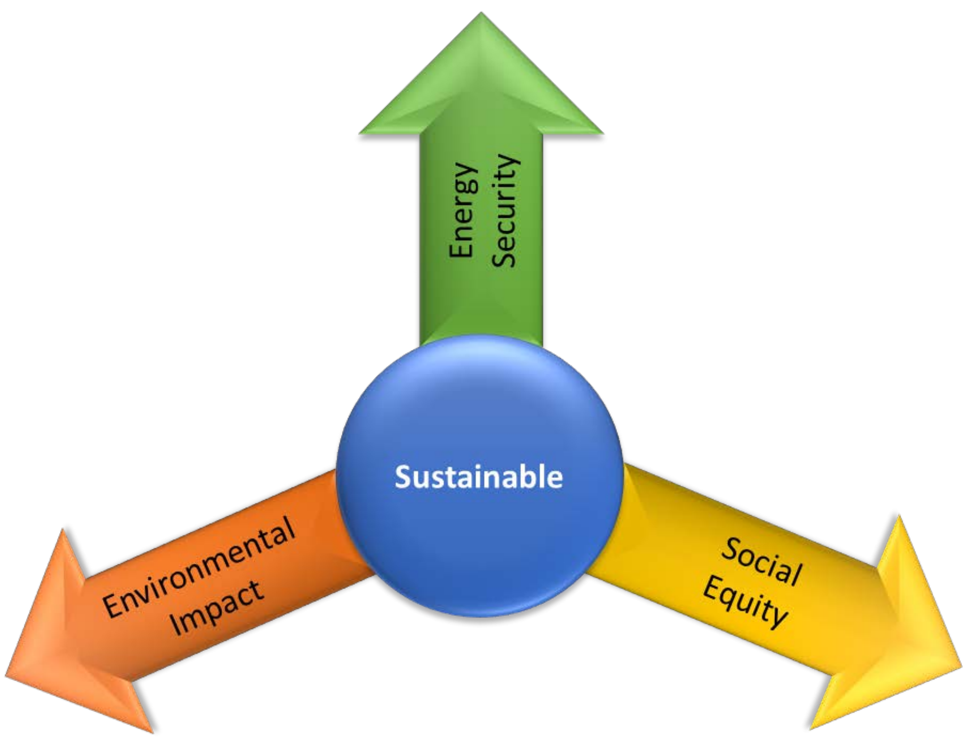
ST. CLAIR COLLEGE

Energy Conservation and Demand Management Plan



July 1, 2019

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Executive Summary

Under ONTARIO REGULATION 507/18, public agencies, including colleges and universities, are required to report their annual energy consumption and greenhouse gas (GHG) emissions, as well as to implement an Energy Conservation and Demand Management Plan (ECDMP) beginning from July 1st 2019 onwards. These plans are required to be reviewed and updated every 5 years thereafter.

St. Clair College's ECDMP will serve as a guide to better understand its energy usage, educate its community (including students and staff) and identify strategies for reducing energy consumption and corresponding greenhouse gas (GHG) emissions. Conserving energy will not only aid St. Clair College in realizing a reduction in waste, but also lower operating costs. Additionally, this comprehensive plan contributes to the development of a larger foundation and framework that will ensure continuous sustainability integration across the three St. Clair College campuses and community.

The ECDMP ensures compliance to current regulations and aids in providing a framework for communicating targets, planning for new and retrofit equipment and infrastructure installations, and monitoring progress in reducing energy demand.

This document is available in print or other formats to suit individual needs, upon request.

St. Clair College appreciates and recognizes the assistance and contribution of the following individuals in the creation of this report:

- St. Clair College
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- Union Gas Ltd.
  - Mark Prociw - Account Manager
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Introduction

A.0 Institutional History

The roots of the College can be found in the Western Ontario Institute of Technology (W.O.I.T.) which opened its doors in 1958 in two rooms at the Mercer Street Public School where 104 students paid $235 for their tuition. There were four programs to choose from; electronics, electrical, mechanics and chemistry.

As the student body grew, it was evident that the Mercer Street facilities were not going to provide the required educational spaces for long term growth. Thanks to William G. Davis, the Premier of Ontario in the mid 1960's, the concept of institutes of applied arts and technology was born and that made way in 1965 for the transformation from W.O.I.T. to St. Clair College of Applied Arts & Technology. St. Clair College was one of the 19 provincial colleges approved that year.

In September 1967, St. Clair College's first building was completed and 300 students commenced their college education at 2000 Talbot Road West. Within 10 short years, the College opened its permanent campus in Chatham, on Grand Avenue, serving the community of Chatham-Kent. Today, St. Clair College has four campuses, two in Windsor, one in Chatham and one in Toronto, providing higher education for over 13, 000 full-time postsecondary students.

In addition, more than 5,000 people a year come to the College to take courses through our Continuing Education and Corporate Training offerings. As a milestone and in celebration of its 50th anniversary year, the College graduated its 100,000th alumni. These celebrated graduates have gone on to prosperous careers and have become contributing members to a strong and vibrant Canadian economy.

St. Clair College provides over 110 advanced diplomas, graduate certificates and degree pathways with a focus on Technology and Trades, Business and Information Technology, Media Art & Design, Community Studies and Health Sciences. The College is proud of its many global university partners which allows students to pursue a pathway to degree completion here in Windsor, in Canada, and around the world.

A.1 Academics

St. Clair College offers more than 110 diplomas, advanced diplomas, certificates and degrees across eight schools:

- Zekelman School of Business and Information Technology
- School of Community Studies
- School of Engineering Technologies
- School of Apprenticeships & Skilled Trades
- School of Health Sciences, Windsor and Chatham Campuses
- School of Nursing, - Windsor and Chatham
- School of Media, Art & Design
- School of Academic Studies – Chatham-Kent

A.2 Campuses

Windsor South Campus

Situated on a sprawling 110 acre campus in South Windsor, this is the College's largest campus with close to 10,000 students studying in the Schools of Business and IT, Community Studies, Engineering Technologies, Health Sciences, Nursing and Apprenticeships and Skilled Trades.

St. Clair College is renowned for its excellence in applied health programs. To support the growing demand for highly trained health care professionals, St. Clair College opened the $32 million Anthony P. Toldo Centre for Applied Health Sciences facility in September 2011. The Centre provides state-of-the-art learning labs for Dental Hygiene, Dental Assisting, Medical Laboratory Science and Technician, Nursing, Practical Nursing, Personal Support Worker, Diagnostic Medical Sonography (Ultrasound), Cardiovascular Technology and Respiratory Therapy. Labs for all programs contain the latest in health care simulation equipment. This includes numerous nursing labs with simulation mannequins including birthing simulators. Similar facilities that support the Nursing and Practical Nursing programs are also found at our Chatham Campus in the Mary Uniac Health Sciences Centre.

St. Clair also offers a popular Veterinary Technician program, which is one of few in the province that provides a teaching hospital environment. The program is accredited by four individual associations including the College of Veterinarians of Ontario and the Canadian Veterinary Medical Association. The College has established a number of outstanding facilities where labs reflect real-world technology environments.

The Cisco-certified computer labs that support Computer Networking, Internet Applications & Web

Development and Mobile Applications, provide students with state-of-the-art technology on which to practice their skills. In 2019, St. Clair College was ranked #1 in North America for the largest enrolment of students in a Computer Networking program by Cisco Network Academy. The College's computer networking program also continues to have one of the highest rates of female enrolment of Cisco Certified Programs in Canada.

The Ford Centre for Excellence in Manufacturing, a 100,000 sq. ft. manufacturing facility, emulates the shop floor and provides hands-on learning for students in Robotics, Power Engineering Technology, Automotive Product Design, CAD/CAM, Industrial Millwright, and more!

The Centre for Construction, Innovation and Production is a skilled-trades lab facility that provides an ideal space for students studying in the electrical, plumbing and carpentry trades at the Windsor South Campus.

St. Clair College fully supports student life activities to help students round out their academic studies. This is done, in part, with a focus on athletics and health and wellness. The College provides students with an 85,000 sq. ft. SportsPlex facility which is one of a kind in Ontario. Triple gym, elevated running track and 10,000 sq. ft. fitness center are available for use by our students and by the community at large. The SportsPlex hosts OCAA varsity sports including Basketball and Volleyball, and many high school sports as well. The College is also on a multi-year development plan of a comprehensive outdoor Sports Park which will include a state-of-the-art turf field soccer stadium, women's softball diamond, indoor tennis facility and beach volleyball courts all integrated around a beautifully landscaped promenade. The first phase of construction started May, 2019.

Downtown Campus

The downtown campus comprised of three signature facilities, which are home to over 1,500 students. In fact, St. Clair College was the first postsecondary institution to open campuses in the Windsor downtown area. St. Clair College Centre For The Arts is home to our Graphic Design program with state-of-the-art Mac lab. The Advertising & Marketing Communications program along with our Hospitality program and some of the Legal and First Responder programs also take residence in this facility. The Centre boasts a 1,200 seat professional theatre known as the Chrysler Theatre, which is used by our Music Theatre Performance students for their productions.

Another significant facility in our downtown campus complex is the MediaPlex. It is home to students studying in Convergence Journalism, Public Relations, Media Convergence, Tourism & Travel, and Event Management. To help prepare students for 21st century news reporting, this facility offers television, radio, web and print platforms where students learn to write and report for all media platforms. The MediaPlex is a one-of-its-kind in North America as it produces a weekly newspaper, radio show, and live television news broadcast in conjunction with the local cable TV station.

Downtown is also home to the newly built (2018) Zekelman School of Business and Technology which consists of eight classrooms, lounge, tutoring/testing and Faculty space. This is home to many business and IT programs.

Lastly, the TD Student Success Centre offers students a computer lab and lounge area and is operated by the Student Representative Council.

Chatham Campus

St. Clair College's Chatham campus is home to over 1,200 full time students who study Business, Community Studies, Skilled Trades and Health Sciences. Similar to the Windsor Campus, students studying Nursing or Practical Nursing will find state-of-the-art simulation equipment in the Mary Uniac Health Sciences Centre.

The Chatham Campus is one of a very few higher education centres across the country to offer Power-Line Technician training. In 2018, St. Clair College completed the construction of a National Powerline Training Centre located on a pole field which simulates powerline construction and installation in the real world.

Students at the Chatham Campus also have their own 50,000 sq. ft. fitness facility called the Chatham HealthPlex. The Healtplex boasts two gyms, a fitness centre and is the home to the College's Paramedic, Occupational Therapy and Physical Therapy Assistant labs.

Ace Accumen Academy

To promote a metropolitan experience to international students, St. Clair College has licensed its curriculum to Ace Acumen Academy (AAA) to allow St. Clair College international students to study academic programs in Toronto. International students can now take advantage of this opportunity to study in Toronto.

For over 45 years, St. Clair College has been a leader in establishing overseas and off site program delivery study options. St. Clair College welcomes the opportunity to now offer a quality student-friendly education experience in Toronto. Following the St. Clair College curriculum, each semester is designed to meet the challenges unique to international students and create a quality academic study environment. We offer small class sizes allowing efficient teacher-student interaction, flexible instruction hours and affordable tuition fees.

Energy Conservation and Demand Management

B.0 Introduction

At St. Clair College, the Safety, Security and Facility Management (SSFM) department is actively involved in campus sustainability initiatives and leads the development and implementation of this ECDMP. The SSFM department is also responsible for all related reporting. Under current regulation all broader public sector (BPS) organizations, including Colleges & Universities, are required to:

- **A.** Prepare, publish, make available to the public and implement energy conservation and demand management plans or joint plans.
- **B.** An energy conservation and demand management plan is composed of two parts:
  - A summary of the public agency's annual energy consumption and greenhouse gas emissions for its operations.
  - A description of previous, current and proposed measures for conserving and reducing the amount of energy consumed by the public agency's operations and for managing the public agency's demand for energy, including a forecast of the expected results of current and proposed measures.

All reports and submissions are available on the St. Clair website (http://www.stclaircollege.ca/boardandstaff/corporatedocuments.html). As required, approval by senior management for this ECDMP is documented in Appendix B.

B.1 Energy Conservation Targets & Goals

A. Energy Intensity

Under ONTARIO REGULATION 507/18, public agencies are required to develop goals and objectives for conserving and otherwise reducing energy consumption and managing demand for energy. At St. Clair College, the ECDMP is an evolving document built on several technical, organizational and behavioral measures. The measures aimed at conservation are based on a number of factors including organizational gaps and needs, current consumptions, available funding, incentives from local utility companies/IESO, existing infrastructure, new technologies, etc. Over the next 5 years, St. Clair College aims to reduce overall energy intensity across all three campuses by 15% (as compared to 2017 baseline) and to foster a stronger sense of sustainability in the organizational culture.

B. Greenhouse Gas Emissions

The recently proposed "Made in Ontario Environment Plan - 2018" introduces emission reduction targets for Ontario, in line with Canada's 2030 targets under the Paris agreement. The plan also recognizes that Ontario has been the leading province in the emission reduction efforts towards meeting the Paris agreement and it is also on track to meeting Canada's commitment under the Copenhagen accord of 17% below 2005 levels by 2020.

St. Clair College recognizes the provincial and federal targets of 30% below 2005 levels by 2030. Consequently, St. Clair College aims to reduce overall GHG emissions across all three campuses, by 15% over the next 5 years (2017 as the baseline), which aligns with both provincial and federal proposed targets. This plan maps out that strategy and is dependent on the ongoing funding from both the Provincial and Federal governments to help facilitate this plan.

B.2 Sustainability Strategy

A. Overview

Recognizing that energy conservation and carbon neutrality are dynamic targets where technology and applications are ever changing and improving, St. Clair College has adopted an integrated sustainability approach. Through the Facilities Management group, resources are dedicated to the ongoing integration, performance measuring and reporting of sustainability initiatives.

Facilities Management has led the development of the ECDMP, which will highlight current practices and target future actions that will influence the quantity or patterns, of energy consumed by St. Clair College. Our five-year strategy will focus on energy use reduction while also considering renewable energy sources and other on-site generation applications.

B. Alignment with Strategic Mandate Agreement (SMA)

St. Clair College's SMA2 identifies the student experience as one of our top priorities. The student experience is greatly impacted by the facilities that students occupy. Enhancing the facilities with improved lighting, ventilation, and other energy efficiency measures will improve the student experience.

St. Clair College is undergoing a significant capital transformation as it knows that the conditions of the interior and exterior spaces that campus stakeholders use, impacts their experience.

The proposed plan fully aligns with St. Clair College's SMA and is a key next step in the capital transformation of campus.

C. Categories

St. Clair College has divided its five-year strategy for the ECDMP into three primary categories:

- **Efficient Buildings**
- **Efficient Energy Sources & Distribution**, and
- **Renewable Energy**.

In addition, three secondary categories were also included:

- **Future Technologies**
- **Demand Management and**
- **Behavioural Energy Efficiency**

D. Efficient Buildings

The Efficient Building category is divided into two primary action items:

1. Retrofit and optimize buildings for energy efficient operation.
2. Perform continuous monitoring, targeting, and commissioning, to ensure best-in-class performance is maintained at all times.

