,000	$5,000	$15,000	≥ 40	(2,800)	$250	10	400	0.5
1.2	Meat Cutting RTU HP	$10,000	$9,000	$19,000	10.0	(800)	$650	60	(4,900)	2.9

3.1.1 Meat Cutting RTU High Efficiency

The meat cutting roof top unit (RTU) provides conditioned air to the entire meat cutting space. It is equipped with direct expansion cooling and gas fired heating. It was installed in 2006 and is nearing the end of its recommended service life. It is unlikely that the RTUs in this building will be connected to the heating water from the district energy plant as the boiler is located in the basement and the RTUs are on the roof. This measure recommends upgrading the existing unit to a high efficiency condensing unit with a variable speed drive (VSD) when it is due to be replaced. Incremental costing was used in the analysis of this measure.

It should be noted that MAU-1 and RTU-1 also have gas fired heating. These units can also be replaced with high efficiency units when they are due for replacement. However, as they are not currently nearing the end of their recommended service life, they were not included in the measure analysis.

3.1.1 Meat Cutting RTU HP

The meat cutting roof top unit (RTU) provides conditioned air to the entire meat cutting space. It is equipped with direct expansion cooling and gas fired heating. It was installed in 2006 and is nearing the end of its recommended service life. It is unlikely that the RTUs in this building will be connected to the heating water from the district energy plant as the boiler is located in the basement and the RTUs are on the roof. This measure recommends upgrading the existing unit to a heat pump unit with gas backup and a variable speed drive (VSD) when it is due to be replaced. Incremental costing was used in the analysis of this measure.

It should be noted that both MAU-1 and RTU-1 also have gas fired heating. These units can also be replaced with heat pump units when they are due for replacement. However, as they are not currently nearing the end of their recommended service life, they were not included in the measure analysis.

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.