St. Clair College recognizes that their energy efficiency efforts must start with ensuring that the buildings on campus, which are the primary energy consuming loads, are utilizing the minimum amount of net energy possible. The pinnacle of energy efficiency for buildings is known as zero-energy, or net-zero building, meaning that the total amount of energy used by the building on an annual basis is roughly equal to the amount of renewable energy created on site.

Over the next 5 years, St. Clair College plans to systematically address the energy efficiency of their buildings by executing projects that will lower total building energy consumption, while simultaneously improving the student experience. To accomplish this goal, in 2017 St. Clair College completed an Investment-grade Energy Feasibility Study, which identified multiple major projects to be finalized according with the Save on Energy (SOE) program's guidelines. The scope of these projects was to perform retrofits of various systems and equipment at the South Campus and the Downtown Campus. As a result of the same study, St. Clair College continued to attack several major energy conservation projects in the 2018 – 2019 timeframe, with funding through the Greenhouse Gas Campus Retrofit Program (GGCRP) run by The Ministry of Training, Colleges and Universities and the Ministry of Environment and Climate Change. The South Campus Central Power Plant, South Campus main building as well as the St. Clair College Centre For The Arts building at the Downtown campus have been identified as strategic targets for synergistic, deep energy efficiency retrofits. *Details can be found in Section C of this plan.*

E. Efficient Energy Sources & Distribution

The Efficient Energy Sources & Distribution category is divided into three primary action items:

1. Hot water generation - boilers optimization and/or replacement.
2. Hot water distribution - system optimizations.
3. Chilled water generation & distribution - system optimizations.

1. <u>Hot water boilers replacement.</u>

St. Clair College recognizes that for at least the next decade, our hot-water boilers will be a key part of our operation to provide efficient and cost-effective thermal energy to the campus. The primary benefits of replacing the existing boilers for state of the art, higher-efficiency ones are:

- Decreased GHG emissions
- Increased energy efficiency
- Decreased energy costs
- Increased economic competitiveness

2. <u>Hot-Water system optimizations.</u>

The hot water system at St. Clair College's campuses provide thermal energy to most buildings for the purposes of space heating and domestic hot water and it uses a medium/high-temperature hydronic system. St. Clair College will be ensuring that we continually optimize our existing system, including, but not limited to the following measures:

- <u>Hot-Water Generation</u>
  - ✓ Integrate boiler controls with BAS
  - ✓ Optimize heat load distribution per boiler, for optimal thermal efficiency.
  - ✓ Regularly perform operational parameters optimizations driven by real-time data.
  - ✓ Regularly check the feed-water quality and implement correct feed-water treatment
  - ✓ Optimized draft working in conjunction with maximizing heat recovery
  - ✓ Prepare and follow best operating and maintenance practices.
- <u>Hot-Water Distribution</u>
  - ✓ Insulation
  - ✓ Leaks
  - ✓ Air venting

3. <u>Chilled-Water system optimizations</u>

The chilled water system at St. Clair College's main campus provides thermal energy to most buildings for the purpose of air conditioning. It is understood that the chilled water system is the most efficient technology to provide cooling, as it can approach an efficiency of 0.5 kW/ton, compared to direct-expansion air conditioning systems which typically can only approach efficiencies of 1.0 kW/ton. Therefore, the chilled water system is expected to be part of the long-term future of St. Clair College's energy system.

F. Renewable Energy

The Renewable Energy category is divided into five primary action items:

1. Solar Photovoltaic (Distributed Electricity Generation)
2. Solar Air (HVAC air pre-conditioning)
3. Solar Thermal (Hot water generation)
4. Micro Wind (Distributed Electricity Generation)
5. Heat Pumps (High efficiency electric Heating & Cooling)

St. Clair College recognizes that in order to make progress towards 'net-zero' energy usage on the campus, renewable energy sources must be extensively utilized. One of the fundamental tenants of renewable energy is to consider that all of the sunlight that lands on St. Clair College's property, and all of the wind that blows across it, is an energy resource that can be tapped into. Practical technologies that currently exist which St. Clair College is studying for implementation include:

- Solar Photovoltaic
  - Solar carports
  - Solar panels on building roofs
  - Solar powered electric vehicle charging stations
  - Solar powered exterior lighting
- Solar Air
  - Solar walls (air pre-conditioning)
- Solar Thermal
  - Solar hot water
- Micro Wind Turbines

A heat pump is a device that transfers heat energy from a source of "heat" to a destination called a "heat sink". Heat pumps are designed to move thermal energy in the opposite direction of spontaneous heat transfer by absorbing heat from a cold space and releasing it to a warmer one. A heat pump uses a small amount of external power to accomplish the work of transferring energy from the heat source to the heat sink and the same heat pump can be used for space heating or space cooling. When a heat pump is used for heating, it employs the same basic refrigeration-type cycle used by an air conditioner or a refrigerator, but in the opposite direction - releasing heat into the conditioned space rather than the surrounding environment. In this use, heat pumps generally draw heat from the cooler external air or from the ground. Though it may seem counterintuitive at first, heat can actually be extracted from air as cold as -40C and used for space heating.

Heat pumps have two primary technologies – ground-sourced and air-sourced. Heat pumps are typically considered to be a hybrid renewable energy source, as they require external power to operate, usually in the form of electricity, however, they achieve higher overall efficiency than conventional heating and cooling systems.

St. Clair College has the potential to provide a vast majority of the heating thermal energy required for the campus with air-sourced heat pumps. Given that the electricity produced for Ontario's grid contains a small percentage of fossil fuel generation, air-sourced heat pumps have the ability to allow St. Clair College to significantly reduce its GHG emissions. However, the installation, operational and maintenance costs will be significantly higher than fossil fuel based heating. *Further details about this trade-off can be found in section D, 'Obstacles and Challenges'.*

G. Future Technologies

St. Clair College understands that in order to achieve the mandated long-term targets to reduce GHG emissions by 30 percent below 2005 levels by 2030, forecasting and predictions about potential future technology need to be included in this ECDMP. The Future Technology category is divided into four primary action items:

1. Electric Vehicles
2. Battery Storage
3. District Energy
4. Nuclear Power

1. Electric Vehicles

St. Clair College recognizes that electric vehicle (EV) technology is maturing at a rapid rate, and that the two key opportunities exist to capitalize on the ongoing deployment:

- Install publicly accessible charging stations
    - Installing EV charging stations will encourage the students and staff of St. Clair College to purchase and utilize EVs in lieu of vehicles powered by fossil fuels. This will lead to a reduction in the indirect amount of GHG emissions generated for transportation associated with St. Clair College.

- Replace fleet vehicles with EVs and install private charging stations
    - St. Clair College could replace all of their fleet vehicles with EVs. Given the relatively compact nature of the main campus, EVs are considered to be very practical for St. Clair College. This will lead to a reduction in the direct amount of GHG emissions generated for transportation by St. Clair College.

2. Battery Storage

The primary function of these systems is to allow for energy to be stored when it is available but not immediately required, then utilizing the energy when demand is high. Examples of systems where St. Clair College could utilize battery storage are:

- Solar powered exterior lighting
- Replacement of diesel & natural gas backup generators with batteries
- Pairing of batteries with Solar Photovoltaic and/or Micro-Wind systems
- Grid-scale battery storage system for entire campus

St. Clair College has great interest in battery storage, and will be exploring opportunities for implementation over the next years.

3. District Energy

District energy is the production and supply of thermal energy. Hot water or steam, and chilled water, are produced at central plants and distributed to surrounding buildings via a closed-loop underground distribution system known as a thermal grid. The thermal energy delivered to the buildings is used for space heating, domestic hot water heating and air conditioning. Buildings connected to the thermal grid do not need their own boiler or furnaces, chillers or air conditioners. Commercial buildings, condominiums, hotels, sports facilities, universities, and government complexes are all examples of buildings commonly connected to a thermal grid.

The Community Energy Plan developed by the City of Windsor indicated potential opportunity for a city-wide district energy system. The plan envisions first connecting the downtown buildings to the existing system in the downtown core, run by the Windsor Utilities Commission. Next, the system would be expanded to connect to the University of Windsor, Ford Windsor site, and FCA Windsor Assembly Plant. By doing so, greater coverage area and overall efficiency could be attained by integrating residential, commercial and industrial buildings onto a single system. In addition, there is opportunity at the South Campus to turn the Central Power Plant into a localized district energy plant for all surrounding buildings.

Further investigations into the potential an integrated district energy system will be considered. District energy is internationally accepted as one of the most efficient method of heating, cooling and powering communities.

4. <u>Nuclear Power</u>

St. Clair College sees the potential application of nuclear power technology to allow them to self-generate most, or all of their electrical and thermal energy needs. Small modular reactors are a type of nuclear fission reactor which are smaller than conventional reactors, manufactured at a plant, and brought to a site to be fully constructed. Modular reactors allow for less on-site construction, increased containment efficiency, and heightened nuclear materials security.

The technology needed to implement small modular reactors has been successfully demonstrated. However, there is currently no regulatory or licensing mechanism available in Canada to allow for this type of reactor to be constructed or operated. St. Clair College could explore this option if the regulatory environment changes in the future.

H. Demand Management

St. Clair College, South Campus, is eligible to participate in the Industrial Conservation Initiative (ICI) as offered by the Independent Electricity System Operator (IESO) since the average electrical demand from the grid exceeds 1 MW. The Industrial Conservation Initiative (ICI) is a form of demand response that allows participating customers to manage their global adjustment (GA) costs by reducing demand during peak periods. Customers who participate in the ICI, referred to as Class A, pay GA based on their percentage contribution to the top five peak Ontario demand hours (i.e. peak demand factor) over a 12-month base period. Ontario`s electricity system is built to meet the highest demand periods of the year. By reducing demand during peak periods, ICI participants can both reduce their global adjustment costs and help defer the need for investments in new electricity infrastructure.

St. Clair College opted-in as an ICI participant on June 2018, therefore the electricity billing rate, including the Global Adjustment component, is being calculated and charged as a Class A customer.

St. Clair College is currently investigating multiple solutions and scenarios available to all ICI participants, which would allow lowering and/or shifting the demand of the campus during peak periods. This would result in a significant reduction of the average cost per kWh of electricity, and indirectly, a reduction in GHG emissions.

St. Clair College is actively investigating the following measures to reduce or control the peak demand:

1. Chilled Water Storage Tanks

2. HVAC Curtailment & Setback
3. Lighting Controls
4. Battery Storage (multiple proposed models)

I. Behavioral Energy Efficiency

Behavior based energy efficiency programs are those that utilize strategies intended to affect energy use behaviors by students, staff, contractors and other actors in order for St. Clair College to achieve energy or peak demand savings. Programs typically include outreach, education, awareness building, reward benchmarking and feedback elements.

Such programs may result in changes to habitual behaviors (i.e. turning off lights where no controls are in place), or one time behaviors (i.e. changing thermostat settings or retro commissioning). In addition, these programs target changes in purchasing behavior (i.e. purchase of energy efficient products or services) often use in conjunction with other programs, as well as other behaviors related to the selection, installation and operation of building systems.

B.3 Energy Policy

St. Clair College is committed to the conservation of natural resources and will endeavor to reduce its energy footprint through all available means. The key elements to sustainable energy are:

- Commitment to the energy and GHG reduction targets:
    - 15% electricity reduction by 2024, below 2017 level (3% / year)
    - 15% natural gas reduction by 2024, below 2017 level (3% / year)
    - 15% GHG emissions reduction by 2024, below 2017 level (3% / year)
- Direct and consistent involvement of students and staff in energy reduction efforts.
- Senior Management commitment and support

St. Clair College adheres to, and promotes energy optimizations and reduction efforts in a structured framework, towards enhancing our competitive position.

B.4 Energy Team

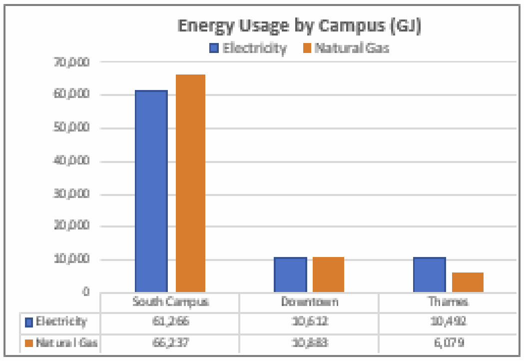
Our core energy team consists of knowledgeable individuals with a broad range of expertise:

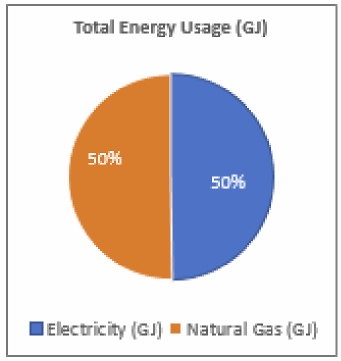
- Cosmin Nahaiciuc — Energy Manager, M.Eng, CEM, CMVP
- Rebecca Demchuk — Assistant VP, Safety, Security and Facilities Management, P.Eng.
- Peter Panzica — Facilities Maintenance Manager
- Mark Lambert — Professor, Power Engineering, CEM
- Scott Dufour — Professor, HVAC
- Dave Gillard — Facilities Electrician
- Kim Kubis — Power Plant Chief Engineer
- Marlon Podhraski — Facilities HVAC Technician
- BAS Technician (TBD) — Convergint Services

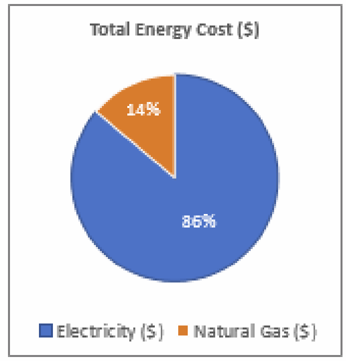
B.5 Energy Baseline

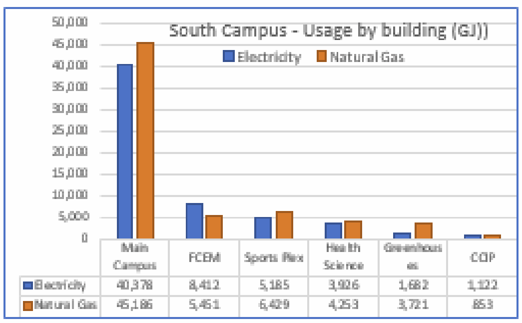
A. Energy usage and cost distribution by campus and buildings

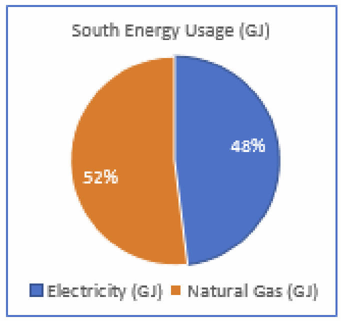
The graphs below show the energy usage and associated costs by campus and buildings, for a 12-month period during 2017 (baseline) calendar year:

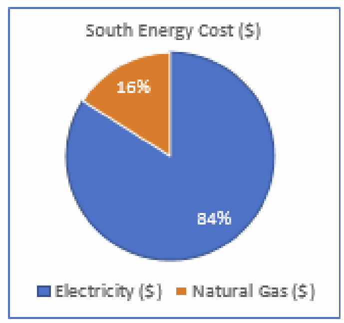


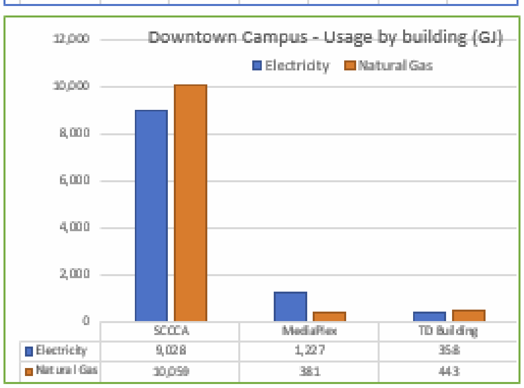


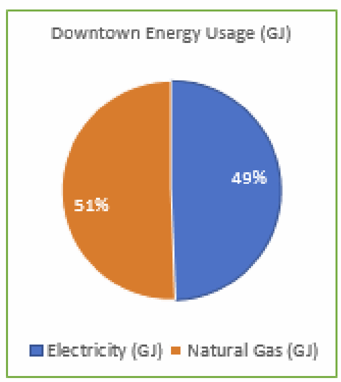


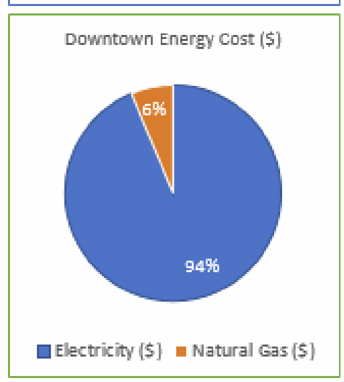


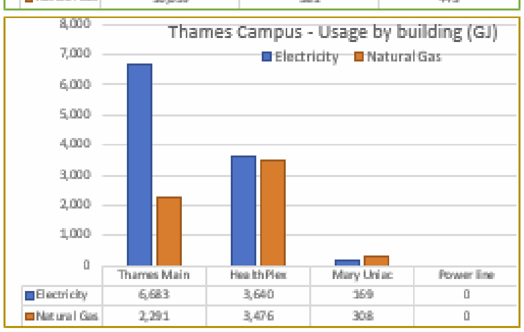


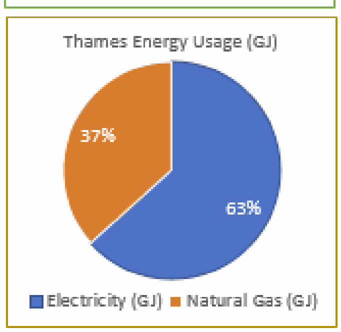


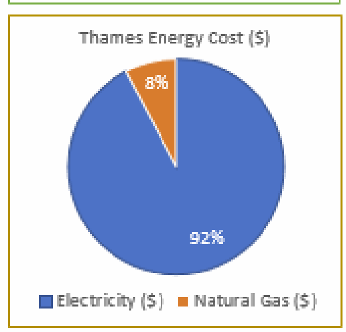






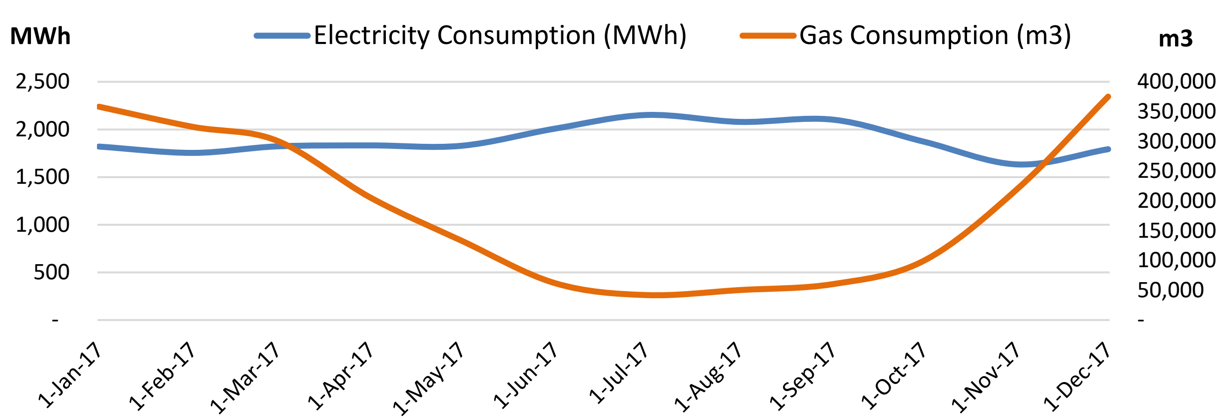






2017	Electricity (GJ)		Natural Gas (GJ)	
South Campus	61,266	74%	66,237	80%
Downtown Campus	10,612	13%	10,883	13%
Chatham Campus	10,492	13%	6,079	7%
TOTAL	**82,371**	**100%**	**83,199**	**100%**

Main Campus	40,378	66%	45,186	68%
FCEM	8,412	14%	5,451	8%
SportsPlex	5,185	8%	6,429	10%
Health Science	3,926	6%	4,253	6%
Greenhouses	1,682	3%	3,721	6%
CCIP	1,122	2%	853	1%
Truck & Coach	561	1%	344	1%
TOTAL SOUTH	**61,266**	**100%**	**66,237**	**100%**
SCCCA	9,028	85%	10,059	92%
MediaPlex	1,227	12%	381	4%
TD Building	358	3%	443	4%
TOTAL DOWNTOWN	**10,612**	**100%**	**10,883**	**100%**
Chatham Main	6,683	64%	2,291	38%
HealthPlex	3,640	35%	3,476	57%
Mary Uniac	169	2%	308	5%
Powerline	0	0%	0	0%
TOTAL CHATHAM	**10,491**	**100%**	**6,075**	**100%**

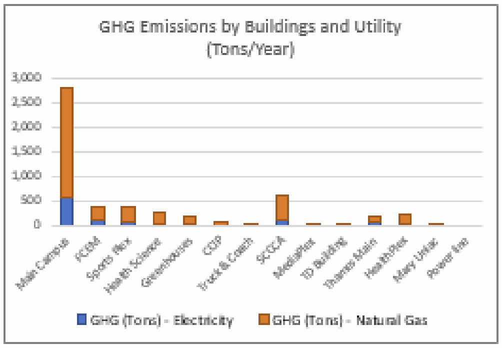


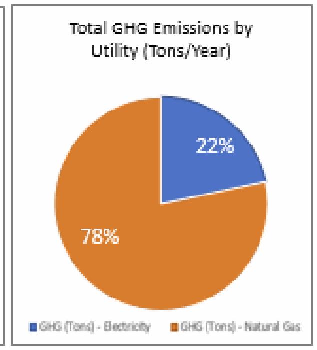
ST. CLAIR COLLEGE

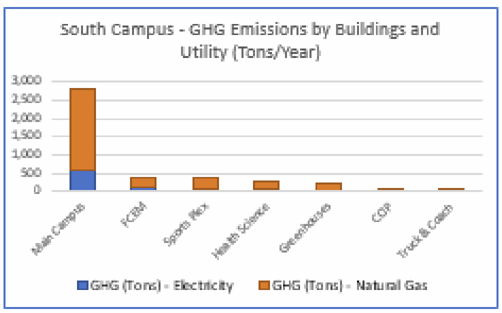
B.6 Greenhouse Gas Emissions Review

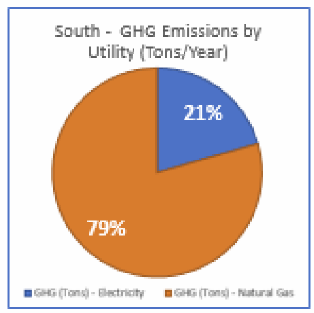
A. Overview

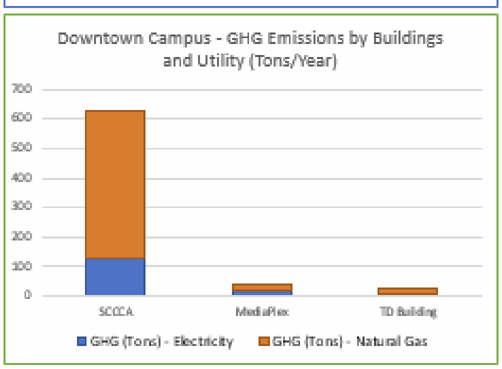
The total GHG emissions for utilities at St. Clair College campuses, for a 12-month period during 2017 (baseline) calendar year, are shown graphically below:

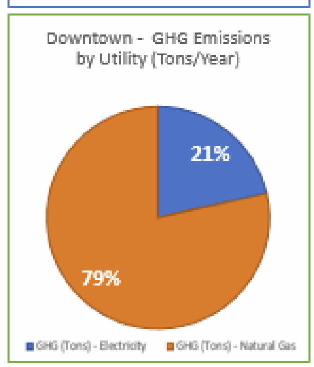


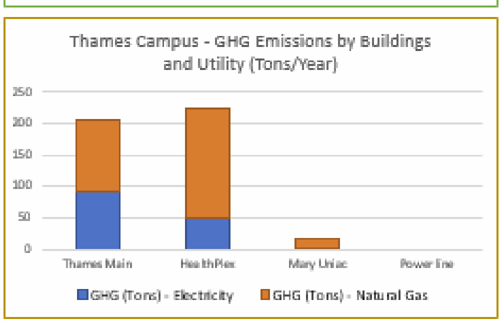


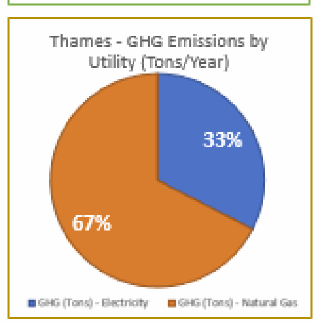












Energy Conservation Measures

C.0 Overview

Based on the Energy Feasibility Study completed in 2017, as well as internal reviews of the design and condition of the buildings on campus, the following list of energy conservation measures (ECM)s were selected to be considered for implementation over the next 5 years (2018-2023), which will result in reductions of both energy usage and GHG emissions:

- ECM C1 - Boilers replacement (South Campus and SCCCA - 6 boilers)
- ECM C2 - HVAC Retro-commissioning (All three Campuses)
- ECM C3 - HVAC Retrofits (All three Campuses)
- ECM C4 - HVAC Controls (All three Campuses)
- ECM C5 - LED Lighting and Controls (All three Campuses)
- ECM C6 - Domestic Water Conservation (South & Downtown Campus)
- ECM C7 - Building Envelope Upgrades (All three Campuses)
- ECM C8 – Distributed Energy Sources (South Campus)

C.1 ECM – Boilers replacement

A. Overview

Hot water and/or steam used for heating and domestic usage need to be generated at higher efficiency, lower cost and reduced GHG emissions.

B. Existing Conditions

South Campus - *Heating* is primarily provided by 4 identical 200 BHP Thermogenics Thermocoil medium temperature, hot water boilers. The boilers were built in 1993 and have since been retrofitted with linkage-free burners and controls. Hot water is circulated by a single, constant speed primary pump per boiler. The thermal system efficiency is estimated at 77%, with an estimated seasonal efficiency of 74%. The vast majority of *domestic hot water* is provided through heat exchangers served with hot water generated by boilers. Multiple types of heat exchangers are conveniently located throughout the entire campus to minimize heat losses.

Downtown Campus - *Heating* in the building is provided by 2 x 125 BHP Volcano forced-draft gas-fired steam boilers with condensate return, that were built in 1990. The steam feeds 2 plate and frame heat exchangers for 3 steam heating coils, humidifier and kitchen equipment. Each heat exchanger has a pair of constant flow pumps for hot water circulation. Condensate is returned to a receiver and circulated back to the boilers by a pair of feed-water pumps. *Domestic hot water* is provided by a gas-fired hot water heater with a DHW re-circulation pump.

C. Proposed Measures

South Campus – Replace the existing boilers for new, same type 3 x 300 BHP boilers to be used primarily for winter heating and one 75 BHP boiler for limited summer loads (domestic hot water and heating). All boilers shall be water-wall combustion chamber, with linkage free burners. The existing primary pumps shall be retained. An increased 10:1 turn-down ratio shall insure increased load range and versatility. Each boiler shall be installed complete with a motorized draft control flue damper, controlled through its integral controller. A 3-stage heat recovery system shall further increase the system's efficiency by recovering residual heat from flue gases: (1) boiler's feed water, (2) space heating and (3) domestic hot water. System efficiency is expected to increase to 84%-85%.

Downtown Campus - Replace the existing boilers for new, 2 x 132 BHP (4,400MBH output) two-drum water-tube design with a tangent tube water-wall combustion chamber mounted on a heavy steel frame. Top, bottom and sides of the furnace shall be water cooled, designed to alleviate thermal stresses, therefore highly suitable for quick starts. The proposed boilers are designed to generate steam, but the system can be modified for hot water hydronic heating. A 7:1 turndown ratio ensures optimized load range. System efficiency is expected to increase from 70% to about 80% - 82%.

C.2 ECM – HVAC Retro-Commissioning

A. Overview

HVAC systems need to provide efficient temperature control and the right amount of fresh air, at the right time, using the minimal amount of energy.

B. Specifics

Retro-commissioning is the process of improving the efficiency of an existing building's equipment and systems. It can often resolve problems that occurred during design or construction, or address problems that occurred throughout the building's life as equipment has aged, or as building usage has changed. Retro-commissioning involves a systemic evaluation of opportunities to improve energy-using systems and also it typically improves the indoor air quality.

The typical kinds of problems that retro-commissioning will identify and fix include:

- Equipment that is on when it may not need to be
- Systems that simultaneously heat and cool
- Belts and valves that are not functioning properly
- Thermostats and sensors that are out of calibration
- Air balancing systems that are less than optimal
- Economizers that are not working as designed
- Controls sequences that are functioning incorrectly
- Variable-frequency drives that operate at unnecessarily high speeds or operate at a constant speed even though the load being served is variable

The key project steps to implement retro-commissioning are:

1. Review existing systems and related documentation
2. Develop retro-commissioning plan
3. Perform calibration and maintenance checks
4. Implement diagnostic monitoring/trending
5. Perform functional tests
6. Analyze the monitoring/trending and test data
7. Assess and document the current operating strategies and sequences of operation
8. Document operations and maintenance improvement opportunities
9. Calculate energy impacts and develop implementation cost estimates for operations and maintenance opportunities
10. Develop and deliver the final retro-commissioning report

C.3 ECM – HVAC Retrofits

A. Overview

HVAC systems need to provide efficient temperature control and the right amount of fresh air, at the right time, using the minimal amount of energy.

B. Specifics

The currently installed, constant-air-volume (CAV) units operate the fan and compressor at full capacity until the temperature drops to a specified setting, then the compressor turns off. The on/off cycling is not efficient at keeping the space at a constant temperature. Variable-air-volume (VAV) systems were developed to meet the varying heating and cooling needs of different building zones. The system is efficient at dehumidifying the space and it's available in a multiple-zone system configuration. VAV systems are one of the most energy efficient building air-handling systems. They offer more precise temperature control as the fan speed varies depending on the temperature in the space. The compressor regulates the refrigerant flow to maintain a constant air temperature. The HVAC industry regards pressure independent VAV systems as the best HVAC system design available.

Below are the proposed optimizations to the current systems:

- VAV Conversion – **Multi-Zone**. This measure proposes converting the existing constant volume, multi-zone air handling units to variable air volume (VAV). Applicable to four AHU in B block and three AHU in C block.
- VAV Conversion – **Large Single-Zone**. This measure proposes converting the existing constant volume large single-zone air handling units to variable air volume (VAV). Applicable to two AHU in C block serving the North and South part of the gymnasium and/or swimming pool.
- VAV Conversion – **Constant volume- reheat**. This measure proposes converting the existing constant volume, reheat box air handling units to variable air volume (VAV). Applicable to four AHU in A block (SAF1A, SAF1B, SAF2, SAF3, SAF4) and one AHU in F block (AC2)
- VAV Conversion – **Dual duct**. This measure proposes converting the existing constant volume, dual-duct air handling units with mixing boxes, to variable air volume (VAV). Applicable to one AHU in B block (AC1B) and one AHU in C block (HV1C)

The following types of equipment are to be considered on all of the above measures:

- VFD (Variable Frequency Drives fit with load reactors), controlled by pressure sensors.
- VAV boxes with electric actuators controlled by air flow, temperature and pressure.
- AHU motors to be replaced (high-efficiency, inverter duty motors).
- On-demand, CO_2 controlled ventilation (where applicable).

C.4 ECM – HVAC Controls

A. Overview

Currently there is no method of identifying whether the HVAC systems are operating as per design conditions, unless visually analyzed on the graphics, or programming automated alarms on the BAS. Triggered alarms, which are programmed into the BAS are initiated to catch anomalies, but without knowing what kind of alarms to program, numerous anomalies are overlooked.

B. Specifics

Building analytics is a method of identifying long term trends towards optimizing energy usage and implementing fault detection diagnostics. A data acquisition device (DAD) pulls up the 5000 data points from the BAS, such as AHU supply air temperature, building return water temperature or a valve position every 15 minutes and stores it on an internal hard drive, and if enabled, it loads it to a secure server. At this point the analytics engine processes this data into actionable insights which deliver critical information identifying energy and maintenance savings opportunities. This information is served to users in a series of dashboards, reports and alerts to help users take charge of their building performance. This insights allow for an in-depth view of how the building HVAC systems operate, outline inefficiencies and highlights opportunities for improved performance.

C. Benefits / Savings

- Optimized/reduced air flow (VAV & VFD)
- Higher efficiency motors (AHU - air supply and return)
- Reduced head load by eliminating most reheat coils (Temperature controlled by flow)
- On-demand ventilation (CO_2 & occupancy controlled)
    - Natural Gas savings resulted from reduced outside air intake (recirculation)
    - Natural Gas savings resulted from shutting down ventilation when not needed.
- GHG emissions reductions (indirect effect as a result of increased system efficiency)

C.5 ECM – LED Lighting and Controls

A Overview

Indoor and outdoor lighting systems need to provide the right amount of light, at the right time, using the minimal amount of energy.

B Specifics

LED lighting is the most efficient lighting technology currently available. In addition to being efficient, it also has a longer life compared to previous lighting technology, which reduces ongoing maintenance costs.

St. Clair College currently has a mix of different types of lighting installed, other than LED, including incandescent, fluorescent and metal halide. The detailed action items are:

- High Efficiency Lighting Systems (e.g., LED)
  - Replace all non-LED lighting with LED luminaire that, at a minimum, is a listed product by the Design Lights Consortium® (DLC).
- Controls and Sensors
  - Install, upgrade and commission lighting controls to minimize energy usage, including ones based on, but not limited to, scheduling, occupancy, daylight harvesting, multi-level switching, and manual dimming.

C.6 ECM – Domestic water conservation

A. Overview

Domestic water fixtures need to provide the proper amount of water, when needed, using the minimal amount of water.

B. Specifics

Replace all existing tank type and flush valve toilets with flow rates exceeding 6 Litres per Flush (LPF). Non-sensored 6 LPF flush-valve toilets to be retrofitted with dual flush models with an effective flow rate of 4.8 LPF. High flow faucet aerators will be retrofitted with either 1.9 LPF aerators in areas where only hand washing is required and with 3.8 LPF aerators in areas where grooming takes place. Flush valve urinals with flow rates of 3.8 LPF will be replaced for new 1.9 LPF valve and existing urinals fed by flush tanks will have urinal tank controllers installed. Existing high flow showers will be replaced for new, 5.7 Litres per Minute (LPM), high efficiency shower heads. The sensing range of sensored urinals and toilets will be inspected and adjusted as needed, to avoid unnecessary flushes.

C.7 ECM – Building Envelope Upgrades

A. Overview

Building envelopes need to provide the highest possible insulation and air sealing performance available to minimize the amount of thermal energy loss.

B. Specifics

The building envelope is the primary interface with the external environment. It is the physical separator between the conditioned and the unconditioned environment of a building; the design and construction of the exterior of a building including the resistance to air, water, heat, light and noise transfer. It also includes the broader aspects of appearance, structure, safety from fire and security. The three basic elements of a building envelope are weather, air and thermal barriers. The detailed action items are:

- Energy Efficient Windows/Doors/Skylights (e.g. lower thermal conductivity fenestration)
- Air sealing projects
- Green Roof or New Roof (with high insulation factors)
- Passive Building Strategies (e.g. solar sun shading)
- Increased Wall & Roof Insulation (with increased air tightness)

C.8 ECM – Distributed Energy Sources

A. Overview

Distributed energy sources (DESs) are electricity-producing sources or controllable loads that are directly connected to the host facility. DESs can include solar panels, combined heat and power plants, electricity storage, natural gas generators, electric vehicles and controllable loads, such as HVAC systems and electric water heaters.

B. Specifics

The following options are being considered for short and medium terms:

- BESS (Battery Energy Storage Solutions) and/or Natural Gas Generators for Global Adjustment mitigation as well as electricity cost reduction beyond the GA portion.
- Heat pumps, both geothermal and air sourced have been identified globally as a key solution to efficiently retrofitting low-carbon buildings. In Asia and Europe heat pumps are commonplace. In Canada, other electric and natural gas powered systems have dominated the HVAC landscape mostly due to the (1) relatively high up front cost, (2) availability of cheap natural gas, (3) lack of familiarity with the technology and (4) skepticism about performance in a cold climate. Though it may seem counterintuitive, heat can actually be extracted from air as cold as -40C and used for space heating. St. Clair College investigates both technologies and will progressively start replacing the aging HVAC equipment.
- Solar panels. Parking lots offer expansive, un-shaded and unobstructed spaces ideal for housing commercial-scale solar carports. With over 800,000 sq. feet of open parking space at our South Main Campus and close to 200,000 sq. feet at the Chatham Campus, St. Clair College plans on exploring this tremendous opportunity. Adding shade structures to a parking lot can reduce lighting costs through the installation of energy-efficient LED lighting under the structures, in place of the often low-efficiency light poles in many lots. Additionally, the panels protect both, the asphalt and cars from damaging solar radiations and hail while also eliminating the need for snow removal in the winter.

Obstacles and Challenges

D.0 Overview

Based on the Energy Feasibility Study completed in 2017, as well as internal reviews of the design and condition of the buildings on campus, the following list of obstacles and challenges were selected to be discussed in detail:

D.1 - Funding for Capital Projects
D.2 - Economics and GHG Emissions of Natural Gas versus Electricity

D.1 Funding for Capital Projects

A. Overview

The capital funding available for projects that improve energy efficiency and GHG emissions is forecasted to lag behind demand.

B. Specifics

St. Clair College, like many other post-secondary institutions in Ontario, has a large inventory of buildings that are more than 20 years old, and limited capital funds to perform campus wide or synergistic deep retrofit projects to the buildings to improve the energy efficiency.

It is expected that the cost of energy will increase faster than the rate of inflation, and as the cost of energy increases, more projects will be viable from a financial perspective (return on investment). However, this may not occur quickly enough to insulate St. Clair College from energy price spikes, or reach the mandated GHG emission reduction targets.

In order to address this challenge, the Facilities Management department will strive to create a 7 to 10 year energy efficiency investment plan for St. Clair College, with the goal being to have the plan approved by Senior Management, as well as utilizing all sources of outside funding available including government grant programs and utility incentives.

D.2 Economics and GHG Emissions of Natural Gas versus Electricity

A. Overview

The mandated GHG emissions reduction targets strongly imply moving away from natural gas as a fuel source, but the economics of doing so are not favorable at this time.

B. Specifics

Natural gas is a safe, clean burning and affordable fuel source. When combusted, it produces very low levels of nitrous oxide compounds, and virtually no sulfur oxides or particulates, unlike liquid or solid fossil fuels such as gasoline, kerosene, diesel, or coal. The primary emission from natural gas usage is carbon dioxide (CO_2), which is the second most significant long-lived greenhouse gas in Earth's atmosphere. Since the Industrial Revolution, anthropogenic emissions – primarily from use of fossil fuels and deforestation – have rapidly increased its concentration in the atmosphere, leading to global warming. The CO_2 released into the atmosphere as a result of the use of fossil fuels "represents 99.4% of CO_2 emissions in 2013". Carbon dioxide also causes ocean acidification because it dissolves in water to form carbonic acid.

In an effort to further reduce GHG emissions, Ontario joined the Western Climate Initiative, and on January 1, 2018 the province implemented a Cap & Trade program for GHG emissions in partnership with Quebec and California. Ontario's cap-and-trade system aimed to lower greenhouse gas emissions by putting caps on the amount of pollution companies in certain industries could emit. If companies exceeded those limits they had to buy allowances at quarterly auctions or from other companies that came in under their limits. On October 31, 2018, however, the Government of Ontario formally repealed the Ontario cap-and-trade program and retired the emissions allowances and offset credits held by Ontario participants under the "Provincial Cap and Trade System". The new legislation would also propose measures to help replace the cap-and-trade carbon tax with a better plan for achieving environmental goals – *still under review at the time of this writing*.

Replacing virtually all of the usage of natural gas at St. Clair College is technically feasible with today's technology. The primary systems where usage could be eliminated would be the boilers and the (Roof Top) heating units directly burning natural gas. Without using natural gas for heating, St. Clair College would need to convert the building heating systems from natural gas or hot water to air sourced heat pumps. Air source heat pumps operate solely on electricity, and would be effective and efficient in the Windsor area as the winter temperatures rarely approach -30C, with an all-time record low being -29.1C, recorded on January 19, 1994.

Given that the electricity purchased from Ontario's grid is very clean from a GHG emissions perspective due to the large amount of baseload nuclear and hydroelectric, St. Clair College could potentially meet the 2030 and 2050 GHG emissions targets of 37% percent and 80% percent reductions respectively, by aggressively moving ahead with converting the building heating systems to air sourced heat pumps. The first result of this conversion would result in running only one and occasionally two boilers, at very low load. Eventually, the boilers could be decommissioned and the campus energy system would be entirely electrical based.

However, the economics of this action plan are not favorable at this time. The cost of electricity in Ontario per GJ is about 7.5 times higher than the cost of natural gas per GJ. Converting buildings to utilize air sourced heat pumps and decommissioning the boilers is forecasted to increase St. Clair College’s purchased electricity cost by a factor of 3X to 5X. In addition to the utility cost impacts, air sourced heat pumps are also more expensive to install and maintain than natural gas or hot water based HVAC equipment.

Further research and planning is required over the next 5 years to understand how to achieve the proper balance of economics and GHG emissions between the usage of natural gas and electricity.

Summary and Targets

E.0 Summary

St. Clair College's organizational culture for promoting energy conservation and sustainable initiatives is evident through its planning for both existing and new infrastructure, as well as through education, outreach and awareness. This ECDMP is a dynamic document intended to not only ensure compliance with Ontario regulations, but also highlight and document the organization's energy and demand management conservation goals, and to measure its progress against them. St. Clair College understands its responsibility towards promoting energy conservation and sustainability, and commits to providing leadership for current and future generations at its organization.

This report provides a background of St. Clair College's current energy conservation practices and highlights the measures that will be taken to further reduce campus-wide consumption over the next 5 years (2023).

Building on past successes and many existing efforts, the EDCMP is anticipated to result in improved efficiencies, utility cost savings, improved energy management, future cost avoidance, and lower greenhouse gas emissions. All measures outlined beyond 2019 are dependent on approved annual College capital funding allocations as well as funding from the Provincial and Federal governments to support these targets and initiatives. This plan will be updated annually to reflect actual projects and reductions.

E.1 General Targets

Through this EDCMP, it is estimated that by 2024, St. Clair College achieves a minimum of:

- 15% electricity reduction by 2024, below 2017 level (3% / year)
- 15% natural gas reduction by 2024, below 2017 level (3% / year)
- 15% GHG emissions reduction by 2024, below 2017 level (3% / year)

E.2 Energy Reduction Plan - Targets and Strategy to 2024 (against 2017 base year)

Year	EL Usage (GJ)	NG Usage (GJ)	Total Usage (GJ)
2,017	82,371	83,199	165,570

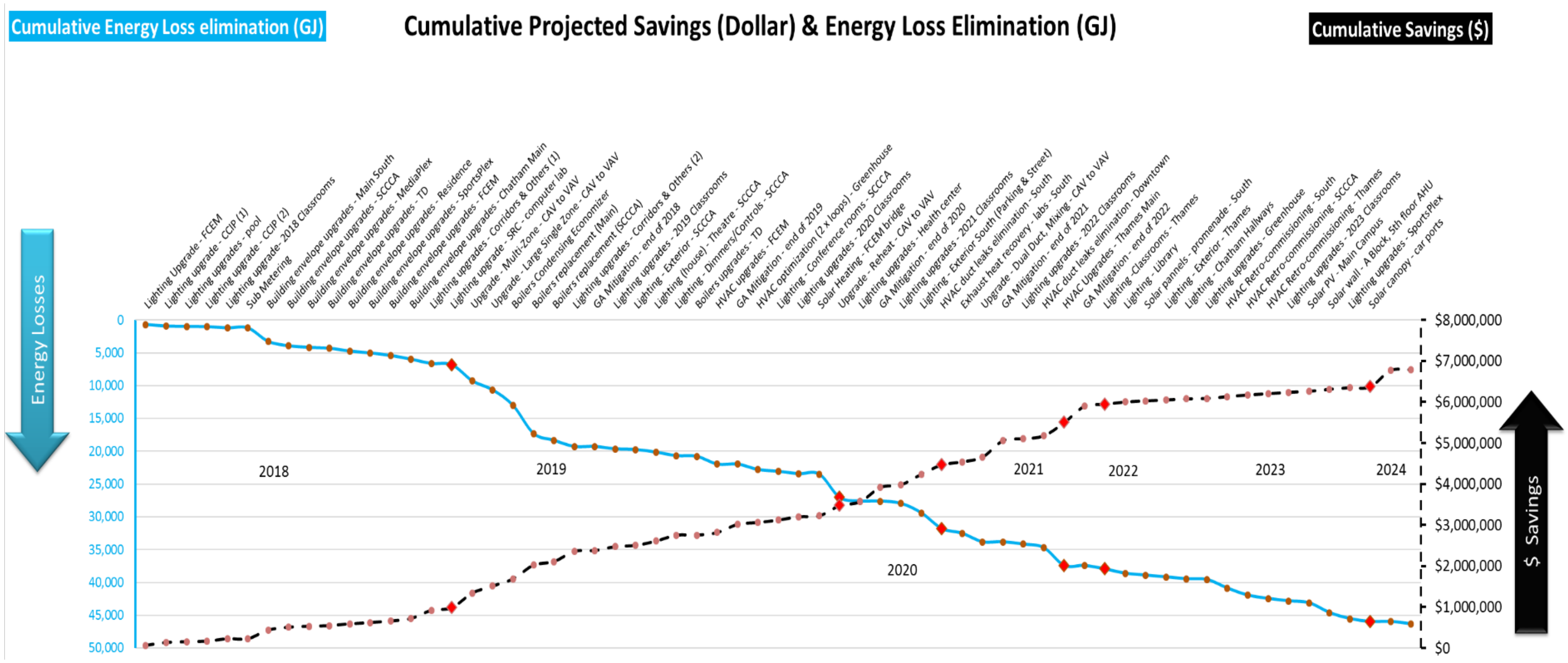
Year	Cumulative number of ECMs			Cumulative Investment	Projected (Cumulative) Energy Savings			
	All Projects	EL Projects	NG Projects			vs. 2017	per year	
	#	#	#	$	GJ	%	%	$
2,018	21	8	13	$6,431,748	18,364	11.1%		$2,108,908
2,019	8	6	2	$7,069,449	21,982	13.3%	2.2%	$2,816,749
2,020	6	3	3	$8,484,449	27,076	16.4%	3.1%	$3,470,957
2,021	7	4	3	$9,864,449	33,820	20.4%	4.1%	$4,656,615
2,022	4	2	2	$11,514,449	37,433	22.6%	2.2%	$5,496,422
2,023	13	10	3	$12,525,449	44,604	26.9%	4.3%	$6,310,217
2,024	4	4	0	$13,595,449	46,332	28.0%	1.0%	$6,787,017

2018-2024 - Proposed Energy Conservation Measures (ECMs)

Year	Estimated Completion Date (DD-MM-YY)	Project Name	Est Project Cost ($) Cost	Est Project Cost ($) Incentives	Estimated Peak Demand Savings (kW)	Electricity Savings CUSUM (GJ)	Electricity Savings ($)	N.G. Savings (GJ)	N.G Savings ($)	Combined Energy Savings CUSUM (GJ)	Total CUMULATIVE Savings ($) 2018	2019	2020	2021	2022	2023	2024	7 Year Combined Savings CUSUM ($)
2018	3-Mar-18	Lighting Upgrade - FCEM	$266,649	$28,163	45	716	$9,741	0	$0	716	$9,741	$9,741	$9,741	$9,741	$9,741	$9,741	$9,741	$68,188
	8-Jun-18	Lighting upgrade - CCIP (1)	$3,538	$1,769	7	936	$9,741	0	$0	936	$9,741	$9,741	$9,741	$9,741	$9,741	$9,741	$9,741	$136,376
	29-Jun-18	Lighting upgrades - pool	$4,530	$1,520	4	994	$2,592	0	$0	994	$2,592	$2,592	$2,592	$2,592	$2,592	$2,592	$2,592	$154,522
	29-Jun-18	Lighting upgrade - CCIP (2)	$3,276	$1,638	4	1,040	$2,048	0	$0	1,040	$2,048	$2,048	$2,048	$2,048	$2,048	$2,048	$2,048	$168,858
	10-Sep-18	Lighting upgrade- 2018 Classrooms	$47,310	$7,770	40	1,229	$8,418	0	$0	1,229	$8,418	$8,418	$8,418	$8,418	$8,418	$8,418	$8,418	$227,783
	1-Dec-18	Sub Metering	$50,000	$0	0	1,229	$0	0	$0	1,229	$0	$0	$0	$0	$0	$0	$0	$227,783
	25-Dec-18	Building envelope upgrades - Main South	$40,850	$0	0	1,229	$15,962	2,053	$14,323	3,282	$30,284	$30,284	$30,284	$30,284	$30,284	$30,284	$30,284	$439,773
	25-Dec-18	Building envelope upgrades - SCCCA	$17,566	$0	0	1,229	$5,197	668	$4,663	3,951	$9,860	$9,860	$9,860	$9,860	$9,860	$9,860	$9,860	$508,793
	25-Dec-18	Building envelope upgrades - MediaPlex	$7,553	$0	0	1,229	$1,856	239	$1,665	4,190	$3,521	$3,521	$3,521	$3,521	$3,521	$3,521	$3,521	$533,443
	25-Dec-18	Building envelope upgrades - TD	$3,248	$0	0	1,229	$1,114	143	$999	4,333	$2,113	$2,113	$2,113	$2,113	$2,113	$2,113	$2,113	$548,233
	25-Dec-18	Building envelope upgrades - Residence	$1,397	$0	0	1,229	$3,341	430	$2,998	4,762	$6,339	$6,339	$6,339	$6,339	$6,339	$6,339	$6,339	$592,603
	25-Dec-18	Building envelope upgrades - SportsPlex	$601	$0	0	1,229	$2,227	286	$1,999	5,049	$4,226	$4,226	$4,226	$4,226	$4,226	$4,226	$4,226	$622,183
	25-Dec-18	Building envelope upgrades - FCEM	$258	$0	0	1,229	$2,970	382	$2,665	5,431	$5,634	$5,634	$5,634	$5,634	$5,634	$5,634	$5,634	$661,623
	25-Dec-18	Building envelope upgrades - Chatham Main	$111	$0	0	1,229	$4,454	573	$3,997	6,004	$8,451	$8,451	$8,451	$8,451	$8,451	$8,451	$8,451	$720,783
	30-Dec-18	Lighting upgrades - Corridors & Others (1)	$95,200	$14,500	20	1,877	$28,800	0	$0	6,651	$28,800	$28,800	$28,800	$28,800	$28,800	$28,800	$28,800	$922,383
	31-Dec-18	Lighting upgrade - SRC - computer lab	$17,662	$1,700	12	2,082	$9,120	0	$0	6,856	$9,120	$9,120	$9,120	$9,120	$9,120	$9,120	$9,120	$986,223
	25-Feb-19	Upgrade - Multi-Zone - CAV to VAV	$975,000	$0	95	2,982	$40,000	1,539	$10,735	9,295	$50,735	$50,735	$50,735	$50,735	$50,735	$50,735	$50,735	$1,341,371
	25-Feb-19	Upgrade - Large Single Zone - CAV to VAV	$300,000	$0	50	3,378	$17,600	997	$6,956	10,688	$24,556	$24,556	$24,556	$24,556	$24,556	$24,556	$24,556	$1,513,261
	31-Mar-19	Boilers Condensing Economizer	$2,100,000	$0	-20	3,144	$7,000	2,611	$18,216	13,065	$25,216	$25,216	$25,216	$25,216	$25,216	$25,216	$25,216	$1,689,770
	31-Mar-19	Boilers replacement (Main)	$1,657,000	$0	35	3,493	$20,300	3,898	$27,193	17,312	$47,493	$47,493	$47,493	$47,493	$47,493	$47,493	$47,493	$2,022,223
	1-Apr-19	Boilers replacement (SCCCA)	$840,000	$0	10	3,601	$5,800	944	$6,584	18,364	$12,384	$12,384	$12,384	$12,384	$12,384	$12,384	$12,384	$2,108,908
2019	30-Apr-19	Lighting upgrades - Corridors & Others (2)	$216,701	$12,853	40	4,537	$41,600	0	$0	19,300		$41,600	$41,600	$41,600	$41,600	$41,600	$41,600	$2,358,508
	30-Jun-19	GA Mitigation - end of 2018	$0	$0	0	4,537	$0	0	$0	19,300		$19,837	$0	$0	$0	$0	$0	$2,378,345
	1-Sep-19	Lighting upgrades - 2019 Classrooms	$70,000	$8,000	15	4,897	$16,000	0	$0	19,660		$16,000	$16,000	$16,000	$16,000	$16,000	$16,000	$2,474,345
	1-Sep-19	Lighting - Exterior - SCCCA	$15,000	$2,000	3	5,005	$4,800	0	$0	19,768		$4,800	$4,800	$4,800	$4,800	$4,800	$4,800	$2,503,145
	1-Sep-19	Lighting (house) - Theatre - SCCCA	$50,000	$7,000	15	5,401	$17,600	0	$0	20,164		$17,600	$17,600	$17,600	$17,600	$17,600	$17,600	$2,608,745
	1-Oct-19	Lighting - Dimmers/Controls - SCCCA	$74,000	$7,000	30	5,941	$24,000	0	$0	20,704		$24,000	$24,000	$24,000	$24,000	$24,000	$24,000	$2,752,745
	1-Nov-19	Boilers upgrades - TD	$42,000	$4,000	-1	5,934	-$320	112	$781	20,809		$461	$461	$461	$461	$461	$461	$2,755,509
	30-Nov-19	HVAC upgrades - FCEM	$170,000	$15,000	5	5,988	$2,400	1,119	$7,807	21,982		$10,207	$10,207	$10,207	$10,207	$10,207	$10,207	$2,816,749
2020	30-Jun-20	GA Mitigation - end of 2019	$0	$0	0	5,988	$0	0	$0	21,982			$200,000	$0	$0	$0	$0	$3,016,749
	1-Oct-20	HVAC optimization (2 x loops) - Greenhouse	$50,000	$3,000	4	6,078	$4,000	746	$5,204	22,818			$9,204	$9,204	$9,204	$9,204	$9,204	$3,062,771
	1-Oct-20	Lighting - Conference rooms - SCCCA	$35,000	$5,000	8	6,348	$12,000	0	$0	23,088			$12,000	$12,000	$12,000	$12,000	$12,000	$3,122,771
	30-Oct-20	Lighting upgrades - 2020 Classrooms	$50,000	$6,000	15	6,708	$16,000	0	$0	23,448			$16,000	$16,000	$16,000	$16,000	$16,000	$3,202,771
	1-Dec-20	Solar Heating - FCEM bridge	$30,000	$3,000	4	6,816	$4,800	-37	-$260	23,518			$4,540	$4,540	$4,540	$4,540	$4,540	$3,225,470
	1-Dec-20	Upgrade - Reheat - CAV to VAV	$1,250,000	$45,000	150	7,464	$28,800	2,909	$20,297	27,076			$49,097	$49,097	$49,097	$49,097	$49,097	$3,470,957
2021	1-Jun-21	Lighting upgrades - Health center	$180,000	$28,000	25	8,004	$24,000	0	$0	27,616				$24,000	$24,000	$24,000	$24,000	$3,566,957
	30-Jun-21	GA Mitigation - end of 2020	$0	$0	0	8,004	$0	0	$0	27,616				$350,000	$0	$0	$0	$3,916,957
	1-Sep-21	Lighting upgrades - 2021 Classrooms	$50,000	$6,000	15	8,364	$16,000	0	$0	27,976				$16,000	$16,000	$16,000	$16,000	$3,980,957
	1-Oct-21	Lighting - Exterior South (Parking & Street)	$200,000	$11,000	60	9,804	$64,000	0	$0	29,416				$64,000	$64,000	$64,000	$64,000	$4,236,957
	1-Oct-21	HVAC duct leaks elimination - South	$200,000	$5,000	60	10,884	$48,000	1,306	$9,108	31,801				$57,108	$57,108	$57,108	$57,108	$4,465,388
	1-Nov-21	Exhaust heat recovery - labs - South	$50,000	$5,000	10	11,244	$16,000	373	$2,602	32,534				$18,602	$18,602	$18,602	$18,602	$4,539,797
	1-Dec-21	Upgrade - Dual Duct, Mixing - CAV to VAV	$700,000	$25,000	80	11,784	$24,000	746	$5,204	33,820				$29,204	$29,204	$29,204	$29,204	$4,656,615
2022	30-Jun-22	GA Mitigation - end of 2021	$0	$0	0	11,784	$0	0	$0	33,820					$400,000	$0	$0	$5,056,615
	1-Sep-22	Lighting upgrades - 2022 Classrooms	$50,000	$6,000	15	12,144	$16,000	0	$0	34,180					$16,000	$16,000	$16,000	$5,104,615
	1-Oct-22	HVAC duct leaks elimination - Downtown	$100,000	$4,000	40	12,684	$24,000	0	$0	34,720					$24,000	$24,000	$24,000	$5,176,615
	1-Oct-22	HVAC Upgrades - Thames Main	$1,500,000	$50,000	150	15,024	$104,000	373	$2,602	37,433					$106,602	$106,602	$106,602	$5,496,422
20123	30-Jun-23	GA Mitigation - end of 2022	$0	$0	0	15,024	$0	0	$0	37,433						$400,000	$0	$5,896,422
	1-Jul-23	Lighting -Classrooms - Thames	$80,000	$10,000	35	15,564	$24,000	0	$0	37,973						$24,000	$24,000	$5,944,422
	1-Jul-23	Lighting - Library	$90,000	$15,000	25	16,212	$28,800	0	$0	38,621						$28,800	$28,800	$6,002,022
	1-Aug-23	Solar pannels - promenade - South	$55,000	$6,000	18	16,500	$12,800	0	$0	38,909						$12,800	$12,800	$6,027,622
	1-Sep-23	Lighting - Exterior - Thames	$40,000	$5,000	10	16,770	$12,000	0	$0	39,179						$12,000	$12,000	$6,051,622
	1-Sep-23	Lighting - Chatham Hallways	$40,000	$5,000	10	17,058	$12,800	0	$0	39,467						$12,800	$12,800	$6,077,222
	1-Sep-23	Lighting upgrades - Greenhouse	$60,000	$9,000	5	17,166	$4,800	0	$0	39,575						$4,800	$4,800	$6,086,822
	1-Sep-23	HVAC Retro-commissioning - South	$80,000	$0	46	17,544	$16,800	933	$6,506	40,886						$23,306	$23,306	$6,133,433
	1-Sep-23	HVAC Retro-commissioning - SCCCA	$50,000	$0	30	17,868	$14,400	746	$5,204	41,956						$19,604	$19,604	$6,172,642
	1-Sep-23	HVAC Retro-commissioning - Thames	$50,000	$0	30	18,192	$14,400	187	$1,301	42,466						$15,701	$15,701	$6,204,044
	1-Sep-23	Lighting upgrades - 2023 Classrooms	$50,000	$6,000	15	18,552	$16,000	0	$0	42,826						$16,000	$16,000	$6,236,044
	1-Oct-23	Solar PV - Main Campus	$186,000	$20,000	60	18,851	$13,280	0	$0	43,125						$13,280	$13,280	$6,262,604
	1-Dec-23	Solar wall - A Block, 5th floor AHU	$230,000	$12,000	15	19,211	$16,000	1,119	$7,807	44,604						$23,807	$23,807	$6,310,217
2024	1-Apr-24	Lighting upgrades - SportsPlex	$220,000	$18,000	40	20,147	$41,600	0	$0	45,540							$41,600	$6,351,817
	1-Apr-24	Solar canopy - car ports	$800,000	$30,000	80	20,579	$19,200	0	$0	45,972							$19,200	$6,371,017
	30-Jun-24	GA Mitigation - end of 2023	$0	$0	0	20,579	$0	0	$0	45,972							$400,000	$6,771,017
	1-Sep-24	Lighting upgrades - 2024 Classrooms	$50,000	$6,000	15	20,939	$16,000	0	$0	46,332							$16,000	**$6,787,017**

	2018	2019	2020	2021	2022	2023	2024	7 year CUSUM
Gross Investment	$6,431,748	$637,701	$1,415,000	$1,380,000	$1,650,000	$1,011,000	$1,070,000	**$13,595,449**
Cumulative ECM Savings	$301,273	$415,940	$506,782	$715,696	$862,298	$1,069,196	$1,145,996	**$5,017,180**
Cost Avoidance (GA)	$0	$19,837	$200,000	$350,000	$400,000	$400,000	$400,000	**$1,769,837**

ST. CLAIR COLLEGE


Cumulative Energy Loss elimination (GJ)
Cumulative Projected Savings (Dollar) & Energy Loss Elimination (GJ)
Cumulative Savings ($)
Energy Losses
$ Savings
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
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45,000
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$8,000,000
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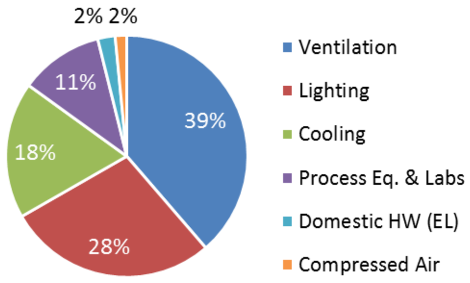
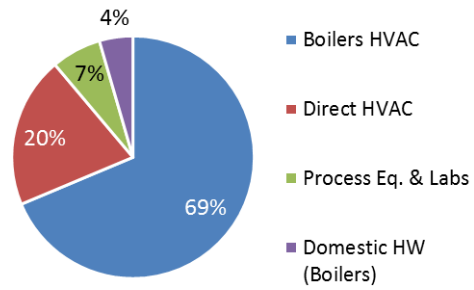
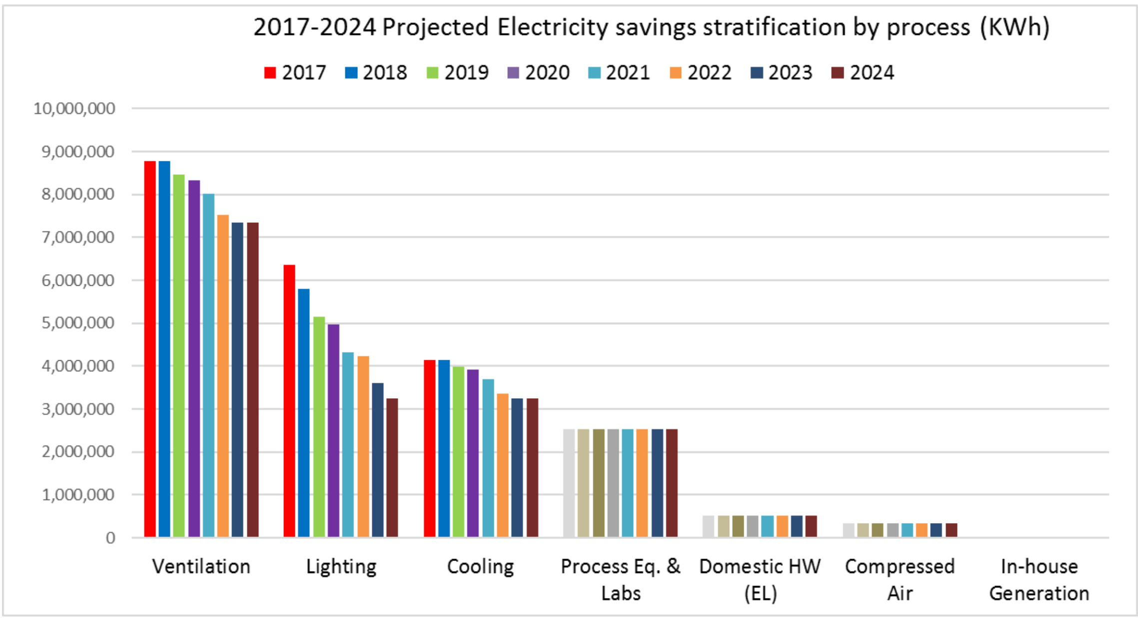
2018
2019
2020
2021
2022
2023
2024
Lighting Upgrade - FCEM
Lighting upgrade - CCIP (1)
Lighting upgrades - pool
Lighting upgrade - CCIP (2)
Lighting upgrade - 2018 Classrooms
Sub Metering
Building envelope upgrades - Main South
Building envelope upgrades - SCCCA
Building envelope upgrades - MediaPlex
Building envelope upgrades - TD
Building envelope upgrades - Residence
Building envelope upgrades - SportsPlex
Building envelope upgrades - FCEM
Building envelope upgrades - Chatham Main
Lighting upgrades - Corridors & Others (1)
Lighting upgrade - SRC - computer lab
Upgrade - Multi-Zone - CAV to VAV
Upgrade - Large Single Zone - CAV to VAV
Boilers Condensing Economizer
Boilers replacement (Main)
Boilers replacement (SCCCA)
Lighting upgrades - Corridors & Others (2)
GA Mitigation - end of 2018
Lighting upgrades - 2019 Classrooms
Lighting - Exterior - SCCCA
Lighting (house) - Theatre - SCCCA
Lighting - Dimmers/Controls - SCCCA
Boilers upgrades - TD
HVAC upgrades - FCEM
GA Mitigation - end of 2019
HVAC optimization (2 x loops) - Greenhouse
Lighting - Conference rooms - SCCCA
Lighting upgrades - 2020 Classrooms
Solar Heating - FCEM bridge
Upgrade - Reheat - CAV to VAV
Lighting upgrades - Health center
GA Mitigation - end of 2020
Lighting upgrades - 2021 Classrooms
Lighting - Exterior South (Parking & Street)
HVAC duct leaks elimination - South
Exhaust heat recovery - labs - South
Upgrade - Dual Duct, Mixing - CAV to VAV
GA Mitigation - end of 2021
Lighting upgrades - 2022 Classrooms
HVAC duct leaks elimination - Downtown
HVAC Upgrades - Thames Main
GA Mitigation - end of 2022
Lighting -Classrooms - Thames
Lighting - Library
Solar pannels - promenade - South
Lighting - Exterior - Thames
Lighting - Chatham Hallways
Lighting upgrades - Greenhouse
HVAC Retro-commissioning - South
HVAC Retro-commissioning - SCCCA
HVAC Retro-commissioning - Thames
Lighting upgrades - 2023 Classrooms
Solar PV - Main Campus
Solar wall - A Block, 5th floor AHU
Lighting upgrades - SportsPlex
Solar canopy - car ports

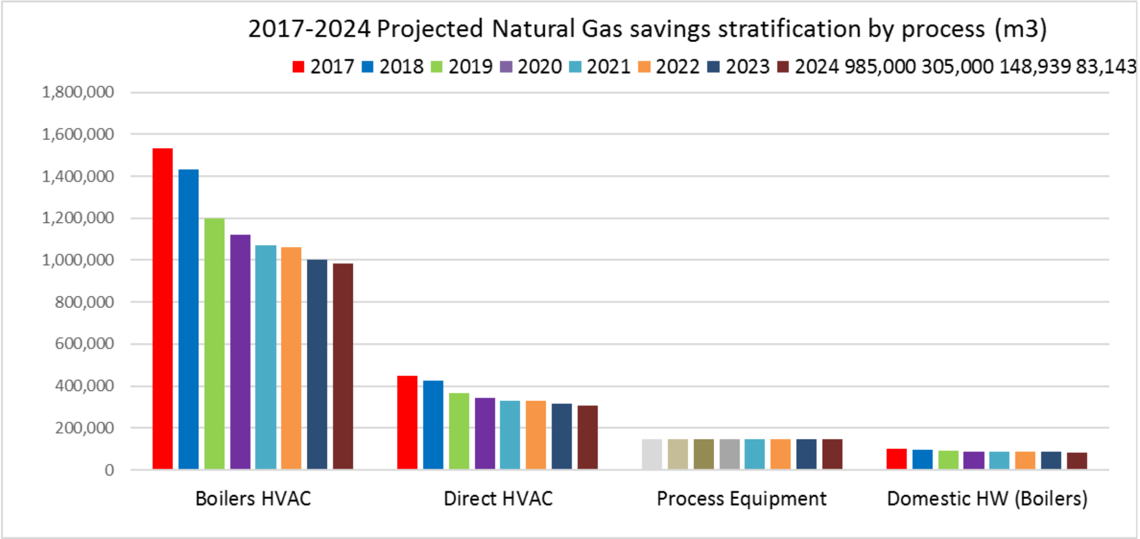
Electricity Stratification by Process



Natural Gas Stratification by Process





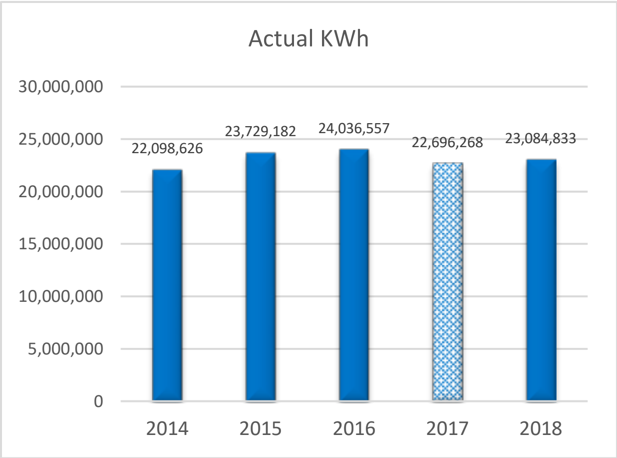


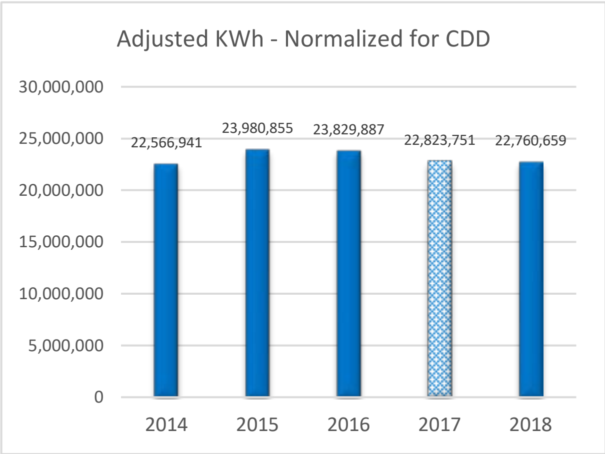
E.3 Actual Results (Electricity, Natural Gas & Combined)

ELECTRICITY Average 10 years

2. Usage is adjusted to the fixed set of conditions (average CDD) using individually developed models (slope / intercept)
(what individual year's consumptions would have been under the average weather conditions)
KWh = Slope*CDD + Intercept

Month	Average 10 Years **CDD**	Adjusted Reporting **2014**	Adjusted Reporting **2015**	Adjusted Reporting **2016**	Adjusted Reporting **2017**	Adjusted Reporting **2018**
January	0	1,777,284	1,877,720	1,902,327	1,795,830	1,784,886
February	0	1,777,284	1,877,704	1,902,311	1,795,814	1,784,886
March	0	1,777,633	1,878,227	1,902,708	1,796,287	1,785,264
April	0	1,778,331	1,878,332	1,902,562	1,796,294	1,786,019
May	25	1,864,875	1,979,467	1,972,540	1,885,252	1,879,720
June	57	1,977,591	2,111,307	2,063,800	2,001,230	2,001,756
July	120	2,195,696	2,368,251	2,242,223	2,227,485	2,237,896
August	104	2,139,163	2,302,713	2,197,038	2,169,902	2,176,688
September	42	1,924,548	2,050,609	2,022,198	1,947,996	1,944,327
October	5	1,794,733	1,898,434	1,916,760	1,814,089	1,803,777
November	2	1,782,519	1,883,623	1,906,346	1,800,996	1,790,553
December	0	1,777,284	1,874,468	1,899,075	1,792,578	1,784,886
Annual Total	**355**	**22,566,941**	**23,980,855**	**23,829,887**	**22,823,751**	**22,760,659**
	Diff	2.12%	1.06%	0.86%	0.56%	1.40%
Actual		**22,098,626**	**23,729,182**	**24,036,557**	**22,696,268**	**23,084,833**



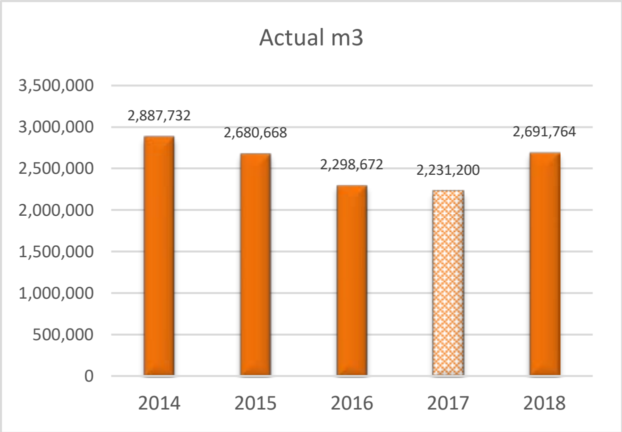


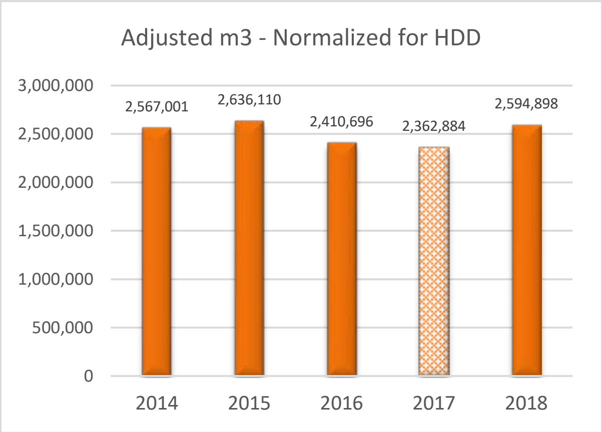
ST. CLAIR COLLEGE

NATURAL GAS Average 10 years

2. Usage is adjusted to the fixed set of conditions (average HDD) using individually developed models (slope / intercept)
(what individual year's consumptions would have been under the average weather conditions)
m3 = Slope*HDD + Intercept

Month	Average 10 Years **HDD**	Adjusted Reporting **2014**	Adjusted Reporting **2015**	Adjusted Reporting **2016**	Adjusted Reporting **2017**	Adjusted Reporting **2018**
January	645	441,017	428,916	402,102	410,611	430,990
February	558	390,708	382,629	357,624	363,319	382,625
March	464	334,878	331,155	308,107	310,756	330,260
April	270	220,076	225,349	206,346	202,701	222,085
May	98	118,116	131,367	115,951	106,726	126,156
June	16	69,808	86,844	73,130	61,257	80,642
July	11	66,569	83,857	70,256	58,207	77,615
August	3	61,963	79,616	66,179	53,874	73,233
September	32	79,016	95,321	81,277	69,916	89,444
October	160	155,486	165,865	149,158	141,942	160,695
November	342	263,358	265,309	244,813	243,492	262,027
December	516	366,006	359,882	335,755	340,083	359,126
Annual Total	**3,114**	**2,567,001**	**2,636,110**	**2,410,696**	**2,362,884**	**2,594,898**
	Diff.	11.11%	1.66%	4.87%	5.90%	3.60%
Actual		**2,887,732**	**2,680,668**	**2,298,672**	**2,231,200**	**2,691,764**





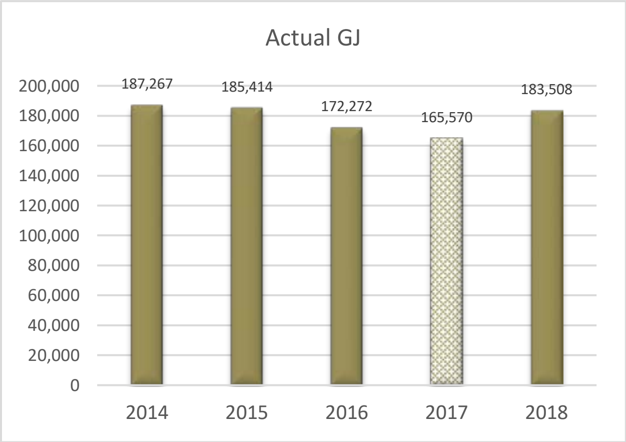
ST. CLAIR COLLEGE

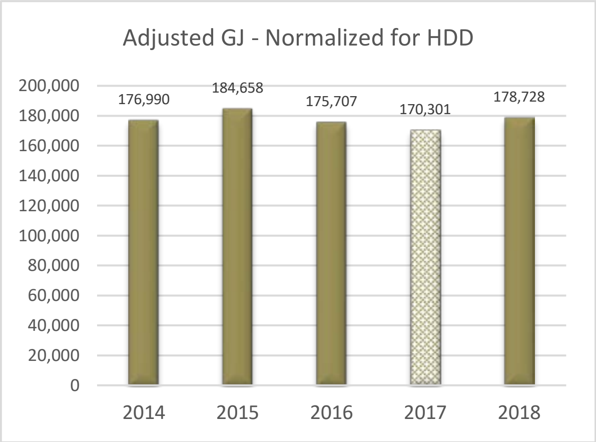
COMBINED

Average 10 years

2. Usage is adjusted to the fixed set of conditions (average HDD & CDD) using individually developed models (slope / intercept)
(what individual year's consumptions would have been under the average weather conditions)
GJ (total) = GJ (Normalized EL) + GJ (Normalized NG)

Month	Average 10 Years **HDD**	Adjusted Reporting **2014**	Adjusted Reporting **2015**	Adjusted Reporting **2016**	Adjusted Reporting **2017**	Adjusted Reporting **2018**
January	0	22,848	22,758	21,847	21,781	22,502
February	0	20,972	21,032	20,188	20,017	20,698
March	0	18,890	19,114	18,342	18,058	18,746
April	0	14,611	15,167	14,546	14,027	14,713
May	0	11,119	12,026	11,426	10,768	11,473
June	0	9,723	10,840	10,157	9,489	10,214
July	0	10,388	11,654	10,693	10,190	10,951
August	0	10,012	11,259	10,378	9,821	10,568
September	0	9,876	10,938	10,312	9,621	10,336
October	0	12,261	13,021	12,464	11,825	12,488
November	0	16,240	16,677	15,994	15,566	16,220
December	0	20,050	20,172	19,360	19,138	19,821
Annual Total	**0**	**176,990**	**184,658**	**175,707**	**170,301**	**178,728**
	Diff.	5.49%	0.41%	1.99%	3.26%	2.60%
Actual		**187,267**	**185,414**	**172,272**	**165,570**	**183,508**





ST. CLAIR COLLEGE

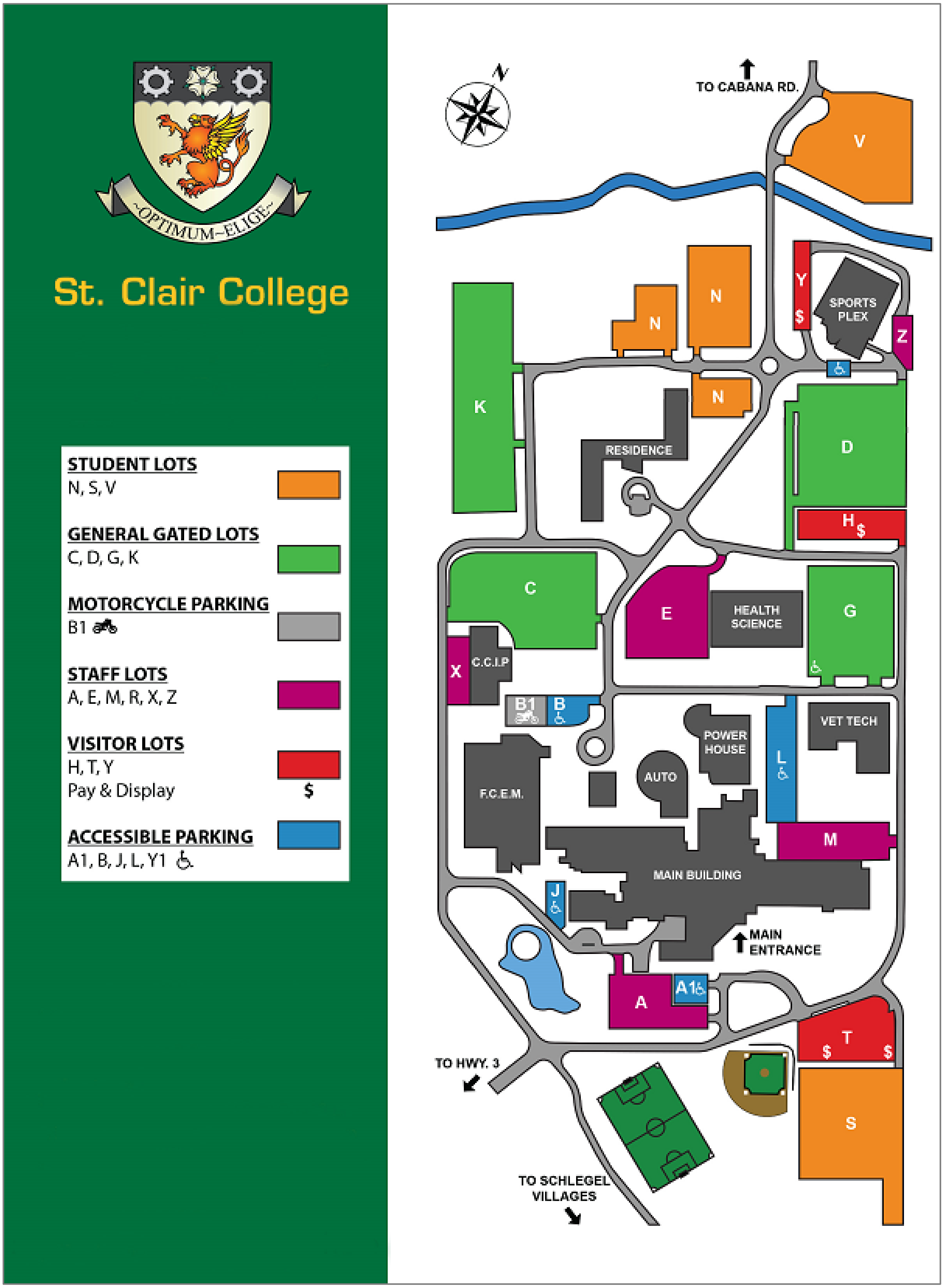
Appendix A – List of Acronyms

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BAS	Building Automation System
CAV	Constant Air Volume
COP	Coefficient of Performance
ECDMP	Energy Conservation and Demand Management Plan
ECM	Energy Conservation Measure
GEA	Green Energy Act
GJ	Gigajoule
HVAC	Heating, Ventilation, and Air Conditioning
IESO	Independent Electricity System Operator
LED	Light Emitting Diode
VAV	Variable Air Volume
VFD	Variable Frequency Drive

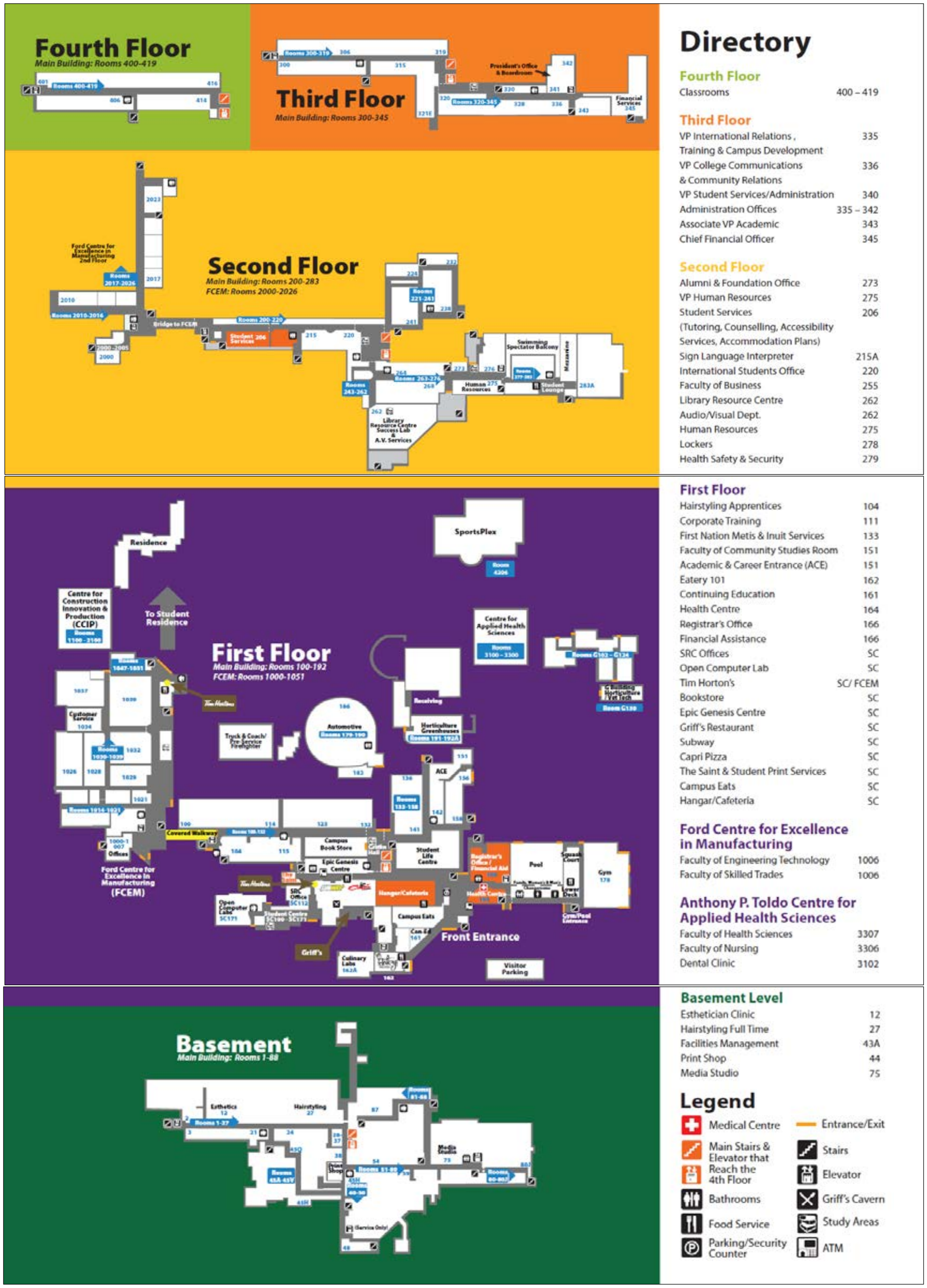
Appendix B – ECDMP Approval from Senior Management

This document has been reviewed and approved by:

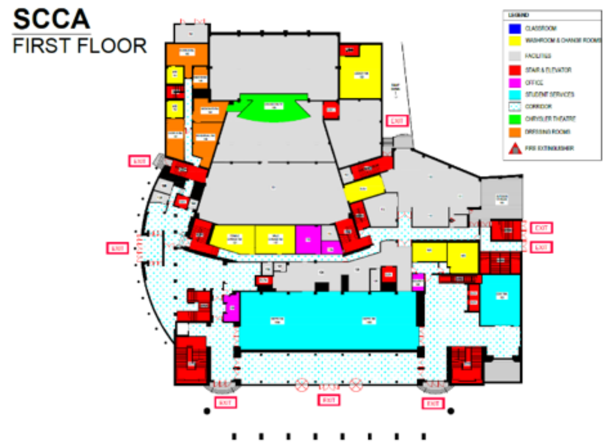
Appendix C1 – South Campus General Layout

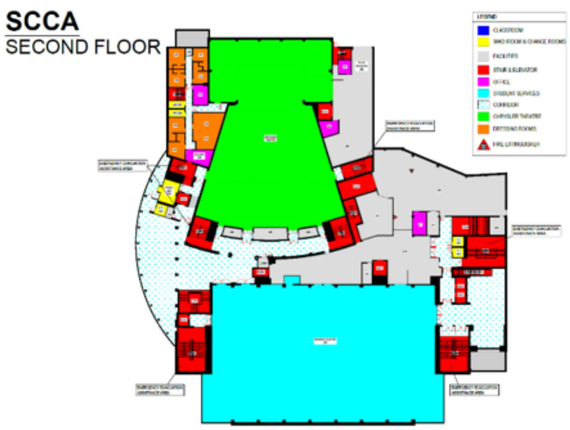


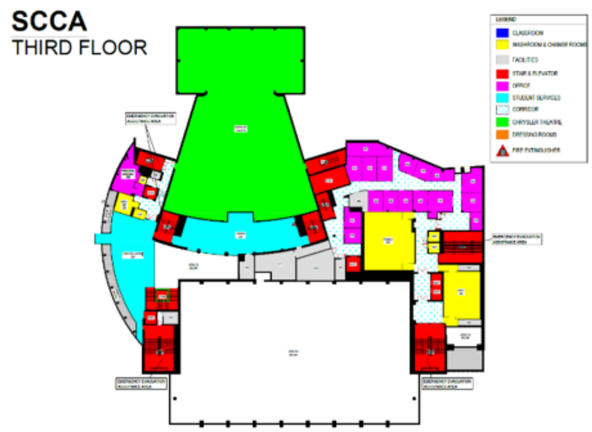
Appendix C2 – South Campus Map

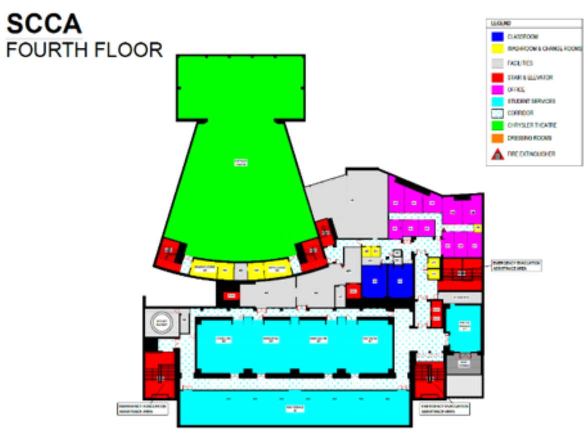


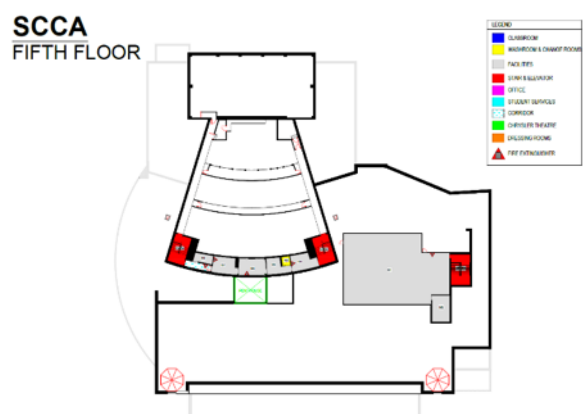
Appendix C3 – Downtown Campus Map



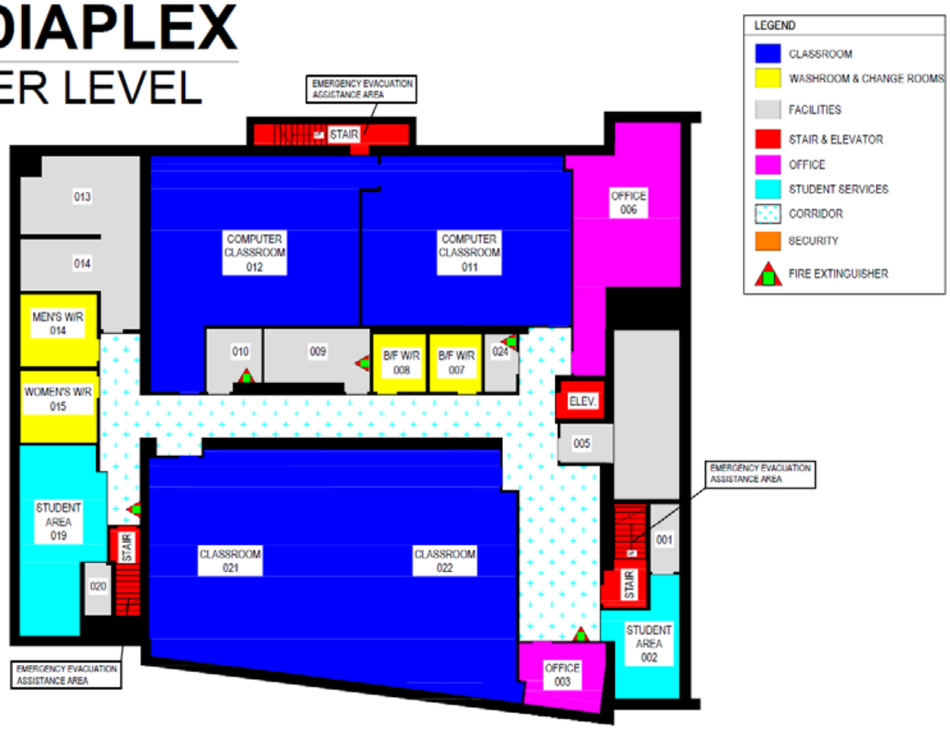




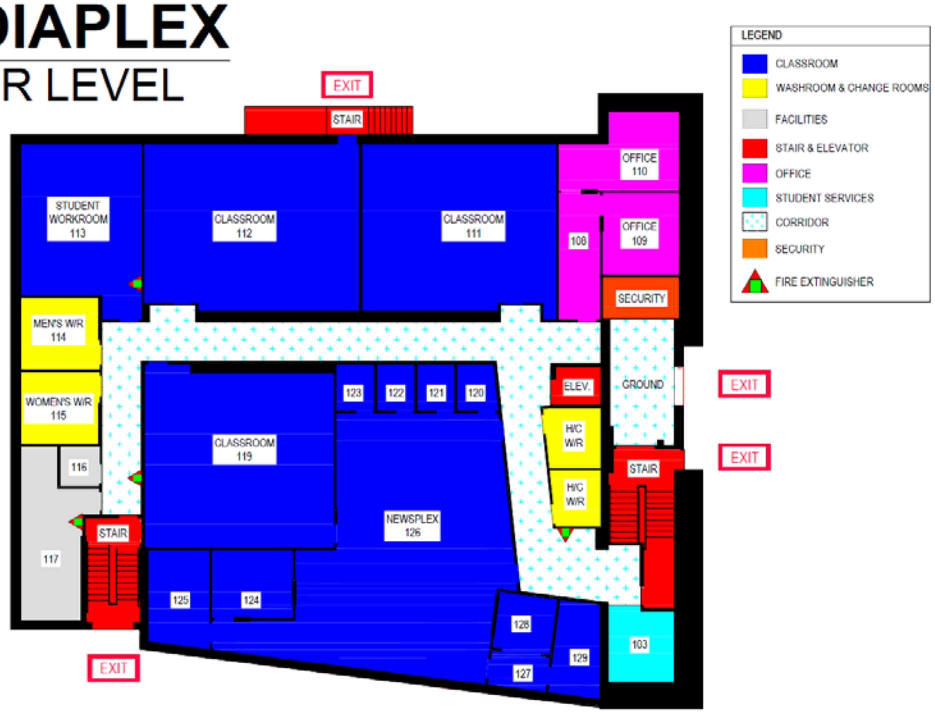




MEDIAPLEX
LOWER LEVEL



MEDIAPLEX
UPPER LEVEL



D

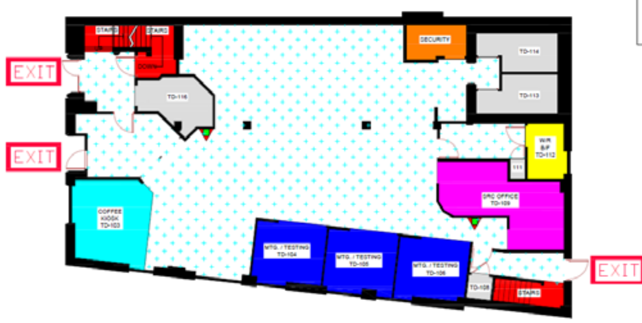
ST. CLAIR COLLEGE

TD STUDENT CENTRE
BASEMENT

LEGEND
- MEETING & TESTING ROOMS
- WASHROOM & CHANGE ROOMS
- FACILITIES
- STAIR & ELEVATOR
- OFFICE
- STUDENT SERVICES
- CORRIDOR
- SECURITY
- FIRE EXTINGUISHER

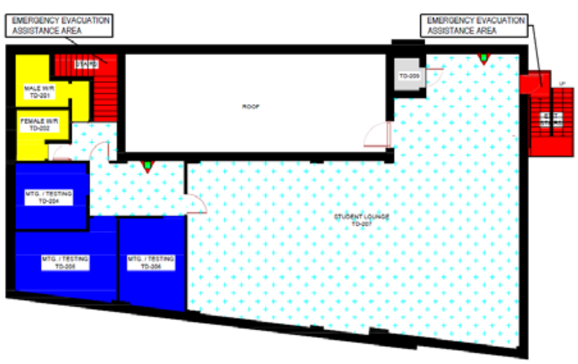
TD STUDENT CENTRE
FIRST FLOOR

LEGEND
- MEETING & TESTING ROOMS
- WASHROOM & CHANGE ROOMS
- FACILITIES
- STAIR & ELEVATOR
- OFFICE
- STUDENT SERVICES
- CORRIDOR
- SECURITY
- FIRE EXTINGUISHER

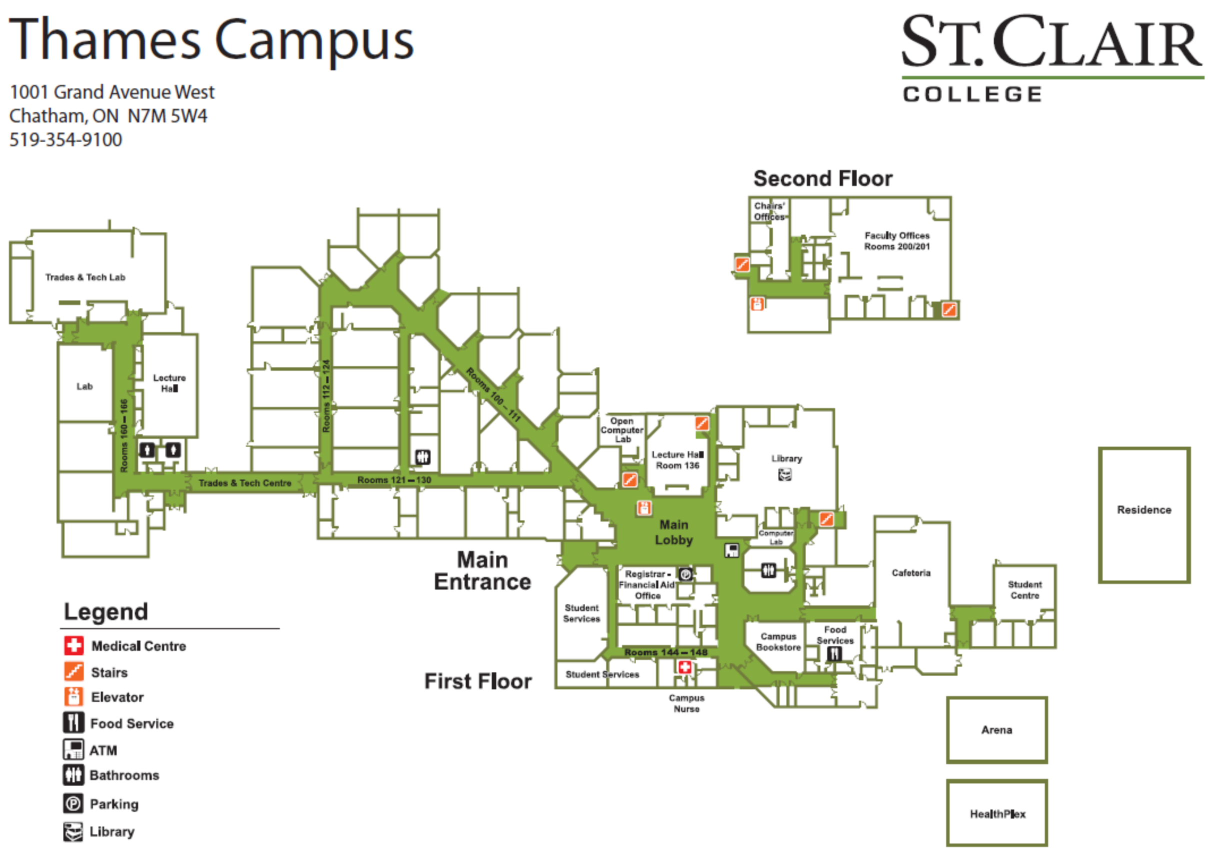


TD STUDENT CENTRE
SECOND FLOOR

LEGEND
- MEETING & TESTING ROOMS
- WASHROOM & CHANGE ROOMS
- FACILITIES
- STAIR & ELEVATOR
- OFFICE
- STUDENT SERVICES
- CORRIDOR
- SECURITY
- FIRE EXTINGUISHER

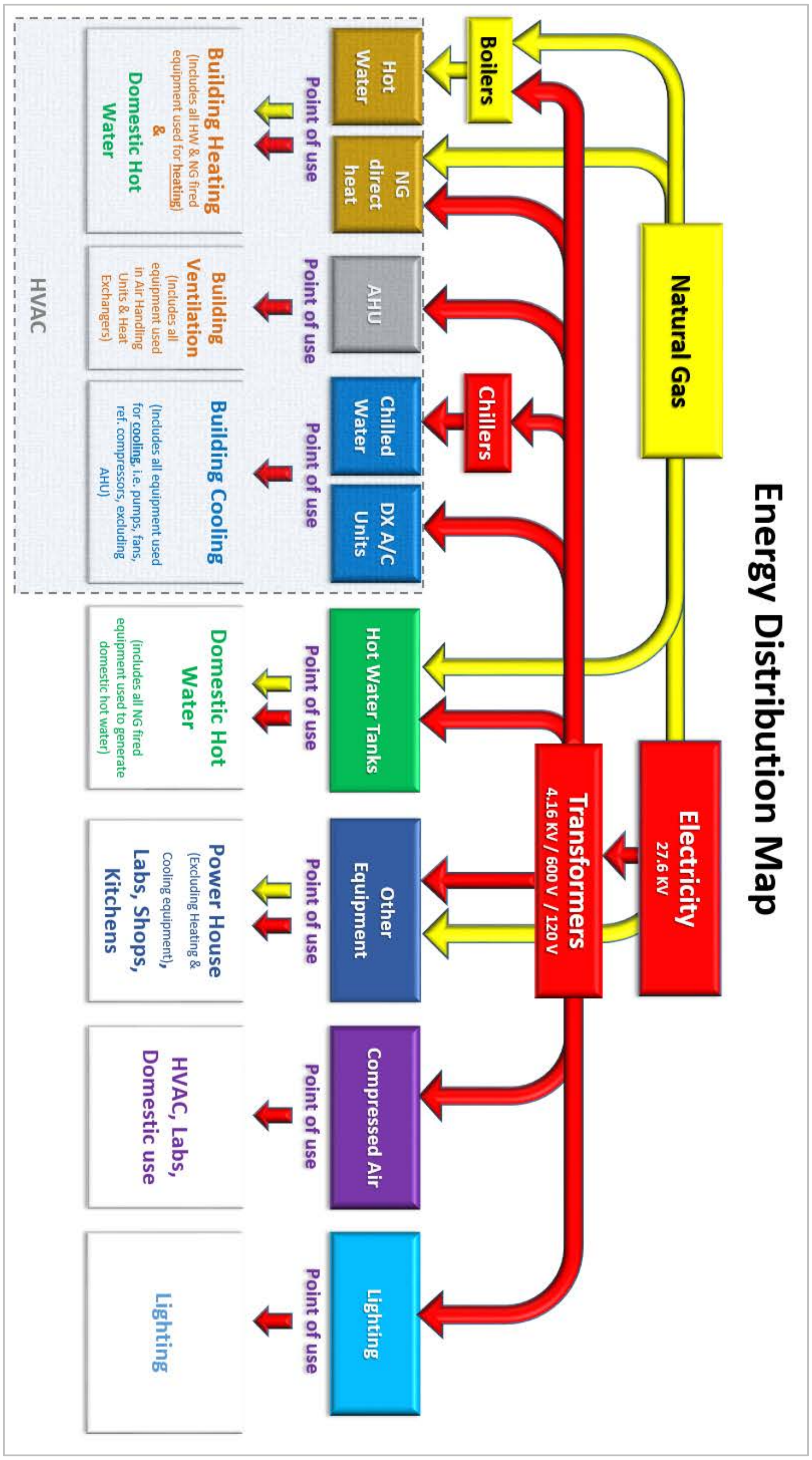


Appendix C4 – Chatham Campus Map



F

Appendix D – Energy Distribution Map



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